NARCO UGR-2/2A GLIDESLOPE RECEIVER GENERAL INDEX

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*CHANGES MADE BY THESE BULLETINS DIRECTLY AFFECT THIS MANUAL.
ATP HAS NOT INCORPORATED THESE CHANGES INTO THE MANUAL.

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MODIFICATION INSTRUCTIONS for UGR 2, 50 KHz KIT

KIT NO. 03502-0501

PURPOSE: The NARCO UGR 2A is a slight modification of the UGR 2 Airborne ILS Glide Slope Receiver. It contains an additional 20 channels for a total of 40 Glide Slope channels. Primarily, the changes to the UGR 2 are the addition of a 2nd LFO Assembly and a shift of the intermediate frequency from 7.35 MHz to 7.50 MHz.

In operation, either the old or new Low Frequency Oscillator is used. The oscillator which is activated is determined by a control wire from the NAV/ COM radio to which the UGR 2A is slaved.

PARTS SUPPLIED

Narco Part No		Description
01166-0101 04429-0001 22041-0004 11485-0009 11485-0001 03502-0670	(C519) (L118) (L506)	50 KHz LFO Assembly LABEL, UGR 2A Capacitor, Variable, Trimmer, 5-18pf Choke, RF, .47 \(\pm\)h \(\pm\)10% Choke, RF, 0.1 \(\pm\)h \(\pm\)10% Modification Inst. UGR 2,50 KHz Kit

ASSEMBLY PROCEDURE

- Remove UGR 2 from case.
- Drill two 1/8" holes in the matrix board at 2. the points indicated in Figure 1. Use caution so as to avoid drilling thru track or wires.
- ORANGE GREEN WHITE BLUE ORANGE HOLE WHITE/BLACK BLACK LFO RED COVER C210 C C2070 VIOLET C2050 60207 32 EXISTING LEAD ★50 KHZ LFO LEAD

FIGURE 1

Remove the red wire between C204 and the matrix board. (See Figure 2)

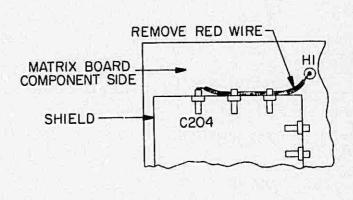


FIGURE 2

MODIFICATION INSTRUCTIONS — 03502-0670

 Install the new assembly, P/N 01166-0101, into the UGR 2 that is being modified. (See Figure 3)

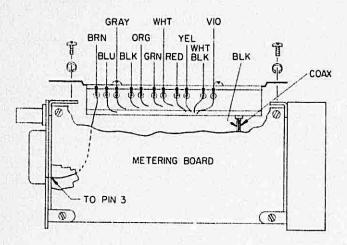


FIGURE 3

- 5. Feed the ten wires thru the holes in the matrix board and connect them to the feedthru capacitors and H-1 as shown in Figure 1.
- 6. Connect the coaxial cable center conductor to Q207's collector and solder the shield and the black wire to ground. (See Figure 4)

CAUTION: Route shield to avoid shorting to track!

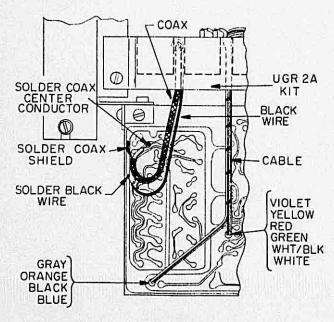


FIGURE 4

7. Solder the BROWN wire to Pin 3 of the rear connector. (See Figure 3)

8. Clip out L118 from the UGR 2 and discard it. (See Figure 5) DO NOT CUT BROWN WIRE.

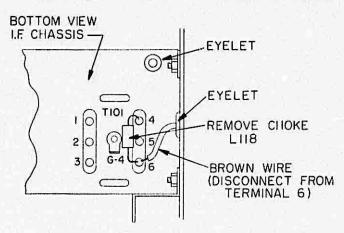


FIGURE 5

9. Cut one end of the new L118, P/N 11485-0009, (.47 μh) to 3/16" from the body. Disconnect the brown wire from terminal 6 of T101. Slip a small piece of plastic sleeving onto the brown wire. Solder the 3/16" choke lead to the brown wire. Slip the sleeving over the joint. Carefully push the brown wire along with the sleeving and the choke into the eyelet until just half of the choke can be seen. (See Figure 6) Attach the exposed end of L118 to terminal 4 of T101. Dress the choke so that it comes straight out of the eyelet to T101.

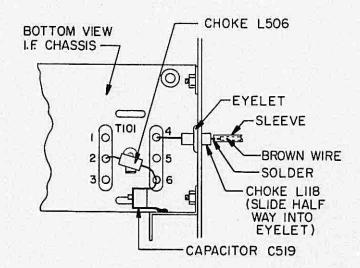


FIGURE 6

- 10. Connect L506, P/N 11485-0001 (0.1 μ h) between T101, Pin 2 and T101, Pin 6. (See Figure 6)
- 11. Connect C519, P/N 22041-0004 (5-18pf) between T101, Pin 6 and the ground as shown. (See Figure 6).

MODIFICATION INSTRUCTIONS — 03502-0670

ALIGNMENT PROCEDURE

It is necessary to realign the intermediate frequency from 7.35 MHz to 7.5 MHz. This is accomplished as follows:

Refer to Figure 7.

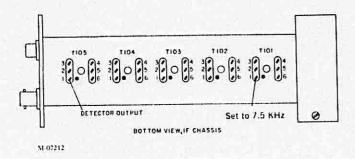


FIGURE 7

- Connect AC VTVM and oscilloscope to Terminal 1 of T105.
- 2. Connect the RF signal generator to the base of Q103 at Terminal 1 of T101 through a .01 mfd capacitor with a 47 ohm resistor to ground on the generator side of the capacitor. Set the generator to 7.5 MHz modulated 30% by 1000 Hz. Set the input voltage to 13.75 or 27.5 volts per cable wiring.
- 3. Tune T102, T103, and T104 for maximum output, keeping the generator output set for approximately 0.1 volts AC detector output.
- 4. Tune T105 for maximum output.
- 5. Connect 100 ohm resistors between Terminals 5 and 6 of T102, T103, and T104. Tune the secondary slugs (slugs away from the chassis) of T104, T103, and T102 on outer peaks for maximum detector output. The generator output should be set to keep the detector level at approximately .05 volts AC. A very high signal input may be required initially to align the IF.
- 6. Tune T105 for maximum output using the peak having the slug closer to the chassis.
- 7. Remove the 100 ohm resistors and connect them between Terminals 1 and 2 of T102, 103, T104. Tune the primaries (slug nearest chassis) on outer peaks for maximum detector output.

- 8. Remove the 100 ohm resistors.
- Check gain. 8μν maximum should produce 0.1 volts AC detector output.
- 9a. Set the channel selector to 110.70 MHz (330.20 MHz)
- 9b. Connect a VTVM to T105, pin 1.
- 9c. Set VTVM to measure positive DC volts.
- 9d. With no signal applied to the UGR 2A, adjust C519 for minimum DC voltage.
- Install the new UGR 2A label (P/N 04429-0001) over the present label.
- Check that all hardware that was removed has been replaced and secure.

PERFORMANCE TEST

The test set-up used to check the UGR 2 should be modified to include a grounding provision for Pin 3 of the rear connector. In all 100 KHz Localizer channels, Pin 3 is not grounded. In all 50 KHz positions, Pin 3 is grounded. After these modifications have been made to the UGR 2 set-up, performance testing may proceed as given in Section 5-9 of the Maintenance Manual.

Table 1 of this instruction gives the Localizer/Glide Slope Paired Channels.

Table 2 of this instruction gives information showing the LFO, Localizer & HFO frequencies over the complete Glide Slope frequency band and is given as a trouble-shooting aid.

MODIFICATION INSTRUCTIONS — 03502-0670

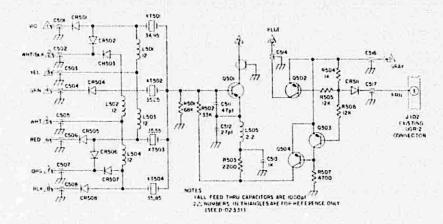
TABLE 1 LOCALIZER/GLIDE SLOPE PAIRED CHANNELS

TABLE 2 LFO AND HFO OSCILLATOR **FREQUENCIES**

Localizer	Glide Slope	Glide Slope	Localizer Receiver	LFO	HFO	A /Dry
Frequency	Frequency	Rcvr. Frequency		Frequency	Frequency	A/B*
		MHz	MHz	MHz	MHz	Selection Group
108.10	334.70	329.15	108.95	34.8	75.4625	•
108.15	334.55	329.30	108.90	34.95	75.4625	G G O
108.30	334.10	329.45	110.55	35.1	75.4625	G C
108.35	333.95	329.60	110.50	35.25	75.4625	ő
108.50	329.90	329.75	108.55	35.4	75.4625	G
108.55	329.75	329.90	108.50	35.55	75.4625	Ğ
108.70	330.50	330.05	110.75	35.7	75.4625	ŏ
108.75	330.35	330.20	110.70	35.85	75.4625	
108.90	329.30	330.35	108.75	34.8	75.7625	O G G O
108.95	329.15	330.50	108.70	34.95	75.7625	Ğ
109.10	331.40	330.65	110.95	35.1	75.7625	õ
109.15	331.25	330.80	110.90	35.25	75.7625	Õ
109.30	332.00	330.95	111.95	35.4	75.7625	Ğ
109.35	331.85	331.10	111.90	35.55	75.7625	Ğ
109.50	332.60	331.25	109.15	35.7	75.7625	ō
109.55	332.45	331.40	109.10	35.85	75.7625	0
109.70	333.20	331.55	111.15	34.8	76.0625	G
109.75	333.05	331.70	111.10	34.95	76.0625	0
109.90	333.80	331.85	109.35	35.1	76.0625	0
109.95	333.65	332.00	109.30	35.25	76.0625	0
110.10	334.40	332.15	111.35	35.4	76.0625	G
110.15	334.25	332.30	111.30	35.55	76.0625	G
110.30	335.00	332.45	109.55	35.7	76.0625	0
110.35	334.85	332.60	109:50	35.85	76.0625	0
110.50	329.60	332.75	111.55	34.8	76.3625	G
110.55 110.70	329.45	332.90	111.50	34.95	76.3625	0
110.75	330.20	333.05	109.75	35.1	76.3625	0
110.75	330.05	333.20	109.70	35.25	76.3625	0
110.95	330.80	333.35	111.75	35.4	76.3625	G
111.10	330.65	333.50	111.70	35.55	76.3625	G
111.15	331.70	333.65	109.95	35.7	76.3625	0
111.13	331.55	333.80	109.90	35.85	76.3625	0
111.35	332.30	333.95	108.35	34.8	76.6625	G
111.50	332.15	334.10	108.30	34.95	76.6625	G
111.55	332.90	334.25	110.15	35.1	76.6625	0
111.70	332.75	334.40	110.10	35.25	76.6625	0
111.75	333.50	334.55	108.15	35.4	76.6625	G
	333.35	334.70	108.10	35.55	76.6625	G
111.90 111.95	331.10	334.85	110.35	35.7	76.6625	O G G O
111.90	330.95	335.00	110.30	35.85	76.6625	0

^{*}O - open circuit
G - connected to ground

NARCO AVIONICS UGR 2 MODIFICATION INSTRUCTIONS — 03502-0670



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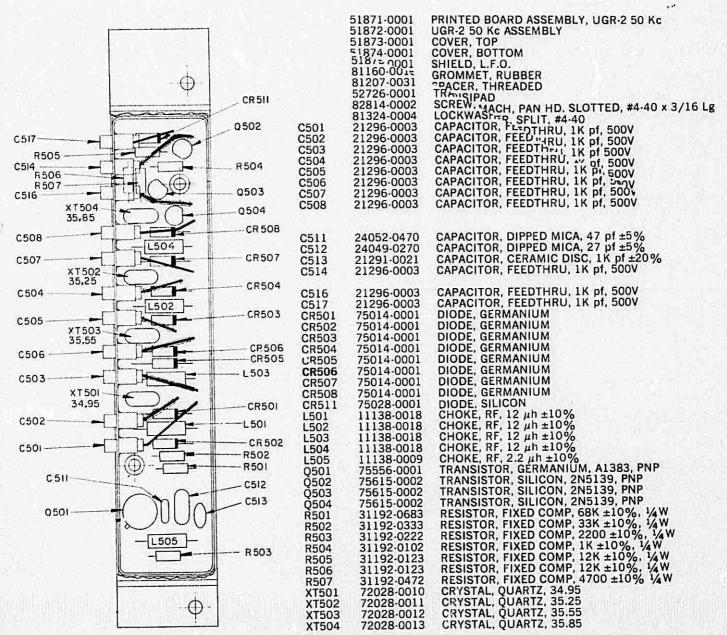


FIGURE 8. UGR 2A, 50 KHz Schematic, Parts List, and Assembly.

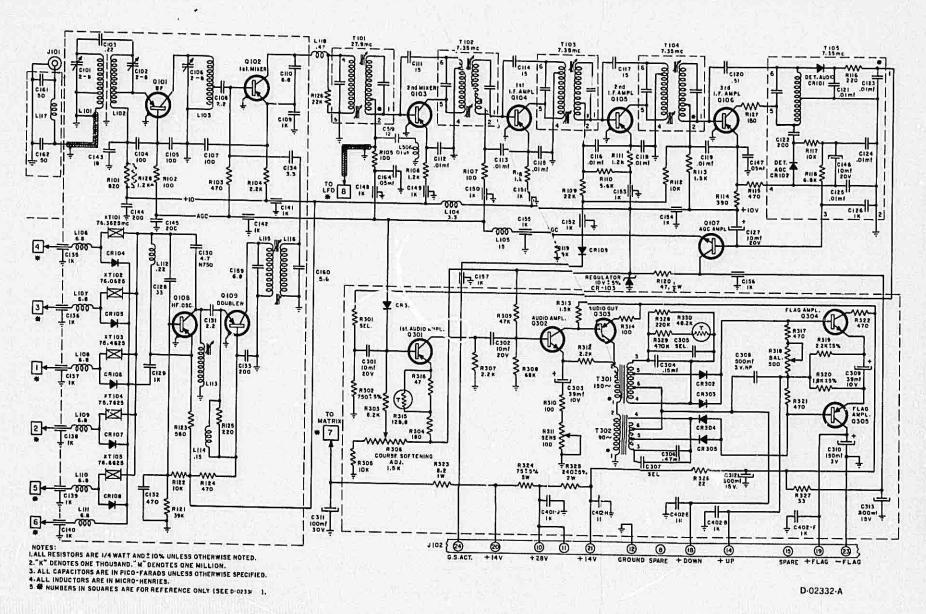


FIGURE 9. RECEIVER SECTION, Glide Slope, UGR 2A

SEE BLOW-UP

MODIFICATION INSTRUCTIONS

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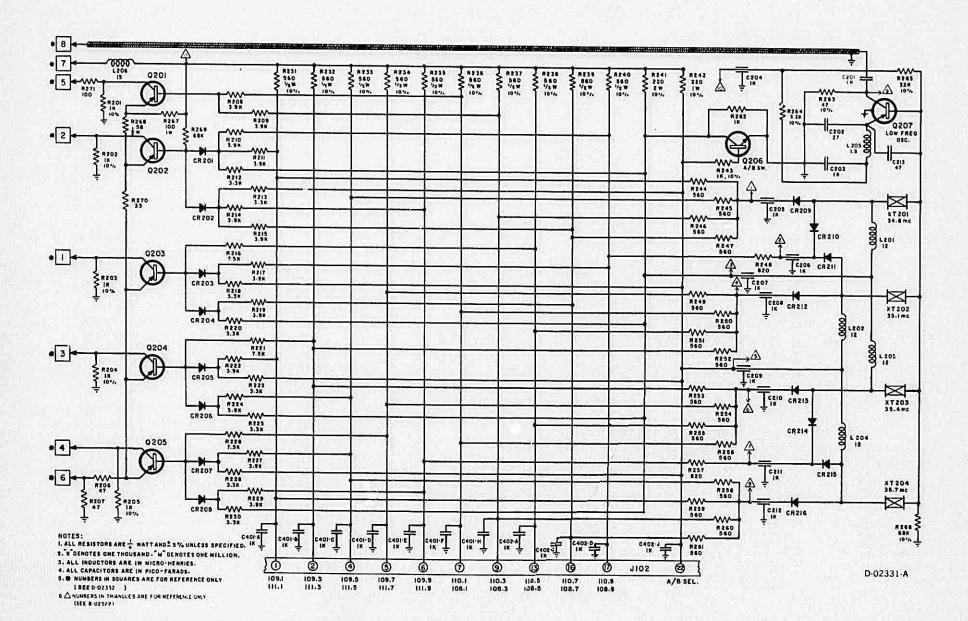
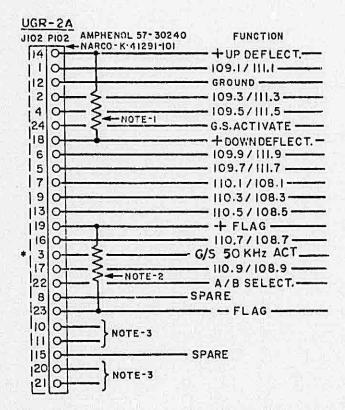


FIGURE 10. GLIDE SLOPE MATRIX, UGR 2A



*Grounding of pin 3 activates the 50 KHz Channel.

- NOTE 1: Resistor installed inside hood of connector to make combination of resistor loads and meter loads equal 333 ohms (3-1K ohm movements max.) 470 ohms supplied installed in connector is standard
- NOTE 2: Resistor installed inside hood of connector to make combination of resistor loads and meter loads equal 500 ohms (2-1K ohm flag loads max.) 1000 ohms supplied installed in connector is standard.
- NOTE 3: The primary voltage input connections (A+) are as follows:
 - a. 28 Volts: Connect input to terminals 10 and 11. No connections to terminals 20 and 21.
 - b. 14 Volts: Connect input to terminals 20 and 21. No connections to terminals 10 and 11.
 - c. Use 0.5 Ampere fuse in series with the A+ input load for either 14V or 28V operation.
- NOTE 4: A+ may be obtained from the aircraft power or from the switched A+ of the associated NAV receiver. It is recommended that 2 wires be paralleled (#22 wire).

MODIFICATION PROCEDURE 03502-0680

PURPOSE:

To provide ARINC 2-out-of-5 and Narco's 2-out-of-11 channeling capability to those UGR-2As* or UGR-3s having only Narco's 2-out-of-11.

REFERENCES:

- a) UGR-2 Maintenance Manual and in particular its Section 8 entitled: UGR-2A 2/5
- b) UGR-2, 50 kHz Modification Instruction, 03502-0670 (7/71) with change page dated Nov. '71.
- c) UGR-3 Maintenance Manual, 03504-0600 dated 9/73.

MODIFICATION KIT PARTS LIST: (Kit No. 03502-0503)

To be used in Step #:	Part Number	Description	Qty.
P3	Installer supplied	LEAD, #22 AWG CAPACITOR, Ceramic Disc, .001 LABEL, ARINC 2/5-Narco 2/11	12" lg.
P4/P6	21291-0021		2
P8	04817-0001		1
M7	01292-0101	MATRIX PC BOARD NUT, Self-locking	1
M7	Installer supplied		AR
R6	75038-0002	DIODE (CR110/CR114)	5
R7	11138-0009	COIL (L119/L123)	5

PROCEDURE:

The Unit to be modified should be one that is known to have been operating properly. If there is any doubt as to its operation it should be tested, before modification, in accordance with the procedure given in the appropriate reference listed above.

Access

1. Remove the cover screws (4) and slide linit out of its enclosure.

Lead Colors

The lead colors shown in the various figures are those found in typical UGR's, however, due to service or manufacture availability lead color may differ from that shown. <u>Verify</u> and <u>Note</u> any difference before unsoldering leads.

This procedure may also be used to modify a UGR-2, however, additional components must be obtained from Narco or from commercial sources (see steps 12 and 13).

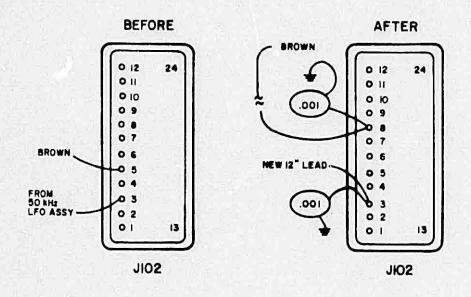
To formalize the UGR-2 to UGR-2A 2/5-2/11 modification apply a new nameplate label over the UGR-2 label (PN 04429-0001) obtainable from Narco at the time of order this modification kit.

NARCO AVIONICS UGR-2A

MODIFICATION PROCEDURE 03502-0680

PRELIMINARY:

- P1. Hinge down the METERING PC BOARD ASSY by removing its two top screws and washers.
- P2. Refer to Figure 1 and unsolder lead from the 50 kHz LFO Assy located at Pin 3 of J102.
- P3. Solder a lead (approximately 12 inches long) to Pin 3 of J102.
- P4. Add a .001 μ F capacitor between Pin 3 of J102 and Ground.
- P5. Remove the wire at Pin 5 of J102 and solder it to Pin 8 of J102.
- P6. Add a .001 µf capacitor between Pin 8 of J102 and Ground.
- P7. Close up the Metering Board Assy and reinstall its hardware.
- P8. Affix ARINC 2-out-of-5 Label opposite nameplate on far side of J102.



11900015

FIGURE 1, J101 CHANGES

MATRIX PC BOARD ASSY:

The existing Matrix Board Assy is to be removed along with the 50 kHz LFO Assy. It shall be replaced by the new Matrix PC Board Assy that includes the 50 kHz LFO circuits.

- M1. Remove the hardware at the top of the board and hinge the board down.
- M2. Locate and note connection points of the 13 wire harness (see Figure 2).
- M3. Unsolder the 13 wire harness carefully to avoid melting or damaging the insulation.
- M4. Remove the IF Section's coax cable clamp (1 screw, washer, and nut) and unsolder the cable's braid and center conductor.
- M5. Unsolder from the Matrix Board Assy the six wire harness connected to the feedthru capacitors (see Figure 2).
- M6. Remove the two hinge screws and nuts holding the Matrix Board Assy. Lift out the Matrix Board Assy complete with the attached 50 kHz LFO Assy.

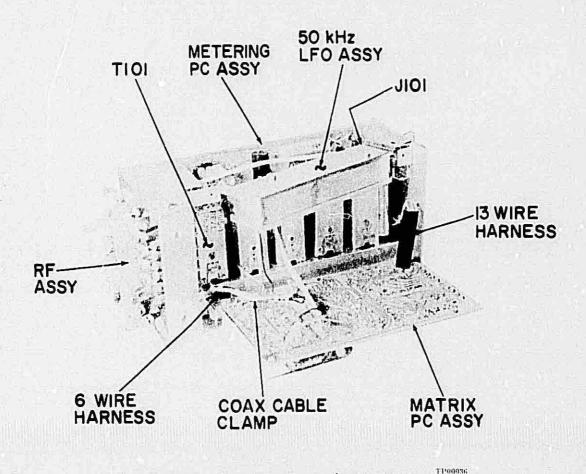


FIGURE 2. 40 CHANNEL 2/11 UGR 2A

NARCO AVIONICS UGR-2A

MODIFICATION PROCEDURE 03502-0680

- M7. Position and secure the new Matrix Board Assy unto the Unit using the same hardware that was removed. (If the locknut fit is loose, replace nut.)
- MS. Position, clamp, and solder the coax lead that was removed in step M4. (see Figure 3).
- M9. Solder the six wire harness from the feedthru capacitors as shown in Figure 4 & 5.

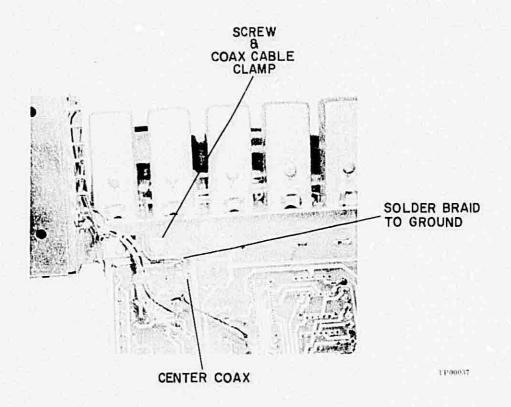


FIGURE 3. MATRIX BOARD COAX CONNECTION

NARCO AVIONICS UGR-2A MODIFICATION PROCEDURE 03502-0680

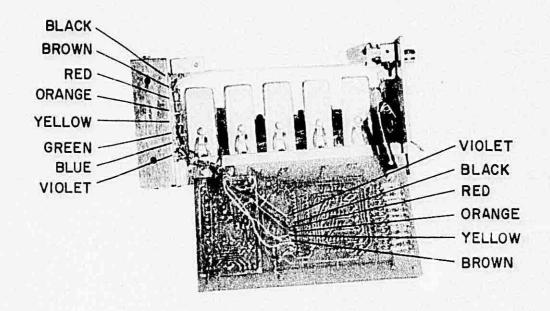


FIGURE 4. SIX WIRE HARNESS

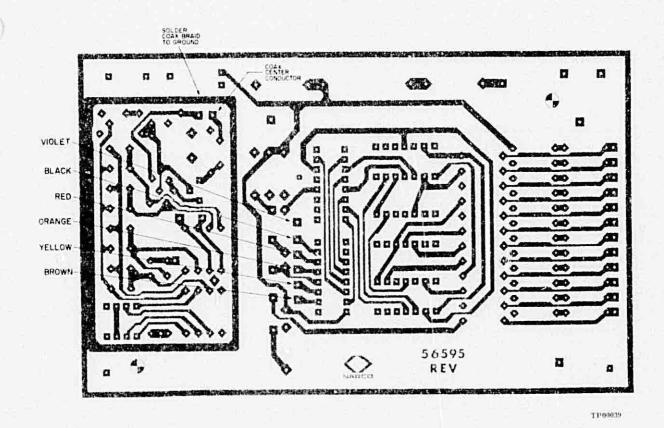


FIGURE 5. SIX WIRE HARNESS CONNECTION POINTS

TP00038

NARCO AVIONICS UGR-2A

MODIFICATION PROCEDURE 03502-0680

- M10. Take the wire that was connected to Pin 3 of J102 (step P3) and route it along with the 13 wire harness. Pass all 14 wires thru the PC board leaving the harness sleeving on the inside (solder side).
- M11. Solder the 14 wires to the component side as shown in Figure 6 after cutting the added wire to a suitable length.
- M12. Carefully hinge the Matrix Board up and secure it with the hardware removed earlier.

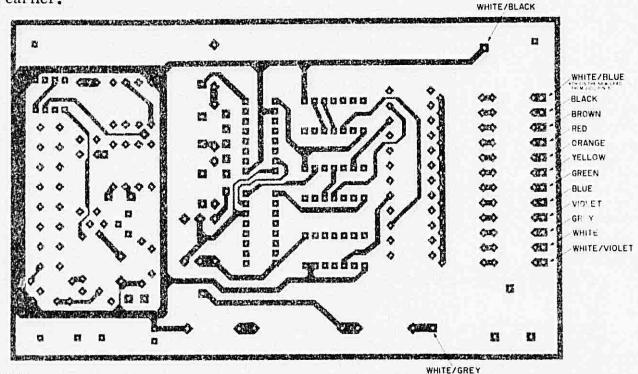


FIGURE 6. THIRTEEN WIRE HARNESS CONNECTION POINTS

Tirecoto

RF BOARD:

- R1. Loosen the two screws (top and bottom) that secures the assembly into the chassis.
- R2. Carefully slide the assembly outward.

 (Note: It will not come out very far as connecting leads are short).
- R3. Unsolder the six coil leads from the feedthru capacitors.
- R4. Remove the feedthru bracket from the RF Assy (see Figure 7).

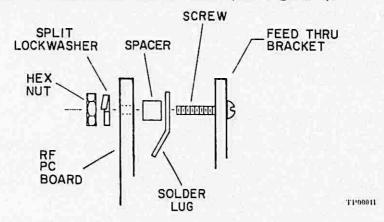


FIGURE 7. RF PC BOARD MOUNTING HARDWARE

- R5. The non-component side of the RF Board should now be accessible, however, care should be taken so that the two leads are not disturbed.
- R6. Remove and replace five diodes (CR110/CR114) with the diodes provided per Figure 8. (Note: The polarity HAS been reversed.)
- R7. Remove and replace five coils (L119/L123) with the coils provided (see Figure 8). (Note: Only solder these coils to the PC board at this time.)

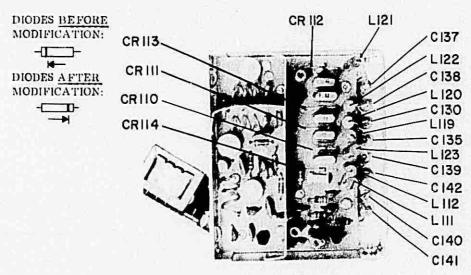


FIGURE 8. REPLACEMENT OF DIODES AND COILS

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NARCO AVIONICS UGR-2A

MODIFICATION PROCEDURE 03502-0680

ALIGNMENT PROCEDURE:

This procedure may be used to align or realign the IF frequency. (If the IF strip had to be modified, use this procedure to change the IF from 7.35 to 7.50 mHz.)

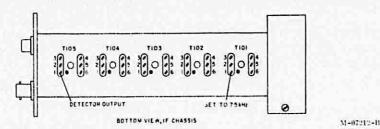


FIGURE 10. IF STRIP ALIGNMENT

- 1. Connect AC VTVM and oscilloscope to Terminal 1 of T105.
- 2. Connect the RF signal generator to the base of Q103 at Terminal 1 of T101 thru a .01 mf capacitor with a 47 ohm resistor to ground on the generator side of the capacitor. Set the generator to 7.5 mHz modulated 30% by 1000 Hz. Set the input voltage to 13.75 or 27.5 volts per cable wiring.
- 3. Tune T102, T103, and T104 for maximum output, keeping the generator output set for approximately 0.1 volts AC detector output.
- 4. Tune T105 for maximum output.
- 5. Connect 100 ohm resistors between Terminals 5 and 6 of T102, T103, and T104. Tune the secondary slugs (slugs away from the chassis) of T104, T103, and T102 on outer peaks for maximum detector output. The generator output should be set to keep the detector level at approximately .05 volts AC. A very high signal input may be required initially to align the IF.
- 6. Tune T105 for maximum output using the peak having the slug closer to the chassis.
- 7. Remove the 100 ohm resistors and connect them between Terminals 1 and 2 of T102, T103, and T104. Tune the primaries (slug nearest chassis) on outer peaks for maximum detector output.
- 8. Remove the 100 ohm resistors.
- 9. Check gain. $8 \,\mu v$ maximum should produce 0.1 volts AC detector output.
- 9A. Set the channel selector to 110.70 mHz (330.20 mHz).
- 9B. Connect a VTVM to T105, Pin 1.
- 9C. Set VTVM to measure positive DC volts.
- 9D. With no signal applied to the UGR, adjust C519 for minimum DC voltage.
- 10. Check that all hardware that was removed was replaced and secure.

NARCO AVIONICS UGR-2A

MODIFICATION PROCEDURE 03502-0680

- R8. Steps R8A to R8D pertain to only those UGRs wherein these steps have not already accomplished.
- R8A. Unsolder and save L118 (located between T101 Pin 4 and a Brown wire).
- R8B. Unsolder the Brown wire from the collector of Q102 (solder side of the RF Board).
- R8C. Replace the Brown wire with a piece of shielded coax cable by soldering the center conductor to the collector of Q102 (solder side) and solder the braid to the board's ground. The opposite end should be threaded thru the eyelet (where L118 was) and then flaired back to cover the eyelet hole and soldered thereto. The center conductor should be cut to approximately 1/8th inch long. (see Figure 9)
- R8D. Resolder L118 to T101 Pin 4 and to the center conductor of the just installed coax cable. (see Figure 9)
- R9. Reassembly the RF Board to the feedthru bracket.
- R10. Slide the RF Board and bracket back into place and secure the top and bottom screws.
- R11. Solder the unterminated ends of the coils (6) to the feedthru capacitors as shown in Figure 8.

IF STRIP:

The Unit should be checked to verify that the IF strip has been modified properly. (Units having L506 and variable capacitor C519 most likely were modified and had the IF aligned from 7.35 mHz to 7.50 mHz.)

If this modification was not accomplished, refer to steps 12 thru 14.

- II. Turn the Unit over exposing the components of the IF strip (see Figure 9).
- 12. Install L506 (Narco P/N 11485-0001 Choke, RF, 0.1 μ h ±10%).
- I3. Install C519 (Narco P/N 22041-0004 Capacitor, Variable, Trimmer, 5-18 pf).
- 14. Realign Unit as directed in the Alignment Procedure.

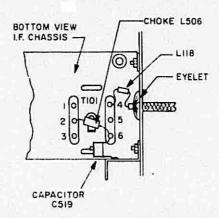


FIGURE 9. IF STRIP MODIFICATIONS

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NARCO AVIONICS UGR-2A MODIFICATION PROCEDURE 03502-0680

PERFORMANCE TEST:

The test set-up used to check the Unit should be checked to include a grounding provision for Pin 3 of J102. In all 100 kHz Localizer channels, Pin 3 is not grounded. In all 50 kHz positions, Pin 3 is grounded. After these modifications have been made to the UGR-2 test set-up, performance testing may proceed as given in Section 5-9 of the Maintenance Manual (Ref. a.)

Table 1 of this instruction give the Localizer/Glide Slope Paired Channels.

Table 2 of this instruction gives information showing the LFO, Localizer and HFO frequencies over the complete Glide Slope frequency band and is given as a trouble shooting aid.



Customline.

Glide Slope Receiver

INCI MAINTENANCE MANUAL



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

CHANGE IN NOMENCLATURE

All future narco technical literature shall refer to frequency in "cycles per second" by using the term "Hertz." This nomenclature has been used in Europe in the past where the International Electrotechnical Commission (IEC) and other professional societies made the change. Recently, the Institute of Electrical and Electronic Engineers (IEEE) and the U.S. Bureau of Standards have changed their standards to make the usage world wide. From this date on, narco has changed to the new form as detailed below:

	Designation		
Frequency	Old Style	New Style	
Cycles per second Kilocycles per second Megacycles per second Gigacycles per second	CPS KCPS mCPS gCPS	Hz kHz MHz GHz	

ATP RECORD OF REVISIONS

REV. NO.	SECTIONS COVERED 'IN REVISION	REV. DATE	INSERTION DATE	ВУ	NOTES
			 		
Mark M					
				1	
		- William			
				7	

UGR-2 Including the UGR-2A, 40 Channel Modification Instruction

03502 0600 dated 3-67 Report 4-73 Report 8-79

This page is provided to identify the complete Maintenance of the matipackage as of August 1979. Changed and added pages are listed with their date of issue. Project date (8.79 reflect only minor typographical corrections or amplifications.)

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SERVICE

NARCO AVIONICS DIVISION OF NARCO SCIENTIFIC INDUSTRIES, Fort Washington, Pa. 19034

NARCO SERVICE BULLETIN UGR-2A No. 2

October 11, 1977

TO:

ALL NARCO AVIONICS CENTERS

ALL NARCO WHOLESALE DISTRIBUTORS

SUBJECT:

MODIFICATION INSTRUCTIONS TO INCORPORATE ARINC 2/5

CHANNELING IN EARLIER NARCO GLIDESLOPE RECEIVERS

(GLIDESLOPE) (APPLICABLE AS REQUIRED)

Included with this bulletin are the modification instructions required to incorporate ARINC 2/5 channeling in the NARCO UGR-2, UGR-3, and earlier UGR-2A glideslope receivers.

Please add these instructions to your UGR-2 Maintenance Manual.

The 2/5 modification kit itself, in regards to ordering procedures, is explained in NARCO Service Rulletin UGR-2A No. 1.

Very truly yours,

NARCO AVIONICS

A Division of Narco Scientific Industries

Gene Salzmann

Technical Representative

GS/pk

Enclosure

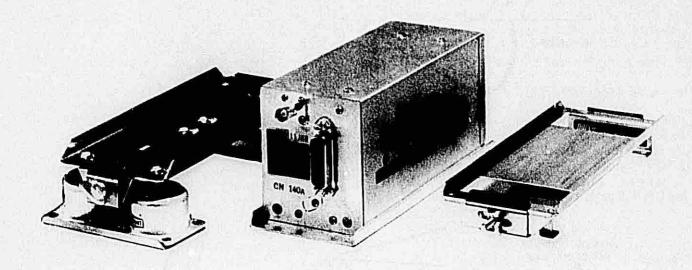
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SECTION 1 GENERAL INFORMATION



NAR-561

FIGURE 1-1. narco UGR-2 UHF GLIDE SLOPE RECEIVER

1-1. INTRODUCTION.

The *narco* UGR-2 Glide Slope Receiver shown in Figure 1-1 is a crystal controlled, double conversion superheterodyne radio for locating the glide slope landing path above an aircraft landing strip. The glide slope information is displayed on a *narco* VOA-9 Navigation Converter or equivalent. The receiver is crystal tuned for operation on 20 UHF channels within the 329.3 to 335.0MHz(mc) range. Channel selection is accomplished by diode switching controlled by 11 input wires.

This manual provides information necessary to the installation, operation, maintenance, and repair of the UGR-2 Glide Slope Receiver. The information in this Maintenance Manual is presented as follows: Section 1 provides general introductory information; Section 2 provides installation information covering the use of the Mark-VI, Mark-10, Mark-12/12A, and Mark-24 Navigation Converters or equivalent; Section 3 provides operational information only to the extent necessary for the performance of operational tests; Section 4 provides a functional description and a detailed circuit description; Section 5 provides maintenance and repair

instructions; Section 6 provides a complete parts list; and Section 7 provides the functional block diagrams and schematic diagrams.

1-2. FUNCTIONAL DESCRIPTION.

The narco UGR-2 is a solid state single unit airborne, UHF receiver that provides signals to drive the UP/DOWN meter and the flag alarm meter movements of a navigation converter. The receiver is comprised of a double conversion crystal controlled superheterodyne, diode matrix- for selection of crystals, and an UP, DOWN/Flag signal detecting section. The receiver utilizes two crystal oscillators for the selection of each glide slope (G/S) channel in this double conversion process. The HF oscillator has five crystals and the LF oscillator has four crystals. The glide slope channel selection may be performed with a narco UGS-1A, channel selector or the channel selector of a navigation receiver such as the narco Mark-12A or Mark-24. Since the UGR-2 is used in an ILS system that includes the VHF Localizer signal, the navigation receiver has an internal switch that selects the G/S UHF channel and the LOC VHF channels simultaneously. The ILS

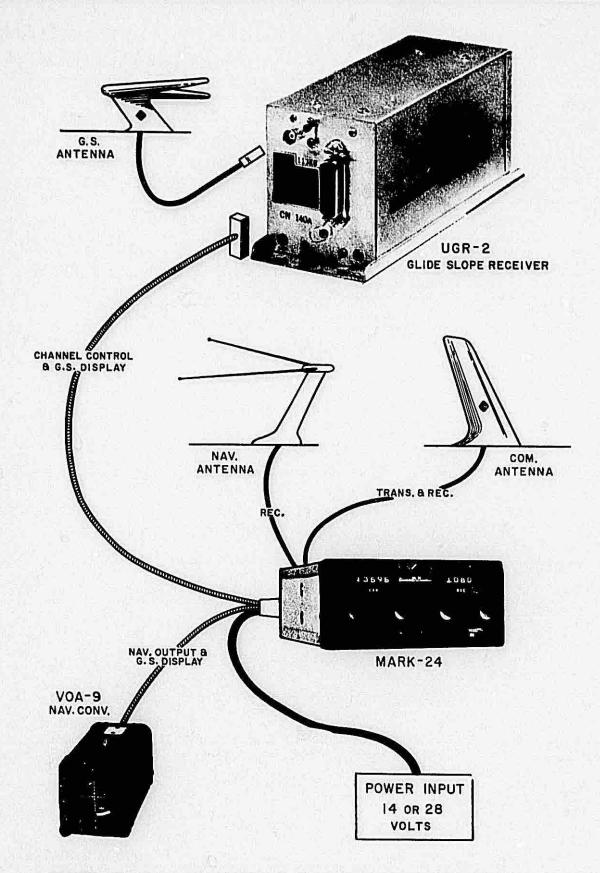


FIGURE 1-2. narco UGR-2 GLIDE SLOPE RECEIVER AND ILS CONNECTIONS

connections are shown functionally in Figure 1-2. When the aircraft and antenna are above the glide path, the rf carrier is modulated predominantly by a 90Hz (cps) tone: below the glide path, the modulating tone is 150Hz (cps).

The 90 and/or 150Hz (cps) output is processed in the meter detector circuits to activate the glide slope UP/DOWN indicator and the flag of the navigation converter. When both signals are equal, the indicator remains at the center position; an increase of 90Hz (cps) signal drives the needle down scale; and an increase of 150Hz (cps) signal drives the needle upscale. The flag is activated only when there is sufficient antenna signal to give a useable output to the UP/DOWN indicator.

1-3. MECHANICAL DESCRIPTION.

The UGR-2 Glide Slope Receiver is comprised of a single unit enclosed in a case 7 7/32 inches long (bottom flange is 8 7/16 inches long) by 3½ inches wide by 3¾ inches high. The bottom of the case is constructed so as to permit rapid insertion or removal of the UGR-2 from a solid mount or shock mount. The various electronic assemblies are secured to the IF chassis, which rests on the bottom of the case. The IF assembly is built on a channel type chassis with the connector panel secured to the front end and the RF/oscillator assembly secured to the far end. The matrix component board and metering component board are located at the left and right sides of the IF assembly, as shown in Figure 5-1.

The two printed circuit component board assemblies are hinged at the bottom to permit access to the inside surface of the assemblies and components located on the top of the IF chassis. Each hinge has a bracket secured to the printed circuit board hole located on the front panel or RF/oscillator assembly, and a mating hinge pin. The hinge pin is a plastic rivet which is expanded by a plug inserted through a hole located on the rivets' axis. Two screws at the top of each printed circuit board secure to threaded mounting brackets with 4-40 screws. The mounting brackets are secured to the rear of the front panel and the case of the RF/ OSC assembly at the rear. The input low-pass filter is an integral part of the front bracket. An additional flange on each mounting bracket has two 4-40 threaded holes (total of 4) for securing the case to the chassis mounting brackets. The RF/OSC assembly has a removable panel at the left side rear as viewed from the front. The removable panel has eight feed-thru capacitors and the RF/OSC printed circuit board secured to it.

1-4. SPECIFICATIONS.

WEIGHT: UGR-2 with Case	2.1	lbs.
Mounting Base	0.25	lbs.
Shock Mount (Accessory Item)	0.75	lbs.
POWER REQUIREMENTS::		
13.75 VDC or 27.5 VDC	230	ma

FUSE recommended:

500 ma

CHANNELS: 20 in the UHF range 329.3 to 335.0 MHz (mc), 0.3 MHz (mc) spacing.

CHANNEL SELECTION: "ARINC" 519, ILS, 11 wire method (standard pairing employed).

REMOTE CHANNEL SELECTION FROM:
narco Mark-VI, narco Mark-10, narco Mark12, o 12A, narco Mark-24, narco UGS-1A, or
"ARIMC" VOR/ILS Standard Selector Switch.

OUTPUT: 1. Indicator Loads—three 150μa, 1000 ohm loads,

2. Flag Alarms Loads—two 250μa, 1000 ohms flag loads.

SENSITIVITY: An input signal of 20 microvolts maximum at the antenna terminals is required for 60% of standard deflection, with erratic movement not exceeding ±5% of standard deflection.

FLAG SENSITIVITY: 20 microvolts maximum at the antenna terminals for 250μa in each flag alarm.

SELECTIVITY:

1. No less than 120 kHz(kc) at 6 db down.

2. No more than 400 kHz(kc) at 40 db down.

3. No more than 600 kHz(kc) at 60 db down.

SPURIOUS RESPONSES: Attenuated at least 60 db below the center response frequency.

ENVIRONMENTAL TEST SPECIFICATIONS:

The narco UGR-2 UHF Glide Slope Receiver is certified under FAA TSO C-34b Environmental Categories B D AAAAAE

Temperature—Altitude, Category B and D Operating Temperature:

-46° to +55° C

Operating Altitude:

30,000 feet

Decompression:

20,000 feet to 40,000 in 15 seconds maximum.

Humidity—Category A

Relative humidity to 95% at 50°C for 48 hours, with condensation once per hour.

Vibration, With Mounting Base—Category E .020" total excursion, 10 to 55 cps, with maximum acceleration of 3G. (Aircraft less than 12,500 lbs.)

Vibration-With Shockmount—Category A .030" total excursion, 10 to 55 cps, with maximum acceleration of 5G. Constant acceleration of 5G from 55 to 500 cps. (Turbine Aircraft).

Audio Frequency Magnetic Field Susceptibility—Category A.

Radio Frequency Susceptibility—Category A. Emission of Spurious Radio-Frequency Energy— Category A.

Explosion-Category E.

CONNECTORS: Antenna, BNC Cable Type. Power/Switching/Indicator, Amphenol 57-30240.

SECTION 2 INSTALLATION

2-1. INTRODUCTION.

The narco UGR-2 Glide Slope Receiver is a single unit with no external controls. The UGR-2 may be secured to the aircraft in a radio rack, on the firewall, or any other location that requires a minimum of interconnecting cable to the glide slope antenna. Mounting dimensions for the rigid mount are given in Figure 2-1 and for the shock mount in Figure 2-2.

The installation consists of securing the UGR-2 mount (rigid or shockmount) to the aircraft structure, installation of the UHF antenna, and connecting the wiring (antenna, output, and power). When connected for glide slope operation only, the UGR-2 requires the following equipments: A navigation converter such as the narco VOA-5 or VOA-9 to permit display of localizer and glide slope information. The UGR-2 requires an 11 wire channel selection system similar to the configuration shown in Figure 2-8. A complete ILS system would include the UGR-2 and the following equipments: a VHF navigation receiver such as the narco Mark-VI, Mark-10, Mark-12 or 12A, or Mark-24 to supply the localizer signal and paired channel selection of the G/S receiver; and a navigation converter such as the narco VOA-5 or VOA-9 to permit display of the localizer and G/S information. All electrical signals and power are obtained from a 24 pin connector located on the front of the case.

2-2. EQUIPMENT SUPPLIED.

- 1. narco UGR-2 UHF Glide Slope Receiver, 20 Channels.
- 2. Mounting Base, UGR-2 (Vibration Category E) or Shockmount, UGR-2 (Vibration Category A).
- 3. Antenna BNC Connector, narco Part No. 41152-1.
- 4. Power/Switching/Indicator Connector supplied with two ¼ watt resistors (1 @ 470 ohms, 1 @ 1,000 ohms), narco Part No. 41291-101.

2-3. EQUIPMENT REQUIRED. but not supplied.

- narco UGA-1 Antenna, UHF Glide Slope Receiving Type (or equivalent).
- narco UGS-1A Channel Selector. This may be part of associated VHF equipment (See Channel Selectors under Specifications).
- 3. Indicator, Glide Slope (1000 ohm).
- 4. Interconnecting wires, cables and hardware as required for the particular installation.

2-4. ANTENNA REQUIREMENTS.

The UGR-2 Receiver is intended to operate with any UHF Glide Slope Antenna having a nominal impedance of 50 ohms. The antenna may have a VSWR of up to 6:1, within the frequency range of 329.0 to 335.3 MHz(mc). For installations where the FAA TSO compliance is desired, the antenna used must meet the requirements of TSO Specification C-34b.

2-5. RECEIVER INSTALLATION.

The UGR-2 Receiver with its mounting base may be mounted in any position; however, with the shockmount, it should be installed in a horizontal position in an equipment rack or other suitable location. The mounting dimensions and space requirements are given in Figures 2-1 and 2-2.

NOTE

It is important to see that all ground straps are properly connected and that the complete installation is securely grounded to the frame.

2-6. UGR-2. MOUNTING CON-SIDERATIONS.

The UGR-2 may be secured in the aircraft by installing in a rigid mount (narco Part No. 51866) or in a shock mount (narco Part No. 51870-102). To satisfy all of the requirements of TSO certification, the shock mounting must be used for installations on a rotary wing aircraft or turbo engine fixed wing aircraft. The rigid mount may be used in all piston engine fixed wing aircraft.

2-7. CHANNEL SELECTOR IN-STALLATION.

If a Navigation Receiver having Glide Slope channel selector switches is not available, the *narco* UGS-1A Glide Slope Channel Selector may be used. The installation and electrical interconnection information is given in Figure 2-8.

2-8. CABLE INTERCONNECTIONS.

Figures 2-3, 2-4, 2-5, and 2-6 provide the required electrical interconnections for the operation of the UGR-2. Receiver with a separate channel selector switch or with the following *narco* navigation receivers: Mark-VI, Mark-10, Mark-12, Mark-12A, or Mark-24. Figure 2-9 shows assembly of the BNC connector on the coax cable.

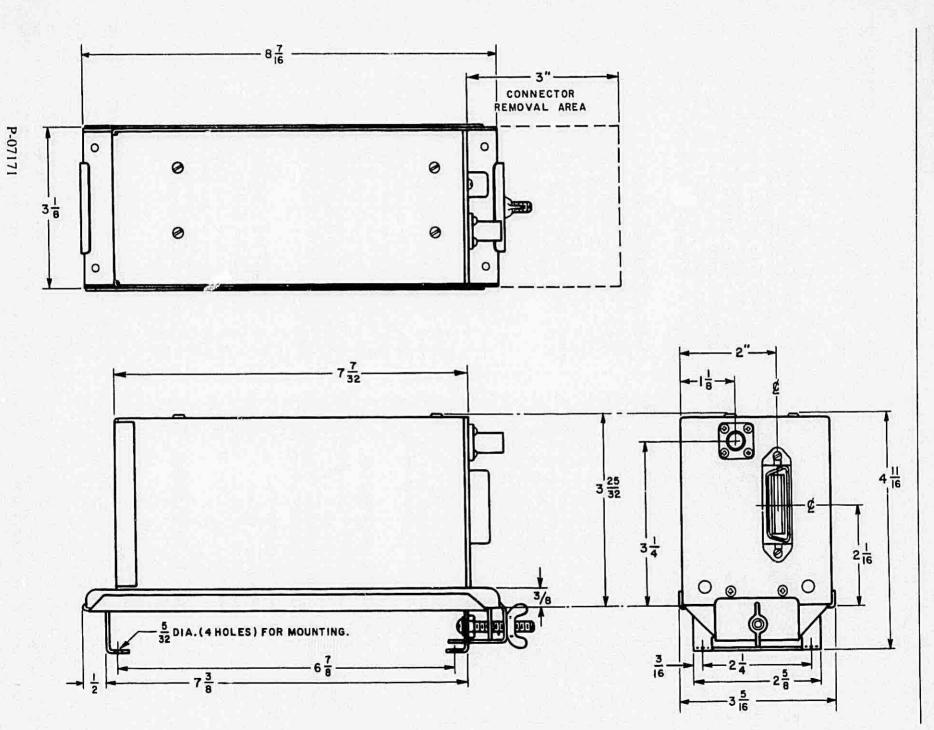


FIGURE 2-1. narco UGR-2 MECHANICAL INSTALLATION, RIGID MOUNT

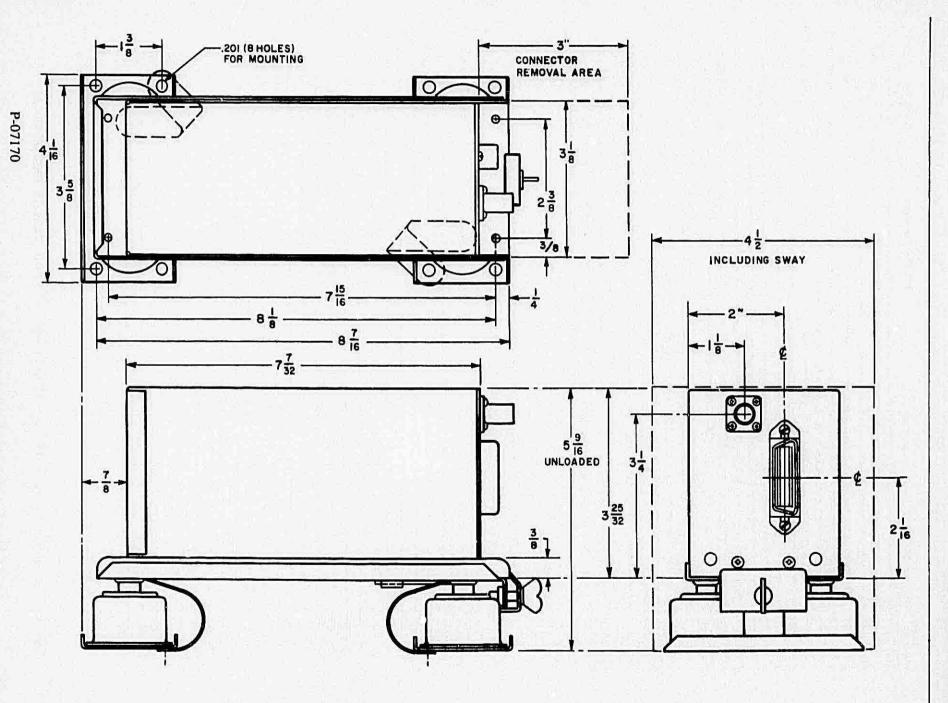


FIGURE 2-2. narco UGR-2 MECHANICAL INSTALLATION, SHOCK MOUNT

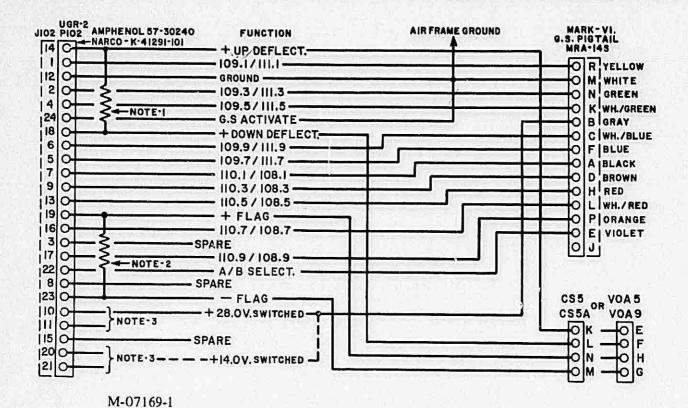


FIGURE 2-3. narco UGR-2 INTERCONNECTIONS WITH MARK-VI

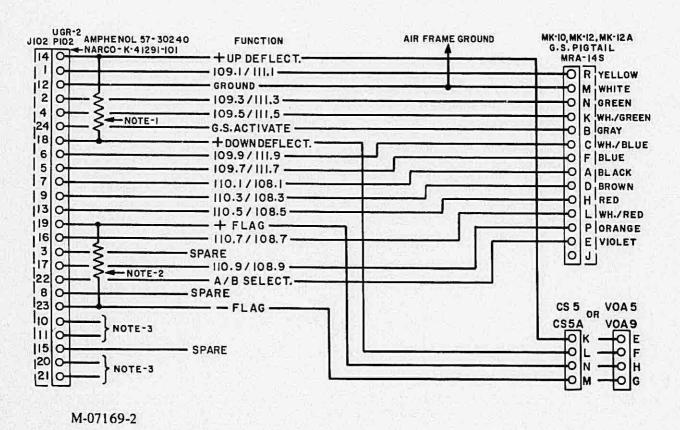
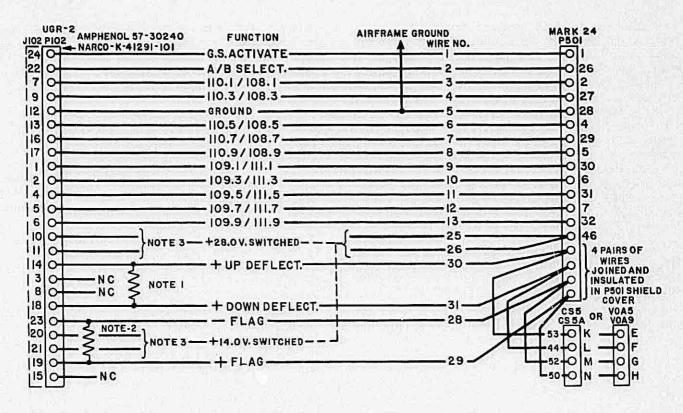


FIGURE 2 - 4. narco UGR-2 INTERCONNECTIONS WITH MARK-10, MARK-12, AND MARK-12A



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FIGURE 2-5. narco UGR-2 INTERCONNECTIONS WITH MARK-24

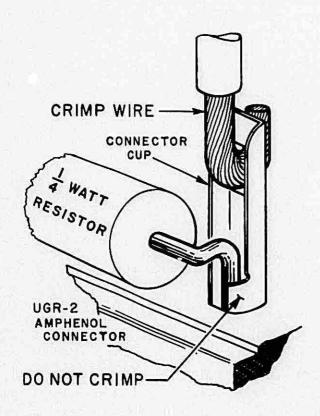
- NOTE 1: Resistor installed inside hood of connector to make combination of resistor loads and meter loads equal 333 ohms (3-1K ohm movements max.) 470 ohms supplied installed in connector is standard.
- NOTE 2: Resistor installed inside hood of connector to make combination of resistor loads and meter loads equal 500 ohms (2-1K ohm flag loads max.) 1000 ohms supplied installed in connector is standard.
- NOTE 3: The primary voltage input connections (A+) are as follows:
 - a. 28 Volts: Connect input to terminals 10 and 11. No connections to terminals 20 and 21.
 - b. 14 Volts: Connect input to terminals 20 and 21. No connections to terminals 10 and 11.
 - c. Use 0.5 Ampere fuse in series with the A+ input load for either 14V or 28V operation.
- NOTE 4: A+ may be obtained from the aircraft power or from the switched A+ of the associated NAV receiver. It is recommended that 2 wires be paralleled (#22 wire).

FIGURE 2-6. narco UGR-2 INTERCONNECTING CABLE NOTES

To realize the specified accuracy of the UGR-2, the receiver outputs must be terminated with three updown indicators and two flag alarms (1000 ohms each). The external load may be the up-down display of an ILS system (narco VOA-9), autopilot, etc. If this maximum display capability is not used, shunting resistors must be installed to provide the correct simulated load. Since each of the shunting loads is 1000 ohms; either three up-down load circuits or 1000 ohm resistors must be connected to the output to total three separate 1000 ohm loads in parallel (333 ohms total); and if one flag indicator is used, a 1000 ohm resistor must be used to simulate the resistance of the unused flag circuit. Figures 2-3, 2-4, and 2-5 show the circuit location of the load resistors installed in the plug.

Refer to Figure 2-7 for connection of the load resistor. Before installing the resistor, make sure that the wire connected to the lug end of the connector cup is routed through the hole, crimped and tack soldered.

On the 1/4 watt resistor, both leads must be bent and cut to the correct length before insertion into the



M-07168

FIGURE 2-7. LOAD RESISTOR INSTALLATION DETAILS

connector cup, then soldered in place. Do not crimp the connector cup; which permits easy removal of the resistor. After soldering of the resistor, push the insulated sleeving as far as possible over the soldered wire lead on the connector receptacle.

2-9. OPERATING INSTRUCTIONS.

The receiver has no direct operating controls and is normally installed at a remote location in the aircraft. It requires only one external control. The receiver operating frequency is controlled by the Glide Slope Channel Selector, which may be part of another equipment.

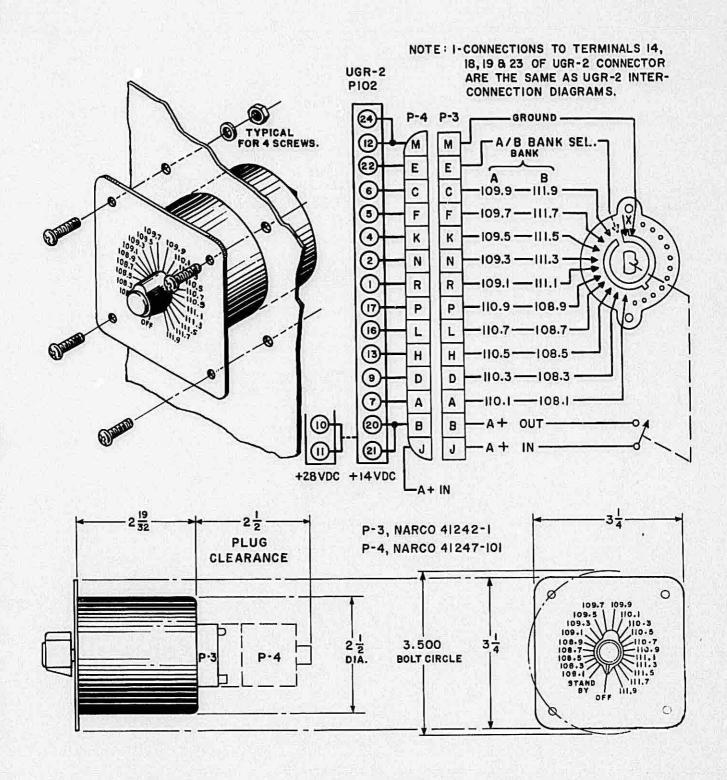
When this receiver is properly interconnected with a navigation receiver such as the narco Mark-12A or Mark-24, operation is entirely automatic. The above equipment has Glide Slope Activate and Channel Select Switch Sections. The Mark-12A may be ordered with the glide slope cable and connector installed. A switching cable and connector kit (narco Part No. EL 3077-500) is available for field installation. The Mark-24 has the glide slope switch sections wired, and does not require any special order. When a VHF localizer channel is selected, the UGR-2 receiver is activated and the corresponding UHF glide slope channel is selected. By noting the position of the Glide Slope Indicator Flag Alarm, it is easy to determine when a reliable signal is being received. When "flying the needle" (keeping the needle centered), the aircraft will remain accurately on glide path. A "needle-up" deflection requires a "fly-up" action and a "needle-down indication requires a "fly-down" action. When the red flag alarm is visible, either an unreliable signal is being received or there is a malfunction in the receiver.

2-10. INDICATOR REQUIREMENTS.

The UGR-2 Receiver is designed to operate any "Glide Slope" indicator movement having the following electrical specification:

- 1. Deflection Movement; $150-0-150\mu a$; 1000 ohms $\pm 10\%$.
- 2. Flag Alarm; $250\mu a$ to be fully energized, 1000 ohms $\pm 10\%$.

The UGR-2 is designed to operate with three deflection indicators (333 ohms) and two flag alarms (500 ohms) connected to the receiver output. When the output circuit has less than three indicators and two alarms, this load must be simulated by connecting 1000 ohm dummy load resistors to the receiver output. An indicator such as the *narco* VOA-9 may be used, with connections to the UP/DOWN movement and the alarm flag.



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FIGURE 2-8. narco UGS-1A GLIDE SLOPE CHANNEL SELECTOR SWITCH



1. Trim cable jacket 19/64" for RG-58A/U.



Fray shield and strip inner dielectric 1/8". Tin center conductor.



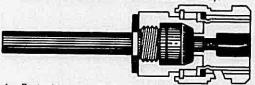
 Toper braid and slide nut, washer, gasket and clamp over braid. Clamp should be squarely against cable jacket.



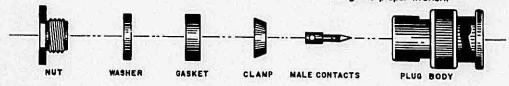
4. Comb out braid, fold back over clamp and trian as shown.



 Slip contact onto center conductor and solder, taking care not to swell dielectric with excessive heat, thereby preventing its entrance into conductor body.



 Push this assembly into the body as far as it will go. Holding the cable and shell rigid, tighten the nut into body using the proper wrench.



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FIGURE 2-9. ASSEMBLY OF BNC CONNECTOR ON RG-58A/U COAX CABLE

SECTION 3 OPERATION

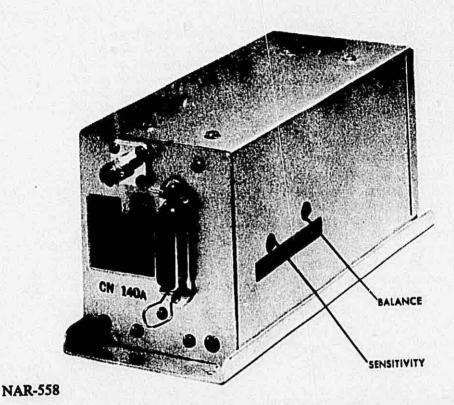


FIGURE 3-1. narco UGR-2 GLIDE SLOPE RECEIVER, LOCATION OF ACCESSIBLE CONTROLS

3-1. NARCO UGR-2, UHF GLIDE RECEIVER.

This receiver has no direct operating controls and is normally installed in a remote location. Two internal controls are accessible through holes in the side of the case (See Figure 3-1); however, the adjustments are critical. Refer to Paragraph 5-8 for adjustment instructions. The glide slope receiver requires only one control, a Glide Slope Channel Selector, which may be part of another equipment.

When this receiver is properly interconnected with equipment such as the *narco* Mark-12A or Mark-24 VHF Navigation or Communication Equipments, operation is entirely automatic. Both of these equipments have Glide Slope Activate and Channel Select Switch Sections. When a VHF Localizer Channel is selected the UGR-2 Receiver is activated and the corresponding UHF Glide Slope Channel is selected.

The UGR-2 Receiver may be equipped with a Shockmount and is usually installed in an equipment rack or other suitable place. Connections to an Antenna, Channel Selector and Indicator are made by appropriate cables.

3-2. NARCO UGS-1A CHANNEL SELECTOR SWITCH.

If a separate Channel Selector is required the narco UGS-1A Channel Selector Switch may be used. Glide slope receivers operate in the UHF frequency range of 329.3 through 335.0 MHz, but each of the twenty glide slope channels is always paired with one particular localizer channel. Instrument approach plates show only the VHF localizer frequencies, never the UHF glide slope frequencies. The narco UGS-1A Glide Slope Channel Selector is therefore marked with the VHF localizer frequencies.

3-3. NAVIGATION

Information concerning operating procedures and the use of Glide Slope Receivers is available in various publications. Among them are the various operating manuals for Navigation and Communication Equipments of the FAA Airman's Information Manual.

SECTION 4 CIRCUIT DESCRIPTION

4-1. INTRODUCTION.

This section provides a detailed circuit description of the narco UGR-2 Glide Slope Receiver. A functional description is given to show the relationship between the various sections of the receiver, followed by a detailed stage-by-stage circuit description. Figure 7-1 is a functional block diagram showing system operation; Figures 7-2 and 7-3 are the schematic diagrams.

4-2. GENERAL FUNCTIONAL DESCRIPTION.

The UGR-2 provides accurate Glide Slope (vertical position) information for aircraft approaching airports equipped with Instrument Landing Systems (ILS). The receiver operates in the UHF range of 329.3 thru 335.0 MHz(mc). The receiver is intended as a companion equipment for any Navigation or Communication equipment which provides Localizer (lateral position) information in the VHF range of 108.1 thru 111.9 MHz(mc).

The UGR-2 is comprised of a single unit receiver that operates in conjunction with a localizer receiver to provide paired channel operation in an ILS system: Table 4-1 lists the channel frequencies. The antenna and mixer circuits are broad-banded to cover the full operating band. The receiver is tuned by means of two crystal oscillators in a dual conversion superheterodyne circuit.

The crystal oscillators are activated by a channel selector switch. For fully automatic operation in an ILS system, the channel selector switch wafers should be located in the associated localizer receiver. The narco Mark-VI, Mark-10, Mark-12, Mark-12A and Mark-24 navigation receivers contain these wafers. An eleven-wire switching system is used. Ten of these wires select two channels each. The eleventh wire (A/B bank) determines which of the two channels related to a particular wire is to be used. The UGR-2 cannot be directly controlled by a glide slope frequency selector using ARINC two-out-of-five switching. A conversion matrix would be required in this case.

If the UGR-2 is to be used with a navigation receiver which does not contain the proper switching wafers, a narco UGS-1A Glide Slope Channel Selector Switch may be mounted in the instrument panel and used to channel the glide slope receiver.

In addition to understanding the operation of the narco UGR-2 Glide Slope Receiver, it is also necessary to have a knowledge of the UHF glide slope signal received by the receiver. The glide slope transmitter radiates a horizontally polarized dual beam signal over

the runway. The two glide slope beams are directed along the landing path at an angle of 2.25 to 3.0 degrees above the horizon, depending upon the surrounding terrain. Each of the two beams has the same carrier frequency. However, the upper beam is modulated by a 90Hz (cps) tone and the lower beam is modulated by a 150Hz (cps) tone.

When the aircraft is located between the two beams, the two signals will be of equal strength at the receiver. Above or below this glide path, one audio tone will be of greater amplitude.

The UGR-2 is a double conversion superheterodyne radio with crystal control of both local oscillators, the Low Frequency Oscillator (LFO) and the High Frequency Oscillator (HFO). In the tuning section, the rf amplifier is broad banded: the injection frequency of the first mixer is the second harmonic of the HFO (additional doubling in the mixer) and the injection frequency of the second mixer is the same frequency as the LFO. Table 4-2 lists all oscillator and IF frequencies.

The HFO has five crystals with diode switching to select the desired operating frequency. Each crystal is activated by a gate circuit that is controlled from the matrix. A DC potential, obtained from the matrix, is used to forward bias a selected diode to connect the desired crystal to the oscillator circuit. A low-pass filter, on each line connected to the matrix, isolates the oscillator circuit from the DC control lines. The potentials that forward bias the switching diodes are obtained from the associated gate transistor (Q-201 thru Q-205) that is controlled from the matrix. The oscillator frequency is doubled in Q-109 and doubled in the first mixer (Q-102). At the first mixer, the injection frequency is the second harmonic of the HF oscillator.

The LFO has four crystals with direct diode switching to select the desired operating frequency. From the common oscillator, each crystal is connected to ground through a diode. When the selected diode conducts, the associated crystal is connected to the LF oscillator. As in the HFO, all control lines connected to the diodes have low-pass filters to isolate the DC control circuits from the rf circuits.

The receiver operates on 20 fixed frequency crystal controlled channels. Although there are 10 channel control lines, an additional control line (A/B select) permits using each line for two channels. The five HF crystal oscillators and four LF crystal oscillators are connected to the 10 input matrix. The channel is selected when the desired input line is connected to ground. Then, the A/B select line will choose the A or B group, depending on whether or not this line is grounded.

J-101 Input Pin Grounded	Loc. Freq.	Glide Slope Freq.	Term #22 A/B Sel.
	109.1	331.4	Open
2	109.3	332.0	Open
4	109.5	332.6	Open
5	109.7	333.2	Open
6	109.9	333.8	Open
7	110.1	334.4	Open
9	110.3	335.0	Open
13	110.5	329.6	Open
16	110.7	330.2	Open
17	110.9	330.8	Open
1	111.1	331.7	Grounded
2	111.3	332.3	Grounded
4	111.5	332.9	Grounded
5	111.7	333.5	Grounded
6	111.9	331.1	Grounded
7	108.1	334.7	Grounded
9	108.3	334.1	Grounded
13	108.5	329.9	Grounded
16	108.7	330.5	Grounded
17	108.9	329.3	Grounded

TABLE 4-1. GLIDE SLOPE AND LOCALIZER OPERATING FREQUENCIES, PAIRED FOR ILS

The HFIF for each selected channel differs as shown in Table 4-2. The frequency range is from 27.45 to 28.35MHz (mc). The LF IF, however, is 7.35MHz (mc) for all channels.

Following three stages of IF amplification, the signal is connected to the detector section, which provides an audio output and an AGC control signal. The filtered AGC signal provides a control voltage for decreasing gain in the presence of strong signals.

The three stage audio amplifier output is connected to the tuned filters in the detector circuit. A difference detector provides signal to the UP/DOWN display and a product detector utilizes the difference detector output to drive the flag alarm. The metering circuits are described in detail below.

4-3. DETAILED FUNCTIONAL DESCRIPTION. 4-4. LOW-PASS RF FILTER.

A low-pass filter (L-117, C-161, C-162) is connected between the antenna terminals and the rf amplifier input. In addition to attenuating received frequencies above the pass band of the rf amplifier; the filter attenuates any beat frequencies generated within the receiver, thereby preventing spurious responses or radiation at harmonics of the oscillator frequency.

J-101 Pin (Gnd)	LFO Selected	LFO Freq.	HFO Selected	HFO Freq.	4 x HFO Freq.	HFIF Freq.	Condition of A/B Select Line
1	4	35.7	2	75.7625	303.05	28.35	Open
2 4	2	35.1	2 3 3	76.0625	304.25	27.75	Open
4	4	35.7	3	76.0625	304.25	28.35	Open
5	2	35.1	4	76.3625	305.45	27.75	Open
6	4	35.7	4 4 5 5	76.3625	305.45	28.35	Open
7	2	35.1	5	76.6625	306.65	27.75	Open
9	4	35.7	5	76.6625	306.65	28.35	Open
13	2	35.1	1	75.4625	301.85	27.75	Open
16	4	35.7	1	75.4625	301.85	28.35	Open
17	2	35.1	2	75.7625	303.05	27.75	Open
1	1	34.8	3	76.0625	304.25	27.45	Grounded
2 4	3	35.4	3	76.0625	304.25	28.05	Grounded
4	1	34.8	4	76.3625	305.45	27.45	Grounded
5	3	35.4	4	76.3625	305.45	28.05	Grounded
6	3	35.4	2 5 5	75.7625	303.05	28.05	Grounded
7	3	35.4	5	76.6625	306.65	28.05	Grounded
9	1	34.8	5	76.6625	306.65	27.45	Grounded
13	3	35.4	1	75.4625	301.85	28.05	Grounded
16	1	34.8	2	75.7625	303.05	27.45	Grounded
17	1	34.8	1100	75.4625	301.85	27.45	Grounded

TABLE 4-2. LOCAL OSCILLATOR OPERATING FREQUENCIES, HF AND LF OSCILLATORS.

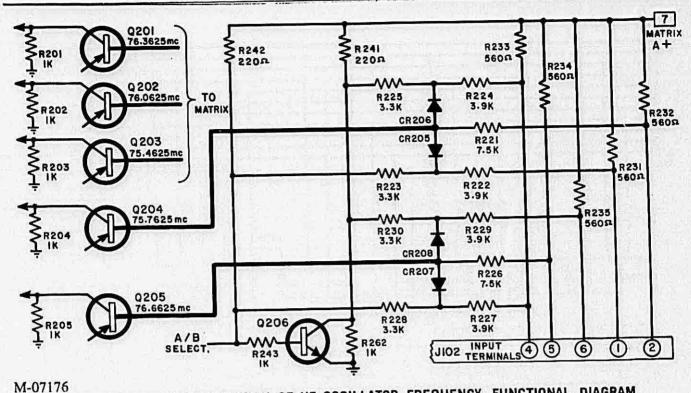


FIGURE 4-1. A/B SELECTION OF HF OSCILLATOR FREQUENCY, FUNCTIONAL DIAGRAM

4-5. RF AMPLIFIER (Q-101).

The low-pass filter is connected to the antenna transformer (L-101/L-102), which couples the antenna signal into the rf amplifier. The input coil and low-pass filter are matched to 50 ohms, the impedance of the receiving antenna. The transformer is broadly tuned from 329.3 to 335MHz (mc), the glide slope receiver frequencies. The rf amplifier (Q-101) is a common base amplifier with its gain set by the AGC voltage applied to the base. The receiver input is fixed tuned; therefore, the signal received is determined by the frequency of the crystals connected to the HFO and LFO.

4-6. HF OSCILLATOR (Q-108).

The High Frequency Oscillator (HFO) is a Colpitts crystal controlled oscillator (Q-108) operating at five crystal frequencies within the 75.4625 to 76.6625MHz (mc) range. The basic oscillator circuit has the crystal (XT-101 thru XT-105) connected in the feedback path. The output signal is developed across L-113, which is broadly tuned to cover the range of the five crystals. The five crystals are effectively connected in parallel from the feedback point to the emitter. However, a single diode (CR-104 thru CR-108) is placed in series with each crystal and a connection made to the junction point. Since there are DC potentials connected to reverse bias each diode, this high resistance in series with each crystal effectively disconnects all crystals from the oscillator. When a command line in the matrix is activated, the associated crystal input line forward biases the selected diode and completes the crystal feedback path to the emitter. Each of the five gate output lines and the common return lines have a low pass filter (L-106 thru L-111 and feed thru capacitors C-135 thru C-140) to isolate rf from the six control lines

The HFO schematic is shown in Figure 7-2, the matrix control of the HFO is shown in Figure 7-3, and the simplified matrix control drawing is shown in Figure 4-1.

4-7. FREQUENCY DOUBLER (Q-109).

The frequency doubler (Q-109) is a common base configuration with the output tank circuit broadly tuned to cover the 150.925 to 153.325MHz (mc) range, the second harmonic of the HFO. The doubler is operated with zero bias for optimum harmonic generation. The output circuit is double tuned for elimination of undesired harmonics.

4-8. FIRST MIXER (Q-102).

The first mixer (Q-102) heterodynes the incoming rf signal with the high frequency oscillator signal to produce the high frequency intermediate frequency signal (HFIF). Although the second harmonic of the HFO is connected to the mixer, the output circuit is tuned to the difference frequency between the rf input signal and fourth harmonic of the HFO. Therefore, the HF mixer serves the dual purpose of: (1) frequency doubler and (2) superheterodyne converter.

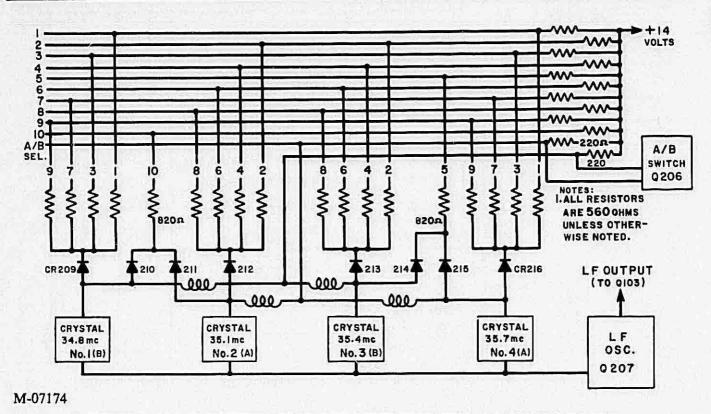


FIGURE 4-2. A/B SELECTION OF LF OSCILLATOR FREQUENCY, FUNCTIONAL DIAGRAM

The undesired high frequencies are by-passed to ground on the HFO assembly by C-110 and only the difference frequency is coupled through L-118 to the HFIF transformer on the IF assembly. The HFIF circuits are tuned to cover the 27.45 to 28.35MHz (mc) range.

4-9. LF OSCILLATOR.

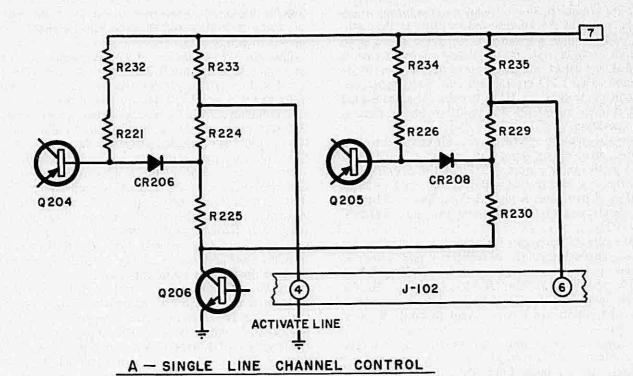
The Low Frequency Oscillator (LFO) is a Colpitts crystal controlled oscillator (Q-207) operating at four crystal frequencies within the 34.8 to 35.7MHz (mc) range. The basic oscillator circuit has the crystals (XT-201 thru XT-204) connected in the feedback path. The common side of each crystal is connected to the base. The ground return of each crystal is through the series diode (CR-209, CR-212, CR-213, CR-216) and the capacitance to ground of the associated feedthru capacitors (C-205, C-208, C-210, C-212). This rf ground path exists only when the associated diode is forward biased. The four crystals are connected into two groups, Group A (35.1 and 35.7MHz and Group B (34.8 and 35.4MHz). A diode is connected in series with each crystal and the four crystals are effectively connected in parallel from the oscillator base to ground. The diode cathodes are connected to the 10 channel select lines and the diode anodes are connected to the A/B select circuit. Additional diodes (CR 210, CR-211, CR-214, CR-215) provide isolation between the A and B groups. With all four crystal circuits connected in parallel, all four series diodes are reverse biased and the high resistance in series with each crystal effectively disconnects all crystals from the oscillator. When a command line in the matrix is activated, the associated crystal input line forward biases the diode and completes the crystal feedback path to ground. Each crystal has a low-pass filter (feedthru capacitors C-205 thru C-212 and rf chokes L-201 thru L-204) to keep rf from the DC lines of the matrix. Figure 4-2 shows the method of connecting the four crystals to the crystal oscillator.

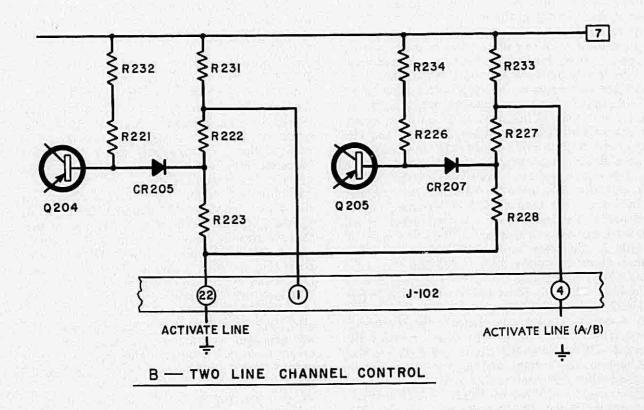
4-10. MATRIX.

The matrix controls the operating frequency of the dual conversion superheterodyne by selecting the frequency of the HF and LF local oscillators. The matrix is comprised of resistor and diode interconnections between 10 channel control lines and nine oscillator control lines. The multiple interconnections permit each input line to set the frequency of one LFO and one HFO. Although there are as many as two LFO's and two HFO's connected to a control line, the A/B select line permits using the correct pair.

Therefore, the 10 channel control lines are capable of selecting from 20 channels: the A group when one channel control line is grounded; and the B group when both the A/B select line and the same channel control line are connected to ground. The frequency control is accomplished by using a forward biased diode to connect the desired crystal to the HFO and the same technique to control the LFO. The oscillator crystal switching is described in detail in Paragraphs 4-6 and 4-9 above.

The matrix will be described as applied to the biasing of the diodes. In the quiescent state with none of the





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 (\mathbf{X})

FIGURE 4-3. MATRIX CONTROL OF HFO GATES

input lines grounded, all diodes are reverse biased (negative potential at the anodes and positive at the cathodes) and the high resistance is the same as an open circuit in each crystal circuit. When an input line is grounded, the effect will be to forward bias one diode connected to an LFO crystal and one diode connected to a gate controlling an HFO crystal. The associated crystal is then connected and both oscillator circuits are in operation.

Each crystal activate circuit of the HFO is controlled by a two, five, or six input gate circuit (Q-201 thru Q-205) as shown in Figure 7-3. Since the operation of three gates are identical (Q-203, Q-204, and Q-205) the action of two gates is given below, followed by the circuit description of the remaining two gates (Q-201

and Q-202).

The base bias of each gate transistor is controlled by potentials applied through a resistor diode network. The bias potential through resistors R-208/R-209 (Q-201), R-269 (Q-202), R-216 (Q-203), R-221 (Q-204), and R-226 (Q-205) (approximately the same as the matrix A+) is sufficient to hold all gates at cut off.

When an input line is connected to ground, it forms the ground return for a voltage divider network to A+. Since there are 10 input lines, there are 10 possible connections of resistors from A+ to ground. The five transistors (base connection) are connected to the 10 input lines directly through a resistor or through a resistor and diode circuit in the matrix.

As shown in Figures 4-1 and 7-3, each gate input circuit has the anodes of two diodes connected to the transistor base. Each diode has two resistors connected to the cathode (3.3K and 3.9K). The 3.3K resistors are connected to the A/B select circuit and the 3.9K resistors are connected to the individual channel select lines of the matrix. It must be noted that there are two A/B select lines, the input and the output of the A/B switch (Q-206). In the schematic, the upper diode of each gate is connected to the A/B switch gate output and the lower diode is connected to the input. There is a polarity difference between the two lines since the output (Q-206 collector) is at ground potential when the base is not grounded. From the above it can be seen that one of the two diodes in each gate is connected to ground through the 3.3K resistor connected to the collector of Q-206.

As an example of this gate action, refer to Figure 4-1, the simplified schematic of channel control through pin 4 of J-102. Since the A/B select line is not grounded Q-206 is conducting and the collector is at ground potential. This provides the ground return for two 3.3K resistors, R-230 in the Q-205 circuit and R-225 in the Q-204 circuit. The voltage divider from Matrix A+ to ground is shown in detail in Figure 4-3. Current flow through voltage divider R-233, R-224, R-225 and return to ground through Q-206 develops a 6.0 volt bias at the base of Q-204. Refer to Figure 4-3A for the voltage divider connections. Current flows through R-235, R-229, R-230 and return to the ground through Q-206 develops a 6.0 volt bias at the base of Q-205.

Similar bleeder resistors connected to Q-203 provide the same potentials and none of the transistor gates is biased to conduction.

When Pin 4 is grounded, R-224 is connected directly to ground to shunt the R-225/Q-206 circuit. The voltage distribution through this new divider provides +2.8 volts at the base of Q-204 and the transistor is biased to conduction. With the emitter biased at 3.0 volts, the 2.8 volt potential at the base turns on the gate. Although pin 4 is connected to Q-205 through R-227 and CR-207, this gate does not conduct since the A/B select line connected to R-228 is ungrounded.

The circuit description given below separates the action of the A/B select line and the channel select line. Actually, when this form of channel selection occurs it is a simultaneous action; however to clarify the description, it is separated into two steps to illustrate the simultaneous application of the ground circuit to the

selected diode/gate transistor circuit.

When the A/B select line is grounded, the two voltage dividers have a different path to ground as shown in Figure 4-2 B. Current flow through R-231, R-222, R-223, and return to ground through the A/B select line (pin 22 of J-102) develops a 6.0 volt bias at the base of Q-204. Current flow through R-223, R-227, R-228, and return to ground through the A/B select line develops 6.0 volts of bias at the base of Q-205. The voltage distribution is almost the same as the bias developed with the A/B select line ungrounded. However, Q-204 base is connected to the voltage divider through CR-205 and Q-205 base is connected through CR-207.

An additional ground at Pin 4 of J-102 serves to shunt R-227 and R-228 to ground. The decrease in positive potential at the base of Q-205 drives Q-205 to conduction. This method is used on the other nine lines to obtain the ten channels with the A/B select line grounded. From the above description it can be summarized that grounding only pin 4 fires gate Q-204. Simultaneously grounding pin 22 (A/B select line) and pin 4 fires gate Q-205.

The above description illustrates the control action of pin 4 as applied to the operation of transistor gates Q-204 and Q-205. This pin is only one of the inputs that controls the conduction of the gates. Gate Q-204 is also controlled by pins 1 and 2: Gate Q-205 is also controlled by pins 5 and 6. The multiple inputs of

Q-204 and Q-205 are shown in Figure 4-1.

Although the 7.5K resistors serve to connect the base of Q-203, Q-204, and Q-205 to the matrix A+, they also serve as additional inputs to the gates. The gates are activated as follows: grounding pin 5 activates Q-205 through R-226; grounding pin 2 activates Q-204 through R-221; and grounding pin 13 activates Q-203 through R-216.

As shown in Figure 7-3, the operation of gate Q-202 is similar since one input diode (CR-202) is connected to the A/B select line through R-213 and the other diode (Q-201) is connected to the A/B gate (Q-206 output) through R-212. Each diode is connected to two channel select input lines that operate the same as the

single input line configuration of Q-203, Q-204, and Q-205. The transistor is held at cutoff by the positive potential supplied through R-269. Grounding of pins 16, or 6 fires the gate through CR-202; grounding of pins 1 or 17 fires the gate through CR-201. When an input line is grounded, the action is similar to the voltage divider action of Q-203, Q-204, and Q-205 as described above.

Transistor gate Q-201 is a two input resistive gate. The base is connected to input terminal 7 through R-208 and to input terminal 9 through R-209. The two resistors connected to the matrix A+ provide the positive bias that holds the transistor at cutoff. When one input terminal is connected to ground, current through the two resistors in series plus the 560 ohm resistor to the matrix A+ forms a voltage divider. The base of Q-201 is connected to approximately 7.0 volts bias, which fires the gate.

Input line 4 also selects the LF oscillator frequency since R-528 is connected to the 37.5MHz (mc) crystal and R-245 is connected to the 34.8MHz (mc) crystal. Although both crystal gate circuits are enabled when line 4 is grounded, the A/B select line determines whether the diodes connected to the odd or even pairs of crystals will conduct. This is explained in detail in paragraph 4-9.

4-11. SECOND MIXER.

The second mixer (Q-103) heterodynes the LFO signal with the HFIF signal to produce the Low Frequency Intermediate Frequency (LFIF) signal. The HFIF signal, which is supplied from T-101, has a frequency range of 27.45 to 28.35MHz (mc) with T-101 broadly tuned to cover this range. The 7.35MHz (mc) LFIF is the difference frequency between the two signals. The base of Q-103 is connected to the AGC buss to control the gain when the signal level increases.

4-12. LF IF AMPLIFIERS (Q-104, Q-105, Q-106).

The three LF IF amplifiers have relatively high gain, operating at 7.35MHz (mc) with 160 kHz (kc) nominal bandwidth at the 6 db points. Each amplifier is of conventional design with a neutralization capacitor and adequate filtering to ensure against interaction between stages. AGC is applied to Q-104; however, Q-105 and Q-106 have an additional control function.

The two base circuits are connected together and tied to Pin 24 of J-102 for control from an external source. When this circuit is open, the positive potentials at the transformer ends of R-110 and R-113 effectively bias both amplifiers at cut off. Connecting Pin 24 to ground will make these two points more negative, permitting Q-105 and Q-106 to operate as IF amplifiers. Since this control line is connected to the OMNI-LOCAL-IZER control circuit, the high voltage transient developed at the switching relay could damage the IF transistors. Any positive transient on this line reverse biases CR-109; however, grounding this point forward biases the diode to operate the two amplifiers.

The G. S. Activate Line is controlled by a deck of the channel selector switch in the localizer receiver or the

UGS-1A selector switch. When the external control opens this circuit, it inhibits operation of the receiver. The HF and LF oscillators will operate only when one of the channel select lines is grounded. This permits using a variety of methods to control the operation of the UGR-2; dependent upon the external switching configuration.

4-13. AUDIO DETECTOR AND AGC DETECTOR

The audio detector, (CR-101) demodulates the IF signal and the low-pass filter (C-121, C-123, R-116) extracts the 90 and 150Hz (cps) Glide Slope Signal. The detector output is connected to the input of the first audio amplifier (Q-301). The time constant of this circuit is relatively long, which minimizes interference from high frequency noise in the AM signal.

The AGC detector is connected to the same signal source. The IF signal is demodulated by the AGC detector and the long time constant filter (R-117, R-118, C-124, C-125, C-126, C-127, C-146) develops a DC level at the input of Q-107, the AGC amplifier. The AGC amplifier serves a dual purpose since it increases the AGC signal current and increases the impedance of the AGC circuit with reference to ground.

The AGC line provides a control potential to the rf amplifier, first mixer, second mixer, first IF amplifier, and the first audio amplifier. The AGC voltage is obtained from the detected output of the LFIF amplifier. Therefore, the amplitude of the AGC voltage is directly related to the level of the received rf signal. If the received signal increases in amplitude, the signal at the AGC buss becomes more positive. Since all transistors connected to the AGC line are PNP, the positive potential reduces the gain and stabilizes the audio output.

4-14. METERING AMPLIFIER (Q-301, Q-302, Q-303).

The metering amplifier is a three stage audio amplifier that provides signals to the meter and alarm detectors. In addition to the detector output signal, the AGC line is diode coupled into the base of the first metering amplifier (Q-301). When the AGC becomes more positive than the base of Q-301 the diode becomes forward biased and the AGC line is connected directly to the base. The course softening control (R-306) sets the operating level of the amplifier, so as to decrease the gain of the amplifier as the aircraft approaches the transmitter. This stage is further stabilized by using a temperature compensation network (R-315, R-316) in the emitter circuit.

The second and third metering amplifiers are stabilized with AC and DC inverse feedback loops. The DC feedback uses R-312 to supply feedback from Q-303 collector to Q-302 emitter. The AC feedback loop is connected in the same circuit. However, there is additional resistance in this circuit (R-310, R-311) isolated from the DC path by capacitor C-303.

The metering amplifier output signal is developed across the input of the 90Hz (cps) and 150 Hz (cps) filters.

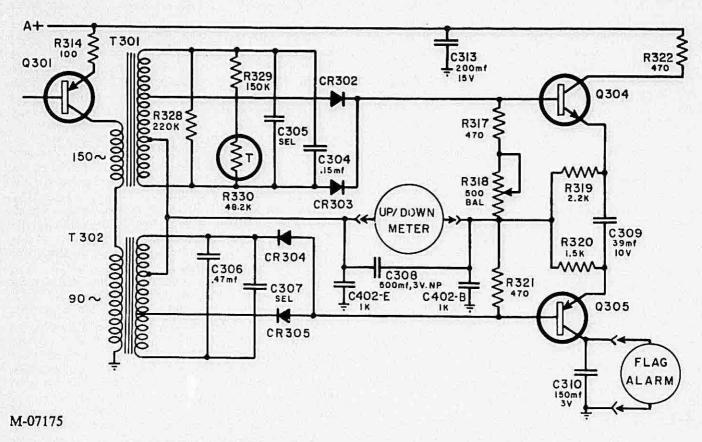


FIGURE 4-4. UP/DOWN AND FLAG DETECTORS, SCHEMATIC DIAGRAM

4-15. FILTER CIRCUITS.

The 90 and 150Hz (cps) filter circuits separate the dual frequency glide slope signal into two separate frequencies. The secondary of T-301 is tuned to 150Hz (cps) by the shunting capacitors (C-304, C-305). The full wave rectifier (CR-302, CR-303) converts this 150Hz (cps) signal to a positive DC level at the load circuit, R-317 and R-318. The secondary of T-302 is tuned to 90Hz (cps) by the shunting capacitors (C-306, C-307). The full wave rectifier (CR-304, CR-305) converts this to a negative DC level at the load circuit, R-321.

4-16. UP/DOWN DETECTOR.

The UP/DOWN detector is a modified form of difference detector circuit. The positive dc circuit of the 150Hz (cps) rectifier and the negative dc output of the 90Hz (cps) rectifier are connected in series, using a three wire output, as shown in Figure 4-4. When the two voltages are of equal amplitudes, the sum of the two currents flowing through the center conductor is zero since they are equal and opposite. The meter is in series with this line, indicating a null when both signals are equal. Unequal DC voltages from the filter circuits creates an unbalance. The difference current flowing in the center conductor shows a + or - (UP or DOWN) indication on the meter. The balance con-

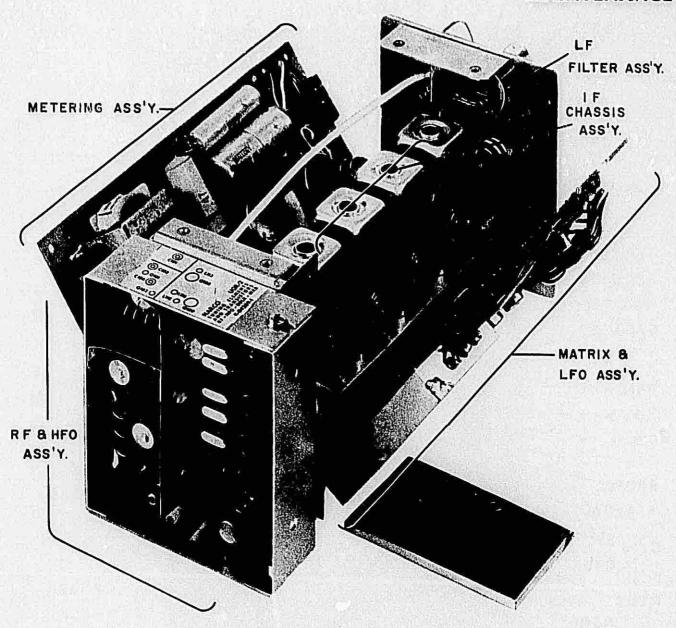
trol (R-318) is adjusted for a null of the UP/DOWN indicator when both signals are equal.

4-17. FLAG ALARM DETECTOR.

The flag alarm amplifier indicates that the level of the UP signal and DOWN signals are within the operating range of the glide slope receiver. The dual output from the UP/DOWN detector (+ from 150Hz (cps) output and - from 90Hz(cps) output) is connected to a two input AND gate (Q-304, Q-305) as shown in Figure 4-4. The positive output (150Hz) is connected to Q-304, which is an NPN transistor and the negative output (90Hz) is connected to Q-305, which is a PNP transistor. When signals are within the operating range. the positive potential at the NPN transistor will cause conduction and the negative potential at the PNP transistor will also cause conduction. Since the two transistors (emitter/collector circuits) are in series with the flag alarm, current will flow through the alarm display. This display will operate when the UP/DOWN indicator shows a null since the gate circuit action depends upon the polarization and amplitude of the UP/ DOWN detector outputs with this complementary transistor circuit.

If only one modulation signal is being transmitted, the flag will not be activated. The absence of either the 90 or 150Hz (cps) signal at the UP/DOWN product detector will deactivate the flag circuit.

SECTION 5 MAINTENANCE



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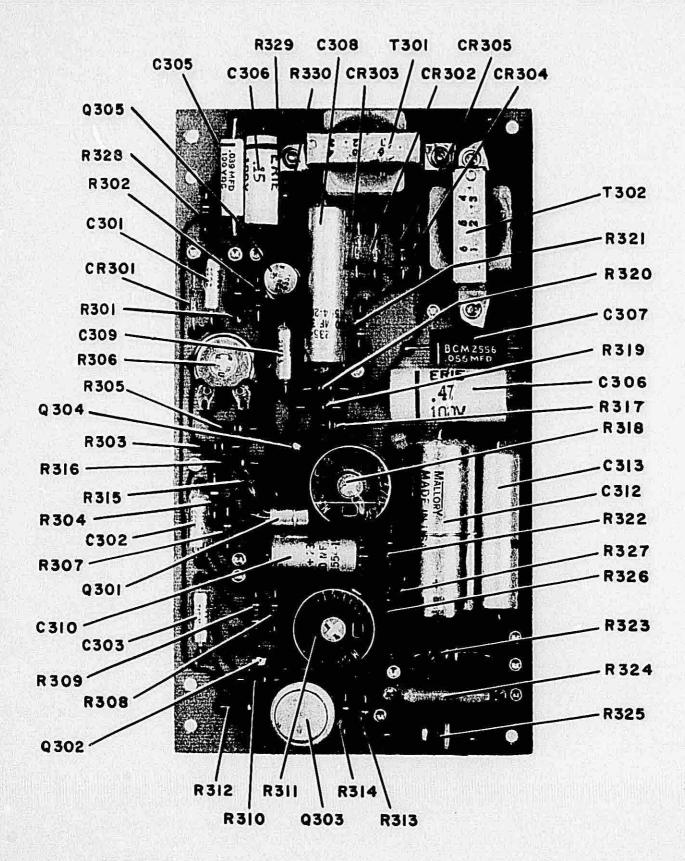
FIGURE 5-1. narco UGR-2 GLIDE SLOPE RECEIVER, LOCATION OF MAJOR ASSEMBLIES

5-1. INTRODUCTION.

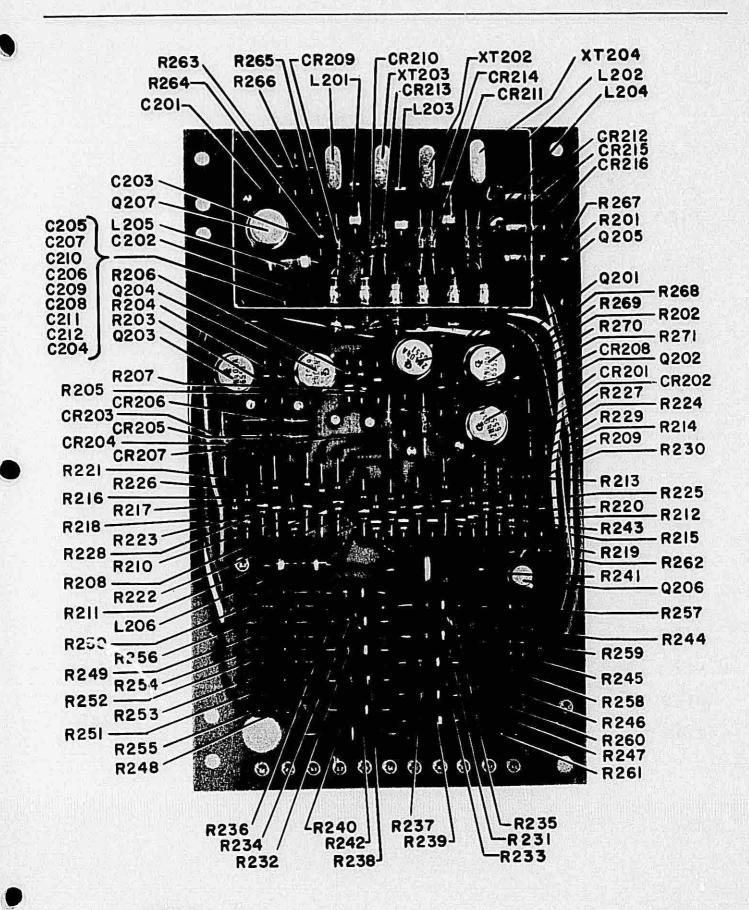
This section provides information necessary for the periodic maintenance, checkout, troubleshooting, alignment, and repair of the UGR-2 Glide Slope Receiver. The performance tests given in Paragraph 5-7 permit evaluating the operation and should assist in determining when alignment is necessary. Paragraphs 5-10 to

5-13 outline a procedure for trouble isolation to the IF/RF, matrix, and metering sections.

Figure 5-1 shows the location of assemblies on the UGR-2 and Figures 5-2, 5-3, 5-4, 5-5, and 5-6 show the location and identification of components on each assembly. Each component is identified on the photograph by the symbol. The same symbol is associated

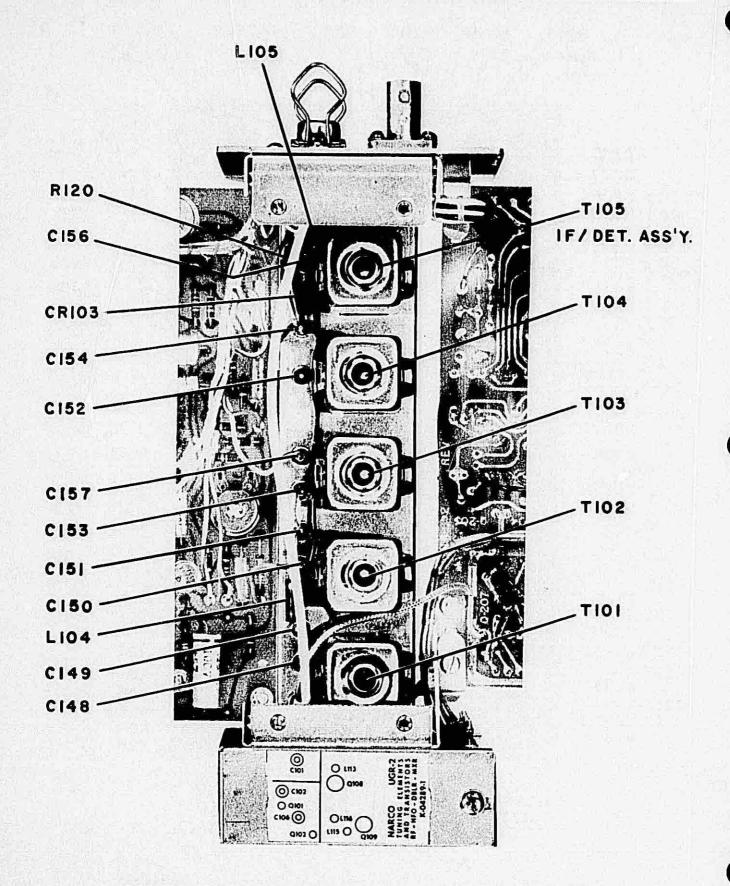


NAR-540
FIGURE 5-2. METERING ASSEMBLY, TOP VIEW SHOWING COMPONENTS



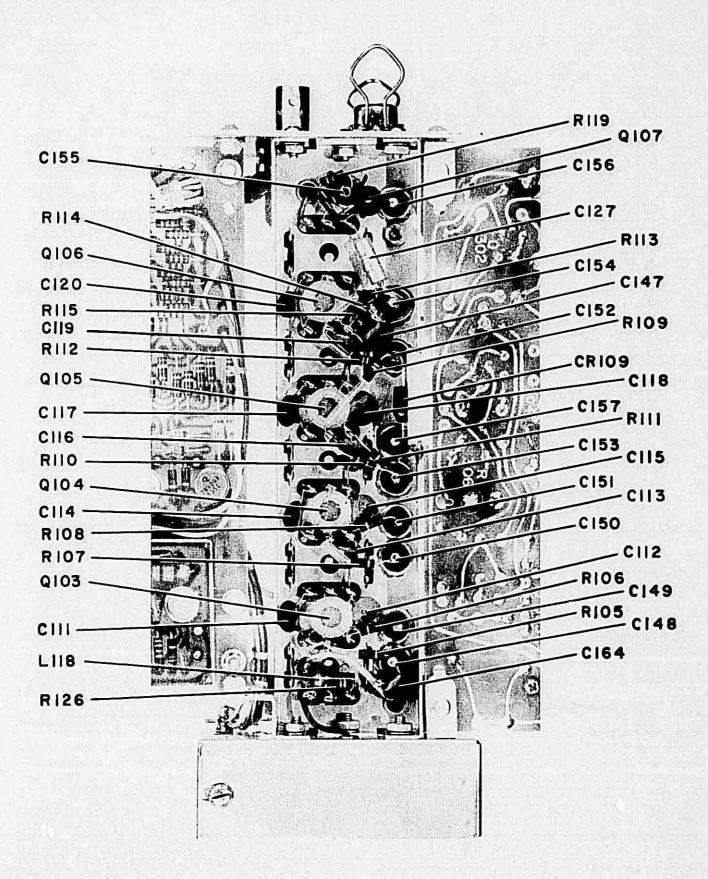
NAR-541

FIGURE 5-3. MATRIX ASSEMBLY, TOP VIEW SHOWING COMPONENTS



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FIGURE 5-4. LFIF ASSEMBLY, TOP VIEW SHOWING COMPONENTS



NAR-537

FIGURE 5-5. LFIF ASSEMBLY, BOTTOM VIEW SHOWING COMPONENTS

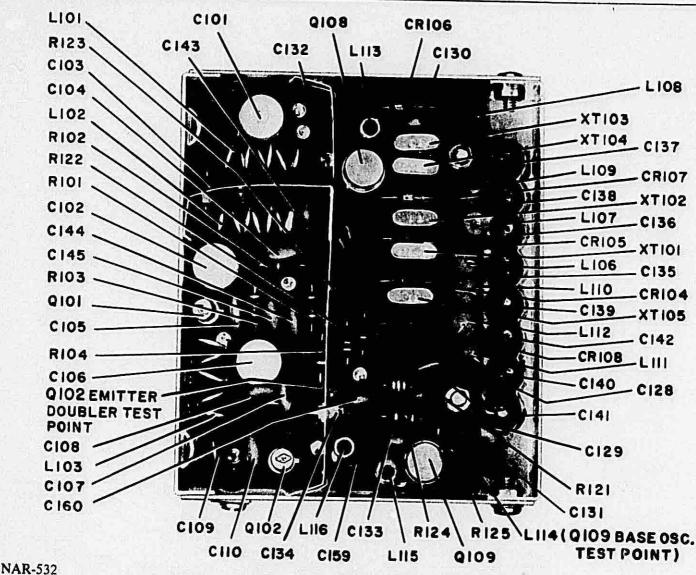


FIGURE 5-6. RF BOARD, COMPONENT LOCATION AND TEST POINTS

with the component in the schematic diagram. In addition, the symbol is listed in the parts list tabulation to provide the electrical description necessary for ordering replacement parts.

5-2. MECHANICAL MAINTE-NANCE.

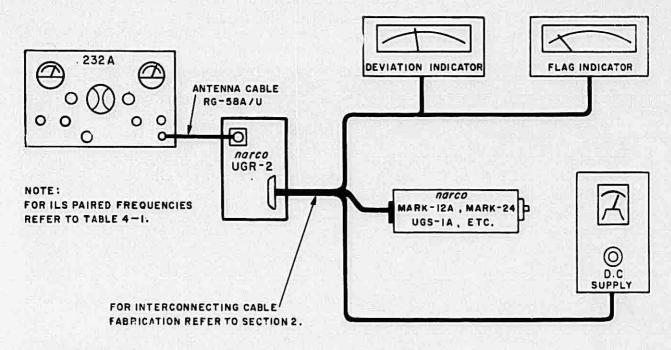
The narco UGR-2 Glide Slope Receiver requires no periodic mechanical maintenance since there are no controls, indicators, or moving parts involved in its operation. The mechanical maintenance covered in this paragraph is only to the extent of disassembly for test, alignment, and/or repair. In most instances, the reassembly following the above operations is essentially the reverse of the disassembly instructions.

The top and bottom surface of each printed circuit component board is accessible with matrix and metering assemblies hinged for access. The RF/OSC assembly must be extracted from the shielding case; slack

in the interconnecting wires permits rotating the board 90° for access to the underside.

5-3. MECHANICAL DISASSEMBLY.

- A. Removal from case.
 - 1. Remove the four (4) 4-40 binding head screws.
 - Hold the case firmly and slide the chassis from the case. Pull on the front panel connectors to remove from the case.
- B. Removal of RF/OSC component board.
 - Loosen the two (2) 4-40 screws at the left end
 of the case, one on top and one on the bottom
 of the RF/OSC assembly case.
 - 2. Slide the RF/OSC board from the case by pulling on the left side of the RF/OSC assembly case.
 - 3. When the screws are clear of the retaining slots in the top and bottom of the case, swing the



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FIGURE 5-7. UGR-2 TEST SETUP

right end of the printed circuit board back at least 90° to expose the underside of the board.

C. Access to Hinged Printed Circuit Boards.

NOTE

The matrix board is hinged from the left side and the metering board is hinged from the right side as viewed from the front.

- Remove the two (2) 4-40 screws that secure the top of the board to the mounting brackets.
- Pull the top of the board away from the chassis to expose the inner surface.
- D. Access to IF Assembly.
 - 1. Components on top of chassis. Move the metering board as described in Step C.
 - Components on underside of chassis. There is no cover on the bottom of the chassis: turn the chassis to expose the bottom of the chassis.
 - 3. IF Core Adjustments. The IF cores are accessible from the top and bottom. IF alignment may be performed after removal from the case (refer to step A).

5-4. ELECTRICAL MAINTENANCE.

The electrical maintenance is separated into three areas: Performance tests (Paragraph 5-7); Trouble Isolation (Paragraph 5-10); and Alignment (Paragraph 5-14). For an inoperative receiver or one that has extremely low output, refer to the trouble isolation procedure. Although the RF and IF alignment procedures are given, there is no need for automatically performing receiver alignment. The performance test procedures given in Paragraph 5-9 will indicate low output from a specific section of the receiver. If align-

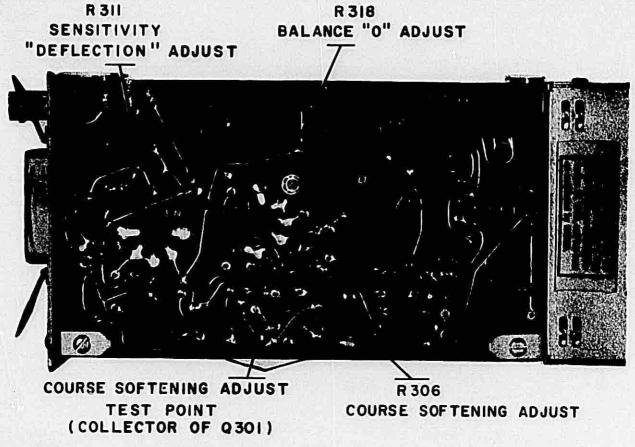
ment does not increase the c tput reading, then use the schematic for voltage checks and circuit tracing to identify the malfunctioning component.

5-5. LIST OF RECOMMENDED TEST EQUIPMENT.

- A. Glide Slope Signal Generator, Boonton Model 232A.
- B. R.F. Signal Generator, Hewlett-Packard Model 606A.
- C. DC Power Supply, Power Designs Model 1015 0-50V, 1.5A.
- D. AC VTVM, Ballantine Model 300D.
- E. DC VTVM, RCA Senior Voltohmyst WV-98C.
- F. Control Head narco Mark-12A, Mark-24, UGS-1A.
- G. Deviation Indicator, Weston 1951T, 1000 ohms, $150-0-15\mu$ amperes $\pm 1\%$.*
- H. Flag Indicator, Weston 901, 1000 ohms, 0-500μamperes ±1%.*
- *For proper operation of the UGR-2, the two indicators must load the output circuit properly. Refer to Figure 2-6 for external load resistor connections.

5-6. PRELIMINARY STEPS.

- A. Connect the unit to the test set up as shown in Figure 5-7.
- B. Set the glide slope generator to 332.0MHz(mc).
- C. Set the channel selector to 109.3.
- D. Set the DC power supply to 13.75 or 27.5 volts per cable wiring. Primary current should be approximately 220 ma.



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FIGURE 5-8. METERING BOARD, LOCATION OF CONTROLS

E. Set the glide slope generator output control to 350μvolts and the tone ratio control to 0 DB, (Standard Centering Signal). Be sure that each of the two audio signals (90 and 150 Hz) modulates the RF carrier exactly 45%.

5-7. PERFORMANCE TESTS.

The performance tests given below are for overall tests of the UGR-2 Glide Slope Receiver. Failure to meet these test specifications indicates that alignment, adjustment, and/or repair of the receiver must be performed. It is recommended that the following performance tests be performed before alignment is attempted. All RF voltages given are "soft" microvolts, i.e. voltage across 50 ohm load. If a 6 DB pad is used in the output of the generator, the RF voltages referred to in the procedure below should be doubled. The metering circuit adjustments (paragraph 5-8) must be completed before continuing with the tests in paragraph 5-9. The "STANDARD SIGNALS" used in the subsequent tests are described below.

A. Standard RF Signal.

An RF carrier amplitude modulated simultaneously with 90 and 150Hz (cps) $\pm 0.3\%$ signals so that the sum of their separate modulation levels equals $90 \pm 2\%$.

B. Standard Centering Signal.

A standard test signal in which the difference in depth of modulation of the 90 and 150Hz (cps) signals is less than .002 (0 DB).

C. Standard Deviation Signal.

A standard test signal in

A standard test signal in which the difference in depth of modulation of the 90 and 150Hz (cps) signals is 0.105 ±.002 (2 DB).

5-8. METERING CIRCUIT ADJUSTMENT.

- A. Adjust BALANCE (R-318) to center the deviation indicator. Refer to Figure 5-8 for location of controls.
- B. Set the glide slope generator tone ratio control to 2 DB, 90 CPS. Adjust SENSITIVITY control (R-311) of the UGR-2 to obtain 78μamperes deflection on the deviation indicator.

C. Repeat steps 1 and 2 until 78μamperes deflection is obtained at 2.0 DB and 0 μa at 0 DB.

5-9. PERFORMANCE TEST PROCEDURES.

A. Sensitivity.

Set the glide slope generator output control to $16\mu v$ and the tone ratio to 2.0 DB, 90Hz (cps). The following shall be observed on each channel:

- Deviation Indication Deflection of 47μa minimum with no more than ±4μamperes, erratic needle movement.
- Flag Indicator should read 250μamperes minimum.

B. Deflection Characteristics.

- 1. Set the glide slope generator to 332.0MHz (mc) and the channel selector to 109.3. Set the output control to 350μ volts and the tone ratio to 2.0 DB, 150 Hz (cps). The deviation indicator should read $78 \pm 3\mu$ amperes.
- 2. Set the tone ratio to each 0.5 DB position. The deviation indicator should read 19.5 $\pm 3\mu$ -amperes.
- 3. Set the tone ratio to each 1.0 DB position. The deviation indicator should read 39 $\pm 4\mu$ amperes.
- Set the tone ratio to each 3.3 DB position. The deviation indicator should read 128 ±13 amperes.
- Increase the glide slope generator output to 7000 μvolts. Set the tone ratio to each 2.0 DB position. The deviation indicator should read 2 to 5 μ amperes less than that obtained at 350 μvolts level.

C. AGC Characteristics.

Set the glide slope generator to 332.0MHz (mc) and the tone ratio to 0 DB. When the glide slope generator output is varied from 20 to $50,000\mu$ -volts the following should be observed:

- The deviation indicator reading should be 0 ±4μamperes.
- The flag indicator reading should vary from 270μamperes minimum to 450μamperes maximum. The maximum reading is nominally 400μamperes.

D. Alarm Flag.

- 1. Set the tone ratio to 0 DB. When the output of the glide slope generator is varied from 20 to $50,000\mu$ volts the flag indicator reading shall be greater than 270μ amperes.
- 2. When the antenna cable is disconnected from the glide slope generator the flag indicator reading should be less than 10μamperes.
- Set the glide slope generator output to 350μ-volts. Set the tone ratio to CAL 90 and CAL 150. The flag indicator reading should be less than 200μamperes in either position.
- 4. Set the glide slope generator output to 350μ -amperes and turn the modulation off. The flag indicator reading should be less than 10μ amperes.
- Set the tone ratio control to 2.0 DB, 90Hz (cps). Set the glide slope generator output for 39μamperes deflection on the deviation indicator. The flag indicator reading should be less than 220μamperes.

5-10. TROUBLE ISOLATION PROCEDURE.

The trouble isolation procedures for the UGR-2 are divided into the following functional areas: RF, tuning (oscillator selection), and IF amplifiers; matrix section; and the metering section. In the procedures that follow, operating frequencies are given on the functional block diagram, references will be made to the simplified schematics in Section 4, and the various operating frequencies are given in Section 4 (Tables 4-1 and 4-2).

The operating voltages are given in red on the schematic diagram; however, waveforms are not included. Since the modulation tones are 90 and 150Hz (cps) sine waves, the demodulated output from the detector is a combination of the two signals. The shape of this complex waveform is dependent upon the amplitude and phase displacement of the two frequencies. The course centering control varies both signals simultaneously. Following the 90 and 150Hz (cps) filters, each signal voltage is a sine wave that is rectified to provide an equivalent amplitude DC voltage. Measurements of the AC voltages are given as read on an AC VTVM and the rectified voltages on a DC VTVM.

When isolating trouble to the malfunctioning area, use the glode slope signal generator as a signal source and connect to a VOA-9 for output indications. The UGR-2 AGC buss must be monitored with a DC VTVM reference to the +10 volt dc regulated power source.

The troubleshooting procedure given below utilizes the glide slope signal generator as the signal source for the operational circuits throughout the receiver. The tests listed below can be used for rapid checks of the various sections of the UGR-2.

- A. Quick check for overall Receiver Operation.

 Connect the signal generator to the antenna and supply a 20 microvolt 332.0MHz (mc) signal, modulated for a centering signal, then ground pin 2 of J-101. The flag should be activated and the indicator should be on the center position.
- B. Quick Check for Metering Section Operation.
 Connect the signal generator DEMOD OUTPUT to the detector output (Terminal 1 of T-105) and set the controls for a centering signal. The flag should be activated and the indicator should be on the center position. The DEMOD output should be set to approximately 0.3 volts rms.
- C. Quick Check of RF, IF and Oscillator Sections. Connect the signal generator to the input of Q-106, Q-105, Q-104, Q-103, Q-102, and Q-101 in the sequence given. Set the frequency and signal levels as indicated in Figure 7-1. If an correct gain indication is obtained at the detector output, the stage tested is assumed to be operative. By progressively moving forward from the detector stage, the malfunctioning stage can be identified.

5-11. TROUBLE ISOLATION, RF and IF SECTIONS.

The RF and LF Quick Check procedure described in the previous paragraph should be sufficient to isolate a non-operate or low-output amplifier stage. It is difficult, however, to decide when a marginal operating stage requires component replacement or when it requires alignment.

Usually, if the operating voltages are within limits and the gain is low, alignment is required. The calibrated rf attenuator on the signal generator can be used to locate low output RF and/or IF amplifier stages. If the input requires higher levels than shown in Figure 7-1, the amplifier has low output. Refer to paragraph 5-14 for alignment instructions.

Although the Quick Check procedure is satisfactory for finding troubles in the IF, RF, and Mixer stages, troubles in the LFO and HFO stages present a different problem. If oscillator trouble is indicated, use an additional RF signal generator to simulate the HFO crystal frequency, 75.4625 to 76.625MHz (mc) or the LFO crystal frequencies, 34.8 to 35.7MHz (mc). Refer to Table 4-2 for crystal oscillator frequencies.

The operating frequency of the LFO or the HFO is determined by the crystal selection. Since the crystal select circuits are interconnected through transistor and diode gating circuits in the matrix, the oscillators are described in the Matrix Trouble isolation, Paragraph 5-12.

5-12. TROUBLE ISOLATION, MATRIX SECTION.

The resistor-diode matrix shown in Figures 4-1, 4-2 and 7-3 controls the crystal selection of the LFO (Q-207) and the HFO (Q-108). Each of the 10 input lines of J-102 is connected into the matrix to select two crystals, one LFO and one HFO. When one of the 10 input lines is grounded, the voltage distribution performs the following: (1) forward biases the diode in one of four LF crystal circuits, and (2) turns ON one of five transistor gates connected to an HF crystal. By simultaneously grounding pin 22 of J-102 and any one of the 10 input lines, a different pair of crystals is selected. As shown in Table 4-2, 10 pairs of crystals are selected with the A/B select line open circuited and an additional 10 pairs are selected when the A/B select line is simultaneously grounded. The LF and HF oscillator selection is described in detail in Paragraphs 4-2, 4-6, 4-9 and 4-10; Simplified Schematics are given in Figures 4-1 and 4-2.

All diodes are identified in Figures 5-3 and 5-4. Polarities are marked on the diodes: the band is on the cathode end of the diode.

The subsequent paragraphs describe the condition of these internal circuits when the 10 input lines or 10 input lines plus A/B select line are connected to ground.

A. A/B Select Circuit.

1. Terminal 22 of J-102 is open on all "A Bank" channels i.e, 109 and 110 odd tenth channels and grounded on all "B Bank" channels (i.e. 108 and 111 odd tenth channels).

2. When terminal 22 of J-102 is open, this line (junction of R-242 and R-243) is at approximately 8.4 volts DC and the collector of Q-206 is approximately 0.5 Volts DC.

3. When terminal 22 of J-102 is grounded this line (junction of R-242 and R-243) is 0 VDC and the collector of Q-206 is approximately 8.0 Volts D.C.

4. If the voltages as given in B and C above are not obtained check Q-206 for open or shorted elements. Check R-241, R-242, and R-243 for an open circuit.

B. HFO Select Circuits.

1. Check the emitter voltages of Q-201 thru Q-205; refer to Figure 7-3. The voltages should be within ±20% as shown on all glide slope channels.

2. Check the collector voltages of O-201 thru Q-205. All of the transistors, except the one selected should have zero volts at the collector. The "ON" transistor should have approximately 2.5 volts at the collector. Refer to Figures 5-3, 7-3, and Table 5-1.

3. Measure the base voltages of Q-201 thru Q-205 and the bias voltages of diodes CR-201 thru CR-208. The "ON" diode should have approximately 0.4 volts DC forward bias. Refer to Figure 7-3 and Table 5-1.

C. LFO Select Circuits.

1. Check to confirm that the forward bias voltage of the "ON" diode (refer to Figure 7-3, Table 5-1) is approximately 0.4 VDC. If the forward bias is too high, check forward and back resistance of the diode by removing from circuit. Replace diode if shorted or open.

2. Check to see that all other diodes (CR-209 thru CR-216) except the "ON" diode are re-

versed biased.

5-13. TROUBLE ISOLATION. METERING SECTION.

The Quick Check tests of Paragraph 5-10 are of value since they permit isolating a malfunction to the area of metering section. This area is shown in the simplified schematic of Figure 4-4 and described in detail in Paragraphs 4-14 through 4-17. The metering circuit adjustments are given in Paragraph 5-8.

The schematic (Figure 7-2) has voltage measurements printed in red. Table 5-3 has additional test voltages with one or two tones modulating the carrier. Troubleshooting may consist of checking voltages and resistances to locate the malfunctioning component. In addition to the conventional components there are three select-by-test components in the metering section. Paragraph 5-15 provides full instructions for the selec-

		-		oso	CILLATOR	CONTROL	COMPONEN	15
J-101			Condition	HF	Oscillator		LF Osci	liator
Input Pin Grounded	Loc. Freq.	Glide Slope Freq.	of A/B Select Line (V-102/22)	Diode Selected	Resistor Selected	Trans. Selected	Switch Activated Diode	Crystal Selected
1 2 4 5 6 7 9 13 16	109.1 109.3 109.5 109.7 109.9 110.1 110.3 110.5 110.7 110.9	331.4 332.0 332.6 333.2 333.8 334.4 335.0 329.6 330.2 330.8	Open Open Open Open Open Open Open Open	CR-201 CR-206 CR-208	R-221 R-226 R-208 R-209 R-216	Q-202 Q-204 Q-204 Q-205 Q-205 Q-201 Q-201 Q-203 Q-203 Q-202	CR-216 CR-212 CR-216 CR-212 CR-216 CR-212 CR-216 CR-212 CR-216 CR-211	XT-204 XT-202 XT-204 XT-202 XT-204 XT-202 XT-204 XT-204 XT-204
1 2 4 5 6 7 9 13	111.1 111.3 111.5 111.7 111.9 108.1 108.3 108.5 108.7	331.7 332.3 332.9 333.5 331.1 334.7 334.1 329.9 330.5 329.3	Grounded Grounded Grounded Grounded Grounded Grounded Grounded Grounded Grounded	CR-205 CR-207 CR-202 CR-202 CR-203	R-221 R-226 R-208 R-209 R-216	Q-204 Q-204 Q-205 Q-205 Q-202 Q-201 Q-201 Q-203 Q-202 Q-203	CR-209 CR-213 CR-209 CR-213 CR-214 CR-213 CR-209 CR-213 CR-209 CR-210	XT-201 XT-203 XT-203 XT-203 XT-203 XT-200 XT-200 XT-200 XT-200 XT-200

TABLE 5-1. MATRIX SECTION, OSCILLATOR CONTROL COMPONENTS.

tion of these components; however, it is necessary to know when these procedures are required. The selectby-test components are: (1) C-305, which tunes the 150Hz (cps) filter; (2) C-307, which tunes the 90Hz (eps) filter; and (3) R-301, which sets the range of the sensitivity control, R-311. The select-by-test components should be checked when all other tests do not indicate the source of trouble. The following tests show that the SELECT components (C-305, C-307, or R-311) may be at fault.

A. When a centering signal is applied, the indicator should be capable of being centered by adjusting

B. When signals 2 DB UP and 2 DB DOWN from the centering signal are used, balance should be within 3 microamperes (±4%).

C. When the sensitivity limits cannot be reached, change R-301 (refer to Paragraph 5-15).* *With the standard deviation signal described in Paragraph 5-7C, R-311 should be capable of varying the deflection current between the 60 to 90 microampere range.

5-14. ALIGNMENT PROCEDURE.

A. Low Frequency IF.

1. Connect the AC VTVM and oscilloscope to terminal 1 of T-105 (Refer to Figure 5-9).

2. Connect the R.F. signal generator to the base of Q-103 at terminal #1 of T-101 through a .01 mfd capacitor with a 47 ohm resistor to ground on the generator side of the capacitor. Set the generator to 7.35MHz (mc) modulated 30% by 1000Hz (cps). Set the input voltage to 13.75 or 27.5 volts per cable wiring.

3. Tune T-102, T-103 and T-104 on the outer peaks for maximum output, keeping the generator output set for approximately 0.1 volts AC detector output.

4. Tune T-105 for maximum output using the peak having the slug close to the bottom of the transformer if two peaks are observed.

5. Connect 100 ohm resistors between terminals 5 and 6 of T-102, T-103, and T-104 (See Figure 5-9). Tune the secondary slugs (slugs away from the chassis) of T-104, T-103 and T-102 on outer peaks for maximum detector output. The generator output should be set to keep the detector level at approximately .05 volts

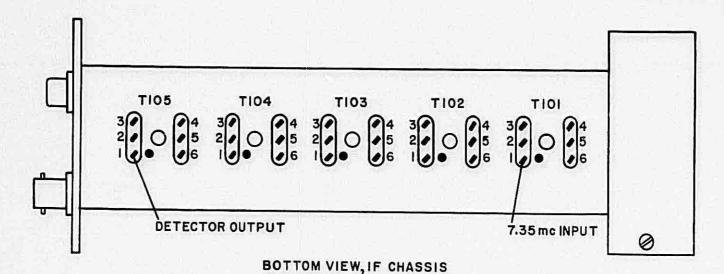
6. Tune T-105 for maximum output using the peak having the slug closer to the chassis.

7. Remove the 100 ohm resistors and connect them between terminals 1 and 2 of T-102, T-103 and T-104 (see Figures 5-9). Tune the primaries (slug nearest chassis) on outer peaks for maximum detector output.

8. Remove the 100 ohm resistors.

9. Check gain. 8μ maximum should produce 0.1 volts AC detector output.

10. Check the bandwidth as follows:



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FIGURE 5 - 9. I. F. ALIGNMENT TEST POINTS

- Set generator output to obtain 0.1 volts AC at the detector output.
- b. Increase generator output 6 DB (2X).
- c. Detune the generator above the resonant frequency to obtain a reference output of
- 0.1 volts AC. Record this frequency.
- d. Detune the generator below the resonant frequency to obtain a reference output of 0.1 volts AC. Record this frequency.
- e. Subtract the frequency recorded in step d from that recorded in step c. The difference should be greater than 130kHz (kc). This is the 6 DB bandwidth.
- Subtract the center of the frequencies recorded in steps c and d from 7.35MHz (mc). This difference should be less than 10 Kc.
- g. Increase the generator output 60 DB (1000X) above that obtained in step a.
- Detune the generator above the resonant frequency to obtain reference output of 0.1 Volts AC. Record this frequency.
- Detune the generator below the resonant frequency to obtain reference output of 0.1 Volts AC. Record this frequency.
- Subtract the frequency recorded in step i from that recorded in step h. The difference should be less than 550kHz (kc).
- k. Subtract the center of the frequencies recorded in steps h and i from 7.35MHz (mc). This difference should be less than 25kHz (kc).
- B. High Frequency Oscillator.

The tuning of the HFO is critical. It is important that the tuning be performed at the correct frequency since proper operation at cold temperatures may be affected.

- Connect the common lead of the DC VTVM to the +10 volt buss. Connect the probe to Q-109 base at L-114 (See Figure 5-4).
- 2. Set the channel selector to 109.3 and A+ to 13.75 or 27.5 volts (Refer to cable wiring).
- 3. Tune L-113 for maximum output (approximately -2 volts).
- 4. Check the drive on all channels. Minimum drive should be -1.0 Volts DC.

C. Doubler.

The tuning of the doubler is critical. It is important that the tuning be performed at the correct frequency since proper operation at cold temperatures may be affected.

- 1. Connect the probe to Q-103 emitter at R-104 (Refer to Figure 5-6).
- 2. Set channel selector to 108.9MHz (mc). Tune L-115 and L-116 for maximum drive level (approximately -1.6 volts DC).

D. RF Circuits.

- 1. Connect glide slope generator to unit. Set the generator to 332.0MHz (mc) and a standard centering signal. Set channel selector to 109.3 MHz (mc).
- 2. Tune C-101, C-102, and C-106 (Refer to Figure 5-6) for maximum detector output keeping the glide slope generator output at the correct level to obtain approximately 0.1 volts AC detector level.
- Increase the glide slope generator output to obtain approximately 0.2 volts AC detector level and place a finger close to L-102 so that the detector level drops to approximately 0.1 volts AC: then tune C-101 for maximum detector output.
- 4. Place a finger close to L-101 and tune C-102 for maximum detector output.

E. High Frequency IF.

1. Set the glide slope generator to 332.0 and channel selector to 109.3MHz (mc).

 Tune the primary and secondary of T-101 for maximum detector output on outer peaks. Keep detector level at approximately 0.1 volts AC by reducing the glide slope output during tuning.

3. Check detector output on channels 108.9, 110.5, 108.5 and 110.7 which is equivalent to 329.3, 329.6, 329.9 and 330.2 respectively.

4. Balance the detector output on these four channels by tuning the secondary of T-101 (slug away from chassis). A nominal variation of 3 DB should be observed between the four channels.

F. Metering Circuits.

1. Set the glide slope generator to 332.0MHz (mc). Set the channel selector to 109.3MHz (mc).

2. Set the sensitivity control (R-311), balance control (R-318), and course softening control (R-306) to mid range.

 Set the glide slope generator to 350µvolts and 0 DB output.

4. Connect the AC VTVM probe to Q-301 collector. (Refer to Figure 5-8). Adjust course softening control (R-306) to maximum reading, then decrease output 0.5 DB by rotating the control clockwise (CW). All adjustments must be made from the circuit side of board. The course softening adjustment should be made with care and checked as under Section 5-9, B, 5 after the steps listed below are completed (steps 5 thru 7).

5. Set the glide slope generator output to 350μ volts and 0 DB output. Set the balance control for center reading of deviation indicator.

 Set the glide slope generator tone ratio to 2 DB, 90Hz (cps). Set the sensitivity control for 78μamperes on the deviation indicator.

Repeat steps 5 and 6 to eliminate interaction results.

G. Final Performance Tests.

 If no problems exist, the unit should meet all requirements as in the Performance Tests given Paragraph 5-9.

If equipment is available to check the bandwidth at UHF, it is recommended that this be performed. The following bandwidth should be obtained.

6 DB BW = 120kHz(kc) minimum 60 DB BW = 550kHz(kc) maximum

NOTE

Equipment recommended for this test is given below:

- 1. RF generator, Boonton Model 211-A.
- 2. Omni Generator, Collins Model 479S3.
- 3. Univerter, ARC Model H23A.

5-15. INSTALLATION OF SELECT-BY-TEST COMPONENTS.

Although all of the UGR-2 electrical components are shown on the schematic and parts list, the values of some are identified as "SELECT". The SELECT components are select-by-test with the values selected at the factory to adjust over all tuning or gain of critical circuits. The selection procedures are as follows:

A. Tuning of 150Hz (cps) Filter, T-301 secondary.

1. Connect as shown in Figure 5-7.

- 2. Set the generator and channel selector to 332.0 MHz (mc).
- 3. Remove C-305 and connect the capacitor substitution box across C-304.
- Set the generator to CAL 150 and decrease the attenuator until the Deviation Indicator reads approximately 100 μamperes.
- 5. Adjust the capacitor substitution controls until the maximum deflection is obtained. Remove the substitution box, obtain an equivalent value capacitor, and solder the capacitor (C-305) in the circuit board.

B. Tuning of 90Hz (cps) Filter, T-302 Secondary.

- 1. Perform Steps 1 and 2, as described above
- 2. Remove C-307 and connect the capacitor substitution box across C-306.
- 3. Set the generator to CAL 90 and decrease the attenuator until the deviation indicator reads approximately 100 μamperes.
- 4. Adjust the capacitor substitution controls until the maximum deflection is obtained. Remove the substitution box, obtain an equivalent value capacitor, and solder the capacitor (C-307) in the circuit board.

C. Selection of R-301.

Resistors R-301 and R-302 form a voltage divider network supplying demodulated audio signal from the detector to the metering circuits. Resistor R-301 is selected to provide the proper level signal that will set the range of the sensitivity control (R-311) for full scale operation. The resistance value is selected as follows:

- 1. Connect as shown in Figure 5-7.
- 2. Set the generator and channel selector to 332.0 MHz (mc).
- 3. Set the generator attenuator to 350μvolts and the tone ratio control to 0 DB.
- 4. Connect the AC voltmeter to Q-301 collector. Set the course softening control (R-306) to maximum; then, turn CW to decrease 0.5 DB. Adjust from the circuit side of the board.
- With the sensistivity control (R-311) set to the maximum CW position, adjust the balance control (R-318) for center reading of the deviation indicator. Set the tone ratio to 2 DB 90 CPS and note the deviation indicator reading.

- With the sensitivity control (R-311) set to the maximum CCW position, adjust the balance control (R-318) for center reading of the deviation indicator. Set the tone ratio to 2 DB 90 CPS and note the deviation indicator reading.
- 7. The SENS control (R-311) adjustment range shall be 60 to 90 μ amperes. If not within this range, remove R-301 and connect a resistance substitution box.
- 8. With the resistance set between 3.3K and 10K ohms, repeat the procedure given in steps 6 and 7. Repeat this procedure until the correct range of adjustment is obtained.
- 9. Remove the resistance substitution box and replace with an equivalent value resistor.

5-16. OSCILLATOR TROUBLE ISOLATION TECHNIQUES.

Since the UGR-2 is a dual conversion superheterodyne receiver, both oscillators must be in operation at all times. If the LFIF signal is not evident at the LFIF amplifiers (Q-104, Q-105, or Q-106) the usual cause is an inoperative HFO or LFO. Repair of the oscillator may be a minor operation; however, isolation to the inoperative stage could be a time consuming task, since there are many multiple paths and diodes to trace through in the matrix. Table 5-2 presents the receiver operating frequency and the operating frequencies of both oscillators. This table is a consolidation of tables 4-1 and 4-2 with the glide slope frequencies listed in consecutive order. After careful examination of the HFO and LFO frequencies, it is evident that as the glide slope operating frequency is increased by the steps shown in the table, the following occurs:

- During the first four steps, the HFO frequency remains constant,
- b. During this four step cycle the LFO frequency is different for each step.
- c. The A/B select line is alternately grounded.
- d. The HFO frequency changes five times during the selection from channel 1 to 20,
- e. The four frequency sequence of the LFO is repeated five times,
- Each LFO operates every fourth step when progressing from channel 1 to 20.
- g. During the 20 steps, each of the four LFO's operates five times (once with each HFO).

5-17. OSCILLATOR REPAIR TECHNIQUES.

A. Localizing the Inoperative Oscillator. If the receiver is inoperative on any one channel, the method given below can be used to locate the oscillator that is not in operation:

 Monitor the detector output signal and rotate the channel selector switch sequentially through

- the 20 channels, changing the RF input signal to the operating frequency of each cannel.
- 2. List the channels that have no detector output signal,
- Refer to Table 5-2 and list the LFO and HFO frequencies,
- Compare frequencies and note which frequency (LFO or HFO) is missing from more than one channel.

NOTE

A single LFO oscillator will affect five channels: a single HFO will affect four channels.

B. Oscillator Trouble Localizing.

With the inoperative oscillator identified, it is now necessary to determine if the crystal or the external oscillator circuit is at fault. Assuming that the inoperative oscillator is the 34.8MHz (mc) LFO, then a suggested procedure is given below:

NOTE

Although the 34.8 MHz (mc) HFO is connected to the 329.3, 330.5, 331.7, 332.9, and 334.1 MHz (mc) glide slope channels, only the 329.3 channel will be used in this example.

- 1. Refer to Table 5-2 for the next glide slope channel that utilizes the same HFO frequency: this is the 329.6MHz (mc) channel, although the LFO is 35.1MHz (mc).
- 2. With the channel selector switch in the 329.3 position, unsolder the 34.8 and 35.1MHz (mc) crystals; then, temporarily interchange and solder the two crystals into the oscillator circuits.
- 3. Increase the RF input frequency 300kHz (from 329.3 to 329.6MHz) and monitor the detector output. Since this crystals originally operated in the adjacent oscillator position, a no-output condition will show that the circuit is at fault (not the crystal).
- 4. Rotate the channel selector to the 329.6 position and set the signal generator 300K Hz (kc) lower (329.3 MHz). Since this circuit originally operated, a no-output condition will show that the 34.8MHz (mc) crystal is at fault (not the external circuit).

NOTE

The external oscillator circuit is comprised of the selector switch, matrix diodes or gate transistors, and inter-connection wires that could have cold solder joints.

C. A/B Select Circuit (Q-206).

As the RF input frequency is changed through the 20 channel positions, the A/B select line is alternately connected to ground or open circuited (refer to Table 5-2). If the receiver operates on only 10 of the 20 channels (alternate channels), the A/B select circuit would be responsible for this malfunction. Check the A/B switch (Q-206) output, diodes, resistors, and interconnection wiring for proper operation.

Glide Slope Receiver Frequency	Localizer Receiver Frequency	LFO Frequency	HFO Frequency	A/B* Selection Group
329.3	108.9	34.8	75,4625	G
329.6	110.5	35.1	75.4625	0
329.9	108.5	35.4	75.4625	G
330.2	110.7	35.7	75.4625	0
330.5	108.7	34.8	75.7625	G
330.8	110.9	35.1	75.7625	0
331,1	111.9	35.4	75.7625	G
331.4	109.1	35.7	75.7625	0
331.7	111.1	34.8	76.0625	G
332.0	109.3	35.1	76.0625	0
332.3	111.3	35.4	76.0625	G
332.6	109.5	35.7	76.0625	0
332.9	111.5	34.8	76.3625	G
333.2	109.7	35.1	76.3625	0
333.5	111.7	35.4	76.3625	G
333.8	109.9	35.7	76.3625	0
334.1	111.9	34.8	76.6625	G
334.4	110.1	35.1	76.6625	0
334.7	108.1	35.4	76.6625	G
335.0	110.3	35.7	76.6625	0

TABLE 5 - 2. GLIDE SLOPE LOCALIZER, LFO, AND HFO OPERATING FREQUENCIES

^{*} O= open circuit * G= connected to ground

5-18 OPERATING VOLTAGE MEASUREMENTS.

The detected glide slope voltages measured during the normal operation of the UGR-2 are given in Table 5-3. All voltages are measured with a standard RF signal input: 332.0 MHz(mc); 350 microvolt; modu-

lated 45% by each tone. All voltages are checked with an AC VTVM (Ballantine or equiv.) The RF and IF voltages are given on the red overprint of the foldout schematics (Figures 7-2A and 7-3A).

Test Point	90Hz (cps) Only	150Hz (cps) Only	90 and 150Hz (cps)	
Detector Output Term. (T105)	0.275 VAC	0.275 VAC	0.34 VAC	
Q-301 (B)	0.0019 VAC	0.0019 VAC	0.0024 VAC	
Q-301 (C)	0.1" VAC	0.17 VAC	0.2 VAC	
Q-301 (E)	0.022 VAC	0.022 VAC	0.026 VAC	
Q-302 (B)	0.17 VAC	0.17 VAC	0.2 VAC	
Q-302 (C)	0.45 VAC	0.43 VAC	0.5 VAC	
Q-302 (E)	0.26 VAC	0.21 VAC	0.26 VAC	
Q-303 (C)	2.3 VAC	2.4 VAC	2.8 VAC	
Q-303 (E)	0.5 VAC	0.47 VAC	0.6 VAC	
*T-301 term. 3	2.2 VAC (Cal. 90)	4.4 VAC (Cal. 150)	5.8 VAC	
*T-301 term. 4	0.8 VAC	1.7 VAC	2.2 VAC	
*T-301 term. 5	0.8 VAC	1.7 VAC	2.2 VAC	
T-302 term. 2	1.4 VAC	0.8 VAC	1.6 VAC	
*T-302 term. 3	3.2 VAC	1.5 VAC	4 VAC	
*T-302 term. 4	1.2 VAC	0.5 VAC	1.5 VAC	
*T-302 term. 5	1.2 VAC	0.5 VAC	1.5 VAC	

Input Signal: Std. signal at center frequency, 332.0 MHz (mc); 350 μ V; 45% modulation of each tone.

Input Voltage: 13.75 Volts DC.

*Measurements ref. to J102 pin 18. Unless otherwise noted, all other measurements ref. to gnd. All voltages checked with AC VTVM (Ballantine or equiv.)

TABLE 5-3. METERING SECTION TEST VOLTAGES



SECTION 6 PARTS LIST

6-1. INTRODUCTION.

This parts list includes all the electrical parts shown in the schematic diagrams of the UGR-2 Glide Slope Receiver. The interconnection of parts is shown on the schematic diagram, the location of parts is shown on the photographs of component boards, and the description of components (and narco part number) is given in the parts list.

The components listed in this section are standard commercially obtainable parts; however, certain components are identified only by a *narco* part number. Where a transistor, diode, or other semi-conductor requires special characteristics, they are selected or

matched at the factory and assigned a narco part number. Other components are select-by-test for compensation of overall system operation. Transformers, coils, sub-assemblies and other units that are specially designed for narco are assigned a narco Part Number. When ordering any narco part, always include the following information:

- a. narco Model Number
- b. narco Chassis Number
- c. narco Serial Number
- d. Schematic Symbol Number
- e. narco Part Number
- f. Component Description (from Parts List)
- g. Special Characteristics (shock mount, operating voltage, etc.)

6-2. PARTS LIST.

SYMBOL	NARCO PART NO.	DESCRIPTION
		C, CAPACITORS
C-101 C-102 C-103 C-104 C-105	22041-1 22041-1 24509-228 21291-14 21291-14	Capacitor, Ceramic Variable, 2-8pf, NPO Capacitor, Ceramic Variable, 2-8pf, NPO Capacitor, Ceramic Tub., .22pf, ±5% Capacitor, Ceramic Disc., 100pf, ±10% Capacitor, Ceramic Disc., 100pf, ±10%
C-106 C-107 C-108 C-109 C-110	22041-1 21291-14 24516-229 21291-21 24516-689	Capacitor, Ceramic Variable, 2-8pf, NPO Capacitor, Ceramic Disc., 100pf, ±10% Capacitor, Ceramic Disc., 2.2pf, ±.25pf, NPO Capacitor, Ceramic Disc., 1K pf, ±20% Capacitor, Ceramic Disc., 6.8pf, ±0.5pf, NPO
C-111 C-112 C-113 C-114 C-115	24516-150 24515-9 24515-9 24516-150 24515-9	Capacitor, Ceramic Disc., $15pf$, $\pm 10\%$, NPO Capacitor, Ceramic Disc., $.01\mu f$, 50V Capacitor, Ceramic Disc., $.01\mu f$, 50V Capacitor, Ceramic Disc., $.01\mu f$, 50V Capacitor, Ceramic Disc., $.15pf$, $\pm 10\%$, NPO Capacitor, Ceramic Disc., $.01\mu f$, 50V
C-116 C-117 C-118 C-119 C-120	24515-9 24516-150 24515-9 24515-9 24516-229	Capacitor, Ceramic Disc., $.01\mu f$, 50V Capacitor, Ceramic Disc., $.15p f$, $\pm 10\%$, NPO Capacitor, Ceramic Disc., $.01\mu f$, 50V Capacitor, Ceramic Disc., $.01\mu f$, 50V Capacitor, Ceramic Disc., $.2.2$, $\pm .25p f$ NPO
C-121 C-122 C-123 C-124 C-125	24515-9 21291-11 24515-9 24515-9 24515-9	Capacitor, Ceramic Disc., $01\mu f$, 50V Capacitor, Ceramic Disc., 200pf, $\pm 10\%$ Capacitor, Ceramic Disc., $01\mu f$, 50V Capacitor, Ceramic Disc., $01\mu f$, 50V Capacitor, Ceramic Disc., $01\mu f$, 50V
C-126 C-127 C-128 C-129 C-130	21291-21 21555-26 24049-470 21291-21 24528-479	Capacitor, Ceramic Disc., $1K$ pf, $\pm 20\%$ Capacitor, Tantalum, $10\mu f$, $\pm 10\%$, $20V$ Capacitor, Mica Dipped, $47pf$, $\pm 5\%$ Capacitor, Ceramic Disc., $1K$ pf, $\pm 20\%$ Capacitor, Ceramic Disc., $4.7pf$, $\pm .5pf$, N750
C-131 C-132 C-133 C-134 C-135	24516-229 21291-21 21291-11 24509-229 21298-1	Capacitor, Ceramic Disc., 2.2pf, ±.25pf, NPO Capacitor, Ceramic Disc., 1K pf, ±20% Capacitor, Ceramic Disc., 200pf, ±10% Capacitor, Ceramic Tub., 2.2pf, ±5% Capacitor, Feedthru, 1K pf

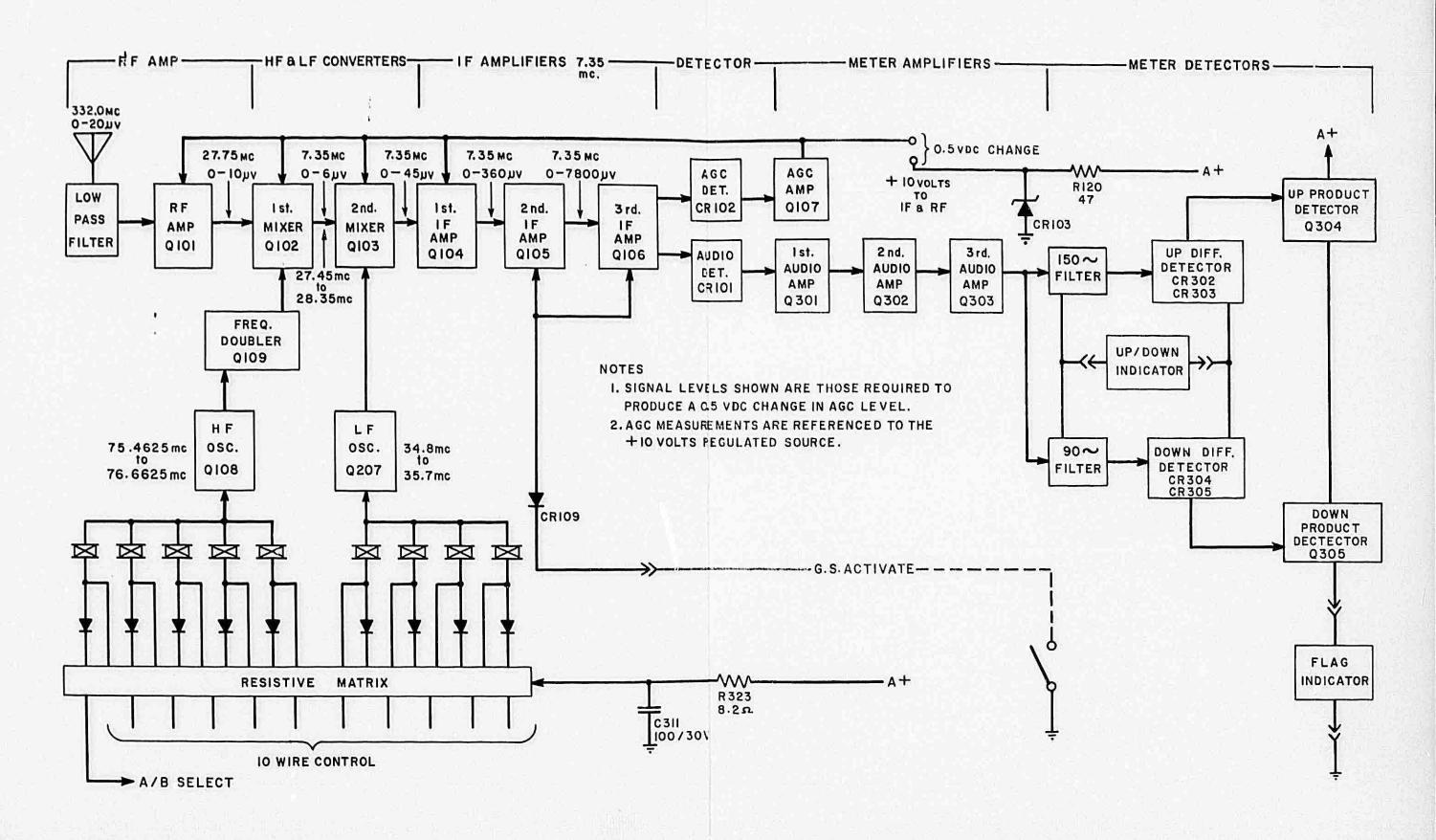
SYMBOL	NARCO PART NO.	DESCRIPTION
	C, CA	APACITORS (Continued)
C-136 C-137 C-138 C-139 C-140	21298-1 21298-1 21298-1 21298-1 21298-1	Capacitor, Feedthru, 1K pf
C-141 C-142 C-143 C-144 C-145	21298-1 21298-1 24516-180 21291-11 21291-11	Capacitor, Feedthru, 1K pf Capacitor, Feedthru, 1K pf Capacitor, Ceramic Disc., 18pf, ±10%, NPO Capacitor, Ceramic Disc., 200pf, ±10% Capacitor, Ceramic Disc., 200pf, ±10%
C-146 C-147 C-148 C-149 C-150	21555-26 24515-7 21298-1 21298-1 21298-1	Capacitor, Tantalum, $10\mu f$, $\pm 10\%$, $20\lor$ Capacitor, Ceramic Disc., $.05\mu f$, $20\lor$ Capacitor, Feedthru, $1K$ pf Capacitor, Feedthru, $1K$ pf Capacitor, Feedthru, $1K$ pf
C-151 C-152 C-153 C-154 C-155	21298-1 21298-1 21298-1 21298-1 21298-1	Capacitor, Feedthru, 1K pf
C-156 C-157 C-159 C-160	21298-1 21298-1 24516-479 24516-689	Capacitor, Feedthru, 1K pf Capacitor, Feedthru, 1K pf Capacitor, Ceramic Disc., 4.7pf, ±.25pf, NPO Capacitor, Ceramic Disc., 6.9pf, ±.5pf, NPO
C-161 C-162 C-164	24037-9 24037-9 24515-7	Capacitor, Fixed Mica, $50pf$, $\pm 10\%$ Capacitor, Fixed Mica, $50pf$, $\pm 10\%$ Capacitor, Ceramic Disc., $.05\mu f$, $20V$
C-201 C-202 C-203 C-204 C-205	21291-21 24049-270 21291-21 21296-3 21296-3	Capacitor, Ceramic Disc., 1K pf, ±20% Capacitor, Dipped Mica, 27pf, ±5% Capacitor, Ceramic Disc., 1K pf, ±20% Capacitor, Feedthru, 1K pf, 500V Capacitor, Feedthru, 1K pf, 500V
C-206 C-207 C-208 C-209 C-210	21296-3 21296-3 21296-3 21296-3 21296-3	Capacitor, Feedthru, 1K pf, 500V Capacitor, Feedthru, 1K pf, 500V Capacitor, Feedthru, 1K pf, 500V Capacitor, Feedthru, 1K pf, 500V Capacitor, Feedthru, 1K pf, 500V
C-211 C-212 C-213	21296-3 21296-3 24052-470	Capacitor, Feedthru, 1K pf, 500V Capacitor, Feedthru, 1K pf, 500V Capacitor, Dipped Mica, 47pf, ±5%
C-301 C-302 C-303 C-304 C-305	21555-26 21555-26 21555-11 23085-427 23085-5EL.	Capacitor, Tantalum, $10\mu f$, $\pm 10\%$, $20V$ Capacitor, Tantalum, $10\mu f$, $\pm 10\%$, $20V$ Capacitor, Tantalum, $39\mu f$, $\pm 10\%$, $20V$ Capacitor, Mylar, $.15\mu f$, $100V$, 5% Capacitor, Mylar SEL., $100V$, $\pm 10\%$
C-306 C-307 C-308 C-309 C-310	. 23085-433 23085-SEL. 21554-20 21555-11 21554-15	Capacitor, Mylar, $.47\mu f$, $100V$, $\pm 5\%$ Capacitor, Mylar SEL., $100V$, $\pm 10\%$ Capacitor, Electrolytic, $500\mu f$, $3V$ NP Capacitor, Tantalum, $39\mu f$, $\pm 10\%$, $10V$ Capacitor, Electrolytic, $150\mu f$, $3V$
C-311 C-312 C-313	21554-4 21554-13 21554-3	Capacitor, Electrolytic, 100μf, 30V Capacitor, Electrolytic, 500μf, 15V Capacitor, Electrolytic, 200μf, 15V
C-401 C-402	24522-1 24522-1	Capacitor, Ceramic 8 Section Capacitor, Ceramic 8 Section

SYMBOL	NARCO PART NO.	DESCRIPTION
		CR, DIODES
CR-101	75011-1	Diode, Germanium
CR-102	75011-1	Diode, Germanium
CR-103	75025-5	Diode, Zener, 10.0V, ±5%, 1W
CR-104	75014-1	Diode, Germanium
CR-105	75014-1	Diode, Germanium
CR-106	75014-1	Diode, Germanium
CR-107	75014-1	Diode, Germanium
CR-108	75014-1	Diode, Germanium
CR-109	75204-45	Diode, Silicon, 500 PIV, 750ma
CR-201	75014-1	Diode, Germanium
CR-202	75014-1	Diode, Germanium
CR-203	75014-1	Diode, Germanium
CR-204	75014-1	Diode, Germanium
CR-205	75014-1	Diode, Germanium
CR-206	75014-1	Diode, Germanium
CR-207	75014-1	Diode, Germanium
CR-208	75014-1	Diode, Germanium
CR-209	75014-1	Diode, Germanium
CR-210	75014-1	Diode, Germanium
CR-211	75014-1	Diode, Germanium
CR-212	75014-1	Diode, Germanium
CR-213	75014-1	Diode, Germanium
CR-214	75014-1	Diode, Germanium
CR-215	75014-1	Diode, Germanium
CR-216	75014-1	Diode, Germanium
CR-301	75014-1	Diode, Germanium
CR-302	75014-1	Diode, Germanium
CR-303	75014-1	Diode, Germanium
CR-304	75014-1	Diode, Germanium
CR-305	75014-1	Diode, Germanium
		J, CONNECTORS
J-101	41153-6	Jack, Coaxial, BNC
J-102	41285-5	Connector, Chassis 24 Terminals
		L, INDUCTORS
L-101	11516-2	Coil, UHF
L-102	11516-2	Coil, UHF
L-103	11516-1	Coil, UHF
L-104	11138-11	Choke, R.F., 3.3µh, ±10%
L-105	11138-19	Choke, R.F., 15µh, ±10%
L-106	11138-15	Choke, R.F., 6.8μh, ±10%
L-107	11138-15	Choke, R.F., 6.8μh, ±10%
L-108	11138-15	Choke, R.F., 6.8μh, ±10%
L-109	11138-15	Choke, R.F., 6.8μh, ±10%
L-110	11138-15	Choke, R.F., 6.8μh, ±10%
L-111	11138-15	Choke, R.F., $6.8\mu h$, $\pm 10\%$
L-112	11138-3	Choke, R.F., $.22\mu h$, $\pm 20\%$
L-113	11517-1	Coil, H.F.O., $75MHz(mc)$
L-114	11138-2	Choke, R.F., $15\mu h$, $\pm 20\%$
L-115	11518-1	Coil, Doubler, $150MHz(mc)$
L-116	11518-1	Coil, Doubler, 150MHz(mc)
L-117	11522-1	Coil, Air, Filter
L-118	11138-4	Choke, R.F., .33µh, ±20%
L-201	11138-18	Choke, R.F., 12μh, ±10%
L-202	- 11138-18	Choke, R.F., 12μh, ±10%
L-203	11138-18	Choke, R.F., 12μh, ±10%
L-204	11138-18	Choke, R.F., 12μh, ±10%
L-205	11138-9	Choke, R.F., 2.2μh, ±10%
L-206	11138-19	Choke, R.F., 15μh, ±10%

SYMBOL	NARCO PART NO.	DESCRIPTION
		Q, TRANSISTORS*
Q-101 Q-102 Q-103 Q-104 Q-105	75561-5 75561-5 75556-1 75556-1 75556-1	Transistor, Germanium, 2N2496, PNP Transistor, Germanium, 2N2496, PNP Transistor, Germanium, Amperex, A1383, PNP Transistor, Germanium, Amperex, A1383, PNP Transistor, Germanium, Amperex, A1383, PNP
Q-106 Q-107 Q-108 Q-109	75556-1 75550-7 75556-9 75556-1	Transistor, Germanium, Amperex, A1383, PNP Transistor, Silicon, 2N3391, NPN Transistor, Germanium, 2NP2654, PNP Transistor, Germanium, Amperex, A1383, PNP
Q-201 Q-202 Q-203 Q-204 Q-205	75561-6 75561-6 75561-6 75561-6 75561-6	Transistor, Germanium, 2N404A, PNP
Q-206 Q-207	75561-3 75556-1	Transistor, Silicon, 2N706, NPN Transistor, Germanium, Amperex, A1383, PNP
Q-301 Q-302 Q-303 Q-304 Q-305	75561-7 75550-7 75537-2 75550-7 75561-6	Transistor, Germanium, 2N2613, PNP Transistor, Silicon, 2N3391, NPN Transistor, Germanium, PNP Transistor, Germanium, 2N404A, NPN Transistor, Silicon, 2N3391, PNP
		Transistors are not acceptable.
		R, RESISTORS
R-101 R-102 R-103 R-104 R-105	31192-821 31192-101 31192-471 31192-222 31192-101	Resistor, Carbon, 820Ω , $\pm 10\%$, $1/4W$ Resistor, Carbon, 100Ω , $\pm 10\%$, $1/4W$ Resistor, Carbon, 470Ω , $\pm 10\%$, $1/4W$ Resistor, Carbon, $2.2K$, $\pm 10\%$, $1/4W$ Resistor, Carbon, 100Ω , $\pm 10\%$, $1/4W$
R-106 R-107 R-108 R-109 R-110	31192-122 31192-101 31192-122 31192-223 31192-562	Resistor, Carbon, $1.2K$, $\pm 10\%$, $1.2W$ Resistor, Carbon, 100Ω , $\pm 10\%$, $1.2W$ Resistor, Carbon, $1.2K$, $\pm 10\%$, $1.2W$ Resistor, Carbon, $1.2K$, $1.2W$ Resistor, Carbon, $1.2K$, $1.2W$
R-111 R-112 R-113 R-114 R-115	31192-122 31192-103 31192-152 31192-391 31192-471	Resistor, Carbon, 1.2K, $\pm 10\%$, $1/4$ W Resistor, Carbon, 10 K, $\pm 10\%$, $1/4$ W Resistor, Carbon, 1.5 K, $\pm 10\%$, $1/4$ W Resistor, Carbon, 1.5 M,
R-116 R-117 R-118 R-119 R-120	31192-221 31192-103 31192-682 31192-183 31141-101	Resistor, Carbon, 220Ω , $\pm 10\%$, $1/4$ W Resistor, Carbon, 10 K, $\pm 10\%$, $1/4$ W Resistor, Carbon, 6.8 , $\pm 10\%$, $1/4$ W Resistor, Carbon, 18 K, $\pm 10\%$, $1/4$ W Resistor, Carbon, 100Ω , $\pm 10\%$, $1/2$ W
R-121 R-122 R-123 R-124 R-125	31192-393 31192-103 31192-102 31192-471 31192-221	Resistor, Carbon, $39K$, $\pm 10\%$, $1/4W$ Resistor, Carbon, $10K$, $\pm 10\%$, $1/4W$ Resistor, Carbon, $11K$, $\pm 10\%$, $1/4W$ Resistor, Carbon, 110% ,
R-126	31192-223	Resistor, Carbon, 22K, ±10%, 1/4W
R-201 R-202 R-203 R-204 R-205	31192-102 31192-102 31192-102 31192-102 31192-102	Resistor, Carbon, $1K$, $\pm 10\%$, $1/4W$ Resistor, Carbon, $1K$, $\pm 10\%$, $1/4W$

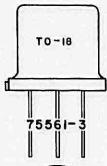
SYMBOL	NARCO PART NO.	DESCRIPTION
	R, R	ESISTORS (Continued)
R-206 R-207 R-208 R-209 R-210	31195-470 31195-470 31195-392 31195-392 31195-392	Resistor, Carbon, 47Ω , $\pm 5\%$, $1/4$ W Resistor, Carbon, 47Ω , $\pm 5\%$, $1/4$ W Resistor, Carbon, 3.9K, $\pm 5\%$, $1/4$ W Resistor, Carbon, 3.9K, $\pm 5\%$, $1/4$ W Resistor, Carbon, 3.9K, $\pm 5\%$, $1/4$ W
R-211 R-212 R-213 R-214 R-215	31195-392 31195-332 31195-332 31195-392 31195-392	Resistor, Carbon, 3.9K, ±5%, 1/4W Resistor, Carbon, 3.3K, ±5%, 1/4W Resistor, Carbon, 3.3K, ±5%, 1/4W Resistor, Carbon, 3.9K, ±5%, 1/4W Resistor, Carbon, 3.9K, ±5%, 1/4W
R-216 R-217 R-218 R-219 R-220	31195-752 31195-392 31195-332 31195-392 31195-332	Resistor, Carbon, 7.5K, ±5%, ¼W Resistor, Carbon, 3.9K, ±5%, ¼W Resistor, Carbon, 3.3K, ±5%, ¼W Resistor, Carbon, 3.9K, ±5%, ¼W Resistor, Carbon, 3.3K, ±5%, ¼W
R-221 R-222 R-223 R-224 R-225	31195-752 31195-392 31195-332 31195-392 31195-332	Resistor, Carbon, 7.5K, ±5%, ¼W Resistor, Carbon, 3.9K, ±5%, ¼W Resistor, Carbon, 3.3K, ±5%, ¼W Resistor, Carbon, 3.9K, ±5%, ¼W Resistor, Carbon, 3.3K, ±5%, ¼W
R-226 R-227 R-228 R-229 R-230	31195-752 31195-392 31195-332 31195-392 31195-332	Resistor, Carbon, 7.5K, ±5%, ¼W Resistor, Carbon, 3.9K, ±5%, ¼W Resistor, Carbon, 3.3K, ±5%, ¼W Resistor, Carbon, 3.9K, ±5%, ¼W Resistor, Carbon, 3.3K, ±5%, ¼W
R-231 R-232 R-233 R-234 R-235	31141-561 21141-561 31141-561 31141-561 31141-561	Resistor, Carbon, 560Ω , $\pm 10\%$, $1/2$ W Resistor, Carbon, 560Ω , $\pm 10\%$, $1/2$ W Resistor, Carbon, 560Ω , $\pm 10\%$, $1/2$ W Resistor, Carbon, $1/2$ W Resistor, $1/2$ W Re
R-236 R-237 R-238 R-239 R-240	31141-561 31141-561 31141-561 31141-561 31141-561	Resistor, Carbon, 560Ω , $\pm 10\%$, $1/2$ W Resistor, Carbon, 560Ω , $\pm 10\%$, $1/2$ W Resistor, Carbon, 560Ω , $\pm 10\%$, $1/2$ W Resistor, Carbon, 560Ω , $\pm 10\%$, $1/2$ W Resistor, Carbon, $1/2$ W Resistor, Carbon, $1/2$ W Resistor, Carbon, $1/2$ W
R-241 R-242 R-243 R-244 R-245	31136-221 31135-221 31192-102 31195-561 31195-561	Resistor, Carbon, 22011, $\pm 10\%$, 2W Resistor, Carbon, 22011, $\pm 10\%$, 1W Resistor, Carbon, 1K, $\pm 10\%$, 1/4W Resistor, Carbon, 5601 , $\pm 5\%$, 1/4W Resistor, Carbon, 5601 , $\pm 5\%$, 1/4W
R-246 R-247 R-248 R-249 R-250	31195-561 31195-561 31195-821 31195-561 31195-561	Resistor, Carbon, 560Ω , $\pm 5\%$, $1/4W$ Resistor, Carbon, 560Ω , $\pm 5\%$, $1/4W$ Resistor, Carbon, 820Ω , $\pm 5\%$, $1/4W$ Resistor, Carbon, 560Ω , $\pm 5\%$, $1/4W$ Resistor, Carbon, 560Ω , $\pm 5\%$, $1/4W$
R-251 R-252 R-253 R-254 R-255	31195-561 31195-561 31195-561 31195-561 31195-561	Resistor, Carbon, 560Ω , $\pm 5\%$, $1/4W$
R-256 R-257 R-258 R-259 R-260	31195-561 31195-821 31195-561 31195-561 31195-561	Resistor, Carbon, 560Ω , $\pm 5\%$, $1/4$ W Resistor, Carbon, 820Ω , $\pm 5\%$, $1/4$ W Resistor, Carbon, 560Ω , $\pm 5\%$, $1/4$ W Resistor, Carbon, 560Ω , $\pm 5\%$, $1/4$ W Resistor, Carbon, $1/4$ W Resistor, Carbon, $1/4$ W Resistor, Carbon, $1/4$ W
R-261 R-262 R-263 R-264 R-265	31195-561 31192-102 31192-470 31192-332 31192-333	Resistor, Carbon, 5600, ±5%, ¼W Resistor, Carbon, 1K, ±10%, ¼W Resistor, Carbon, 470, ±10%, ¼W Resistor, Carbon, 3.3K, ±10%, ¼W Resistor, Carbon, 33K, ±10%, ¼W

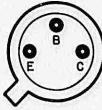
SYMBOL	NARCO PART NO.	DESCRIPTION
		R, RESISTORS (Continued)
R-266 R-267 R-268 R-269 R-270	31192-683 31150-101 31149-560 31195-683 31195-330	Resistor, Carbon, $68K$, $\pm 10\%$, $\frac{1}{4}W$ Resistor, Carbon, 100Ω , $\pm 5\%$, $1W$ Resistor, Carbon, 56Ω , $\pm 5\%$, $\frac{1}{2}W$ Resistor, Carbon, $68K$, $\pm 5\%$, $\frac{1}{4}W$ Resistor, Carbon, 33Ω , $\pm 5\%$, $\frac{1}{4}W$
R-271	31192-101	Resistor, Carbon, 100Ω, ±10%, ¼W
R-301 R-302 R-303 R-304 R-305	31192-472 31192-102 31192-103 31192-151 31192-153	Resistor, Carbon, 4.7K, $\pm 10\%$, $1/4\%$ Resistor, Carbon, 1K, $\pm 10\%$, $1/4\%$ Resistor, Carbon, 10K, $\pm 10\%$, $1/4\%$ Resistor, Carbon, 150 Ω , $\pm 10\%$, $1/4\%$ Resistor, Carbon, 15K, $\pm 10\%$, $1/4\%$
R-306 R-307 R-308 R-309 R-310	32047-4 31192-222 31192-683 31192-473 31192-181	Potentiometer, Carbon, 1.5K, $\pm 30\%$ Resistor, Carbon, 2.2K, $\pm 10\%$, $1/4\%$ Resistor, Carbon, 68K, $\pm 10\%$, $1/4\%$ Resistor, Carbon, 47K, $\pm \%$, $1/4\%$ Resistor, Carbon, 180% , $\pm 10\%$, $1/4\%$
R-311 R-312 R-313 R-314 R-315	32045-7 31192-222 31192-152 31192-101 31205-4	Resistor, Variable, 100Ω , $\pm 20\%$, $2W$ Resistor, Carbon, $2.2K$, $\pm 10\%$, $1/4W$ Resistor, Carbon, $1.5K$, $\pm 10\%$, $1/4W$ Resistor, Carbon, 100Ω , $\pm 10\%$, $1/4W$ Resistor, Thermistor, 128.8Ω , $\pm 10\%$, $1W$
R-316 R-317 R-318 R-319 R-320	31192-101 31192-471 32045-8 31192-222 31192-152	Resistor, Carbon, 100Ω , $\pm 10\%$, $\frac{1}{4}$ W Resistor, Carbon, 470Ω , $\pm 10\%$, $\frac{1}{4}$ W Resistor, Variable, 500Ω , $\pm 20\%$, 2 W Resistor, Carbon, 2.2 K, $\pm 10\%$, $\frac{1}{4}$ W Resistor, Carbon, 1.5 K, $\pm 10\%$, $\frac{1}{4}$ W
R-321 R-322 R-323 R-324 R-325	31192-471 31192-471 31135-829 31189-3 31151-241	Resistor, Carbon, 470Ω , $\pm 10\%$, $\frac{1}{4}$ W Resistor, Carbon, 470Ω , $\pm 10\%$, $\frac{1}{4}$ W Resistor, Carbon, 8.2Ω , $\pm 10\%$, 1 W Resistor, Wirewound, 75Ω , $\pm 5\%$, 5 W Resistor, Carbon, 240Ω , $\pm 5\%$, 2 W
R-326 R-327 R-328 R-329 R-330	31192-220 31192-330 31192-224 31192-154 31205-3	Resistor, Carbon, 22Ω , $\pm 10\%$, $1/4$ W Resistor, Carbon, 33Ω , $\pm 10\%$, $1/4$ W Resistor, Carbon, $220K$, $\pm 10\%$, $1/4$ W Resistor, Carbon, $150K$, $\pm 10\%$, $1/4$ W Resistor, Thermistor, $48.2K$, $\pm 10\%$, $360m$ W
		T, TRANSFORMERS
T-101 T-102 T-103 T-104 T-105	11515-1 11514-1 11514-1 11514-1 11513-1	Transformer, HF IF, 27.9MHz(mc) Transformer, LF IF, 7.35MHz(mc) Transformer, LF IF, 7.35MHz(mc) Transformer, LF IF, 7.35MHz(mc) Transformer, LF IF, Output 7.35MHz(mc)*
T-301	11679-1 11679-1	Transformer, Glideslope P.C. Transformer, Glideslope P.C.
T-302	(10/7-1	*Transformer only: does not include C-121, C-122, C-123, C-124, C-125, C-126, C-146, CR-101, CR-102, R-116, R-117, and R-118.
		XT, CRYSTALS
XT-101 XT-102 XT-103 XT-104 XT-105	72028-4 72028-3 72028-1 72028-2 72028-5	Crystal, Series Mode, 5th 76.3625MHz(mc) Crystal, Series Mode, 5th 76.0625MHz(mc) Crystal, Series Mode, 5th 75.4625MHz(mc) Crystal, Series Mode, 5th 75.7625MHz(mc) Crystal, Series Mode, 5th 76.6625MHz(mc)
XT-201 XT-202 XT-203 XT-204	72028-6 72028-7 72028-8 72028-9	Crystal, Parallel Mode, 3rd, 34.8MHz(mc) Crystal, Parallel Mode, 3rd, 35.1MHz(mc) Crystal, Parallel Mode, 3rd, 35.4MHz(mc) Crystal, Parallel Mode, 3rd, 35.7MHz(mc)

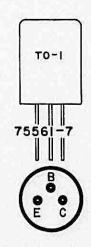


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FIGURE 7-1. narco UGR-2 GLIDE SLOPE RECEIVER, FUNCTIONAL BLOCK DIAGRAM



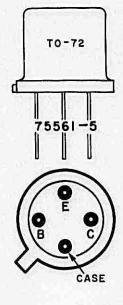


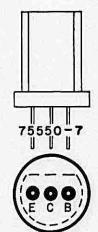


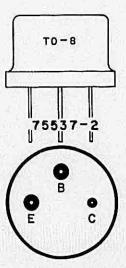
SYMBOL	NARCO PART. NO.
Q-101	75561-5
Q-102	75561-5
Q-103	75556-1
Q-104	75556-1
Q-105	75556-1
Q-106	75556-1
Q-107	75550-7
Q-108	75556-1
Q-109	75556-1
Q-201	75561-6
Q-202	75561-6
Q-203	75561-6
Q-204	75561-6
Q-205	75561-6
Q-206	75561-3
Q-207	75556-1
Q-301	75561-7
Q-302	75550-7
Q-303	75537-2
Q-304	75550-7
Q-305	75561-6

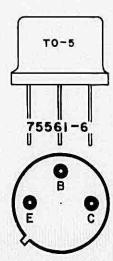
Transistor Identification

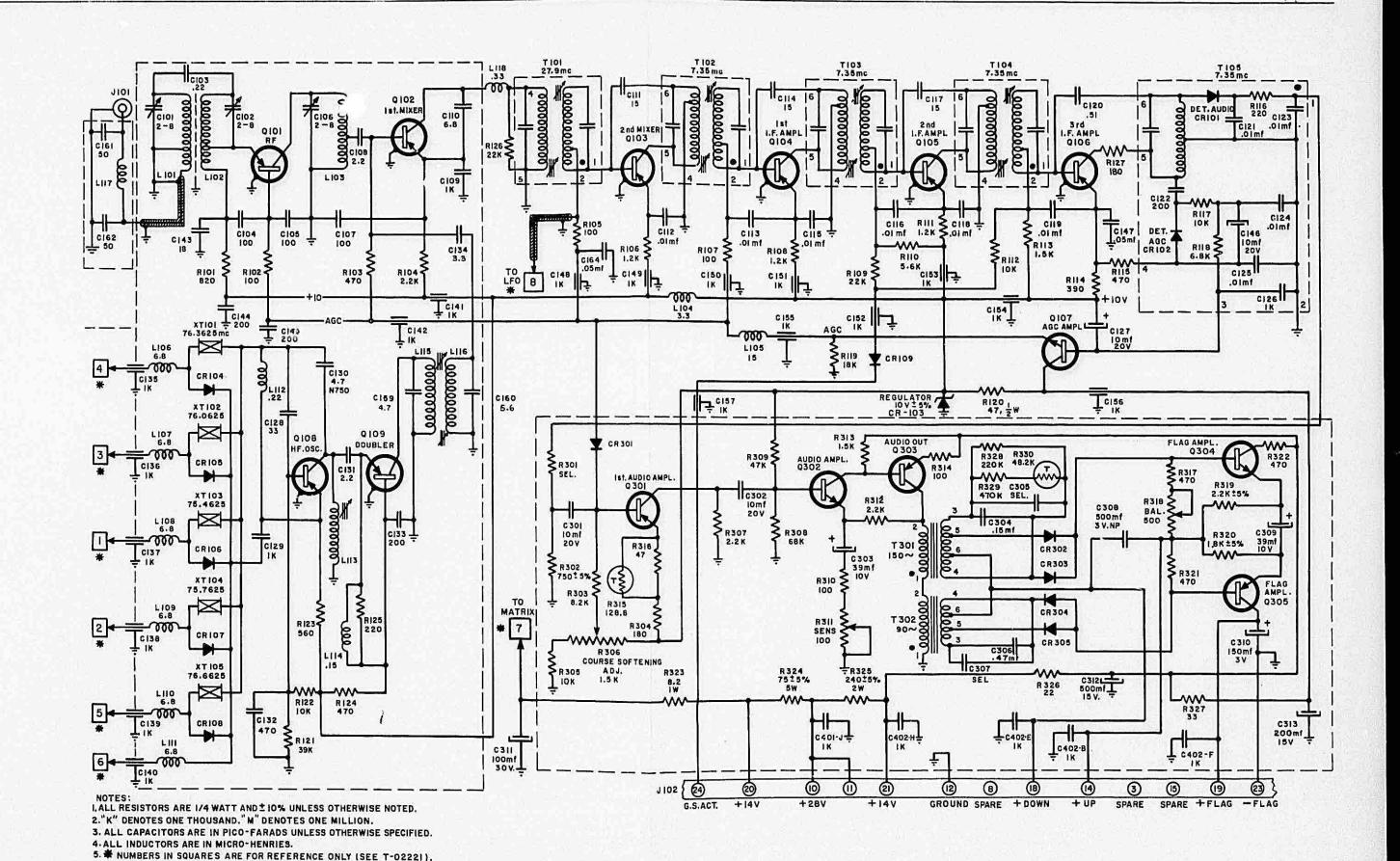












T-02222

FIGURE 7-2. narco UGR-2 GLIDE SLOPE RECEIVER, SCHEMATIC DIAGRAM, SHEET 1

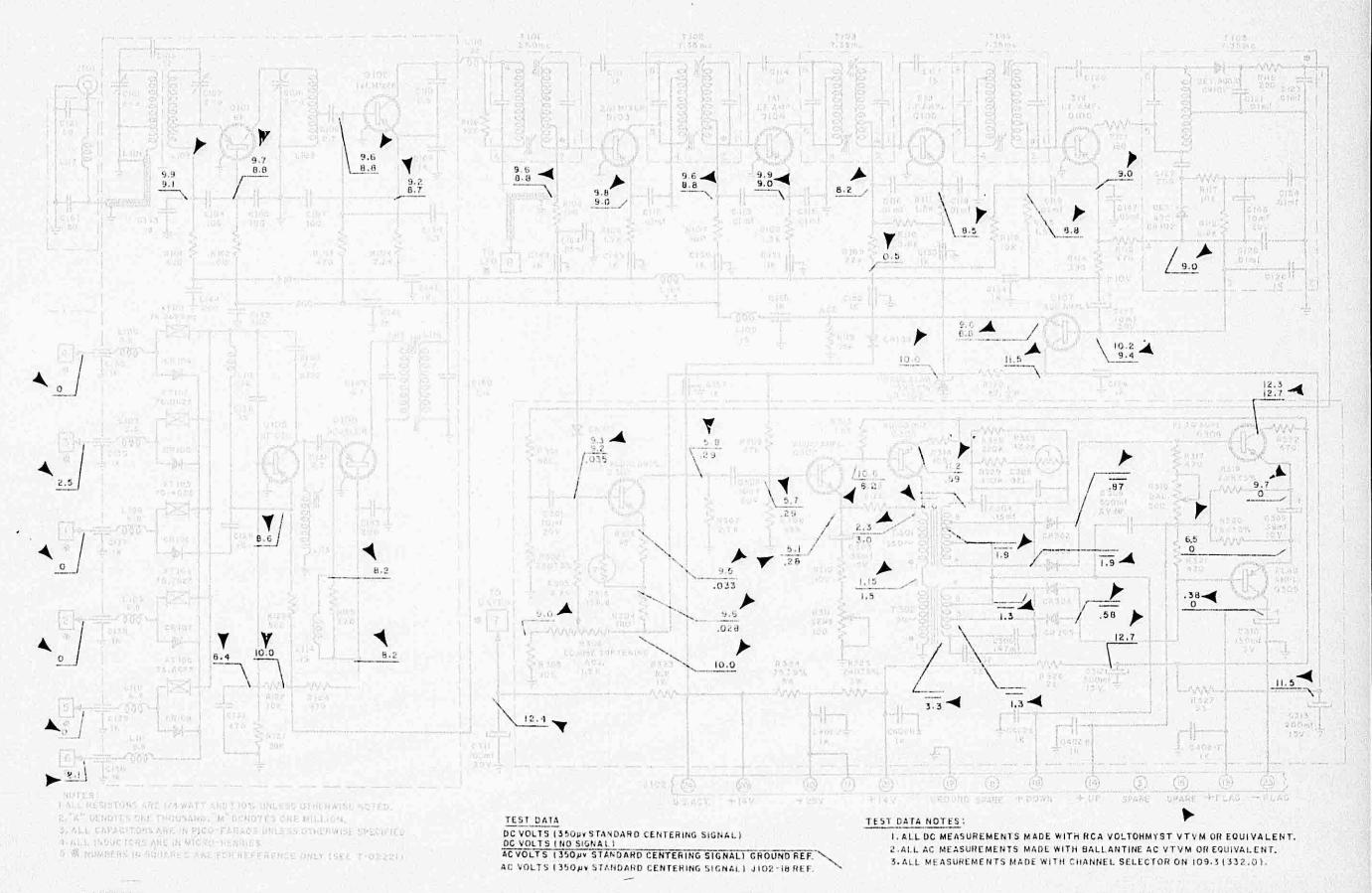
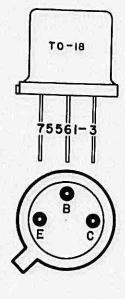
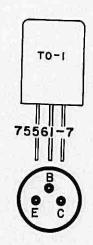
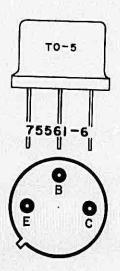
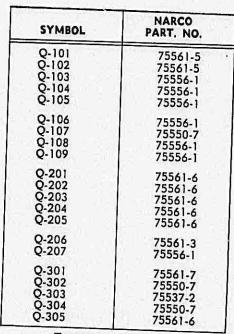


FIGURE 7 - 2A. narco UGR-2 GLIDE SLOPE RECEIVER, SCHEMATIC DIAGRAM, SHEET 1 WITH SERVICE DATA

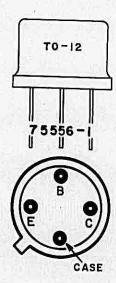


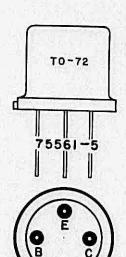


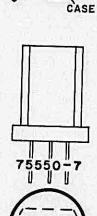


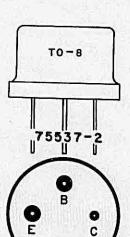


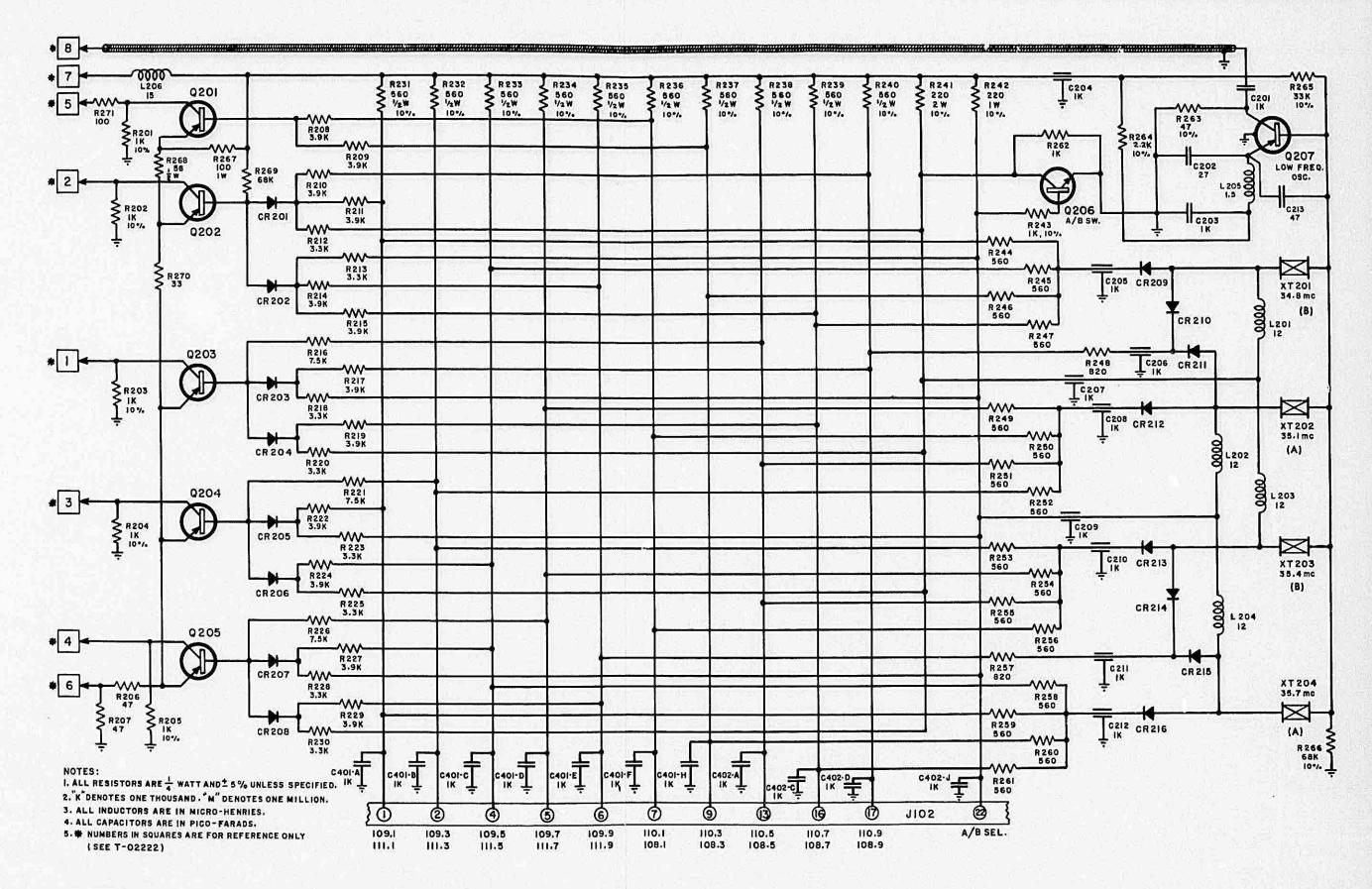
Transistor Identification











T-02221

10-72

75561-5

T0-8

75537-2

FIGURE 7-3. narco UGR-2 GLIDE SLOPE RECEIVER, SCHEMATIC DIAGRAM, SHEET 2

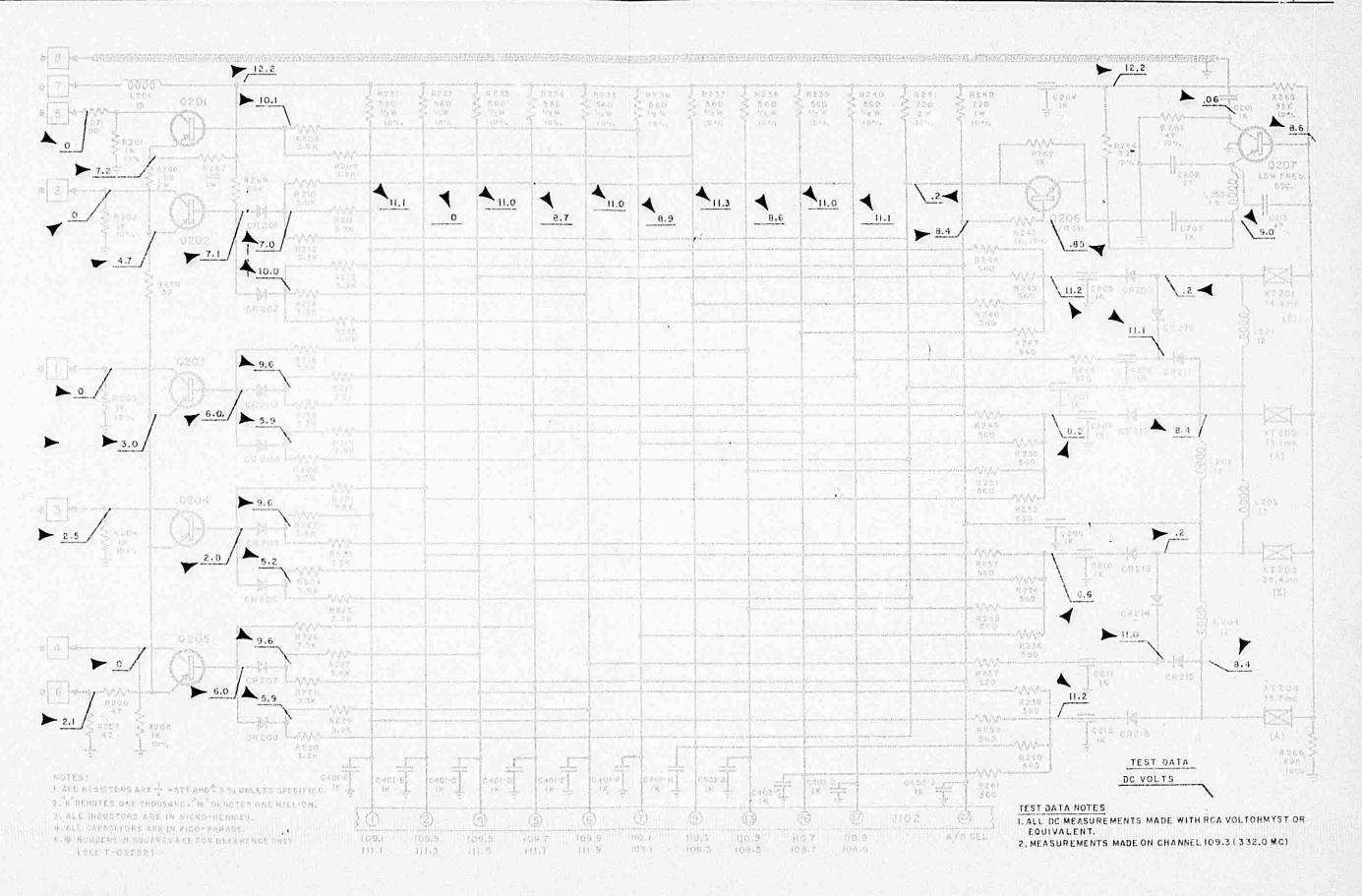


FIGURE 7-3A. narco UGR-2 GLIDE SLOPE RECEIVER, SCHEMATIC DIAGRAM, SHEET 2 WITH SERVICE DATA

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8-1.3	Physical Description	8-1	
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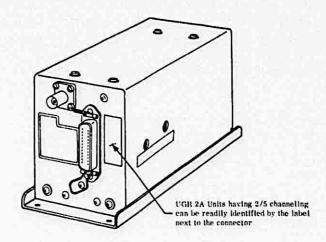
da dikiring pungkah sakir dan dalah dalah dalah dalah dalah dalah kiril jak bari kalim kalim bari pasa pesagir

LIST OF ILLUSTRATIONS

Figure Number	Title	Page ATP Number GRID	BLOW-UP FICHE
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8.4.3	ARINC 2/5 Conversion Chart 40 Channel Selection of HF and LF Crystals	8-13 1H16 8-14 1H17



8-1.1 GENERAL

This section supplements the Maintenance Manual for Glide Slope Receivers UGR-2 and UGR-2A. This supplement concerns a third model, namely, the UGR-2A 2/5. Since the UGR-2A 2/5 Receiver is similar in many respects to the other two receivers, reference is made throughout the supplement to applicable sections of the basic manual.

8-1.2 FUNCTIONAL DESCRIPTION

The UGR-2A 2/5 Glide Slope Receiver is crystal tuned for operation on 40 UHF channels within the 329.15 to 335.0 MHz range; channel spacing is 0.15 MHz. This receiver is similar to the UGR-2A Receiver in that it has 40 channel capability. The two receivers differ only in the channel selection circuitry. The UGR-2A 2/5 Receiver uses integrated circuits and diodes to select HF and LF oscillator crystals; this channel selection matrix responds to either the Narco 2/11 selection code or the ARINC 2/5 code. The original UGR-2A Receiver employs a diode matrix that responds only to the Narco 2/11 code.

8-1.3 PHYSICAL DESCRIPTION

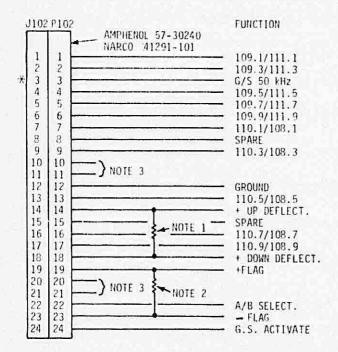
The UGR-2A 2/5 Receiver has a new Glide Slope Matrix and LFO board that can be identified by its six IC chips and eight crystals. All components on this PC board carry 600 series reference designators. The layout of this PC board is shown in Figure 8-4.1.

The UGR-2A 2/5 Receiver RF board has five different coils (L119 through L123) and five different crystal diodes (CR110 through CR114) as shown in Figure 8-4.2. Note that the polarity of the crystal diodes is reversed with respect to the crystal diodes of the original UGR-2A Receiver.

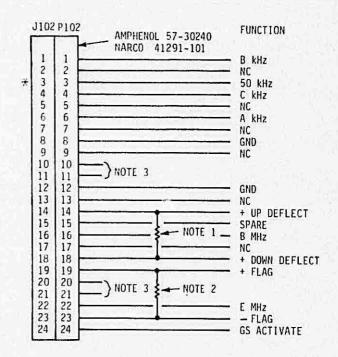
8-2.1 INSTALLATION AND INTERCONNECTIONS

Installation instructions given in Section 2 of the UGR-2 Maintenance Manual are applicable to the UGR-2A 2/5 Receiver with the exception of interconnections to the rear panel connector. The cable connections to this rear panel connector are shown in Figure 8-2.1.

Installation information for this equipment is also contained in Maintenance Manuals for NAV 121, 122A, 124, 124A and 124R Receivers.



- A. UGR-2A 2/5 Rear Connector Showing 2/11 Wiring (For use with such NAV units as Mk 12 Series, Mk 16, Mk 24, NAV 11, 12, 14, 111, 112, 114)
 - GROUNDING OF PIN 3 ACTIVATES THE 50 kHz
 CHANNEL.
 - NOTE 1: RESISTOR INSTALLED INSIDE HOOD OF CONNECTOR TO MAKE COMBINATION OF RESISTOR LOADS AND METER LOADS EQUAL 333 OHMS (3-1K OHM MOVEMENTS MAX.) 470 OHMS SUPPLIED INSTALLED IN CONNECTOR IS STANDARD.
 - NOTE 2: RESISTOR INSTALLED INSIDE HOOD OF CONNECTOR
 TO MAKE COMBINATION OF RESISTOR LOADS AND
 AND METER LOADS EQUAL 500 OHMS (2-1K OHM
 FLAG LOADS MAX.) 1000 OHMS SUPPLIED INSTALLED IN CONNECTOR IS STANDARD.



- B. UGR-2A 2/5 Rear Connector Showing ARINC Wiring (For use with such NAV units as NAV 121, 122, 122A, 124 Series)
- NOTE 3: THE PRIMARY VOLTAGE INPUT CONNECTIONS(A+) ARE AS FOLLOWS:
 - a. 28 VOLTS: CONNECT INPUT TO TERMINALS 10 AND 11. NO CONNECTIONS TO TERMINALS 20 AND 21.
 - b. 14 VOLTS: CONNECT INPUT TO TERMINALS 20 AND 21. NO CONNECTIONS TO TERMINALS 10 AND 11.
 - c. USE 0.5 AMPERE FUSE IN SERIES WITH THE A+ INPUT LOAD FOR EITHER 14V OR 28V OPERATION.
 - d. A+ MAY BE OBTAINED FROM THE AIRCRAFT POWER OR FROM THE SWITCHED A+ OF THE ASSOCIATED NAV RECEIVER. IT IS RECOMMENDED THAT 2 WIRES BE PARALLELED (#22 WIRE).

8-3.1 OPERATION

Operation of Glide Slope Receiver UGR-2A 2/5 is described in Section 3 of the UGR-2 Maintenance Manual.

The circuit description of the UGR-2 Receiver contained in Section 4 of the UGR-2 Maintenance Manual is applicable to the UGR-2A 2/5 Receiver except for the description of the Matrix. A description of the UGR-2A 2/5 matrix for channel selection is given here.

8-3.2 GLIDE SLOPE MATRIX AND LOW-FREQUENCY OSCILLATOR

Refer to Figure 8-6.1. The glide slope matrix consists of integrated circuit components that provide code conversion for HF and LF crystal selection, and a diode matrix that assists in the selection of LF crystals. The LF oscillator and its crystals are located on this board where as the HF components are on the receiver board.

8-3.2.1 CODE CONVERTER

Gates U601, U603 and U604 in conjunction with inverters U602A through E and PROM U605 are employed as a code converter. This converter accepts either the Narco 2/11 code or the ARINC 2/5 code to select the proper HF and LF oscillator crystals that provide 40 channel tuning. With J102 input terminals ungrounded, +5V is applied via diodes CR601-606 and CR610-614 to appropriate pins of the gates; this establishes a high (1) condition. With a J102 terminal grounded, a low (0) condition is established at the associated gate input.

The code converter provides 20 different output conditions in response to 100 kHz switching. The 50 kHz selection for the other 20 channels is obtained by grounding terminals J102-3; refer to paragraph 8-3.2.2.

Table 8.4.1 shows the code converter operating sequences when the Narco 2/11 code is employed. Observe that the active input terminals of J102 are shown first in the table. Terminal 5, not used in this circuit, is considered as being low, and pin 8 is always high. If pin 22 (A/B) is not considered, only one of the remaining terminals is grounded at each LOC FREQ setting.

Table 8.4.2 shows the code converter operating sequences when the ARINC 2/5 code is employed. The + (NC on schematic) terminals are always high and the - (GND) is always low. The five active terminals are identified by letters.

For maintenance purposes, the tables show conditions at key points in the code converter, such as the inputs to the PROM. The inputs to the inverters that feed the PROM are obviously the reciprocal of their outputs.

PROM output terminals 7, 2, 6, 5 and 3 select one of the five HF crystals on the receiver board; the tables show that only one of these terminals is low at each LOC FREQ setting. Output terminals 4, 9 and 1 are partly responsible for the selection of LF crystals as described below.

8-3.2.2 LOW-FREQUENCY OSCILLATOR

Low-frequency oscillator Q601 is a crystal-controlled oscillator whose frequency is determined by the selection of one of eight crystals. Two circuit conditions must be satisfied to connect one of the crystals in the transistor base circuit. Figure 8-3.1 shows the conditions that must be met to place crystal XT601 in operation. First, the output of U606A must be low to cause diode CR609 to conduct and thereby connect one terminal of the crystal to the base of Q601. Second, PROM output terminal 4 must be high and 9 must be low. This causes diode CR616 to conduct and provide a ground return for the other terminal of the crystal. If these conditions are not met, one of the other LF crystals will be selected instead of XT601.

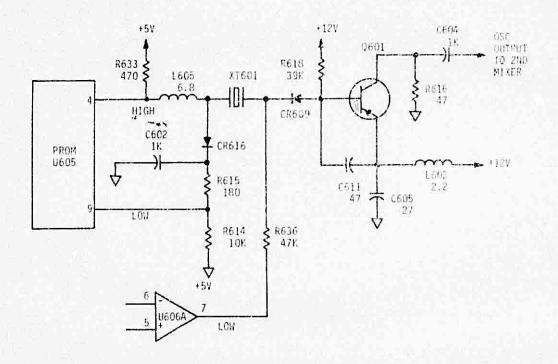


FIGURE 8-3.1 SIMPLIFIED LF OSCILLATOR CIRCUIT

Some general observations about the diode matrix used for low-frequency crystal selection may be an aid to tracing other circuit combinations. See Figure 8-6.1. Note that the only PROM output terminals involved are 4, 9 and 1. When terminal 9 is low, either CR616 or CR618 can be activated; when 9 is high, either CR617 or CR619 can be activated (because of inverter U602F). Which one of either pair is actuated is determined by the condition of terminals 4 and 1. When one of these outputs is high, the other is low and vice versa. The high state is the enabling condition.

8-3.2.2 Continued

Control of CR608 and CR609 of the diode matrix is exercised by amplifiers U606A and B. In the 100 kHz condition, J102-3 is ungrounded, CR615 conducts and input terminals U606A-6 and U606B-3 are high; as a result, the output of U606A is low and that of U606B is high. This activates diode CR609 and disables CR608. For 50 kHz operation, J102-3 is grounded and the input terminals of U606 both go low; as a result, the output conditions are reversed and CR608 is activated instead of CR609. Table 8-4.3 lists all 40 channels and the LF crystal selected.

8-3.3 HIGH FREQUENCY OSCILLATOR

Refer to Figure 8-6.2. The HF crystal selection circuit is designed to be compatible with the code converter of the glide slope matrix. The affected components are L119 through L123 and CR110 through CR114. In this circuit, +5V is applied via resistor R613 on the matrix board and L111 to the anodes of the five diodes. PROM outputs on the matrix board hold four diode cathodes high and only one selected diode cathode low. This actuates the one diode to complete the circuit from the associated crystal to capacitor C129; therefore, the selected crystal determines the HF oscillator frequency.



The information given in Section 8-5 of the UGR-2 Maintenance Manual is applicable to the UGR-2A 2/5 Receiver except for that concerning the channel selection matrix. Instructions for maintaining the new matrix are given here.

8-4.2 TROUBLE ISOLATION, MATRIX SECTION

The integrated circuit components and associated diode switches control the crystal selection of the HFO (Q108) and LFO (Q601). The input lines of J102 are connected to the switching matrix to select two crystals, one for the HFO and one for the LFO. Table 8.4.3 shows the HF and LF crystal frequency that is selected for each LOC FREQ setting, and the schematic diagrams, Figures 8-6.1 and 8-6.2, show which crystal is associated with that frequency. The physical location of the matrix and receiver components is shown on Figures 8-4.1 and 8-4.2.

Table 8.4.1 or 8.4.2 in conjunction with Figure 8-6.3 can be used to troubleshoot the switching matrix. Table 8.4.1 is used when Narco 2/11 channel selection is employed, and Table 8.4.2 for ARINC 2/5 channel selection. Referring to Figure 8-6.3, note that all voltages to the left of the PROM (U605) are digital; that is, they are either high (5V) or low (0V). The voltages shown apply only to LOC FREQ settings 109.30 and 109.35, but the results of all other settings can be interpreted by means of Tables 8.4.1 or 8.4.2 and 8.4.3.

Under the same conditions, voltages at the HF oscillator reference terminals are as follows:

-] 4V
- 3 .26V
- 1 4V
- 2 4V
- 5 4V
- 6 1.1V

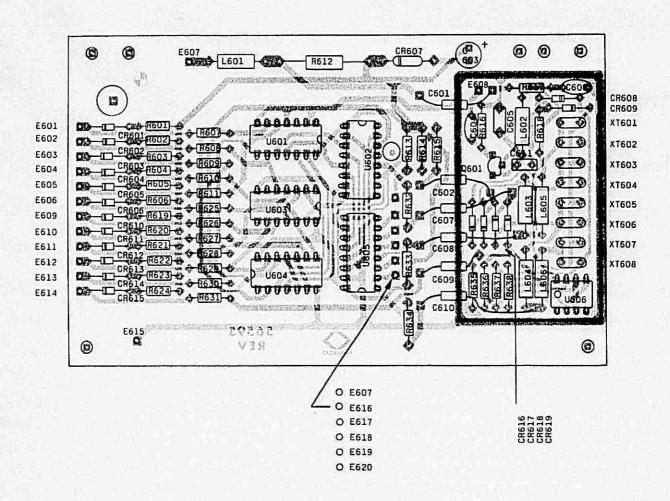


FIGURE 8-4.1 MATRIX ASSEMBLY, TOP VIEW SHOWING COMPONENTS

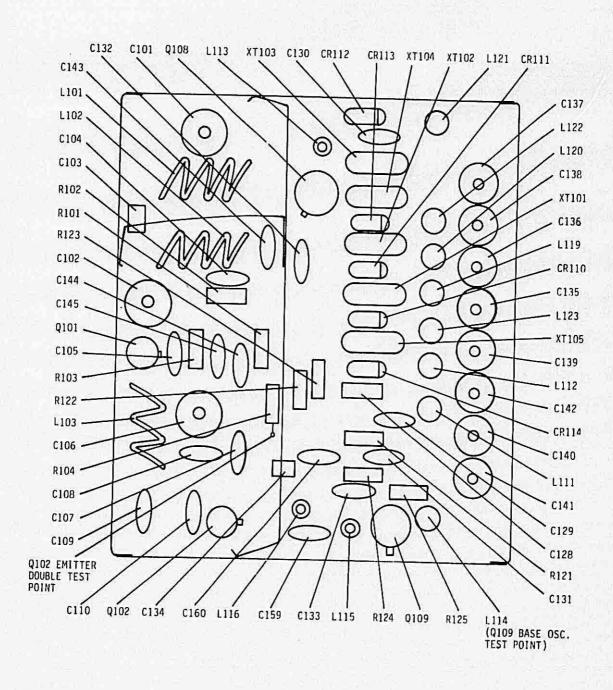


FIGURE 8-4.2 RF BOARD, COMPONENT LOCATION AND TEST POINTS

8-11 JAN. 1977

TABLE 8.4.1 NARCO 2/11 CONVERSION CHART

y Mwu Per 1	INPUT	CODE CONVERTER	OUTPUT
	J102 PIN NO.	U605-11 U605-11 U605-13 U603B-1 U605-14 U604D-3 U605-12	U605 PIN NO.
LOC FREQ	7 9 13 16 17 1 2 4 5 6 22 8	U605- U605- U603E U605- U605- U604I	7 2 6 5 3 4 9 1
108.1	0 1 1 1 1 1 1 1 1 0 1	0 0 1 1 0 0 0	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
108.1	10111111101	0 1 1 1 0 0 0	
108.5	1 1 0 1 1 1 1 1 1 0 1	1 1 1 1 0 0 0	
108.7	1 1 1 0 1 1 1 1 1 0 1	1 0 1 1 0 0 0	
108.9	11110111 101	1 0 0 1 0 0 0	V + + + + + + + + + + + + + + + + + + +
109.1	1 1 1 1 1 0 1 1 1 1 1	0 0 1 0 1 0 1	
109.3	1111111111	0 1 1 0 1 0 1	1 1 1 1 0 0
109.5	11111110 111	1 1 1 0 1 0 1	
109.7	1 1 1 1 1 1 1 1 0 1 1 1	1 0 1 0 1 0 1	1 1 1 0 1
109.9	1 1 1 1 1 1 1 1 0 1 1	1 0 0 0 1 0 1	
110.1	0 1 1 1 1 1 1 1 1 1	0 0 1 1 1 0 0	
110.3	1 0 1 1 1 1 1 1 1 1 1	0 1 1 1 1 0 0	
110.5	1 1 0 1 1 1 1 1 1 1 1	1 1 1 1 1 0 0	1 7 5 5 5 5 6 7 7
110.7	1 1 1 0 1 1 1 1 1 1 1	1 0 1 1 1 0 0	
110.9	1 1 1 1 0 1 1 1 1 1 1	1 0 0 1 1 0 0	
111.1	1 1 1 1 1 0 1 1 1 0 1	0 0 1 0 0 0 1	
111.3	1 1 1 1 1 1 0 1 1 0 1	0 1 1 0 0 0 1	
111.5	1 1 1 1 1 1 1 0 1 0 1	1 1 1 0 0 0 1	
111.7	1 1 1 1 1 1 1 1 0 1 0 1	1 0 1 0 0 0 1	
111.9	1 1 1 1 1 1 1 1 0 0 1	1 0 0 0 0 0 1	1 0 1 1 1 1 1

TABLE 8.4.2 ARINC 2/5 CONVERSION CHART

v	INPUT	CODE CONVERTER OUTPUT
LOC	ARINC CODE B B C A E + + + MHz + kHz + kHz kHz MHz (-) J102	01-5090
FREQ	7 9 13 16 17 1 2 4 5 6 22 8	5 5 5 5 5 5 5 7 2 6 5 3 4 9 1
108.1	1 1 1 1 1 0 1 1 0 1 0	0 0 0 0 0 1 0 1 1 1 1 0 1 1 0
108.3	1 1 1 1 1 0 1 0 1 1 0	0 1 1 0 0 1 0 1 1 1 1 0 0 1 1
108.5	11111110 110	1 1 1 0 0 1 0 0 1 1 1 1 1 1 0
108.7		1010010 10111011
108.9	1 1 1 1 1 1 1 1 0 1 0	1 0 0 0 0 1 0 0 1 1 1 1 0 1 1
109.1	1 1 1 1 1 0 1 1 0 0 0	0 0 0 0 1 0 1 1 0 1 1 1 1 0 0
109.3	11111010 100	0 1 1 0 1 0 1 1 1 0 1 1 0 0 1
109.5	1 1 1 1 1 1 1 0 1 0 0	1 1 1 0 1 0 1 1 1 0 1 1 1 0 0
109.7	11111111 100	1 0 1 0 1 0 1 1 1 1 0 1 0 0 1
109.9	1 1 1 1 1 1 1 1 0 0 0	1 0 0 0 1 0 1 1 1 1 0 1 1 0 0
110.1	1, 1 1 0 1 0 1 1 0 0 0	0 0 0 1 1 0 0 1 1 1 1 0 0 0 1
110.3	11101010 100	0 1 1 1 1 0 0 1 1 1 1 0 1 0 0
110.5	1 1 1 0 1 1 1 0 1 0 0	1 1 1 1 1 0 0 0 1 1 1 1 1 0 0 1
110.7	1 1 1 0 1 1 1 1 1 0 0	1 0 1 1 1 0 0 0 1 1 1 1 1 0 0
110.9	1 1 1 0 1 1 1 1 0 0 0	1001100 10111001
111.1	1 1 1 0 1 0 1 1 0 1 0	0 0 0 1 0 1 1 1 1 0 1 1 0 1 1
111.3	1 1 1 0 1 0 1 0 1 1 0	0 1 1 1 0 1 1 1 1 0 1 1 1 1 0
111.5	1 1 1 0 1 1 1 0 1 1 0	1 1 1 1 0 1 1 1 1 1 0 1 0 1 1
111.7	1 1 1 0 1 1 1 1 1 1 0	1 0 1 1 0 1 1 1 1 1 0 1 1 1 0
111.9	1 1 1 0 1 1 1 1 0 1 0	1001011 1011110

TABLE 8.4.3 40 CHANNEL SELECTION OF HF AND LF CRYSTALS

G/S FREQ	LOC FREQ	SELECTED HF CRYSTAL	SELEC'	
(MHz)	(MHz)		100 kHz	50 kHz
329.15	108.95	75.4625	34.8	
329.30	108.90	75.4625		34,95
329.45	110.55	75.4625	35.1	-
329.60	110.50	75.4625	<u> </u>	35,25
329.75	108.55	75.4625	35.4	
329.90	108.50	75.4625	1 P4 1	35.55
330.05	110.75	75.4625	35.7	-
330.20	110.70	75.4625	· · · · · · · · · · · · · · · · · · ·	35.85
330.35	108.75	75.7625	34.8	i i v
330.50	108.70	75.7625	2	34.95
330.65	110,95	75.7625	35.1	
330.80	110.90	75.7625	<u> -</u>	35.25
330.95	111.95	75,7625	35.4	
331.10	111.90	75.7625	-	35.55
331.25	109.15	75.7625	35.7	_
331.40	109.10	75.7625		35.85
331.55	111.15	76.0625	34.8	Y E
331.70	111.10	76.0625		34.95
331,85	109.35	76.0625	35.1	-
332.00	109.30	76.0625	_	35.25
332.15	111.35	76.0625	35.4	-
332.30	111.30	76.0625		35.55
332.45	109.55	76,0625	35.7	
332.60	109.50	76.0625		35.85
332.75	111.55	76.3625	34.8	
332.90	111.50	76.3625		34, 95
333.05	109.75	76.3625	35.1	
333.20	109.70	76.3625		35.25
33.35	111.75	76.3625	35.4	
333.50	111.70	76.3625	_	35.55
333.65	109.95	76.3625	35.7	
33.80	109.90	76.3625		35.85
33.95	108.35	76,6625	34.8	_
34.10	108.30	76.6625		34.95
334.25	110.15	76.6625	35.1	
34.40	110.10	76.6625		35.25
334.55	108.15	76.6625	35.4	-
334.70	108.10	76.6625	Y Y	35.55
34.85	110.35	76.6625	35.7	00,00
35.00	110.30	76.6625	00.1	35.85

8-5.1 GENERAL

This supplementary Replacement Parts List includes all the mechanical and electrical parts shown in the schematic diagrams of the UGR-2A 2/5 Glide Slope Receiver. The location of parts is shown in Figure 8-4.1 and 8-4.2 illustrations of the component boards, and the description of components (and Narco part number) is given in the parts list.

The components listed in this section are standard commercially obtainable parts; however, certain components are identified only by a Narco part number. Where a transistor,
diode, or other semiconductor requires special characteristics, they are selected or
matched at the factory and assigned a Narco part number. Other components are selectby-test for compensation of overall system operation. Transformers, coils, sub-assemblies and other units that are specially designed for Narco are assigned a Narco Part
Number. When ordering any Narco part, always include the following information:

- a. Narco Model Number
- b. Narco Chassis Number
- c. Narco Serial Number
- d. Schematic Symbol Number
- e. Narco Part Number
- f. Component Description (from Parts List)
- g. Special Characteristics (shock mount, operating voltage, etc.)

8-5.2

MECHANICAL PARTS LIST

PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
MOMBER			
01085-0104		GLIDE SLOPE RECEIVER, UGR-2A 2/5	- 1
81254-0041		EYELET	2
81254-0037		EYELET	1
04069-0001		LABEL, FCC Certification	1
04293-0001		LABEL, Adjustments	
81275-0001		STOP NUT, Elastic	
81716-0001		LUG, Solder	
81738-0001		LUG, Solder	1
91016-0037		TUBING, Fiberglass, 1-1/2 lg	1
81290-0001		U-NUT, 4-40	4
82814-0403		SCREW, Mach, Bind. Hd, Sl	4
51869-0001		SPRING, IF Ground	1
51865-0001		SPRING, Ground	3
51850-0101		CASE	1
51851-0101		CHASSIS, IF	1
51855-0001		BOX, RF	1
51857-0001		BOX, RF BRACKET	1
51856-0001		PANEL, Connector	1
51864-0001		BRACKET	1
51860-0001		BRACKET	- 1
51861-0001		HINGE	4
51862-0001		SHIELD, RF	1
51859-0001		SHIELD, Cover	1
81213-0054		SPACER	2
51863-0001		SPRING, Ground	1
81336-0003		WASHER, Insulating Flat	4
82904-0101		NUT, Self-Clinching, 4-40	10
81423-0005		TERMINAL, Standoff	1
81355-0002		RIVET, Fastex Plastic	4
82864-0003		SCREW, Nylon, 4-40	1
82003-0005		CLAMP, Cable	. 1
51853-0102		RF PC BOARD ASSY	1
51852-0102		METERING PC BOARD ASSY	1
82841-0404		SCREW, Mach, Rd Hd, Sl, 3-56	4
04289-0002		LABEL, Transistor Location	1
04429-0001		NAMEPLATE, UGR-2A	4
51878-0001		SHIELD, Frame	1
56595-0001		MATRIX PC BOARD	1
04817-0001		LABEL, Switching Identification	1
54559-0001		INSULATOR	
56596-0001		MATRIX PC BOARD ASSY	1

8-5.3 ELECTRICAL PARTS LIST

SYMBOL	NARCO PART NO.	DESCRIPTION
		C, CAPACITORS
C-101	22041-1	Capacitor, Ceramic Variable, 2-8 pf, NPO
C-102	22041-1	Capacitor, Ceramic Variable, 2-8 pf, NPO
C-103	24509-228	Capacitor, Ceramic Tub., .22 pf, -5%
C-104	21291-14	Capacitor, Ceramic Disc., 100 pf, -10%
C-105	21291-14	Capacitor, Ceramic Disc., 100 pf, -10%
C-106	22041-1	Capacitor, Ceramic Variable, 2-8 pf, NPO
C-107	21291-14	Capacitor, Ceramic Disc., 100 pf, +10%
C-108	24516-229	Capacitor, Ceramic Disc., 2.2 pf, 25 pf, NPO
C-109	21291-21	Capacitor, Ceramic Disc., 1K pf, -20%
C-110	24516-689	Capacitor, Ceramic Disc., 6.8 pf,5 pf, NPO
C-111	24516-150	Capacitor, Ceramic Disc., 15 pf, +10%, NPO
C-112	24515-9	Capacitor, Ceramic Disc., 01uf, 50V
C-113	24515-9	Capacitor, Ceramic Disc., .01uf, 50V
C-114	24516-150	Capacitor, Ceramic Disc., 15 pf, -10%, NPO
C-115	24515-9	Capacitor, Ceramic Disc., .01uf, 50V
C-116	24515-9	Capacitor, Ceramic Disc., .01uf, 50V
C-117	24516-150	Capacitor, Ceramic Disc., 15 pf, -10%, NPO
C-118	24515-9	Capacitor, Ceramic Disc., .01uf, 50V
C-119	24515-9	Capacitor, Ceramic Disc., .01uf, 50V
C-120	24509-518	Capacitor, Ceramic Tub., .51pf, -5%
C-121	24515-9	Capacitor, Ceramic Disc., .01uf, 50V
C-122	21291-11	Capacitor, Ceramic Disc., 200 pf, -10%
C-123	24515-9	Capacitor, Ceramic Disc., .01uf, 50V
C-124	24515-9	Capacitor, Ceramic Disc., .01uf, 50V
C-125	24515-9	Capacitor, Ceramic Disc., .01uf, 50V
C-126	21291-21	Capacitor, Ceramic Disc., 1K pf, -20%
C-127	21555-26	Capacitor, Tantalum, 10uf, -10%, 20V
C-128	21201-330	Capacitor, Ceramic Tub., 33 pf, -10%, NPO
C-129	21291-21	Capacitor, Ceramic Disc., 1K pf, -20%
C-130	24528-479	Capacitor, Ceramic Disc., 4.7 pf,5pf, N750
		. (4.) 이 등록 하다 있는데 이 시간에 이 없는데 이 생활을 받으면 하는데 하지 않는데 하지 않는데 하는데 하다 하다 되었다.

SYMBOL	NARCO PART NO.	DESCRIPTION
		C, CAPACITORS (Continued)
Q 101	0451 0 990	Capacitor, Ceramic Disc., 2.2 pf, + 25 pf, NPO
C-131	24516-229	Capacitor, Ceramic Disc., 470 pf, +20%
C-132	21291-7	Capacitor, Ceramic Disc., 200 pf, +10%
C-133	21291-11	Capacitor, Ceramic Disc., 3.3 pf,25 pf, NPO
C-134	24516-339	Capacitor, Feedthru, 1K pf
C-135	21298-1	Capacitor, reedim u, in pr
C-136	21298-1	Capacitor, Feedthru, 1K pf
C-137	21298-1	Capacitor, Feedthru, 1K pf
C-138	21298-1	Capacitor, Feedthru, 1K pf
C-139	21298-1	Capacitor, Feedthru, 1K pf
C-140	21298-1	Capacitor, Feedthru, 1K pf
C-141	21298-1	Capacitor, Feedthru, 1K pf
C-142	21298-1	Capacitor, Feedthru, 1K pf
C-143	24516-180	Capacitor, Ceramic Disc., 18 pf, -10%, NPO
C-144	21291-11	Capacitor, Ceramic Disc., 200 pf, 10%
C-145	21291-11	Capacitor, Ceramic Disc., 200 pf, -10%
0 110		
C-146	21555-26	Capacitor, Tantalum, 10uf, -10%, 20V
C-147	24515-7	Capacitor, Ceramic Disc., .05uf, 20V
C-148	21298-1	Capacitor, Feedthru, 1K pf
C-149	21298-1	Capacitor, Feedthru, 1K pf
C-150	21298-1	Capacitor, Feedthru, 1K pf
		O U D W W IV of
C-151	21298-1	Capacitor, Feedthru, 1K pf
C-152	21298-1	Capacitor, Feedthru, 1K pf
C-153	21298-1	Capacitor, Feedthru, 1K pf
C-154	21298-1	Capacitor, Feedthru, 1K pf
C-155	21298-1	Capacitor, Feedthru, 1K pf
C-156	21298-1	Capacitor, Feedthru, 1K pf
C-157	21298-1	Capacitor, Feedthru, 1K pf
C-159	24516-689	Capacitor, Ceramic Disc., 6.8 pf, - 5 pf, NPO
C-160	24516-569	Capacitor, Ceramic Disc., 5.6 pf,5 pf, NPO
C-161	24037-9	Capacitor, Fixed Mica, 50 pf, -10%
C-162	24037-9	Capacitor, Fixed Mica, 50 pf, -10%
C-164	24515-7	Capacitor, Ceramic Disc., .05uf, 20V

	NARCO	
SYMBOL	PART NO.	DESCRIPTION
		C, CAPACITORS (Continued)
C-301	21555-26	Capacitor, Tantalum, 10uf, +10%, 20V
C-302	21555-26	Capacitor, Tantalum, 10uf, +10%, 20V
C-303	21555-11	Capacitor, Tantalum, 39uf, -10%, 20V
C-304	23094-175	Capacitor, Met. Mylar, .10uf, 10%, 200V
C-305	23085-SEL.	Capacitor, Mylar SEL., 100V, -10%
C-306	23085-81	Capacitor, Mylar, .33uf, 100V,5%
C-307	23085-SEL.	Capacitor, Mylar SEL., 100V, -10%
C-308	21554-20	Capacitor, Electrolytic, 500uf, 3V NPO
C-309	21555-11	Capacitor, Tantalum, 39uf, -10%, 10V
C-310	21554-15	Capacitor, Electrolytic, 150uf, 3V
C-311	21554-4	Capacitor, Electrolytic, 100uf, 30V
C-312	21554-13	Capacitor, Electrolytic, 500uf, 15V
C-313	21554-3	Capacitor, Electrolytic, 200uf, 15V
C-401	24522-1	Capacitor, Ceramic 8 Section
C-402	24522-1	Capacitor, Ceramic 8 Section
C-403	21291-21	Capacitor, Ceramic Disc., 1K pf, -20%
C-519	22041-4	Capacitor, Ceramic Variable, 5.5-18 pf, 200V, NPO
C-601	21296-3	Capacitor, Feedthru, 1K pf
C-602	21296-3	Capacitor, Feedthru, 1K pf
C-603	21564-47	Capacitor, Tantalum, 15uf, -20%, 20V
C-604	21291-21	Capacitor, Ceramic Disc., 1K pf20%
C-605	24052-270	Capacitor, Mica Dipped, 27 pf, -5%
C-606	21291-21	Capacitor, Ceramic Disc, 1K pf, -20%
C-607	21296-3	Capacitor, Feedthru, 1K pf
C-608	21296-3	Capacitor, Feedthru, 1K pf
C-609	21296-3	Capacitor, Feedthru, 1K pf
C-610	21296-3	Capacitor, Feedthru, 1K pf
C-611	24052-470	Capacitor, Mica Dipped, 47 pf, +5%

SYMBOL	NARCO PART NO.	DESCRIPTION
		CR, DIODES
CR-101	75011-1	Diode, Germanium
CR-102	75011-1	Diode, Germanium
CR-103	75025-12	Diode, Zener, 10.0V, -2%, 1W
CR-109	75204-45	Diode, Silicon, 500 PIV, 750ma
CR-110	75038-2	Diode, RF Switch
CR-111	75038-2	Diode, RF Switch
CR-112	75038-2	Diode, RF Switch
CR-113	75038-2	Diode, RF Switch
CR-114	75038-2	Diode, RF Switch
CR-301	75028-1	Diode, Silicon
CR-302	75014-1	Diode, Germanium
CR-303	75014-1	Diode, Germanium
CR-304	75014-1	Diode, Germanium
CR-305	75014-1	Diode, Germanium
CR-601	75028-1	Diode, Silicon
CR-602	75028-1	Diode, Silicon
CR-603	75028-1	Diode, Silicon
CR-604	75028-1	Diode, Silicon
CR-605	75028-1	Diode, Silicon
CR-606	75028-1	Diode, Silicon
CR-607	75027-11	Diode, Zener
CR-608	75038-2	Diode, R.F. Switch
CR-609	75038-2	Diode, R.F. Switch
CR-610	75028-1	Diode, R. F. Switch
CR-611	75028-1	Diode, Silicon
CR-612	75028-1	Diode, Silicon
CR-613	75028-1	Diode, Silicon
CR-614	75028-1	Diode, Silicon
CR-615	75028-1	Diode, Silicon
CR-616	75038-2	Diode, R.F. Switch
CR-617	75038-2	Diode, R.F. Switch
CR-618	75038-2	Diode, R.F. Switch
CR-619	75038-2	Diode, R. F. Switch

	NARCO	
SYMBOL	PART NO.	DESCRIPTION
		J, CONNECTORS
J-101	41153-6	Jack, Coaxial, BNC
J-102	41285-5	Connector, Chassis 24 Terminals
		L, INDUCTORS
L-101	11516-2	Coil, UHF
L-102	11516-2	Coil, UHF
L-103	11516-1	Coil, UHF
L-104	11138-11	Choke, R. F., 3.3uh, +10%
L-105	11138-19	Choke, R.F., 15uh, -10%
L-111	11138-15	Choke, R. F., 6.8uh, +10%
L-112	11138-3	Choke, R.F., .22uh, -20%
L-113	11517-1	Coil, H. F.O., 75MHz
L-114	11138-2	Choke, R.F., 15uh, -20%
L-115	11518-1	Coil, Doubler, 150MHz
L-116	11518-1	Coil, Doubler, 150MHz
L-117	11522-1	Coil, Air, Filter
L-118	11485-9	Choke, R.F., .47uh, $\frac{+}{+}10\%$
L-119	11138-9	Choke, R.F., 2.2uh, -10%
L-120	11138-9	Choke, R.F., 2.2uh, -10%
L-121	11138-9	Choke, R. F., 2.2uh, $\frac{+}{1}$ 10%
L-122	11138-9	Choke, R.F., 2.2uh, -10%
L-123	11138-9	Choke, R.F., 2.2uh, -10%
L-506	11485-1	Choke, R.F., 0.1uh, -10%
L-601	11138-19	Choke, R. F., 15uh, -10%
L-602	11451-11	Choke, R. F., 2. 2uh, $\frac{1}{7}10\%$
L-603	11451-17	Choke, R. F., 6.8uh, -10%
L-604	11451-17	Choke, R. F., 6.8uh, $\frac{+10\%}{-10\%}$
L-605	11451-17	Choke, R.F., 6.8uh, -10%
L-606	11451-17	Choke, R. F., 6.8uh, +10%

	NARCO	DECODIDEION
SYMBOL	PART NO.	DESCRIPTION
		Q, TRANSISTORS*
Q-101	75561-5	Transistor, Germanium, 2N2496, PNP
Q-102	75561-5	Transistor, Germanium, 2N2496, PNP
Q-103	75533-1	Transistor, Germanium, 2N2089, PNP
Q-104	75533-1	Transistor, Germanium, 2N2089, PNP
Q-105	75533-1	Transistor, Germanium, 2N2089, PNP
Q-106	75533-1	Transistor, Germanium, 2N2089, PNP
Q-107	75550-7	Transistor, Silicon, 2N3391, NPN
Q-108	75561-9	Transistor, Germanium, 2N2654, PNP
Q-109	75556-2	Transistor, Germanium
Q-301	75535-1	Transistor, Germanium, 2N2613, PNP
Q-302	75550-7	Transistor, Silicon, 2N3391, NPN
Q-303	75561-8	Transistor, Silicon, 2N4037, PNP
Q-304	75550-7	Transistor, Germanium, 2N3391, NPN
Q-305	75561-6	Transistor, Silicon, 2N404A, NPN
Q-601	75561-31	Transistor, Silicon, PN4258, PNP

^{*}Substitute Transistors are not acceptable.

R, RESISTORS

R-101	31192-821	Resistor, Carbon, 820, +10%, 1/4V	
R-102	31192-101	Resistor, Carbon, 100, -10%, 1/4W	
R-103	31192-471	Resistor, Carbon, 470, -10%, 1/4W	
R-104	31192-222	Resistor, Carbon, 2.2K, -10%, 1/4W	
R-105	31192-101	Resistor, Carbon, 100, -10%, 1/4W	7
R-106	31192-122	Resistor, Carbon, 1.2K, -10%, 1/4W	
R-107	31192-101	Resistor, Carbon, 1.2K, + -10%, 1/4W Resistor, Carbon, 100, -10%, 1/4W	
R-108	31192-122	Resistor, Carbon, 1.2K, +10%, 1/4W	
R-109	31192-223	Resistor, Carbon, 22K, -10%, 1/4W	
R-110	31192-562	Resistor, Carbon, 5.6K, -10%, 1/4W	
R-111	31192-122	Resistor, Carbon, 1.2K, +10%; 1/4W Resistor, Carbon, 10K, -10%, 1/4W	
R-112	31192-103	Resistor, Carbon, 10K, -10%, 1/4W	
R-113	31192-152	Resistor, Carbon, 1.5K, -10%, 1/4W	
R-114	31192-391	Resistor, Carbon, 1.5K, -10%, 1/4W Resistor, Carbon, 390, -10%, 1/4W	
R-115	31192-471	Resistor, Carbon, 470, -10%, 1/4W	

	NARCO	
SYMBOL	PART NO.	DESCRIPTION
		R, RESISTORS (Continued)
R-116	31192-221	Resistor, Carbon, 220, -10%, 1/4W
R-117	31192-103	Resistor, Carbon, 10K, -10%, 1/4W
R-118	31192-682	Resistor, Carbon, 6.8, +10%, 1/4W
R-119	31192-183	Resistor, Carbon, 18K, -10%, 1/4W
R-120	31141-330	Resistor, Carbon, 33, -10%, 1/2W
R-121	31192-393	Resistor, Carbon, 39K, +10%, 1/4W
R-122	31192-103	Resistor, Carbon, 10K, +10%, 1/4W
R-123	31192-561	Resistor, Carbon, 1K, +10%, 1/4W
R-124	31192-471	Resistor, Carbon, 560, -10%, 1/4W
R-125	31192-221	Resistor, Carbon, 220, -10%, 1/4W
R-126	31192-223	Resistor, Carbon, 22K, +10%, 1/4W
R-127	31192-181	Resistor, Carbon, 180, -10%, 1/4W
R-128	31192-122	Resistor, Carbon, 1.2K, -10%, 1/4W
R-301	31195-SEL.	Resistor, Carbon, SEL., +5%, 1/4W
R-302	31195-751	Resistor, Carbon, 750, -5%, 1/4W
R-303	31192-822	Resistor, Carbon, 8.2K, -10%, 1/4W
R-304	31192-181	Resistor, Carbon, 180, -10%, 1/4W
R-305	31192-472	Resistor, Carbon, 4.7K, -10%, 1/4W
R-306	32047-4	Potentiometer, Carbon, 1,5K, -30%
R-307	31192-222	Resistor, Carbon, 2.2K, -10%, 1/4W
R-308	31192-683	Resistor, Carbon, 68K, +10%, 1/4W
R-309	31192-473	Resistor, Carbon, 47K, +10%, 1/4W
R-310	31192-101	Resistor, Carbon, 100, -10%, 1/4W
R-311	32045-7	Resistor, Variable, 100, +20%, 2W
R-312	31192-222	Resistor, Carbon, 2.2K, +10%, 1/4W
R-313	31192-152	Resistor, Carbon, 1.5K, -10%, 1/4W
R-314	31192-101	Resistor, Carbon, 100, -10%, 1/4W
R-315	31205-4	Resistor, Thermistor, 128.8, -10%, 1W
R-316	31192-470	Resistor, Carbon, 47, -10%, 1/4W
R-317	31192-471	Resistor, Carbon, 470, -10%, 1/4W
R-318	32045-8	Resistor, Variable, 500, 20%, 2W
R-319	31195-222	Resistor, Carbon, 2.2K, +5%, 1/4W
R-320	31195-182	Resistor, Carbon, 1.8K, -5%, 1/4W
The state of the		

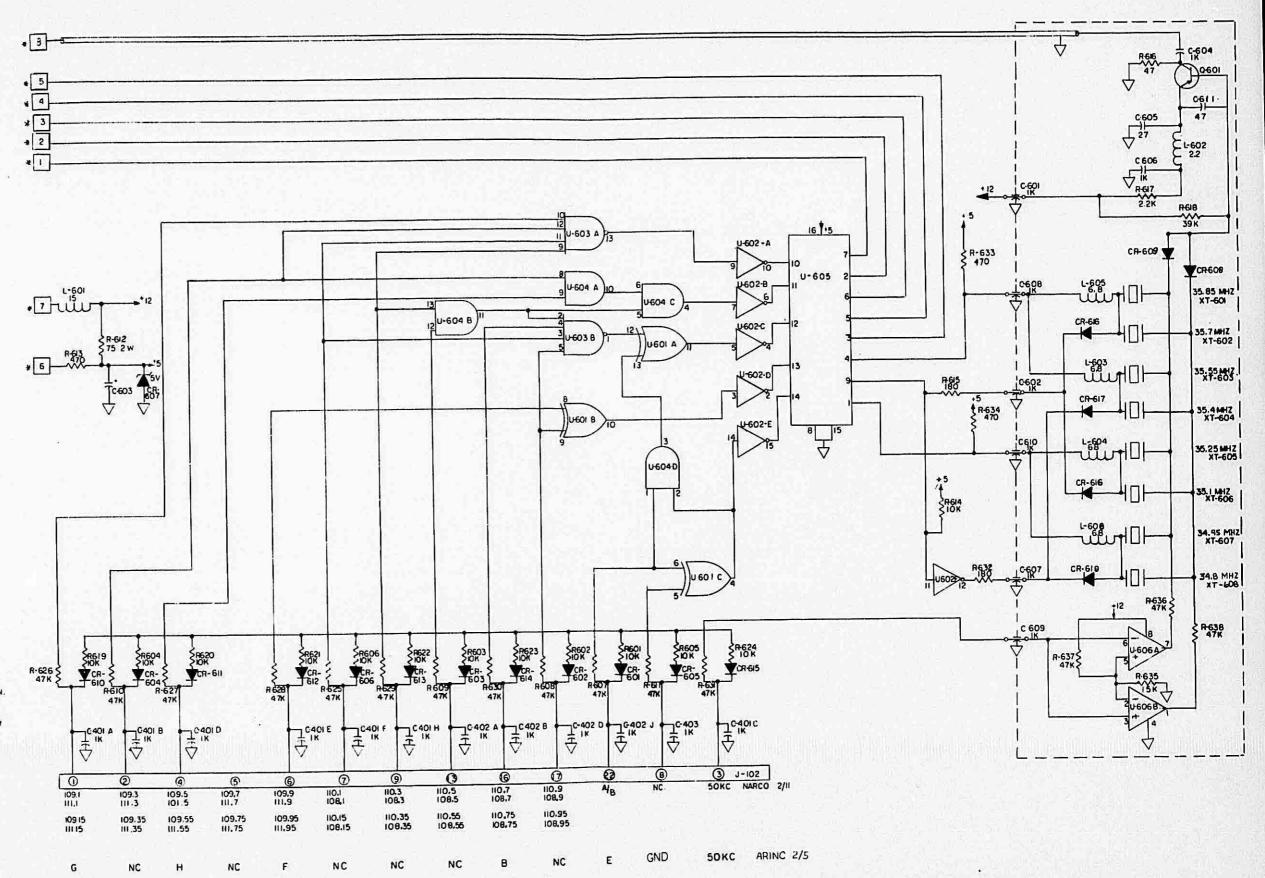
R-321 31192-471 Resistor, Carbon, 470, \(\frac{+}{1}0\)%, 1/4W R-322 31192-471 Resistor, Carbon, 470, \(\frac{+}{1}0\)%, 1/4W R-323 31125-829 Resistor, Carbon, 8.2, \(\frac{-}{1}0\)%, 1W R-324 31189-3 Resistor, Wirewound, 75, \(\frac{+}{5}\)%, 5W R-325 31151-241 Resistor, Carbon, 240, \(\frac{+}{5}\)%, 2W R-326 31192-220 Resistor, Carbon, 22, \(\frac{+}{1}0\)%, 1/4W	inued)
R-321 31192-471 Resistor, Carbon, 470, $\frac{+}{1}$ 10%, 1/4W R-322 31192-471 Resistor, Carbon, 470, $\frac{+}{1}$ 10%, 1/4W R-323 31125-829 Resistor, Carbon, 8.2, -10%, 1W R-324 31189-3 Resistor, Wirewound, 75, $\frac{+}{5}$ 5%, 5W R-325 31151-241 Resistor, Carbon, 240, $\frac{+}{5}$ 5%, 2W R-326 31192-220 Resistor, Carbon, 22, $\frac{+}{4}$ 10%, 1/4W	inued)
R-322 31192-471 Resistor, Carbon, 470, -10%, 1/4W R-323 31125-829 Resistor, Carbon, 8.2, -10%, 1W R-324 31189-3 Resistor, Wirewound, 75, -5%, 5W R-325 31151-241 Resistor, Carbon, 240, -5%, 2W R-326 31192-220 Resistor, Carbon, 22, +10%, 1/4W	
R-322 31192-471 Resistor, Carbon, 470, -10%, 1/4W R-323 31125-829 Resistor, Carbon, 8.2, -10%, 1W R-324 31189-3 Resistor, Wirewound, 75, -5%, 5W R-325 31151-241 Resistor, Carbon, 240, -5%, 2W R-326 31192-220 Resistor, Carbon, 22, +10%, 1/4W	
R-322 31192-471 Resistor, Carbon, 470, -10%, 1/4W R-323 31125-829 Resistor, Carbon, 8.2, -10%, 1W R-324 31189-3 Resistor, Wirewound, 75, -5%, 5W R-325 31151-241 Resistor, Carbon, 240, -5%, 2W R-326 31192-220 Resistor, Carbon, 22, +10%, 1/4W	
R-324 31189-3 Resistor, Wirewound, 75, -5%, 5W R-325 31151-241 Resistor, Carbon, 240, -5%, 2W R-326 31192-220 Resistor, Carbon, 22, +10%, 1/4W	
R-324 31189-3 Resistor, Wirewound, 75, -5%, 5W R-325 31151-241 Resistor, Carbon, 240, -5%, 2W R-326 31192-220 Resistor, Carbon, 22, +10%, 1/4W	
R-325 31151-241 Resistor, Carbon, 240, -5%, 2W R-326 31192-220 Resistor, Carbon, 22, +10%, 1/4W	
R-326 31192-220 Resistor, Carbon, 22, $\frac{+}{+}$ 10%, 1/4W	
11-020 01102 220 11001011,, +,	
R-327 31192-330 Resistor, Carbon, 33, -10%, 1/4W	
R-328 31192-394 Resistor, Carbon, 390K, +10%, 1/4W	
R-329 31192-154 Resistor, Carbon, 150K, -10%, 1/4W	
R-330 31205-3 Resistor, Thermistor, 48.2K, -10%, 360n	nw
R-601 31218-103 Resistor, Carbon, 10K, +5%, 1/4W	
R-602 31218-103 Resistor, Carbon, 10K, -5%, 1/4W	
R-603 31218-103 Resistor, Carbon, 10K, $\pm 5\%$, 1/4W	
R-604 31218-103 Resistor, Carbon, 10K, -5%, 1/4W	
R-605 31218-103 Resistor, Carbon, 10K, -5%, 1/4W	
R-606 31218-103 Resistor, Carbon, 10K, $\pm 5\%$, 1/4W	
R-607 31218-473 Resistor, Carbon, 47K, ±5%, 1/4W	
R-608 31218-473 Resistor, Carbon, 47K, +5%, 1/4W	
R-609 31218-473 Resistor, Carbon, 47K, ±5%, 1/4W	
R-610 31218-473 Resistor, Carbon, 47K, -5%, 1/4W	
R-611 31218-103 Resistor, Carbon, 10K, -5%, 1/4W	
R-612 31161-10 Resistor, Wire Wound, 75, -5%, 3W	
R-613 31218-471 Resistor, Carbon, 470, -5%, 1/4W	
R-614 31218-103 Resistor, Carbon, 10K, -5%, 1/4W	
R-615 31218-181 Resistor, Carbon, 180, -5%, 1/4W	
R-616 31218-470 Resistor, Carbon, 47, -5%, 1/4W	
R-617 31218-222 Resistor, Carbon, 2.2K, -5%, 1/4W R-618 31218-393 Resistor, Carbon, 39K, -5%, 1/4W R-619 31218-103 Resistor, Carbon, 10K, -5%, 1/4W	
R-618 31218-393 Resistor, Carbon, 39K, -5%, 1/4W	
R-619 31218-103 Resistor, Carbon, 10K, -5%, 1/4W	
R-620 31218-103 Resistor, Carbon, 10K, -5%, 1/4W	
R-621 31218-103 Resistor, Carbon, 10K, +5%, 1/4W	
R-621 31218-103 Resistor, Carbon, 10K, -5%, 1/4W	
R-622 31218-103 Resistor, Carbon, 10K, -5%, 1/4W	
R-623 31218-103 Resistor, Carbon, 10K, -5%, 1/4W	
R-624 31218-103 Resistor, Carbon, 10K, +5%, 1/4W	
R-625 31218-473 Resistor, Carbon, 47K, -5%, 1/4W	

	NARCO	
SYMBOL	PART NO.	DESCRIPTION
		R, RESISTORS (Continued)
R-626	31218-473	Resistor, Carbon, 47K, +5%, 1/4W
R-627	31218-473	Resistor, Carbon, 47K, +5%, 1/4W
R-628	31218-473	Resistor, Carbon, 47K, +5%, 1/4W
R-629	31218-473	Resistor, Carbon, 47K, +5%, 1/4W
R-630	31218-473	Resistor, Carbon, 47K, +5%, 1/4W
R-631	31218-473	Resistor, Carbon 47K +5% 1/4W
R-632	31218-181	Resistor, Carbon, 47K, +5%, 1/4W Resistor, Carbon, 180, +5%, 1/4W
R-633	31218-471	Resistor, Carbon, 470, +5%, 1/4W
R-634	31218-471	Resistor, Carbon, 470, 75%, 1/4W
R-635	31218-153	Resistor, Carbon, 15K, -5%, 1/4W
R-636	31218-473	Resistor, Carbon, 47K, +5%, 1/4W
R-637	31218-473	Resistor, Carbon, 47K, 5%, 1/4W
R-638	31218-473	Resistor, Carbon, 47K, -5%, 1/4W
		T, TRANS FORMERS
T-101	11515-1	Transformer, HF IF, 27.9MHz
T-102	11514-1	Transformer, LF IF, 7.35MHz
T-103	11514-1	Transformer, LF IF, 7.35MHz
T-104	11514-1	Transformer, LF IF, 7.35MHz
T-105	11513-1	Transformer, LF IF, Output 7.35MHz*
T-301	11679-1	Transformer, Glideslope P.C.
T-302	11679-1	Transformer, Glideslope P.C.
	*Transform C-124, C- R-117 and	ner only: does not include C-121, C-122, C-123, 125, C-126, C-146, CR-101, CR-102, R-116, R-118.

U, INTEGRATED CIRCUITS

U-601	74089-1	I.C. Quad Exclusive OR Gate (4070)
U-602	74110-1	I.C. Hex Buffer (4049)
U-603	74115-1	I.C. Dual 4 Input Pos. NAND Gate (4012)
U-604	74091-1	I. C. Quad AND Gate (4081)
U-605	74102-8	I.C. Prom Tristate Output (82S123)
U-606	74127-1	I.C. Comparator, Voltage Dual (LM2903)

Grandor	NARCO	DESCRIPTION
SYMBOL	PART NO.	
		XT CRYSTALS
XT-101	72028-4	Crystal, Series Mode, 5th 76,3625MHz
XT-102	72028-3	Crystal, Series Mode, 5th 76.0625MHz
XT-103	72028-1	Crystal, Series Mode, 5th 75,4625MHz
XT-104	72028-2	Crystal, Series Mode, 5th 75.7625MHz
XT-105	72028-5	Crystal, Series Mode, 5th 76.6625MHz
XT-601	72028-13	Crystal, Quartz, 35.85MHz
XT-602	72028-9	Crystal, Parallel Mode, 3rd, 35.7MHz
XT-603	72028-12	Crystal, Quartz, 35,55MHz
XT-604	72028-8	Crystal, Parallel Mode, 3rd, 35,4MHz
XT-605	72028-11	Crystal, Quartz, 35.25MHz
XT-606	72028-7	Crystal, Parallel Mode, 3rd, 35.1MHz
XT-607	72028-10	Crystal, Quartz, 34.9MHz
XT-608	72028-6	Crystal, Parallel Mode, 3rd, 34.8MHz



MOTES:

UNLL RESISTORS ARE 1/4 W2 5% UNLESS OTHERWISE SPECIFIED.

20 K DENOTES ONE THOUSAND, M DENOTES ONE MILLION.

30 ALL INDUCTORS ARE IN MICRO - HENRIES.

4) ALL CAPICTORS ARE IN PICO FARADS.

5) NUMBERS IN SQUARES ARE FOR REFERENCE ONLY. - #

FIGURE 8-6.1 GLIDE SLOPE MATRIX AND LFO SCHEMATIC DIAGRAM

TEST DATA

DC VOLTS (350W STANDARD CENTERING SIGNAL) DC VOLTS (NO SIGNAL)

AC VOLTS (350 NY STANDARD CENTERING SIGNAL) GROUND(REF)

AC VOLTS (350 UV STANDARD CENTERING SIGNAL) JIOZ 18 (REF)

TEST DATA NOTES

I-ALL DC MEASUREMENTS MADE WITH HEA VOLTOHMYST VIVM OR EQUIVALENT. 2-ALL AC MEASUREMENTS MADE WITH BALLANTINE AC VIVM OR EQUIVALENT 3-ALL MEASUREMENTS MADE WITH CHANNEL SELECTOR ON 109.3 (332.0)

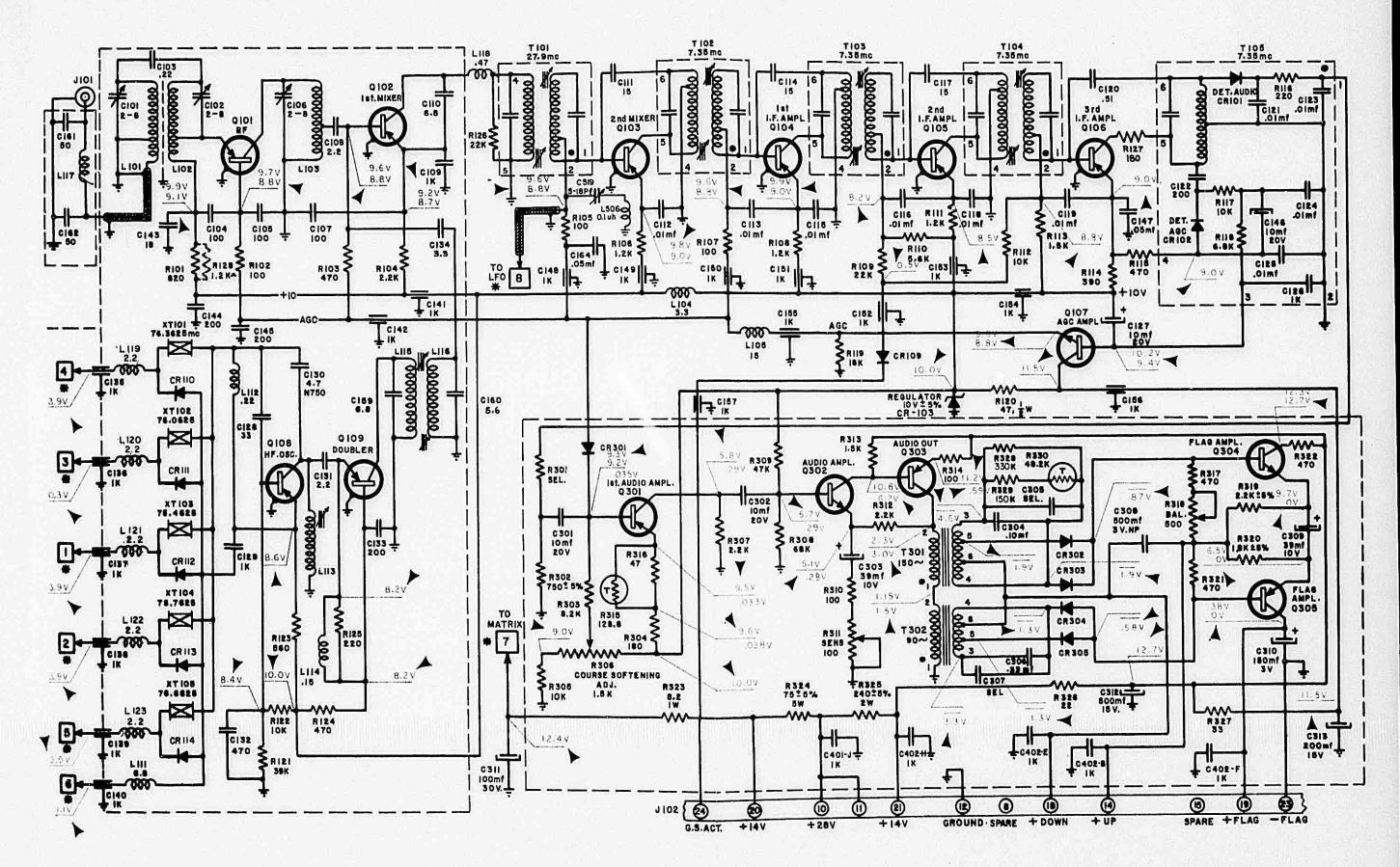


FIGURE 8-6.2 RECEIVER SECTION SCHEMATIC DIAGRAM

8-29(8-30 Blank) JAN, 1977

ING SIGNAL)

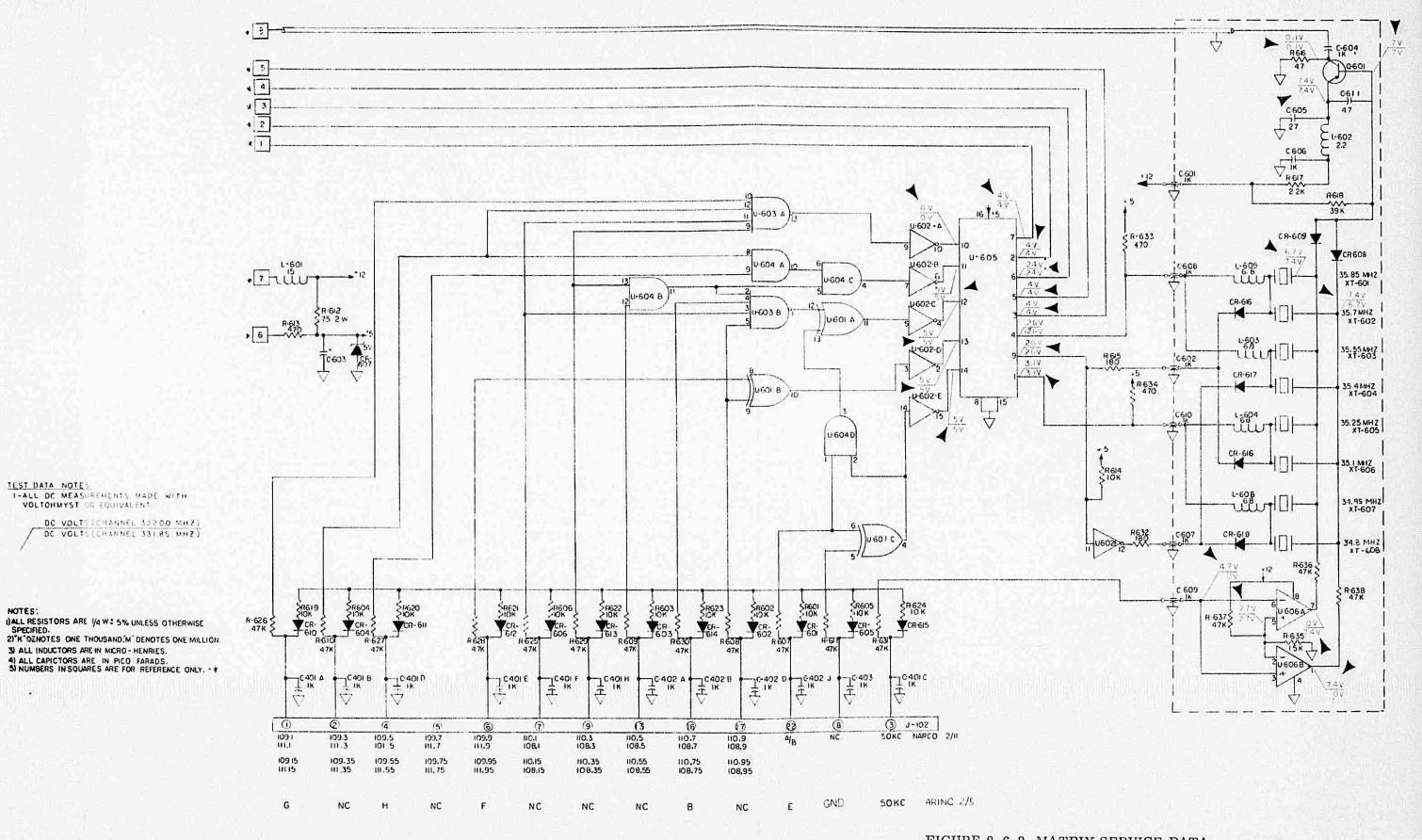
ING SIGNAL) GROUND (REF)

ING SIGNAL) JIO2 18 (REF)

CA VOLTOHMYST VIVM OR EQUIVALENT.

BALLANTINE AC VIVI OR EQUIVALENT.

THEL SELECTOR ON 109.3 (332.0)



TEST DATA NOTES.

1-ALL DC MEASUREMENTS MADE WITH VOLTOHMYST OR EQUIVALENT.

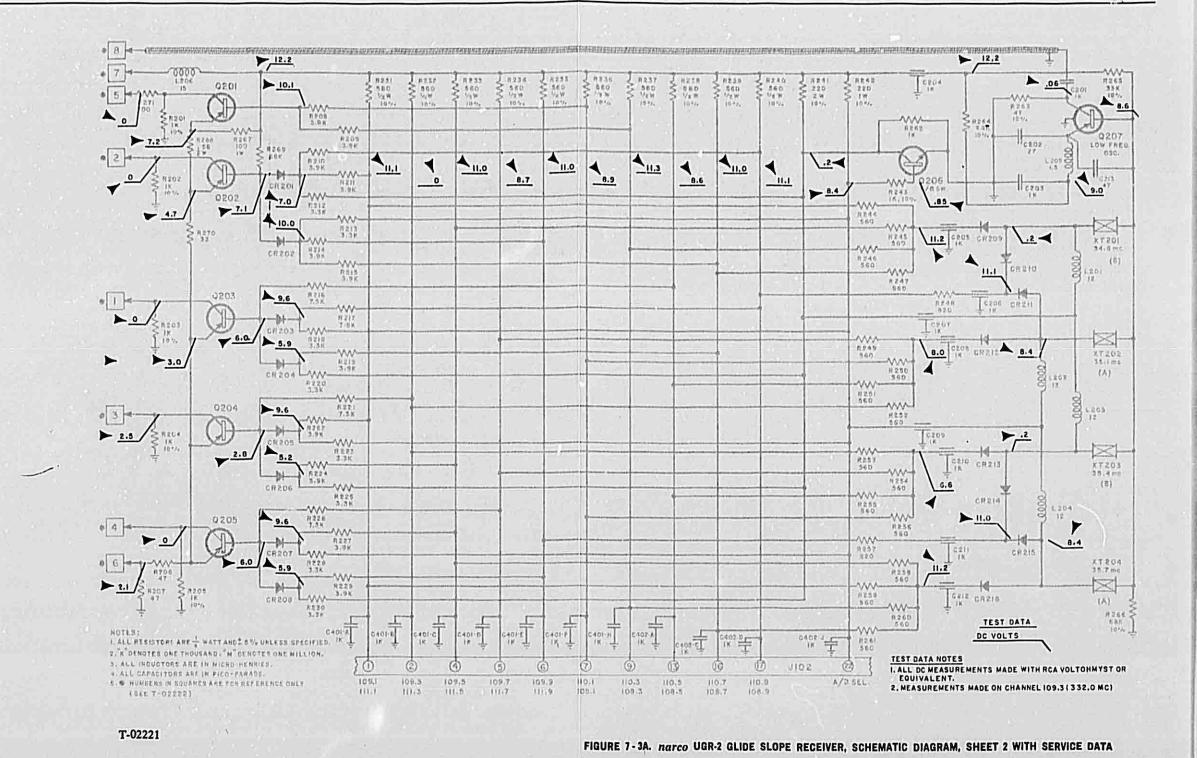
NOTES:

DC VOLTS (CHANNEL 33200 MHZ) DC VOLTS (CHANNEL 331.85 MHZ)

FIGURE 8-6.3 MATRIX SERVICE DATA

8-31(8-32 Blank) JAN. 1977

7-9

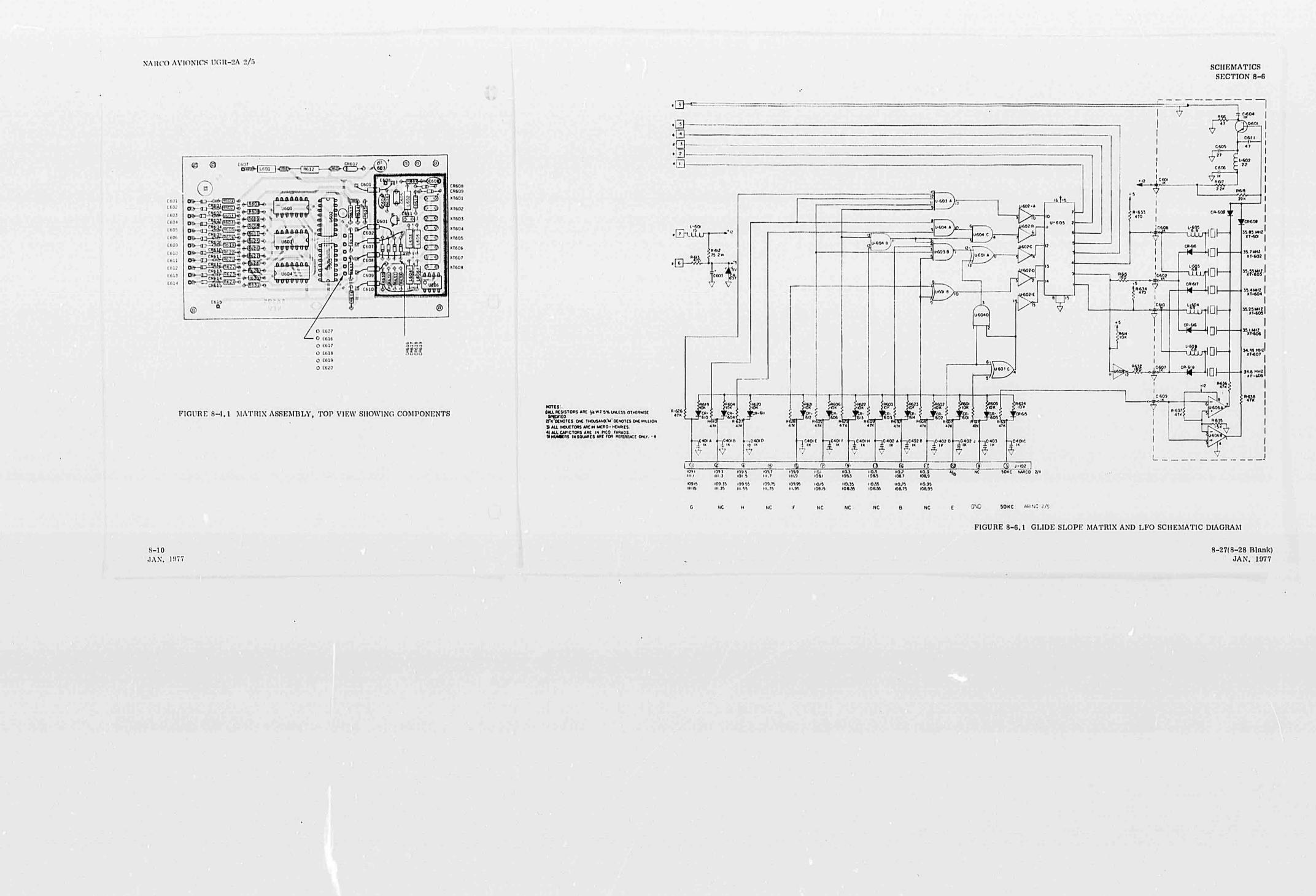


SCIEMATICS
BECTION 8-6

BECTION

VICE DATA

8-31(8-32 Blank) JAN. 1977



TEST DATA

DE VOLTS (350AV STANDARD CENTERING SIGNAL)

DE VOLTS (NO SIGNAL)

AC VOLTS (350AV ETANDARD CENTERING SIGNALI GROUND(REF)

AC VOLTS (350AV STANDARD CENTERING SIGNALI JIOZ IRREF)

SALE OF DESCRIPTIONS WAS A WITH BCA VOLTOHINGS VIVID OR FOUNDATION.

JUNEAU AL MEASUREMENTS MADE WITH BALLANTINE ACTIVE OR IQUIVALENT.

JUNEAU MEASUREMENTS WAS A WITH HANNES SELECTED ON 109 3 (332.0).

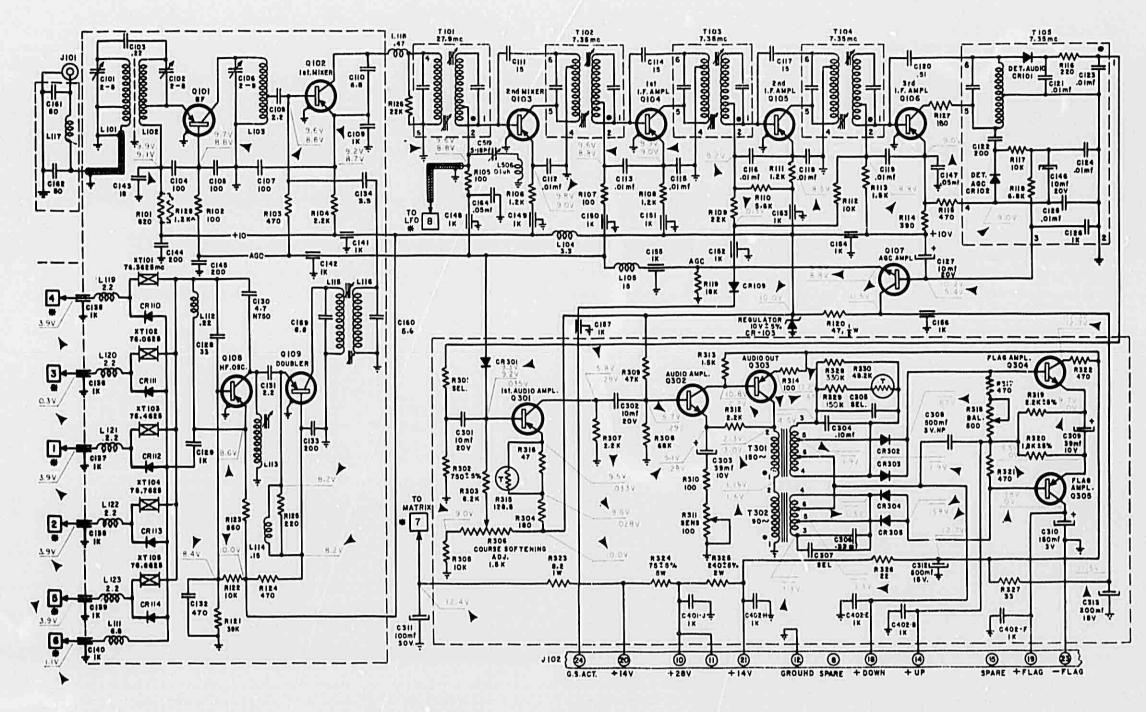


FIGURE 8-6,2 RECEIVER SECTION SCHEMATIC DIAGRAM

8-29(8-30 Blank) JAN, 1977

MODIFICATION INSTRUCTIONS — 03502-0670

ALIGNMENT PROCEDURE

It is necessary to realign the intermediate frequency from 7.35 MHz to 7.5 MHz. This is accomplished as follows: Refer to Figure 7

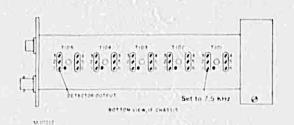


FIGURE 7

- 1. Connect AC VTVM and oscilloscope to Terminal 1 of T105.
- 2. Connect the RF signal generator to the base of Q103 at Terminal 1 of T101 through a .01 mfd capacitor with a 47 ohm resistor to ground on the generator side of the capacitor. Set the generator to 7.5 MHz modulated 30% by 1000 Hz. Set the input voltage to 13.75 or 27.5 volts per cable wiring.
- 3. Tune T102, T103, and T104 for maximum output, keeping the generator output set for approximately 0.1 volts AC detector output.
- 4. Tune T105 for maximum output.
- 5. Connect 100 ohm resistors between Terminals 5 and 6 of T102, T103, and T104. Tune the secondary slugs (slugs away from the chassis) of T104, T103, and T102 on outer peaks for maximum detector output. The generator output should be set to keep the detector level at approximately .05 volts AC. A very high signal input may be required initially to align the IF.
- 6. Tune T105 for maximum output using the peak having the slug closer to the chassis.
- Remove the 100 ohm resistors and connect them between Terminals 1 and 2 of T102, 103, T104. Tune the primaries (slug nearest chassis) on outer peaks for maximum detector

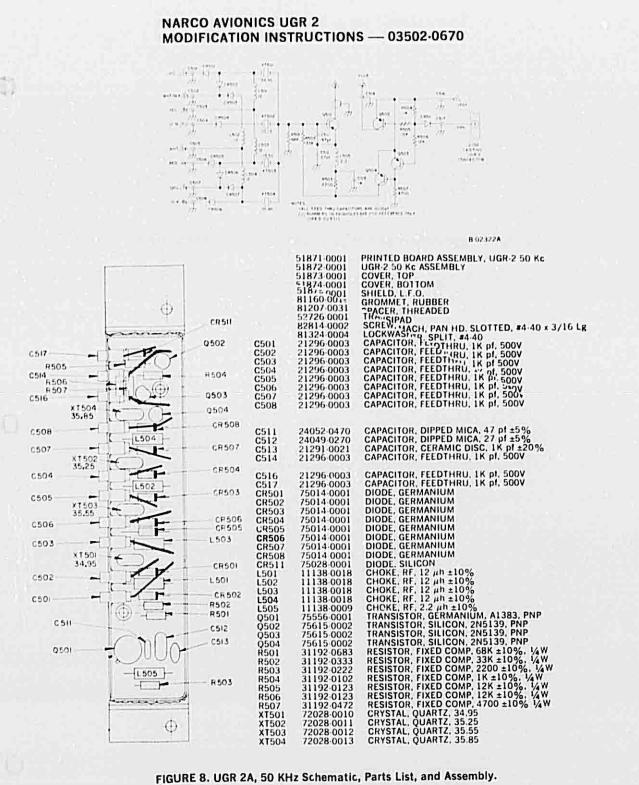
- 8. Remove the 100 ohm resistors.
- Check gain. 8μν maximum should produce 0.1 volts AC detector output.
- 9a. Set the channel selector to 110.70 MHz (330.20 MHz).
- 9b. Connect a VTVM to T105, pin 1. 9c. Set VTVM to measure positive DC volts.
- 9d. With no signal applied to the UGR 2A, adjust C519 for minimum DC voltage.
- 10. Install the new UGR 2A label (P/N 04429-0001) over the present label.
- 11. Check that all hardware that was removed has been replaced and secure.

PERFORMANCE TEST

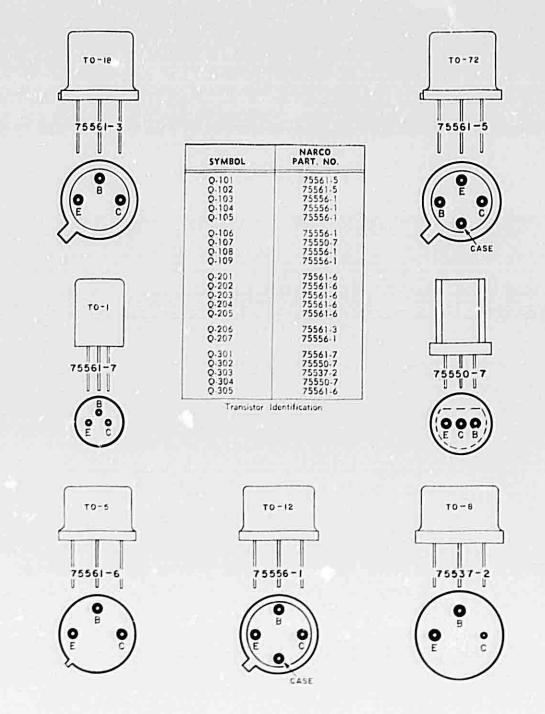
The test set-up used to check the UGR 2 should be modified to include a grounding provision for Pin 3 of the rear connector. In all 100 KHz Localizer channels, Pin 3 is not grounded. In all 50 KHz positions, Pin 3 is grounded. After these modifications have been made to the UGR 2 set-up, performance testing may proceed as given in Section 5-9 of the Maintenance Manual.

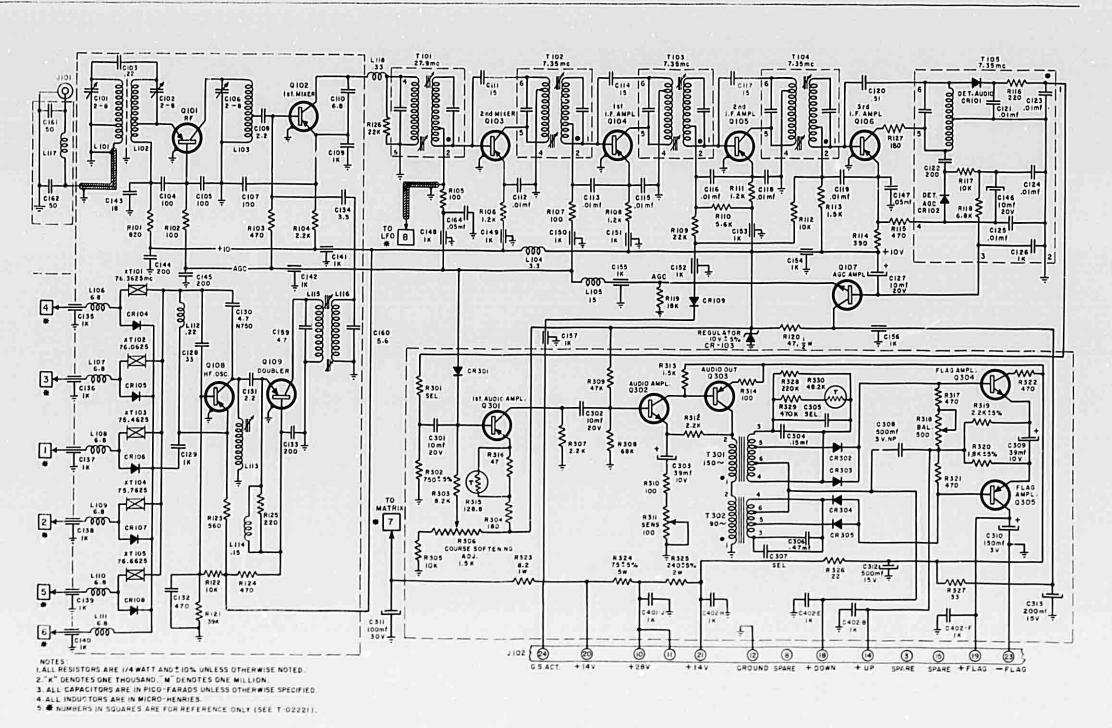
Table 1 of this instruction gives the Localizer/Glide Slope Paired Channels.

Table 2 of this instruction gives information showing the LFO, Localizer & HFO frequencies over the complete Glide Slope frequency band and is given as a trouble-shooting aid.



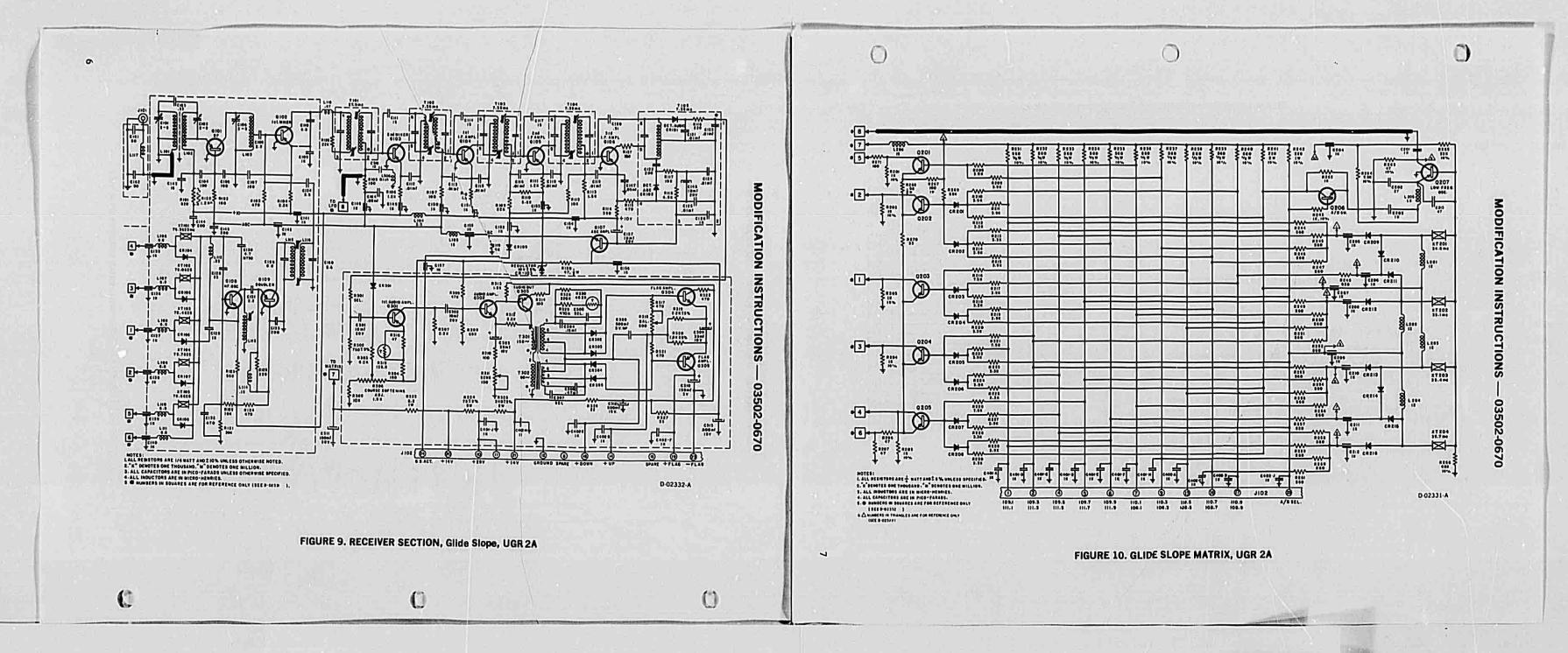
SCHEMATICS



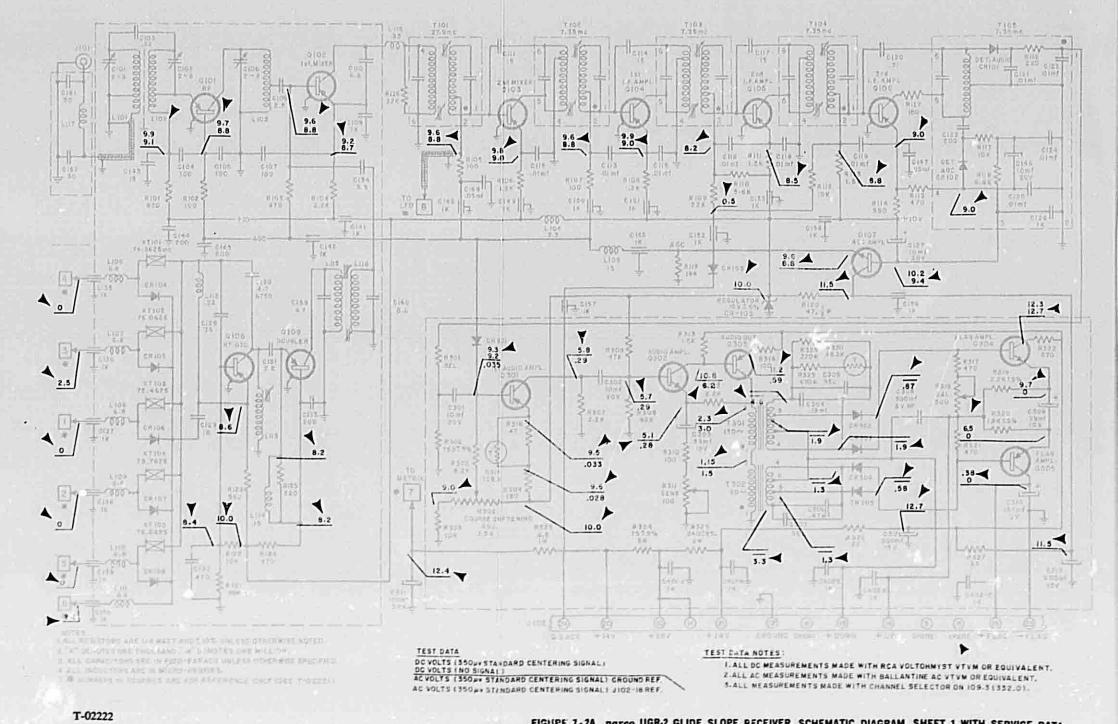


T-02222

7 - 3



SCHEMATICS



NARCO AVIONICS UGR-2A

MODIFICATION PROCEDURE 03502-0680

ALIGNMENT PROCEDURE:

This procedure may be used to align or realign the IF frequency. (If the IF strip had to be modified, use this procedure to change the IF from 7.35 to 7.50 mHz.)

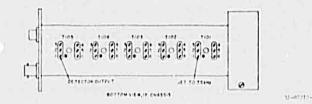
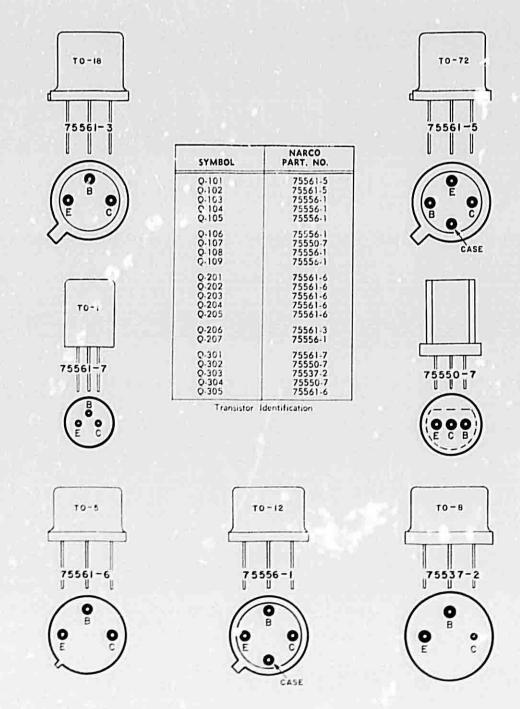


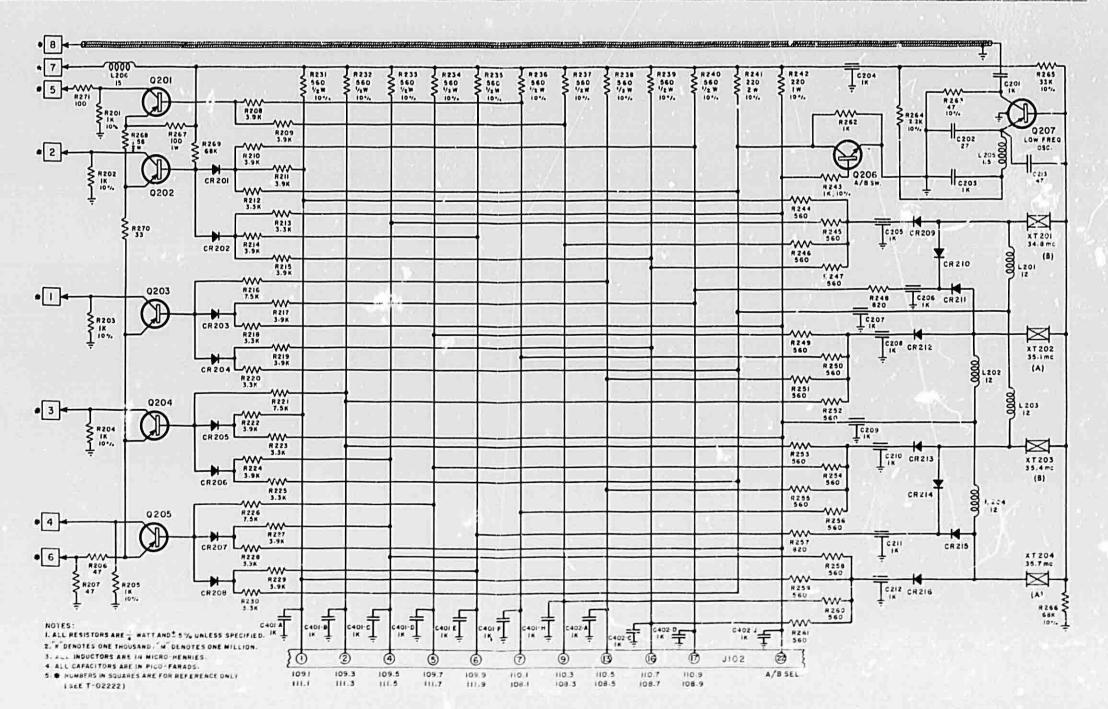
FIGURE 10. IF STRIP ALIGNMENT

- 1. Connect AC VTVM and oscilloscope to Terminal 1 of T105.
- 2. Connect the RF signal generator to the base of Q103 at Terminal 1 of T101 thru a .01 mf capacitor with a 47 ohm resistor to ground on the generator side of the capacitor. Set the generator to 7.5 mHz modulated 30% by 1000 Hz. Set the input voltage to 13.75 or 27.5 volts per cable wiring.
- 3. Tune T102, T103, and T104 for maximum output, keeping the generator output set for approximately 0.1 volts AC detector output.
- 4. Tune T105 for maximum output.
- 5. Connect 100 ohm resistors between Terminals 5 and 6 of T102, T103, and T104. Tune the secondary slugs (slugs away from the chassis) of T104, T103, and T102 on outer peaks for maximum detector output. The generator output should be set to keep the detector level at approximately .05 volts AC. A very high signal input may be required initially to align the IF.
- 6. Tune T105 for maximum output using the peak having the slug closer to the chassis.
- 7. Remove the 100 ohm resistors and connect them between Terminals 1 and 2 of T102, T103, and T104. Tune the primaries (slug nearest chassis) on outer peaks for maximum detector output.
- 8. Remove the 100 ohm resistors.
- 9. Check gain. 8 µv maximum should produce 0, 1 volts AC detector output.
- 9A. Set the channel selector to 110,70 mHz (330,20 mHz).
- 9B. Connect a VTVM to T105, Pin 1.
- 9C. Set VTVM to measure positive DC volts.
- 9D. With no signal applied to the UGR, adjust C519 for minimum DC voltage.
- 10. Check that all hardware that was removed was replaced and secure.

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SCHEMATICS





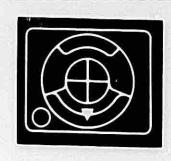
NARCO UGR 3 GLIDESLOPE RECIEVER GENERAL INDEX

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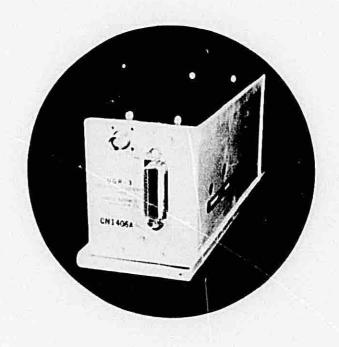
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NARCO AVIONICS



UGR 3 Glide Slope Receiver



MAINTENANCE MANUAL



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

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ATP RECORD OF REVISIONS

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1.1 INTRODUCTION

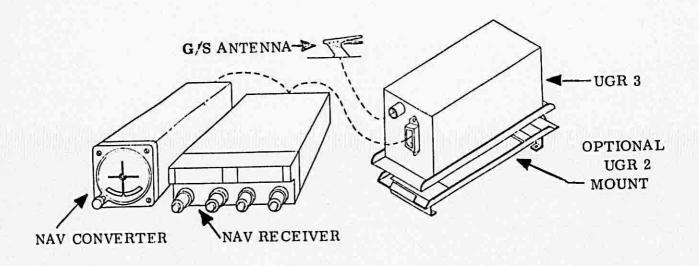
The NARCO UGR 3 Gli de Slope Receiver is a crystal controlled, double conversion superheterodyne radio for locating the glide slope landing path above a runway. The glide slope information is displayed on a navigation converter with an appropriate indicator with a crosspointer indicator. The receiver is crystal tuned for operation on 40 UHF channels within the 329.15 to 335.00 MHz range. Channel selection is accomplished by diode switching, controlled by 12 input wires.

This maintenance manual provides information necessary to the installation, operation, maintenance and repair of the UGR 3 Glide Slope Receiver. The information is presented as follows: Section 1, general introductory information; Section 2, installation information; Section 3, functional description and circuit description; Section 4, maintenance and repair instructions; Section 5, replacement parts list; and Section 6, schematics.

1.2 FUNCTIONAL DESCRIPTION

The NARCO UGR 3 is a solid state 40 channel UHF receiver that provides signals to drive the UP/DOWN meter and the flag alarm meter movements of a navigation converter. The unit is comprised of a double conversion crystal controlled superheterodyne receiver, diode matrix for selection of crystals, and an UP/DOWN and flag signal detection section. The receiver utilizes two of the three crystal oscillators for the selection of each glide slope (GS) channel in the double conversion process. When an ILS channel is selected at the NAV receiver, the NAV receiver's internal switching selects the GS UHF and the LOC VHF channels simutaneously. An ILS installation is shown functionally in Fig. 1-1. When the aircraft's antenna is above the glide path, the RF carrier is modulated predominately by a 90 Hz tone, below the glide path the modulating tone is 150 Hz.

The 90 and/or 150 Hz output is processed in the meter detector circuits to activate the glide slope UP/DOWN indicator and the flag of the navigation converter. When both signals are equal, the indicator remains at the center position; an increase of 90 Hz signal drives the needle down scale, and an increase of 150 Hz drives the needle up scale. The flag is activated only when there is sufficient antenna signal to give a useable output to the UP/DOWN indicator.



1.3 MECHANICAL DESCRIPTION

The UGR 3 Glide Slope Receiver is a single unit enclosed in a case 7-7/32" long (bottom flange is 8-7/16" long) by 3-1/8" wide by 3-3/4" high.

Access to the receiver's subassemblies is by removing the four top screws and sliding the chassis out. All the electronic subassemblies are mounted to the chassis that the IF Assembly is built upon.

- 1. The LFO Assy is free to move to the extent of it's leads when the chassis is removed from the case. (Two of the four screws that hold the case to the chassis also hold the LFO Assy in place.) Two additional screws hold the LFO Assy cover in place.
- 2. The Metering Assy and the Matrix/LFO Assy are each secured to the chassis by two screws. Upon removing the screws these assemblies can be hinged down for total access.
- 3. The RF/HFO Assy is secured by two screws.

NOTE:

To completely remove a subassembly, make note of the wiring, then desolder all necessary leads.

1.4 SPECIFICATIONS

WEIGHT:

2.3 lbs. 1.04 Kilograms

POWER REQUIREMENTS:

13.75 or 27.5 VDC, 230 ma

FUSE RECOMMENDED:

500 ma

CHANNELS:

40 channels in the UHF range, 329.15 to 335.00 MHz,

0.15 MHz spacing.

CHANNEL SELECTION:

12 wire method (standard pairing employed)

40 CHANNEL REMOTE SELECTION FROM: Most NAV receivers, such as NARCO's:

Mark 12, Mark 12A, or Mark 12B (with 50 KHz channeling)

Mark 16 (with 50 KHz channeling) Mark 24 (with 50 KHz channeling)

NAV 100 NAV 14 NAV 114

The UGR 3 may be used as a 20 channel GS UHF receiver when used with NAV receivers that have only 100 KHz channel selection. In this case no connection is made at

pin 3 (50 KHz Act.)

OUTPUT:

Indicator loads......three 150 ua, 1000 ohm loads. Flag Alarm loadstwo 250 ua, 1000 ohm loads.

SENSITIVITY:

An input signal of 20 microvolts maximum at the antenna terminals is required for 60% of standard deflection, with erratic movement not exceeding -5 % of standard deflection.

FLAG SENSITIVITY:

25 microvolts maximum at the antenna terminals for 250

ua in each flag alarm.

SELECTIVITY:

No less than 100 KHz at 6 db down. No more than 520 KHz at 60 db down.

SPURIOUS RESPONSES:

Attenuated at least 50 db below the center response

frequency.

ENVIRONMENTAL TEST SPECIFICATIONS:

Temperature:

Operating Temperature Storage Temperature -46° to +55°C -60° to +85°C

Operating Altitude:

30,000 feet

Decompression:

20,000 feet to 40,000 feet in 15

seconds, maximum

Humidity:

Relative humidity to 95% at 50°C for

48 hours

Vibration:

With mounting base - . 02" total

excursion, 10 to 55 Hz, with maximum acceleration of 3 G.

2.1 INTRODUCTION

The NARCO UGR 3 Glide Slope Receiver is a single unit that can be secured to the aircraft radio rack, to the firewall, or any other location that requires a minimum of interconnecting cable to the glide slope antenna.

The installation consists of securing the UGR 3 to the aircraft structure, installing a UHF antenna, and connecting the wiring to the rest of the System. A complete Instrument Landing System (ILS) would include the UGR 3, a VHF NAV receiver for channel selection and for detecting the LOC signal, and a navigation converter to display the localizer and glide slope (GS) information. The following (one of each) or equivalent equipments may be part of the System.

NAV Converter	NAV Receiver
VOA 9	Mark 12, Mark 12A, Mark 12B (with
VOA 50	50 KHz Channeling)
CLC 60	Mark 16 (with 50 KHz Channeling)
NAV 112	NAV 114
NAV 12	NAV 14

NOTE:

The UGR 3 may be used as a 20 channel GS UHF receiver when used with NAV receivers that have only 100 KHz channel selection. In this case no connection is made at pin 3 (50 KHz Act.).

All electrical signals and power are obtained from a 24 pin connector and the antenna connector on the front of the UGR 3's Chassis.

If a total TSO System is desired, use the NARCO UGR 2A as the UGR 3 is a non-TSO'd Glide Slope Receiver.

2.2 EQUIPMENT SUPPLIED

- 1. NARCO UGR 3 Glide Slope Receiver, 40 Channel
- 2. Connector Kit, 03502-0500 consisting of: 1 BNC Connector, P/N 41152-0001 1 Connector Assy, P/N 41291-0101

2.3 EQUIPMENT REQUIRED, but Not Supplied

UGA 1 Antenna, UHF Glide Slope Receiving type (or equivalent). A NAV receiver and an Indicator (See Section 2.1). Interconnecting wires, cables, and hardware, as required.

2.4 ANTENNA REQUIREMENTS

The UGR 3 is intended to operate with any UHF Glide Slope Antenna having a nominal impedance of 50 ohms. The antenna may have a VSWR of up to 6:1, within the frequency range of 329.0 and 335.3 MHz.

2.5 INSTALLATION

The UGR 3 may be mounted in any position in an equipment rack or other suitable location. The mounting dimensions and space requirements are given in Fig. 2-1.

The UGR 3 may be installed utilizing the four mounting holes located in the base of the case. It is suggested that readily available RIV-NUTS be used to provide for easy removal when required. The UGR 3 can be mounted on the optional UGR 2 Mounting Base (P/N 01402-0102) if desired.

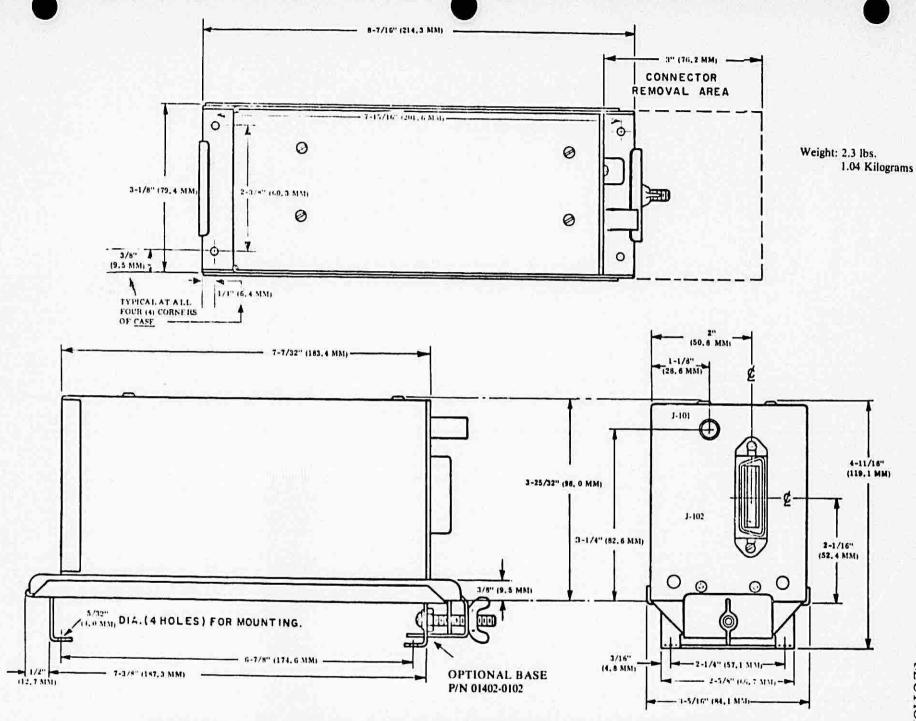


FIGURE 2-1. UGR 3 MECHANICAL INSTALLATION ON OPTIONAL MOUNTING BASE

2.6 CABLE INTERCONNECTIONS

Connector pin wiring information as well as descriptive data pertaining to each leads function is provided in Fig. 2-4.

Refer to the Maintenance Manual of the NAV receiver and/or NAV converter for System hook-ups.

Proper assembly of the BNC connector to the coax cable is shown in Fig. 2-3.

To realize the specified accuracy of the UGR 3, the receiver outputs must be terminated with the equivalent of three UP-DOWN indicators and two Flag Alarms (1000 ohms each). The external load may be the UP-DOWN display of the ILS, the autopilot, etc. If this maximum display capability is not used, shunting resistors MUST be installed to provide the correct simulated load. Since each of the shunting loads is 1000 ohms; either three UP-DOWN load circuits or 1000 ohm resistors must be connected to the output to total three separate 1000 ohm loads in parallel (333 ohms total); and if one flag indicator is used, a 1000 ohm resistor must be used to simulate the resistance of the unused flag circuit. The location of the load resistors installed in the plug can be seen in Fig. 2-4. Refer to Fig. 2-2 for method of connection of the load resistor. Before installing the resistor, make sure that the wire connected to the lug end of the connector cup is routed through the hole, crimped, and tack soldered.

On the 1/4 watt resistor, both leads must be bent and cut to the correct length before insertion into the connector cup, then soldered in place. Do not crimp the connector cup. After soldering the resistor in place, push the insulated sleeving down over the soldered wire lead on the connector receptacle.

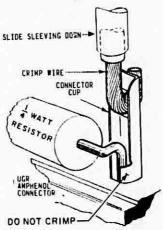


FIGURE 2-2. LOAD RESISTOR INSTALLATION DETAILS

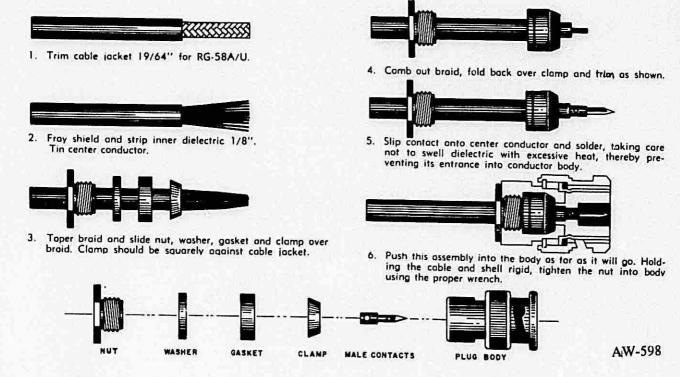


FIGURE 2-3. ASSEMBLY OF BNC CONNECTOR ON RG-58A COAX CABLE

2.7 OPERATING INSTRUCTIONS

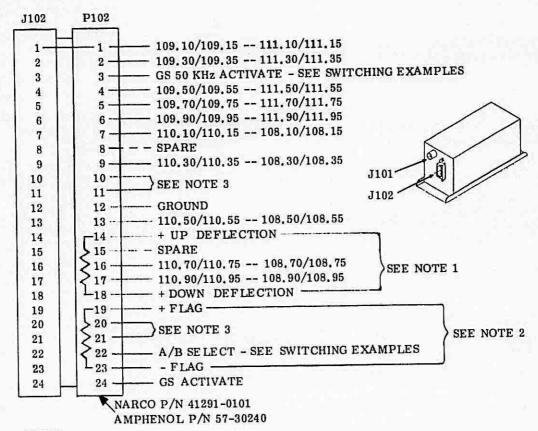
The UGR 3 has no direct operating controls, it's circuits are activated by channeling to a glide slope or localizer channel, via the NAV receiver, and interpreting it's output at the Systems NAV converter indicator.

By noting the position of the glide slope indicator flag alarm, it is easy to determine when a reliable signal is being received.

When "flying the needle" a "needle-up" deflection requires a "fly-up" action, and a "needle-down" deflection requires a "fly-down" action.

When the red flag alarm is visible, either an unreliable signal is being received or there is a malfunction in the System.

UGR 3



NOTES:

- Resistor installed inside hood of connector to make combination of resistor loads and meter loads equal 333 ohms (3-1K ohm movements max.) 470 ohms supplied installed in connector is standard.
- Resistor installed inside hood of connector to make combination of resistor loads and meter loads equal 500 ohms (2-1K ohm flag loads max.) 1000 ohms supplied installed in connector is standard.
- 3. The primary voltage input connections (A+) are as follows:
 - a. 28 Volts: Connect input to terminals 10 and 11.

No connections to terminals 20 and 21.

b. 14 Volts: Connect input to terminals 20 and 21,

No connections to terminals 10 and 11.

c. For unit protection and independent operation of the UGR 3 and the NAV receiver it is recommended that each obtain their A+ via a seperate circuit protection device (0.5 amp for the UGR 3). In this manner should either the UGR 3 or the NAV receiver fail --- the remaining unit will still be operational.

SWITCHING EXAMPLES

P102 1 3 22	109.15 GROUNDED OPEN	P102 1 3 22	109.10 OPEN OPEN	P102 1 3 22	111.15 GROUNDED GROUNDED	P102 1 3 22	111.10 OPEN GROUNDED
P102		P102		P102		P102	
7	110.15	7	110.10	7	108.15	7	108.10
3	GROUNDED	3	OPEN	3	GROUNDED	3	OPEN
22	OPEN	22	OPEN	22	GROUNDED	22	GROUNDED

The grounding of pin 3, via the NAV receiver switch, activates the 50 KHz channels. In a like manner, grounding pin 22 activates the 108 and 111 frequencies.

3.1 INTRODUCTION

This Section provides a functional description as well as a circuit description of the UGR 3.

3.2 FUNCTIONAL DESCRIPTION

The UGR 3 provides accurate Glide Slope (vertical position) information for aircraft approaching airports equipped with an Instrument Landing System (ILS). The Glide Slope (GS) receiver operates in the UHF range of 329.15 thru 335.0 MHz. The GS receiver is intended as a companion equipment for any navigation or communication equipment which provides Localizer (lateral position) information in the VHF range of 108.10 thru 111.95 MHz.

The UGR 3 is a single unit that operates in conjunction with a localizer receiver to provide paired channel operation in an ILS. See Table 3.1 for channel frequencies. The antenna and mixer circuits are broad-banded to cover the full operating band. The GS receiver is tuned by means of two crystal oscillators in a dual conversion superheterodyne circuit.

The Crystal oscillators, one HFO and one of the two LFO's are activated by a channel selector switch located in the associated NAV receiver. (Refer to Section 2-1 for a list of associated equipments.)

Both LFO circuits are basically identical thus all discussion pertaining to the LFO circuit pertains equally to both, unless otherwise noted.

A twelve wire switching system is used wherein ten of these wires select two channels each. The eleventh wire (A/B Select) determines which of the two channels is activated. The twelfth wire (50 KHz Act) determines which of the two LFO's is activated.

In addition to understanding the operation of the UGR 3, it is also necessary to have a knowledge of the UHF glide slope signal received by the receiver. The glide slope transmitter radiates a horizontally polarized dual beam signal over the runway. The two glide slope beams are directed along the landing path at an angle of 2.25 to 3.0 degrees above the horizon, depending upon the surrounding terrain. Each of the two beams has the same carrier frequency. However, the upper beam is modulated by a 90 Hz tone and the lower beam is modulated by a 150 Hz tone.

TABLE 3.1
LOCALIZER/GLIDE SLOPE PAIRED CHANNELS

J102	Localizer	Glide Slope
Pin No.	Frequency	Frequency
7	108.10	334.70
7	108.15	334.55
9	108.30	334.10
9	108.35	333.95
13	108.50	329.90
13	108.55	329.75
16	108.70	330.50
16	108.75	330.35
17	108.90	329.30
17	108.95	329.15
1	109.10	331.40
1	109.15	331.25
2	109.30	332.00
2	109.35	331.85
4	109.50	332,60
4	109.55	332.45
5	109.70	333,20
5	109.75	333.05
6	109.90	333.80
6	109.95	333.65
7	110.10	334.40
7	110.15	334.25
9	110.30	335.00
- 9	110.35	334.85
13	110.50	329.60
13	110.55	329.45
16	110.70	330.20
16	110.75	330.05
17	110.90	330,80
17	110,95	330.65
1	111.10	331.70
1	111.15	331.55
2	111.30	332.30
2	111.35	332.15
4	111.50	332.90
4	111.55	332.75
5	111.70	333,50
5	111.75	333.35
6	111.90	331.10
6	111,95	330.95

3.2 Continued

When the aircraft is located between the two beams, the two signals will be of equal strength at the receiver. Above or below this glide path, one audio tone will be of greater amplitude.

The UGR 3 is a dual conversion superheterodyne radio with crystal control of the HFO and the selected LFO. In the tuning section, the RF amplifier is broadbanded: the injection frequency of the first mixer is the second harmonic of the HFO (additional doubling in the mixer) and the injection frequency of the second mixer is the same frequency as the LFO. See Table 3.2 for all oscillator and IF frequencies.

The HFO has five crystals with diode switching to select the desired operating frequency. Each crystal is activated by a gate circuit that is controlled from the matrix. A DC potential, obtained from the matrix, is used to forward bias a selected diode to connect the desired crystal to the oscillator circuit. The potentials that forward bias the switching diodes are obtained from the associated gate transistor (Q201 thru Q205) that is controlled from the matrix. The oscillator frequency is doubled in Q109 and doubled in the first mixer (Q102). At the first mixer, the injection frequency is the second harmonic of the HFO.

Refer to Table 3.2 and note that the crystals used for the 100 KHz channels are located on a printed circuit board found in the case mounted on the top of the chassis whereas the 50 KHz crystals are those on the Matrix printed circuit board.

Each LFO has four crystals with direct diode switching to select the desired operating frequency. From the common oscillator, each crystal is connected to ground through a diode. When the selected diode conducts, the associated crystal is connected to the LFO. As in the HFO, all control lines connected to the diodes have low-pass filters to isolate the DC control circuits from the RF circuits.

3.3 CIRCUIT DESCRIPTION

Refer to Section 6, Schematics for general circuit orientation.

3.4 RF AMPLIFIER (Q101)

The signal is connected to the antenna transformer (L101/L102), which couples the antenna signal into the RF amplifier. The input coil is matched to 50 ohms, the impedance of the receiving antenna. The transformer is broadly tuned from 329.0 to 335 MHz, the glide slope receiver frequencies. The RF amplifier (Q101) is a common base amplifier with its gain set by the AGC voltage applied to the base. The receiver input is fixed tuned; therefore, the signal received is determined by the frequency of the crystals connected to the HFO and the appropriate LFO.

3.5 HFO (Q108)

The High Frequency Oscillator (HFO) is a Colpitts crystal controlled oscillator operating at five crystal frequencies within the 75,4625 to 76,6625 MHz range. The basic oscillator circuit has the crystal (XT101 thru XT105) connected in the feedback path. The output signal is developed across L113, which is broadly tuned to cover the range of the five crystals. The five crystals are effectively connected in parallel from the feedback point to the emitter. However, a single diode (CR104 thru CR108) is placed in series with each crystal and a connection made to the junction point. Since there are DC potentials connected to reverse bias each diode, this high resistance in series with each crystal effectively disconnects all crystals from the oscillator. When a command line in the matrix is activated, the associated crystal input line forward biases the selected diode and completes the crystal feedback path to the emitter. Each of the five gate output lines and the common return lines have a low-pass filter (L106 thru L111 and feed-thru capacitors C135 thru C140) to isolate RF from the six control lines.

Refer to the simplified matrix control drawing, Fig. 3-1.

3.6 FREQUENCY DOUBLER (Q109)

The frequency doubler (Q109) is a common base configuration with the output tank circuit broadly tuned to cover the 150,925 to 153,325 MHz range, the second harmonic of the HFO. The doubler is operated with zero bias for optimum harmonic generation. The output circuit is doubled tuned for elimination of undersired harmonics.

3.7 FIRST MIXER (Q102)

The first mixer (Q102) heterodynes the incoming RF signal with the high frequency oscillator signal to produce the high frequency intermediate frequency signal (HFIF). Although the second harmonic of the HFO is connected to the mixer, the output circuit is tuned to the difference frequency between the RF input signal and the fourth harmonic of the HFO. Therefore, the HF mixer serves the dual purpose of: (1) frequency doubler, and (2) superheterodyne converter.

The undesired high frequencyies are by-passed to ground on the HFO assembly by C110 and only the difference frequency is coupled through L118 to the HFIF transformer on the IF assembly. The HFIF circuits are tuned to cover the 27.30 to 28.35 MHz range.

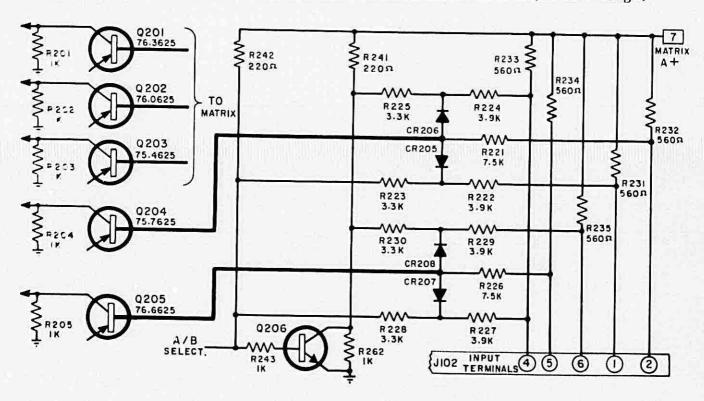


FIGURE 3-1. A/B SELECTION OF THE HFO FREQUENCY, FUNCTIONAL DIAGRAM

3.8 LFO

As there are two LFOs, both basically identical, only the LFO located on the Matrix PC Board, will be described. This LFO is active for all 50 KHz channels (when J102-3 is grounded). The seperately contained LFO is active for all 100 KHz channels (when J102-3 is not grounded).

The Low Frequency Oscillator (LFO) is a Colpitts crystal controlled oscillator (Q207) operating at four crystal frequencies within the 34.8 to 35.7 MHz range. The basic oscillator circuit has the crystals (XT 201 thru XT204) connected in the feedback path. The common side of each crystal is connected to the base. The ground return of each crystal is through the series diode (CR209, CR212, CR213, CR216) and the capacitance to ground of the associated feed-thru capacitors (C205, C208, C210, C212). This RF ground path exists only when the associated diode is forward biased. The four crystals are connected into two groups, Group A (35,1 and 35,7 MHz) and Group B (34,8 and 35,4 MHz). A diode is connected in series with each crystal and the four crystals are effectively connected in parallel from the oscillator base to ground. The diode cathodes are connected to the 10 channel select lines and the diode anodes are connected to the A/B select circuit. Additional diodes ,CR210, CR211, CR214, CR215) provide isolation between the A and B groups. With all four crystal circuits connected in parallel, all four series diodes are reverse biased and the high resistance in series with each crystal effectively disconnects all crystals from the oscillator. When a command line in the matrix is activated, the associated crystal input line forward biases the diode and completes the crystal feedback path to ground. Each crystal has a low-pass filter (feedthru capacitors C205 thru C212 and RF chokes L201 thru L204) to keep RF from the DC lines of the matrix. Figure 3-2 shows the method of connecting the four crystals to the crystal oscillator.

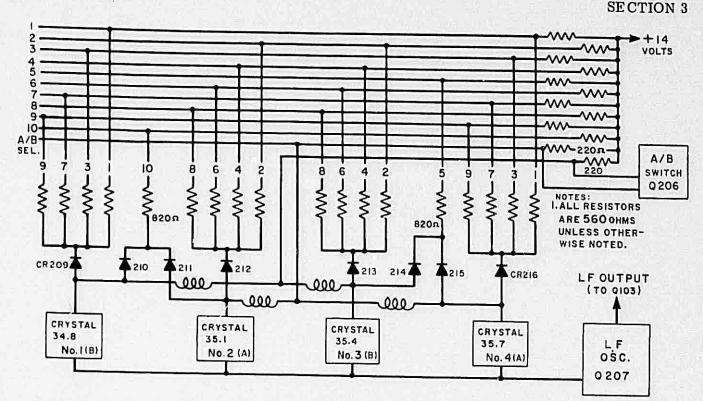


FIGURE 3-2. A/B SELECTION OF THE LFO FREQUENCY, FUNCTIONAL DIAGRAM

3.9 MATRIX

The matrix controls the operating frequency of the dual conversion superheterodyne by selecting the frequency of the HFO and LFO. The matrix is comprised of resistor and diode interconnections between 10 channel control lines and nine oscillator control lines. The multiple interconnections permit each input line to set the frequency of one LFO and one HFO. Although there are as many as two LFO crystals and two HFO crystals connected to a control line, the A/B select line in conjunction with pin 3 of J102 permits using the correct pair.

Therefore, the 10 channel control lines are capable of selecting from 20 channels of either LFO. The A group when one channel control line is grounded, and the B group when both the A/B select line and the same channel control line are connected to ground. The frequency control is accomplished by using a forward biased diode to connect the desired crystal to the HFO and the same technique to control the LFO. The oscillator crystal switching is described in detail in Sections 3.5 and 3.8.

3.9 Continued

The matrix will be described as applied to the biasing of the diodes. In the quiescent state with none of the input lines grounded, all diodes are reverse biased (negative potential at the anodes and positive at the cathodes) and the high resistance is the same as an open circuit in each crystal circuit. When an input line is grounded, the effect will be to forward bias one diode connected to an LFO crystal and one diode connected to a gate controlling an HFO crystal. The associated crystal is then connected and both oscillator circuits are in operation.

Each crystal active circuit of the HFO is controlled by a two, five, or six input gate circuit (Q201 thru Q205) as shown in the schematic. Since the operation of three gates are identical (Q203, Q204, and Q205) the action of two gates is given below, followed by the circuit description of the remaining two gates (Q201 and Q202).

The base bias of each gate transistor is controlled by potentials applied through a resistor diode network. The bias potential through resistors R208/R209 (Q201), R269 (Q202), R216 (Q203), R221 (Q204), and R226 (Q205) (approximately the same as the matrix A+) is sufficient to hold all gates at cut off.

When an input line is connected to ground, if forms the ground return for a voltage divider network to A+. Since there are 10 input lines, there are 10 possible connections of resistors from A+ to ground. The five transistors (base connection) are connected to the 10 input lines directly through a resistor or through a resistor and diode circuit in the matrix.

As shown in Figure 3-1 and in the schematic in Section 6, each gate input circuit has the anodes of two diodes connected to the transistor base. Each diode has two resistors connected to the cathode (3.3K and 3.9K). The 3.3K resistors are connected to the A/B select circuit and the 3.9K resistors are connected to the individual channel select lines of the matrix. It must be noted that there are two A/B select lines, the input and the output of the A/B switch (Q206). In the schematic, the upper diode of each gate is connected to the A/B switch gate output and the lower diode is connected to the input.

3,9 Continued

There is a polarity difference between the two lines since the output (Q206 collector) is at ground potential when the base is not grounded. Therefore, it can be seen that one of the two diodes in each gate is connected to ground through the 3.3K resistor connected to the collector of Q206.

As an example of this gate action, refer to Figure 3-1, a simplified schematic of channel control through pin 4 of J102. Since the A/B select line is not grounded, Q206 is in conduction and the collector is at ground potential. This provides the ground return for two 3.3K resistors, R230 in the Q205 circuit and R225 in the Q204 circuit. The voltage divider from Matrix A+ to ground is shown in detail in Figure 3-3. Current flow through voltage dividers R233, R224, R225 and return to ground through Q206 develops a 6.0 volt bias at the base of Q204. Refer to Figure 3-3 (A) for the voltage divider connections. Current flows through R235, R229, R230 and return to ground through Q206 develops a 6.0 volt bias at the base of Q205. Similar bleeder resistors connected to Q203 provide the same potentials and none of the transistor gates is biased to conduction.

When Pin 4 is grounded, R224 is connected directly to ground to shunt the R225/Q206 circuit. The voltage distribution through this new divider provides +2.8 volts at the base of Q204 and the transistor is biased to conduction. With the emitter biased at 3.0 volts, the 2.8 volt potential at the base turns on the gate. Although pin 4 is connected to Q205 through R227 and CR207, this gate does not conduct since the A/B select line connected to R228 is ungrounded.

The following circuit description separates the action of the A/B select line and the channel select line. Actually, when this form of channel selection occurs it is a simultaneous action: however to clarify the description, it is separated into two steps to illustrate the simultaneous application of the ground circuit to the selected diode/gate transistor circuit.

3.9 Continued

When the A/B select line is ground, the two voltage dividers have a different path to ground as shown in Figure 3-3 (B). Current flow through R231, R223 and return to ground through the A/B select line (pin 22 of J102) developes a 6.0 volt bias at the base of Q204. Current flow through R223, R227, R228 and return to ground through the A/B select line develops 6.0 volts of bias at the base of Q205. The voltage distribution is almost the same as the bias developed with the A/B select line ungrounded. However, Q204 base is connected to the voltage divider through CR205, and Q205 base is connected through CR207.

An additional ground at pin 4 of J102 serves to shunt R227 and R228 to ground. The decrease in positive potential at the base of Q205 drives Q205 to conduction. This method is used on the other nine lines to obtain the ten channels with the A/B select line grounded. From this description it can be summarized that grounding only pin 4, fires gate Q204. Simultaneously grounding pin 22 (A/B select line) and pin 4 fires gate Q205.

The above description illustrates the control action of pin 4 as applied to the operation of transistor gates Q204 and Q205. This pin is only one of the inputs that controls the conduction of the gates. Gate Q204 is also controlled by pins 1 and 2: Gate Q205 is also controlled by pins 5 and 6. The multiple inputs of Q204 and Q205 are shown in Figure 3-1.

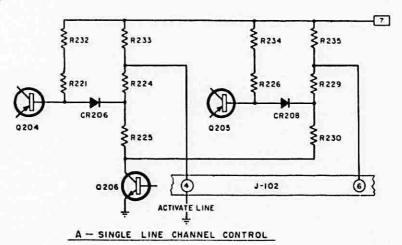
Although the 7.5K resistors serve to connect the base of Q203, Q204, and Q205 to the matrix A+, they also serve as additional inputs to the gates. The gates are activated as follows: grounding pin 2 activates Q204 through R221; and grounding pin 13 activates Q203 through R216.

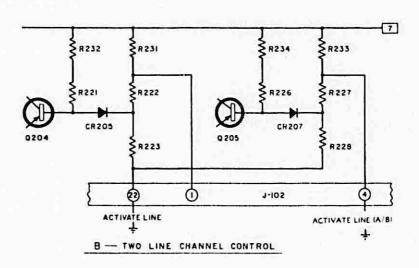
As the schematic shows, the operation of gate Q202 is similar since one input diode (CR202) is connected to the A/B select line through R213 and the other diode (CR201) is connected to the A/B gate (Q206 output) through R212. Each diode is connected to two channel select input lines that operate the same as the single input line configuration of Q203, Q204, and Q205. The transistor is held at cutoff by the positive potential supplied through R269. Grounding of pin 16 or 6 fires the gate through CR202; grounding of pin 1 or 17 fires the gate through CR201. When an input line is grounded, the action is similar to the voltage divider action of Q203, Q204, and Q205 as described above.

3.9 Continued

Transistor gate (Q201) is a two input resistive gate. The base is connected to input terminal 7 through R208 and to input terminal 9 through R209. The two resistors connected to the matrix A+ provide the positive bias that holds the transistor at cutoff. When one input terminal is connected to ground, current through the two resistors in series plus the 560 ohm resistor to the matrix A+ forms a voltage divider. The base of Q201 is connected to approximately 7.0 volts bias, which fires the gate.

Input line 4 also selects the LFO frequency since R258 is connected to the 35.7 MHz crystal and R245 is connected to the 34.8 MHz crystal. Although both crystal gate circuits are enabled when line 4 is grounded, the A/B select line determines whether the diodes connected to the odd or even pairs of crystals will conduct. This is explained in detail in Section 3.8.





P-07236

P-07236

FIGURE 3-3. MATRIX CONTROL OF HFO GATES

3.10 SECOND MIXER

The second mixer (Q103) heterodynes the LFO signal with the HFIF signal to produce the Low Frequency Intermediate Frequency (LFIF) signal. The HFIF signal, which is supplied from T101, has a frequency range of 27.30 to 28.35 MHz with T101 broadly tuned to cover this range. The 7.50 MHz LFIF is the difference frequency between the two signals. The base of Q103 is connected to the AGC buss to control the gain when the signal level increases.

3.11 LFIF AMPLIFIERS (Q104, Q105, Q106)

The three LFIF amplifiers have relatively high gain operating at 7.50 MHz with 120 KHz nominal bandwidth at the 6 db points. Each amplifier is of conventional design with a neutralization capacitor and adequate filtering to ensure against interaction between stages. AGC is applied to Q104; however, Q105 and Q106 have an additional control function.

The two base circuits are connected together and tied to pin 24 of J102 for control from an external source. When this circuit is open, the positive potentials at the transformer ends of R110 and R113 effectively bias both amplifiers at cut off. Connecting pin 24 to ground will make these two points more negative, permitting Q105 and Q106 to operate as IF amplifiers. Since this control line is connected to the OMNI-LOCALIZER control circuit, the high voltage transient developed at the switching relay could damage the IF transistors. Any positive transient on this line reverse biases CR109; however, grounding this point forward biases the diode to operate the two amplifiers.

The GS Activate Line is controlled by a deck of channel selector switch in the localizer receiver. When the external control opens this circuit, it inhibits operation of the receiver. The HF and LF oscillators will operate only when one of the channel select lines is grounded. This permits using a variety of methods to control the operation of the UGR 3; dependent upon the external switching configuration.

3,12 AUDIO DETECTOR AND AGC DETECTOR

The audio detector (CR101) demodulates the IF signal and the low-pass filter (C121, C123, R116) extracts the 90 and 150 Hz Glide Slope Signal. The detector coutput is connected to the input of the first audio amplifier (Q301). The time constant of this circuit is relatively long, which minimizes interference from high frequency noise in the AM signal.

The AGC detector is connected to the same signal source. The IF signal is demodulated by the AGC detector and the long time constant filter (R117, R118, C124, C125, C126, C127, and C146) developes a DC level at the input of Q107, the AGC amplifier. The AGC amplifier serves a dual purpose since it increases the AGC signal current and increases the impedance of the AGC circuit with reference to ground.

The AGC line provides a control potential to the RF amplifier, first mixer, second mixer, first IF amplifier, and the first audio amplifier. The AGC voltage is obtained from the detected output of the LFIF amplifier. Therefore, the amplitude of the AGC voltage is directly related to the level of the received RF signal. If the received signal increases in amplitude, the signal at the AGC buss becomes more positive. Since all transistors connected to the AGC line are PNP, the positive potential reduces the gain and stabilizes the audio output.

3,13 METERING AMPLIFIER, Q301, Q302, Q303

The metering amplifier is a three stage audio amplifier that provides signals to the meter and alarm detectors. In addition to the detector output signal, the AGC line is diode coupled into the base of the first metering amplifier (Q301). When the AGC becomes more positive than the base of Q301, the diode becomes forward biased and the AGC line is connected directly to the base. The course softening control (R306) sets the operating level of the amplifier, so as to decrease the gain of the amplifier as the aircraft approaches the transmitter. This stage is further stablized by using a temperature compensating network (R315, R316) in the emitter circuit.

3.13 Continued

The second and third metering amplifiers are stablized with AC and DC inverse feedback loops. The DC feedback used R312 to supply feedback from Q303 collector to Q302 emitter. The AC feedback loop is connected in the same circuit. However, there is additional resistance in this circuit (R310, R311) isolated from the DC path by capacitor C303.

The metering amplifier output signal is developed across the input of the 90 and 150 Hz filters.

3.14 FILTER CIRCUITS

The 90 and 150 Hz filter circuits separate the dual frequency glide slope signal into two separate frequencies. The secondary of T301 is tuned to 150 Hz by the shunting capacitors (C304, C305). The full wave recitifier (CR302, CR303) converts this 150 Hz signal to a positive DC level at the load circuit, R317 and R318. The secondary of T302 is tuned to 90 Hz by the shunting capacitors (C306, C307). The full wave rectifier (CR304, CR305) converts this to a negative DC level at the load circuit, R321.

3.15 UP/DOWN DETECTOR

The UP/DOWN detector is a modified form of difference detector circuit. The positive DC circuit of the 150 Hz rectifier and the negative DC output of the 90 Hz rectifier are connected in series, using a three wire output, as shown in Figure 3-4. When the two voltages are of equal amplitudes, the sum of the two currents flowing through the center conductor is zero since they are equal and opposite. The meter is in series with this line, indicating a null when both signals are equal. Unequal DC voltages from the filter circuits creates an unbalance. The difference current flowing in the center conductor shows a + or - (UP or DOWN) indication on the meter. The balance control (R318) is adjusted for a null of the UP/DOWN indicator when both signals are equal.

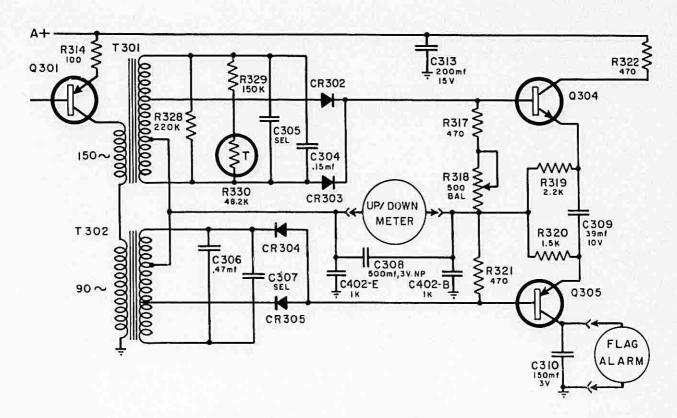


FIGURE 3-4, UP/DOWN AND FLAG DETECTORS, SCHEMATIC DIAGRAM

3.16 FLAG ALARM DETECTOR

The flag alarm amplifier indicates that the level of the UP/DOWN signals are within the operating range of the glide slope receiver. The dual output from the UP/DOWN detector (+ from 150 Hz output and - from 90 Hz output) is connected to a two input AND gate (Q304,Q305) as shown in Figure 3-4. The positive output (150 Hz) is connected to Q304, which is an NPN transistor and the negative output (90 Hz) is connected to Q305, which is a PNP transistor. When signals are within the operating range, the positive potential at the NPN transistor will cause conduction and the negative potential at the PNP transistor will also cause conduction. Since the two transistors (emitter/collector circuits) are in series with the flag alarm, current will flow through the alarm display. This display will operate when the UP/DOWN indicator shows a null since the gate circuit action depends upon the polarization and amplitude of the UP/DOWN detector outputs with this complementary transistor circuit.

If only one modulation signal is being transmitted, the flag will not be activated. The absence of either the 90 or 150 Hz signal at the UP/DOWN product detector will deactivate the flag circuit.

TABLE 3.2 LFO AND HFO OSCILLATOR FREQUENCIES

The state of the s		,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				1.0
10.7				John Charles		SE LECTED	
G/S LOC		SELECTED	SELECTED	SELECTED	SWITCH ACTIVATED DIODE	CRYSTAL	
Rec. Rec.	GROUND J102	DIODE	RESISTOR	TRANSISTOR	CR	XT	
Freq- Freq-	Pin number(s) for	CR	R	Q	(Matrix Bd, LFO) (Top LFO Assy)		HFO 4
uency uency	Freq- 50KHz A/B				(Top in Chasy)	(Matrix Bd, LFO) (Top LFO Assy)	Freq- Times
MHz MHz	uency Act. Sel.	201 202 203 204 205 206 207 208	208 209 216 221 226	201 202 203 204 205	209 210 211 212 213 214 216 501 502 503 504 505 506 508	201 202 203 204 501 502 503 504	uency HFO HFIF
329, 15 108, 95	17 3 22	x		x	- x	34.8	75.4625 301.85 27.30
329,30 108,90	1.6.00	x		x	x	34.95	75,4625 301,85 27,45
329,45 110,55	1000		x	x	x	35.1	75,4625 301.85 27.60
329,60 110,50			x	x	x	35.25	75,4625 301.85 27.75
329,75 108,55 329,90 108,50	UE-60111 100 90000		x	x	x	35,4	75,4625 301,85 27,90
330,05 110,75	1550 100 100		x	x	x		75,4625 301.85 28.05
330, 20 110, 73	1.21.201			7 - X		35.7	75,4625 301,85 28,20
330, 35 108, 75				- ×		35.85	75,4625 301,85 28,35 75,7625 303,05 27,30
330,50 108,70	1 (1847) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	- x		- x		34.95	75, 7625 303, 05 27, 45
330,65 110,95		x		- x		35.1	75,7625 303.05 27.40
330, 80 110, 90	17	x		- x	x	N 2 1 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2	75, 7625 303, 05 27, 75
330,95 111,95	6 3 22	- x		- x	x	35.4	75,7625 303.05 27.90
331,10 111,90	6 - 22	- x		- x	x -	35,55	75,7625 303.05 28.05
331,25 109,15	1 3 -	x		- x	x	35.7	75.7625 303.05 28.20
331,40 109,10	1	x =		- x	x]	75.7625 303.05 28.35
331,55 111,15	1 3 22	x		x -	x	34.8	76,0625 304,25 27.30
331,70 111,10		x		x -	x	34,95	76,0625 304,25 27,45
331.85 109.35			x -	x -	X	35.1	76,0625 304.25 27.60
332,00 109.30			x -	x -	x x	35.25	76,0625 304,25 27,75
332,15 111,35	A REG TO THE RESERVE		x -	x -	X	1 . 35,4	76,0625 304,25 27,90
332,30 111,30 332,45 109,55	1		x -	x -	x	35,55	76.0625 304.25 28.05
332, 60 109, 50	4 3 -	x		x -		35.7	76,0625 304,25 28,20
332,75 111,55	4 3 22	x		x -		35,85	76,0625 304,25 28,35
332,90 111,50				x	X	34.8	76,3625 305,45 27,30
333,05 109,75						34,95	76,3625 305,45 27,45 76,3625 305,45 27,60
333,20 109,70	2002 - 2000		°	1 ·		35,1	76.3625 305.45 27.75
333,35 111,75			x	· · · ·		35.4	76,3625 305,45 27,90
333,50 111.70	5 - 22		x	x	x	35,55	76,3625 305,45 28,05
333,65 109,95	6 3 -	x		x	x]	76,3625 305,45 28,20
333,80 109,90	6	x		x	x	35,85	76,3625 305,45 28,35
333,95 108,35	The state of the s		- x	x	x	34.8	76.6625 306.65 27.30
334.10 108.30			- x	x	x	34.95	76.6625 306.65 27.45
334,25 110,15			x	x	x		76,6625 306,65 27,60
334.40 110.10			x	x =	x	35,25	76,6625 306,65 27,75
334,55 108,15			x	x	· · x		76.6625 306.65 27.90
334.70 108.10			X	x	x	35,55	76,6625 306,65 28,05
334,85 110,35			- x	x	· · · · · · · · · · · · · · · · ·] 35.7	76,6625 306,65 28,20
335.00 110.30	1 9		- x	x	x		76.6625 306.65 28.35

4.1 INTRODUCTION

This Section provides information for checkout, troubleshooting, alignment, and repair of the UGR 3 Glide Slope Receiver. Performance tests are given in Subsection 4.7 that permits evaluation of the unit's operation, and should also assist in determining when alignment is necessary. Subsections 4.10 thru 4.13 outline procedures for trouble isolation in the IF/RF, matrix, and metering subassemblies.

Symbol numbers are used to identify specific electrical components in the text, illustrations, parts list, and schematics.

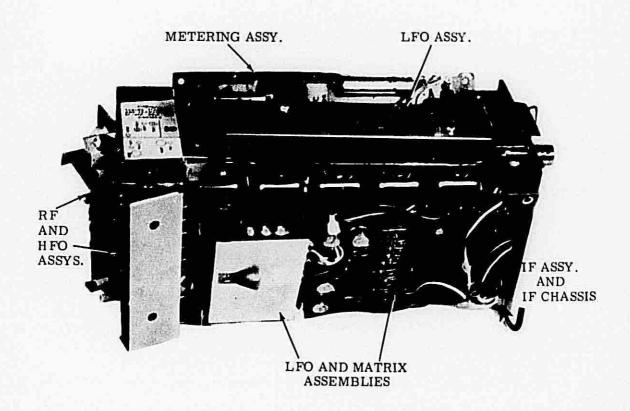


FIGURE 4-1. UGR 3 GLIDE SLOPE RECEIVER

4.2 MECHANICAL MAINTENANCE

The UGR 3 Glide Slope Receiver requires no mechanical maintenance as there are no controls, indicators, or moving parts involved in it's operation. The mechanical discussion therefore covers only the disassembly procedures required for test, alignment and/or repair. In most instances, the reassembly is essentially the reverse of the disassembly instruction.

All subassemblies are attached to the IF Chassis that slides into the covering case. The IF chassis is secured in place by four slot drive screws on the top.

The Top LFO Assy is not mechanically attached to the chassis when the case is removed. This is due to the fact that two of the cases attaching screws also secures this LFO Assy to the chassis. When replacing the case check that the Top LFO Assy is in position, that is, so the mounting flanges are flat on the chassis support. Slide the cover on. There should be little difficulty in aligning the screw holes as the assembly "just fits" between the Matrix Assy and T302 of the Metering Assy.

The top and bottom surfaces of the Matrix and Metering Assys are accessable by removing the two top Phillips head screws holding each board in place and hinging the boards down.

The RF and HFO Assy is held in position by two slot drive screws and two slots formed in the frame. Loosening these screws allows the assembly to be slid out and be rotated 90° .

4.3 MECHANICAL DISASSEMBLY

Remove the UGR 3 from the aircraft as all adjustments except sensitivity and balance are performed with the unit out of the case. (Refer to Figure 4-1.)

A. Removal of the case

- 1. Remove the four (4) #4-40 screws from the top.
- 2. Hold the case firmly and slide the chassis out by gently pulling on the front panel connector and it's mounting plate.

B. Access to the Top LFO Assy

- 1. Two of the four case attaching screws also attach this assembly. Therefore when the unit is removed from the case, the Top LFO Assy is not attached but held in place only by the leads attached to it.
- 2. The cover of this LFO Assy is secured in place by two (2) screws on the top.

C. Access to the RF/OSC Assy solder side

- 1. Loosen the two (2) #4-40 screws (one on top, one on bottom).
- 2. Slide the frame outward until the screws are clear of the screw slots, once clear, the assembly can be rotated 90° without disconnecting any leads.

 (Note: In reassembly make sure the PC board is positioned between the two dimpled slots.)
- D. Access to the metering and matrix PC board "inner side"
 - 1. Each board has hinges at the bottom corners. To hinge down, remove the two top corner screws from the boards.

E. Access to the IF Assy

1. All components are accessible from either the top or the bottom without removing any other subassembly, however the Top LFO Assy may have to be moved a bit.

4.4 ELECTRICAL MAINTENANCE

The electrical maintenance is separated into three areas: Performance Tests (Section 4-7), Trouble Isolation (Section 4-10), and Alignment (Section 4-14). For an inoperative receiver or one that has low output, refer to the trouble isolation procedure. Although the RF and IF alignment procedures are given, there is no need for automatically performing receiver alignment. The performance test procedures given in Section 4-9 will indicate low output from a specific section of the receiver. If alignment does not increase the output reading, then use the schematic voltage checks and circuit tracing to identify the malfunctioning component.

4.5 LIST OF RECOMMENDED TEST EQUIPMENT

- A. Glide Slope Signal Generator, Boonton Model 232A or equivalent
- B. RF Signal Generator, Hewlett-Packard Model 606A or equivalent
- C. DC Power Supply, Power Designs Model 1015 0-50V, 1,5A or equivalent
- D. AC VTVM, Ballantine Model 300D or equivalent
- E. DC VTVM, RCA Senior Voltohmyst WV-98C or equivalent
- F. NAV/COM receiver for channel selection
- G. Deviation Indicator, Weston 1951T, 1000 ohms, 150-0-15 microamps -1%* or equivalent
- H. Flag Indicator, Weston 901, 1000 ohms, 0-500 microamps -1%* or equivalent 'For proper operation of the UGR 3, the two indicators must load the output circuit properly. Refer to Figure 2-4 for external load resistor connections.

4.6 PRELIMINARY STEPS

- A. Connect the unit to the test set-up as shown in Figure 4-2.
- B. Set the glide slope generator to 332.0 MHz.
- C. Set the channel selector to 109.3
- D. Set the DC power supply to 13.75 or 27.5 volts per the cable wiring. Primary current should be approximately 220 ma.
- E. Set the glide slope generator output control to 350 microvolts and the tone ratio control to 0 db (standard centering signal). Be sure that each of the two audio signals (90 and 150 Hz) modulates the RF carrier exactly 45%.

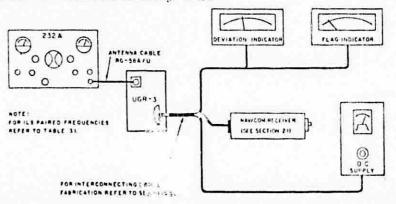


FIGURE 4-2. UGR 3 TEST SET-UP

4.7 PERFORMANCE TESTS

The performance test given below are for overall tests of the UGR 3. Failure to meet these test specifications indicates that alignment, adjustment, and/or repair of the receiver must be performed. It is recommended that the following performance tests be performed before alignment is attempted. All RF voltages given are "soft" microvolts, i.e. voltages across 50 ohm load. If a 6 db pad is used in the output of the generator, the RF voltages referred to in the procedure below should be doubled. The metering circuit adjustments (Section 4.8) must be completed before continuing with the tests in Section 4.9. The "STANDARD SIGNALS" used in the subsequent tests are described below:

- A. Standard RF Signal
 An RF carrier amplitude modulated simultaneously with 90 and 150 Hz +0.3% signals so that the sum of their separate modulation levels equals 90 +2%.
- B. Standard Centering Signal
 A standard test signal in which the difference in depth of modulation of the 90 and 150
 Hz signals is less than .002 (0 db).
- C. Standard Deviation Signal
 A standard test signal in which the difference in depth of modulation of the 90 and 150
 Hz signals is 0.105 -.002 (2 db).

4.8 METERING CIRCUIT ADJUSTMENT

- A. Adjust BALANCE (R318) to center the deviation indicator.
- B. Set the glide slope generator tone ratio control to 2 db, 90 Hz. Adjust SENSITIVITY control (R311) of the UGR 3 to obtain 78 microamperes deflection on the deviation indicator.
- C. Repeat steps A and B until 78 microamperes deflection is obtained at 2.0 db and 0 microamperes at 0 db.

 R311

 R318

 NAB.514

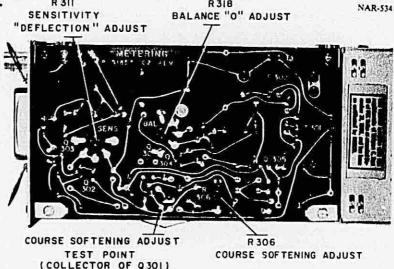


FIGURE 4-3. METERING BOARD, LOCATION OF CONTROLS

4.9 PERFORMANCE TEST PROCEDURES

A. Sensitivity

Set the glide slope generator output control to 25 microvolts and the tone ratio to 2.0 db, 90 Hz. The following shall be observed on each channel:

- 1. Deviation indication deflection of 47 microamperes minimum with no more than -4 microamperes, erratic needle movement.
- 2. Flag indicator should read 250 microamperes, minimum.

B. Deflection Characteristics

- 1. Set the glide slope generator to 332.00 MHz and the channel selector to 109.3. Set the output control to 350 microvolts and the tone ratio to 2.0 db, 150 Hz. The deviation indicator should read 78 -3 microamperes.
- 2. Set the tone ratio to each 0.5 db position. The deviation indicator should read 19.5 -6 microamperes.
- 3. Set the tone ratio to each 1.0 db position. The deviation indicator should read 39 -6 microamperes.
- 4. Set the tone ratio to each 3.3 db position. The deviation indicator should read 128-18 micro amperes.
- 5. Increase the glide slope generator output to 7000 microvolts. Set the tone ratio to each 2.0 db position. The deviation indicator should read -12 microamperes of that obtained at 350 microvolts level.

C. AGC Characteristics

Set the glide slope generator to 332.0 MHz and the tone ratio to 0 db. When the glide slope generator output is varied from 25 microvolts to 30,000 microvolts the following should be observed:

- 1. The deviation indicator reading should be 0 -5 microamperes.
- 2. The flag indicator reading should vary from 250 microamperes, minimum, to 450 microamperes, maximum. The maximum reading is nominally 400 microamperes.

D. Alarm Flag

- 1. Set the tone ratio to 0 db. When the output of the glide slope generator is varied from 25 microvolts to 30,000 microvolts the flag indicator reading shall be greater than 250 microamperes.
- 2. When the antenna cable is disconnected from the glide slope generator the flag indicator reading should be less than 10 microamperes.
- 3. Set the glide slope generator output to 350 microvolts. Set the tone ratio to CAL 90 and CAL 150. The flag indicator reading should be less than 200 microamperes in either position.
- 4. Set the glide slope generator output to 350 microamperes and turn the modulation off. The flag indicator reading should be less than 10 microamperes.
- 5. Set the tone ratio control to 2.0 db, 90 Hz. Set the glide slope generator output for 39 microamperes deflection on the deviation indicator. The flag indicator reading should be less than 220 microamperes.

4.10 TROUBLE ISOLATION PROCEDURE

The trouble isolation procedures for the UGR 3 are divided into the following functional areas: RF, tuning (oscillator selection), and IF amplifiers; matrix section; and the metering section. In the procedures that follow, operating frequencies are given on the functional block diagram, references will be made to the simplified schematics of Section 3, and the various operating frequencies are given in Section 3's Table 3.2.

The operating voltages are shown on the schematics of Section 6. The modulation tones are 90 and 150 Hz sine waves, the demodulated output from the detector is a combination of the two signals. The shape of this complex waveform is dependent upon the amplitude and phase displacement of the two frequencies. The course centering control varies both signals simultaneously. Following the 90 and 150 Hz filters, each signal voltage is a sine wave that is rectified to provide an equivalent amplitude DC voltage. Measurements of the AC voltages are given as read on an AC VTVM and the rectified voltages on a DC VTVM.

When isolating trouble to the malfunctioning area, use the glide slope signal generator as a signal source and connect to a NAV converter for output indications. The UGR 3 AGC buss must be monitored with a DC VTVM reference to the +10 volt DC regulated power source.

The troubleshooting procedure given here utilizes the glide slope signal generator as the signal source for the operational circuits throughout the receiver. The tests listed can be used for quick checks of the various sections of the UGR 3.

- A. Quick Check for Overall Receiver Operation
 Connect the signal generator to the antenna and supply a 25 microvolt 332.0 MHz
 signal, modulated for a centering signal, then ground pin 2 of J102. The flag
 should be activated and the indicator should be on the center position.
- B. Quick Check for Metering Section Operation

 Connect the signal generator DEMOD OUTPUT to the detector output (Terminal 1 of T105) and set the controls for a centering signal. The flag should be activated and the indicator should be on the center position. The DEMOD output should be set to approximately 0.3 volts rms.
- C. Quick Check of RF, IF, and Oscillator Sections Connect the signal generator to the input of Q106, Q105, Q103, Q102, and Q101 in the sequence given. Set the frequency and signal levels as indicated in Figure 6-1. Correct gains indicates that the stage is operative, improper gains suggests a malfunctioning stage.

4.11 TROUBLE ISOLATION, RF and IF SECTIONS

The RF and LF Quick Check procedure described in Section 4.10C should be sufficient to isolate a non-operative or low output amplifier stage. It is difficult, however, to decide when a marginal operating stage requires component replacement or when it requires alignment.

Usually, if the operating voltages are within limits and the gain is low, alignment is required. The calibrated RF attenuator on the signal generator can be used to locate low output RF and/or IF amplifier stages. If the input requires higher levels than shown in Figure 6-1, the amplifier has low output. Refer to Section 4.14 for alignment instructions.

Although the Quick Check procedure is satisfactory for finding troubles in the IF, RF, and mixer stages, troubles in the LFO and HFO stages present a different problem. If oscillator trouble is indicated, use an additional RF signal generator to simulate the HFO crystal frequency, 75.4625 to 76.6625 MHz or the LFO crystal frequencies, 34.8 to 35.85 MHz. Refer to Table 3.2 for crystal oscillator frequencies.

The operating frequency of the LFO or the HFO is determined by the crystal selection which is explained in Section 4.12.

4.12 TROUBLE ISOLATION, MATRIX SECTION

The resistor-diode matrix shown in Figures 3-1, 3-2, and 6-3 controls the crystal selection of the LFO (Q207/Q501) and the HFO (Q108). Each of the 10 input lines of J102 is connected into the matrix to select two crystals, one LFO and one HFO. When one of the 10 input lines is grounded, the voltage distribution performs the following:

- 1. forward biases the diode in one of four LFO crystal circuits
- 2. turns ON one of five transistor gates connected to an HFO crystal.

By simultaneously grounding pin 22 of J102 and any one of the 10 input lines, a different pair of crystals is selected. As shown in Table 3.2, 10 pairs of crystals are selected with the A/B select line open circuited and an addition 10 pairs are selected when the A/B select line is simultaneously grounded. The LFO and HFO selection is described in detail in Sections 3-2, 3-6, 3-9, and 3-10. Simplified schematics are shown in Figures 3-1 and 3-2.

4.12 Continued

NOTE

All diodes are identified in Section 5. Polarities are marked on the diodes, the band is on the cathode end of the diode.

The subsequent paragraphs describe the condition of these internal circuits when the 10 input lines or 10 input lines plus the A/B select line are connected to ground.

A. A/B Select Circuits

- 1. Terminal 22 of J102 is open on all "A Bank" channels (ie: 109 and 110 odd tenth channels) and grounded on all "B Bank" channels (ie: 108 and 111 odd tenth channels).
- 2. When terminal 22 of J102 is open, this line (junction of R242 and R243) is at approximately 8.4 volts DC and the collector of Q206 is approximately 0.5 volts DC.
- 3. When terminal 22 of J102 is grounded, this line (junction of R242 and R243) is at approximately 0 volts DC and the collector of Q206 is approximately 8.0 volts DC.
- 4. If the voltages as given in step 2 and 3 are not obtained, check Q206 for open or shorted elements. Check R241, R242, and R243 for an open circuit.

B. HFO Select Circuits

- 1. Check the emitter voltages of Q201 thru Q205, refer to Figure 6-3. The voltages should be within -20% as shown on all glide slope channels.
- 2. Check the collector voltages of Q201 thru Q205. All of the transistors, except the one selected should have zero volts at the collector. The "ON" transistor should have approximately 2.5 volts.

 Refer to Table 3.2 and Figure 6-3.
- 3. Measure the base voltages of Q201 thru Q205 and the bias voltages of diodes CR201 thru CR208. The "ON" diode should have approximately 0.4 volts DC forward bias. Refer to Table 3.2 and Figure 6-3.

C. LFO Select Circuits

- 1. Check to confirm that the forward bias voltage of the "ON" diode is approximately 0.4 volts DC.
- 2. If the forward bias is too high, check forward and back resistance of the diode by removing it from the circuit. Replace the diode if shorted or open.
- 3. Check to see that all other diodes in the circuit are reverse biased except the "ON" diode.

4.13 TROUBLE ISOLATION, METERING SECTION

The Quick Check tests of Section 4-10 are of value since they permit isolating a malfunction to the area of metering section. This area is shown in the simplified schematic in Figure 3-4 and described in detail in Sections 3-14 thru 3-17. The metering circuit adjustments are given in Section 4-8.

Refer to Figure 6-2 as it shows the metering schematic as well as voltage measurements. Table 4.1 has additional test voltages with one or two tones modulating the carrier. Troubleshooting may consist of checking voltages and resistances to locate the malfunctioning component. In addition to the conventional components there are three select-by-test components in the metering section. Section 4-15 provides full instructions for the selection of these components; however, it is necessary to know when these procedures are required. The select-by-test components are:

C305, it tunes the 150 Hz filter

C307, it tunes the 90 Hz filter

R301, it sets the range of the sensitivity control (R311).

These select-by-test components should be checked when all other tests do not indicate the source of trouble.

The following tests show that the select-by-test components may be at fault:

- A. When a centering singal is applied, the indicator should be capable of being centered by adjusting R318.
- B. When signals 2 db UP and 2 db DOWN from the centering signal are used, balance should be within 5 microamperes.
- C. When the sensitivity limits cannot be reached, change R301 (Refer to Section 4-15)*.
 - * With the standard deviation signal described in Section 4-7C, R311 should be capable of varying the deflection current between the 70 to 90 microampere range.

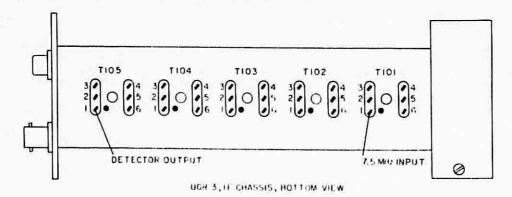


FIGURE 4-4. IF CHASSIS, BOTTOM VIEW

SECTION 4

4.14 ALIGNMENT PROCEDURE

A. Low Frequency IF

- 1. Connect AC VTVM and oscilloscope to terminal 1 of T105. (Refer to Figure 4-4.)
- 2. Connect the RF signal generator to the base of Q103 at terminal 1 of T101 through a .01 mfd capacitor with a 47 ohm resistor to ground on the generator side of the capacitor. Set the generator to 7.5 MHz modulated 30% by 1000 Hz. Set the input voltage to 13.75 or 27.5 volts per cable wiring.
- 3. Tune T102, T103, and T104 for maximum output, keeping the generator output set for approximately 0.1 volts AC detector output.
- 4. Tune T105 for maximum output.
- 5. Check gain, 8 microvolts maximum should produce 0.1 volts AC detector output. Set the channel selector to 110.70 MHz (330.20 MHz). Connect a VTVM to T105, pin 1. Set VTVM to measure positive DC volts. With no signal applied to the UGR 3, adjust C519 for minimum DC voltage.

Check the bandwidth as follows:

- a. Set generator output to obtain 0.1 volts AC at the detector output.
- b. Increase generator output 6 db (2X).
- c. Detune the generator above the resonant frequency to obtain a reference output of 0.1 volts AC. Record this frequency.
- d. Detune the generator below the resonant frequency to obtain a reference output of 0.1 volts AC. Record this frequency.
- e. Subtract the frequency recorded in step d from that recorded in step c. The difference should be greater than 100 KHz. This is the 6 db bandwidth.
- f. Subtract the center of the frequencies recorded in steps c and d from 7.5 MHz. This difference should be less than 20 KHz.
- g. Increase the generator output 60 db (1000X) above that obtained in step a.
- h. Detune the generator above the resonant frequency to obtain reference output of 0.1 volts AC. Record this frequency.
- i. Detune the generator below the resonant frequency to obtain reference output of 0.1 volts AC. Record this frequency.
- j. Subtract the frequency recorded in step i from that recorded in step h. This difference should be less than 520 KHz.
- k. Subtract the center of the frequencies recorded in steps h and i from 7.5 MHz. This difference should be less than 25 KHz.

B. High Frequency Oscillator

The tuning of the HFO is critical. It is important that the tuning be performed at the correct frequency since proper operation at cold temperatures may be affected.

- 1. Connect the common lead of the DC VTVM to the +10 volt buss. Connect the probe to Q109 base at L114.
- 2. Set the channel selector to 109.3 and A+ to 13.75 or 27.5 volts (Refer to cable wiring.)
- 3. Tune L113 for maximum output (approximately -2 volts).
- 4. Check the drive on all channels. Minimum drive should be -1.0 volts DC.

4.14 Continued

C. Doubler

The tuning of the doubler is critical. It is important that the tuning be performed at the correct frequency since proper operation at cold temperatures may be affected.

- 1. Connect the probe to Q103 emitter at R104.
- 2. Set channel selector to 108.9 MHz. Tune L115 and L116 for maximum drive level (approximately -1.6 volts DC).

D. RF Circuits

- 1. Connect glide slope generator to the unit. Set the generator to 332.0 MHz and a standard centering signal. Set channel selector to 109.3 MHz.
- 2. Tune C101, C102, C106 for maximum detector output keeping the glide slope generator output at the correct level to obtain approximately 0.1 volts AC detector level.
- 3. Increase the glide slope generator output to obtain approximately 0.2 volts AC detector level and place a finger close to L102 so that the detector level drops to approximately 0.1 volts AC; then tune C101 for maximum detector output.
- 4. Place a finger close to L101 and tune C102 for maximum detector output.

E. High Frequency IF

- 1. Set the glide slope generator to 332.0 and channel selector to 109.3 MHz.
- 2. Tune the primary and secondary of T101 for maximum detector output on outer peaks. Keep detector level at approximately 0.1 volts AC by reducing the glide slope output during tuning.
- 3. Check detector output on channels 108.9, 110.5, 108.5, and 110.7 which is equivalent to 329.3, 329.6, 329.9, and 330.2 respectively.
- 4. Balance the detector output on these four channels by tuning the secondary of T101 (slug away from chassis). A nominal variation of 3 db should be observed between the four channels.

F. Metering Circuits

- 1. Set the glide slope generator to 332.0 MHz. Set the channel selector to 109.3 MHz.
- 2. Set the sensitivity control (R311), balance control (R318), and course softening control (R306) to mid-range.
- 3. Set the glide slope generator to 350 microvolts and 0 db output.
- 4. Connect the AC VTVM probe to Q301 collector. (Refer to Figure 4-3.) Adjust course softening control (R306) to maximum reading, then decrease output 0.5 db by rotating the control clockwise (CW). All adjustments must be made from the circuit side of the board. The course softening adjustment should be made with care and checked, as under Section 4.9 B step 5, after steps 5, 6, and 7 are completed.
- 5. Set the glide slope generator output to 350 microvolts and 0 db output. Set the balance control for center reading of deviation indicator.
- 6. Set the glide slope generator tone ratio to 2 db, 90 Hz. Set the sensitivity control for 78 microamperes on the deviation indicator.
- 7. Repeat steps 5 and 6 to eliminate interaction results.

4.14 Continued

G. Final Performance Tests

If no problems exist, the unit should meet all the requirements as in the Performance Tests given in Section 4.9.

If equipment is available to check the bandwidth at UHF, it is recommended that this be performed. The following bandwidth should be obtained.

6 db bandwidth = 100 KHz, minimum 60 db bandwidth = 520 KHz, maximum

NOTE:

Equipment recommended for this test:

RF Generator, Boonton Model 211-A or equivalent
Omni Generator, Collins Model 479S3 or equivalent
Univerter, ARC Model H23A or equivalent

4.15 INSTALLATION OF SELECT-BY-TEST COMPONENTS

Although all of the UGR 3 electrical components are shown in the parts list and schematics, the values of some are identified as "SELECT". The SELECT components are select-by-test with the values selected at the factory to adjust overall tuning or gain of critical circuits. The selection procedures are as follows:

A. Tuning of 150 Hz Filter, T301 secondary

- 1. Connect as shown in Figure 4-2.
- 2. Set the generator and channel selector to 332.0 MHz (109.30).
- 3. Remove C305 and connect the capacitor substitution box across C304.
- 4. Set the generator to CAL 150 and decrease the attenuator until the deviation indicator reads approximately 100 microamperes.
- 5. Adjust the capacitor substitution controls until the maximum deflection is obtained. Remove the substitution box, obtain an equivalent value capacitor, and solder the capacitor (C305) in the circuit board.

B. Tuning of 90 Hz Filter, T302 secondary

- 1. Perform steps A1 and A2.
- 2. Remove C307 and connect the capacitor substitution box across C306.
- 3. Set the generator to CAL 90 and decrease the attenuator until the deviation indicator reads approximately 100 microamperes.
- 4. Adjust the capacitor substitution controls until the maximum deflection is obtained. Remove the substitution box, obtain an equivalent value capacitor, and solder the capacitor (C307) in the circuit board.

C. Selection of R301

- 1. Connect the unit as shown in Figure 4-2.
- 2. Set the generator and channel selector to 332.0 MHz (109.30).
- 3. Set the generator attenuator to 350 microvolts and the tone ratio control to 0 db.
- 4. Connect the AC voltmeter to Q301 collector. Set the course softening control (R306) to maximum; then, turn CW to decrease 0.5 db. Adjust from the circuit side of the board.
- 5. With the sensitivity control (R311) set to the maximum CW position, adjust the balance control (R318) for center reading of the deviation indicator. Set the tone ratio to 2 db 90 Hz and note the deviation indicator reading.
- 6. With the sensitivity control (R311) set to the maximum CCW position, adjust the balance control (R318) for center reading of the deviation indicator. Set the tone ratio to 2 db 90 Hz and note the deviation indicator reading.
- 7. The SENS control (R311) adjustment range shall be 70 to 90 microamperes. If not within this range, remove R301 and connect a resistance substitution box.
- 8. With the resistance set between 3.3K and 10K ohms, repeat this procedure until the correct range of adjustment is obtained.
- 9. Remove the resistance substitution box and replace with an equivalent value resistor.

4.16 OSCILLATOR TROUBLE ISOLATION TECHNIQUES

Since the UGR 3 is a dual conversion superheterodyne receiver, both oscillators must be in operation at all times. If the LFIF signal is not evident at the LFIF amplifiers (Q104, Q105, or Q106) the usual cause is an inoperative HFO or LFO. Repair of the oscillator may be a minor operation; however, isolation to the inoperative stage could be a time consuming task, since there are many multiple paths and diodes to trace through in the matrix.

Table 3.2 presents the receiver operating frequency and the operating frequencies of the oscillators. The table is arranged to show sequentially from left to right: glide slope input frequency as related to the selected channel and the key points within the UGR 3 that should be activated at that particular setting.

- A. The glide slope frequency as well as the HFIF frequencies increase in 150 KHz steps.
- B. The 50 KHz activate line (J102-3) is alternately grounded.
- C. The A/B Select line (J102-22) closes and opens every two steps (ground-ground/open-open).
- D. Either a diode or a resistor is selected.
- E. A transistor is used for eight (8) successive frequencies.
- F. That each LFO Assy operates at every other step whereas each LFO crystal operates every eighth step (once with each HFO).

4.17 OSCILLATOR REPAIR TECHNIQUES

A. Localizing the Inoperative Oscillator

If the receiver is inoperative on any one channel, the method provided here can be used to locate the oscillator that is not in operation.

- 1. Monitor the detector output signal and rotate the channel selector switch sequentially through the 40 channels, changing the RF input signal to the operating frequency of each channel.
- 2. List the channels that have no detector output signal.
- 3. Refer to Table 3.2 and list the LFO and HFO frequencies.
- Compare frequencies and note which frequency (LFO or HFO) is missing from more than one channel.
 NOTE:

A single LFO oscillator will affect five channels.

A single HFO oscillator will affect eight channels.

B. Oscillator Trouble Localizing

With the inoperative oscillator identified, it is now necessary to determine if the crystal or the external oscillator circuit is at fault. Assuming that the inoperative oscillator is the 34.8 MHz LFO, the following procedure is suggested.

NOTE:

Although the 34.8 MHz LFO is connected to other channels, only the 329.15 (108.95) channel will be used in this example.

- 1. Refer to Table 3.2. Remember all Localizer Receiver MHz frequencies ending in "0" are related to the Top LFO Assy and those ending in "5" are related to the LFO Assy located on the Matrix Board.
- 2. With the channel selector switch in the 108.95 position, unsolder the 34.8 and 35.1 MHz crystals; then, temporarily interchange and solder the two crystals into the oscillator circuits.
- 3. Increase the RF input frequency 300 KHz (from 329.15 to 329.45 MHz) and monitor the detector output. Since the 35.1 MHz crystal originally operated in the adjacent crystal position, a no-output condition will show that the circuit is at fault (not the crystal).
- 4. Rotate the channel selector to the 110.55 position and set the signal generator 300 KHz lower (329.15 MHz). Since this circuit originally operated, a no-output condition will show that the 34.8 MHz crystal is at fault (not the external circuit). NOTE:

The external oscillator circuit is comprised of the selector switch, matrix diodes or gate transistors, and interconnection wires that could have cold solder joints.

C. A/B Select Circuit (Q206)

As the RF input frequency is changed through the 40 channel positions, the A/B select line is connected to ground or open circuited (refer to Table 3.2). If the receiver operates only on 20 of the 40 channels, the A/B circuit could be responsible. Check the A/B switch (Q206) output, diodes, resistors, and the interconnection wiring for proper operation.

4-18 OPERATING VOLTAGE MEASUREMENTS

The detected glide slope voltages measured during the normal operation of the UGR 3 are given in Table 4.1

TABLE 4.1 METERING SECTION TEST VOLTAGES

Test Point	90Hz Only	150Hz Only	90 and 150Hz
Detector Output Term. (T105)	0.275 VAC	0.275 VAC	0.34 VAC
Q-301 (B)	0.0019 VAC	0.0019 VAC	0.0024 VAC
Q-301 (C)	0.17 VAC	0.17 VAC	0.2 VAC
Q-301 (E)	0.022 VAC	0.022 VAC	0.026 VAC
Q-302 (B)	0.17 VAC	0.17 VAC	0.2 VAC
Q-302 (C)	0.45 VAC	0.43 VAC	0.5 VAC
Q-302 (E)	0.26 VAC	0.21 VAC	0.26 VAC
Q-303 (C)	2.3 VAC	2.4 VAC	2.8 VAC
Q-302 (E)	0.5 VAC	0.47 VAC	0.6 VAC
*T-301 term. 3	2.2 VAC (Cal. 90)	4.4 VAC (Cal. 150)	5.8 VAC
*T-301 term. 4	0.8 VAC	1.7 VAC "	2.2 VAC
*T-301 term. 5	0.8 VAC	1.7 VAC	2.2 VAC
T-302 term. 2	1.4 VAC	0.8 VAC	1.6 VAC
*T-302 term. 3	3.2 VAC	1.5 VAC	4 VAC
*T-302 term. 4	1.2 VAC	0.5 VAC	1.5 VAC
*T-302 term. 5	1.2 VAC	0.5 VAC	1.5 VAC

Input Signal: Std. signal at center frequency, 332.0 MHz 350 μV ; 45% modulation of each tone.

Input Voltage: 13.75 Volts DC.

^{*}Measurements ref. to J102 pin 18. Unless otherwise noted, all other measurements ref. to gnd. All voltages checked with AC VTVM (Ballantine or equiv.)

REPLACEMENT PARTS LIST

SECTION 5

Item No.	Part Number	Description
	04069-0001	LABEL, FCC CERTIFICATION
	04293-0001	LABEL, ADJUSTMENTS
	81275-0001	NUT, SELF-LOCKING
	81716-0001	LUG, SOLDER
	81738-0001	LUG, SOLDER
	91016-0037	TUBING, FIBERGLASS, 1-1/2" LONG
	81290-0001	NUT, "U", #4-40
	82814-0403	SCREW, BD. HD. SL. STAINLESS
	51869-0001	SPRING, GROUND
	51865-0001	SPRING, GROUND
	51850-0101	CASE
	51851-0101	CHASSIS, IF
	51855-0001	BOX, RF
	51857-0001	BRACKET, RF BOX
	51856-0001	PANE L, CONNECTOR
	51864-0001	BRACKET
	51860-0001	BRACKET
	51861-0001	HINGE
	51862-0001	SHIE LD, RF
	51858-0001	FRAME, SHIELD
	51859-0001	COVER, SHIELD
	81213-0054	SPACER
	51863-0001	SPRING, GROUND
	81336-0003	WASHER, FLAT (INSULATING)
	82904-0101	NUT, SELF-CLINCHING, #4-40
	81423-0005	TERMINAL, STAND-OFF
	81355-0002	RIVET, PLASTIC, FASTEX
	82864-0003	SCREW, NYLON, #4-40
	82003-0005	CLAMP, CABLE
	82841-0404	SCREW, MACHINE, RD HD, SL, #3-56

Item No.	Part Number	Description
	51873-0001	COVER, TOP
	51874-0001	COVER, BOTTOM
	51875-0001	SHIELD, LFO
	81160-0015	GROMMET, RUBBER
	81207-0031	SPACER, THREADED
	52726-0001	TRANSIPAD
	82814-0002	SCREW, MACH, PAN HD, SL, #4-40 x 3/16
	81324-0004	LOCKWASHER, SPLIT, #4-40
	90071 -0001	CABLE, COAX
	91022-0003	SLEEVING
	51853-0102	RF PC BOARD (Less Components)
	51854-0102	MATRIX PC BOARD (Less Components)
	51852-0102	METERING PC BOARD (Less Components)
	51871-0001	LFO PC BOARD (Less Components)

C101 22041-0001 CAPACITOR, CER, VARIABLE, 2-8 pf, NPO C102 22041-0001 CAPACITOR, CER, VARIABLE, 2-8 pf, NPO C103 24509-0228 CAPACITOR, CER, TUB, .22pf -5% C104 21291-0014 CAPACITOR, CER DISC, 100 pf -10% C105 21291-0014 CAPACITOR, CER DISC, 100 pf -10% C106 22041-0001 CAPACITOR, CER DISC, 100 pf -10% C107 21291-0014 CAPACITOR, CER DISC, 100 pf -10% C108 24516-0229 CAPACITOR, CER DISC, 100 pf -10% C109 21291-0021 CAPACITOR, CER DISC, 2, 2 - 25 pf, NPO C110 24516-0689 CAPACITOR, CER DISC, 15 pf -10%, NPO C111 24516-0150 CAPACITOR, CER DISC, 6, 8 pf -0, 5 pf, NPO C112 24515-0009 CAPACITOR, CER DISC, .01 MFD, 560V C113 24515-0009 CAPACITOR, CER DISC, .01 MFD, 560V C114 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C115 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C117 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C118 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C110 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C111 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C112 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C113 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, .01 MFD, 50V C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, .01 MFD, 50V C128 21201-0330 CAPACITOR, CER DISC, .01 MFD, 50V C129 21291-0021 CAPACITOR, CER DISC, .1k pf -20% CAPACITOR, CER DISC, .4, 7 -5, pf, N750	ltem No.	Part Number	Description
C102 22041-0001 CAPACITOR, CER, VARIABLE, 2-8 pf, NPO C103 24509-0228 CAPACITOR, CER, TUB, .22pf -5% C104 21291-0014 CAPACITOR, CER DISC, 100 pf -10% C105 21291-0014 CAPACITOR, CER DISC, 100 pf -10% C106 22041-0001 CAPACITOR, CER, VARIABLE, 2-8 pf, NPO C107 21291-0014 CAPACITOR, CER, VARIABLE, 2-8 pf, NPO C108 24516-0229 CAPACITOR, CER DISC, 100 pf -10% C109 21291-0021 CAPACITOR, CER DISC, 2,2 - 25 pf, NPO C110 24516-0689 CAPACITOR, CER DISC, 6,8 pf -0,5 pf, NPO C111 24516-0150 CAPACITOR, CER DISC, 6,8 pf -10,5 pf, NPO C112 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C113 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C114 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C115 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C117 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C118 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, .01 MFD, 50V C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C123 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, .01 MFD, 50V C128 21201-0330 CAPACITOR, CER DISC, .1k pf -20% C129 21291-0021 CAPACITOR, CER DISC, .1k pf -20% C129 21291-0021 CAPACITOR, CER DISC, .1k pf -20% C129 21291-0021 CAPACITOR, CER DISC, .1k pf -20%	C101	22041-0001	CAPACITOR, CER, VARIABLE, 2-8 pf, NPO
C103 24509-0228 CAPACITOR, CER, TUB, .22pf $^{+}$ 5% C104 21291-0014 CAPACITOR, CER DISC, 100 pf $^{+}$ 10% C105 21291-0014 CAPACITOR, CER DISC, 100 pf $^{+}$ 10% C106 22041-0001 CAPACITOR, CER, VARIABLE, 2-8 pf, NPO C107 21291-0014 CAPACITOR, CER, VARIABLE, 2-8 pf, NPO C108 24516-0229 CAPACITOR, CER DISC, 100 pf $^{+}$ 10% C108 24516-0229 CAPACITOR, CER DISC, 100 pf $^{+}$ 10% NPO C109 21291-0021 CAPACITOR, CER DISC, 16, 8 pf $^{+}$ -0.5 pf, NPO C110 24516-0689 CAPACITOR, CER DISC, 6, 8 pf $^{+}$ -0.5 pf, NPO C111 24515-0009 CAPACITOR, CER DISC, 15 pf $^{+}$ 10%, NPO C112 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C114 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C115 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C117 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C118 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C128 21201-0330 CAPACITOR, CER DISC, .01 MFD, 50V C128 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C129 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C128 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C129 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C129 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C129 21291-0021 CAPACITOR, C	C102	22041-0001	
C104 21291-0014 CAPACITOR, CER DISC, 100 pf $^{+}$ 10% C105 21291-0014 CAPACITOR, CER DISC, 100 pf $^{+}$ 10% C106 22041-0001 CAPACITOR, CER, VARIABLE, 2-8 pf, NPO C107 21291-0014 CAPACITOR, CER DISC, 100 pf $^{+}$ 10% C108 24516-0229 CAPACITOR, CER DISC, 2, 2 $^{+}$, 25 pf, NPO C109 21291-0021 CAPACITOR, CER DISC, 16 pf $^{+}$ 20% C110 24516-0689 CAPACITOR, CER DISC, 15 pf $^{+}$ 10%, NPO C111 24515-0009 CAPACITOR, CER DISC, 01 MFD, 50V C113 24515-0009 CAPACITOR, CER DISC, 01 MFD, 50V C114 24516-0150 CAPACITOR, CER DISC, 01 MFD, 50V C115 24515-0009 CAPACITOR, CER DISC, 01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, 01 MFD, 50V C117 24516-0150 CAPACITOR, CER DISC, 01 MFD, 50V C118 24515-0009 CAPACITOR, CER DISC, 01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, 01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, 01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, 01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, 01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, 01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, 01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, 01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, 01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, 01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, 01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, 01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, 01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, 18 pf $^{+}$ 20% CAPACITOR, CER DISC, 18 pf $^{+}$ 20% CAPACITOR, CER DISC, 18 pf $^{+}$ 10%, NPO C128 21201-0330 CAPACITOR, CER DISC, 18 pf $^{+}$ 10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 18 pf $^{+}$ 10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 18 pf $^{+}$ 10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 18 pf $^{+}$ 10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 18 pf $^{+}$ 10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 18 pf $^{+}$ 10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 18 pf $^{+}$ 10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 18 p	C103	24509-0228	
C105 21291-0014 CAPACITOR, CER DISC, 100 pf $^{+}$ 10% C106 22041-0001 CAPACITOR, CER, VARIABLE, 2-8 pf, NPO C107 21291-0014 CAPACITOR, CER DISC, 100 pf $^{+}$ 10% C108 24516-0229 CAPACITOR, CER DISC, 2, 2 $^{+}$.25 pf, NPO C109 21291-0021 CAPACITOR, CER DISC, 16, 8 pf $^{+}$ -0.5 pf, NPO C110 24516-0689 CAPACITOR, CER DISC, 15 pf $^{+}$ 10%, NPO C111 24515-0009 CAPACITOR, CER DISC, 01 MFD, 50V C113 24515-0009 CAPACITOR, CER DISC, 01 MFD, 50V C114 24516-0150 CAPACITOR, CER DISC, 01 MFD, 50V C115 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C117 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C118 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .1k pf $^{+}$ 20% CAPA	C104	21291-0014	
C106 22041-0001 CAPACITOR, CER, VARIABLE, 2-8 pf, NPO C107 21291-0014 CAPACITOR, CER DISC, 100 pf -10% C108 24516-0229 CAPACITOR, CER DISC, 2.2 - 2.5 pf, NPO C109 21291-0021 CAPACITOR, CER DISC, 1.6 pf -2.0% C110 24516-0689 CAPACITOR, CER DISC, 1.5 pf -1.0 pf, NPO C111 24516-0150 CAPACITOR, CER DISC, 1.5 pf -1.0 pf, NPO C112 24515-0009 CAPACITOR, CER DISC, 0.1 MFD, 50V C113 24515-0009 CAPACITOR, CER DISC, 0.1 MFD, 50V C114 24516-0150 CAPACITOR, CER DISC, 0.1 MFD, 50V C115 24515-0009 CAPACITOR, CER DISC, 0.1 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, 0.1 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, 0.1 MFD, 50V C117 24516-0150 CAPACITOR, CER DISC, 0.1 MFD, 50V C118 24515-0009 CAPACITOR, CER DISC, 0.1 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, 0.1 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, 0.1 MFD, 50V C121 24515-0009 CAPACITOR, CER DISC, 0.1 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, 0.1 MFD, 50V C123 24515-0009 CAPACITOR, CER DISC, 0.1 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, 0.1 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, 0.1 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, 0.1 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, 0.1 MFD, 50V C128 21201-0330 CAPACITOR, CER DISC, 1k pf -20%	C105	21291-0014	
C107 21291-0014 CAPACITOR, CER DISC, $100 \text{ pf}^{+}10\%$ C108 $24516-0229$ CAPACITOR, CER DISC, $2.2^{+}2.25 \text{ pf}$, NPO C109 $21291-0021$ CAPACITOR, CER DISC, $1 \text{K pf}^{+}20\%$ C110 $24516-0689$ CAPACITOR, CER DISC, $6.8 \text{ pf}^{+}0.5 \text{ pf}$, NPO C111 $24516-0150$ CAPACITOR, CER DISC, $6.8 \text{ pf}^{+}0.5 \text{ pf}$, NPO C112 $24515-0009$ CAPACITOR, CER DISC, 0.1 MFD , 50V C113 $24515-0009$ CAPACITOR, CER DISC, 0.1 MFD , 50V C114 $24516-0150$ CAPACITOR, CER DISC, 0.1 MFD , 50V C115 $24515-0009$ CAPACITOR, CER DISC, 0.1 MFD , 50V C116 $24515-0009$ CAPACITOR, CER DISC, 0.1 MFD , 50V C117 $24516-0150$ CAPACITOR, CER DISC, 0.1 MFD , 50V C118 $24515-0009$ CAPACITOR, CER DISC, 0.1 MFD , 50V C119 $24515-0009$ CAPACITOR, CER DISC, 0.1 MFD , 50V C119 $24515-0009$ CAPACITOR, CER DISC, 0.1 MFD , 50V C119 $24515-0009$ CAPACITOR, CER DISC, 0.1 MFD , 50V C120 $24509-0518$ CAPACITOR, CER DISC, 0.1 MFD , 50V C121 $24515-0009$ CAPACITOR, CER DISC, 0.1 MFD , 50V C122 $21291-0011$ CAPACITOR, CER DISC, 0.1 MFD , 50V C123 $24515-0009$ CAPACITOR, CER DISC, 0.1 MFD , 50V C124 $24515-0009$ CAPACITOR, CER DISC, 0.1 MFD , 50V C125 $24515-0009$ CAPACITOR, CER DISC, 0.1 MFD , 50V C126 $21291-0021$ CAPACITOR, CER DISC, 0.1 MFD , 50V C127 $21555-0026$ CAPACITOR, CER DISC, 0.1 MFD , 50V C128 $21201-0330$ CAPACITOR, CER DISC, 0.1 MFD , $0.1 $	C106	22041-0001	
C108 24516-0229 CAPACITOR, CER DISC, $2.2 \stackrel{+}{-} .25 \text{ pf}$, NPO C109 21291-0021 CAPACITOR, CER DISC, $1 \text{K pf} \stackrel{+}{-} 20\%$ C110 24516-0689 CAPACITOR, CER DISC, $6.8 \text{ pf} \stackrel{+}{-} 0.5 \text{ pf}$, NPO C111 24516-0150 CAPACITOR, CER DISC, $15 \text{ pf} \stackrel{+}{-} 10\%$, NPO C112 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C113 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C114 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C115 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C117 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C118 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, .01 MFD, 50V C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C123 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, .1K pf $\stackrel{+}{-}20\%$ C128 21201-0330 CAPACITOR, CER DISC, .1K pf $\stackrel{+}{-}20\%$	C107	21291-0014	
C109 21291-0021 CAPACITOR, CER DISC, $1 \text{K pf} \pm 20\%$ C110 24516-0689 CAPACITOR, CER DISC, $6.8 \text{ pf} \pm 0.5 \text{ pf}$, NPO C111 24516-0150 CAPACITOR, CER DISC, $15 \text{ pf} \pm 10\%$, NPO C112 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C113 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C114 24516-0150 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C115 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C116 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C117 24516-0150 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C118 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C119 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C119 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C120 24509-0518 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C121 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C122 21291-0011 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C123 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C124 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C125 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C126 21291-0021 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50V C127 21555-0026 CAPACITOR, CER DISC, $.1 \text{ MFD} \pm 0.00 \text{V}$ C128 21201-0330 CAPACITOR, CER TUB, $33 \text{ pf} \pm 0.00 \text{ NPO}$ C129 21291-0021 CAPACITOR, CER DISC, $.01 \text{ MFD} \pm 0.00 \text{ NPO}$	C108	24516-0229	
C110 24516-0689 CAPACITOR, CER DISC, $6.8 \text{ pf}^{+}-0.5 \text{ pf}$, NPO C111 24516-0150 CAPACITOR, CER DISC, $15 \text{ pf}^{+}-10\%$, NPO C112 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C113 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C114 24516-0150 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C115 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C116 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C117 24516-0150 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C118 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C119 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C120 24509-0518 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C121 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C122 21291-0011 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C123 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C124 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C125 24515-0009 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C126 21291-0021 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C127 21555-0026 CAPACITOR, CER DISC, $.01 \text{ MFD}$, 50 V C128 21201-0330 CAPACITOR, CER TUB, $.33 \text{ pf}^{+}-10\%$, NPO C129 21291-0021 CAPACITOR, CER TUB, $.33 \text{ pf}^{+}-10\%$, NPO C129 21291-0021 CAPACITOR, CER DISC, $.1 \text{ K pf}^{+}-20\%$	C109	21291-0021	
C111 24516-0150 CAPACITOR, CER DISC, 15 pf -10%, NPO C112 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C113 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C114 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C115 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C117 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C118 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, .01 MFD, 50V C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C123 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, .1K pf -20% C128 21201-0330 CAPACITOR, CER TUB, 33 pf -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C110	24516-0689	
C112 24515-0009 CAPACITOR, CER DISC, .01 MFD, 56V C113 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C114 24516-0150 CAPACITOR, CER DISC, .15 pf -10%, NPO C115 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C117 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C118 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, .01 MFD, 50V C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C123 24515-0009 CAPACITOR, CER DISC, .00 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, .1 MFD, 50V C128 21201-0330 CAPACITOR, CER DISC, .1 MFD -10%, 20V C129 21291-0021 CAPACITOR, CER DISC, .1 MFD -10%, 20V C129 21291-0021 CAPACITOR, CER DISC, .1 MFD -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, .1 MFD -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, .1 MFD -20%	C111	24516-0150	A DO TO THE SAME OF THE SAME O
C113 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C114 24516-0150 CAPACITOR, CER DISC, 15 pf +10%, NPO C115 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C117 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C118 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, .01 MFD, 50V C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C123 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, .01 MFD, 50V C128 21201-0330 CAPACITOR, CER DISC, .1K pf +20% C129 21291-0021 CAPACITOR, CER DISC, .1K pf +10%, NPO C129 21291-0021 CAPACITOR, CER DISC, .1K pf +20%	C112	24515-0009	
C114 24516-0150 CAPACITOR, CER DISC, 15 pf -10%, NPO C115 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C117 24516-0150 CAPACITOR, CER DISC, .01 MFD, 50V C118 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER DISC, .01 MFD, 50V C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C123 24515-0009 CAPACITOR, CER DISC, .00 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, .1K pf -20% C128 21201-0330 CAPACITOR, CER TUB, 33 pf -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C113	24515-0009	
C115 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C117 24516-0150 CAPACITOR, CER DISC, .15 pf -10%, NPO C118 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER TUB, .51 pf -5% C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C123 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .1K pf -20% C127 21555-0026 CAPACITOR, CER DISC, 1K pf -10%, 20V C128 21201-0330 CAPACITOR, CER TUB, 33 pf -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C114	24516-0150	
C116 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C117 24516-0150 CAPACITOR, CER DISC, 15 pf -10%, NPO C118 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER TUB, .51 pf -5% C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C123 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, .1K pf -20% C128 21201-0330 CAPACITOR, CER TUB, 33 pf -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C115	24515-0009	
C117 24516-0150 CAPACITOR, CER DISC, 15 pf -10%, NPO C118 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER TUB, .51 pf -5% C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, .01 MFD, 50V C123 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, .1K pf -20% C128 21201-0330 CAPACITOR, CER TUB, 33 pf -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C116	24515-0009	
C118 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER TUB, .51 pf +5% C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, 200 pf +10% C123 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, .1k pf +20% C128 21201-0330 CAPACITOR, CER TUB, 33 pf +10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1k pf +20% CAPACITOR, CER TUB, 33 pf +10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1k pf +20%	C117	24516-0150	
C119 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C120 24509-0518 CAPACITOR, CER TUB, .51 pf -5% C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, 200 pf -10% C123 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, 1K pf -20% C128 21201-0330 CAPACITOR, CER TUB, 33 pf -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20% C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C118	24515-0009	
C120 24509-0518 CAPACITOR, CER TUB, .51 pf +5% C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, 200 pf +10% C123 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, 1K pf +20% C128 21201-0330 CAPACITOR, CER TUB, 33 pf +10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf +20%	C119	24515-0009	
C121 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C122 21291-0011 CAPACITOR, CER DISC, 200 pf -10% C123 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .01 MFD, 50V C127 21555-0026 CAPACITOR, CER DISC, 1K pf -20% C128 21201-0330 CAPACITOR, CER TUB, 33 pf -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C120	24509-0518	
C123 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, .1K pf -20% C127 21555-0026 CAPACITOR, TANT, 10 MFD -10%, 20V C128 21201-0330 CAPACITOR, CER TUB, 33 pf -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C121	24515-0009	
C123 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, 1K pf -20% C127 21555-0026 CAPACITOR, TANT, 10 MFD -10%, 20V C128 21201-0330 CAPACITOR, CER TUB, 33 pf -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C122	21291-0011	CAPACITOR, CER DISC, 200 pf +10%
C124 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, 1K pf -20% C127 21555-0026 CAPACITOR, TANT, 10 MFD -10%, 20V C128 21201-0330 CAPACITOR, CER TUB, 33 pf -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C123	24515-0009	CAPACITOR, CER DISC, .01 MFD, 50V
C125 24515-0009 CAPACITOR, CER DISC, .01 MFD, 50V C126 21291-0021 CAPACITOR, CER DISC, 1K pf -20% C127 21555-0026 CAPACITOR, TANT, 10 MFD -10%, 20V C128 21201-0330 CAPACITOR, CER TUB, 33 pf -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C124	24515-0009	
C126 21291-0021 CAPACITOR, CER DISC, 1K pf -20% C127 21555-0026 CAPACITOR, TANT, 10 MFD -10%, 20V C128 21201-0330 CAPACITOR, CER TUB, 33 pf -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C125	24515-0009	
C127 21555-0026 CAPACITOR, TANT, 10 MFD +10%, 20V C128 21201-0330 CAPACITOR, CER TUB, 33 pf +10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C126	21291-0021	
C128 21201-0330 CAPACITOR, CER TUB, 33 pf -10%, NPO C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C127	21555-0026	
C129 21291-0021 CAPACITOR, CER DISC, 1K pf -20%	C128	21201-0330	
	C129	21291-0021	
	C130	24528-0479	CAPACITOR, CER DISC, 4,7 + 5 pf, N750

Item No.	Part Number	Description
C131	24516-0229	CAPACITOR, CER DISC, 2.2 pf 25 pf, NPO
C132	21291-0007	CAPACITOR, CER DISC, 470 pf $^{+}$ 20%
C133	21291-0011	CAPACITOR, CER DISC, 200 pf -10%
C134	24516-0339	CAPACITOR, CER DISC, 3.3 pf25 pf, NPO
C135	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C136	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C137	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C138	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C139	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C140	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C141	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C142	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C143	24516-0180	CAPACITOR, CER DISC, 18 pf -10%, NPO
C144	21291-0011	CAPACITOR, CER DISC, 200 pf -10%
C145	21291-0011	CAPACITOR, CER DISC, 200 pf -10%
C146	21555-0026	CAPACITOR, TANT, 10 MFD -10%, 20V
C147	24515-0007	CAPACITOR, CER DISC, .05 MFD, 20V
C148	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C149	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C150	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C151	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C152	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C153	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C154	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C155	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C156	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C157	21298-0001	CAPACITOR, FEEDTHRU, 1K pf
C159	24516-0689	CAPACITOR, CER DISC, 6.85 pf, NPO
C160	24516-0569	CAPACITOR, CER DISC, 5.65 pf, NPO
C164	24515-0007	CAPACITOR, CER DISC, .05 MFD, 20V

Item No.	Part Number	Description
C201	21291-0021	CAPACITOR, CER DISC, 1K pf -20%
C202	24049-0270	CAPACITOR, DIPPED MICA, 27 pf -5%
C203	21291-0021	CAPACITOR, CER DISC, 1K pf -20%
C204	21296-0003	CAPACITOR, FEEDTHRU, 1K pf
C205	21296-0003	CAPACITOR, FEEDTHRU, 1K pf
C206	21296-0003	CAPACITOR, FEEDTHRU, 1K pf
C207	21296-0003	CAPACITOR, FEEDTHRU, 1K pf
C208	21296-0003	CAPACITOR, FEEDTHRU, 1K pf
C209	21296-0003	CAPACITOR, FEEDTHRU, 1K pf
C210	21296-0003	CAPACITOR, FEEDTHRU, 1K pf
C211	21296-0003	CAPACITOR, FEEDTHRU, 1K pf
C212	21296-0003	CAPACITOR, FEEDTHRU, 1K pf
C213	24052-0470	CAPACITOR, DIPPED MICA, 47 pf -5%
C301	21555-0026	CAPACITOR, TANT, 10 MFD -10%, 20V
C302	21555-0026	CAPACITOR, TANT, 10 MFD +10%, 20V
C303	21555-0011	CAPACITOR, TANT, 39 MFD +10%, 20V
C304	23094-0175	CAPACITOR, MET MYLAR, .10 MFD -10%, 200V
C305	23085 -SE L	CAPACITOR, MYLAR, SELECT +10%, 100V
C306	23085-0081	CAPACITOR, MYLAR, .33 MFD +10%
C307	23085 -SE L	CAPACITOR, MYLAR, SELECT -10%, 100V
C308	21554-0020	CAPACITOR, ELECTRO, 500 MFD, 3V, NP
C309	21555-0011	CAPACITOR, TANT, 39 MFD -10%, 10V
C310	21554-0015	CAPACITOR, ELECTRO, 150 MFD, 3V
C311	21554-0004	CAPACITOR, ELECTRO, 100 MFD, 30V
C312	21554-0013	CAPACITOR, ELECTRO, 500 MFD, 15V
C313	21554-0003	CAPACITOR, ELECTRO, 200 MFD, 15V
C401	24522-0001	CAPACITOR, CER, 8 SECTION
C402	24522-0001	CAPACITOR, CER, 8 SECTION

Item No.	Part Number	Description
C501	21296-0003	CAPACITOR, FEEDTHRU, 1K pf, 500V
C502	21296-0003	CAPACITOR, FEEDTHRU, 1K pf, 500V
C503	21296-0003	CAPACITOR, FEEDTHRU, 1K pf, 500V
C504	21296-0003	CAPACITOR, FEEDTHRU, 1K pf, 500V
C505	21296-0003	CAPACITOR, FEEDTHRU, 1K pf, 500V
C506	21296-0003	CAPACITOR, FEEDTHRU, 1K pf, 500V
C507	21296-0003	CAPACITOR, FEEDTHRU, 1K pf, 500V
C508	21296-0003	CAPACITOR, FEEDTHRU, 1K pf, 500V
C511	24052-0470	CAPACITOR, DIPPED MICA, 47 pf -5%
C512	24049-0270	CAPACITOR, DIPPED MICA, 27 pf +5%
C513	21291-0021	CAPACITOR, CER DISC, 1K pf -20%
C514	21296-0003	CAPACITOR, FEEDTHRU, 1K pf, 500V
C516	21296-0003	CAPACITOR, FEEDTHRU, 1K pf, 500V
C517	21296-0003	CAPACITOR, FEEDTHRU, 1K pf, 500V
C519	22041-0004	CAPACITOR, CER, 5.5 to 18 pf, 200V, NPO (Located at T101-6 and GND)
CR101	75011-0001	DIODE, GERMANIUM, 1N 295
CR102	75011-0001	DIODE, GERMANIUM, 1N295
CR103	75025-0012	DIODE, ZENER, $10.0V - 2\%$, $1W$
CR104	75014-0001	DIODE, GERMANIUM
CR105	75014-0001	DIODE, GERMANIUM
CR106	75014-0001	DIODE, GERMANIUM
CR107	75014-0001	DIODE, GERMANIUM
CR108	75014-0001	DIODE, GERMANIUM
CR109	75204-0045	DIODE, SILICON, 500 PIV
CR201	75014-0001	DIODE, GERMANIUM
CR202	75014-0001	DIODE, GERMANIUM
CR203	75014-0001	DIODE, GERMANIUM
CR204	75014-0001	DIODE, GERMANIUM
CR205	75014-0001	DIODE, GERMANIUM
CR206	75014-0001	DIODE, GERMANIUM

ltem No.	Part Number	Description
CR207	75014-0001	DIODE, GERMANIUM
CR208	75014-0001	DIODE, GERMANIUM
CR209	75014-0001	DIODE, GERMANIUM
CR210	75014-0001	DIODE, GERMANIUM
CR211	75014-0001	DIODE, GERMANIUM
CR212	75014-0001	DIODE, GERMANIUM
CR213	75014-0001	DIODE, GERMANIUM
CR214	75014-0001	DIODE, GERMANIUM
CR215	75014-0001	DIODE, GERMANIUM
CR216	75014-0001	DIODE, GERMANIUM
CR301	75028-0001	DIODE, SILICON
CR302	75014-0001	DIODE, GERMANIUM
CR303	75014-0001	DIODE, GERMANIUM
CR304	75014-0001	DIODE, GERMANIUM
CR305	75014-0001	DIODE, GERMANIUM
CR501	75014-0001	DIODE, GERMANIUM
CR502	75014-0001	DIODE, GERMANIUM
CR503	75014-0001	DIODE, GERMANIUM
CR504	75014-0001	DIODE, GERMANIUM
CR505	75014-0001	DIODE, GERMANIUM
CR506	75014-0001	DIODE, GERMANIUM
CR507	75014-0001	DIODE, GERMANIUM
CR508	75014-0001	DIODE, GERMANIUM
CR511	75028-0001	DIODE, SILICON
J101	41211-0001	CONNECTOR, BNC
J102	41285-0005	CONNECTOR, 24 TERMINALS

Item No.	Part Number	Description
L101	11516-0002	COIL, UHF
L102	11516-0002	COIL, UHF
L103	11516-0001	COIL, UHF
L104	11138-0011	CHOKE, RF, 3.3 uh -10%
L105	11138-0019	CHOKE, RF, 15 uh -10%
L106	11138-0015	CHOKE, RF, 6.8 uh -10%
L107	11138-0015	CHOKE, RF, 6.8 uh -10%
L108	11138-0015	CHOKE, RF, 6.8 uh -10%
L109	11138-0015	CHOKE, RF, 6.8 uh -10%
L110	11138-0015	CHOKE, RF, 6.8 uh -10%
L111	11138-0015	CHOKE, RF, 6.8 uh -10%
L112	11138-0003	CHOKE, RF, .22uh -20%
L113	11517-0001	COIL, HFO, 75 MHz
L114	11138-0002	CHOKE, RF, .15 uh $^{+}_{-20}\%$
L115	11518-0001	COIL, DOUBLER, 150 MHz
L116	11518-0001	COIL, DOUBLER, 150 MHz
L118	11485-0009	CHOKE, RF, .47 uh -10%
L201	11138-0018	CHOKE, RF, 12 uh -10%
L202	11138-0018	CHOKE, RF, 12 uh -10%
L203	11138-0018	CHOKE, RF, 12 uh $^+$ -10%
L204	11138-0018	CHOKE, RF, 12 uh -10%
L205	11138-0008	CHOKE, RF, 1.5 uh -10%
L206	11138-0019	CHOKE, RF, 15 uh -10%
L501	11138-0018	CHOKE, RF, 12 uh -10%
L502	11138-0018	CHOKE, RF, 12 uh -10%
L503	11138-0018	CHOKE, RF, 12 uh -10%
L504	11138-0018	CHOKE, RF, 12 uh -10%
L505	11138-0009	CHOKE, RF, 2.2 uh -10%
L506	11485-0001	CHOKE, RF, 0.1 uh -10% (Located at T101-2/6)

Item No.	Part Number	<u>De</u>	scription	
Q101	75561-0005	TRANSISTOR,	GERMANIUM, PNP, 2N2496	
Q102	75561-0005	TRANSISTOR,	GERMANIUM, PNP, 2N2496	
Q103	75556-0001	TRANSISTOR,	GERMANIUM, PNP, A1383	
Q104	75556-0001	TRANSISTOR,	GERMANIUM, PNP, A1383	
Q105	75556-0001	TRANSISTOR,	GERMANIUM, PNP, A1383	
Q106	75556-0001	TRANSISTOR,	GERMANIUM, PNP, A1383	
Q107	75550-0007	TRANSISTOR,	SILICON, NPN, 2N3391	
Q108	75561-0009	TRANSISTOR,	GERMANIUM, PNP, 2N2654	
Q109	75556-0002	TRANSISTOR,	GERMANIUM	
Q201	75561-0006	TRANSISTOR,	GERMANIUM, PNP, 2N404A	L
Q202	75561-0006	TRANSISTOR,	GERMANIUM, PNP, 2N404A	Ĺ
Q203	75561-0006	TRANSISTOR,	GERMANIUM, PNP, 2N404A	¥.
Q204	75561-0006	TRANSISTOR,	GERMANIUM, PNP, 2N404A	i.
Q205	75561-0006	TRANSISTOR,	GERMANIUM, PNP, 2N404A	L
Q206	75561-0003	TRANSISTOR,	SILICON, NPN, 2N706	
Q207	75556-0001	TRANSISTOR,	GERMANIUM, PNP, A1383	
Q301	75535-0001	TRANSISTOR,	GERMANIUM, PNP, 2N2613	
Q302	75550-0007	TRANSISTOR,	SILICON, NPN, 2N3391	
Q303	75561-0008	TRANSISTOR,	SILICON, PNP, 2N4037	
Q304	75550-0007	TRANSISTOR,	GERMANIUM, NPN, 2N3391	
Q305	75561-0006	TRANSISTOR,	SILICON, PNP, 2N404A	
Q501	75556-0001	TRANSISTOR,	GERMANIUM, PNP, A1383	
Q502	75615-0002	TRANSISTOR,	SILICON, PNP, 2N5139	
Q503	75615-0002	TRANSISTOR,	SILICON, PNP, 2N5139	
Q504	75615-0002	TRANSISTOR.	SILICON, PNP, 2N5139	

Item No.	Part Number	Description
R101	31192-0821	RESISTOR, CARBON, $820 - 10\%$, $1/4W$
R102	31192-0101	RESISTOR, CARBON, 100 -10%, 1/4W
R103	31192-0471	RESISTOR, CARBON, $470 - 10\%$, $1/4W$
R104	31192-0222	RESISTOR, CARBON, 2.2K -10%, 1/4W
R105	31192-0101	RESISTOR, CARBON, 100 -10%, 1/4W
R106	31192-0122	RESISTOR, CARBON, 1.2K -10%, 1/4W
R107	31192-0101	RESISTOR, CARBON, 100 -10%, 1/4W
R108	31192-0122	RESISTOR, CARBON, 1.2K -10%, 1/4W
R109	31192-0223	RESISTOR, CARBON, $22K - 10\%$, $1/4W$
R110	31192-0562	RESISTOR, CARBON, $5.6K^{+}_{-10\%}$, $1/4W$
R111	31192-0122	RESISTOR, CARBON, 1.2K -10%, 1/4W
R112	31192-0103	RESISTOR, CARBON, 10K -10%, 1/4W
R113	31192-0152	RESISTOR, CARBON, $1.5K - 10\%$, $1/4W$
R114	31192-0391	RESISTOR, CARBON, 390 -10%, 1/4W
R115	31192-0471	RESISTOR, CARBON, 470 -10%, 1/4W
R116	31192-0221	RESISTOR, CARBON, 220 -10%, 1/4W
R117	31192-0103	RESISTOR, CARBON, 10K -10%, 1/4W
R118	31192-0682	RESISTOR, CARBON, 6.8K -10%, 1/4W
R119	31192-0183	RESISTOR, CARBON, 18K -10%, 1/4W
R120	31141-0470	RESISTOR, CARBON, $47 - 10\%$, $1/4$ W
R121	31192-0393	RESISTOR, CARBON, $39K^{+}_{-10\%}$, $1/4W$
R122	31192-0103	RESISTOR, CARBON, 10K -10%, 1/4W
R123	31192-0561	RESISTOR, CARBON, $560 - 10\%$, $1/4W$
R124	31192-0471	RESISTOR, CARBON, $470 + 10\%$, $1/4$ W
R125	31192-0221	RESISTOR, CARBON, 220 -10%, 1/4W
R126	31192-0223	RESISTOR, CARBON, 22K -10%, 1/4W
R127	31192-0181	RESISTOR, CARBON, 180 -10%, 1/4W
R128	31192-0122	RESISTOR, CARBON, $1.2K^{+}_{-10\%}$, $1/4W$

REPLACEMENT PARTS LIST

SECTION 5

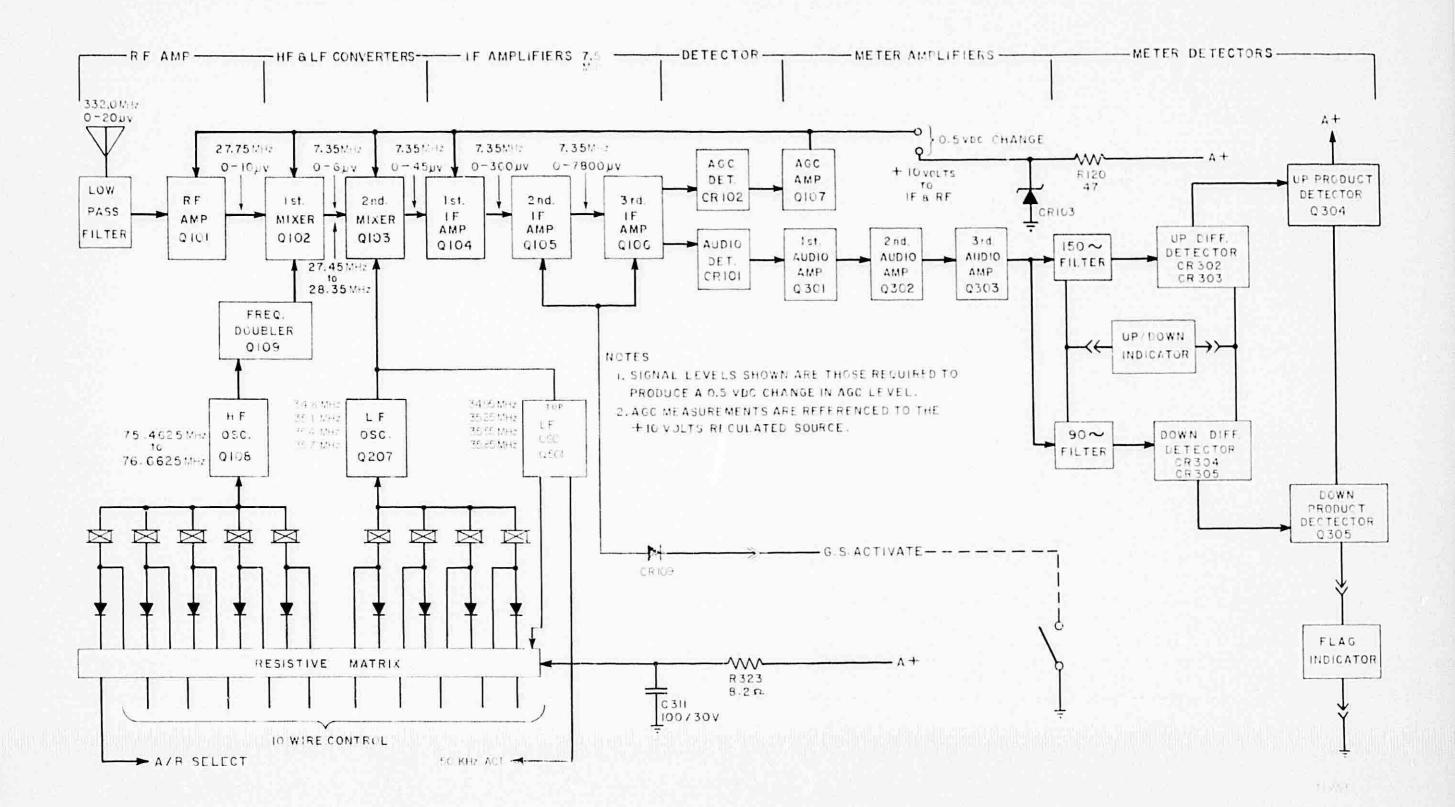
Item No.	Part Number	Descriptio	<u>n</u>
R201	31192-0102	RESISTOR, CARBON,	1K ⁺ -10%, 1/4W
R202	31192-0102	RESISTOR, CARBON,	1K ⁺ -10%, 1/4W
R203	31192-0102	RESISTOR, CARBON,	1K ⁺ -10%, 1/4W
R204	31192-0102	RESISTOR, CARBON,	1K ⁺ 10%, 1/4W
R205	31192-0102	RESISTOR, CARBON,	1K ⁺ 10%, 1/4W
R206	31195-0470	RESISTOR, CARBON,	47 ⁺ 5%, 1/4W
R207	31195-0470	RESISTOR, CARBON,	47 ⁺ 5%, 1/4W
R208	31195-0392	RESISTOR, CARBON,	3.9K ⁺ 5%, 1/4W
R209	31195-0392	RESISTOR, CARBON,	3.9K ⁺ 5%, 1/4W
R210	31195-0392	RESISTOR, CARBON,	3.9K ⁺ 5%, 1/4W
R211	31195-0392	RESISTOR, CARBON,	3.9K ⁺ 5%, 1/4W
R212	31195-0332	RESISTOR, CARBON,	3.3K ⁺ 5%, 1/4W
R213	31195-0332	RESISTOR, CARBON,	3.3K ⁺ 5%, 1/4W
R214	31195-0392	RESISTOR, CARBON,	
R215	31195-0392	RESISTOR, CARBON,	3.9K ⁺ 5%, 1/4W
R216	31195-0752	RESISTOR, CARBON,	
R217	31195-0392	RESISTOR, CARBON,	
R218	31195-0332	RESISTOR, CARBON,	$3.3K \pm 5\%$, $1/4W$
R219	31195-0392	RESISTOR, CARBON,	3.9K ⁺ 5%, 1/4W
R220	31195-0332	RESISTOR, CARBON,	3.3K ⁺ -5%, 1/4W
R221	31195-0752	RESISTOR, CARBON,	7.5K ⁺ 5%, 1/4W
R222	31195-0392	RESISTOR, CARBON,	3.9K ⁺ 5%, 1/4W
R223	31195-0332	RESISTOR, CARBON,	3.3K ⁺ -5%, 1/4W
R224	31195-0392	RESISTOR, CARBON,	3.9K ⁺ 5%, 1/4W
R225	31195-0332	RESISTOR, CARBON,	3.3K -5%, 1/4W

Item No.	Part Number	Description
R226	31195-0752	RESISTOR, CARBON, $7.5K - 5\%$, $1/4W$
R227	31195-0392	RESISTOR, CARBON, $3.9K - 5\%$, $1/4W$
R228	31195-0332	RESISTOR, CARBON, 3.3K -5%, 1/4W
R229	31195-0392	RESISTOR, CARBON, $3.9K^{+}-5\%$, $1/4W$
R230	31195-0332	RESISTOR, CARBON, $3.3K^{+}-5\%$, $1/4W$
R231	31141-0561	RESISTOR, CARBON, 560 -10%, 1/2W
R232	31141-0561	RESISTOR, CARBON, 560 -10%, 1/2W
R233	31141-0561	RESISTOR, CARBON, 560 -10%, 1/2W
R234	31141-0561	RESISTOR, CARBON, 560 -10%, 1/2W
R235	31141-0561	RESISTOR, CARBON, 560 -10%, 1/2W
R236	31141-0561	RESISTOR, CARBON, $560 - 10\%$, $1/2W$
R237	31141-0561	RESISTOR, CARBON, $560 - 10\%$, $1/2W$
R238	31141-0561	RESISTOR, CARBON, 560 -10%, 1/2W
R239	31141-0561	RESISTOR, CARBON, 560 -10%, 1/2W
R240	31141-0561	RESISTOR, CARBON, 560 -10%, 1/2W
R241	31136-0221	RESISTOR, CARBON, 220 -10%, 2W
R242	31135-0221	RESISTOR, CARBON, 220 -10%, 1W
R243	31192-0102	RESISTOR, CARBON, 1K -10%, 1/4W
R244	31195-0561	RESISTOR, CARBON, 560 -5%, 1/4W
R245	31195-0561	RESISTOR, CARBON, 560 -5%, 1/4W
R246	31195-0561	RESISTOR, CARBON, 560 -5%, 1/4W
R247	31195-0561	RESISTOR, CARBON, 560 -5%, 1/4W
R248	31195-0821	RESISTOR, CARBON, 820 -5%, 1/4W
R249	31195-0561	RESISTOR, CARBON, 560 -5%, 1/4W
R250	31195-0561	RESISTOR, CARBON, 560 -5%, 1/4W

Item No.	Part Number	Description
R251	31195-0561	RESISTOR, CARBON, 560 +5%, 1/4W
R252	31195-0561	RESISTOR, CARBON, 560 +5%, 1/4W
R253	31195-0561	RESISTOR, CARBON, 560 +5%, 1/4W
R254	31195-0561	RESISTOR, CARBON, 560 +5%, 1/4W
R255	31195-0561	RESISTOR, CARBON, 560 +5%, 1/4W
R256	31195-0561	RESISTOR, CARBON, 560 +5%, 1/4W
R257	31195-0821	RESISTOR, CARBON, 820 +5%, 1/4W
R258	31195-0561	RESISTOR, CARBON, 560 +5%, 1/4W
R259	31195-0561	RESISTOR, CARBON, 560 +5%, 1/4W
R260	31195-0561	RESISTOR, CARBON, 560 +5%, 1/4W
R261	31195-0561	RESISTOR, CARBON, 560 +5%, 1/4W
R262	31192-0102	RESISTOR, CARBON, 1K -10%, 1/4W
R263	31192-0470	RESISTOR, CARBON, 47 -10%, 1/4W
R264	31192-0222	RESISTOR, CARBON, 2.2K -10%, 1/4W
R265	31192-0333	RESISTOR, CARBON, 33K -10%, 1/4W
R266	31192-0683	RESISTOR, CARBON, 68K -10%, 1/4W
R267	31150-0101	RESISTOR, CARBON, 100 +5%, 1W
R268	31149-0560	RESISTOR, CARBON, 56 +5%, 1/2W
R269	31195-0683	RESISTOR, CARBON, 68K +5%, 1/4W
R270	31195-0330	RESISTOR, CARBON, 33 +5%, 1/4W
R271	31192-0101	RESISTOR, CARBON, 100 +10%, 1/4W

Item No.	Part Number	Description
R301	31195-SE L	RESISTOR, CARBON, SELECT -5%, 1/4W
R302	31195-0751	RESISTOR, CARBON, 750 -5%, 1/4W
R303	31192-0822	RESISTOR, CARBON, 8.2K -10%, 1/4W
R304	31192-0181	RESISTOR, CARBON, $180 - 10\%$, $1/4W$
R305	31192-0103	RESISTOR, CARBON, 10K -10%, 1/4W
R306	32047-0004	RESISTOR, POT. CARBON, 1.5K -30%
R307	31192-0222	RESISTOR, CARBON, 2.2K -10%, 1/4W
R308	31192-0683	RESISTOR, CARBON, 68K -10%, 1/4W
R309	31192-0473	RESISTOR, CARBON, 47K -10%, 1/4W
R310	31192-0101	RESIS "OR, CARBON, 100 -10%, 1/4W
R311	32045-0007	RESISTOR, VARIABLE, 100 -20%, 2W
R312	31192-0222	RESISTOR, CARBON, 2.2K -10%, 1/4W
R313	31192-0152	RESISTOR, CARBON, 1.5K $^{+}_{-}$ 10%, 1/4W
R314	31192-0101	RESISTOR, CARBON, 100 -10%, 1/4W
R315	31205-0004	RESISTOR, THERMISTOR, 128.8 -10%, 1W
R316	31192-0470	RESISTOR, CARBON, 47 -10%, 1/4W
R317	31192-0471	RESISTOR, CARBON, 470 -10%, 1/4W
R318	32045-0008	RESISTOR, VARIABLE, 500 -20%, 2W
R319	31195-0222	RESISTOR, CARBON, 2.2K -5%, 1/4W
R320	31195-0182	RESISTOR, CARBON, 1.8K -5%, 1/4W
R321	31192-0471	RESISTOR. CARBON, $470 - 10\%$, $1/4W$
R322	31192-0471	RESISTOR, CARBON, 470 -10%, 1/4W
R323	31135-0829	RESISTOR, CARBON, 8.2 -10%, 1W
R324	31189-0003	RESISTOR, WIREWOUND, 75 +5%, 5W
R325	31151-0241	RESISTOR, CARBON, 240 -5%, 2W
R326	31192-0220	RESISTOR, CARBON, 22 -10%, 1/4W
R327	31192-0330	RESISTOR, CARBON, 33 -10%, 1/4W
R328	31192-0394	RESISTOR, CARBON, 390K -10%, 1/4W
R329	31192-0154	RESISTOR, CARBON, 150K -10%, 1/4W
R330	31205-0003	RESISTOR, THERMISTOR, 48.2K -10%, 360MW

ltem No.	Part Number	Description
R501	31192-0683	RESISTOR, CARBON, 68K -10%, 1/4W
R502	31192-0333	RESISTOR, CARBON, 33K -10%, 1/4W
R503	31192-0222	RESISTOR, CARBON, 2.2K -10%, 1/4W
R504	31192-0102	RESISTOR, CARBON, 1K -10%, 1/4W
R505	31192-0123	RESISTOR, CARBON, 12K -10%, 1/4W
R506	31192-0123	RESISTOR, CARBON, 12K -10%, 1/4W
R507	31192-0472	RESISTOR, CARBON, 4.7K -10%, 1/4W
11101	11515-0001	TRANSFORMER, HFIF, 27.9 MHz
Т102	11514-0001	TRANSFORMER, LFIF, 7.35 MHz
T103	11514-0001	TRANSFORMER, LFIF, 7.35 MHz
Т104	11514-0001	TRANSFORMER, LFIF, 7.35 MHz
T105	11513-0001	TRANSFORMER, LFIF OUTPUT, 7.35 MHz
T301	11679-0001	TRANSFORMER, GLIDESLOPE
Т302	11679-0001	TRANSFORMER, GLIDESLOPE
ХТ101	72028-0004	CRYSTAL, SERIES MOD, 5ths, 76.3625 MHz
XT102	72028-0003	CRYSTAL, SERIES MOD, 5ths, 76.0625 MHz
XT103	72028-0001	CRYSTAL, SERIES MOD, 5ths, 75.4625 MHz
XT104	72028-0002	CRYSTAL, SERIES MOD, 5ths, 75.7625 MHz
XT105	72028-0005	CRYSTAL, SERIES MOD, 5ths, 76.6625 MHz
XT201	72028-0006	CRYSTAL, PARALLEL MODE, 3rd, 34.8 MHz
XT202	72028-0007	CRYSTAL, PARALLEL MODE, 3rd, 35.1 MHz
XT203	72028-0008	CRYSTAL, PARALLEL MODE, 3rd, 35.4 MHz
XT204	72028-0009	CRYSTAL, PARALLEL MODE, 3rd, 35.7 MHz
XT501	72028-0010	CRYSTAL, QUARTZ, 34.95 MHz
XT502	72028-0011	CRYSTAL, QUARTZ, 35.25 MHz
XT503	72028-0012	CRYSTAL, QUARTZ, 35.55 MHz
XT504	72028-0013	CRYSTAL, QUARTZ, 35.85 MHz



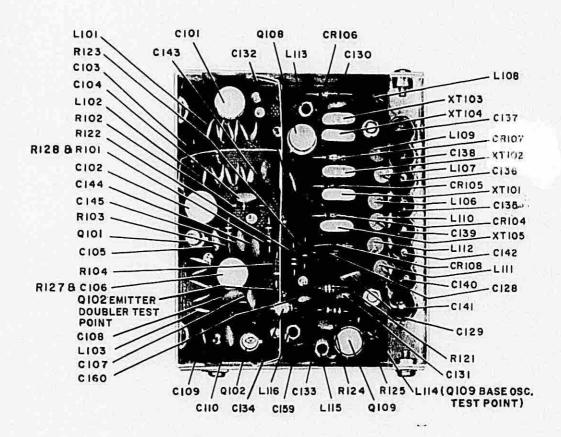


FIGURE 6-2A. RF PC BOARD, COMPONENT LOCATION

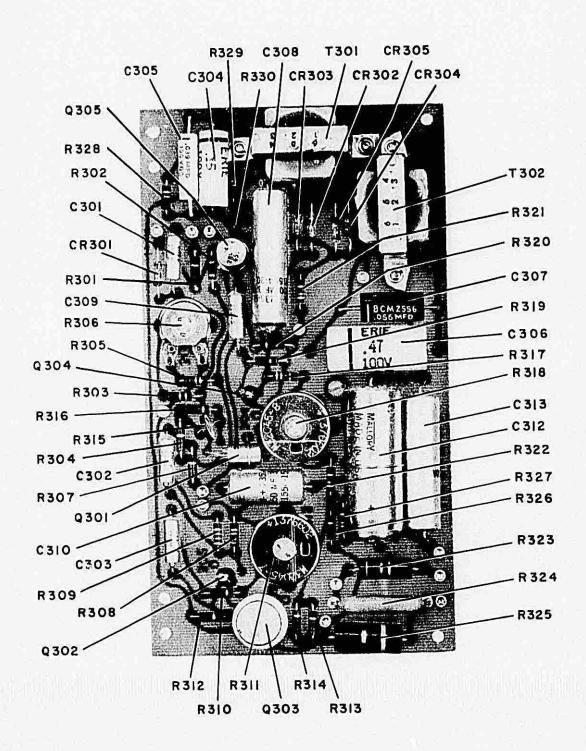
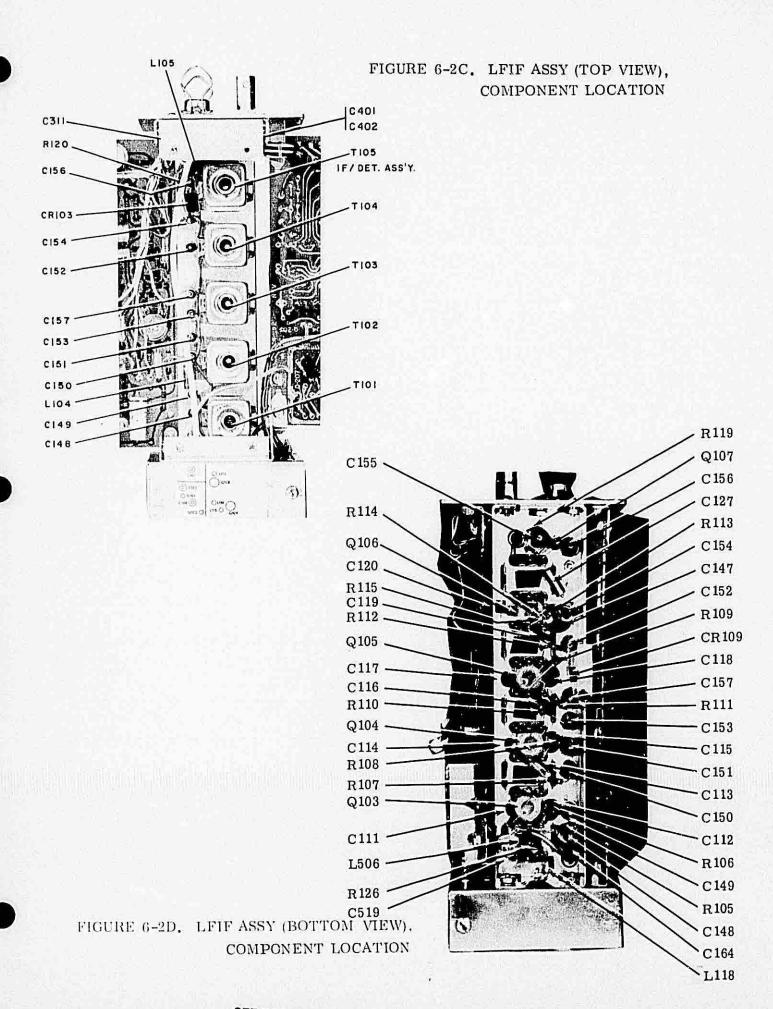
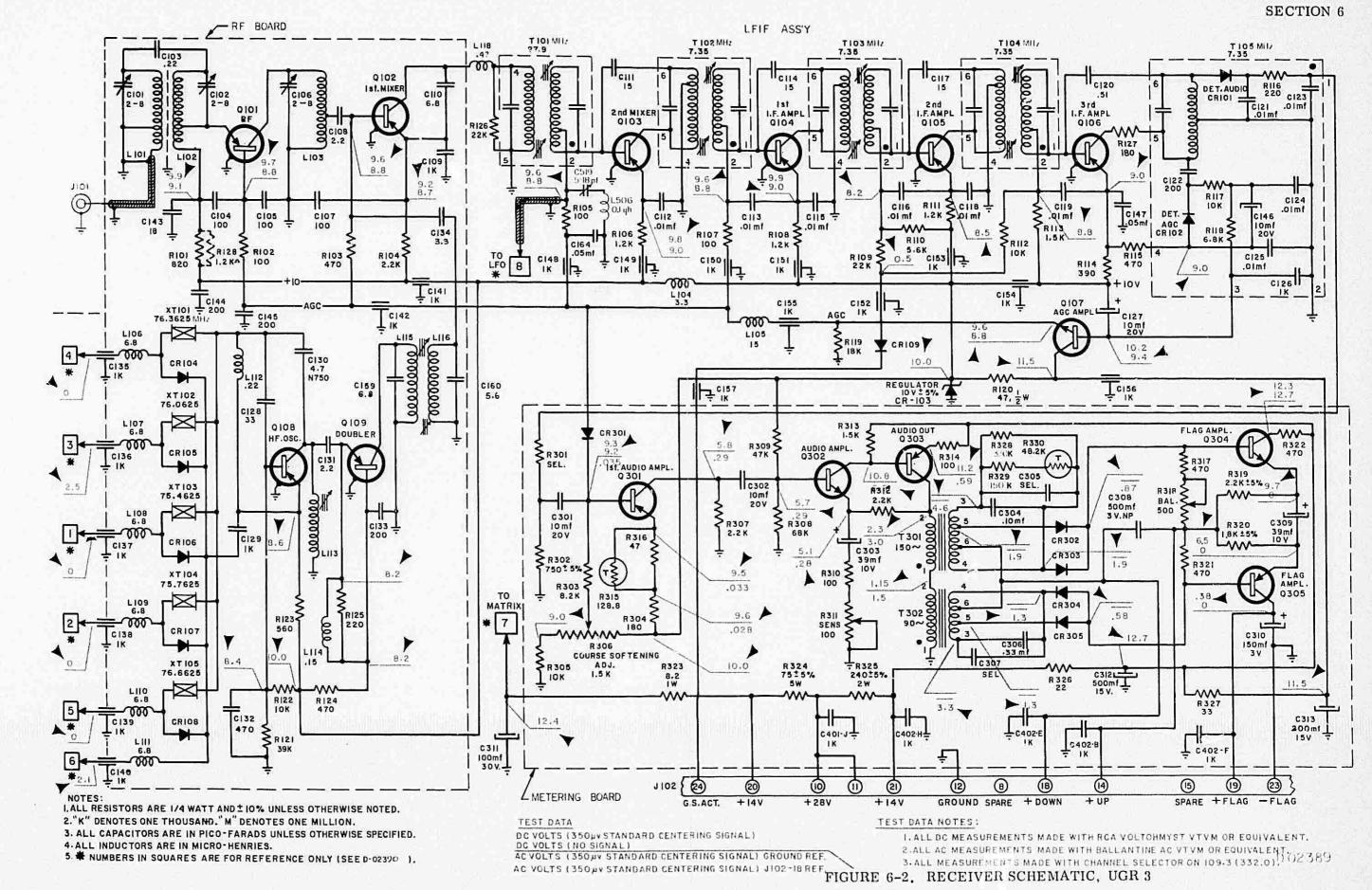


FIGURE 6-2B. METERING PC BOARD, COMPONENT LOCATION





OP VIEW), OCATION

R119

Q107

C156

C127

R113

C154

C147

C152

R109

CR 109

C118

- C157

R111

C153

C115

C151

C113

C150

C112

R106

C149

R105

C148 C164 L118

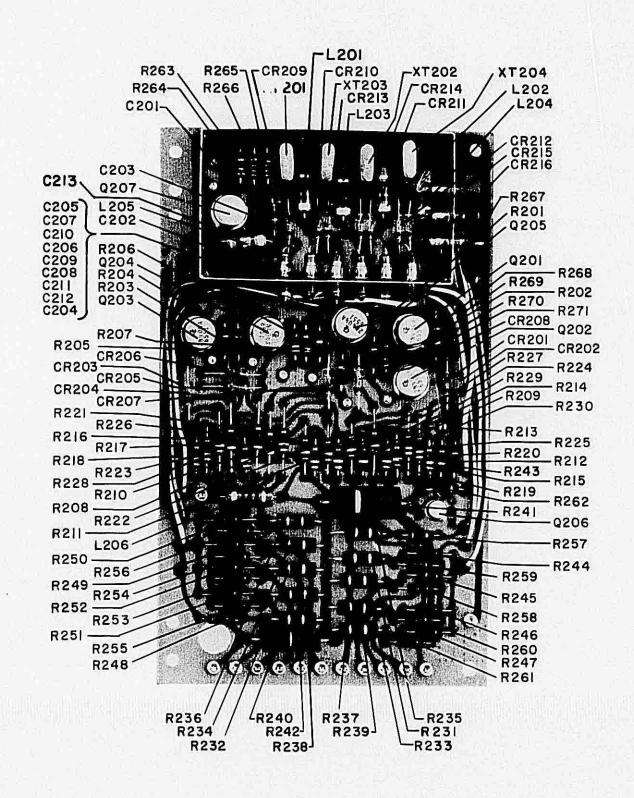


FIGURE 6-3A. MATRIX ASSY, COMPONENT LOCATION

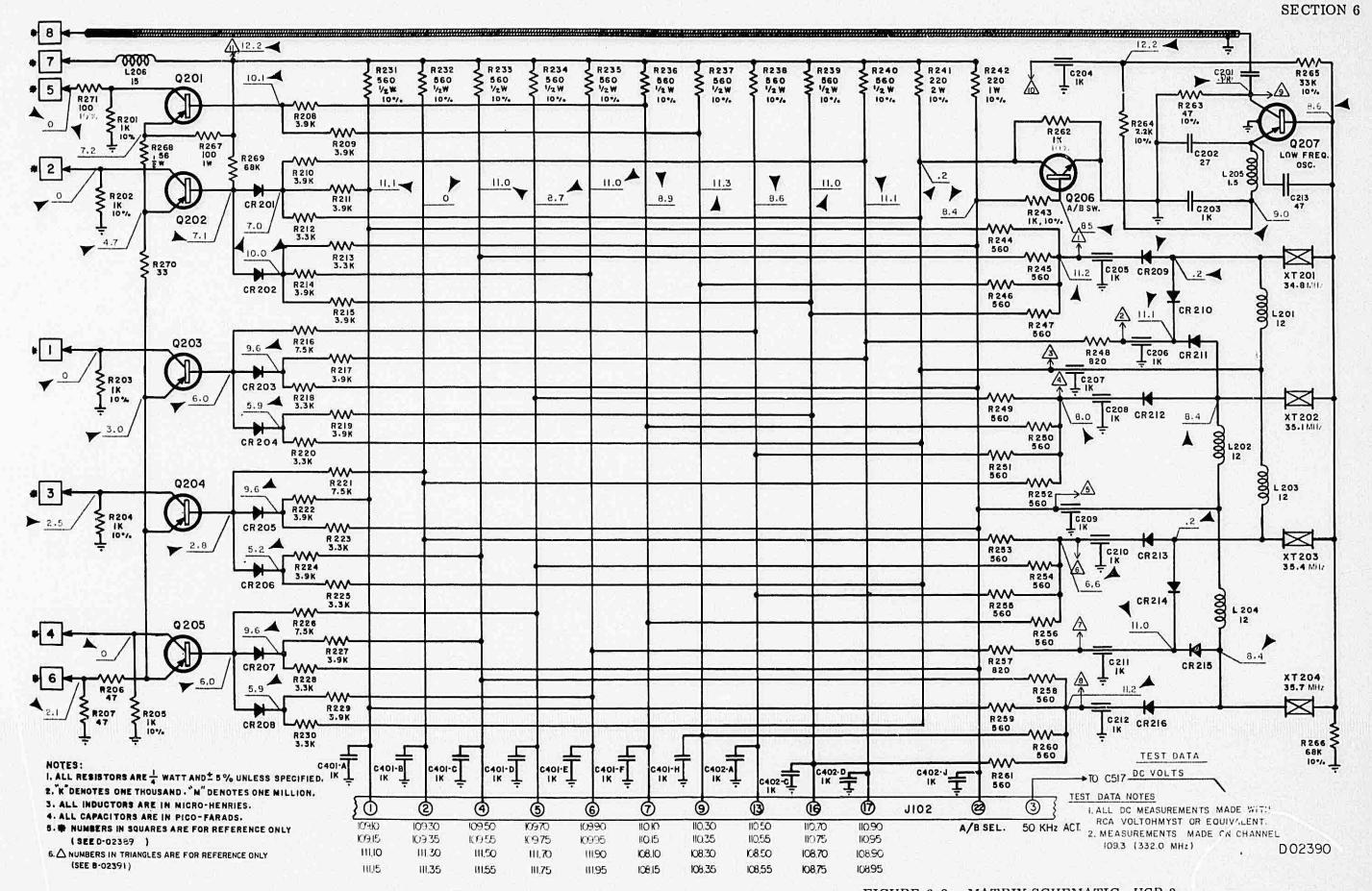


FIGURE 6-3. MATRIX SCHEMATIC, UGR 3

XT204

L202

CR216

-R 267

,R201

Q201

R269

R270

CR208

CR201

R227

R229

R209

R213

-R220

-R243

R219

R241

R259

R245

R258

R246

R260

R247

R261

OCATION

R202

R271

Q202

-R224

R214

R230

R225

-R212

R215

R262

Q206

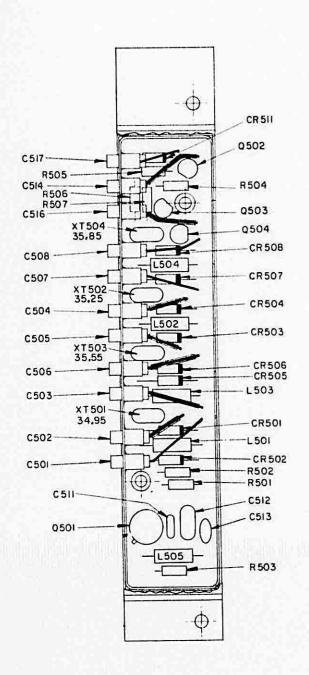
R257

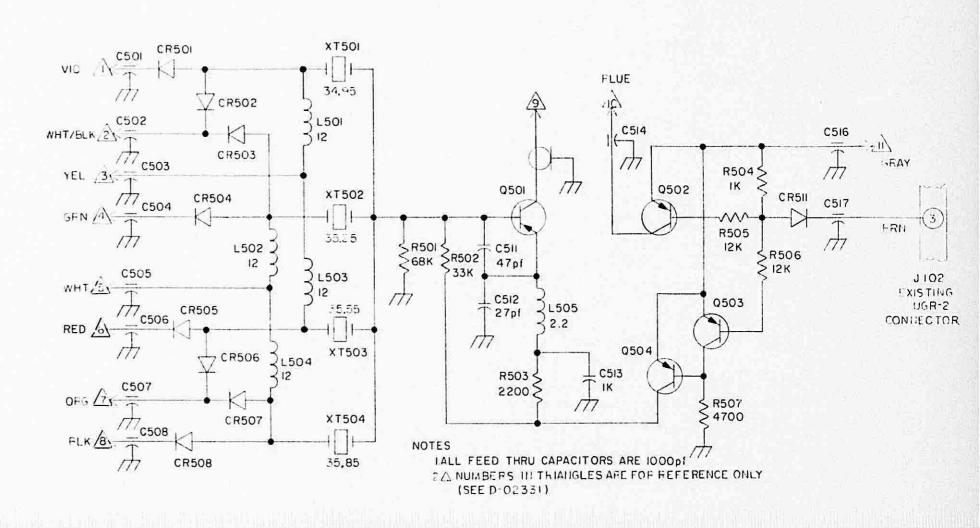
R244

CR202

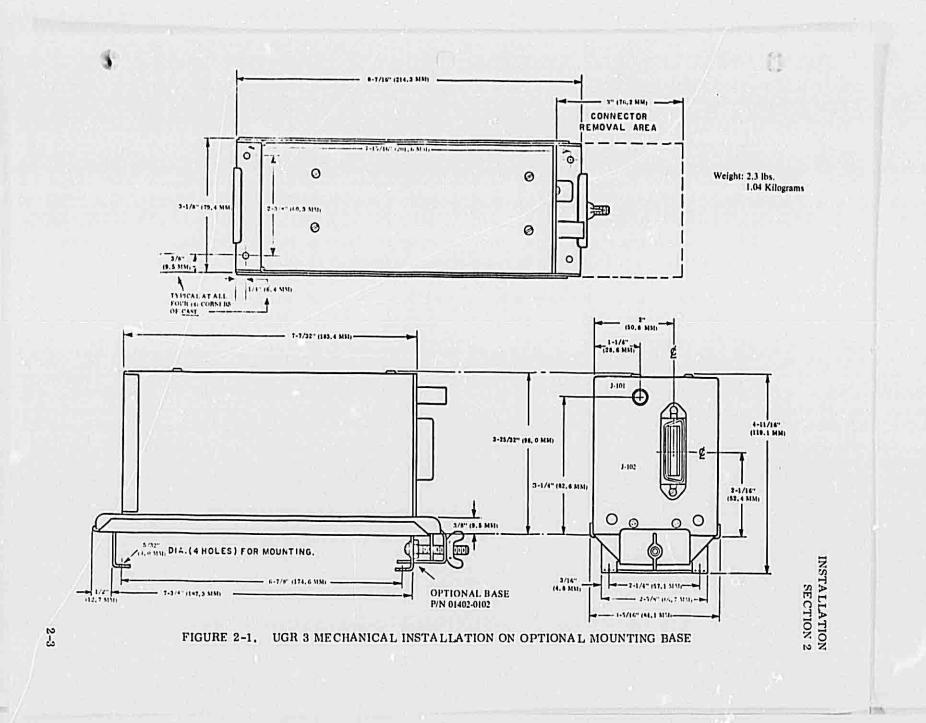
Q205

L204





B-02322



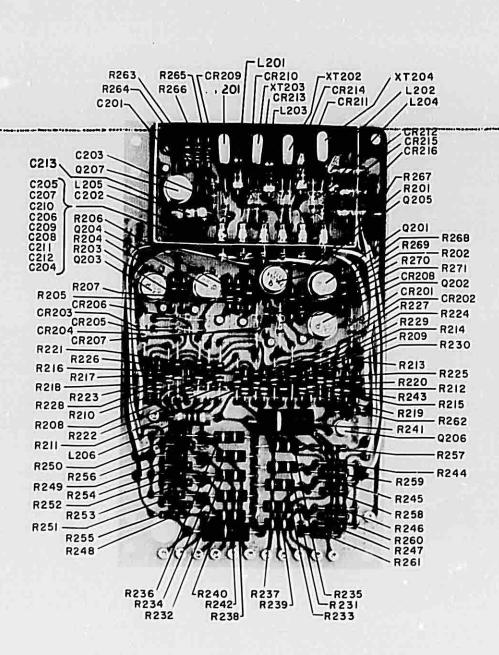
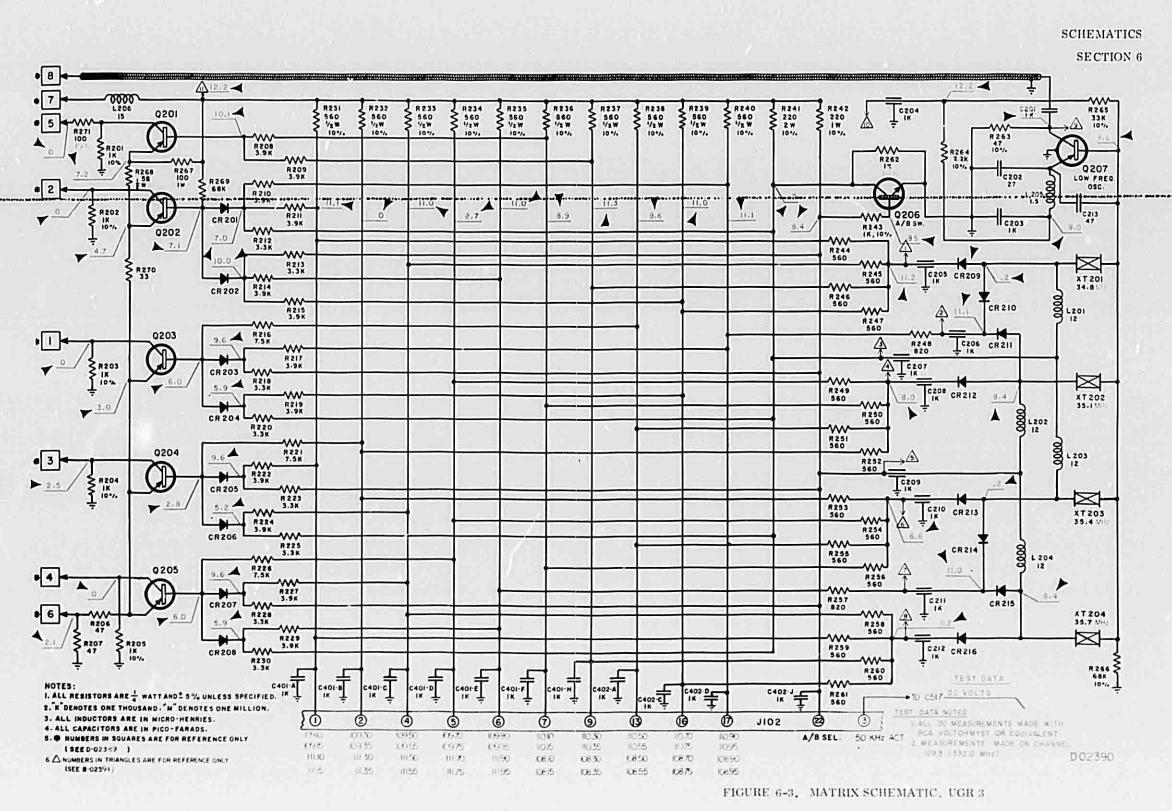


FIGURE 6-3A. MATRIX ASSY, COMPONENT LOCATION



6-7 (6-8 Blank)

2-4

Refer to the Maintenance Manual of the NAV receiver and/or NAV converter for System

Proper assembly of the BNC connector to the coax cable is shown in Fig. 2-3.

To realize the specified accuracy of the UGR 3, the receiver outputs must be terminated with the equivalent of three UP-DOWN indicators and two Flag Alarms (1000 ohms each). The external load may be the UP-DOWN display of the ILS, the autopilot, etc. If this maximum display capability is not used, shunting resistors MUST be installed to provide the correct simulated load. Since each of the shunting loads is 1000 ohms; either three UP-DOWN load circuits or 1000 ohm resistors must be connected to the output to total three separate 1000 ohm loads in parallel (333 ohms total); and if one flag indicator is used, a 1000 ohm resistor must be used to simulate the resistance of the unused flag circuit. The location of the load resistors installed in the plug can be seen in Fig. 2-4. Refer to Fig. 2-2 for method of connection of the load resistor. Before installing the resistor, make sure that the wire connected to the lug end of the connector cup is routed through the hole, crimped, and tack soldered.

On the 1/4 watt resistor, both leads must be bent and cut to the correct length before insertion into the connector cup, then soldered in place. Do not crimp the connector cup. After soldering the resistor in place, push the insulated sleeving down over the soldered wire lead on the connector receptacle.

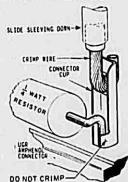


FIGURE 2-2, LOAD RESISTOR INSTALLATION DETAILS

SCHEMATICS SECTION 6

C517

C517

O5C2

R505

C514

R506

C516

X1504

C508

C508

C7508

C507

X1502

C504

C505

C7504

C505

C7504

C505

C7506

C7506

C7506

C7506

C7506

C7506

C7506

C7507

C501

C7501

C7501

C7502

C7501

C7502

C7501

C7502

C7503

C7501

C7502

C7503

C7502

C7503

C7501

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C7503

C7503

C7502

C7503

₩ CR502 . C502 CR503 C503 YEL 35 7 9FN (A) 7 C504 CR504 12 3 1 102 1 x 15 T 11 G 1 (CR-2 C506 CR505 0503 CONLECTOR XT503 T CR506 3 L504 C507 FLX /8. 77 CR508 XT504 CR507 IALL FEED THRU CAPACITORS ARE 1000pf EZENUMBERS III THIANGLES ARE FOR REFERENCE ONLY

FIGURE 6-4A, LFO (TOP), COMPONENT LOCATION

FIGURE 6-4. LFO (TOP) SCHEMATIC

6-9 (6-10 Blank)

B-02322

CIRCUIT DESCRIPTION

SECTION 3

3,9 Continued

Transistor gate (Q201) is a two input resistive gate. The base is connected to input terminal 7 through R208 and to input terminal 9 through R209. The two resistors connected to the matrix A+ provide the positive bias that holds the transistor at cutoff. When one input terminal is connected to ground, current through the two resistors in series plus the 560 ohm resistor to the matrix A+ forms a voltage divider. The base of Q201 is connected to approximately 7.0 volts bias, which fires the gate.

Input line 4 also selects the LFO frequency since R258 is connected to the 35.7 MHz crystal and R245 is connected to the 34.8 MHz crystal. Although both crystal gate circuits are enabled when line 4 is grounded, the A/B select line determines whether the diodes connected to the odd or even pairs of crystals will conduct. This is explained in detail in Section 3.8.

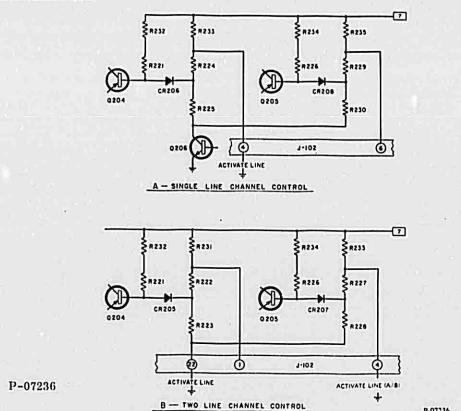


FIGURE 3-3. MATRIX CONTROL OF HFO GATES

3-11