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June 1, 1975

TO: HOLDERS OF 477U-2 ADF ANTENNA SIMULATOR INSTRUCTION BOOK (523-0750000)

EDITION NO 2 DATED MAY 1/75

HIGHLIGHTS

The attached manual completely replaces the existing 477U-2 ADF Antenna Simulator Instruction Book. Pages that have been added, revised, or deleted are indicated below together with the highlights of the change. Retain this letter of transmittal for future reference.

PAGE NUMBER	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
List of Effective Pages	Revised to reflect current changes.		All
Record of Revisions	Added latest edition number and date.		All
ii	Revised to reflect figure number changes to figures 5-1A, 5-2, and 5-3, and to reflect page number changes to figures 5-2 through 5-4 and figures 7-1 and 7-2.		All
1-1	Corrected 477U-2 part number in table 1-1 from 522-2710-004 to 522-2710-000.		All models
5-1	Revised paragraph 5.3.1.e to add effect of SB 3 to the 477V-2 used for testing the DF-203 components.		All models
5-5	Corrected capacitance limits measurements for 1750-kc frequency, table 5-4.		All models
5-6	Corrected tables 5-5 and 5-6 voltage limits.		All models

PAGE NUMBER	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
7-1/7-2	Added schematic changes page.		All models
7-3	Corrected synchro wiring between connector J4 and P1, added synchro pin assignments at J4 for clarification, and added notes 1 and 2.		All models

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477U-2
ADF Antenna Simulator

Collins Avionics Division
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List of Effective Pages

*The asterisk indicates pages changed, added, or deleted by the current change.

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Collins welcomes your comments concerning this instruction book. Although every effort has been made to keep it free of errors, some do occur. When reporting a specific problem, please describe it briefly and include the instruction book part number, the paragraph or figure number, and the page number.

Send your comments to: Publications Engineering Department
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Cedar Rapids, Iowa 52406

Record of Revisions

RETAIN THIS RECORD IN THE FRONT OF MANUAL.
ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER DATE INSERTED AND INITIALS.

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1st Ed	1 Dec 62						
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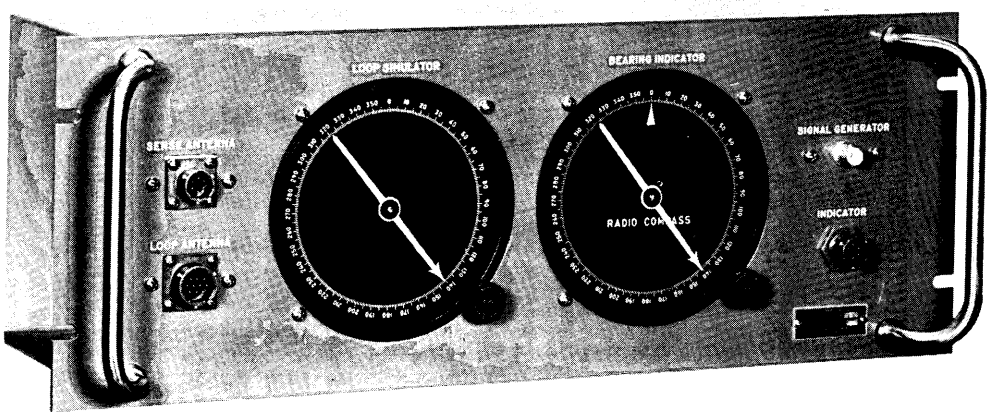
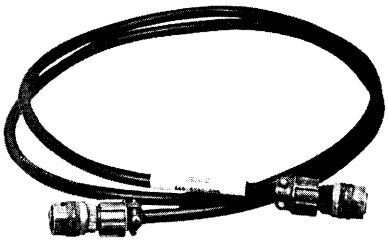
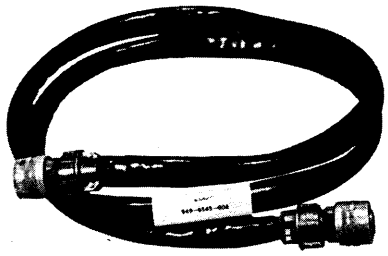


477U-2 ADF ANTENNA SIMULATOR



SENSE ANTENNA
CABLE

RF SIMULATOR
CABLE



LOOP ANTENNA
CABLE

Figure 1-1. 477U-2 ADF Antenna Simulator and Associated Equipment

section 1

general description

1.1 Purpose of Instruction Book.

This instruction book provides information on the 477U-2 ADF Antenna Simulator. The book includes installation procedure, theory of operation, maintenance data, and operating instructions.

1.2 Purpose of Equipment.

The 477U-2 is designed to provide complete testing of the DF-203 ADF System when used with the 477V-2 ADF Test Set and an rf signal generator, and complete testing of the DF-202G ADF System when used with the 477V-1 ADF Test Set. The 477U-2 ADF Antenna Simulator with its associated cables provides the following functions for the ADF Test station:

a. Simulates the fixed-crossed loop antenna and standard loop cable.
b. Simulates the standard sense antenna, sense antenna coupler, and sense antenna cable.
c. Provides an accurately calibrated, interference free source of signal at the simulated antennas.
d. Provides a radio bearing indicator.

The loop simulator impedance networks in the 477U-2 accurately produce the same signal level and source impedance at the 51Y-4/4A ADF Receiver or 179L-1 Goniometer Antenna Coupler as the 137A-4 Fixed Loop Antenna and the 440L-8 Loop Antenna Cable in a standard shield room. The sense antenna simulator network in the 477U-2 accurately produces the same signal level and source impedance at the 51Y-3/4/4A as 60 feet of RG-11/U cable with a 1750-uuf source capacitance and a sense antenna with a hi-root-cap product of 1.0. A low capacitance sense antenna adapter, Collins part number 554-6109-004, and a UG-274A/U BNC TEE Adapter, Collins part number 357-9314-00, are required to test the 51Y-4A ADF Receiver. Since these components are in accordance with the requirements of ARINC characteristic 550, the 477U-2 accurately simulates the ARINC 550 antenna systems.

The input circuits of the 477U-2 are designed so that the field strengths at the simulated antennas in microvolts-per-meter are the same as the signal level at the input jack (J1) in microvolts. That is, in shield room terminology, the attenuation constant (ratio of shield room input signal level to field strength) is 1.0. The 477U-2 has a 50-ohm impedance. When a signal generator that is calibrated to read the output voltage across a 50-ohm load is used with the 477U-2, the simulated field strength may be read directly from the signal generator output meter.

The bearing indicator conveniently provides a remote bearing indicator adjacent to the simulated bearing indicator for ease of performance testing.

1.3 Equipment Supplied.

Refer to figure 1-1 and table 1-1 for equipment supplied.

TABLE 1-1
EQUIPMENT SUPPLIED

COMPONENT	COLLINS PART NUMBER
477U-2 ADF Antenna Simulator	522-2710-000
Cable, simulator r-f input	544-5037-002
Cable, sense antenna	549-6540-003
Cable, loop antenna	549-6545-004

NOTE

The sense antenna cable, Collins part number 549-6540-003, and loop antenna cable, Collins part number 549-6545-004, that are supplied as part of the 477U-2 are not standard aircraft installation cables. These cables are constructed of six feet of flexible cable for convenience at the test station. An appreciable length of the system cabling is simulated in the 477U-2. Therefore, these cables cannot be used to interconnect a loop antenna or sense antenna coupler and the receiver and maintain the proper impedances nor can standard aircraft installation cables, such as the 440L-8 or 440S-1, be used to interconnect the 477U-2 and the receiver.

1.4 Associated Equipment.

Table 1-2 lists all associated equipment needed to complete the ADF test facility for either the DF-202G or the DF-203 ADF System.

TABLE 1-2. ASSOCIATED EQUIPMENT

COMPONENT	COLLINS PART NUMBER
477V-1 ADF Test Set	522-1214-004
477V-2 ADF Test Set	522-2711-004
Adapter, connector	549-6539-003
Adapter, low capacitance sense (51Y-4A only)	554-6109-004
Adapter, UG-274A/U, BNC TEE (51Y-4A only)	357-9314-00
Signal generator	Hewlett-Packard 606A or equivalent

1.5 Physical Description.

The 477U-2 ADF Antenna Simulator is 19 inches wide, 7 inches high, and 6 inches deep. The 477U-2 weighs 7.5 pounds and is designed to be mounted in a standard 19-inch relay rack. Refer to section 3 of this manual for the location and function of all operating controls, jacks, and indicators mounted on the 477U-2.

1.6 477U-2 ADF Antenna Simulator - Performance Data and Specifications.

RADIO COMPASS indicator	5-inch dial with graduations in one degree increments through 360 degrees of rotation.
Finish	Collins gray.
Ambient humidity range	Up to 100 percent.
Ambient temperature range	-20°C (-4°F) to 55°C (131°F).
Altitude	Sea level to 10,000 feet.
Vibration	10 to 33 cps at 0.06 inches total excursion and 10 to 55 cps at 0.03 inches total excursion in each of the three planes for 15 minutes.
Power source	477V-1 ADF Test Set or 477V-2 ADF Test Set.
R-f input frequency	90 kc to 1800 kc.
R-f input impedance	50 ohms.
Sense antenna output impedance	Simulates the output impedance of 60 feet of RG-11/U cable with 1750-uuf input capacitance (approximately 3000 uuf at lower frequencies).
Loop antenna output impedance	Simulates the output impedance of the fixed-crossed loop antenna and 30 feet of loop cable listed in ARINC characteristic 550.
External interference	May be used in environments which have field strengths up to 10,000 microvolts-per-meter without interference.

section 2

installation

2.1 Unpacking and Equipment Inspection.

Refer to the packing slip for a list of all units supplied on the order. Open crates or cartons carefully, check for damage, and search all packing material for small packages. Inspect the unit for loose screws and bolts. Be certain that all controls such as knobs and switches work properly.

All claims for damage must be filed promptly with the transportation company involved. Keep all original packing material, crates, or cartons if a claim is to be made.

2.2 Mounting.

The 477U-2 ADF Antenna Simulator may be set on a bench or mounted in a standard 19-inch relay rack panel with four screws. Outline and mounting dimensions are given in figure 2-1. Refer to section 5 of this manual for bench performance tests before actual use.

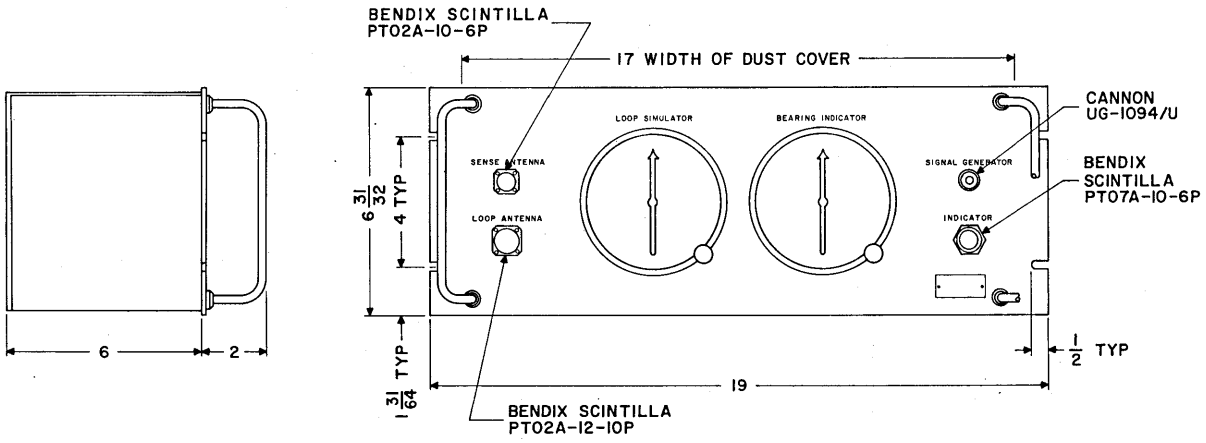


Figure 2-1. 477U-2 ADF Antenna Simulator, Outline and Mounting Dimensions

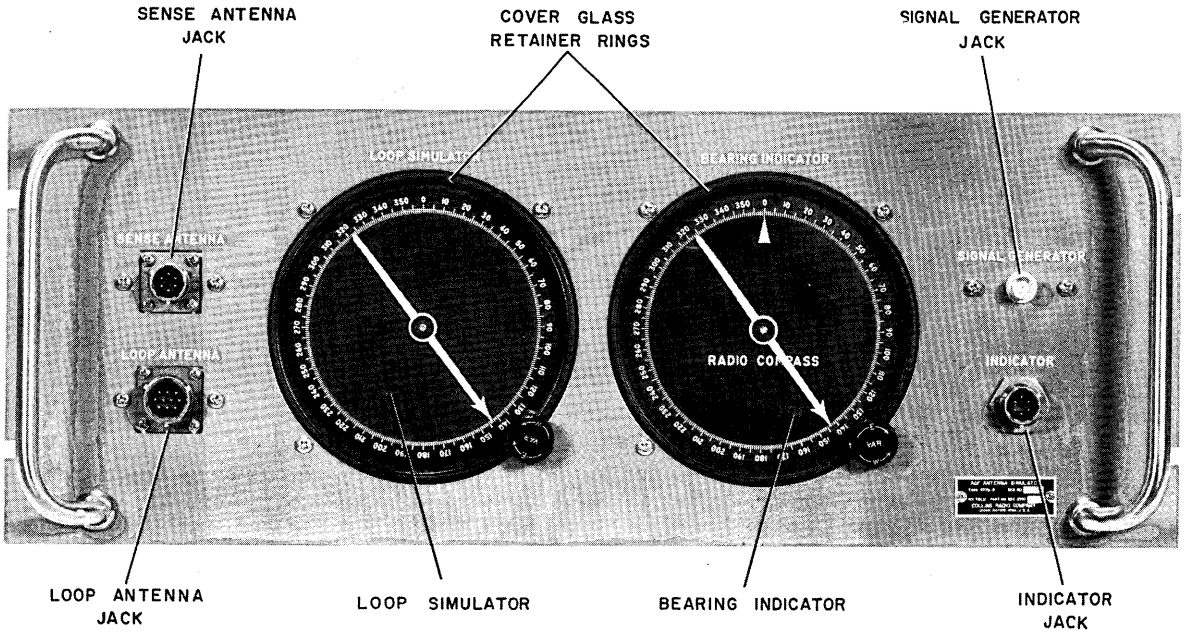


Figure 3-1. 477U-2 ADF Antenna Simulator, Front Panel

section 3

operation

3.1 General.

This section describes the function and location of all operating controls, jacks, and indicators mounted on the 477U-2 ADF Antenna Simulator. The 477U-2 is used to test the DF-203 ADF System. Refer to the DF-203 overhaul manual for these tests. The 477U-2 is also used to test the DF-202G ADF System.

3.2 Description of Operating Controls, Jacks, and Indicators.

Refer to figure 3-1 for the location of the controls, jacks, and indicators located on the front panel of the 477U-2. See table 3-1 for a description of these items.

TABLE 3-1. CONTROLS, JACKS, AND INDICATORS ON THE 477U-2

COMPONENT	PURPOSE
LOOP SIMULATOR	Provides for observation and manual control of simulated loop antenna position.
BEARING INDICATOR	Shows bearing of signal being received by the 51Y-3/4/4A.
INDICATOR jack	Provides for front panel input of bearing information to BEARING INDICATOR and 100-kc spectrum generator rf power from the 477V-2 ADF Test Set.
LOOP ANTENNA jack	Provides for front panel rf output from the loop simulator resolver to the 51Y-3/4/4A ADF Receiver.
SENSE ANTENNA jack	Provides for front panel rf output of the simulated sense antenna signal to the 51Y-3/4 ADF Receiver, and to the 51Y-4A ADF Receiver when used with adapters listed in table 1-2.
SIGNAL GENERATOR jack	Provides front panel input of rf power from signal generator.

3.3 DF-202G Performance Tests.

This paragraph covers the testing of the DF-202G ADF System. This procedure tests the 51Y-3 ADF Receiver, the 179L-1 Goniometer Antenna Coupler, the 614L-( ) Control Unit, and the 440L-3 Cable Assembly. The sensitivity of the DF-202G ADF System is dependent upon the sense antenna and the sense antenna coupler. Different sense antennas and couplers are used in various installations so they are not tested to make a standard test possible.

3.3.1 PRETEST PROCEDURES.

a. Obtain the test equipment listed in table 3-2.
b. Fabricate the 179L-1 Interconnection Test Cable according to figure 3-2.
c. Interconnect the test equipment as shown in figure 3-3.
d. Refer to table 3-3 for test conditions.

3.3.2 DEFINITIONS.

a. Signal strength. Signal strength is read directly from the 477V-1 SIGNAL GENERATOR meter since the 477U-2 ADF Antenna Simulator has a simulation factor

$$\left(K_d = \frac{\text{Signal generator output}}{\text{Field strength at loop antenna}}\right) \text{of } 1.0.$$

b. Sensitivity. ANT sensitivity, LOOP sensitivity, and ADF MCW sensitivity are defined as input field

TABLE 3-2. EQUIPMENT REQUIRED FOR TESTING THE DF-202G ADF SYSTEM

DESCRIPTION	COLLINS PART NUMBER
477V-1 51Y Test Set	522-1214-00
Receiver power cable	544-5546-00 (supplied with 477V-1)
Power cable, 477V-1 ADF Test Set	553-2426-002 (supplied with 477V-1)
Adapter, polarized electrical	368-0110-00 (supplied with 477V-1)
R-f input simulator cable	544-5037-00 (supplied with 477V-1)
*Connector, Cannon WK-5-23C-3/8, mates with 477V-1 LOOP MOTOR connector	371-0152-00 (supplied with 477V-1)
477U-2 ADF Antenna Simulator	522-2710-00
R-f cable, 477U-2 to 179L-1	549-6545-004 (supplied with 477U-2)
R-f cable, 477U-2 to 51Y-3	549-6540-003 (supplied with 477U-2)
Adapter, connector	549-6539-003
*Connector, Cannon DPXB-45-33S-002, mates with rear connector of 179L-1	370-5211-00
*Connector, Scintilla PT06A-10-6S(SR), mates with 477U-2 INDICATOR jack	371-6361-00
Stop watch	
Vtvm, r-f, Ballantine 314 or equivalent	
*Used to fabricate 179L-1 Interconnection Test Cable (see figure 3-2).	

strength that is required, in microvolts per meter, to produce a signal-plus-noise to noise ratio (MOD switch of the 477V-1 SIGNAL GENERATOR ON to MOD switch OFF) of 6 db simultaneously with a minimum audio output of 20 mw. The audio output may drop to 5 mw at 420 kc in the ANT function.

c. Signal-plus-noise to noise ratio. The standard 6-db signal-plus-noise to noise ratio is a 4 to 1 ratio in power and a 2 to 1 ratio in voltage (power indicated in milliwatts on the 477V-1 TEST METER).

3.3.3 TEST PROCEDURES.

If the DF-202G fails to pass any of the tests in this paragraph refer to the trouble shooting section of the DF-202G overhaul manual (Collins part number 523-0755448).

3.3.3.1 GONIOMETER NULL.

a. Set the 477V-1 controls as shown in table 3-4.

b. Adjust the 477V-1 FREQ control to 195 KC. Adjust the ATTENUATOR and RF OUTPUT control of the 477V-1 for an output of 10,000 microvolts per meter as indicated on the 477V-1 SIGNAL GENERATOR meter.

c. Using the LOOP L-R control on the 477V-1 CONTROL UNIT, rotate the resolver rotor for a null as indicated on the 477V-1 TEST METER.

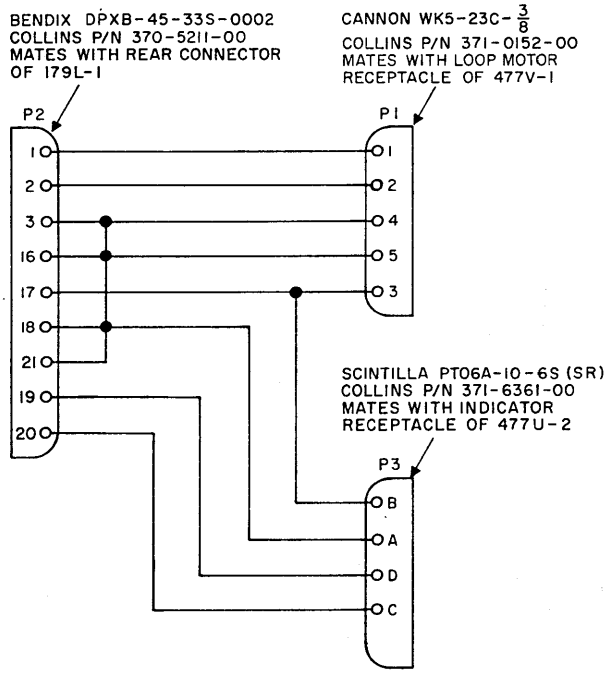
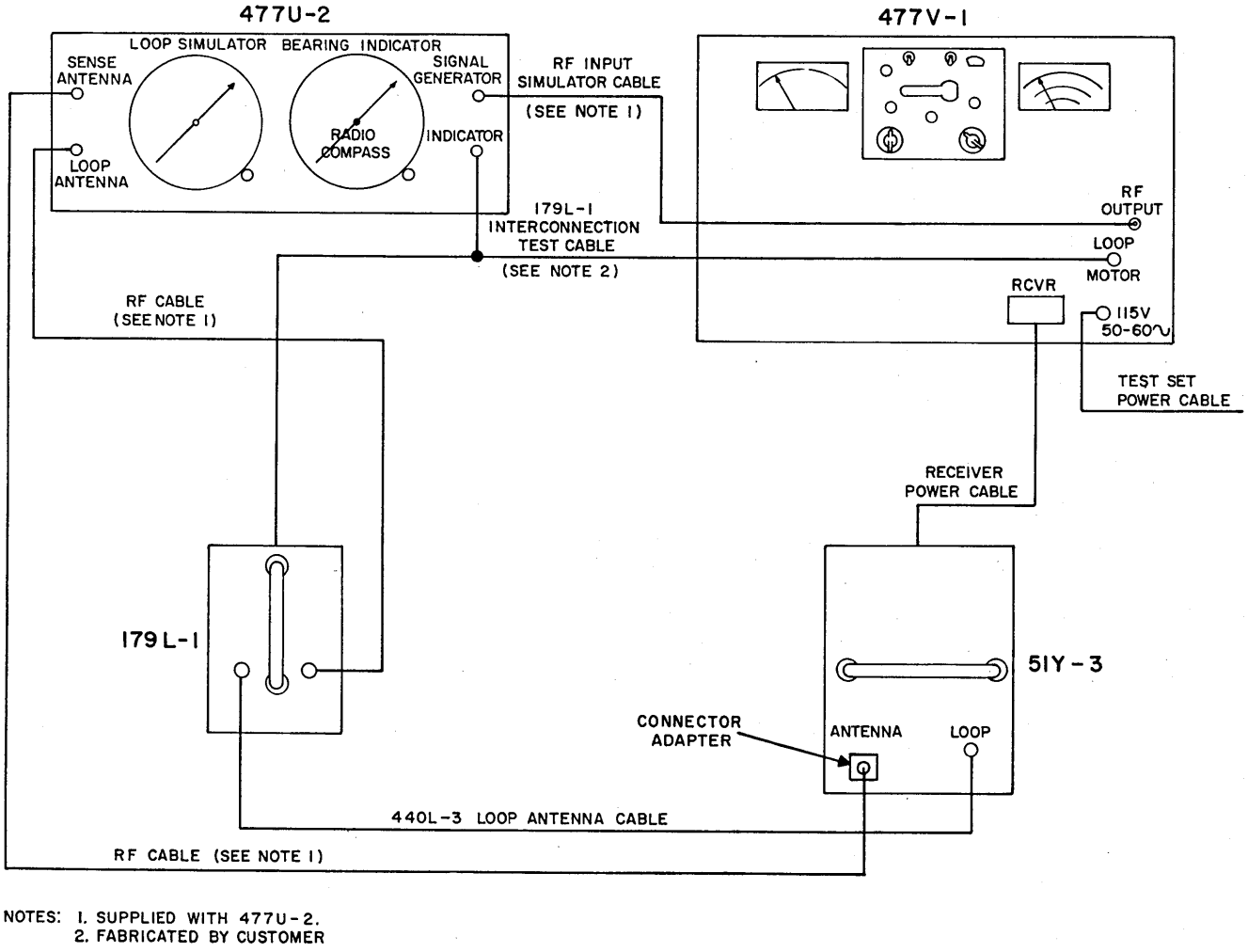


Figure 3-2. 179L-1 Interconnection Test Cable, Schematic Diagram



NOTES: 1. SUPPLIED WITH 477U-2.
2. FABRICATED BY CUSTOMER

Figure 3-3. DF-202G Test Setup

TABLE 3-3. TEST CONDITIONS FOR DF-202G ADF SYSTEM

TEST FACTOR	CONDITION
Warmup period	15 minutes.
Performance test area	All performance test procedures may be performed outside a shielded room.
Humidity	Normal shop ambient.
Temperature	Normal shop ambient.
Atmospheric pressure	Normal shop ambient.
Output impedance	All performance tests shall be made with the 51Y-3 ADF Receiver audio output terminated in a 500-ohm load (selected by switching the PHONE-SPEAKER-500Ω switch of the 477V-1 to 500Ω).
Tuning	Unless otherwise specified, the 51Y-3 ADF Receiver shall be tuned to the signal generator frequency by adjusting the FREQUENCY KC selector of the 477V-1 CONTROL UNIT for maximum audio output with the SELECT switch in the BROAD position.

d. Record the bearing indicated on the 477U-2 BEARING INDICATOR. This should be within 0.5 degree of the reading on the LOOP SIMULATOR indicator of the 477U-2. If null readings are not within these limits, refer to the 179L-1 goniometer zeroing adjustments in the 179L-1 overhaul manual, chapter 34-33-1.

e. Repeat steps b through d at 390, 880, and 1750 KC positions of the 477V-1 FREQ control.

3.3.3.2 LOOP SENSITIVITY.

a. Set the 477V-1 controls as shown in table 3-4, except adjust the GAIN control as required.

b. Adjust the 477V-1 FREQ control to 95 KC.

c. With the LOOP L-R control on the 477V-1, position the resolver rotor of the 179L-1 to the position for maximum signal into the 51Y-3.

d. Tune the 51Y-3 to 95 kc by tuning for maximum audio output (which should correspond closely to the maximum tuning meter reading) as indicated on the 477V-1 TEST METER.

e. Adjust the 477V-1 ATTENUATOR and RF OUTPUT control and CONTROL UNIT GAIN control to obtain a 6-db signal-plus-noise to noise ratio (MOD switch ON to MOD switch OFF). Adjust for a 20-mw signal (MOD switch ON) and 5-mw noise (MOD switch OFF) as indicated on the 477V-1 TEST METER.

f. Record the field strength in microvolts per meter indicated on the 477V-1 SIGNAL GENERATOR meter, and compare with value listed in table 3-5 under the LOOP SENSITIVITY column.

TABLE 3-4
INITIAL CONTROL POSITIONS OF 477V-1

CONTROL	POSITION
BFO	OFF
SELECT	BROAD
GAIN	Maximum clockwise
Function switch	LOOP
PHONE-SPEAKER-500Ω	500Ω
CONTROL UNIT	PANEL
SIGNAL GENERATOR - 10 KC SPECTRUM	SIGNAL GENERATOR
CARRIER	ON
MOD	ON
METER FUNCTION	AUDIO-MW-X1
VOLTAGE RANGE	300 (not in circuit)

TABLE 3-5. MINIMUM SENSITIVITY OF DF-202G ADF SYSTEM

RECEIVER FREQUENCY (kc)	LOOP SENSITIVITY (uv/m)	ADF MCW SENSITIVITY (uv/m)	ANT SENSITIVITY (uv/m)	ADF THRESHOLD SENSITIVITY (uv/m)
95	230	60	30	80
145	150	90	40	40
195	125	120	50	40
210	125	60	20	40
300	110	70	30	30
390	90	80	40	30
420	80	60	20	30
650	70	60	20	20
880	60	70	20	20
950	60	80	15	20
1350	50	60	15	20
1750	40	60	15	20

g. Repeat steps b through f at the frequencies listed in table 3-5.

3.3.3.3 ANTENNA SENSITIVITY.

a. Set the 477V-1 controls as shown in table 3-4 except change the function switch to ANT.
b. Adjust the 477V-1 FREQ control to 95 KC.
c. Tune the 51Y-3 to 95 kc by tuning for maximum audio output as indicated on the 477V-1 TEST METER.
d. Adjust the 477V-1 ATTENUATOR and RF OUTPUT control and CONTROL UNIT GAIN control to obtain a 6-db signal-plus-noise to noise ratio (MOD switch ON to MOD switch OFF). Adjust for a 20-mw signal and 5-mw noise.
e. Record the signal strength indicated on the 477V-1 SIGNAL GENERATOR meter, and compare with the value in the ANT SENSITIVITY column of table 3-5 for the frequency being tested.
f. Repeat steps b through e at the frequencies listed in table 3-5.

3.3.3.4 ADF MCW SENSITIVITY.

a. Set the 477V-1 controls as shown in table 3-4 except change the function switch to ADF.
b. Adjust the 477V-1 ATTENUATOR, RF OUTPUT control, and CONTROL UNIT GAIN control to obtain a 6-db signal-plus-noise to noise ratio (MOD switch ON to MOD switch OFF). Adjust for a 20-mw signal and 5-mw noise.
c. Record the ADF MCW sensitivity, and compare with the value in the ADF MCW SENSITIVITY column of table 3-5.
d. Repeat steps b and c at the frequencies listed in table 3-5.

3.3.3.5 ADF THRESHOLD SENSITIVITY.

a. Set the 477V-1 controls as shown in table 3-4 except change the function switch to ADF and turn the MOD switch OFF.
b. Manually position the 477U-2 LOOP SIMULATOR indicator to 0 degree.
c. Adjust the 477V-1 FREQ control to 95 KC.
d. Adjust the 477V-1 ATTENUATOR and RF OUTPUT control for a 477V-1 SIGNAL GENERATOR meter reading of the field strength specified in the ADF THRESHOLD SENSITIVITY column of table 3-5 for 95 kc.
e. Tune the 51Y-3 to the signal generator frequency by adjusting the FREQUENCY KC selector of the 477V-1 CONTROL UNIT for maximum indication on the 477V-1 CONTROL UNIT tuning meter.
f. Note the difference in bearing of the BEARING INDICATOR and the LOOP SIMULATOR of the 477U-2. This bearing error should be less than 2 degrees.
g. Vary the field strength from the value of step d to 100,000 microvolts per meter by adjusting the 477V-1 ATTENUATOR and RF OUTPUT control. Note the maximum deviation of the 477U-2 BEARING INDICATOR from zero, excluding hunting and noise. The deviation should be not more than 2 degrees.
h. Repeat steps c through g at the frequencies listed in table 3-5.

3.3.3.6 GONIOMETER ROTATION TIME.

a. Set the 477V-1 controls as shown in table 3-4 except adjust the GAIN as required and turn the MOD switch OFF.
b. Adjust the 477V-1 ATTENUATOR and RF OUTPUT control for the signal strength indicated under the ADF THRESHOLD SENSITIVITY column of table 3-5 at 95 kc.
c. Tune the 51Y-3 to 95 kc by adjusting the FREQUENCY KC selector of the 477V-1 CONTROL UNIT for maximum indication on the 477V-1 CONTROL UNIT tuning meter.
d. Using the LOOP L-R control, manually rotate the 477U-2 BEARING INDICATOR pointer to 175 degrees.
e. Turn the function switch to the ADF position, and record the time required for the BEARING INDICATOR pointer to return to the zero reading. Do not include the time required by the 51Y-3 for switching. This should be not more than 7 seconds.
f. Repeat steps b through e at the frequencies listed in table 3-5.

3.3.3.7 AUDIO OUTPUT LEVEL.

a. Set the 477V-1 controls as shown in table 3-4 except adjust the SELECT switch to SHARP, the function switch to ANT, and the METER FUNCTION to AUDIO-MW-X10.
b. Set the 477V-1 FREQ control to 300 KC.
c. Adjust the 477V-1 ATTENUATOR and RF OUTPUT control for a 477V-1 SIGNAL GENERATOR meter reading of 100 microvolts per meter.
d. Tune the 477V-1 CONTROL UNIT FREQUENCY KC selector for maximum deflection of the 477V-1 TEST METER.
e. Change the 477V-1 SELECT switch to BROAD. The 477V-1 TEST METER should indicate not less than 5 on the MILLIWATTS scale since the power output should be at least 50 milliwatts (5 milliwatts with an X10 METER FUNCTION position equals 50 milliwatts).

section 4

principles of operation

4.1 General.

The 477U-2 is used with the 477V-1 or 477V-2 ADF Test Set to provide complete testing of the Collins DF-202G or DF-203 ADF System respectively. The 477U-2 provides simulated loop and sense antennas and cables and a radio bearing indicator. Refer to figure 7-1 during the following detailed circuit analysis.

4.2 Signal Generator R-F Input.

The r-f input impedance at jack J1 (SIGNAL GENERATOR) of the 477U-2 is 50 ohms to match standard r-f signal generators. The r-f output of the signal generator is connected to the rotor of the resolver B1 through jack J1 and an RC network comprised of R1, R2, C13, R3, R4, and R5. This RC network attenuates the r-f input so that the operator can read the simulated antenna field strength directly from the dial of the signal generator in microvolts per meter when the signal generator dial reads the signal level at J1. The rotor of the resolver generates the same field that would be produced by the transmitting antenna in an ADF screen room. The impedance of capacitor C13 decreases with an increase in frequency and simulates the change in effective height of the ADF antenna with a similar change in frequency.

4.3 Loop Antenna.

The two stator windings of resolver B1 simulate the loops in the 137A-4/5/6 Fixed Loop Antenna. The stators are connected to two LC networks consisting of inductors L1 through L10 and capacitors C1 through C4. These networks, and the 5 feet of cable connecting the LOOP ANTENNA jack of the 477U-2 to the 51Y-4/4A or 179L-1, simulate the capacitance and inductance of the loop cable in an aircraft ADF installation. A variable inductor, L3 or L10, is connected across each of the resolver stators so that the impedance at the end of the loop cable may be adjusted to the nominal value.

4.4 Sense Antenna.

The simulated sense antenna in the 477U-2 provides a standard rf sense output for the 51Y-3/4 ADF Receiver. The 51Y-4A ADF Receiver must be used with the adapters listed in table 1-2 to receive the standard rf sense output from the 477U-2. The output of the signal generator is connected from jack J1 to the LC network comprised of L12, L13, and C5 through C12. This network simulates 60 feet of RG-11/U sense antenna cable and attenuates the rf signal so that the sense antenna field strength may be read from the signal generator in microvolts per meter when the signal generator dial reads the signal level at J1.

4.5 Indicator Jack J4.

INDICATOR jack J4 provides for the interconnection of the 477U-2 and the loop indicator circuits in the 477V-1/2.

section 5

maintenance

5.1 General.

The 477U-2 ADF Antenna Simulator has been carefully adjusted and aligned at the factory and inspected before shipment. This section provides complete testing and alignment information.

5.2 Test Equipment Required.

The equipment listed in table 5-1 or its equivalent is necessary to align and calibrate the 477U-2 ADF Antenna Simulator.

TABLE 5-1
TEST EQUIPMENT REQUIRED FOR ALIGNMENT

ITEM	TYPE
Rf signal generator	Hewlett-Packard 606A
Ac vtvm	Ballantine 310
Rf bridge	Wayne Kerr B601
Oscilloscope	Heathkit 0-10
477V-2 ADF Test Set	Collins part number 522-2711-00
51Y-4 ADF Receiver	Collins part number 522-1836-00
or 51Y-4A ADF Receiver	Collins part number 522-2587-000
Test jig	To be fabricated according to figure 5-1
Adapter, low capacitance sense antenna (used with 51Y-4A only)	Collins part number 554-6109-004
Adapter, UG-274A/U, BNC TEE (used with 51Y-4A only)	Collins part number 357-9314-00

5.3 Performance Tests.

The following test procedure is to be used to check for proper operation of the 447U-2 ADF Antenna Simulator. Two test setups are presented since the 477U-2 can be used to test either the DF-203 or DF-202G ADF System.

5.3.1 TEST PROCEDURES USING DF-203 COMPONENTS.

a. Obtain the equipment listed in table 5-2.

b. Refer to figure 5-1 and interconnect the 477U-2, the signal generator, a 477V-2 ADF Test Set, and a 51Y-4 ADF Receiver that is known to be in good operating condition. Figure 5-2 shows the interconnect configuration for the 477U-2, a signal generator, a 477V-2 ADF Test Set, and a 51Y-4A ADF Receiver.

NOTE

The low capacitance sense antenna adapter used with the 51Y-4A should be set to 150 or 270 pf, depending on the sense input used in the aircraft installation for the particular 51Y-4A.

TABLE 5-2
TEST EQUIPMENT REQUIRED

ITEM	IDENTIFICATION
477V-2 ADF Test Set	Collins part number 522-2711-00
51Y-4 ADF Receiver	Collins part number 522-1836-00
Associated cables	Supplied with 477V-2 and 477U-2
Signal generator	Hewlett-Packard 606A or equivalent

c. Apply power to the signal generator and the 477V-2.

d. Turn the 477V-2 function switch to the ADF position and adjust the output level of the signal generator to 1000 uv at a frequency of 210 kc.

e. Tune the 477V-2 to 210 kc and turn the GONIO DRIVE switch to the ON position (477V-2 units without SB 3).

f. Rotate the 477U-2 LOOP SIMULATOR needle from 0 to 330 degrees in 30-degree steps. The BEARING INDICATOR should read the same as the LOOP SIMULATOR within 2 degrees in all positions. If the BEARING INDICATOR does not read the same as the

LOOP SIMULATOR within these limits refer to paragraph 5.4.

g. Turn the 477V-2 function switch to the LOOP position. Operate the LOOP L-R control on the 477V-2 and check to see that the BEARING INDICATOR rotates clockwise with the switch in the R position and counterclockwise with the switch in the L position. If the BEARING INDICATOR does not operate properly refer to paragraph 5.5 for troubleshooting information.

5.3.2 TEST PROCEDURES USING DF-202G COMPONENTS.

a. Obtain the equipment listed in table 3-2.

b. Refer to figure 3-3 and make the interconnections shown.

c. Apply power to the 477V-1 and set the controls as indicated in table 5-3.

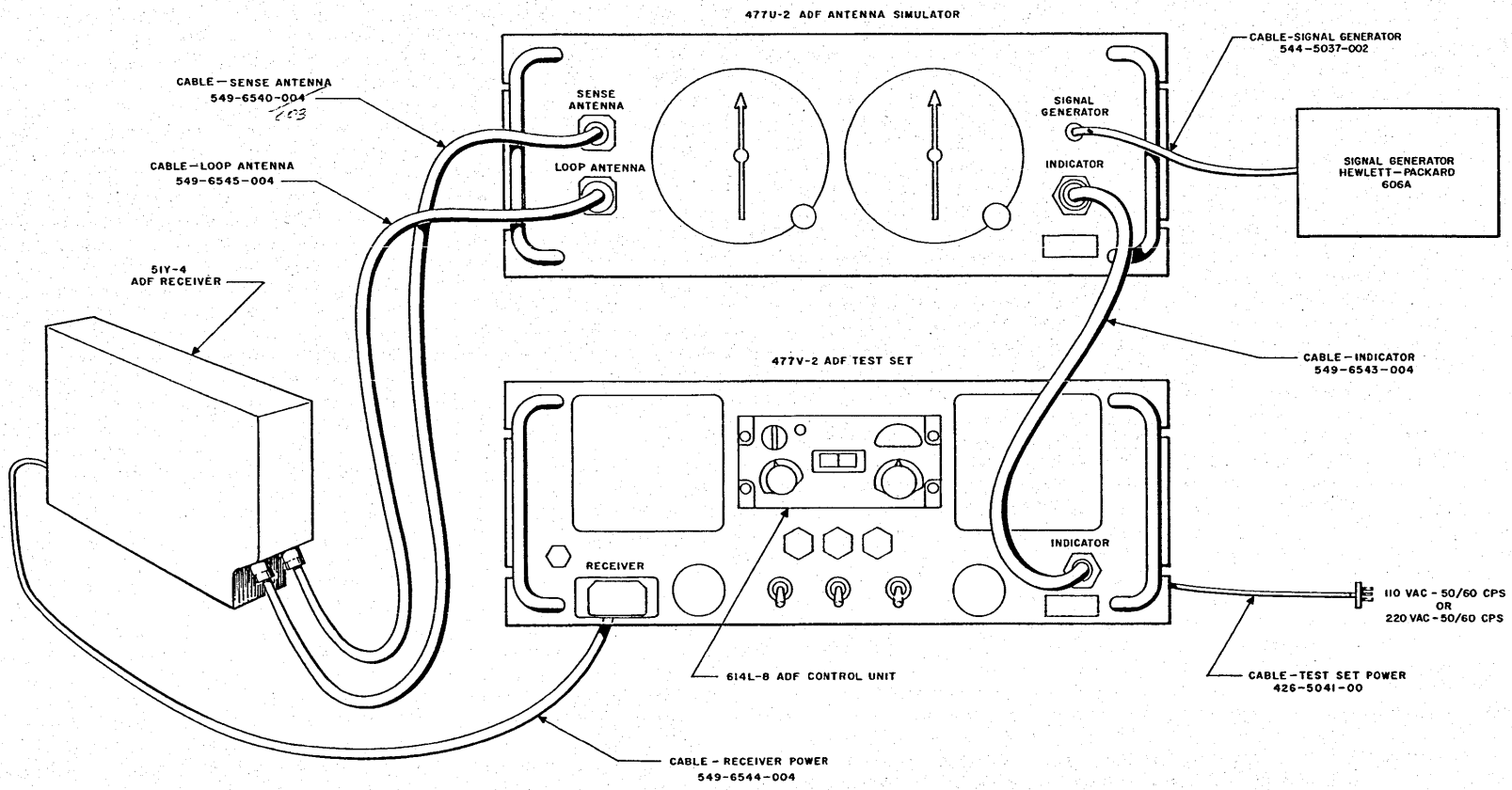


Figure 5-1. 477U-2 Performance Test Setup Using DF-203 Components (51Y-4 ADF Receiver)

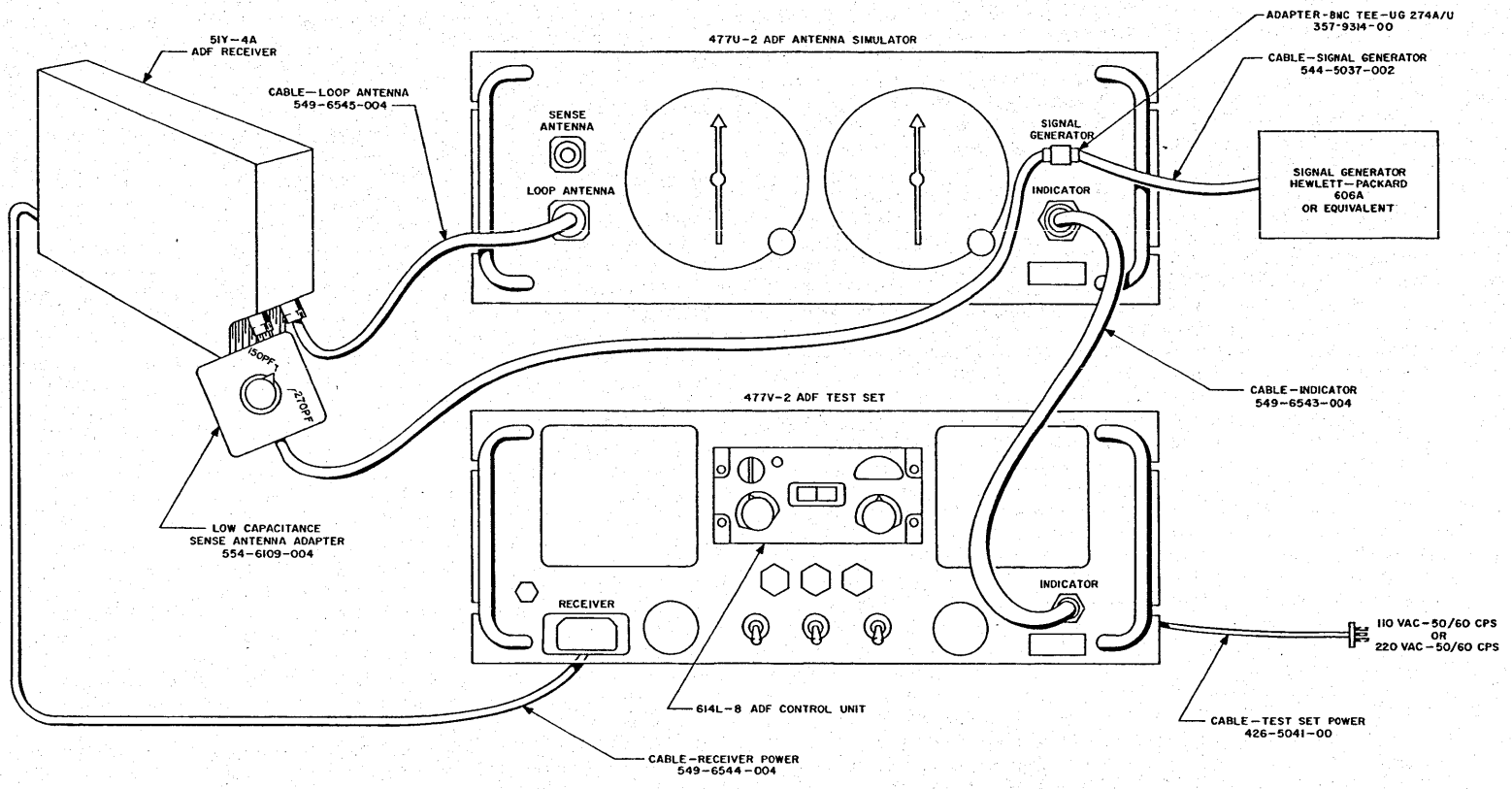


Figure 5-2. 477U-2 Performance Test Setup Using DF-203 Components (51Y-4A ADF Receiver)

TABLE 5-3
INITIAL CONTROL SETTINGS OF THE 477V-1

CONTROL	POSITION
BFO	OFF
SELECT	BROAD
GAIN	As required
Function switch	ADF
PHONE-SPEAKER-500 Ω	SPEAKER
CONTROL UNIT	PANEL
SIGNAL GENERATOR - 10 KC SPECTRUM	SIGNAL GENERATOR
CARRIER	ON
MOD	OFF
METER FUNCTION	AUDIO-MW-X1
VOLTAGE RANGE	300 (not in circuit)

d. Set the signal generator frequency to 300 kc and the output to produce a field strength of 1000 uv/meter.
e. Tune the 51Y-3 for maximum tuning meter deflection.
f. Rotate the 477U-2 LOOP SIMULATOR needle from 0 to 330 degrees in 30-degree steps. The BEARING INDICATOR should read the same as the LOOP SIMULATOR within 2 degrees in all positions. If the BEARING INDICATOR does not read the same as the LOOP SIMULATOR within these limits refer to paragraph 5.4.
g. Turn the 477V-1 function switch to the LOOP position. Operate the LOOP L-R control on the 614L-( ) Control Unit and check to see that the BEARING INDICATOR rotates clockwise with the switch in the R position and counterclockwise with the switch in the L position. If the BEARING INDICATOR does not operate properly refer to paragraph 5.5.

5.4 Alignment and Calibration.

5.4.1 LOOP SIMULATOR ZERO.

NOTE

In the following steps, an in-phase null must be obtained to zero the loop simulator correctly. It is also possible, but not correct, to obtain an out-of-phase null. The in-phase null must be determined by Lissajous figures on the oscilloscope. To determine which Lissajous figure indicates in-phase signals on the oscilloscope that is in use, connect the signal generator to both the vertical and horizontal inputs of the oscilloscope. Switch the horizontal selector of the oscilloscope to external. Note the quadrant into which the figure is tilted. The figure will be tilted into the other quadrants when signals are out of phase.

a. Remove back cover from the 477U-2.
b. Connect the output of the signal generator to terminal R1 of LOOP SIMULATOR resolver B1 and to the horizontal input of the oscilloscope.
c. Connect terminal R2 of resolver B1 to ground.
d. Set the oscilloscope for external horizontal input.
e. Connect pin H of the 477U-2 LOOP ANTENNA jack to the vertical input of the oscilloscope and pin F to ground.
f. Connect the a-c vtvm across the vertical input of the oscilloscope.
g. Manually rotate the LOOP SIMULATOR indicator needle until a null is observed on the a-c vtvm.
h. Rotate the needle of the LOOP SIMULATOR indicator 5 degrees clockwise from the null position and adjust the gain of the horizontal and vertical oscilloscope traces until their lengths are equal. Disconnect one input while the other is being adjusted.
i. Reconnect both inputs. If the Lissajous figure is tilted into the same quadrant as was determined to indicate in-phase voltages, the null determined in step g was the correct null. The exact angle of tilt of the figure is unimportant. If the Lissajous figure is tilted into the other quadrants, use the knob to rotate the LOOP SIMULATOR needle 180 degrees.
j. Rotate the LOOP SIMULATOR to the center of the null determined in step i.
k. The LOOP SIMULATOR needle should indicate exactly 0 degrees. If there is a slight error, loosen the three butterfly brackets holding resolver B1 to the dial assembly and rotate the entire resolver until the needle indicates 0 degrees. Tighten the three butterfly brackets.
l. Repeat steps h through k.

5.4.2 BEARING INDICATOR ZERO.

a. Connect 26 volts 400 cps across pins A and B of the INDICATOR jack on the front panel of the 477U-2.
b. Connect the a-c vtvm across pins C and D of the INDICATOR jack.
c. Rotate the BEARING INDICATOR needle by hand until a null is observed on the vtvm.

NOTE

A complete rotation of the BEARING INDICATOR needle will produce two nulls. To find the correct null measure the voltage between pins B and D of the INDICATOR jack. This voltage will be less than 26 volts when the correct null has been found.

d. When the proper null has been found, the BEARING INDICATOR needle should point to 0. Adjustments may be made by removing the housing on the rear of the bearing indicator. Loosen the three screws holding synchro B2, and rotate B2 until the needle reads 0 in the null position.

5.4.3 LOOP SIMULATOR IMPEDANCE ADJUSTMENT.

If variable inductors L3 and L10, shown in figure 5-3, are not both set to the same prescribed value, the stator windings of resolver B1 will each be looking into a different impedance and a sizable error in the simulated loop antenna output to the 51Y-4 will result. The following procedure concerns the alignment of these inductors.

a. Construct the test jig shown in figure 5-4.
b. Connect the loop cable to the loop connector on the test jig.
c. Place the test jig on the Wayne-Kerr B601 r-f bridge. Connect the output of the signal generator to the SOURCE terminal of the bridge and the sense input of the 51Y-4 to the DETECTOR terminal.
d. Adjust the signal generator to a frequency of 650 kHz at 3 volts output and set the resistance and inductance multipliers on the bridge to Rx 10 and Lx 1.0 respectively.
e. Adjust loop simulator to 45 degrees or 225 degrees.
f. Turn the switch on the test jig to BAL and balance the bridge with the R and C dials in the CALIBRATE position. The meter on the 477V-2 indicates a null when the bridge is balanced.
g. Turn the switch on the test jig to I and balance the bridge with the R and C controls.
h. Turn the switch on the test jig to II and balance the bridge with the R and C controls.
i. If the bridge does not read 1980 to 2020 pf when balanced in positions I and II, switch to I and set the C dial on the bridge to -2000 ±20 pf.

NOTE

The Wayne-Kerr Bridge measures inductance as negative capacitance.

j. Adjust the tuning slug of L10 (see figure 5-3) until a null is indicated by the 477V-2 test meter.
k. Repeat step j. with the switch on the test jig in the II position, using L3 to adjust for the null condition.
l. Measure the impedance of the loop simulator with the test jig switch in both the I and II positions at frequencies of 210 and 1750 kHz. See table 5-4 for impedance values. If the impedance values obtained in this test do not agree with the values given in table 5-4 refer to paragraph 5.5 for troubleshooting information.

5.4.4 LOOP SIMULATOR CALIBRATION CHECK.

Construct a test jig by connecting a 22-uh inductor across pins B and D of a Bendix PTO-2A-12-10P plug (Collins part number 371-2055-00) and another 22-uh inductor across pins F and H. Connect one end of the loop cable to the test jig and the other end to the LOOP ANTENNA jack on the front of the 477U-2. Connect the signal generator to the SIGNAL

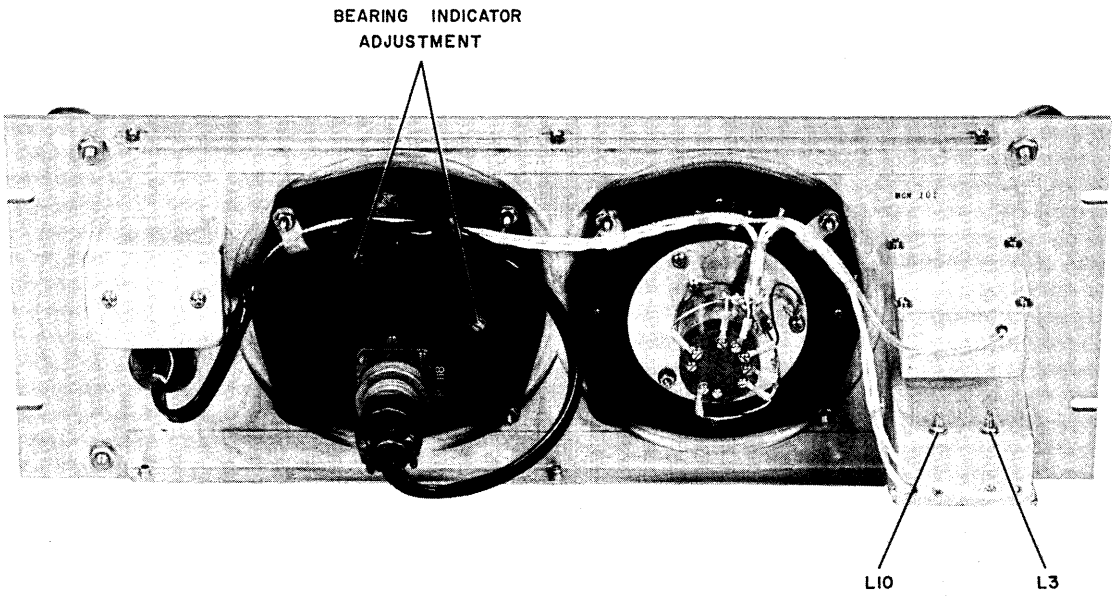


Figure 5-3. 477U-2 ADF Antenna Simulator Adjustments

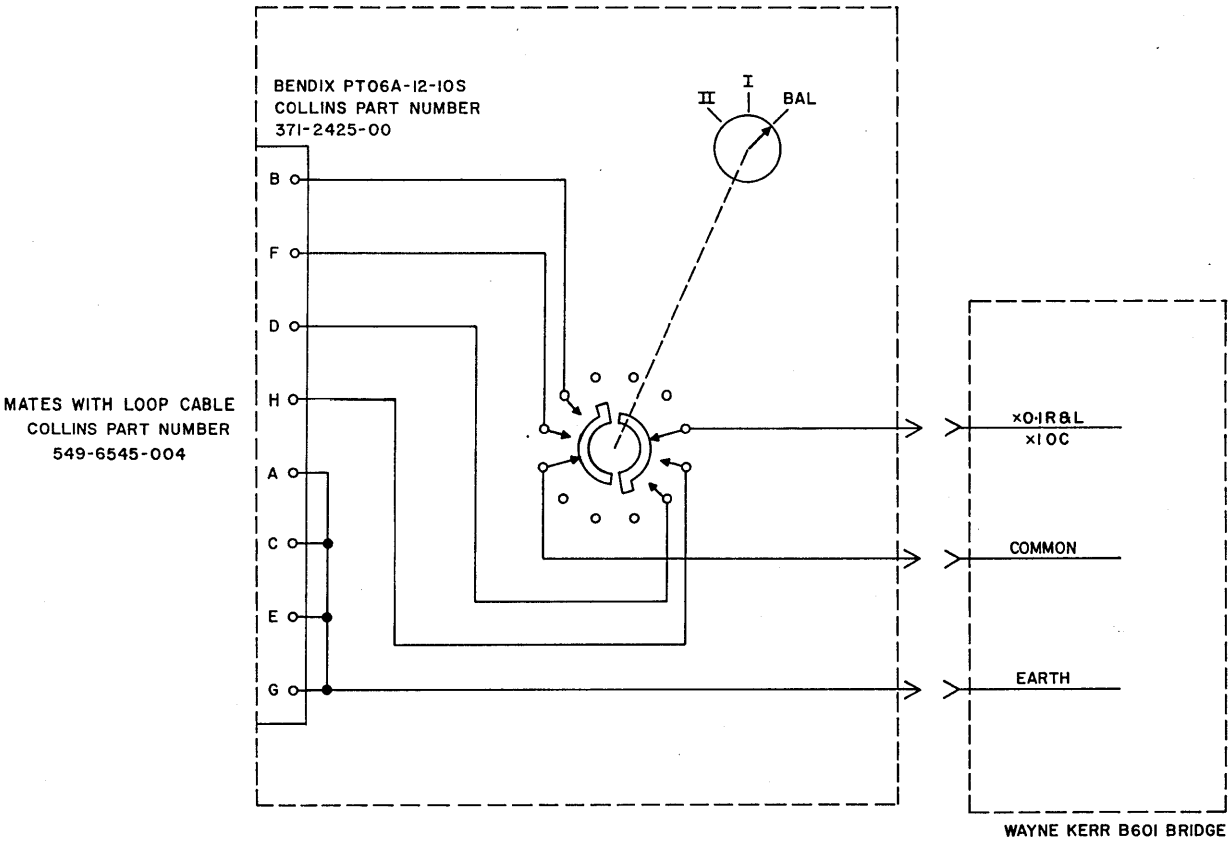


Figure 5-4. 477U-2 Test Jig

TABLE 5-4
LOOP IMPEDANCE MEASUREMENTS

FREQUENCY (kc)	LIMITS	
	R (ohms)	C (uuf)
210	Greater than 400	-20,400 to -21,800
650	Greater than 2500	-1980 to -2020
1750	Greater than 2000	-10 to -55

GENERATOR jack and adjust the output to 3 volts. Refer to table 5-5 and measure the indicated voltages across the 22-uh inductor. If the 477U-2 does not meet these requirements refer to paragraph 5.5.

5.4.5 SENSE SIMULATOR CALIBRATION CHECK.

Construct a test jig by connecting a 3300-uuf capacitor across pins A and C of a Bendix PTO-2A-10-6P plug (Collins part number 371-2016-00) and shorting pins C and E. Connect one end of the sense cable to the test jig and the other end to the SENSE ANTENNA jack on the front of the 477U-2. Connect the signal generator to the SIGNAL GENERATOR jack and adjust the output to 3 volts. Refer to table 5-6 and measure the indicated voltages across the 3300-uuf capacitor. If the 477U-2 does not meet these requirements refer to paragraph 5.5.

5.5 Trouble Shooting.

The 477U-2 is comprised of three major circuits: a resolver and simulated loop antenna, a simulated sense antenna, and a bearing indicator. The three circuits are isolated from each other and if any one of them is malfunctioning it will be easily detected while performing the procedures outlined in paragraphs 5.3 and 5.4. When the faulty circuit has been determined refer to figure 7-1 and check to see that all connections are correct. If the connections are found correct, make a continuity check of all inductors in the circuit and check for shorted capacitors. If resolver B1 or synchro B2 is suspected to be faulty, refer to figure 7-1 and check the windings for continuity. After the trouble has been isolated and corrected, perform the procedures outlined in paragraphs 5.3 and 5.4.

TABLE 5-5. LOOP SIMULATOR CALIBRATION

FREQ (kc)	LOOP SIMULATOR NEEDLE SETTING	MEASURE BETWEEN PINS	VOLTAGE LIMITS (mv)
200	0	F and H	1.7 to 2.4
200	90	B and D	1.7 to 2.4
400	0	F and H	3.2 to 3.9
400	90	B and D	3.2 to 3.9
850	0	F and H	7.2 to 8.9
850	90	B and D	7.2 to 8.9

TABLE 5-6. SENSE SIMULATOR CALIBRATION

FREQUENCY (kc)	VOLTAGE LIMITS BETWEEN PINS A and C (mv)
200	19.0 to 22.0
400	19.0 to 22.0
850	25.5 to 28.5

section 6

parts list

ITEM	DESCRIPTION	COLLINS PART NUMBER
	477U-2 ADF ANTENNA SIMULATOR	522-2710-00
B1	SYNCHRO, RESOLVER: 4.8 + J236 ohms stator impedance, 5.4 + J294 ohms rotor impedance; single phase rotor, 2-phase stator; 1.437 in. dia by 2.323 in. lg o/a; Clifton Precision part no. XEWC15A5 (part of DS2)	229-6000-00
B2	SYNCHRO, RECEIVER: single phase rotor, wyc-connected 3-phase stator; 26.0-v primary; 11.8-v max stator output; 400 cps; 18 ohms d-c rotor resistance, 7.5 d-c stator resistance; Clifton Precision part no. TRH-11-E2 (part of DS1)	229-0224-00
C1	CAPACITOR, FIXED, MICA: 430 uuf ±5%, 500 v d-c; Electro Motive part no. DM15F431G	912-2860-00
C2	CAPACITOR, FIXED, MICA: 390 uuf ±5%, 500 v d-c; Electro Motive part no. DM15F391J01	912-2858-00
C3	CAPACITOR, FIXED, MICA: same as C1	912-2860-00
C4	CAPACITOR, FIXED, MICA: same as C2	912-2858-00
C5	CAPACITOR, FIXED, MICA: 43 uuf ±2%, 500 v d-c; Electro Motive part no. DM15E430G01	912-2788-00
C6	CAPACITOR, FIXED, MICA: 510 uuf ±2%, 300 v d-c; Electro Motive part no. DM15F511G01	912-2866-00
C7	CAPACITOR, FIXED, MICA: 100 uuf ±5%, 500 v d-c; Electro Motive part no. DM15F101J01	912-2816-00
C8	CAPACITOR: FIXED, MICA: same as C6	912-2866-00
C9	CAPACITOR, FIXED, MICA: 1500 uuf ±5%, 500 v d-c; Electro Motive part no. DM20F152J	912-3327-00
C10	CAPACITOR, FIXED, MICA: 5 uuf ±5%, 500 v d-c; Electro Motive part no. DM15C050J01	912-2750-00
C11	CAPACITOR, FIXED, MICA: 36 uuf ±2%, 500 v d-c; Electro Motive part no. DM15E360G01	912-2782-00
C12	CAPACITOR, FIXED, MICA: 200 uuf ±2%, 500 v d-c; Electro Motive part no. DM15F201G01	912-2836-00
C13	CAPACITOR, FIXED, MICA: 1800 uuf ±2%, 500 v d-c; Electro Motive part no. DM19F182C.	912-3018-00
DS1	INDICATOR, ADF: proprietary data control dwg	555-1125-003
DS2	DIAL, RESOLVER: inscribed 0 to 360 degrees	549-6462-003
J1	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 contact, straight shape; panel mtg; Communication Electronics part no. UG-1094/U	357-9183-00
J2	CONNECTOR, RECEPTACLE, ELECTRICAL: 10 male contacts, bayonet locking, 7.5 amps; Bendix aviation Corp. part no. PT02A-12-10P	371-2055-00
J3	CONNECTOR, RECEPTACLE, ELECTRICAL: 6 male contacts, bayonet locking 7.5 amps; Bendix Aviation Corp. part no. PT02A-10-6P	371-2016-00
J4	CONNECTOR, RECEPTACLE, ELECTRICAL: 6 male contacts, bayonet locking, 7.5 amps; Bendix Aviation Corp. part no. PT07A-10-6P (p/o W1)	371-6684-00
L1	COIL, RADIO FREQUENCY: 1.7-uh inductance; 60-mc frequency, 1.0 amps d-c current rating; 700 v rms	240-1530-00
L2	COIL, RADIO FREQUENCY: 1.5 uh inductance, 60-mc frequency, 1.0 amps d-c current rating; 700 v rms	240-1531-00
L3	COIL, RADIO FREQUENCY: includes steatite coil form w/ adjustable core; 0.205 in. w approx by 15/16 in. lg	549-6541-003

ITEM	DESCRIPTION	COLLINS PART NUMBER
L4	COIL, RADIO FREQUENCY: same as L2	240-1531-00
L5	COIL, RADIO FREQUENCY: same as L1	240-1530-00
L6	COIL, RADIO FREQUENCY: same as L1	240-1530-00
L7	COIL, RADIO FREQUENCY: same as L2	240-1531-00
L8	COIL, RADIO FREQUENCY: same as L2	240-1531-00
L9	COIL, RADIO FREQUENCY: same as L1	240-1530-00
L10	COIL, RADIO FREQUENCY: same as L3	549-6541-003
L11	NOT USED	
L12	COIL, RADIO FREQUENCY: single layer solenoid wound, powdered iron coil form; 3.3-uh inductance, 60-mc frequency; 0.15 ohms d-c resistance; 1150 ma; Jeffers Electronics part no. 10102-110	240-0065-00
L13	COIL, RADIO FREQUENCY: single layer wound; 26 turns no. 32 AWG wire; 3.9 uh inductance, 0.16 ohms max d-c resistance; 1440 ma max current rating; Jeffers Electronics Div. of Spur Carbon Co. part no. 10102-114	240-0144-00
P1	CONNECTOR, PLUG, ELECTRICAL: 5 female contacts; straight shape (p/o W1)	357-4007-00
P1	CONNECTOR, PLUG, ELECTRICAL: 6 female contacts; cable mounting bayonet locking; 7.5 amps; Bendix Aviation Corp. part no. PT06A-10-6S (p/o W2)	371-6519-00
P1	CONNECTOR, PLUG, ELECTRICAL: 10 female contacts, bayonet locking; 7.5 amps; 700 v d-c rating; Bendix Aviation Corp. part no. PT06A-12-10S (p/o W3)	371-2425-00
P1	CONNECTOR, PLUG, ELECTRICAL: 1 male contact; 50 ohms, 90° angle; Amphenol part no. 31-204 (p/o W4)	357-9169-00
P2	CONNECTOR, PLUG, ELECTRICAL: same as P1 (p/o W2)	371-6519-00
P2	CONNECTOR, PLUG, ELECTRICAL: same as P1 (p/o W3)	371-2425-00
P2	CONNECTOR, PLUG, ELECTRICAL: same as P1 (p/o W4)	357-9169-00
R1	RESISTOR, FIXED, FILM: 51.1 ohms ±1%, 1/4 w	705-7034-00
R2	RESISTOR, FIXED, FILM: 909 ohms ±1%, 1/4 w	705-7094-00
R3	RESISTOR, FIXED, FILM: 1000 ohms ±1%, 1/4 w	705-7096-00
R4	RESISTOR, FIXED, FILM: 4220 ohms ±1%, 1/4 w	705-7126-00
R5	RESISTOR, FIXED, FILM: same as R4	705-7126-00
TB1	TERMINAL BOARD: phenolic w/5 solder lug type terminals; 11/16 in. w by 1-7/8 in. lg; Cinch Mfg. Corp. part no. 1542-A	306-0550-00
TB2	TERMINAL BOARD: same as TB1	306-0550-00
W1	CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL: 5 conductors, terminated each end w/ connector; 20 in. lg o/a	549-6430-003
W2	CABLE ASSEMBLY, RADIO FREQUENCY: sense coaxial cable terminated each end w/ connector; 60 in. lg o/a	549-6540-003
W3	CABLE ASSEMBLY, SPECIAL PURPOSE LOOP, ELECTRICAL: 6 conductors, terminated each end w/ connector; 60 in. lg o/a	549-6545-004
W4	CABLE, RADIO FREQUENCY: RG-58C/U coaxial cable terminated each end w/ connector; 27 in. lg o/a	544-5037-002

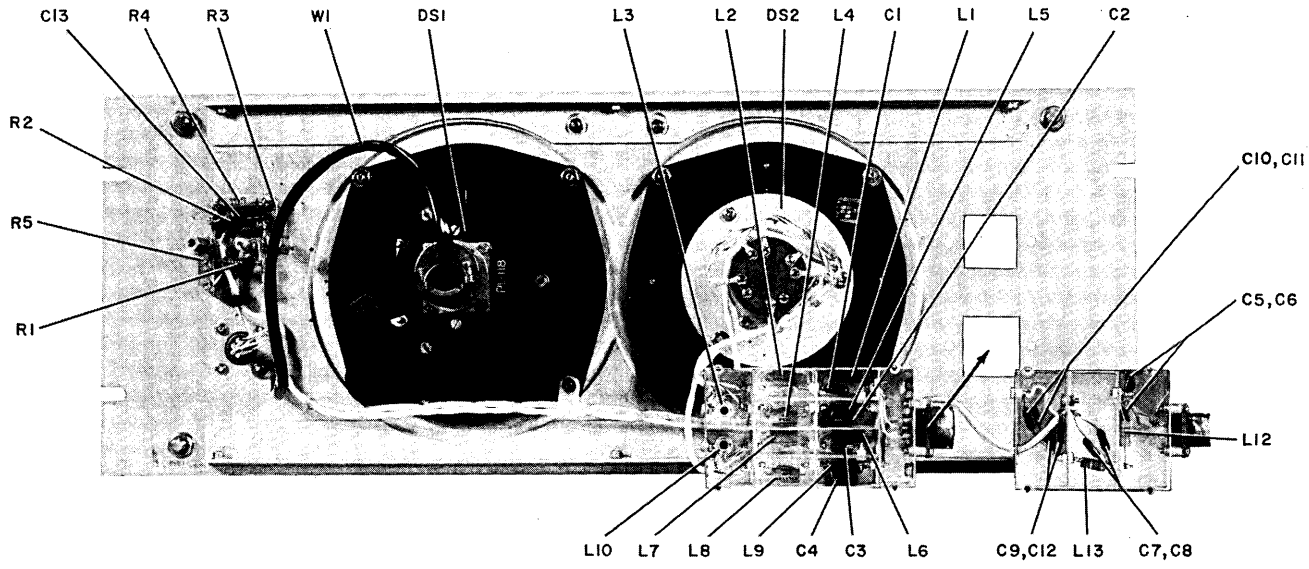


Figure 6-1. 477U-2 ADF Antenna Simulator, Rear View, Cover Removed

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A1	Corrected synchro wiring between connector J4 and P1, added synchro pin assignments at J4 for clarification, and added notes 1 and 2.		All models

Figure 7-1. 477U-2 ADF Antenna Simulator, Schematic Diagram (Sheet A)

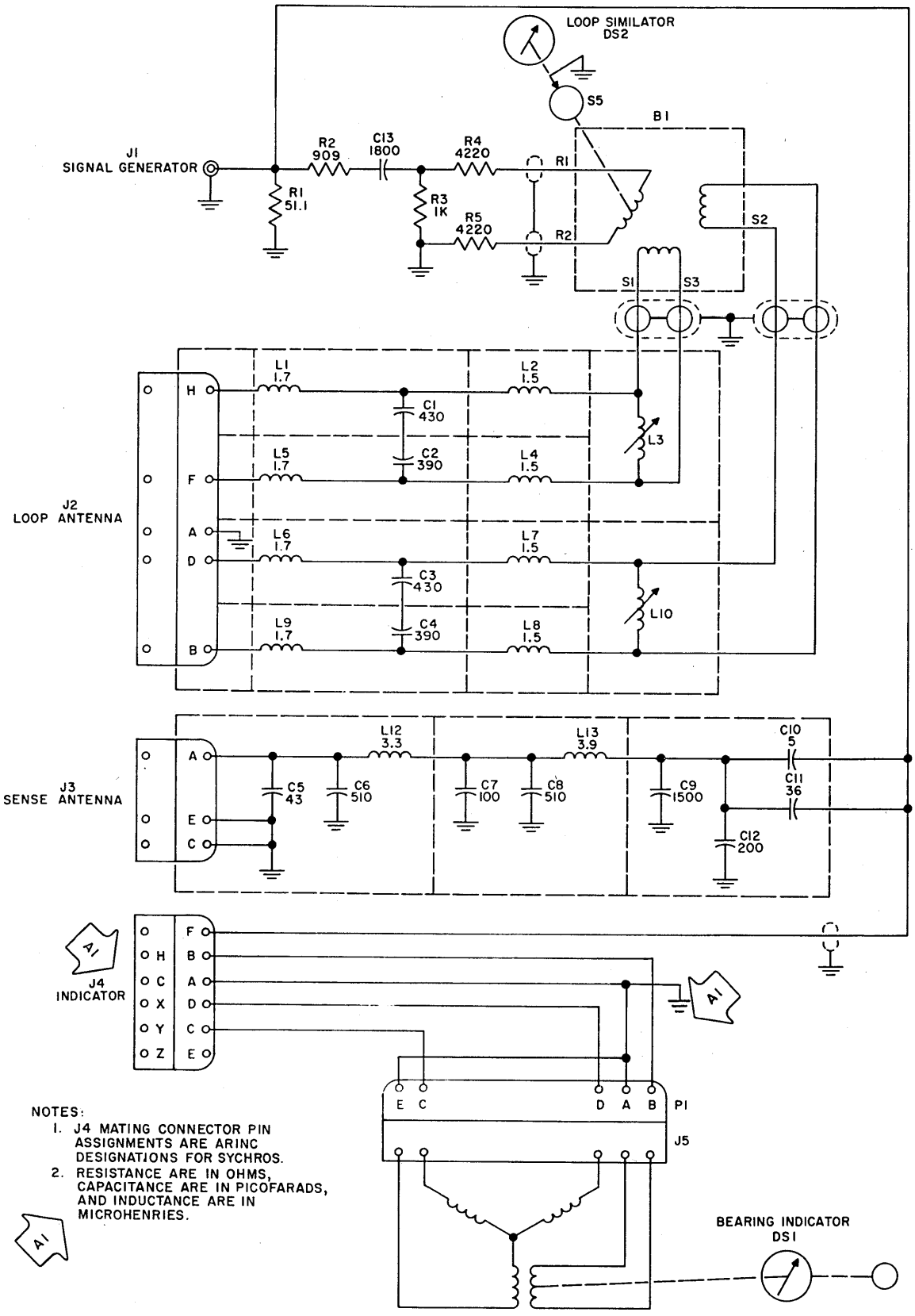


Figure 7-1. 477U-2 ADF Antenna Simulator, Schematic Diagram

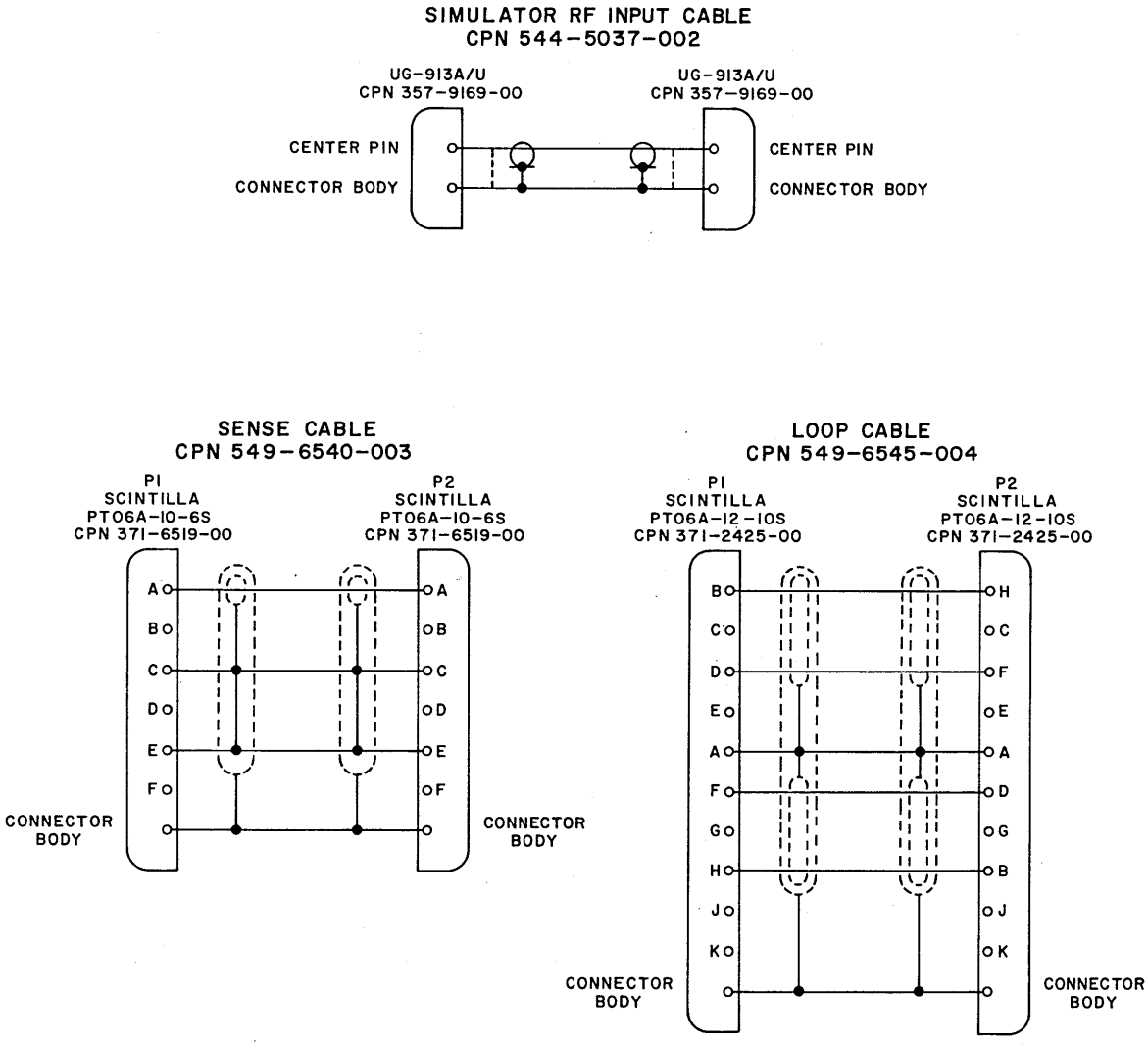


Figure 7-2. Simulator R-F Input Cable, Sense Cable, and Loop Cable, Schematic Diagram