MICROWAVE ANTENNAS
KS-15676 HORN-REFLECTOR AND WAVEGUIDE SYSTEM
INSTALLATION
ORIENTATION USING 11A DIRECTIONAL COUPLER

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1. GENERAL

1.01 This section describes the orientation of KS-15676 antenna and associated waveguide assemblies using the 11A directional coupler.

1.02 The horn-reflector antenna is used for either single-polarity or 2-polarity transmission of the radio waves. Single-polarity systems require separate antennas for transmitting and receiving. The 2-polarity system uses the same antenna for transmitting to and receiving from an adjacent radio repeater. This practice describes antenna and waveguide alignment for 2-polarity systems and includes additional transmission tests of the 11A directional coupler.

***Caution:** The horn-reflector antenna has a weather cover which is expanded by the normal pressure from the station dry-air supply. The cover must be under pressure from this supply during the transmission testing and level measurements. To avoid delays, all waveguide changes are made on the unpressurized side of the pressure window.*

Note 1: Fig. 5 shows the steps to follow in orienting antennas and waveguide components. The exact procedure, using 4-kmc test signals, is detailed in the following text:

(a) Do not attempt to orient the antennas during fading periods greater than 1 db.

(b) At the rotational flanges employing an O ring gasket, which are used during orientation alignment, the application of a small amount of petroleum jelly is recommended to facilitate a smooth action. Care should be exercised to avoid any application of the jelly on the inside of the waveguide.

Note 2: The transmitting and receiving equipment at each station shall have passed all acceptance tests before it is used for orienting.

1.03 The following tools and apparatus are required at ***each repeater station:***

QUANTITY	DESCRIPTION
2	ED-59410-70 Transducers
2	KS-5783, L4 Flexible Waveguides
1	ED-59449-70 Azimuth Scale
1	KS-15676, L12 Azimuth Adjusting Screw
1	P-38B664 Circular-waveguide Wrench
1	P-38B665 Rectangular-waveguide Wrench
1	J68340A, L3 or L4 Test Bay or J68345A, L1 or L2 Test Set
1	KS-15658 Noise-Figure Test Set
1	J68340N or J68340E Power Meter (J68345A Test Set applications only)

QUANTITY	DESCRIPTION
1	KS-14191 Attenuator (J68345A, L2 Test Set applications only)
1	ED-45465-01, G2 Cable Assembly (6 feet)
2	ED-45466-01, G1 Transducers
1	Adjustable Open-end Wrench with 3-inch capacity
2	Ratchet Wrenches with 3/8-inch square drive
1	1/2-inch Socket with 3/8-inch square drive
1	7/16-inch Socket with 3/8-inch square drive
1	3/8-inch Socket with 3/8-inch square drive
1	5/16-inch Socket with 3/8-inch square drive
1	1/4-inch Socket with 3/8-inch square drive
1	1/2-inch, twelve-point Box Wrench
1	7/16-inch, twelve-point Box Wrench
20	Regular SF hex head 1/4-20 Bolts, 1-3/4 inches long for rectangular-waveguide flange
16	Regular SF hex head 5/16-18 Bolts, 1-3/4 inches long for circular-waveguide flange
Misc	IF Patch Cords
1	BNC Connector
1	358A Plug
7	No. 5-849B heavy duty, castaloy, cylinder-type Pinchclamps — Fisher Scientific Company, 633 Greenwich Street, New York, N. Y.
1	Standard Black Pressure Gauge, Fig. 633S, US Gauge Company, lower 1/4 Standard Male Pipe Thread, 2-1/2 dial, 0 to 15 inches water
1	No. 5499 Schrader Chuck
Misc	Spare Round- and Rectangular-waveguide Gaskets
	Telephone communication system between station-to-station radio bays and from station radio bays to antenna decks. Provide flexibility in telephone connection to antenna decks for reuse at base of the towers at the lower end of the circular-waveguide run.

Caution: Communication lines between the antenna decks and the radio bays should be run inside the tower structure.

2. CONNECTION AND ALIGNMENT OF COMPONENTS AND WAVEGUIDE TEST EQUIPMENT

2.01 The connection of the waveguide components and test assemblies required for orienting the antennas is shown in Fig. 1. The following paragraphs cover the installation of this equipment.

2.02 At both stations, install the ED-59455-70 tuning section and the 11A directional coupler C1, shown in Fig. 1, as follows:

(1) Attach the ED-59455-70 tuning section, with the movable flange upward, to the base of the circular-waveguide run. Use eight 5/16-18 cap screws 1-1/4 inches long, together with the O ring gasket supplied with the tuning section, for this purpose. (Use a thick wafer here.)

(2) Loosen the nuts fastening the rotational restrainer to the tower, and then slide the restrainer down out of the way. (This restrainer, used to support the lower end of the 11A coupler, will be aligned in a later step.)

(3) Using eight 5/16-18 cap screws 1-1/2 inches long, loosely connect the 11A coupler C1 to the lower end of the tuning section. (Use a thin wafer here.)

(4) Slide the rotational restrainer to its normal position. ***Do not*** tighten the two 3/8-inch cap screws which fasten the restrainer plate to the bottom of the 11A coupler.

(5) Connect the waveguide test connections as shown in Fig. 1. Note that the test connections to arms B and C of the 11A coupler are made on the unpressurized side of the pressure window inside the repeater building;

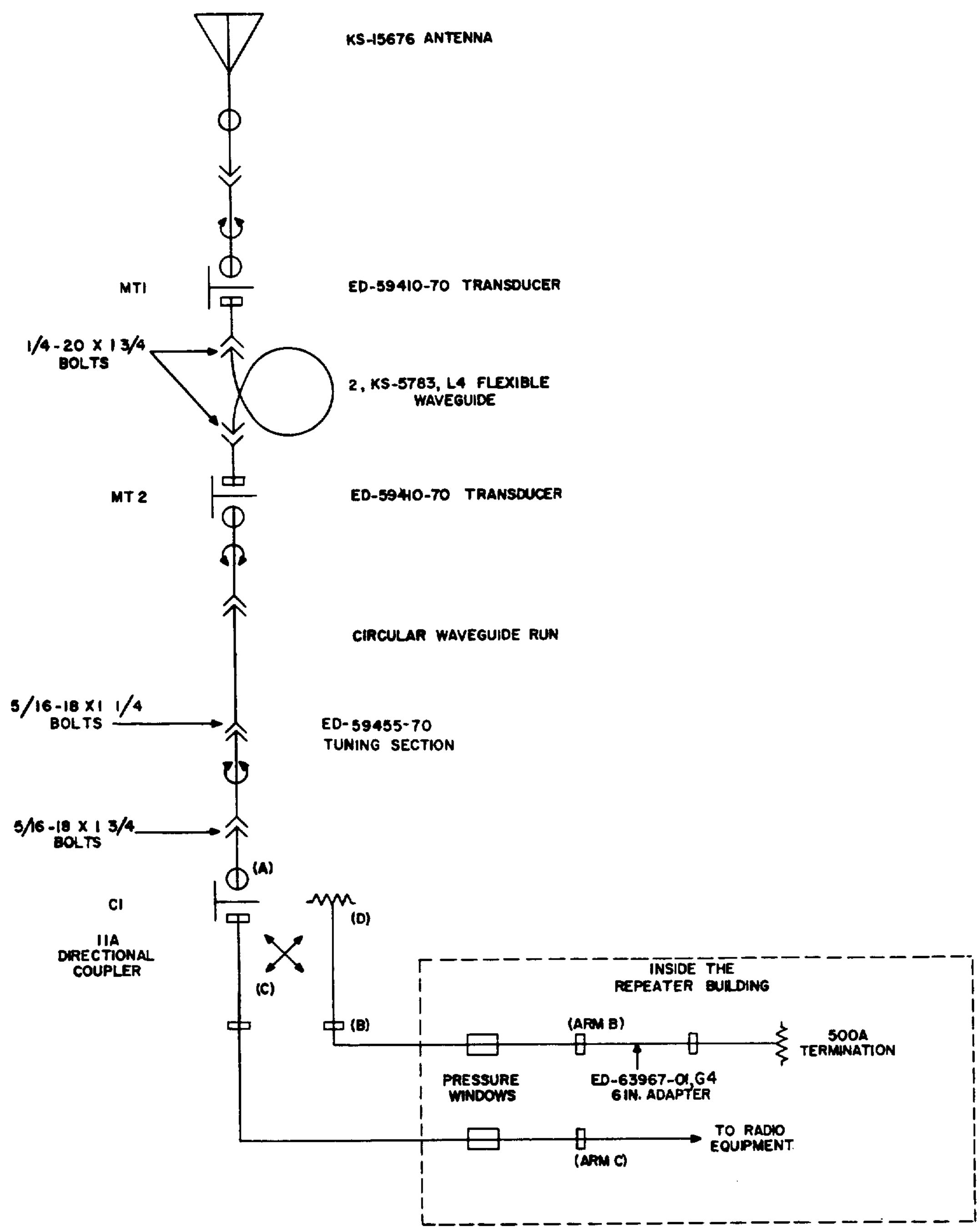


Fig. 1 – Waveguide Setup for Aligning Antennas Used with 2-Polarity Transmission

this eliminates the difficulty of making connections to arm C inside the rotational restrainer at the bottom of the tower.

2.03 At both stations, align the 11A coupler as follows:

(1) Using the P-36B664 wrench on the free ends of the bolts between C1 and the tuning section, rotate the coupler so that the waveguide flange to branch B of the coupler is parallel to the face of the antenna.

Note: Branch B should point away from the inside of the tower.

(2) Tighten the bolts between the coupler and the tuning section.

(3) Tighten the nuts fastening the restrainer at the base of the coupler to the tower.

Note: This restrainer should be oriented to present a minimum of strain on the coupler.

(4) Connect the coupler to the KS-5783 flexible rectangular waveguides leading to the station.

2.04 At both stations, align the transducer MT1 for illumination of the antenna with ***horizontal polarization*** as follows:

(1) Using eight 5/16-18 bolts 1-1/4 inches long, loosely connect the transducer MT1 to the feed horn. Drop enough bolts through the bolt holes in the rectangular flange at the other end to furnish a purchase for the P-38B665 wrench.

Caution: Do not injure the face of the rectangular flange on the transducer.

(2) Sight through the rectangular flange on the transducer up into the antenna. Rotate, using the P-38B665 wrench, until the wide face of the rectangular opening is parallel to the seam between the reflector halves of the antenna. This seam is parallel to the direction of transmission between antennas. Tighten the bolts between the transducer and the feed horn.

2.05 At both stations, install transducer MT2 and the flexible rectangular waveguide as follows:

(1) Using eight 5/16-18 bolts 1-1/4 inches long, loosely connect MT2 to the circular-waveguide run.

(2) Using 1/4-20 bolts 1-1/4 inches long, connect the two sections of KS-5783 flexible waveguide in tandem. Using 1/4-20 bolts 1-3/4 inches long, connect the assembly of the two KS-5783 flexible waveguides to MT1 and MT2, as shown in Fig. 1.

(3) Using the P-38B665 wrench on the free ends of the bolts in the rectangular flange on the transducer MT2, rotate MT2 so that the wide face of the rectangular waveguide is parallel to the face of the antenna.

(4) Tighten the bolts holding the transducer MT2 to the circular-waveguide run.

(5) All waveguide test connections should now exist as shown in Fig. 1. At this point, the circular-waveguide run to the top of the tower is merely acting as a transmission line, with its polarities arbitrarily related to the face of the antenna.

2.06 ***Applying Air Pressure:*** The weather cover of the antenna must be expanded so that the characteristics of the antenna are the same as they will be when the antenna is in use.

(1) Be sure that the KS-16001 air supply in the station is connected to the antenna which is under test, through the waveguide pressure window.

(2) Turn the switch on the KS-16001 air supply to the ON position. Check to see that the exhaust cap has been removed from the dehydrator unit and that the unit is operating properly.

(3) Connect the 0- to 15-inch pressure gauge to the Schrader chuck. Attach the combination to the spare valve on the waveguide pressure window.

Requirement: Gauge shall read at least 4 inches of water after air blower has been on 3 minutes.

2.07 If pressure does not build up, the plastic air lines to the other pressure windows may be closed off with pinch clamps in order to locate any excessive leak. Closing off the air lines shall be performed as follows:

(1) Read and record the pressure on the lines to be closed off.

(2) Close off the lines with pinch clamps.

(3) Read and record the pressure at 5-minute intervals during the period the pinch clamps are applied.

When any line shows an increase in pressure, the pinch clamps must be removed from that line immediately. The pinch clamps should be removed from any line which shows no change in pressure.

Caution: ***Do not interfere with the air supply of other antennas if they are in use. Where waveguide runs and antennas are exposed to the direct rays of the sun, pressures sufficient to damage the weather cover can build up in a short time if no relief is provided. The design of the KS-16001 air supply unit provides protection from excessive air pressure regardless of the position of the switch; however, when pinch clamps are applied to the air lines, this protection no longer exists for those guides and antennas closed off. In order to reduce the possibility of damage, the pinch clamps should be removed when conditions are such that pressure readings cannot be made at frequent intervals.***

3. TEST SETUP AT TRANSMITTING STATION

3.01 To send a test signal using the J68340A test bay, proceed as follows:

(1) Connect the ED-63773 cable assembly, as shown in Fig. 2, to the input of the TD-2 repeater which feeds the antenna being aligned.

(2) Adjust the frequency of the J68340H RF oscillator to the midband receiver frequency for the channel selected. The adjustment of the oscillator frequency should be made in accordance with the instructions contained in Section 104-400-300, Single Frequency Output.

(3) Adjust the AUTO control on the receiver control panel to obtain a 0-db reference reading on the output-power sensitrol meter M3, thus obtaining a test signal level of +27 dbm into the transmitting branch filter.

Note: At a main or terminal station, an IF oscillator (sweep off) or an FM transmitter (input terminated) may be used to feed the microwave transmitter to obtain the required output.

3.02 To send a test signal using the J68345A test set, proceed as follows:

(1) Connect the 35-db output of the J68345A test set to the input of the TD-2 repeater which feeds the transmitting antenna being aligned, as shown in Fig. 3.

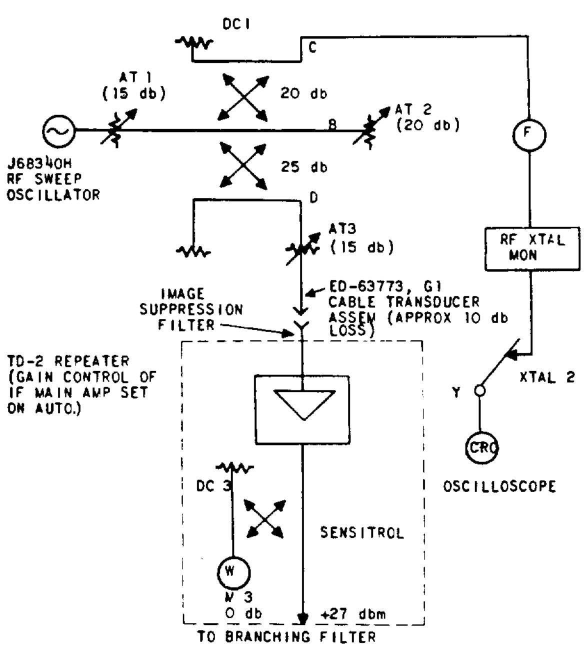


Fig. 2 – Transmitting Equipment Arrangement — Using J68340A Test Bay

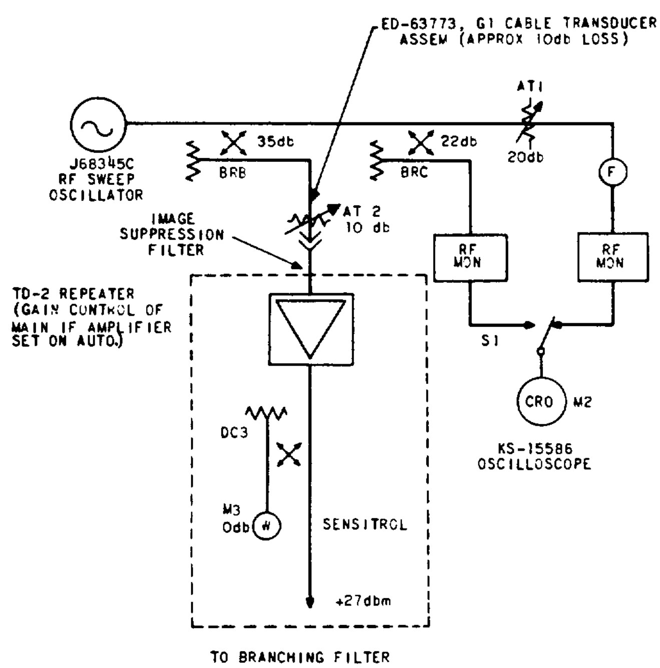


Fig. 3 – Transmitting Equipment Arrangement — Using J68345A Test Set

(2) Adjust the frequency of the J68345C RF oscillator to the midband receiver frequency for the channel selected. The adjustment of the frequency should be made in accordance with the instructions contained in Section 104-410-300. The SWEEP should be in the OFF position.

(3) Adjust the AUTO control on the receiver control panel to obtain a 0-db reference reading on the output-power sensitrol meter M3, thus obtaining a test signal level of +27 dbm into the transmitting branch filter.

Note: At a main or terminal station, an IF oscillator (sweep off) or an FM transmitter (input terminated) may be used to feed the microwave transmitter to obtain the required output.

4. TEST SETUP AT RECEIVING STATION

4.01 To receive a test signal using either the J68340A test bay or the J68345A test set, proceed as follows:

(1) Connect the receiving test equipment as shown in Fig. 4. The noise-figure amplifier is a part of the KS-15658 test set.

(2) Set AT13 at 18 db and the KS-14191 portable IF attenuator ATP or AT14 at 35 db before connecting into the circuit to avoid overloading of the IF power indicating meter. The main IF amplifier gain control should be set for maximum gain under manual control.

(3) With AT13 at 18 db, adjust ATP or AT14 for an IF power meter reading of 0 dbm when the signal is being received from the distant transmitting antenna. Adjust AT13 as required to compensate for the larger attenuation steps of ATP or AT14. In general, it is desirable to keep as much attenuation in AT13 as possible, reducing the attenuation in ATP or AT14 first.

5. ANTENNA ORIENTATION

5.01 The sequence of steps used in orienting the antennas and the waveguide components is illustrated in Fig. 5. The details of these steps are covered in the text which follows. All data taken should be recorded for future reference. The final received signal level measurement, as well as the calculated received signal level, should be posted at the station.

5.02 ***The transmitting antenna*** is first oriented for a maximum received signal at the distant receiving station.

Caution: Minor lobes on these antennas will be found approximately 2.5 degrees each side of the main lobe.

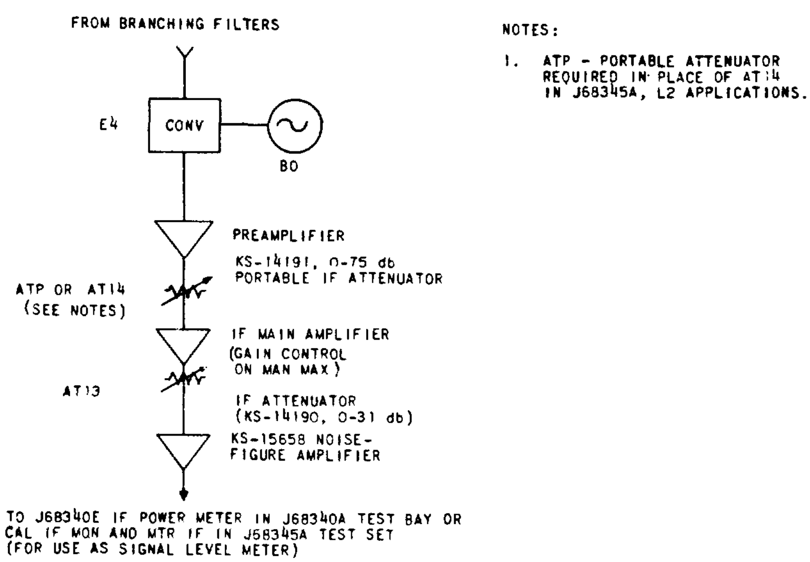
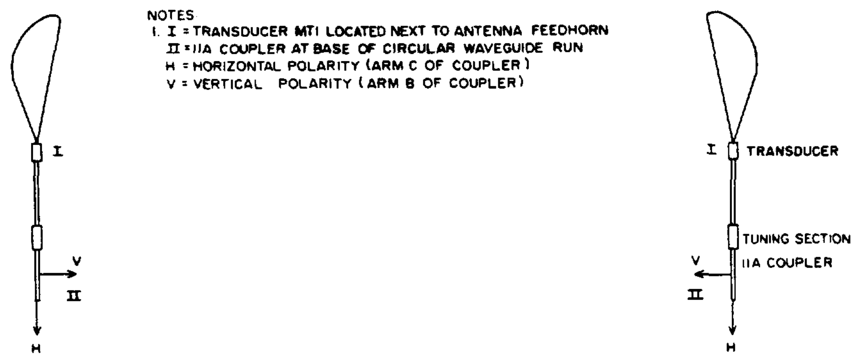


Fig. 4 — Receiving Equipment Arrangement — Using J68340A Test Bay or J68345A Test Set



	STEP NO	STATION A ACTION	STATION A POLARITY OF RADIO WAVE	STATION A DETERMINED AT POINT	DIRECTION OF TRANSMISSION	STATION B POLARITY OF RADIO WAVE	STATION B DETERMINED AT POINT	STATION B ACTION
ANTENNA ALIGNMENT	1.	ALIGN ANTENNA FOR MAXIMUM SIGNAL AT STATION B	H	I	——→	H	I	MEASURE SIGNAL LEVEL
	2.	←—	H	I	——→	H	I	ALIGN ANTENNA FOR MAXIMUM RECEIVED SIGNAL
	3.	—	H	I	——→	V	I	ORIENT TRANSDUCER(I) & ANTENNA FOR MINIMUM RECEIVED SIGNAL. MEASURE SIGNAL LEVEL
	4	—	H	I	——→	H	I	ORIENT TRANSDUCER(I) FOR MAXIMUM RECEIVED SIGNAL
	5.	—	H	I	——→	H	I	MEASURE PATH LOSS, COMPUTE CROSS-POLARIZATION DIS-CRIMINATION.
	6.	PERMANENTLY FASTEN ANTENNA						PERMANENTLY FASTEN ANTENNA; INSTALL CIRCULAR FLEXIBLE WAVEGUIDE
COUPLER & TUNING SECTION ORIENTATION	7.	—	H	I	——→	H	II	ORIENT COUPLER FOR MAXIMUM SIGNAL
	8.	—	H	I	——→	V	II	ORIENT COUPLER & TUNING SECTION FOR MINIMUM RECEIVED SIGNAL. LOCK WAVEGUIDE RESTRAINER
	9.	INSTALL CIRCULAR FLEX GUIDE; ORIENT COUPLER FOR MAXIMUM RECEIVED SIGNAL	H	II	——→	H	II	REVERSE WAVEGUIDE CONNECTIONS TO IIA COUPLER
	10.	ORIENT TUNING SECTION & COUPLER FOR MINIMUM SIGNAL. LOCK WAVEGUIDE RESTRAINER	H	II	——→	V	II	MEASURE RECEIVED SIGNAL LEVEL
	11.	RESTORE WAVEGUIDE CONNECTIONS TO NORMAL	H V	II II	——→ ←——	H V	II II	RESTORE WAVEGUIDE CONNECTIONS TO NORMAL
	12.	RECHECK PATH LOSS (BOTH DIRECTIONS)	V OR H		←——→	V OR H		RECHECK PATH LOSS (BOTH DIRECTIONS)
	13.	NEAR END CROSSTALK TESTS			LOCAL			NEAR END CROSSTALK TESTS

Fig. 5 — Steps in Orienting Antennas and Waveguide Components Using 11A Directional Coupler

5.03 ***In Azimuth***

(1) Install the antenna azimuth adjusting screw at a convenient location between the circular mounting ring and the mounting frame as covered in Section 402-421-202 and shown in Fig. 6 of this section.

(2) The remaining mounting clamp assemblies, shown in Fig. 7, should be loosened so that the mounting frame is free to turn on the mounting ring.

(3) Apply lubricant to the top surface of the circular mounting ring in such a manner

that the area of contact between the ring and mounting frame will obtain lubrication during adjustment.

(4) Install the azimuth scale on the circular mounting ring at a point convenient to the azimuth adjusting screw.

(5) Adjust the four guide wheels on the mounting frame for minimum clearance, without binding, between the wheels and the circular mounting ring.

Caution: Failure to adjust the guide wheels properly will cause excessive play between the mounting frame and ring leading to false azimuth scale readings during adjustment.

(6) Watch the signal level meter, indicated in Fig. 4, at the receiving station. It will be necessary to adjust the IF attenuators as required so that the meter reads on scale. Turn the azimuth adjusting screw to rotate the antenna through the maximum received test signal (main lobe) and through one lobe each side of the main lobe for positive identification. The side lobes in general will produce a signal level approximately 12 db down from the main lobe and be spaced about 2.5 degrees from the main lobe. Record the readings of the azimuth scale for points about 4 db down (equal within ±0.25 db) on opposite sides of the position observed for maximum received signal. The difference on the azimuth scale between these two readings should be about 2.5 degrees.

(7) Using the azimuth adjusting screw, orient the antenna so that the azimuth scale indicates a reading halfway between the two points obtained in (6).

(8) Tighten the three mounting clamp assemblies to the mounting ring to secure the azimuth adjustment. Remove the azimuth adjusting tool and reassemble and secure the mounting clamp.

5.04 ***In Elevation***

(1) Loosen the locking nuts on the tilt-control assembly. Watching the signal level meter at the receiving end, adjust the tilt-control turnbuckle so that it rotates the antenna through the maximum received signal (main lobe) and through one lobe above and below the main lobe for positive identification. Record the complete number of turns of the turnbuckle between points about 6 db down (but equal within ±0.25 db) on the two sides of the position for maximum received signal. The difference should be about nine turns.

(2) Using the turnbuckle, adjust the orientation of the antenna halfway between, accurate to 1/4 turn of the turnbuckle.

(3) Tighten the locking nuts on the tilt-control assembly.

Note: The procedure for orientation in elevation given below is adequate for the great majority of paths. However, an occasional path may be found that requires special treatment. Strong ground reflections, usually from a point near one end of the path, may produce a condition where the direct and reflected signal components arrive at significantly different vertical angles. Care should be taken in such cases to orient the antenna on the direct signal and to discriminate as much as possible against the reflected signal. In some cases, it may even be desirable to point the antenna above the direct signal a small amount (no more than about 0.5 db down from maximum signal) to reduce the effect of the reflection. A nonsymmetrical or double-peaked vertical antenna pattern may be an indication of strong ground reflections. This kind of situation can become noticeable with horn-reflector antennas even when it is not found by the usual path test survey. Consult your transmission engineering group when a case of this kind is suspected.

5.05 ***The receiving antenna,*** next, is oriented for the maximum received test signal.

5.06 ***In azimuth:*** Follow the procedure outlined in 5.03, but do not remove the azimuth adjusting screw at this time.

5.07 ***In elevation:*** Follow the procedure outlined in 5.04.

5.08 ***The receiving antenna*** is next oriented for the ***minimum received test signal*** from the cross-polarized component as follows:

(1) Loosen the bolts in the circular flange between the transducer MT1, shown in

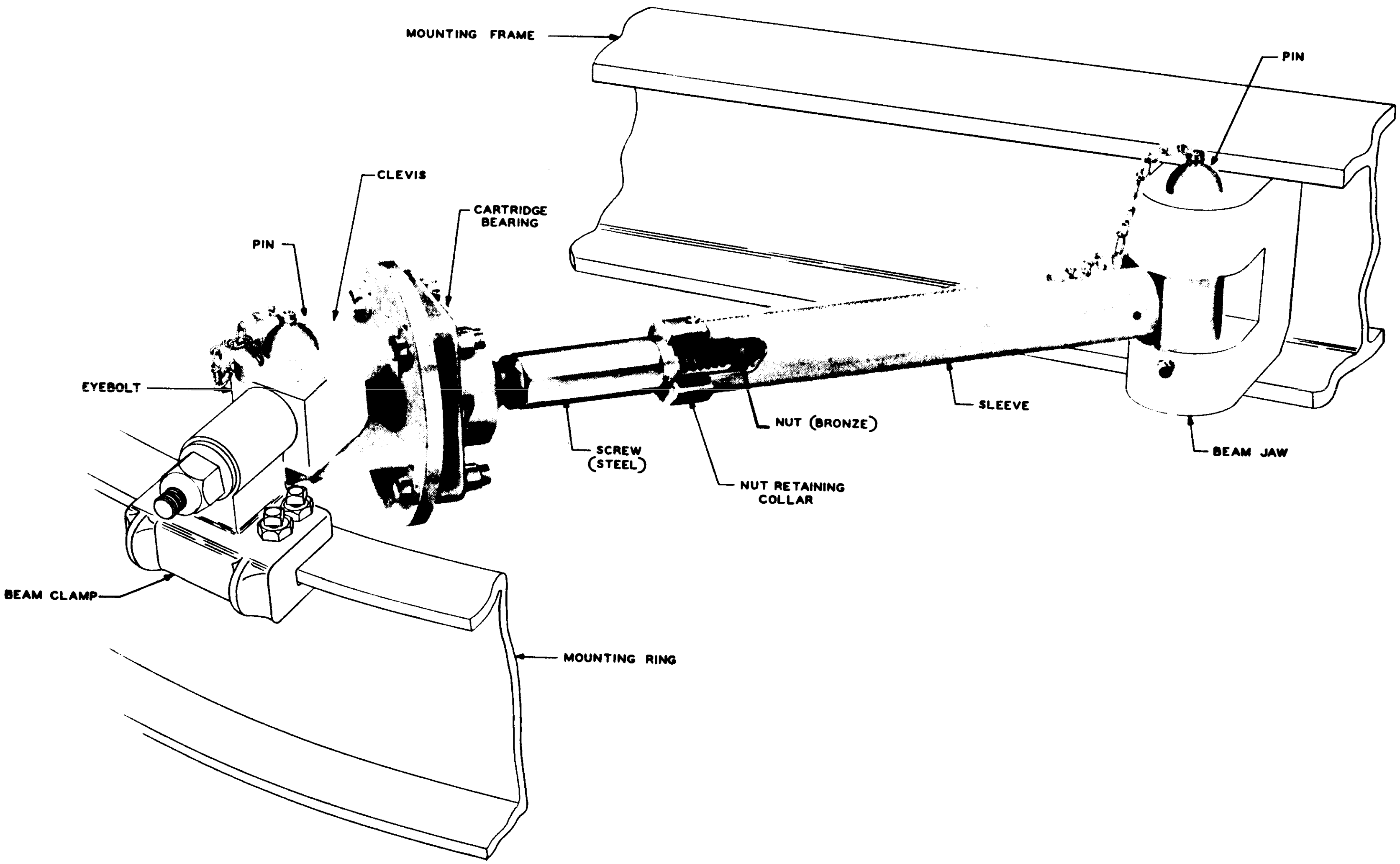


Fig. 6 – Azimuth Adjusting Screw

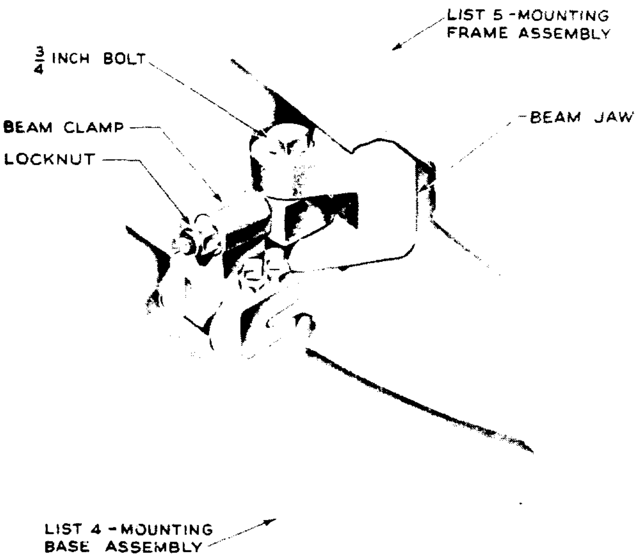


Fig. 7 – Mounting Clamp Assembly

Fig. 1, and the feed horn. Rotate the transducer to the approximate position for the minimum received test signal.

Note: This tuning point is very sharp. Adjust slowly or it will be missed completely.

(2) Tighten the bolts finger tight, but loose enough so that the transducer may be rotated with the P-38B665 wrench. Using this wrench, adjust the transducer to the correct position for the minimum received test signal.

Note: In making this adjustment, it will be found helpful if any mechanical side-thrust at the rotary joint is reduced to a minimum while rotating the transducer.

(3) Readjust the IF attenuators so that the signal level meter reads 0 dbm when the test signal is being received from the transmitting antenna. Record the sum of the IF attenuator settings as H1. H1 will be compared with P1, obtained in (6).

(4) Loosen the bolts in the circular flange between the transducer MT1 (Fig. 1) and the feed horn. Rotate the transducer 90 degrees to the approximate position for maximum received test signal.

Note: This position may also be obtained by marking the position obtained in (2) and then turning the transducer two bolt holes.

(5) Tighten the bolts finger tight but loose enough so that the transducer may be rotated with the P-38B665 wrench. Using the wrench, slightly adjust the transducer for maximum received test signal.

(6) Set the IF attenuators so that the signal level meter reads 0 dbm when the test signal is being received from the transmitting antenna. Record the sum of the IF attenuator settings as P1.

Requirement: The difference between H1 and P1 shall be at least 40 db.

If this requirement is not met, loosen the mounting clamp assemblies on the receiving antenna frame. Repeat the tests listed in 5.08 (1) through (6), but in Step (2), after adjusting the transducer for minimum received signal, adjust the azimuth adjusting screw in the direction which causes the minimum received test signal to decrease in magnitude. Limit this adjustment to a maximum change of ±0.3 degree. Although the required difference between maximum and minimum signals is 40 db, a greater difference is desirable.

(7) Tighten the mounting clamp assemblies on the receiving antenna frame. Remove the azimuth adjusting screw and reassemble the mounting clamp and tighten.

6. CHECK BETWEEN MEASURED RECEIVED SIGNAL POWER AND THEORETICAL RECEIVED POWER

6.01 *Check as follows:*

(1) Measure the maximum received signal power for antenna orientation as outlined in 410-100-510. Record this value as RL1.

Note: Add 2.0 db to this measurement if the ED-45465 cable assembly and ED-45466 transducers are being used in the waveguide run, as their loss will not normally be included in the circuit.

(2) Calculate the ***theoretical value*** of received power for the path being measured as in succeeding steps.

(3) From Table A, find the received power from waveguide to waveguide for a frequency of 3950 mc.

(4) From Table B, column 2, find the correction for two KS-15676 antennas for the frequency of the test signal.

(5) From Table B, column 3, find the attenuation per foot for the circular waveguide. Multiply by the total number of feet of circular waveguide for both transmitting and receiving antenna runs.

(6) From Table B, column 4 or 5, find the attenuation per foot for the rectangular waveguide. Multiply by the total number of feet of rectangular waveguide for both transmitting and receiving runs.

(7) Add the loss for the branching filters included between the transmitting and receiving equipment. See Fig. 8 for representative figures of this loss. It will be noted that each successive channel filter adds 0.2 db loss to the basic channel No. 1 loss of 0.5 db. Should a channel-dropping filter be omitted at a station because that channel is not equipped, the resultant loss becomes 0.2 db less than that shown in Fig. 8 for the particular channel being measured. For example: If channel 4 is being measured, with channels 1 and 2 equipped, and channel 3 not equipped, then the branching filter loss become 0.9 db.

(8) Add the loss of the 11A couplers — about 0.2 db for each coupler.

(9) Obtain the algebraic sum of (2) through (8) and designate as P3, the calculated received power.

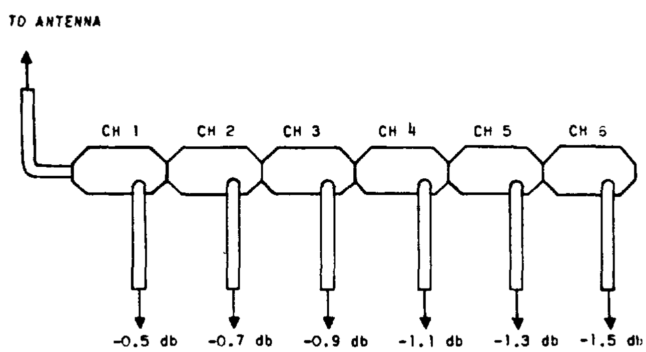


Fig. 8 – Branching Filter Loss versus Channel Number

Requirement: P3 and RL1 shall not differ more than 3 db.

(10) ***Example of a calculation of P3***

Conditions:

Path length	26 miles
Test frequency (channel 2)	4010 mc
Waveguide runs:	
Transmitting Antenna:	
Circular waveguide	269 feet
Rectangular waveguide	54 feet
Receiving Antenna:	
Circular waveguide	175 feet
Rectangular waveguide	42 feet
Branching filters:	2 at each end

Calculation:

Step		
(3)	Received power (26 miles)	−30.8 dbm
(4)	Antenna correction (4010 mc)	+0.4 db
(5)	Circular waveguide (444 x 0.0038)	−1.7 db
(6)	Rectangular waveguide (96 x 0.0083)	−0.8 db
(7)	Branching filters — Channel 2 (2 filters at each end)	−1.4 db
(8)	11A coupler loss (2)	−0.4 db
(9)	***Calculated Received Power (P3)***	−34.7 dbm

(11) After the antenna and transducer at each end of the circuit have been aligned as covered in Parts 2, 3, 4, and 5 and the requirement in Part 6 (9) has been met, a check should be made to tighten, if necessary, the mounting clamp assemblies to the mounting ring and the locking nuts on the tilt-control assemblies.

TABLE A*

NORMAL RECEIVED SIGNAL USING TWO KS-15676 ANTENNAS

ANTENNA SEPARATION	RECEIVED SIGNAL	ANTENNA SEPARATION	RECEIVED SIGNAL	ANTENNA SEPARATION	RECEIVED SIGNAL
miles	dbm	miles	dbm	miles	dbm
7	−19.5	20	−28.6	42	−35.0
8	−20.6	21	−29.0	44	−35.4
9	−21.6	22	−29.4	46	−35.8
10	−22.5	23	−29.8	48	−36.2
11	−23.3	24	−30.2	50	−36.5
12	−24.1	26	−30.8	52	−36.9
13	−24.8	28	−31.5	54	−37.2
14	−25.5	30	−32.1	56	−37.5
15	−26.1	32	−32.7	58	−37.8
16	−26.6	34	−33.2	60	−38.1
17	−27.1	36	−33.7	62	−38.4
18	−27.6	38	−34.2	64	−38.7
19	−28.1	40	−34.6	66	−38.9

* Applies if transmitting power is +27 dbm at a frequency of 3950 mc. Neglects waveguide and filter loss.

TABLE B

CORRECTIONS FOR DIFFERENT FREQUENCIES

COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
FREQUENCY	CORRECTION FOR TWO KS-15676 ANTENNAS	ATTENUATION OF 2.812 CIRCULAR WAVEGUIDE	ATTENUATION OF COPPER WR229 RECTANGULAR WAVEGUIDE	ATTENUATION OF BRASS WR229 RECTANGULAR WAVEGUIDE
mc	db	db	db per foot	db
3730	−1.1	0.0040	0.0089	0.0124
3830	−0.7	0.0039	0.0087	0.0121
3890	−0.4	0.0039	0.0086	0.0119
3950	0.0	0.0038	0.0084	0.0117
4010	+0.4	0.0038	0.0083	0.0116
4070	+0.8	0.0037	0.0082	0.0115
4130	+1.2	0.0037	0.00815	0.0114
4170	+1.6	0.0037	0.0081	0.0113

7. FLEXIBLE-WAVEGUIDE INSTALLATION AND CROSS-POLARIZATION CHECK

7.01 *At the Receiving Antenna*

(1) After the receiving antenna has been oriented in accordance with Part 5, replace the KS-5783 flexible rectangular waveguide with KS-15690 flexible circular waveguide. KS-15690, List 1 flexible circular waveguide, having a length of 8 feet, is used to connect the rigid circular waveguide to the bottom of the KS-15676, List 3 feed horn. This is shown on ED-59393-01. There may be several flexible waveguides in the crate which will be marked as follows:

(Number in crate) — KS-15690, L________

FLEXIBLE CIRCULAR WAVEGUIDE.

(2) The attachment of the upper flange of the flexible waveguide to the feed horn is accomplished by using an O ring gasket and the bolts, nuts, and lock-washers supplied with the flexible waveguide. No wafer is required for the joint at this end.

(3) In order to attach the flexible waveguide to the rigid waveguide, proceed as follows:

(a) Always bring the rigid waveguide up to meet the lower flange of the flexible waveguide. Do this by adjusting the four 3/4-inch square nuts in order to raise the split plate which supports the waveguide run. This is accomplished by loosening the locking nuts on top of the split plate and alternately turning, by the same amount, each of the four square nuts which support the plate.

Caution:* *The flexible circular waveguide is not extensible and should never be forced down to meet the rigid waveguide.

(b) When the adjustment is complete, each of the nuts shall have been raised the same amount and the locking nuts shall be secured again.

Caution:* *Never take more than a quarter turn at any time on any of the square nuts which support the split plate.

(c) Before making up the lower joint, form the flexible waveguide into a smooth curve so that its lower flange is parallel to and in contact with the upper flange of the rigid waveguide. A precise setting is necessary to avoid strain on the flexible waveguide.

(d) Make up the joint between the flexible and the rigid circular waveguide using an O ring gasket, a thin wafer, four of the bolts supplied with the flexible waveguide, and the four bolts supplied with the split plate of the hanger assembly. Use the nuts and lockwashers supplied with these bolts.

Note: If the elevation of the antenna is changed at any time after the flexible circular waveguide has been installed, readjustment of the hanger plate is required. Before making a change in elevation adjustment, the bolts should be removed from the joint, and the split plate should be lowered to allow the lower flange of the flexible waveguide to move freely. When the adjustment is completed, a new setting of the split plate should be made as described in (3) above, after which the joint may be made up again.

7.02 *Cross-polarization Check and Final Orientation of 11A Coupler C1 — Station B*

Note: Stations A and B are shown in Fig. 5. Station B was called receiving antenna during antenna orientation.

(1) Move the telephone from the antenna deck and relocate it at the bottom of the waveguide run. The man orienting C1 now may communicate with the man at the receiving equipment.

(2) Loosen the eight 5/16-18 bolts 1-1/4 inches long, connecting the 11A coupler C1 to the tuning section as shown in Fig. 9. Rotate C1 to the approximate position for the maximum received test signal.

(3) Now tighten the bolts finger tight, but loose enough so that C1 may be rotated with a P-38B665 wrench. Using this wrench, adjust C1 to the correct position for the maximum received test signal.

(4) Set the IF attenuators so that the signal level meter reads 0 dbm when the maximum signal is being received from the transmitting antenna. Record the sum of the IF attenuator settings for the maximum test signal as received in (3).

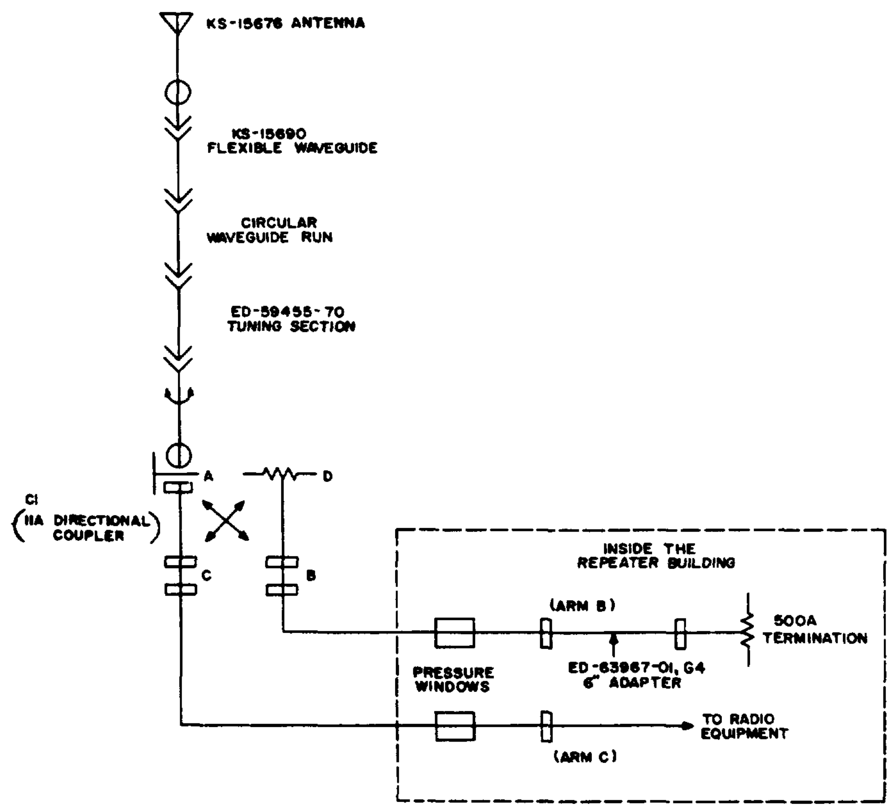


Fig. 9 – Orienting 11A Coupler and Tuning Section

(5) Transfer the flexible rectangular waveguide from arm C to arm B of C1. Transfer the waveguide termination and adapter from arm B to arm C.

Note: Do not make this change at the coupler. For convenience, make it inside the station at the repeater side of the pressure window using the transducer cable assembly to make the "through" connection.

(6) Adjust C1 slightly for a minimum received test signal.

(7) Set the IF attenuators so that the signal level reads +0 dbm when the minimum signal is being received from the transmitting antenna. Record the sum of the settings for the minimum test signal as received in (6).

Requirement: The difference between the maximum and minimum received test signals shall be at least 30 db.

If this requirement is not met, rotate ***only*** the ED-59455-70 tuning section about 10 degrees and repeat the tests listed in (6) and (7). Continue to rotate the tuning section to new positions until the requirement in (7) is met.

(8) Readjust C1 slightly to check that it is set for minimum received test signal. Tighten the 3/8-inch cap screws to lock the restrainer plate to the coupler. Tighten the 5/16-18 cap screws 1-1/2 inches long, between C1 and the tuning section.

Note: At this time, the waveguide elbow should be under the ice guard, if one is provided.

(9) Tighten the cap screws in the flanges joining the ***tuning section*** to the waveguide run.

(10) The waveguide run of station B is now oriented. Check that the hood assembly **is**

properly adjusted. Transfer the flexible rectangular waveguide from arm B to arm C of C1. Transfer the waveguide termination and adapter from arm C to arm B. See note to (5).

7.03 ***At the Transmitting Antenna:*** In order to install the flexible waveguide at the transmitting antenna, follow the instructions given in 7.01 (1) through (3) (d).

7.04 ***Cross-polarization Check and Final Orientation of 11A Coupler C1 — Station A***

Note: Stations A and B are shown in Fig. 5. Station B was called receiving antenna during antenna orientation.

Follow 7.02 (1) through (9). The waveguide run of Station A is now oriented. Check that the hood assembly is properly arranged.

7.05 At both stations, restore all waveguide connections to normal.

7.06 Check the path loss in both directions. Follow the instructions as outlined in Part 6. Note that it will not be necessary to make an allowance for use of the ED-45465 cable assembly and ED-45466 transducers in this case as noted under Part 6 (1).

(1) Record the value of RL1 in each direction.

(2) Compare the value of RL1 in each direction with the value of P3 calculated in Part 6.

Requirement: P3 and RL1 shall not differ by more than 3 db.

8. NEAR-END CROSSTALK BALANCE TEST

8.01 This test verifies that the 11A directional coupler has adequate isolation (or cross-polarization discrimination) between arms B and C. The normal isolation is at least 50 db; this test verifies that it is more than 40 db. The test is made in two steps:

(1) The TD-2 radio receiver is calibrated for an IF output of +10 dbm at an RF input of −35 dbm using either the J68340A test bay or the J68345A test set, Fig. 10 or 11.

(2) The calibrated radio receiver is used as the measuring device of the crosstalk balance of the 11A coupler as shown in Fig. 12.

Note: Choose a TD-2 receiver whose operating frequency lies near the center of the 3700-4200 mc band.

8.02 To calibrate the TD-2 radio receiver using the J68340A test bay, proceed as follows:

(1) Set attenuators as follows: (Reference, Fig. 10)

AT1	15 db	AT4	0 db
AT2	20 db	AT5	15 db
AT3	0 db	AT13	10 db

(2) Connect the test circuit as shown in Fig. 10, Y option. Adjust the RF sweeper to the normal frequency of the TD-2 receiver. Turn the sweep off and verify that rest frequency is within 3 mc of the receiver normal frequency. Readjust if necessary.

(3) Adjust AT1 for 0 dbm on the RF power meter. Set AT4 to 10 db. (If the loss in the ED-63773-01, G1 cable assembly is not exactly 10 db, adjust AT4 accordingly to produce a −35 dbm signal at the input to the receiver.)

(4) Set the receiver CONT switch to MAN. Connect the test circuit as shown in Fig. 10, X option. Adjust the MAN GAIN control for an IF power output of 0 dbm into the IF power meter.

(5) Disconnect AT5 from the TD-2 receiver. Restore the normal waveguide connections to the receiver input.

Note: The receiver bay line-up should have all the normal waveguide connections out to the 11A coupler mounted at the tower.

8.03 To calibrate the TD-2 radio receiver using the J68345A test set, proceed as follows:

(1) Set attenuators as follows: (Reference, Fig. 11)

AT2	13 db
AT13	10 db

(2) Connect the test circuit as shown in Fig. 11. Adjust the RF sweeper to the normal frequency of the TD-2 receiver. Turn the sweep off and verify that the sweep is still within 3 mc of the receiver normal frequency. Readjust if necessary.

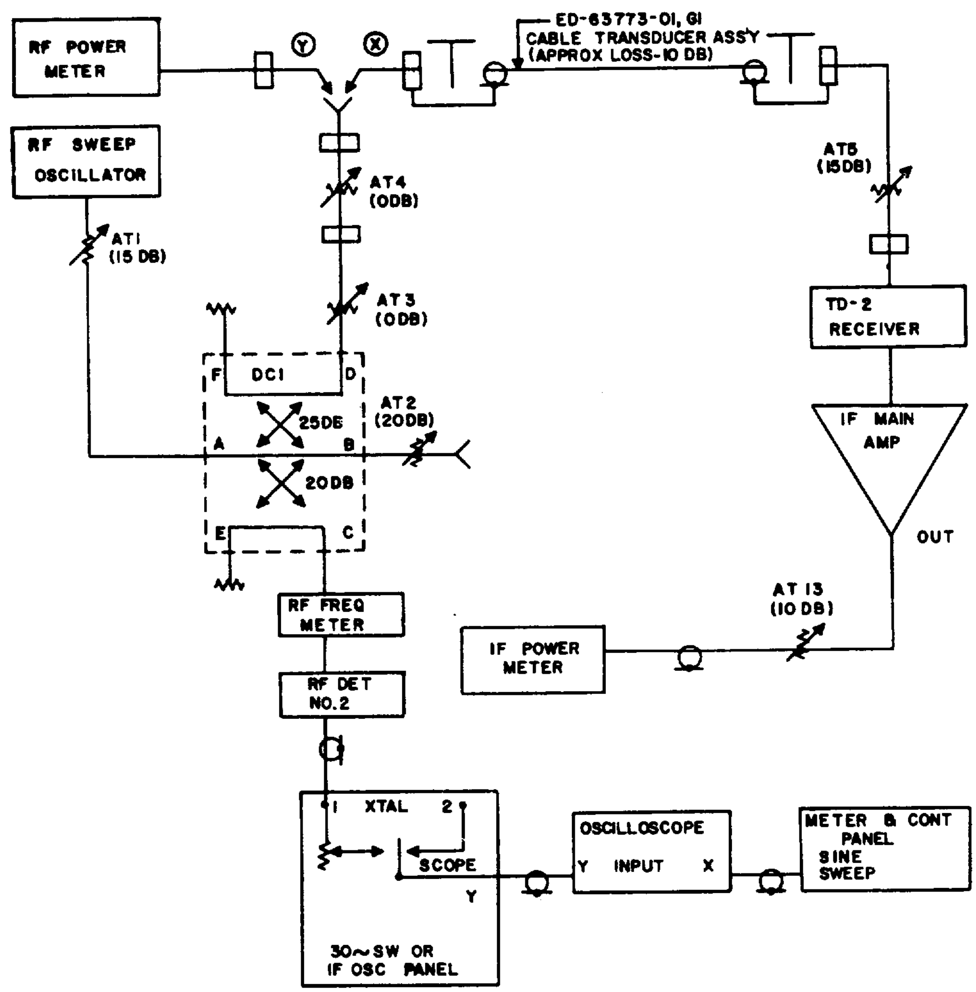


Fig. 10 – Calibration of TD-2 Receiver — Using J68340A Test Bay

(3) Adjust AT2 for a −35 dbm input to the TD-2 receiver. Set the receiver CONT switch to MAN, adjust the MAN GAIN control for an IF power output of 0 dbm into the calibrated IF detector.

(4) Disconnect AT2 from the TD-2 receiver. Restore the normal waveguide connections to the receiver input.

Note: The receiver bay line-up should have all the normal waveguide connections out to the 11A coupler mounted at the tower.

8.04 To measure the near-end crosstalk proceed as follows:

(1) Turn off the corresponding transmitter at the sending end to keep unwanted signals out of the TD-2 receiver. The sending end may be disabled by turning off the RF sweeper (OSC switch).

(2) Make the (Y) connection to the transmitter waveguide, as shown in Fig. 12. Set the attenuators to produce an RF power level into the 10-foot lossy cord of +15 dbm from the test equipment — J68340A Test Bay or J68345A Test Set.

Requirement: The receiver output shall be less than 0 dbm.

If this requirement is not met, verify that all waveguide and coaxial connections to the receiver are tight enough to prevent signal leakage. If the requirement is still not met, replace the 11A directional coupler.

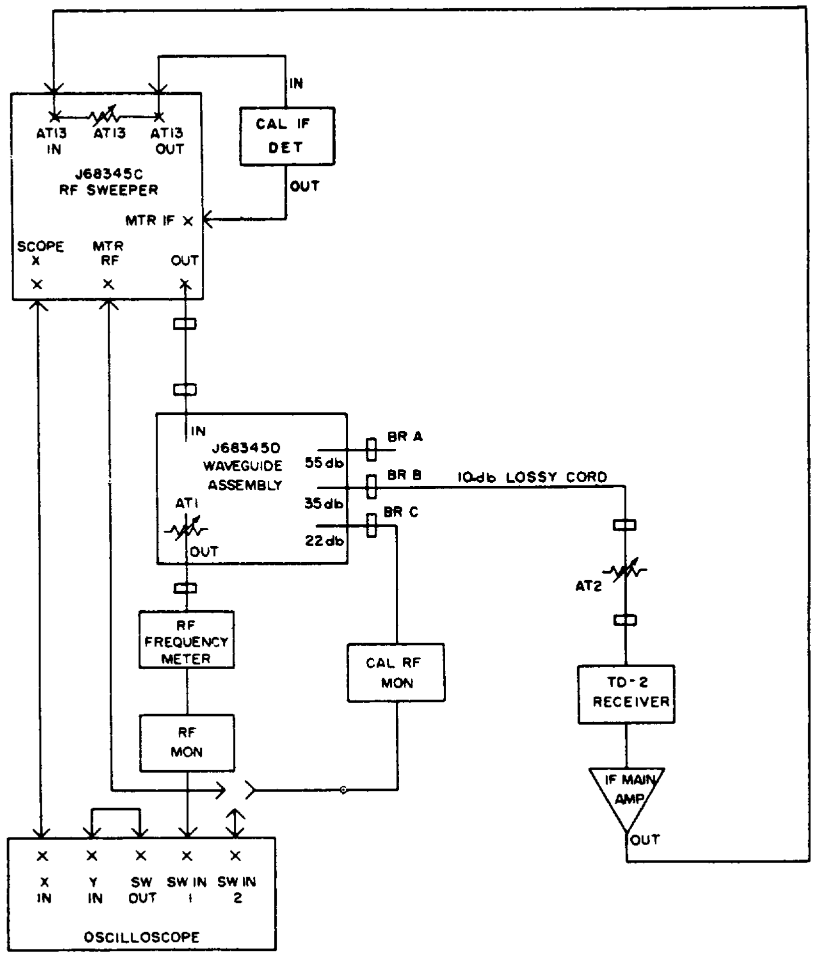


Fig. 11 – Calibration of TD-2 Receiver — Using J68345A Test Set

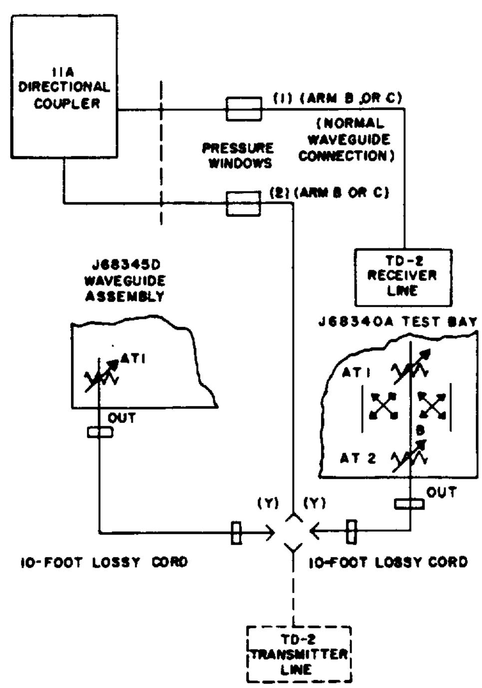


Fig. 12 – Partial Test Equipment Connections for 11A Coupler Crosstalk Measurements