MOBILE RADIO

INSTRUCTIONS FOR MASTR™ II STATION DUPLEXERS OPTIONS 9573-9577 (MASTR II IMTS STATION OPTIONS 9630-9631)

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DESCRIPTION

The MASTR II station duplexers are Band Reject or Band Pass/Reject duplexers that are used in medium power (up to 100 Watts) repeater stations to permit the simultaneous transmission and reception of RF signals using a single antenna.

In duplex applications, the transmitter and receiver operate on different frequencies. The frequency range, frequency spacing, insertion loss and other information for each duplexer is shown in Table 1.

The 19D402955 High Band Duplexers operate as band-reject duplexers, with a transmitter branch and receiver branch. Each branch includes tuneable cavities that are used in conjunction with the transmitter or receiver to attenuate (reject) a specific undesired signal while passing other signals with minimum loss.

Either branch may be used for the transmitter or receiver, depending on the operating frequencies. The cavities in tuning ports 4, 5, and 6 are tuned for maximum rejection of the low frequency and minimum attenuation of the high frequency. The cavities in tuning ports 1, 2, and 3 are tuned for maximum rejection of the high frequency and minimum attenuation of the low frequency. The frequency response of each branch of the 19D402955 duplexer is symmetrical as shown by the typical high frequency and low frequency notch response in Figure 1.

OPTION NO.	GE PART NO.	TYPE DUPLEXER	FREQ. RANGE	FREQ. SPACING	REJECTION (MINIMUM)	Tx NOISE SUPPRESSION AT Rx FREQ. (MINIMUM)	Rx ISOLATION AT Tx FREQ. (MINIMUM)	INSERTION LOSS (MAXIMUM)
9573	19D402955P5	Band Reject	150-162 MHz	5-12 MHz	55 dB			1.5 dB
9574	19D402955P6	Band Reject	160-174 MHz	5-14 MHz	55 dB			1.5 dB
9575	19C307166P1	Band Pass/Reject	450-470 MHz	5 MHz		75 dB	35 dB	1.5 dB
9576	19C307166P2	Band Pass/Reject	470-488 MHz	3 MHz		80 dB	80 dB	1.5 dB
9577	19C307166P3	Band Pass/Reject	488-512 MHz	3 MHz		80 dB	80 dB	1.5 dB
9630	19D402955P5	Band Reject	150-162 MHz	2-12 MHz	55 dB			1.5 dB
9631	19C307166P1	Band Pass/Reject	450-470 MHz	5 MHz		75 dB	35 dB	1.5 dB

TABLE 1 - DUPLEXER INFORMATION

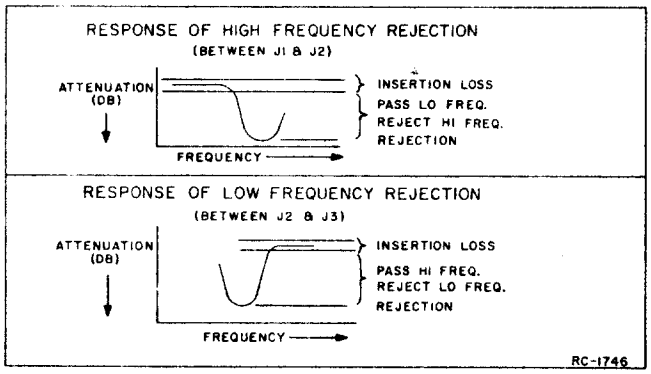


Figure 1 - Typical 19D402955 Duplexer Notch Response

The 19C307166 UHF Duplexers operate as Band Pass/Reject Duplexers that consist of multiple identical 1/4 wave cavity resonators. The Band Pass characteristics are tuned with an adjustable center conductor and the Band Reject characteristics are tuned with a notching adjustment. The frequency response of the 19C307166 duplexer is shown in Figure 2.

ADJUSTMENT PROCEDURE

WARNING

Do not tune any of the Duplexers with the transmitter keyed into the Duplexer.

19D402955 DUPLEXER

This adjustment procedure consists of re-tuning the duplexer for maximum high-frequency and low-frequency rejection, making the system connections, and measuring the insertion loss. The following equipment is required for making the adjustments:

- A signal generator (M560 or equivalent) and a 6 dB pad
- A receiver on each operating frequency (or one capable of being tuned to each or the operating frequencies)
- A 50-ohm load
- A wattmeter
- A 20,000 ohms-per-volt meter (GE Test Set Model 4EX3A10, 4EX8K12 or equivalent)
- A frequency counter may be used to set the signal generator on frequency

HIGH-AND-LOW-FREQUENCY REJECTION

Connect the test equipment as shown in Figure 3, and make the following adjustments:

1. Use a receiver aligned to the lowest operating frequency and set the signal generator on the receiver frequency. Increase the generator output until a reading is obtained at the receiver limiter. Do not saturate the limiter.
2. Remove the plug-buttons from tuning

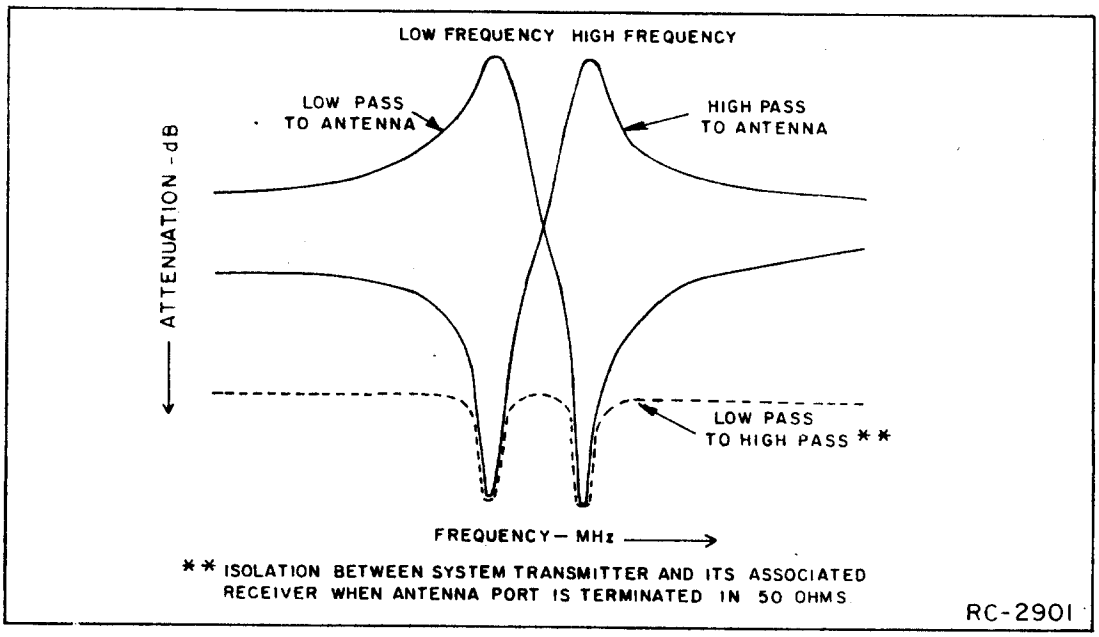


Figure 2 - Typical 19C307166 Duplexer Response

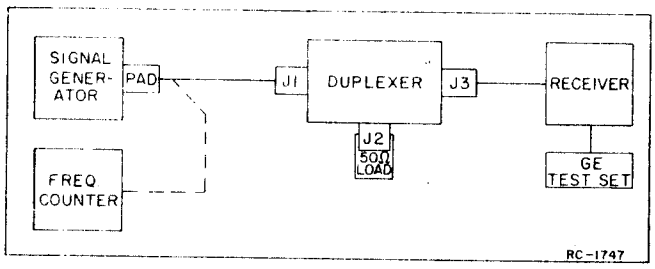


Figure 3 - Test Set-Up

ports 4, 5, and 6 (see Figure 4). Then loosen the locking nuts on the cavities to be tuned.

3. Tune the cavities for minimum limiter reading. Increase the generator output as necessary to obtain a good null. Tighten the locking nuts and replace the plug buttons after tuning.

4. Set the signal generator output for a reference reading on the limiter meter. Note this reading on the generator dB scale.

5. Disconnect the cables from J1 and J3. Connect the signal generator to the receiver, using a suitable coaxial adapter.

6. Decrease the signal generator output until the reference limiter meter reading is recovered. Note this reading on the generator dB scale.

7. The difference between the two readings is the dB rejection, and should be equal to or greater than 55 dB.

8. Using a receiver aligned on the highest operating frequency, re-connect the signal generator to J1 and the receiver to J3. Set the generator on the new operating frequency and increase the output until a reading is obtained at the receiver limiter. Do not saturate the limiter.

9. Repeat Steps 2 through 7, tuning the cavities in ports 1, 2, and 3.

SYSTEM CONNECTIONS

After completing the high-and-low frequency rejection adjustments, connect the transmitter, receiver and antenna cables using the applicable method as follows:

- If the receiver frequency is Higher than the transmitter frequency, connect the cables as follows (see Figure 4):

  J1 - Transmitter
  J2 - Antenna
  J3 - Receiver

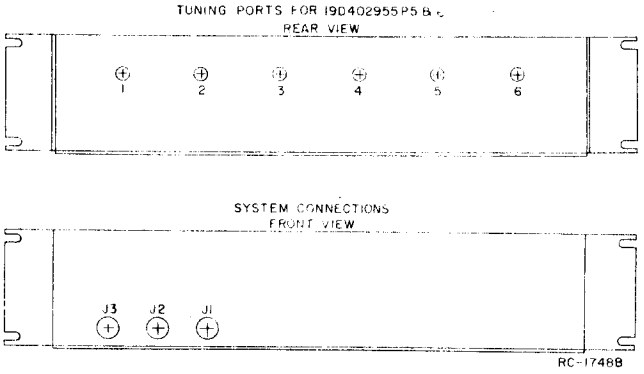


Figure 4 - Duplexer Outline Diagram

- If the receiver frequency is lower than the transmitter frequency, connect the cables as follows:

  J1 - Receiver
  J2 - Antenna
  J3 - Transmitter

INSERTION LOSS

After re-tuning the cavities on the new frequencies, check the transmitter and receiver insertion loss according to the following procedure.

Transmitter to Antenna

1. Connect a wattmeter to J2 (Antenna) on the duplexer. Adjust the transmitter for maximum power output, and note the wattmeter reading (P1).

2. Disconnect the wattmeter from J2 and connect it to the output of the transmitter. Adjust the transmitter for maximum power output, and note the wattmeter reading (P2).

3. The insertion loss is the difference (in dB) between the two readings. This difference can be determined by the following formula:

$$10 \log_{10} \frac{P1}{P2}$$

Receiver to Antenna

1. Connect a signal generator to J2, and set a reference on the receiver limiter meter. Note this reading (V1).

2. Disconnect the signal generator from J2 and connect it to the receiver input.

3. Decrease the generator output until the limiter meter reading is the same as the reading obtained in Step 1 and

note the reading (V2).

4. The insertion loss is the difference between the two readings, and can be read from the generator dB scale or determined by the following formula:

$$20 \log_{10} \frac{V1}{V2}$$

The insertion loss for both the transmitter and receiver should not exceed 1.5 dB.

19C307166 PHELPS DODGE DUPLEXERS
(Refer to Figure 5)

1. THE DUPLEXER AS RECEIVED WILL BE FACTORY TUNED TO THE CUSTOMER OPERATING FREQUENCIES SPECIFIED. READJUSTMENT SHOULD NOT BE REQUIRED. IF OPERATING FREQUENCIES ARE CHANGED, THE FOLLOWING EQUIPMENT WILL BE REQUIRED TO TUNE THE DUPLEXER:

   - A 50 ohm signal generator with a variable attenuator which covers the desired transmit and receive frequencies.
   - A 50 ohm input receiver tuned to the desired transmit frequency.
   - A 50 ohm input receiver tuned to the desired receive frequency.
   - Two six dB attenuators to place in the lines to the receivers.

The reject (or notch) frequency will maintain its spacing to the pass frequency when the pass adjustment of a cavity (the large central screw) is moved several MHz. For example, a system operating at 460 and 465 MHz which is moved to 462 and 467 MHz will require a minimum of readjustment if the adjustment is made first. It is strongly recommended that the pass adjustments be made first and that the following instructions be followed.

2. REMOVE THE CABLES, TAKING NOTE OF THEIR POSITIONS AS THE DUPLEXER MUST BE ASSEMBLED IN THE SAME MANNER.

   NOTE: In the following steps, the signal generator must be adjusted to prevent saturation of the first limiter in the receiver.

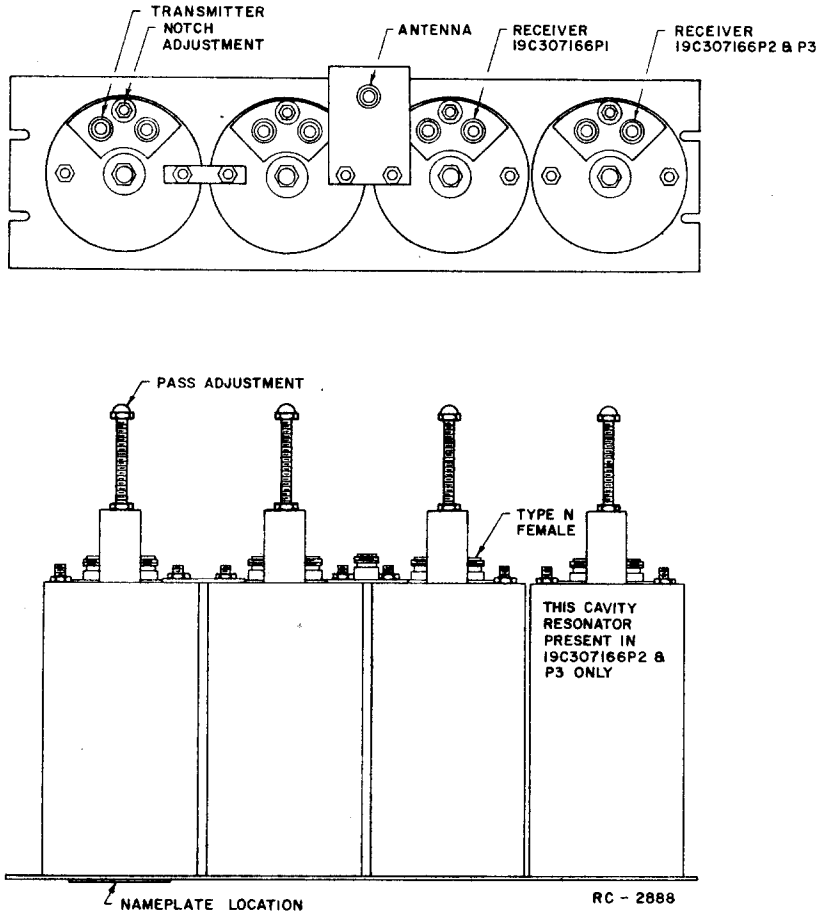


Figure 5 - Phelps Dodge Duplexer

3. RECEIVER SIDE

3.1 Connect the resonator or resonators between a signal generator tuned to the receive frequency and a 50 ohm receiver tuned to the receive frequency. Turn the large central tuning screw for maximum transfer of signal at the receive frequency.

3.2 Now connect the resonator between a signal generator tuned to the transmit frequency and a 50 ohm receiver tuned to the transmit. Turn the small off-center notching screw for minimum transfer of signal at the transmit frequency.

4. TRANSMITTER SIDE

4.1 Connect each of the two resonators, one at a time, between a signal generator tuned to the transmit frequency and a 50 ohm receiver tuned to the transmit frequency. Turn the large central tuning screw for maximum transfer of signal at the transmit frequency.

4.2 Now connect each of the two resonators between a signal generator now tuned to the receive frequency and a 50 ohm receiver tuned to the receive frequency. Turn the small off-center notching screw for minimum transfer of signal at the receive frequency.

5. RE-INSTALL THE CABLE HARNESS. THE UNIT MAY NOW BE PLACED BACK IN SERVICE.

19C307166 dB PRODUCTS DUPLEXERS
(Refer to Figure 7)

1. THE DUPLEXER AS RECEIVED WILL BE FACTORY TUNED TO THE CUSTOMER OPERATING FREQUENCIES SPECIFIED. READJUSTMENT SHOULD NOT BE REQUIRED.

If operating frequencies are changed the following tuning procedure should be followed.

2. REFER TO FIGURE 6 WHEN TUNING DUPLEXER.

3. HIGH FREQUENCY PASS - LOW FREQUENCY REJECT.

3.1 Pretune notching adjustment(s) clockwise until screw bottoms out.

3.2 Turn notching adjustment(s) counter-clockwise nine (9) turns.

3.3 Tune cavity (cavities) to pass frequency (minimum insertion loss).

3.4 Tune notching adjustment(s) to reject frequency (maximum insertion loss).

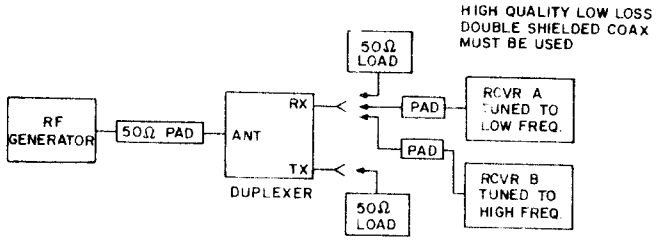


Figure 6 - Block Diagram of Duplexer Connections

4. LOW FREQUENCY PASS - HIGH FREQUENCY REJECT.

4.1 Pretune notching adjustment(s) until screw bottoms out.

4.2 Tune cavity (cavities) to pass frequency (minimum insertion loss).

4.3 Tune notching adjustment(s) to reject frequency (maximum insertion loss).

INSTALLATION

NOTE

Duplexer must be tuned before installation and test.

1. For Vertical Cabinet, 44 inch cabinet, or Pole Mount Cabinet rack up Duplexer directly above Radio Housing using hardware supplied with the kit. Connect cables and Test by the following instructions. If the Duplexer is 19D402955, modify per Figure 8 prior to installation.

2. For 30 inch cabinet, rack up Duplexer directly below Radio Housing using hardware supplied with the kit. Connect cables and Test by the following instructions. If the Duplexer is 19D402955, modify per Figure 8.

3. In applications where there is an excess of cable between the Duplexer and Transmitter or Receiver connector, the cable should be coiled and tied as shown in Figure 9. Do not harness the transmitter and receiver cables together.

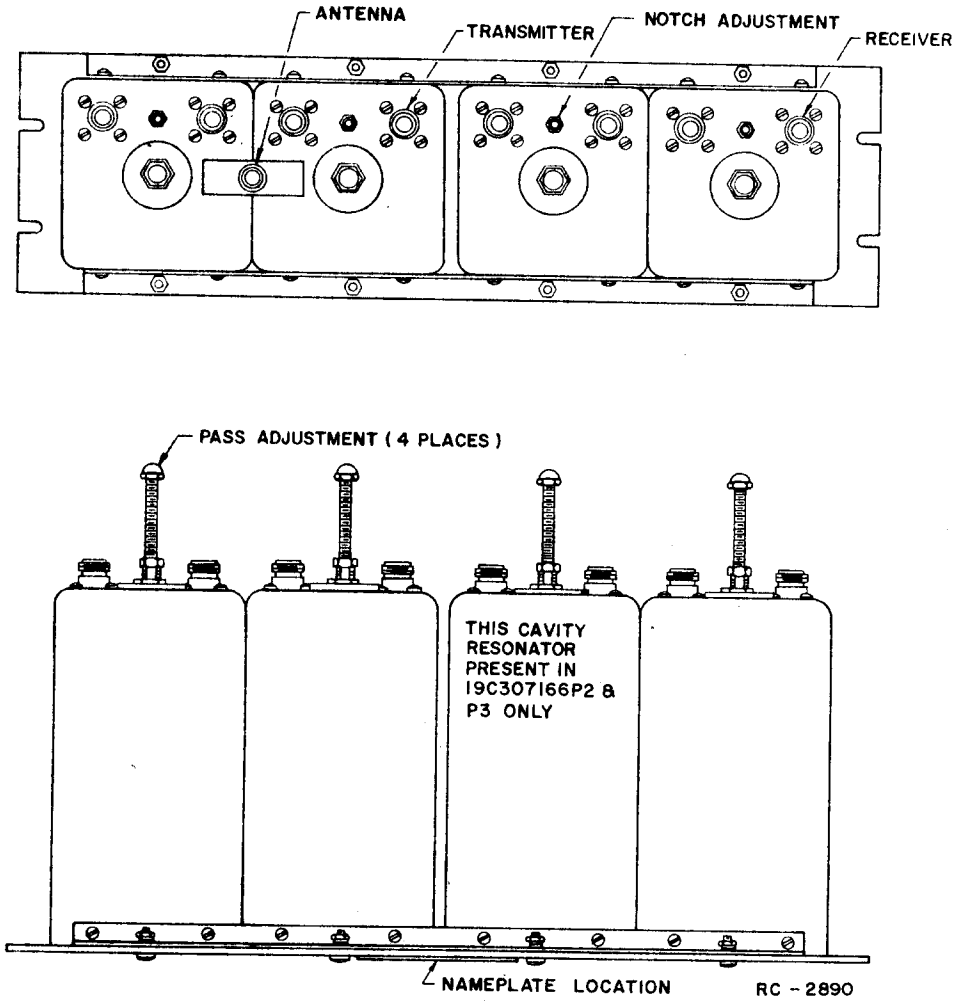


Figure 7 - DB Products Duplexer

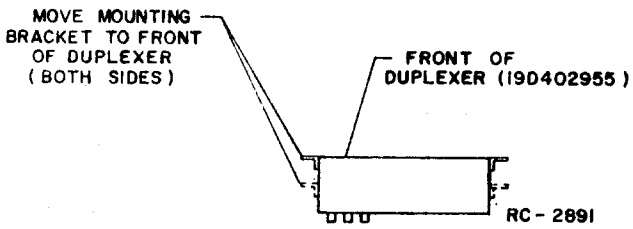


Figure 8 - Mounting Bracket Location for 19D402955 Duplexer

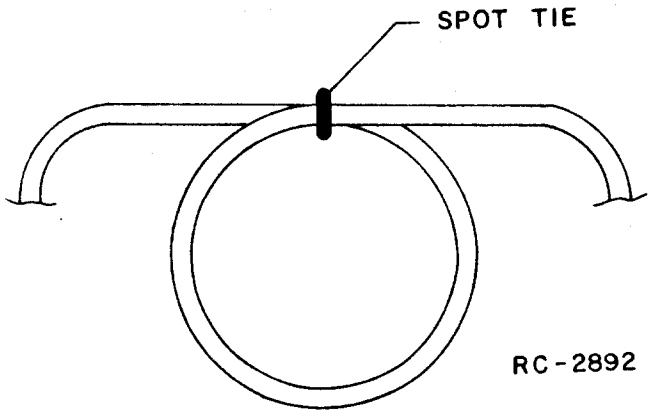


Figure 9 - Arrangement of Long Cables

TEST

1. Connect the station as shown in Figure 10 & 11. Adjust the signal generator to produce 12 dB SINAD.

2. Key the transmitter. The 12 dB SINAD should not degrade more than 1 dB.

3. If the SINAD does degrade more than 1 dB, refer to the Adjustment Procedure for the Duplexer used.

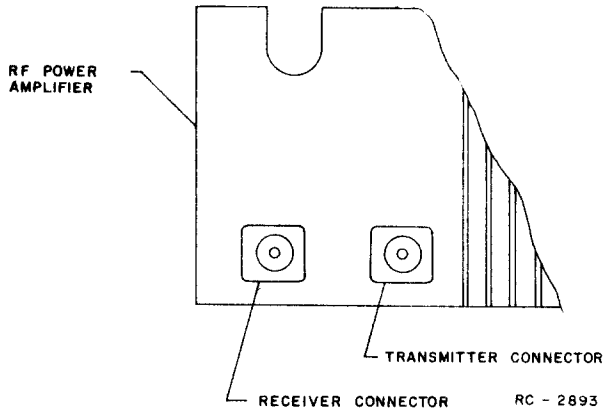


Figure 10 - Transmitter and Receiver Connections

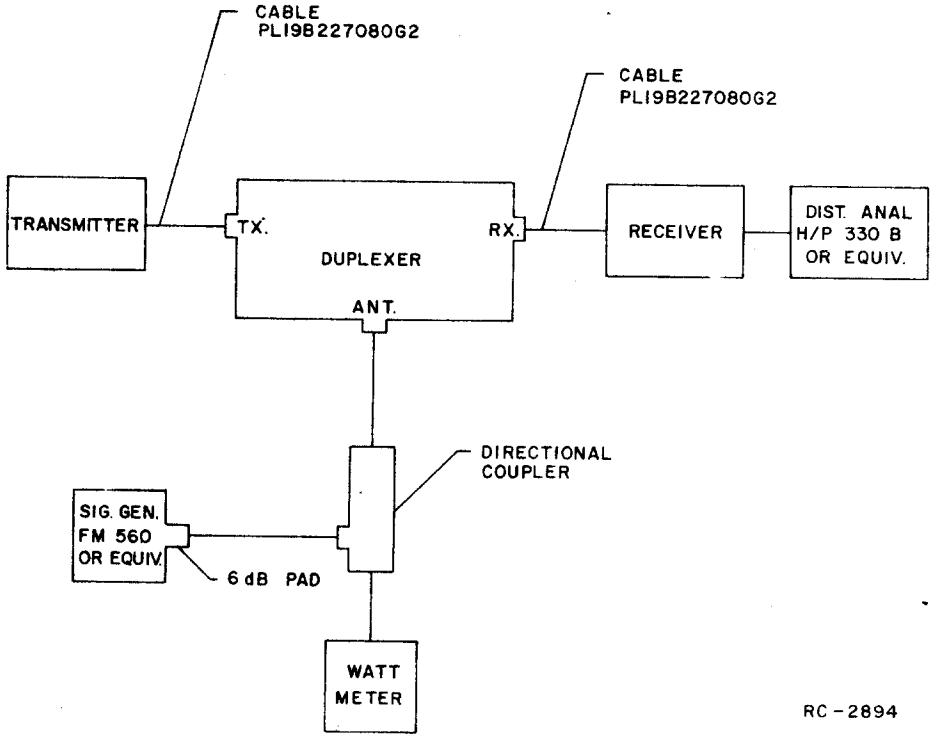
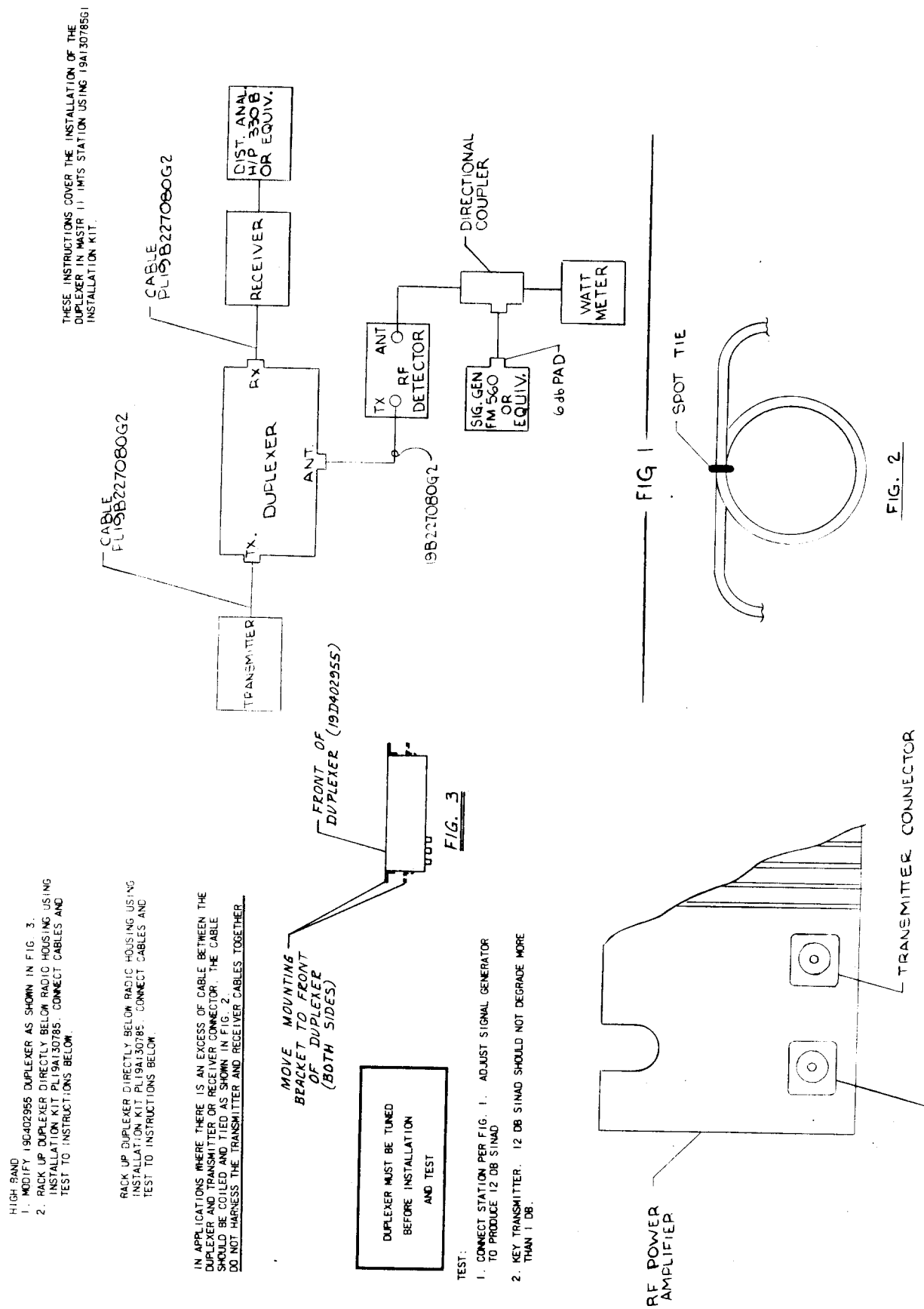


Figure 11 - Connections for Testing Duplexer



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