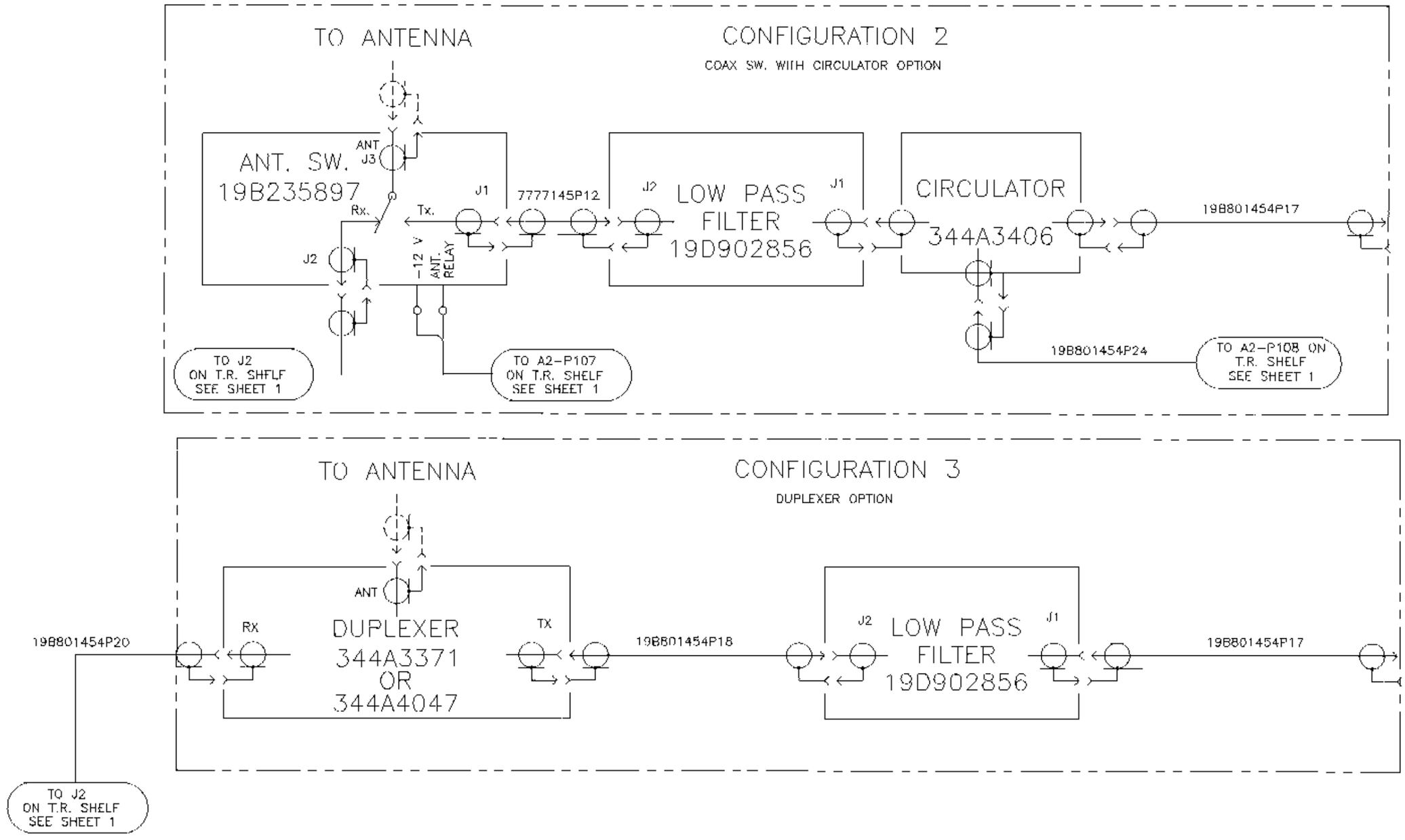
Mobile Communications

MASTR® III
DUPLEXER OPTIONS
DU1J 344A3371P1 150-162 MHz
DU1K 344A3371P2 162-174 MHz
DU1M 344A4047P1 440-470 MHz

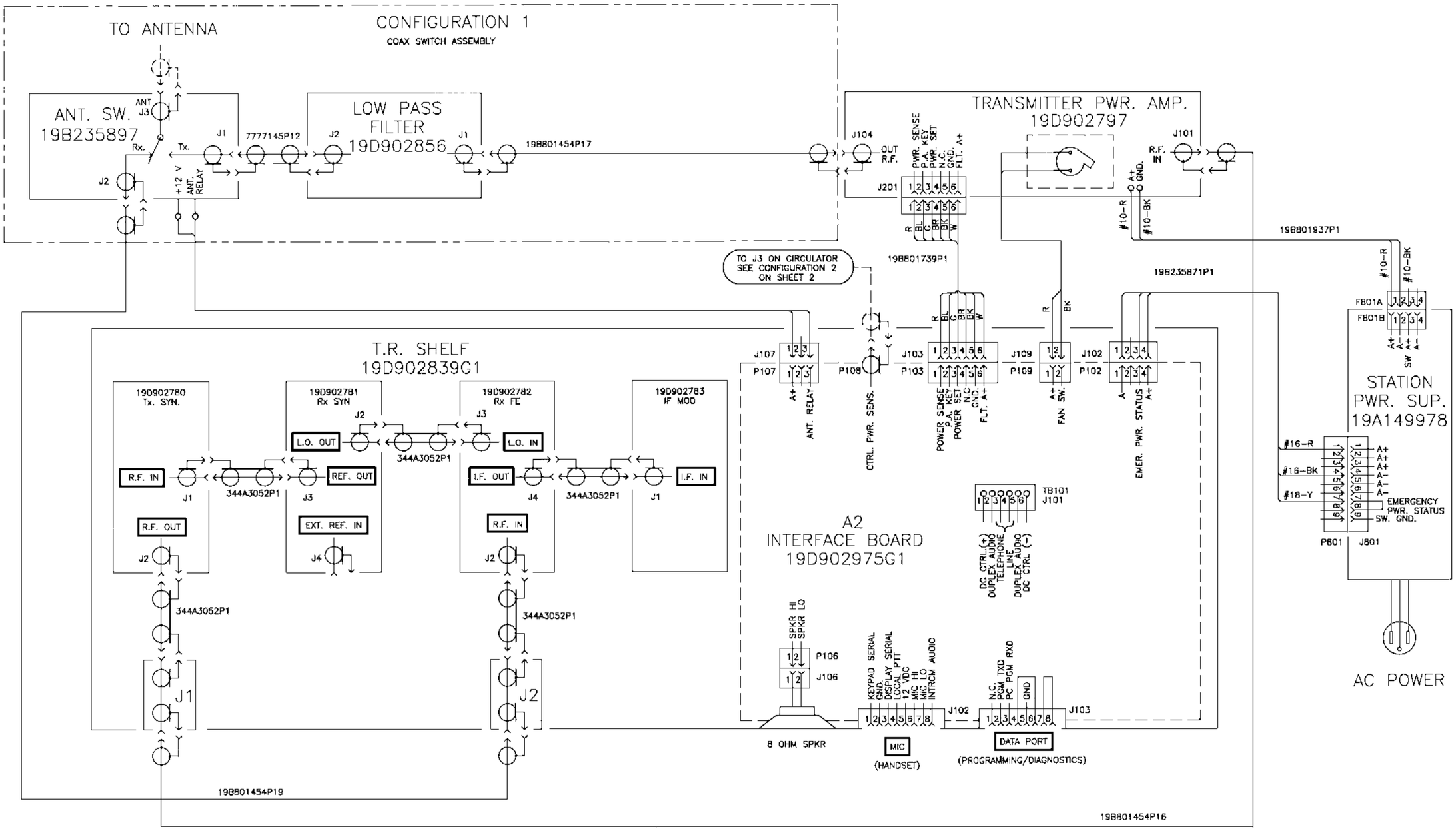
Maintenance Manual

Ericsson GE Mobile Communications Inc.
Mountain View Road • Lynchburg, Virginia 24502

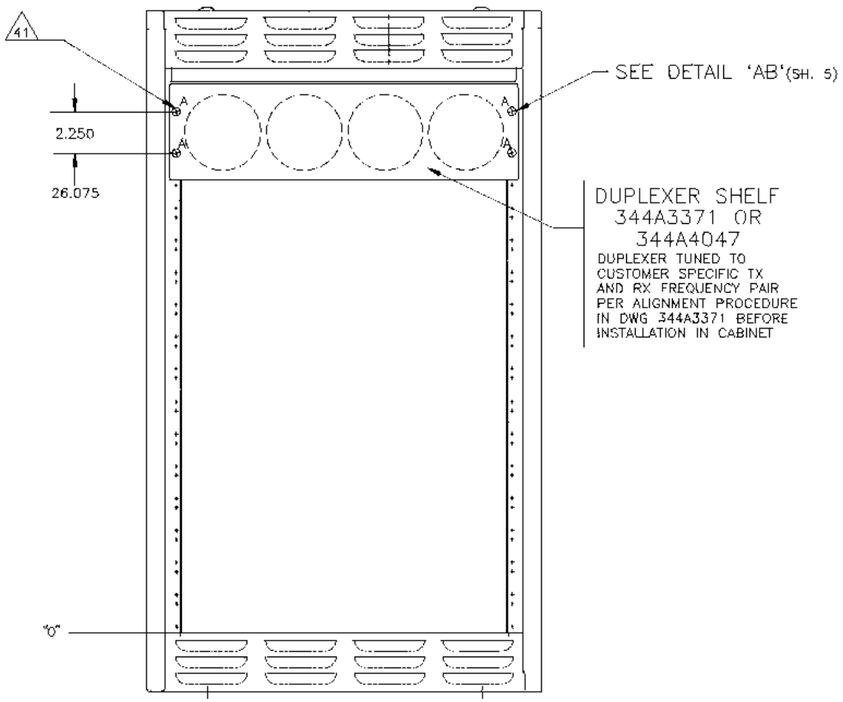
Printed in U.S.A



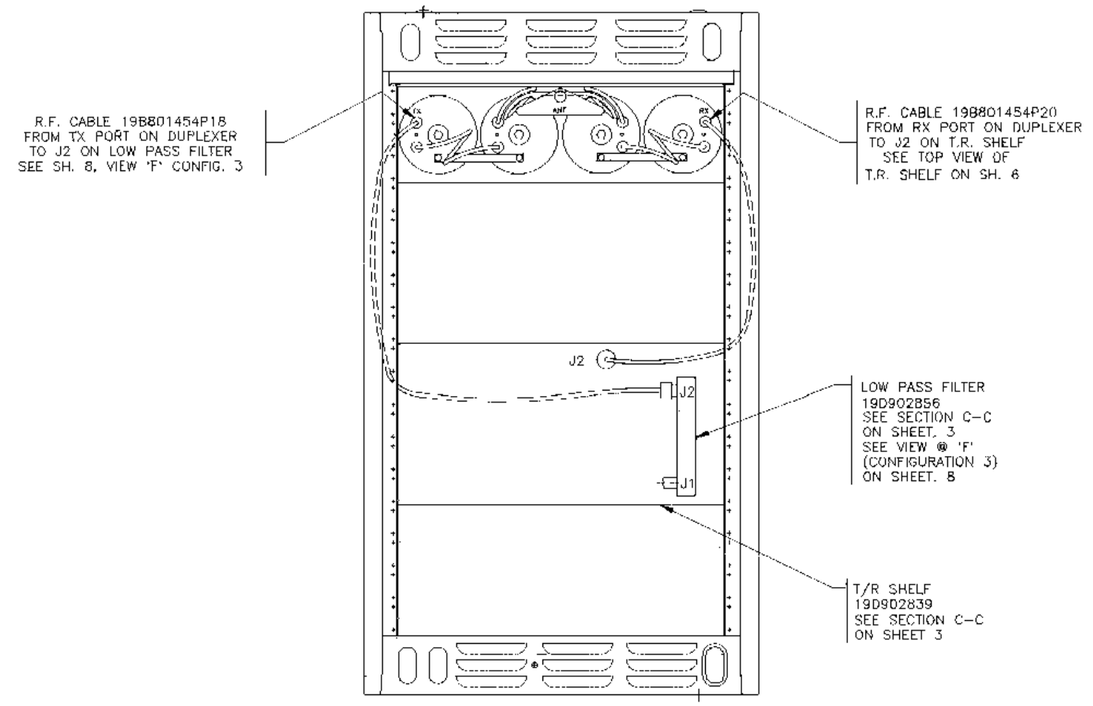
MASTR III STATION WITH DUPLEXER OPTION
(19D903635, Sh. 2, Rev. 4)



MASTR III STATION WITH DUPLEXER OPTION
(19D903635, Sh. 1, Rev. 2)



FRONT VIEW



REAR VIEW

(4) 37in.HIGH INDOOR FIXED LAND CABINET
MASTR III STATION WITH DUPLEXER SHELF

NOTES:

41 ITEMS REFERENCING THIS CALLOUT ARE CALLED FOR ON HARDWARE KIT P.L. 344A3450G4.

2. INSTALL CABLES AS SHOWN AND INTERCONNECT IN ACCORDANCE WITH INTERCONNECT DIAGRAM 19D903635 (CONFIGURATION 3)

LBI-38763

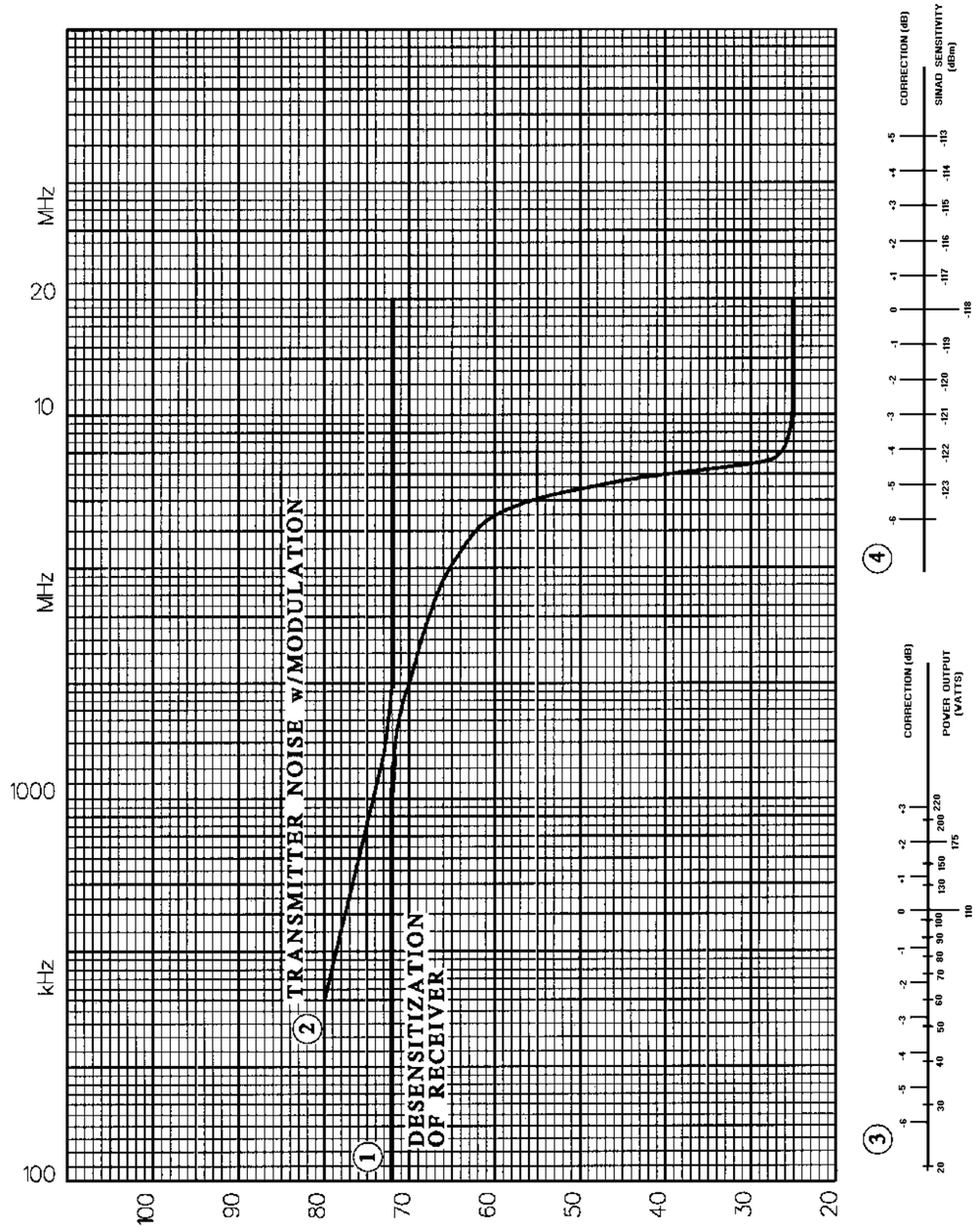


Figure 12 - Duplex Operation Curves For MASTR III UHF

LBI-38763

Tune "Reject" Frequency Of Cavities Three And Four

15. Connect the equipment to the duplexer as shown in Figure 9.

16. Set the signal generator to the transmit frequency. Tune the receiver to the transmit frequency.

17. Rotate the tuning slugs of capacitors C and D (in cavities 3 and 4) clockwise or counterclockwise to maximize the needed output power of the signal generator for the receiver to maintain a 12 dB SINAD output. Tune each capacitor several times because of interaction between the cavities.

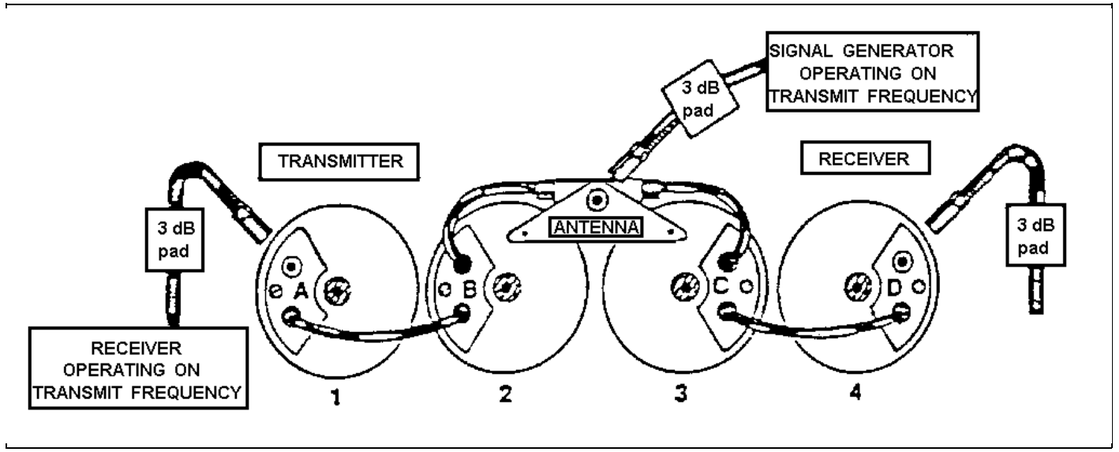


Figure 9

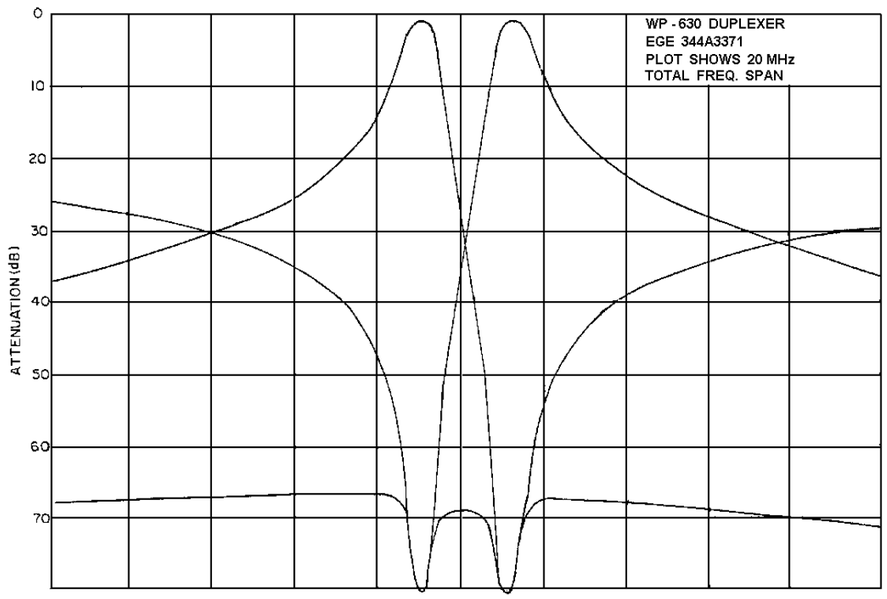


Figure 10

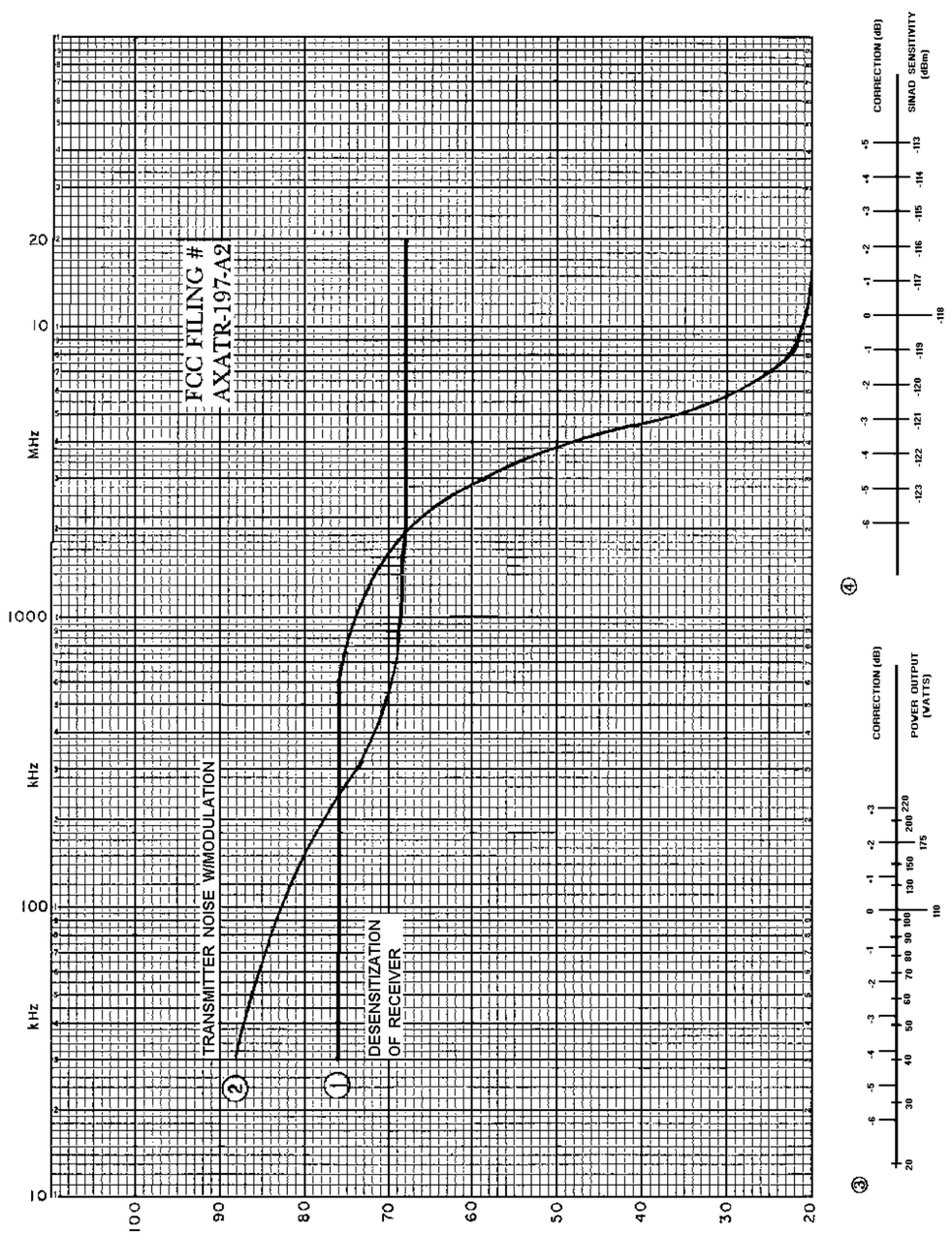


Figure 11 - Duplex Operation Curves For MASTR III High Band

LBI-38763

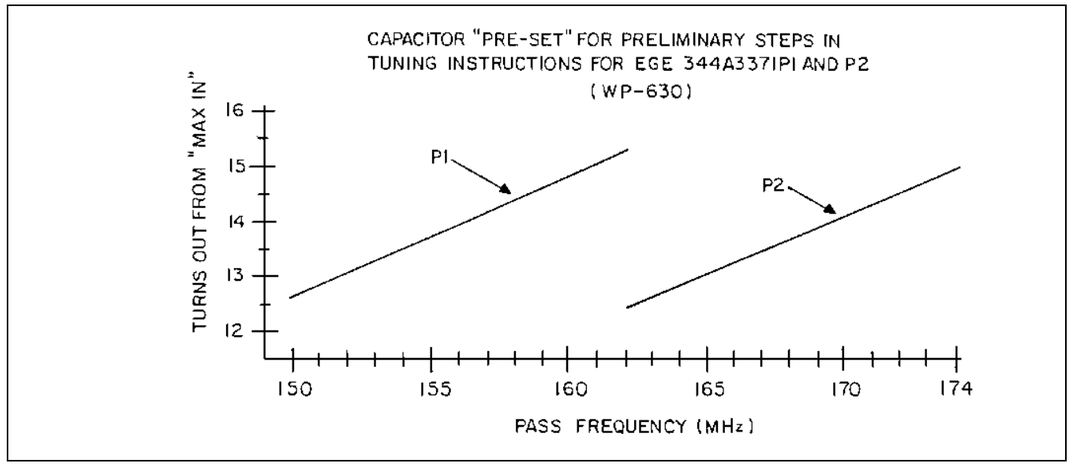


Figure 5

Tune "Pass" Frequency Of Cavities Three And Four

6. Connect the equipment to the duplexer as shown in Figure 7.

7. Set the signal generator to the receiver frequency. Tune the receiver to the receiver frequency.

8. Rotate the threaded tuning rods of cavities 3 and 4 to minimize the needed output power of the signal generator for the receiver to maintain a 12 dB SINAD output. Tune each cavity several times because of interaction between the cavities.

9. Tighten the hex nuts locking the tuning rods of cavities three and four.

Retune "Pass" Frequency Of Cavities One And Two

10. Repeat steps 3, 4 and 5. This is a precautionary step to ensure that cavities 1 and 2 are properly tuned. This step is not necessary if the duplexer is being retuned to new frequencies that are close to the old frequencies. This step is mandatory if the new "pass" frequency of cavities 1 and 2 is close to the old "pass" frequency of cavities 3 and 4.

11. Tighten the hex nuts locking the tuning rods of cavities one and two.

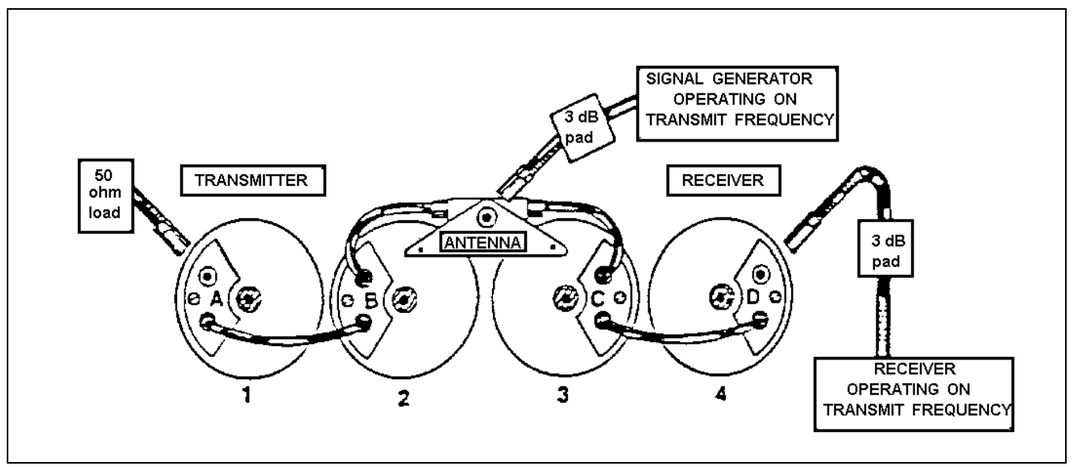


Figure 6

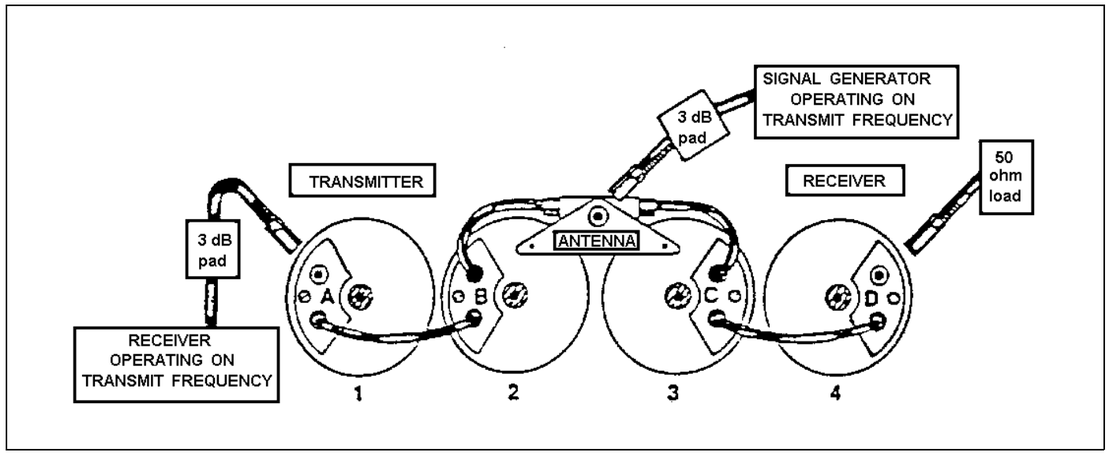


Figure 7

Tune "Reject" Frequency Of Cavities One And Two

12. Connect the equipment to the duplexer as shown in Figure 8.

13. Set the signal generator to the receive frequency. Tune the receiver to the receive frequency.

14. Rotate the tuning slugs of capacitors A and B (in cavities 1 and 2) clockwise or counterclockwise to maximize the needed output power of the signal generator for the receiver to maintain a 12 dB SINAD output. Tune each capacitor several times because of interaction between the cavities.

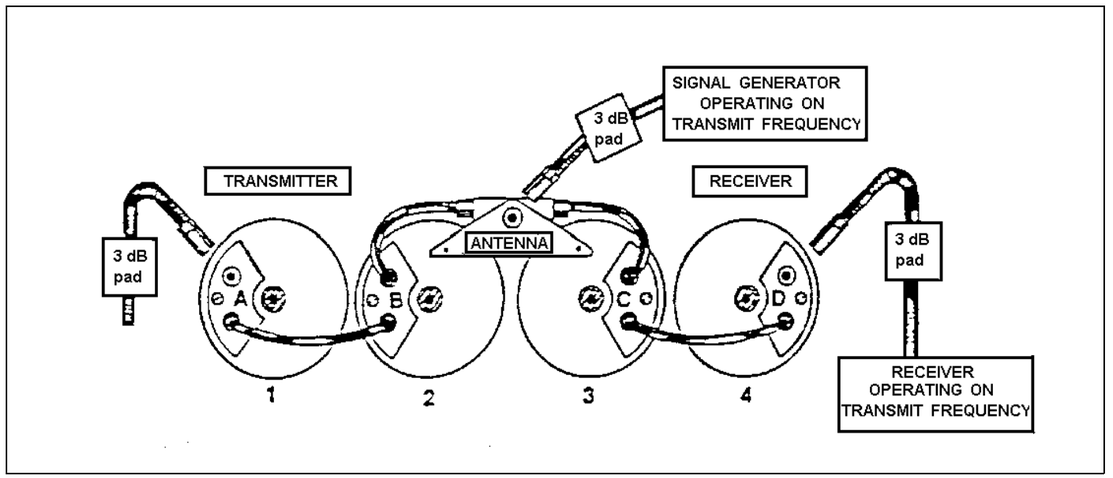


Figure 8

LBI-38763

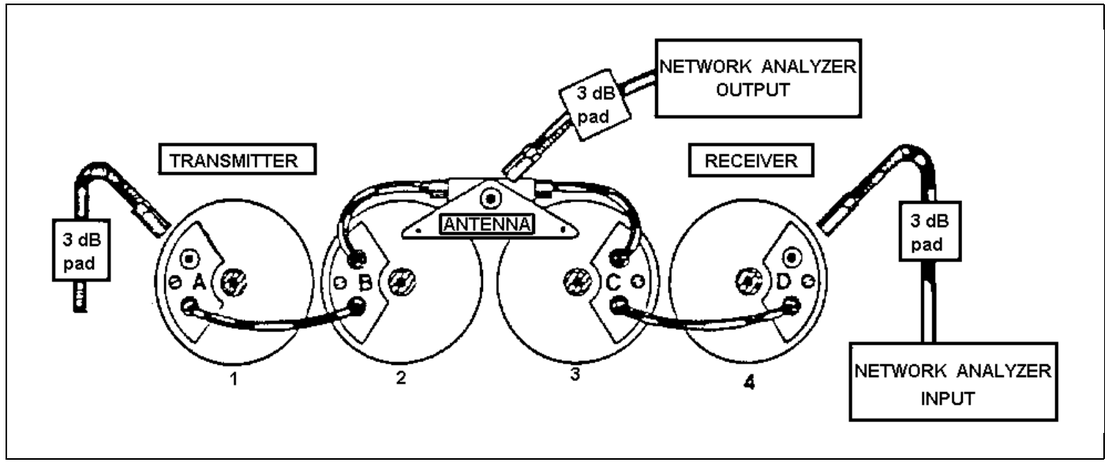


Figure 3

13. Rotate the threaded tuning rods of cavities 1 and 2 for maximum signal at the center frequency into the analyzer. (Tune both cavities several times because of interaction between cavities.)

14. Tighten the hex nuts locking the tuning rods on cavities 1 and 2.

The duplexer receiver and transmitter pass frequencies are now set and will not need to be changed or retuned. The following steps are for tuning the duplexer reject frequencies.

15. Connect the output of the network analyzer (or tracking generator) to the transmit port of the duplexer and the input of the network analyzer (or spectrum analyzer) to the receive port of the duplexer. Terminate the antenna port of the duplexer with a known good 50 ohm load termination. (See Figure 4.)

16. Change the vertical scale of the analyzer system to 10 dB per division and tune the center frequency of the network analyzer to the transmit frequency.

17. Tune capacitors C and D for maximum rejection at the center frequency. This rejection will be greater than 80 dB, take appropriate steps to increase the sensitivity/dynamic range of the analyzer to accurately tune the rejection notch.

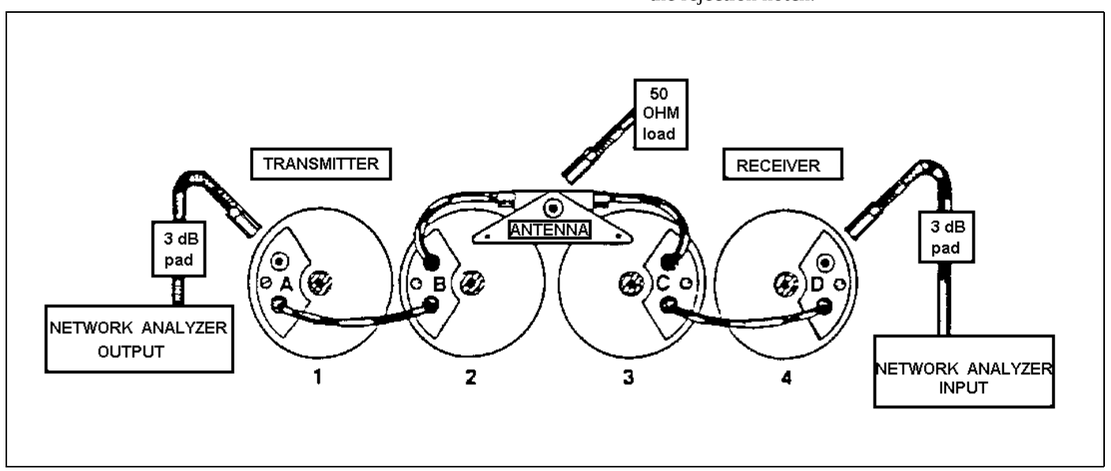


Figure 4

NOTE

Tuning the capacitors counter-clockwise will tune the rejection notch to a higher frequency (clockwise to a lower frequency).

18. Change the center frequency of the network analyzer to the receive frequency.

19. Tune capacitors A and B for maximum rejection at the center frequency. This rejection will be greater than 80 dB, take appropriate steps to increase the sensitivity/dynamic range of the analyzer to accurately tune the rejection notch.

NOTE

Tuning the capacitors counter-clockwise will tune the rejection notch to a higher frequency (cw to a lower frequency).

This completes the duplexer alignment. Remove the 50 ohm pads and load.

ALTERNATE PROCEDURE

Test Equipment Required

Signal generator	50-ohm, capable of generating signals at the receive and transmit frequencies (using 3 or 6 dB pads).
Receiver	50-ohm, capable of being tuned to the desired receive and transmit frequencies.
Attenuator pad (2 required)	3 dB into 50-ohms (or 6 dB) pads.
Termination	50-ohm load.

Procedure

The 50-ohm pads isolate the duplexer from the signal generator and receiver. Most signal generators and receivers are 50 ohm impedance devices, but many are not. If the signal generator and/or receiver does not present a 50-ohm impedance at the ports of the duplexer, the impedance mismatch will tend to "pull" the signal off frequency and will result in improper alignment of the cavities. The use of 50-ohm pads will help minimize the effects of an impedance mismatch.

Explanation Of Adjustments

For proper alignment, each cavity filter in the duplexer must be tuned to two different frequencies:

1. The Frequency to be passed by the cavity.

2. The frequency to be attenuated or rejected by the cavity.

The threaded Invar tuning rod is the "pass" frequency adjustment and the capacitor is the "reject" frequency adjustment. The "reject" frequency adjustment (capacitor) must always be the last adjustment to each cavity. Rotation of the slug in the capacitor moves the notch (reject frequency) closer to, or farther from the pass frequency, but does not change the pass frequency alignment. Rotation of the threaded tuning rod changes alignment of the "pass" frequency as desired, but also changes alignment of the notch to some unknown frequency. For this reason, the "pass" frequency adjustment is made first and the "reject" frequency is made last.

Cavities one and two are always tuned to pass the transmit frequency and reject the receive frequency. Cavities three and four are always tuned to pass the receive frequency and to reject the transmit frequency.

Prepare The Cavities For Realignment

1. Loosen the hex nut locking the threaded tuning rod on each of the cavities. The tuning rod should now be free to rotate in either direction.

2. Tune each capacitor inward (clockwise) until lightly seated against the stop. DO NOT FORCE AGAINST STOP. Then tune each capacitor outward (counterclockwise) the number of turns shown in Figure 5 according to the desired pass frequency of the cavity.

Tune "Pass" Frequency Of Cavities One And Two

3. Connect the equipment to the duplexer as shown in Figure 6.

4. Set the signal generator to the transmit frequency. Tune the receiver to the transmit frequency.

5. Rotate the threaded tuning rods of cavities 1 and 2 to minimize the needed output power of the signal generator for the receiver to maintain a 12 dB SINAD output. Tune each cavity several times because of interaction between the cavities.

LBI-38763

CAUTION

DO NOT TUNE ANY OF THE DUPLEXERS WITH THE TRANSMITTER KEYED INTO THE TRANSMIT PORT. FAILURE TO HEED THIS WARNING WILL RESULT IN THE FOLLOWING UNDESIRED BEHAVIOR.

1. The duplexer, when tuned to the transmit frequency, is a highly reflective load and will reflect most of the power back into the Power Amplifier. This will not damage the Power Amplifier, but will result in the P.A. output power level being reduced.

2. The RF power that is not reflected will be absorbed by the duplexer. This will result in improper tuning due to excessive RF power being dissipated as heat in the duplexer.

IT IS RECOMMENDED THAT THE DUPLEXER BE TUNED WITH NOT MORE THAN +10 dBm (10 mW) BEING DELIVERED TO THE DUPLEXER.

NOTE

The 344A3371 duplexer was designed for symmetry which allows the left side port (as viewed from the rear) to be the transmitter port and the right side port (as viewed from the rear) to be the receiver port regardless of whether the transmitter frequency is above or below the receiver frequency. This duplexer does not have a defined "high frequency" port or a "low frequency" port. The ports are defined as "transmitter" or "receiver" ports.

NOTE

The 344A4047 duplexer was designed with the left side port (as viewed from the rear) to be the transmitter port and the right side port (as viewed from the rear) to be the receiver port. This duplexer does not have a defined "high frequency" port or a "low frequency" port. The ports are defined as "transmitter" or "receiver" ports.

NOTE

In order to obtain accuracy in the final steps of tuning the duplexer, all steps must be performed in sequence.

PRIMARY ALIGNMENT PROCEDURE

Use this procedure if the duplexer will be installed in a 200 kHz band (344A3371) or 500 kHz band (344A4047P1) with multi-frequency applications.

Test Equipment Required

Attenuator 50 ohm, 3 dB (3 required).

Termination 50 ohm.

Network Analyzer.

Spectrum Analyzer (If Network Analyzer is not available).

Tracking Generator (If Network Analyzer is not available).

Procedure

Perform the following steps:

1. Determine the customer's transmit and receive frequencies.

2. Connect a 50 ohm 3 dB pad to each of the three ports (TX, ANT, and RX).

3. Connect the output of the network analyzer (or tracking generator) to the duplexer antenna port via the 50 ohm pad. Connect the input of the network analyzer (or spectrum analyzer) to the transmitter port via the 50 ohm pad. Set the middle screen frequency of the analyzer system to the transmit frequency and use a 20 MHz sweep (±10 MHz). (See Figure 1)

4. Loosen the hex nuts locking the threaded tuning rods on cavities 1 and 2. Rotate the threaded tuning rods for maximum signal (minimum loss) at the center frequency as observed on the analyzer.

5. Tune capacitors A and B to obtain rejection notches at approximately 8 to 10 MHz away from the center frequency, as shown in Figure 2.

6. Leave the output of the network analyzer (or tracking generator) connected to the antenna port. Connect the input of the network analyzer (or spectrum analyzer) to the 50 ohm pad connected to the receiver port. Set the middle screen frequency of the analyzer system to the receive frequency and use a 20 MHz sweep (±10 MHz). (See Figure 3.)

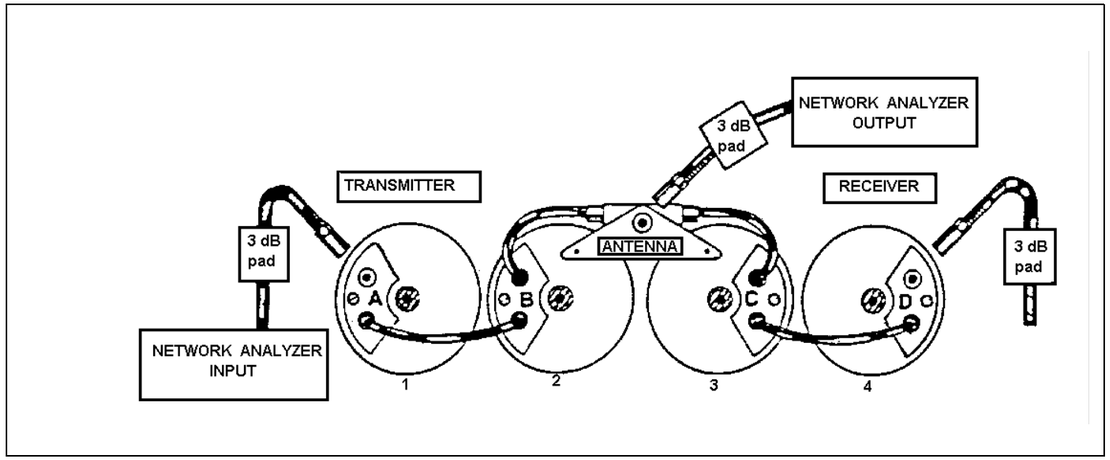


Figure 1

7. Loosen the hex nuts locking the threaded tuning rod on cavities 3 and 4. Rotate the threaded tuning rods for maximum signal (minimum loss) into at the center frequency as observed on the analyzer.

8. Tune capacitors C and D to obtain rejection notches at approximately 8 to 10 MHz away from the center frequency, as shown in Figure 2.

The duplexer is now in the proper preliminary state for "fine tuning" to the duplex frequencies.

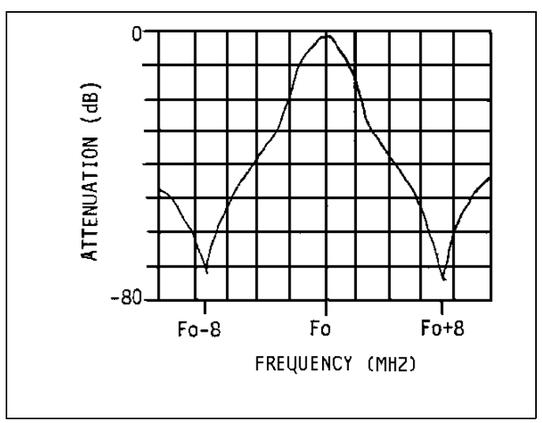


Figure 2

Leave the output of the network analyzer (or tracking generator) connected to the antenna port and the input of the network analyzer (or spectrum analyzer) to the receiver port.

NOTE

Set the network analyzer (or spectrum analyzer) horizontal and vertical scale resolution to obtain accurate and reliable frequency and amplitude measurements. We recommend a frequency sweep width of less than 200 kHz per division and an amplitude scale of less than 2 dB per division for insertion loss measurements. (10 dB per division will be necessary for isolation measurements.)

Change the horizontal (frequency) scale to 100 kHz (or 200 kHz) per division and the vertical scale to 1 dB (or 2 dB) per division.

9. Set the network analyzer (or spectrum analyzer) center frequency at the exact receive frequency.

10. Rotate the threaded tuning rods of cavities 3 and 4 for maximum signal at the center frequency into the analyzer. (Tune both cavities several times because of interaction between cavities.)

11. Tighten the hex nuts locking the tuning rods of cavities 3 and 4.

12. Connect the input of the network analyzer (or spectrum analyzer) to the transmitter port of the duplexer and set the analyzer center frequency to the exact transmitter frequency. (See Figure 1.)

LBI-38763

TABLE OF CONTENTS

SPECIFICATIONS*

Receive Tuning Range		
344A3371P1		150-162 MHz
344A3371P2		162-174 MHz
344A4047P1		440-470 MHz
Transmit Tuning Range		
344A3371P1		150-162 MHz
344A3371P2		162-174 MHz
344A4047P1		440-470 MHz
Receive Insertion Loss	(344A3371)	1.5 dB max.
	(344A4047)	1.2 dB max.
Transmit Insertion Loss	(344A3371)	1.5 dB max.
	(344A4047)	1.2 dB max.
solation @ Rx freq.	(344A3371)	75 dB min.
	(344A4047)	80 dB min.
Isolation @ Tx freq.	(344A3371)	75 dB min.
	(344A4047)	80 dB min.
Receive Bandwidth	(344A3371)	±100 kHz
	(344A4047)	±250 kHz
Transmit Bandwidth	(344A3371)	±100 kHz
	(344A4047)	±250 kHz
Receiver Port VSWR	(344A3371)	1.5:1 max.
	(344A4047)	1.3:1 max.
ransmitter Port VSWR	(344A3371)	1.5:1 max.
	(344A4047)	1.3:1 max.
Frequency Separation	(344A3371)	2.0-12.0 MHz
	(344A4047)	5.0-30.0 MHz
Power Handling	(344A3371)	132 Watts max.
	(344A4047)	240 Watts max.
Temperature Range		-30° to +80°C

The 344A3371 and 344A4047 duplexer meets all of the above specifications concurrently. However, the MASTR III Base Station receiver sensitivity and transmitter output power is derated due to required insertion loss in the receiver and transmitter paths.

	Without Duplexer Installed	With 344A3371 Duplexer Installed	With 344A4047 Duplexer Installed
Receiver Sensitivity	-116.0 dBm (0.35 µV)	-114.5 dBm (0.42 µV)	-114.8 dBm (0.41 µV)
Transmitter Output Power	110 Watts (+ 50.4 dBm)	77 Watts (+ 48.9 dBm)	83 Watts (+49.2 dBm)

* These specifications are intended primarily for use by service personnel. Refer to the appropriate Specification Sheet for complete specifications.

DESCRIPTION

Duplex operation in the MASTR III High Band Base Station can be accomplished in one of three ways:

1. Using separate receive and transmit antennas, separated by an appropriate distance to provide enough isolation between the base station's receiver and transmitter.

2. For transmit-receive frequency separations less than 2 MHz, an external-to-the-cabinet duplexer may be used. (Duplexers listed in the Ericsson GE Equipment catalog are compatible for use with the MASTR III Base Station.)

3. For transmit-receive frequency separations greater than 2 MHz, a factory installed rack mount duplexer option may be ordered. The advantages of using a rack mount duplexer are lower cost, size, weight, and installed in the rack instead of external to the cabinet resulting in less floor space used.

Duplex operation in the MASTR III UHF Base station can be accomplished by:

1. Using separate receive and transmit antennas, separated by an appropriate distance to provide enough isolation between the base station's receiver and transmitter.

2. For transmit-receive frequency separations of 5 MHz or more, the 344A4047P1 factory installed rack mount duplexer option may be ordered.

This LBI provides maintenance information on the factory installed rack mount duplexer options:

Option	Frequency Range	Duplexer No.
DU1J	150-162 MHz	344A3371P1
DU1K	162-174 MHz	344A3371P2
DU1M	440-470 MHz	344A4047P1

All duplexers are of the bandpass/band-reject design. This design is superior to duplexers with band-reject only because of the addition of stop-band attenuation. The stop-band attenuation assists the receiver in rejecting interference from other transmitters at the same site. Both the receiver and transmitter cavities are tuned for minimum insertion loss for the receive signal and transmitter output power. They are also tuned for maximum isolation from the transmitter port to the receiver port.

ALIGNMENT PROCEDURES

Duplexers are shipped from the factory pretuned to the customer's specific operating frequencies. Readjustment should not be required. If the operating frequencies must be changed, this manual provides instructions for retuning the duplexer. The Primary Alignment Procedure is the preferred method, and must be used if the duplexer is to meet all specifications for a 200 kHz (344A3371) or 500 kHz band (344A4047P1) bandwidth for multi-frequency applications. The Alternate Alignment Procedure may be used only if the duplexer is to be used for single frequency pair repeater applications.