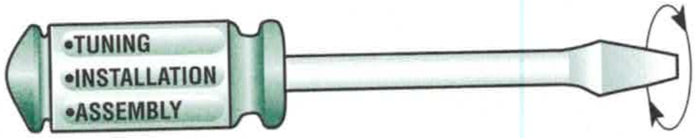

Part No.
7-9296-1

Field Tuning Instructions for 4-Cavity BpBr Circuit Duplexer Models WP-604/609/612/621/629/639/641

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This warranty applies for one year from shipping date.

TX RX SYSTEMS INC. warrants its products to be free from defects in material and workmanship at the time of shipment. Our obligation under warranty is limited to replacement or repair at our option, of any such products (with the exception of tubes) which shall have been defective at the time of manufacture. TX RX SYSTEMS INC. reserves the right to replace with merchandise of equal performance although not identical in every way to that originally sold. TX RX SYSTEMS INC. is not liable for damage caused by lightning or other natural disasters. No product will be accepted for repair or replacement without our prior written approval.

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Product part numbering in photographs and drawings is accurate at time of printing. Part number labels on TX RX products supercede part numbers given within this manual.

Symbols Commonly Used

WARNING
CAUTION
ATTENTION

ESD Electrostatic Discharge

High Voltage

Electrical Shock Hazard

Use Safety Glasses

Hot Surface

Radio Frequency Hazard

Protective Earth

⎓ **Direct Current**

∼ **Alternating Current**

Table of Contents

Figures and Plots

HIGHLIGHTS

(1) The duplexer is factory-tuned to the exact frequencies appearing on the decal with use of a spectrum analyzer/tracking generator and no further tuning or "touching up" is required.

(2) To maintain maximum isolation, use double-shielded type cable (RG-142 or RG-214) to connect the duplexer to the transmitter and receiver.

(3) The duplexer includes interconnecting cables between cavities which are critical in length. **Do not change**.

(4) With some transmitters, the length of the cable between the transmitter chassis and the duplexer may have to be optimized to obtain a proper impedance match (see instructions).

INSTALLATION

The three input connectors are marked "Low Freq. Input", "High Freq. Input" and "Antenna". Connect your equipment to the appropriate connector. The frequency is the only concern. All of the four cavities are built to handle the power output of a transmitter.

EQUIPMENT REQUIRED FOR ALIGNMENT

The duplexer is factory tuned to the exact operating frequencies prior to shipment from the factory. No further field tuning or adjustment is normally required. If it becomes necessary to change the operating frequencies of the duplexer, it can be field tuned if a spectrum analyzer with a tracking generator is available. In addition a 50 ohm load will be required.

EXPLANATION OF TUNING ADJUSTMENTS

Each section of the duplexer includes two bandpass-reject cavities. The coupling loop of each bandpass-reject cavity is fixed and can not be adjusted. For proper alignment, each section of the duplexer must be tuned to two different frequencies: (1) the frequency to be passed and (2) the frequency to be attenuated or rejected by the filter. Cavities 1 and 2 are always used to pass the lower of the two frequencies and reject the higher frequency. Cavities 3 and 4 are always used to pass the higher and reject the lower frequency.

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

Prepare the Cavities for Realignment (Pretune)

These first six steps are preliminary steps and a high degree of accuracy in the frequency or amplitude is not required. Even though high accuracy is not needed, these steps are necessary in order to obtain accuracy in the final steps of tuning the duplexer.

1) Connect the equipment as shown in **Figure 1**. Set the analyzer center frequency to the lower of the two frequencies and adjust the sweep setting as to include the full response curve (see **Plot 1**).

2) Loosen the hex nut which locks the threaded tuning rod of the four cavities and then rotate the threaded tuning rod of cavities 1 and 2 for minimum loss into the analyzer at the pass frequency.

3) Loosen the hose clamps on each of the four stubs so the rexolite rod can be adjusted (in and out). Leave the clamp slightly tight to prevent the rexolite rod from sliding out of the stub. Use the rexolite rods to adjust the notches on cavities 1 and 2 so as to obtain a symmetrical response about the center frequency as shown in Plot 1.

4) Connect the equipment to the duplexer as shown in **Figure 2**. Set the analyzer to the higher of the two frequencies.

and a VSWR (referenced to 50 ohms) of 1.3 to 1 or 1.5 to 1. At a VSWR of 1.5 to 1, the transmitter, or duplexer, or antenna could have an impedance of anything from 33 ohms to 75 ohms and still be within specifications. (At 1.3 to 1 VSWR, the impedance can be anything from 38 to 65 ohms). In a worst-case-scenario, the transmitter might have an actual impedance of 33 ohms, the duplexer 75 ohms and the antenna 33 ohms. As such, system performance will be degraded and yet, all components will individually meet manufacturers specifications. This impedance mismatch problem can usually be resolved by "optimizing" the length of coax cable between transmitter and duplexer and/or by installing one of the impedance-matcher PI Networks available through TX RX Systems Inc.

If a transmitter is overly sensitive to a mismatched load impedance, a variety of symptoms might appear, including one or more of the following:

1) The transmitter might generate numerous spurious radiations.

2) The transmitter output power might become erratic, either too high or too low as measured on a wattmeter.

3) The insertion loss of the duplexer might measure normal with sweep equipment but measure too high or too low on a wattmeter when connected to the transmitter.

4) The reflected power might change when the length of cable between the transmitter and the first cavity is changed.

5) Use of a ferrite isolator at the output of the transmitter solves the forward power and reflected power problem, and eliminates change in reflected power when the length of cable between the isolator and the first cavity is changed. (In this instance, the ferrite isolator can be used to reveal the symptoms or as a solution to the problem.)

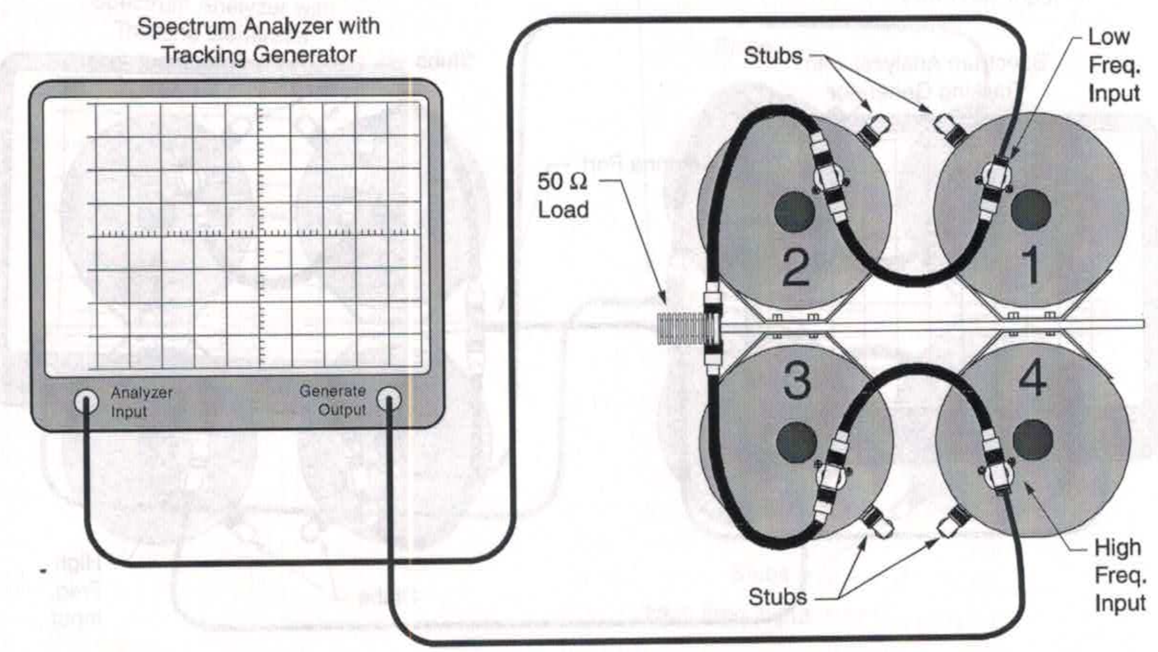


Figure 3: Tuning of reject notches.

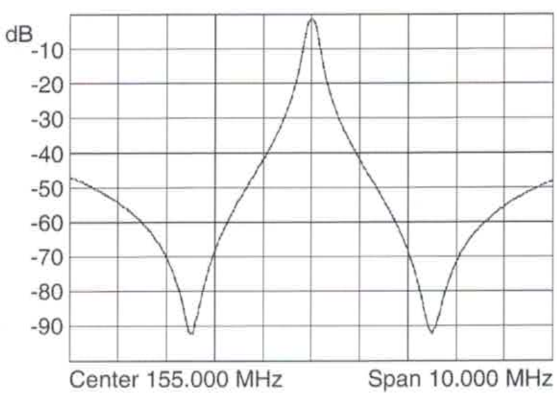
The above problems might be reduced or minimized by optimizing the length of cable between the transmitter and first cavity of the duplexer. The optimum length of cable can be found by the following procedure:

A) Tune the transmitter into a 50 ohm dummy load according to the manufacturers instruction.

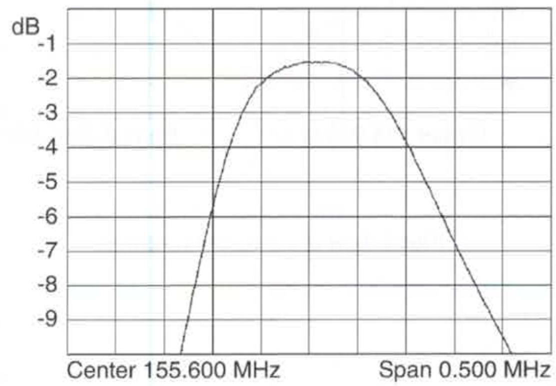
B) Connect the duplexer to the transmitter. The transmitter output signal should feed through the wattmeter, then through the duplexer then into a dummy load. If there is an impedance mismatch the duplexer will detune the transmitter and the cable length should be optimized.

C) Using short lengths of cable (no longer than 1" @ 900 MHz, 2" @ 460 Mhz, 6" @ 160 MHz, 24" @ 40 MHz) or right angle elbow connectors, gradually increase the length of the cable between the transmitter and duplexer until the optimum length (no detuning effect) is found. Up to four of these short cables should be tried.

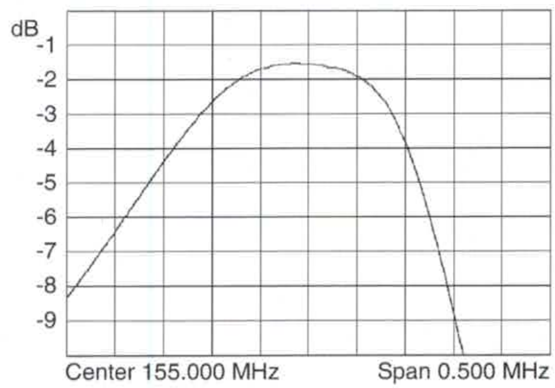
D) When the proper cable length is determined, i.e., when the system is operating as it should, replace all of the short and long lengths of cables, right angle elbow connectors and wattmeter with one continuous length of cable of equivalent electrical length. Do not overlook the fact that the wattmeter was a part of the cable length between the transmitter and duplexer during this process. If the wattmeter is removed from the circuit, the cable length <u>without</u> the wattmeter must be lengthened by some amount in order to be the same equivalent electrical length as the cable <u>with</u> the wattmeter in the circuit.



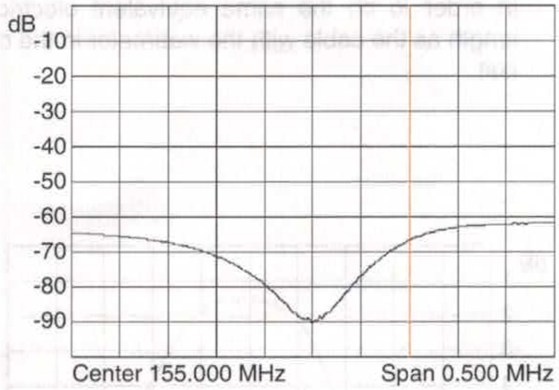
Plot 1: Symetrical response curve.



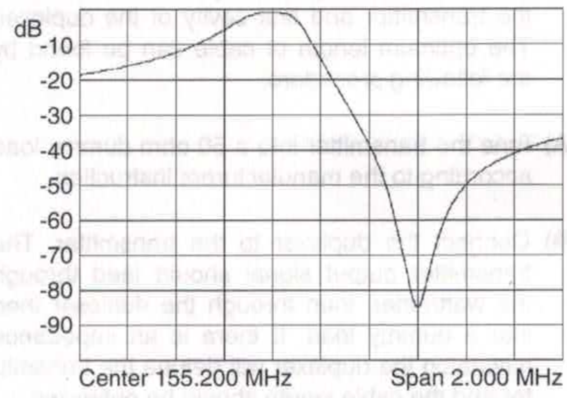
Plot 2: High pass response curve.



Plot 3: Low pass response curve.



Plot 4: Low reject response curve.



Plot 5: Duplex curve of low side.

NOTES