MWL-RADIOUNIT

900MHz RF Tunup Procedure

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1 CONFIGURATION, CONTROL AND MONITORING SYSTEM

1.1 OVERVIEW OF THE CCMS

- CCMS stands for **C**onfiguration, **C**ontrol and **M**onitoring **S**ystem
- It is a web based configuration, requiring only a web browser (Internet Explorer or Mozilla Firefox)
- No “service kit” software is required
- CCMS is used to configure radio, perform software updates etc.
- CCMS has levels of access such as: user and tech
- The radio has a database which contains all settings; these are manipulated with the CCMS web application.

1.2 TASKS THAT CAN BE PERFORMED VIA THE CCMS

- Monitoring radio link performance
- Radio link configuration
- Changing passwords
- Changing RF parameters (Power and Frequency)
- Changing a radio’s IP address
- Configuring Serial parameters (Synchronous, Asynchronous and Submux)
- Configuring M-SEC
- Configuring M-DNP3
- Performing software upgrades
- Backing up radio settings
- Activating software feature enables
- Configuring SNMP
- Configuring M-RAP
- Configuring M-DAP
- Configuring M-PoD

1.3 LOGGING INTO CCMS

MiMOMax radios use a built in web configuration package called CCMS. To access the CCMS, point a web browser to the radio’s IP address (see Figure 1). MiMOMax radios are often preconfigured with an IP address specified by the customer when the radio is ordered. If no IP address has been assigned, the default is 192.168.0.1/24 for Tx-High radios and 192.168.0.2/24 for Tx-Low radios. Additionally MiMOMax radios will broadcast 3 gratuitous ARPs to advertise the IP address when the radio boots up.

Figure 1: MiMOMax logon

To logon to the radio, press the “log into System” button. MiMOMax radios have two levels of access (user and tech). The default login credentials are:

Username	Default password
user	user
tech	tech

Figure 2: Default login credentials

1.4 RF SETTINGS

MiMOMax radios include the ability to set frequency and output power level for the tech login. They also have a range of options for advanced configuration and debugging.

The current transmit and receive frequencies can be viewed on the RF Tx and Rx page (see Figure 3). The procedure to change the operating frequencies of the unit is covered in section 2. Output power can be set on the RF Tx and Rx page, see Figure 3. Its range is between 0 and +30 dBm. The power can be specified in either dBm or mW, by selecting either dBm or mW as the transmitter power unit.

A number of other options are available on this page such as three advanced parameters that are used to optimise the radio’s behaviour in challenging RF conditions. These parameters should only be changed under the direction of MiMOMax support.

As with all options, to save changes press the “Save” button and then to activate the changes, click “Apply changes” in the control panel.

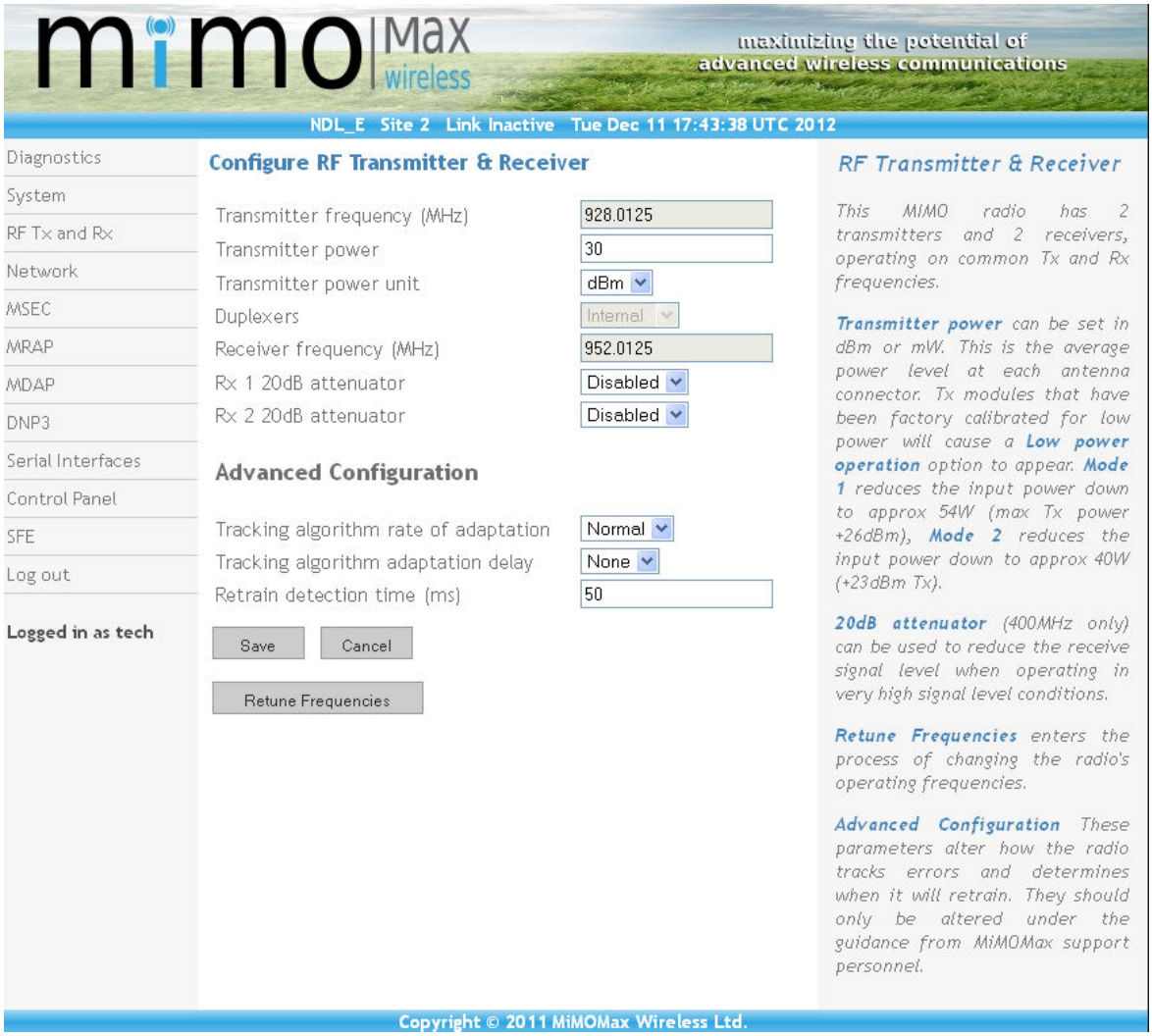

Figure 3: RF Configuration Page

2 SETTING OPERATING FREQUENCY & TRANSMITTER CALIBRATION

2.1 INTRODUCTION

Setting operating frequencies of a MiMOMax radio is done via the CCMS. The radio's internal duplexers also may need to be re-tuned. This is covered in section 3. The tech and factory use the same process with the factory being able to perform the additional step of saving the current settings as "factory default".

2.2 EQUIPMENT REQUIRED: POWER METER & POWER ATTENUATORS

For accurate measurement of average power from MiMOMax transmitters a thermocouple sensor type of power meter (e.g. HP8482A sensor with HP435B meter and 30dB power attenuators) is required. Other types of power meter may give inaccurate average power readings when used with MiMOMax transmitters, and may be suitable only for relative power measurement.
The transmitters are set up in the factory to produce 1W average power output with tolerance of +/-1dB over the operating range. If retuning transmitters to a different frequency is required, and a suitable power meter is not available to accurately set the average power to 1W after retuning, then the power output of each transmitter channel should be measured using the available power indicator BEFORE any retuning is carried out. The values obtained can then be used as reference points to reset the final power for each channel after retuning.

2.3 PROCESS OVERVIEW

The process of changing frequencies and transmitter calibration can be seen in Figure 4.

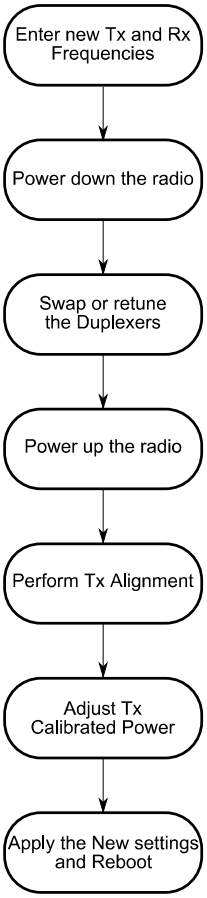

Figure 4: Frequency change flow chart

2.4 CCMS PAGES

To start the process, click on "RF Tx and Rx", see Figure 5. This page displays the transmitter power level, Tx and Rx frequencies. The output power can be re-adjusted once the Radio Units are operating on the new frequency. Note that it is strongly advised to set the unit to 30dBm output power and to measure the transmit power before starting the process. (The output power can be re- adjusted once the Radio Units are operating on the new frequency.) Click on "Retune Frequencies" to start the frequency change procedure.

Figure 5: Configure RF CCMS Page

This will display the page shown in Figure 6. From here on, no other CCMS pages will be accessible. One has to press the Abort button if one wants to leave the retune process. Enter the desired frequencies and press Next.

Figure 6: Enter New Frequencies Page

The new frequencies will be checked to ensure that they are supported by the hardware. A message saying that the frequency check passes will be displayed if the check is successful, see Figure 7.

Figure 7: Frequency Check Page

Next, the radio checks that the VCOs lock. The user will also be prompted to power the radio down, retune the duplexers, and attach attenuators before powering back up again. See Figure 8. It is crucial that the radio is connected to loads or attenuators and the duplexers are tuned appropriately! See section 3 for more information on duplexer tuning.

Figure 8: Decommission and VCO Check Page

Once the radio has powered up again, refresh the page and log back into the CCMS. The VCOs will be checked once again, then press Next to start the auto alignment process. See Figure 9.

Figure 9: Page after Powering Up

Next, the radio will execute its auto alignment procedure before displaying the results, see Figure 10. The auto alignment process is then repeated for transmitter two.

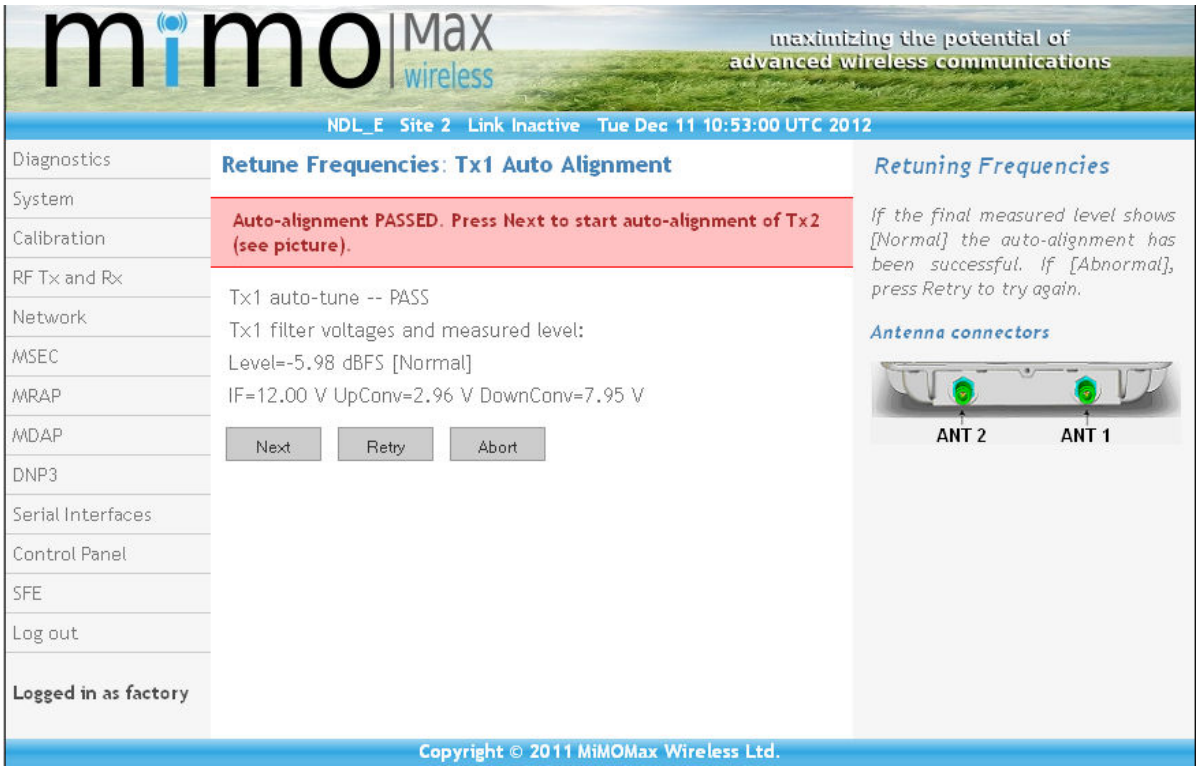

Figure 10: Tx Auto Alignment Result Page

The radio will then initialise the transmitter, see Figure 11. The user is then required to calibrate the output power. This is done by adjusting the loop attenuation and clicking “Apply” (see Figure 11). While measuring the output power on a power meter, adjust the loop attenuation until +30dBm is measured. If a thermocouple sensor type power meter is not available, then adjust the loop attenuation until the power measure is the same as when operating on the original frequencies.

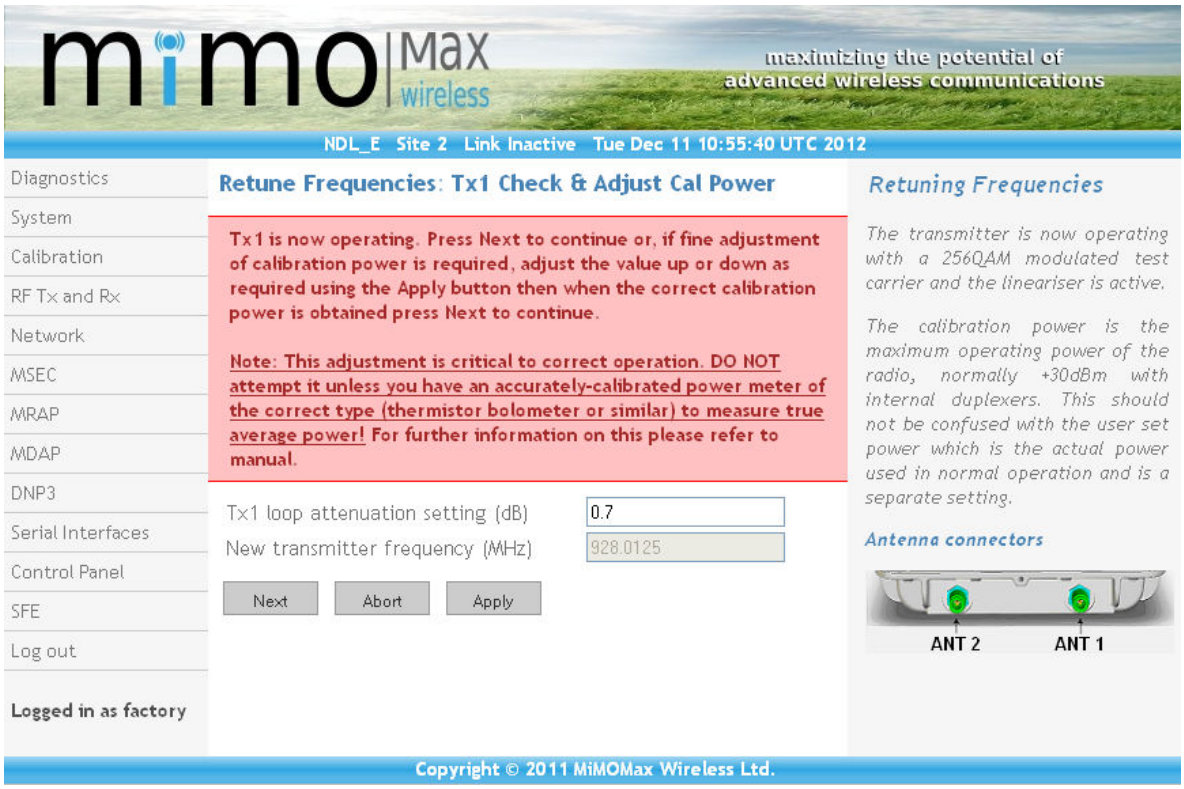

Figure 11: Tx Fine Power Adjustment

This alignment and power adjustment process is then repeated again for transmitter 2. Once transmitter 2 is complete, a success screen is shown, see Figure 12.

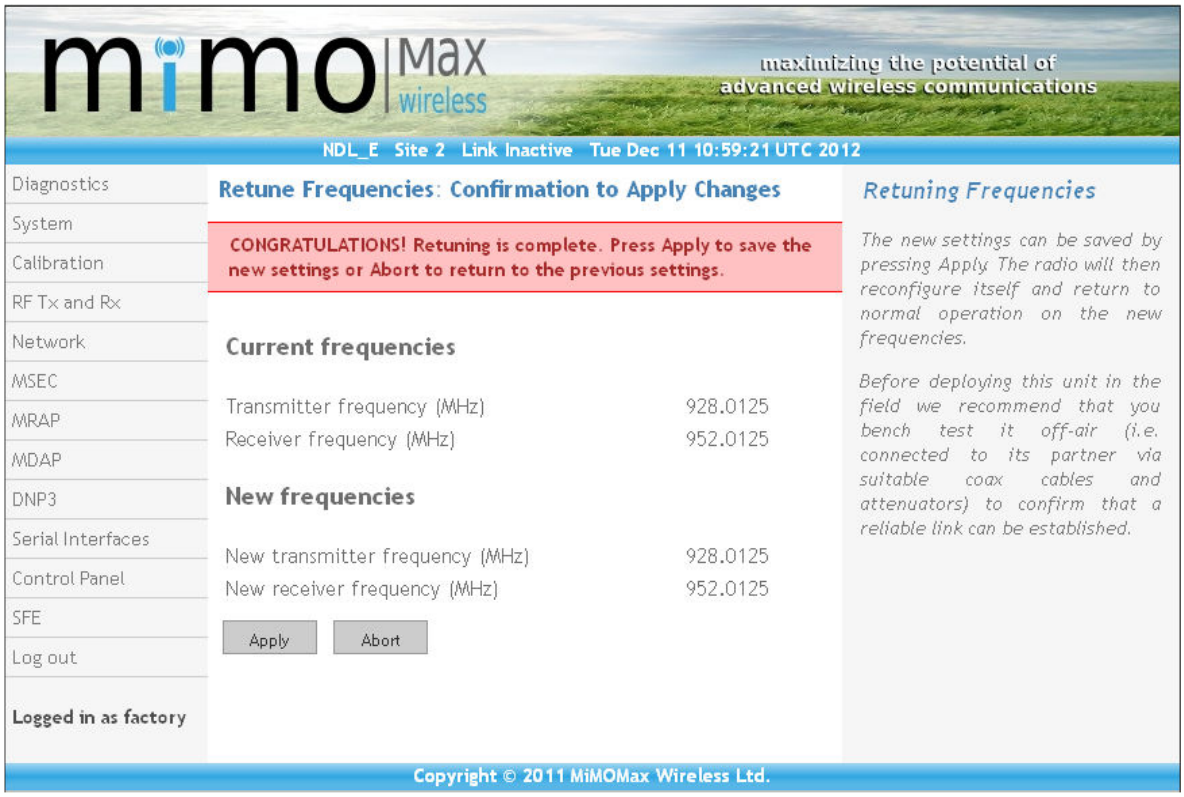

Figure 12: Success Page

Once apply is clicked, the radio will reboot and can be put back into service, see Figure 13. If the process is aborted, then please ensure that the duplexers are retuned to the original frequencies, see Figure 14.

Figure 13: Application of New Settings and Reboot

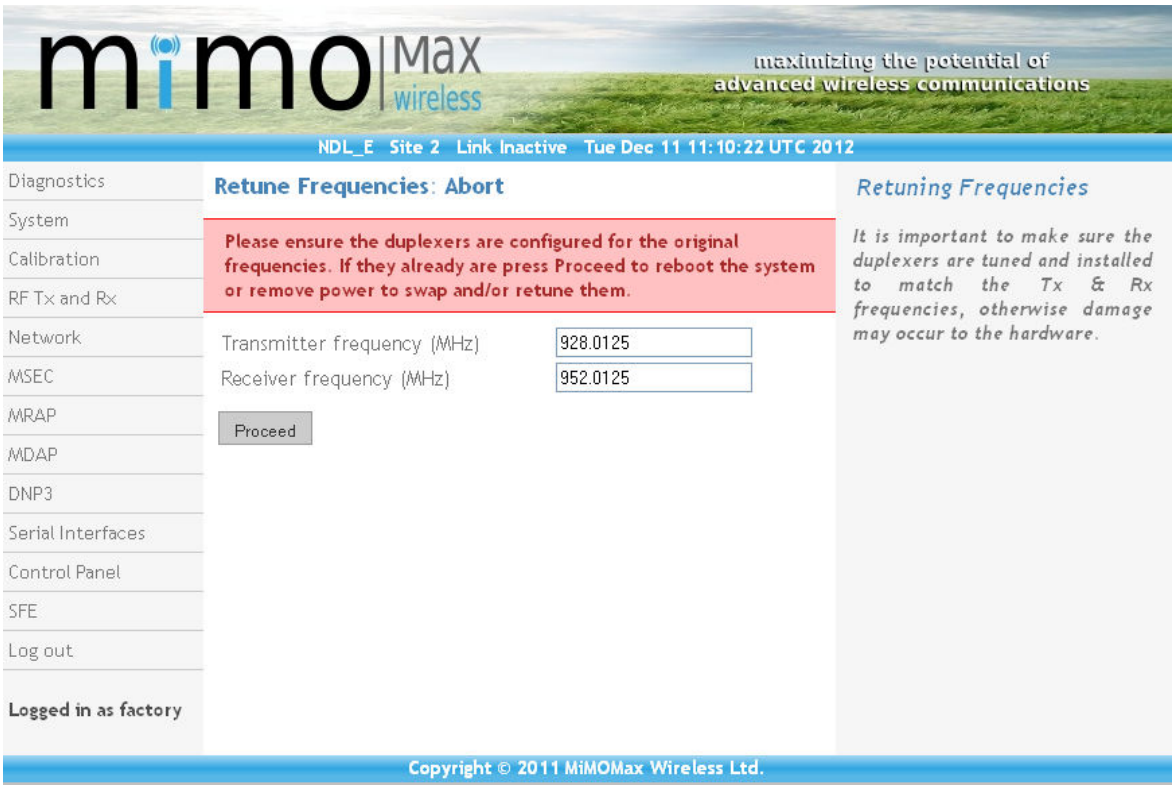

Figure 14: Returning to the Original Frequencies

3 DUPLEXERS

The MiMOMax radio unit has 2 transmitters and 2 receivers; these connect to 2 antenna ports via 2 duplexers.

The duplexer serves 2 primary functions:

1) It allows one transmitter and one receiver to be connected to a single antenna port.
2) It reduces the high power transmitter signal and noise getting into the sensitive receiver, and the received signal getting into the transmitter.

It does this by putting a very sharp and deep notch on each of the Tx and Rx signal paths whilst providing a low loss pass response to the desired signal. The transmitter path will have a notch filter tuned to the receiver frequency. The receiver path will have a notch filter tuned to the transmitter frequency. Each of these notch filters are made up of 3 tunable elements, these groups of three are called filter banks, and are covered by a single shield (note 2 silver shields as seen in **Figure** 15).

Figure 15: MiMOMax Duplexer

The duplexers are designed for a Tx to Rx frequency difference of 24MHz or more. To achieve optimum performance the filters are asymmetric - that is, the filter will have a notch on one side of the pass-band. As such each filter bank is considered to be a bandpass filter with low side notch or a bandpass filter with high side notch.

There are two 'types' of duplexers (aside from frequency bands), 'Type A' and 'Type B' (See **Figure 16**). The type can be read off the label on the duplexers. The code on them should read "XMWL-DPLXR-Axxx" or "XMWL-DPLXR-Bxxx", the first letter in the suffix is either A or B referring to type A or type B.

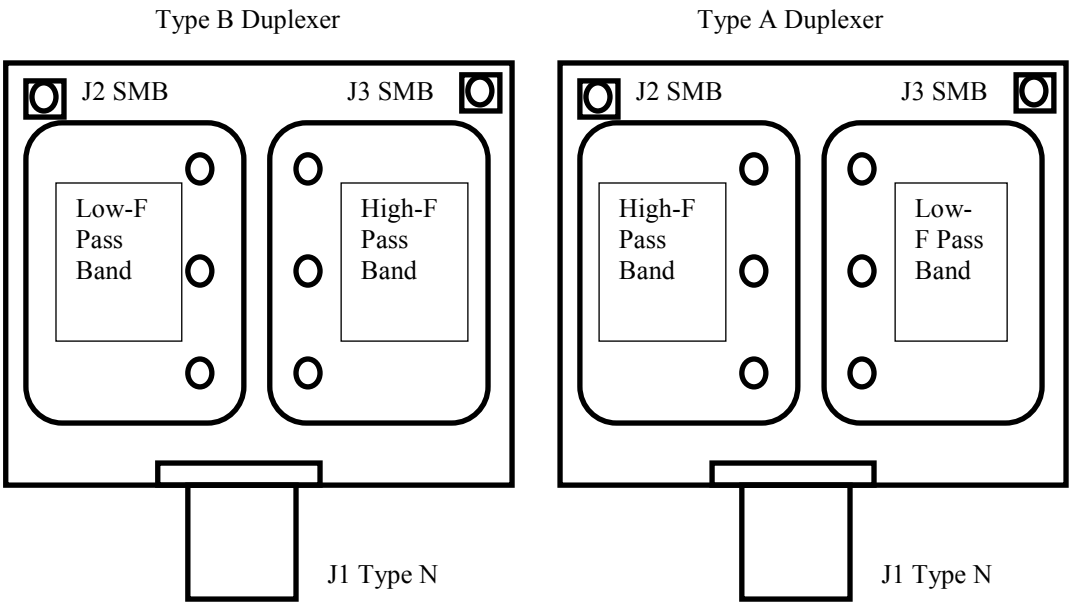

Figure 16: Tx High configuration as arranged in the chassis

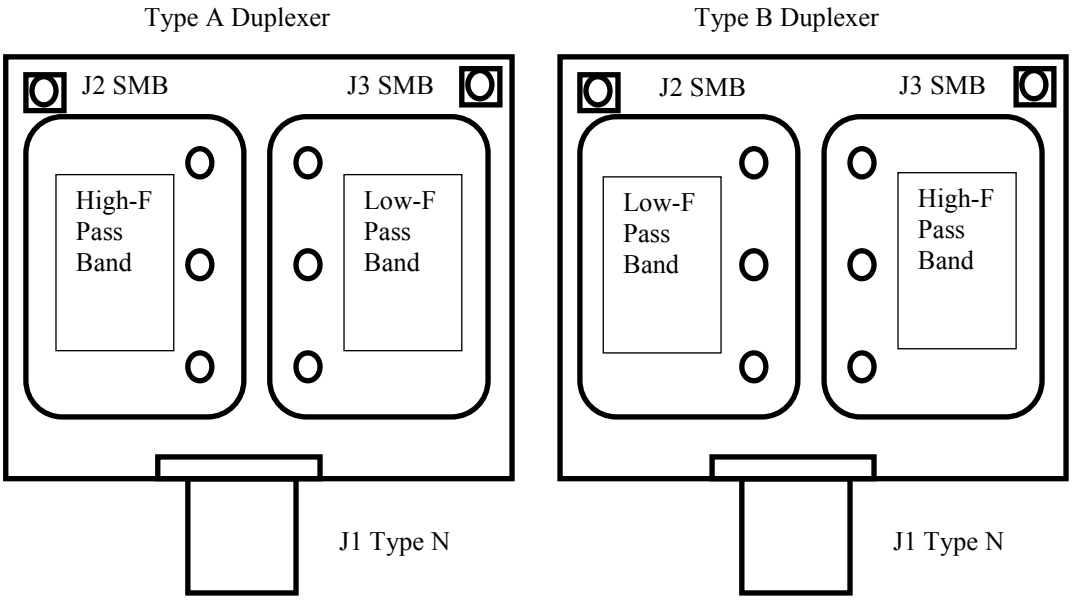

Figure 17: Tx Low configuration arranged in the chassis

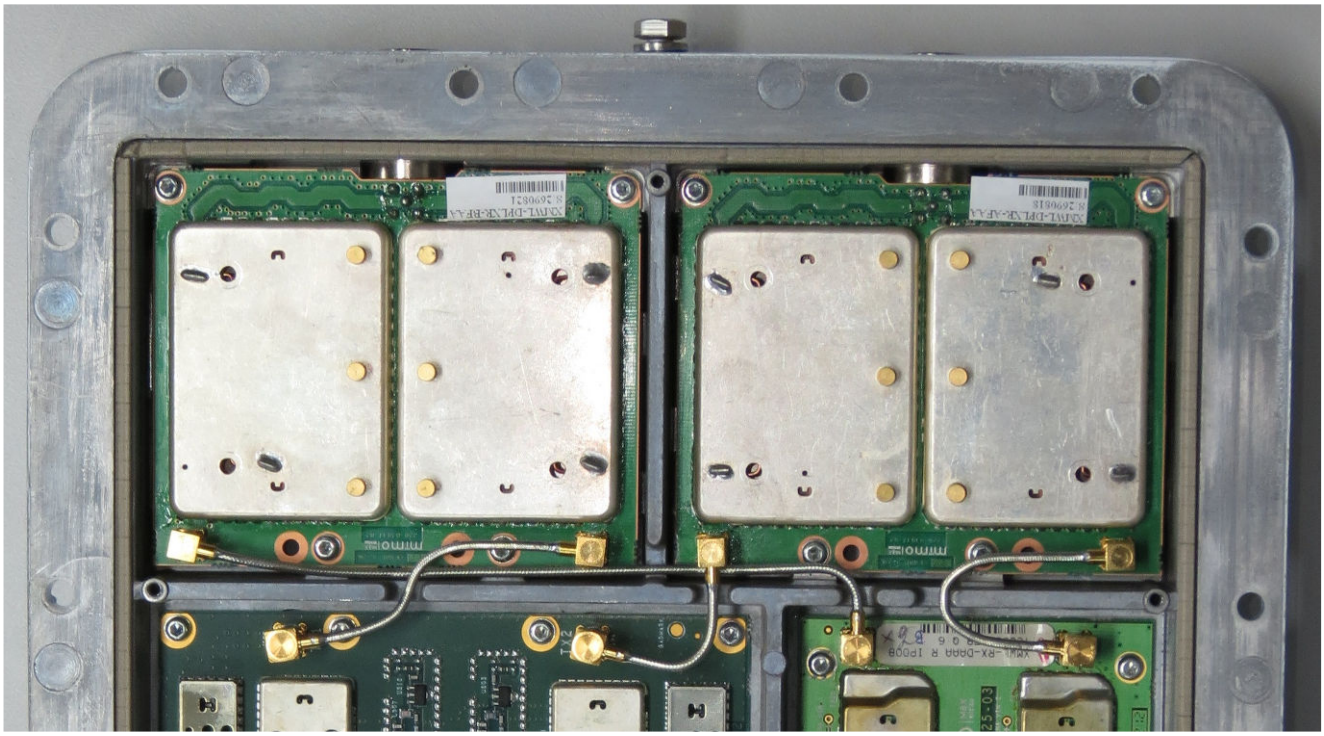

Figure 18: Duplexers & coax cables mounted in the chassis

By swapping the duplexer positions the radio unit is changed from Tx high to Tx low or vice versa.

Note: Tx high means the transmitter frequency is above the receive frequency. Tx low means the transmitter frequency is below the receive frequency. A point-to-point link will have a Tx high unit at one end and a Tx low at the other.

3.1 DUPLEXER TUNING GUIDE

3.1.1 Tools/Equipment Required

- Network analyser, Spectrum analyser with tracking generator or other suitable frequency sweeping set up covering 800~960MHz
- Leads and adaptors to connect measuring equipment to type N female and type N Male and the load to SMB male
- 50ohm SMB load
- Fine blade tuning tool 1.5 to 2mm x 0.35mm e.g. Goot CD-15
- T10 screwdriver
- T25 screwdriver

NB: full anti-static precautions are to be taken

3.1.2 Procedure

1) Remove the 18x T25 screws from the perimeter of the radio.
2) Pull the 2 clamshell halves away from each other, separating them at the connector end and pivoting at the other end. Do not unplug the multi-way cables between clamshell halves.
3) Remove the 4x T10 screws securing the separating plate.
4) Remove the 4x semi rigid coax assemblies. **Note: gently unclip each SMB connector but don't fully remove it, then remove both ends of each cable assembly at the same time, this prevents damaging the cable assembly by twisting it.**
5) Remove the trimmer capacitor covers from the Type B duplexer.
6) Calibrate/set up the measuring equipment to the desired frequency band.
7) Set markers to the desired Tx and Rx frequencies to aid tuning.
8) Connect the measuring equipment to antenna port J1 and J2 of the Type B duplexer, and place the 50ohm load on J3.
9) Using the tuning tool, tune the 3 left hand trimmers to maximise the pass band response at the lower desired frequency.
10) Swap the 50 Ohm load to J2 and the measuring equipment to J3.

11) Tune the 3 right hand trimmers to maximise the response at the higher desired frequency. A small amount of iteration between the left and right hand sides may be required to get best pass band responses.
12) Refit the trimmer covers.
13) Remove the trimmer capacitor covers from the Type A duplexer.
14) Connect the measuring equipment to antenna port J1 and J3 of the Type B duplexer, and place the 50ohm load on J2.
15) Using the tuning tool, tune the 3 right hand trimmers to maximise the pass band response at the lower desired frequency.
16) Swap the 50 Ohm load to J3 and the measuring equipment to J2.
17) Tune the 3 left hand trimmers to maximise the response at the higher desired frequency. A small amount of iteration between the left and right hand sides may be required to get best pass band responses.
18) Refit the trimmer covers and coax assemblies.
19) The pass-band loss should be less than 2.5dB and the loss at the stop frequency should be greater than 65dB. Typical response curves are shown below.
20) Reassemble the dividing plate and clamshell halves back together ensuring weather seal O-ring is seated and multi-way cables are plugged in and not pinched.

See Figure 19 for a plot of the final tuned filter characteristic as seen on the Network Analyser

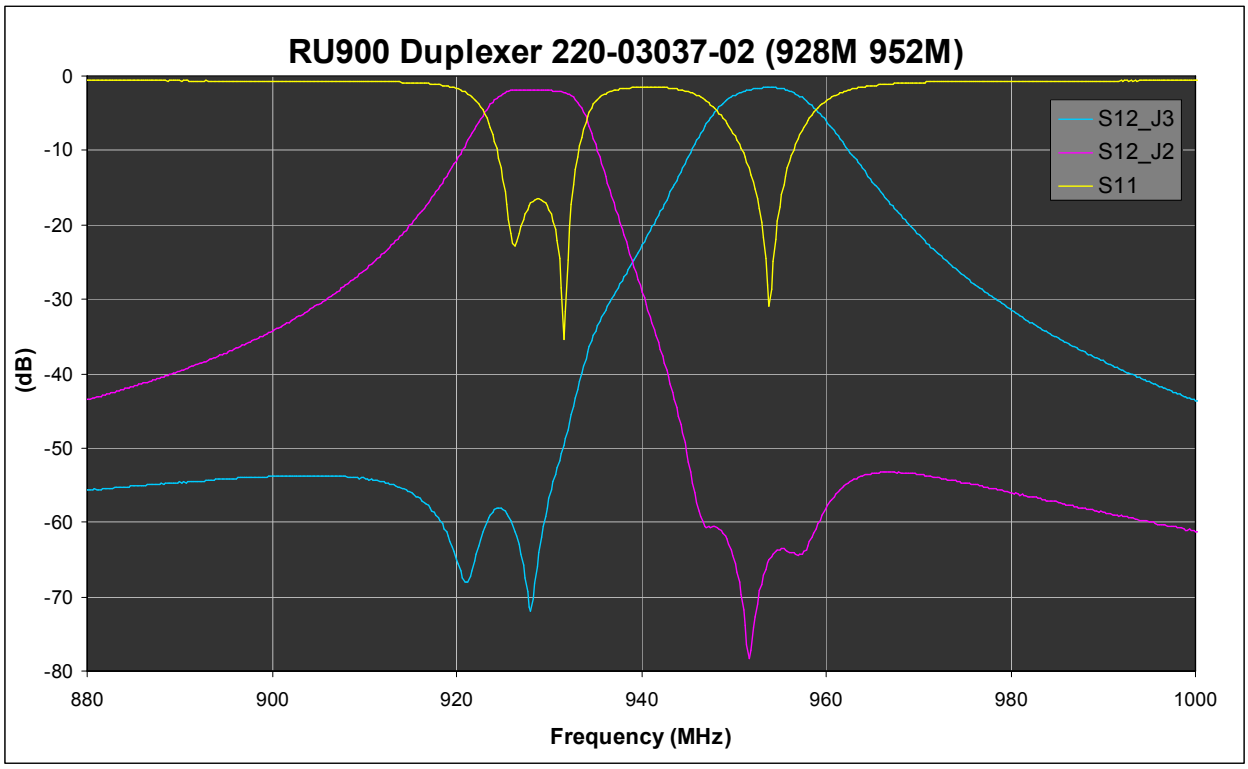

Figure 19: Filter Characteristic as Seen on Network Analyser