

Duplexer Tuning. WA2KJC Dave Petrie

The object is to pass the desired frequency and reject the unwanted.

The generator will serve to generate a very weak signal on/in the desired path. It will also generate as strong a signal as it can on the unwanted frequency in the same desired frequency path.

Doing these two things will allow you to tune the path by adjusting the tuning rod for the desired frequency and the screw [capacitor] for the unwanted frequency notch.

There are two paths in the duplexer. TX and RX. The generator will hook up to the antenna port and stay there.

A receiver tuned to the desired frequency will attach to the equipment end of the duplexer, TX and RX one path at a time.

First, pick a path to adjust, lets pick the antenna to RX path, but first attach the generator to the test receiver, program the receiver to the RX pass frequency, program the generator to the desired pass freq, generate a 1 kc tone at approximately 1kc deviation, this is to make sure it is the generator you are listening too and not to be too annoying, adjust the generator level until you have the weakest sounding audio to clearly distinguish the tone,

Make a note on your note pad the frequency, path, and level, that means it will be the RX frequency, direct connect to receiver, and I am hoping it is about .15 uv sensitivity. This is the reference goal for the path through the duplexer; it is also going to show us how much loss there is in the duplexer path.

Now we have established the receiver reference for the RX frequency, do the same test for the TX frequency, there should not be any difference, but I am one for detail, if you say it's raining outside, it's not that I don't believe you, I just have to look.

Now hook the generator onto the antenna port of the duplexer, it will not move again until the tuning is complete.

Always, always, use double shielded coax between the generator and duplexer and duplexer and receiver. Also note that some generators will emit rf through their cabinet when tuning at high power for the reject notch, so make sure the generator is at least 5 feet away from the receiver, both can have leakage in and out of their cabinets.

We are tuning the RX path first to pass the desired frequency.

Set the generator to the receive frequency, set the receiver to the receive frequency, attach the receiver to the RX connector with a short, like used at the repeater site, up to 10ft or so should be fine using super flex or double shielded, it's not that critical but in some cases a 1/4 wave length or multiples thereof, does help with interference and high swr, so 468 divided by the frequency in MHz, then divided by half and multiplied by 12 will give you the 1/4 wavelength in inches. $468/146.355=3.197704212360357$ divided by 2= 1.598852106180178 times 12= 19.18622527416214 or 19 inches.

This is more to do with transmit path if a minor adjustment doesn't cure the reflected, we will discuss that when we do the transmit path.

So we have the generator set on the RX frequency, the receiver set and connected to the RX port of the duplexer. Adjust the output of the generator so you can hear it on the receiver, weak but sufficient audio to tune to.

Adjust the first tuning rod on the nearest can to the antenna port/generator until you can pass the weakest amount of generator signal through the RX path. Then do the same adjustment to the next tuning rod on the next can in the RX path. Go back and forth until the best weakest amount of signal can make its way from antenna port to receiver. The end result should be very close to the original direct test to the receiver, if there is a concern a preamp can be placed in the rx line later. Most repeater receivers have one.

Now let's get rid of or put up a real good fight against the unwanted frequency, the next door neighbor, the TX frequency.

Do not move a single coax. We are now going to set the generator frequency to the TX frequency and the receiver to the TX frequency; we are still in the RX path. Adjust the output power on the generator until you can hear the tone on the receiver and adjust the first can's screw [cap] to remove the audio tone from the receiver, in other words, notch the unwanted frequency.

Keep increasing the generator output and adjusting the notch until the maximum effort, maximum generator output, maximum notch is accomplished; now move onto the second can and adjust the notch.

You may have to do one can at a time by removing the jumper between the cans and hooking the receiver up, all depends on how good the notch is.

This is where the leakage I mentioned comes into play, if you are not getting a result, a decrease in signal to the receiver when you adjust then it's possible that the generator, the coax, the receiver are leaking. It is also possible that the relationship between the pass tuning rod and the cap tuning [notch] are too far out of sync, worst case at this point if you're not getting any notch, is to adjust the tuning rod and cap for maximum notch and then go back and adjust for maximum pass at the desired RX frequency, bouncing back and forth, having fun yet? Where's my IRF spectrum analyzer and tracking generator, oh well.

Repeat this procedure on the TX path with frequency change.

The last step that is important to protect the transmitter power amplifier. Hook a watt meter with connectors, close coupled, to the tx connector on the repeater, Then the coax that goes to the duplexer on the antenna side of the watt meter.

Force the transmitter up and measure the forward power and the reflected power.

The reflected power is where we might have to make a minor adjustment of the first Tx path tuning rod so that there is minimum reflected power to keep the power amp safe. After the minor adjustment to the first tuning rod in the tx path you might have to make minor adjustment to the notch. The way I do the final minor notch adjustments is to make an isolation T connector, the letter T laid on its side, so it can be attached at the duplexer antenna port and pass signals to the antenna or in this case a dummy load if that's easier, with the right angle connector port of the T attached to the generator.

It is very important that the right angle center pin on the T connector be removed so as not to have any electrical contact with the generator, this will keep the high rf power from the TX amplifier passing by to the antenna, away from the generator which would damage the generator severely. So we ready for the big test. Turn on your HT and listen to the repeater transmit, generate enough signal on the repeater receive frequency to hear it passing through the repeater, you might have to turn the repeater TX power to minimum to start with.

When you have a very weak signal being repeated, then turn up the repeater transmit power until you hear interference, at that point adjust the notches to get rid of the interference. You might get lucky and not have any interference; this means you are done tuning.