Telewave.io Pass Cavity Tuning

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Introduction

Cavity tuning should be performed using a low power RF source, Tracking Generator or Network Analyzer. When transmitter power is passing through a cavity, high voltage & current exists on the internal surfaces. Tuning under power may cause internal arcing and damage.

Refer to the product Data Sheet for the specific product parameters before making any adjustments.

Setup

1. Setup the Test Leads – Cables
    a. Any quality 50-ohm flexible coaxial cable with Type "N" Connectors will work.
    b. The lead length should be an electrical increment of ½ wavelength of the primary frequency
        i. The actual length of the cable will depend on the cables velocity factor
        ii. The lead length does not need to be exact… for example, a set of cables cut to the center of the VHF high band will almost always be OK for the entire 144 to 174 MHz
        iii. Will need three cables if using an external directional coupler to measure return loss
2. Setup the Test Equipment
    a. Service Monitor (with a tracking generator), or a Network Analyzer
        i. Refer to the user manual for instructions on how to operate your test equipment.
        ii. Network analyzers generally work better for tuning operations since they can indicate return loss and insertion loss at the same time.
        iii. Tracking Generators will require an external directional coupler to indicate return loss (a directional coupler with > 30 dB isolation works best.)
    b. Configure the start and stop frequency of the sweep.
    c. Set a marker at the desired pass frequency.
    d. Set the transmit level to 0 dBm (1 mW)
    e. Normalize the leads that will be used to connect to the cavities (see equipment instructions)

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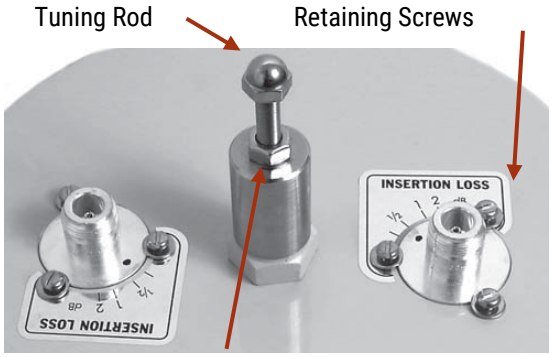
Sequence

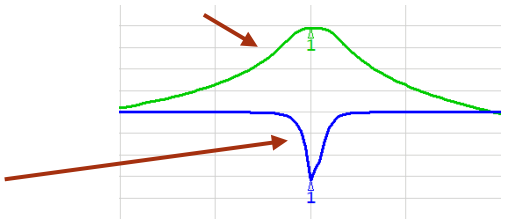
3. Tune each cavity individually.
    a. If there are multiple cavities, disconnect one end of each interconnecting cable from one cavity, to isolate the cavity from the set (will be easier to re-cable the network later.)
    b. Connect the leads from the test equipment to the connectors on the isolated cavity.
    c. Tune the isolated cavity.
    d. Disconnect the test equipment leads from the cavity (leave connected to the test eq.)
    e. Reconnect the cavity to the network cables, and then isolate the next cavity in the system.
    f. Continue isolating and tuning each individual cavity till all are tuned; be mindful that you want all the cables and cavities to end up connected the same way they were before starting.
4. Tune the complete system.
    a. If there are multiple cavities, verify that all are connected as they were before starting.
    b. Connect the leads from the test equipment to the input and output of the cavity system.
    c. Fine tune all cavities as required to optimize the performance of the system.
        i. Cavities will interact with each other.
        ii. A small change to a single cavity will affect the entire system, move slowly.
        iii. Maintain a proper balance between Insertion Loss and best Return Loss.
    d. Disconnect the test equipment leads and wire the cavity filter/s into the final system.



Procedure

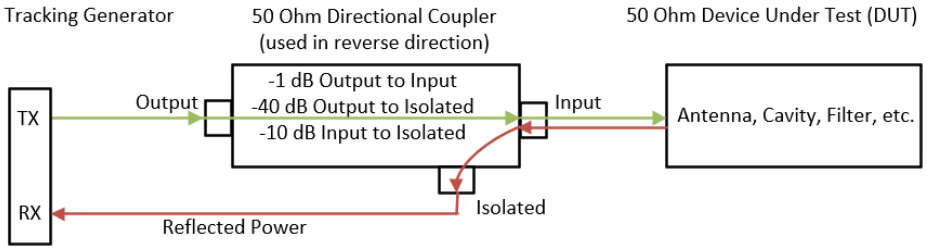
5. Tune the Pass Frequency
    a. Loosen the locking nut on the center tuning shaft.
    b. Turn the tuning rod slowly (left/right) till the pass is centered at the target frequency.
    c. Tighten the locking nut, just enough to hold the rod on frequency.
6. Tune the Insertion Loss (typical 0.5 to 2.0 dB / cavity @ resonance)
    a. Loosen the three retaining screws around the loop connector, just enough to rotate the loop.
    b. Rotate the loop slowly (left/right) until the desired insertion loss and/or the desired isolation at a particular number of KHz or MHz from the primary frequency is indicated.
    c. Snug the loop/connector retaining screws, just enough to hold in place.
7. Verify the Return Loss.
    a. If tuning the cavity with a Network Analyzer, Return Loss can be monitored at the same time as the cavity is being tuned.
    b. If tuning the cavity with a Tracking Generator, Return Loss cannot be checked until the tuning has been completed.
    c. Return Loss should be >= 18 dB across the modulated signal bandwidth.

Insertion Loss ~ 1 dB at Pass Frequency



Checking the Return Loss with a Directional Coupler

8. If tuning the cavity with a Tracking Generator the return loss cannot be checked until the tuning has been completed (and can only be checked on one side of the cavity at a time – input or output.)
    a. Disconnect the lead from one side of the cavity, connect a 50 Ohm Load to this connector.
    b. Connect the Tracking Generator to the Directional Coupler and Cavity per the diagram.
    c. Sweep the cavity with the same settings used to tune the cavity.
    d. In the example below, the Return Loss = ((TX level dB – RX level dB) + 10 dB)



Cleanup

9. While watching the test equipment display the sweep of the insertion loss – tighten everything…
    a. Tighten the retaining screws around the loop connector (hold the N connector in place.)
    b. Tighten the locking nut on the center tuning shaft with a wrench (hold the center head of the tuning rod in place with a wrench while tightening the locking nut – just needs to be snug)
    c. Tighten all cable connections to the cavity.

Notes

10. The Frequency and insertion loss adjustments interact.
    a. After changing the frequency, verify that the insertion loss is still correct, adjust if needed
    b. After changing the insertion loss, verify that the frequency is still correct, adjust if needed
11. It is recommended to keep the insertion loss of each loop equal, but the slope of the pass band can be leaned to the high or low side by setting the insertion loss of one side slightly different from the other.
    a. Very little difference is required to create a significant difference in the shape of the slope.

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