Piston Absorption Wavemeter

By G8MNY (Updated Mar 06)
(8 Bit Graphics use code page 437 or 850)

NEED

A Frequency counter of course will only read one parameter "the frequency of the strongest signal!

Using a scanner Rx to look for abnormal signals you can be lead astray, as it will have image & harmonic problems. Although a scanner check is very useful, but it can be..

a) difficult making sure it is not overloaded.

b) Seeing a signal at say +42.8MHz because your Scanner uses say a 21.4MHz IF.

At one time a simple abortion wavemeters like this used to be need for the Licence to check a Tx was inband & not Tx significant power outside the band or on its harmonics. e.g. all spurious < 1% power is > 20dB down.

Although absorption wavemeters are not spectrum analysers, they are able to detecting high levels (e.g. > -30dBc) of harmonics, unwanted mixer products, & not too "close in" side spurious.

FREQUENCY RANGE

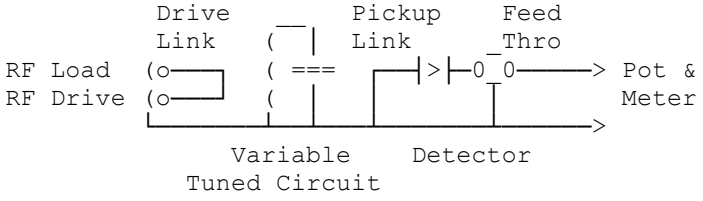
This ¼ wave line absorption wave meter can detect Tx frequencies from 70MHz to 1.3GHz in one range. With an accuracy of about 1%. At the higher frequencies 3/4 or 5/4 wavelength resonance modes also give good accuracy.

POWER

Powers of 100mW - 50W should be OK mainly limited by the diode PIV.

PRINCIPLE

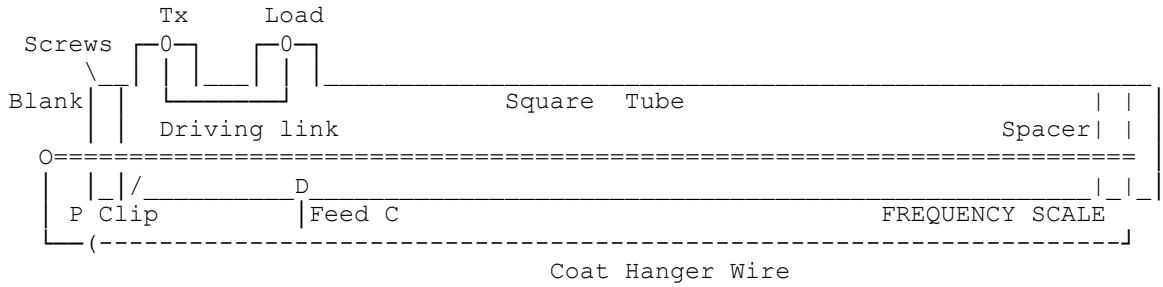
RF is coupled into a variable length ¼ wave resonator. At resonance a pickup loop drives a diode detector to give an indication to a meter. As the length is varied the exact position of the peak is indicated on a frequency (wavelength) scale.

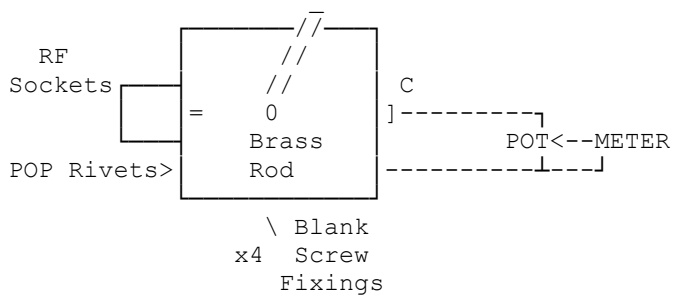


HARDWARE

1.1M of 25mm Square Aluminium tube.
1.1m of 3 to 5mm Brass rod.
x1 22x22x6mm or thicker Aluminium Blanks (off old heatsink?)
2x Chassis sockets N, SO239, or BNC's
4 Screws e.g. Steel 4BA/3mm Counter Sunk
8 pop rivets/Self tap screws
2cm of plastic support rod (heat glue stick)
Steel Wire (Coat hanger)
Clip to support Steel wire!
1x Signal diode e.g. 1N4148/914 or better.
10cm of 18-25swg enamelled copper wire
1x 1n feed through cap (bolt in type)

TOOLS
- Metal Saws
- Metal Files
- Needle Files
- Taps for screws
- Pop Rivet Gun (with tube collar!)
- Drill & bits for Screw tap & clearance
- Wire wool/sand paper
- Blow lamp / large heat source
- 70cm & 2M Tx for calibration





CONSTRUCTION

1/ Make an Aluminium blank at least 6mm think to closely fit inside the end of the tubing.
2/ Fit the blank, drilled 4 tapping sized holes one each side of the tube. Mark the blanks position & remove.
3/ Tap the blank to take the screws. Drill clearance holes in the tube.
4/ Centrally mark the bank. Drilled hole out & file (needle files) to be a tight sliding fit to the brass rod.
5/ Drill holes for the 2 RF sockets (pop rivet size/self tap) in the tube near to the blank as possible, with then as close to each other as possible.
6/ Solder a thick wire to make the Driving link on one of the sockets. Check that it clears the Brass rod OK. Pop rivet/screw in place in the LOAD position.
7/ Put the Tx Socket in place Pop rivet cut the link to length & solder up.
8/ Drill a hole for the bolt in feed through capacitor in the tube opposite to the load socket.
9/ Solder the signal diode with minimum lead to the capacitor. Then solder a wire to free end of the diode to make the detection loop.
10/Fit the capacitor making sure that all the bits will clear the brass rod.
11/File or saw a slot in the blank to ground the detector wire. Bare the end of the wire. The wire can be placed under a blank fixing screw if needed.
12/Place the blank & brass rod in place. Push the brass rod so it just protrudes from the tube open end. Cut the spacer plastic bar to neatly fit diagonally across the tube. Drill an undersized hole centrally on it. Heat the brass rod up & force into spacer. This should attach it OK. Otherwise glue it.
13/Bend up a coat hanger wire to make the frequency pointer. A few turns around the brass rod. clean up with wire wool & soldered up will attach it.

14/Put a small cable clip (folded P shaped type) as a guide around the sliding wire & use a blank fixing screw & washer to hold firmly in place.
15/Attach a sensitive meter (& a pot) to the detector O/P & connect some RF. If moving the rod you can see a peak, then you can do the calibration.

CALIBRATION
Two frequencies are needed for this as the electrical end point will not be the same as the brass rod's physical end (usually outside the tube!).

Reference
Infinity point 432MHz 144MHz

The distance between 432 & 144MHz marks is exactly 2x the distance from the Reference scale infinity to 432. Note 432MHz will also produce resonance around the 144MHz mark as a 3/4 wave resonance. Ignore the longer resonances for now.

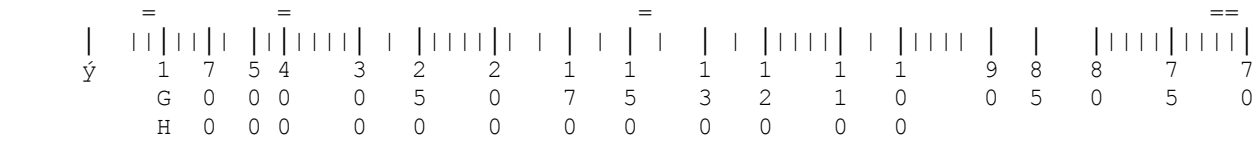
$$\text{End point from 432 Mark} \quad D432 = \frac{\text{(144-432 marks mm)}}{2} \text{ mm}$$

So place a length light coloured tape under the coat hanger pointer & mark off all the known frequency lines you can. Accurately measure these & put into a chart (eg a spread sheet) to calculate the length of any frequency.

$$\text{Distance from End point for Fx MHz} \quad DFx = \frac{D432 * 432}{Fx} \text{ mm}$$

So using just 2M & 70cms markers it is quiet easy to extrapolate the full scale.

Now make a scale chart for 70,75,80,85 90,95,100,110,120,130,140,150,160,170, 200,250,300 400 500 600 700 800 900 1000MHz
1.1, 1.2, 1.3 GHz. Note the high frequencies a very close together & suitable marking are difficult.



wave scale sets if you want to add those in further calibration scales.

IN USE
I high lighted the ham bands (=) in coloured felt pen. You should find that they show up as quite wide bands, as 2MHz of 2M is 1cm long. So if you have been accurate in the scale marking, basic frequency measurement down to about 1% quite possible.

Why Don't U send an interesting bul?

73 de John G8MNY @ GB7CIP