CHEAP Microwave Filters

By: Kent Britain

WA5VJB

These filters are for our 3, 5, and 10 GHz ham bands. The design is based on the filters used in the DJ6EP 5760 MHz Xverter.

When I first saw these filters used in the DJ6EP transverter I thought; Wow, how neat and simple! But Roman's design used Teflon P.C. board and small pins through 50 Ohm stripline for coupling. The next trick was to find a simple way of putting them together with commonly available materials. I ended up using 1/2", 3/4", and 1" Copper plumbing end caps sweat soldered onto common PC board.

First I've built a bunch of these filters, and they all worked. Next I built several with intentional errors, lots of sloppy solder, misaligned probes, unequal probes, off center tuning screws, etc. Loss went up a bit on a few of them, but they all WORKED! These guys are very forgiving!

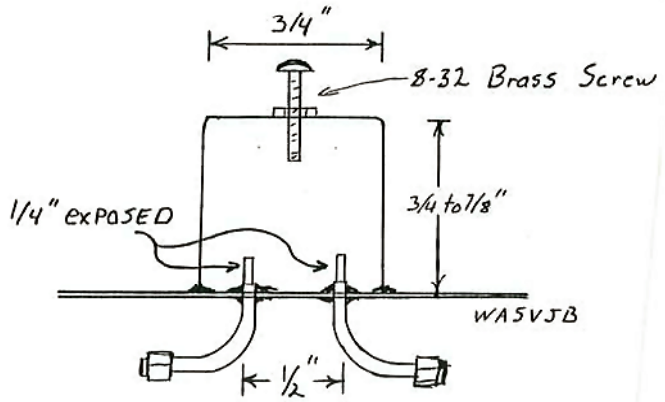
The length of the probe determines the coupling and therefore the Q of the filter. Keep the probes as short as you can, consistent with how much loss you can stand in your system. I did build some multi-stage versions to get a tighter bandwith. But it really wasn't worth effort, just use shorter probes.

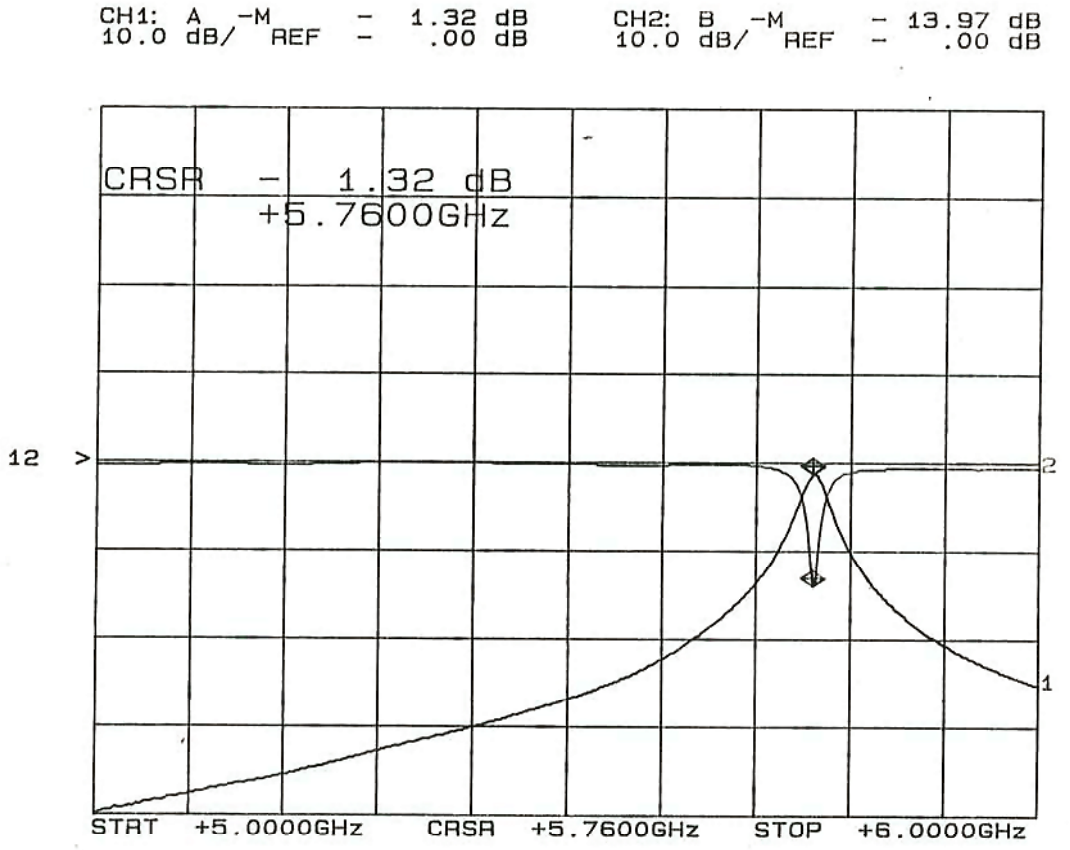
You can drill and tap the hole for the tuning screw, but I found it much easier to drill a slightly undersized hole and just force a steel screw (same thread size) through. The locking nut is tightened down after you have everything tuned.

5760 MHz 3/4" FILTER

WA5VJB

This was one of the filters I was fortunate to get plotted on some really fancy equipment. I didn't get an opportunity to build a family of these filters before the proceedings deadline, but my first try seems to have done pretty well. Again a 5760 MHz transverter using a 144 MHz I.F. would have about 20 dB rejection of the L.O. and almost 30 dB image rejection with less insertion loss than the 1" filter.





3456 MHz FILTER

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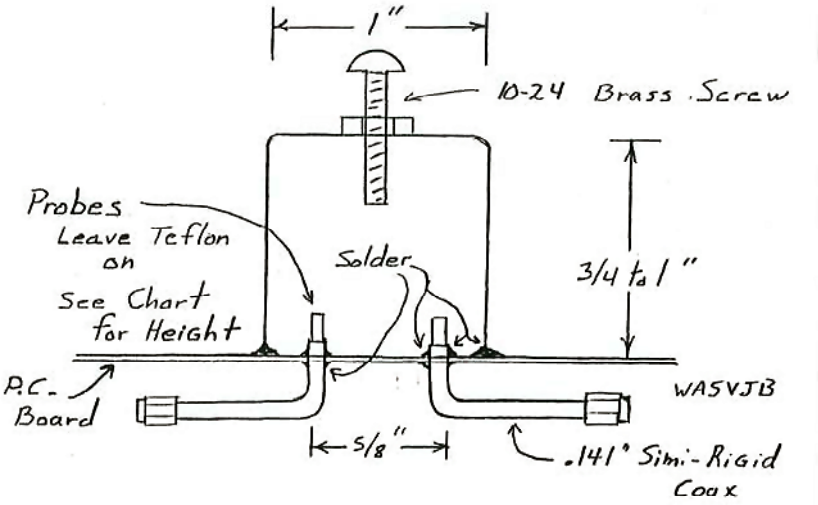
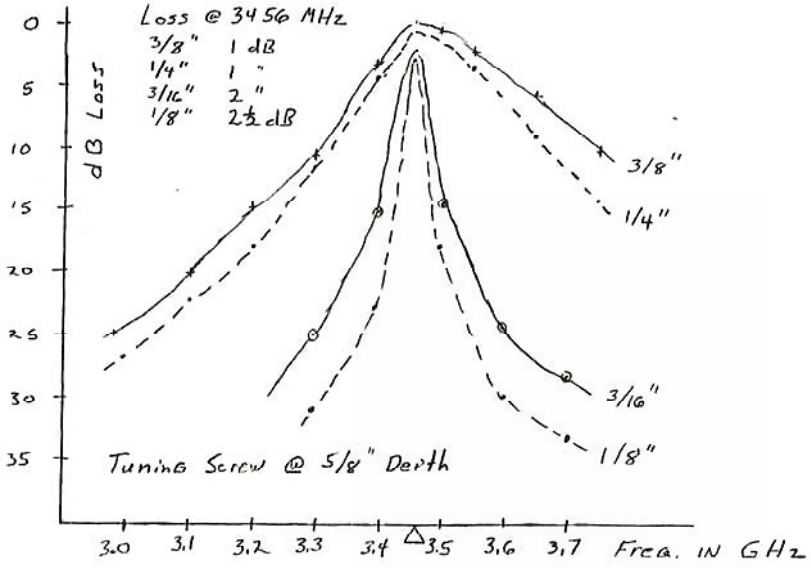
The 3456 MHz version is based on a 1" Copper plumbing end cap. The hollow filter resonates between 6 and 7 GHz. The tuning screw pulls the filter down to 3.4 GHz at a depth of about 5/8"



These plots were made using my HP-616A Signal Generator and HP-415B indicator, and they give a pretty good idea of the shape of these filters. In a 3456 MHz station using a 144 MHz I.F., a filter using 3/16" probes would give 25 dB rejection of the L.O. and better than 30 dB rejection of the image with 2 dB of loss.

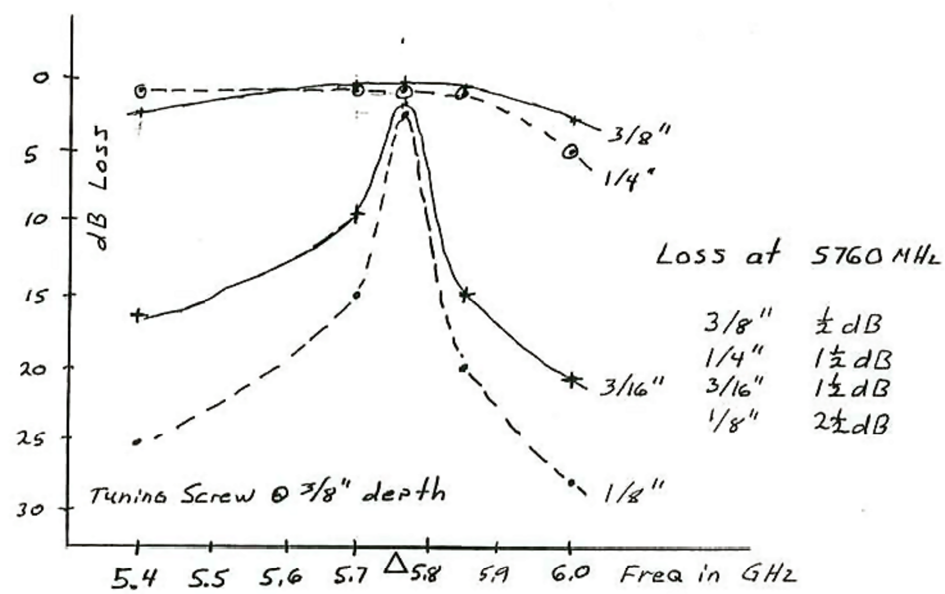


5760 MHz 1" FILTER

WA5VJB

The 1" filters will also tune 5760 MHz with the tuning screw set at about 3/8" into the cavity. The plots below were made using my HP-614A signal generator driving a passive tripler and bandpass filter into a HP-415B indicator. Again a pretty good idea of the characteristics of these filters emerge.

With a 1/8" long probe, a 5760 MHz transverter would see about 20 dB rejection of the L.O. and almost 30 dB rejection of the image when using 144 MHz I.F.'s.

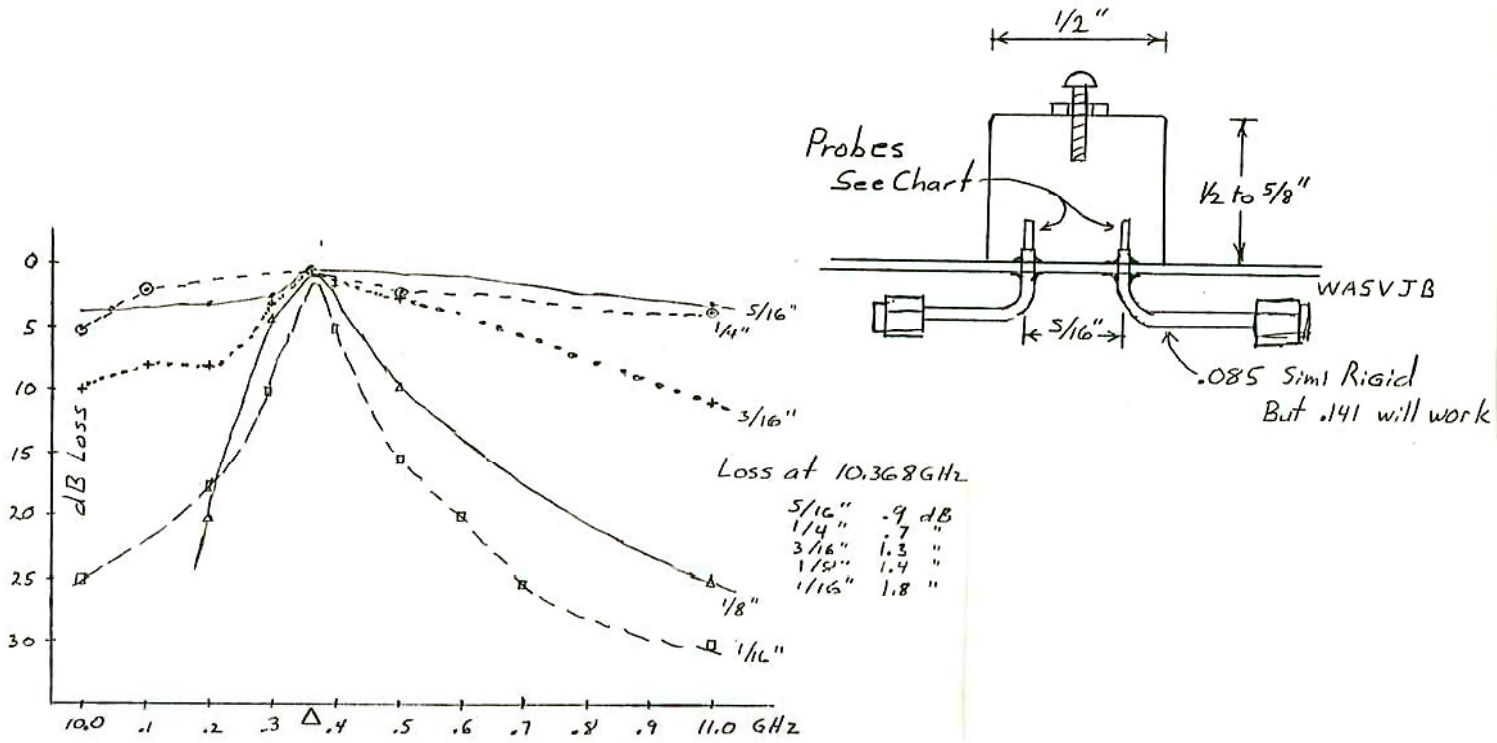


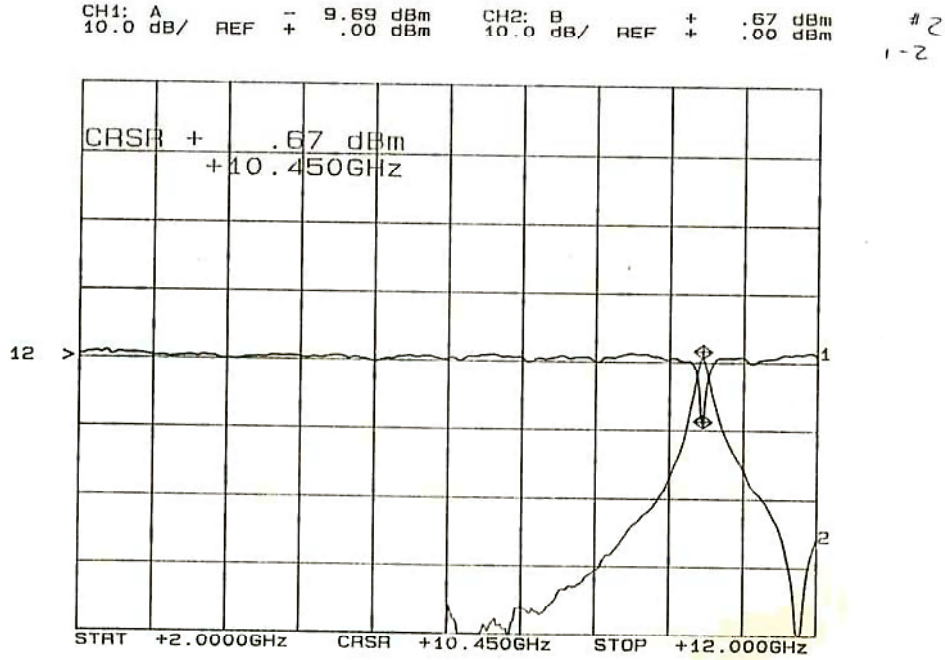
10 GHz Filter

WA5VJB

When I first started building these probe coupled filters, they were used at 10.368 GHz. If you can dig up some .085" simi-rigid coax, it's much easier to use than the larger .141", but both sizes work. The filter resonates somewhere between 11.5 and 12 GHz, so while digging through the bins at your hardware store, look for the longer end caps. The longer ones will have slightly lower loss, but it's not worth driving around town. I did try replacing the brass tuning screw with a steel screw on the 1/8" filter, loss went up from 1.3 to 2.0 dB.

The fancy plot shows a filter plotted from 2 to 12 GHz.





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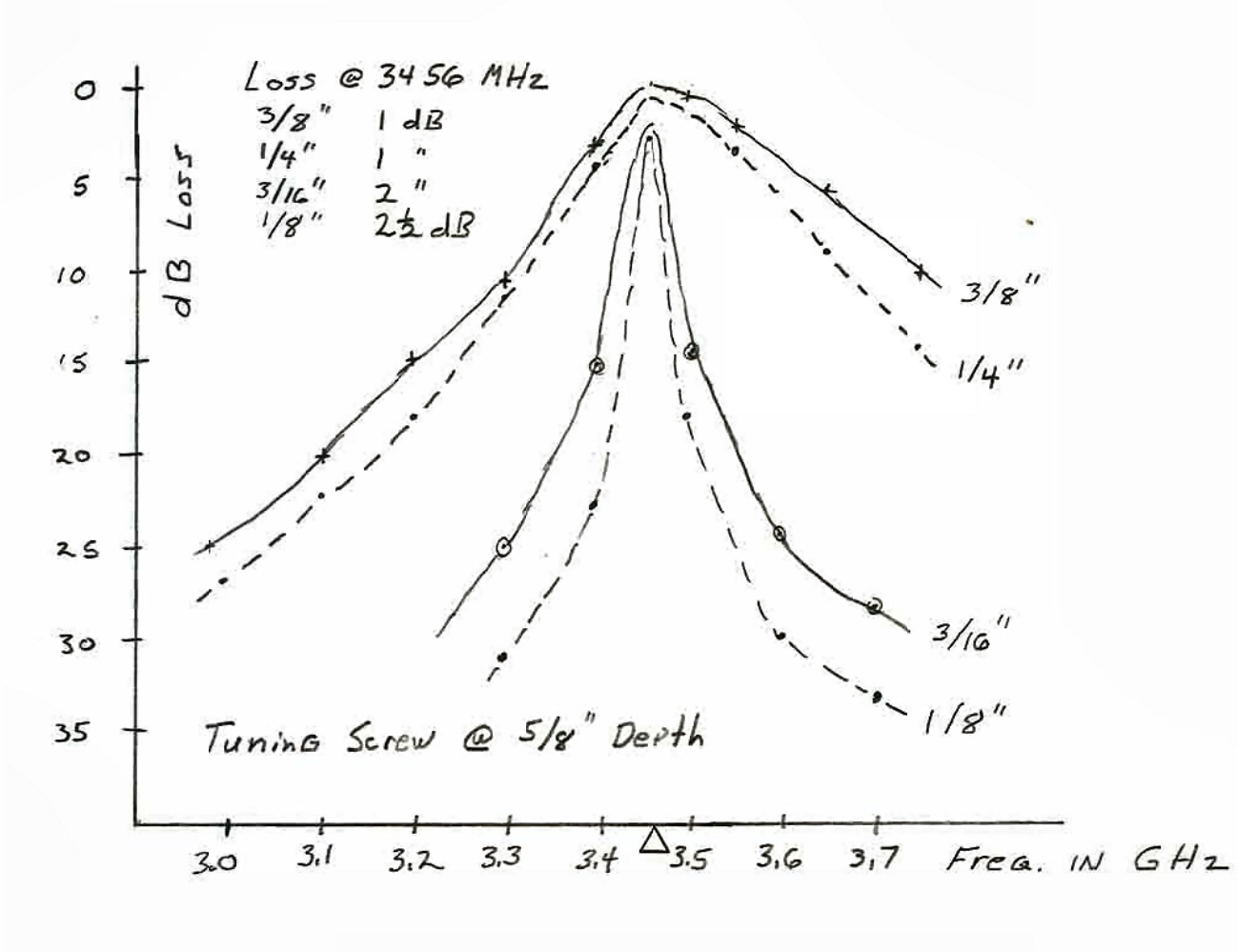
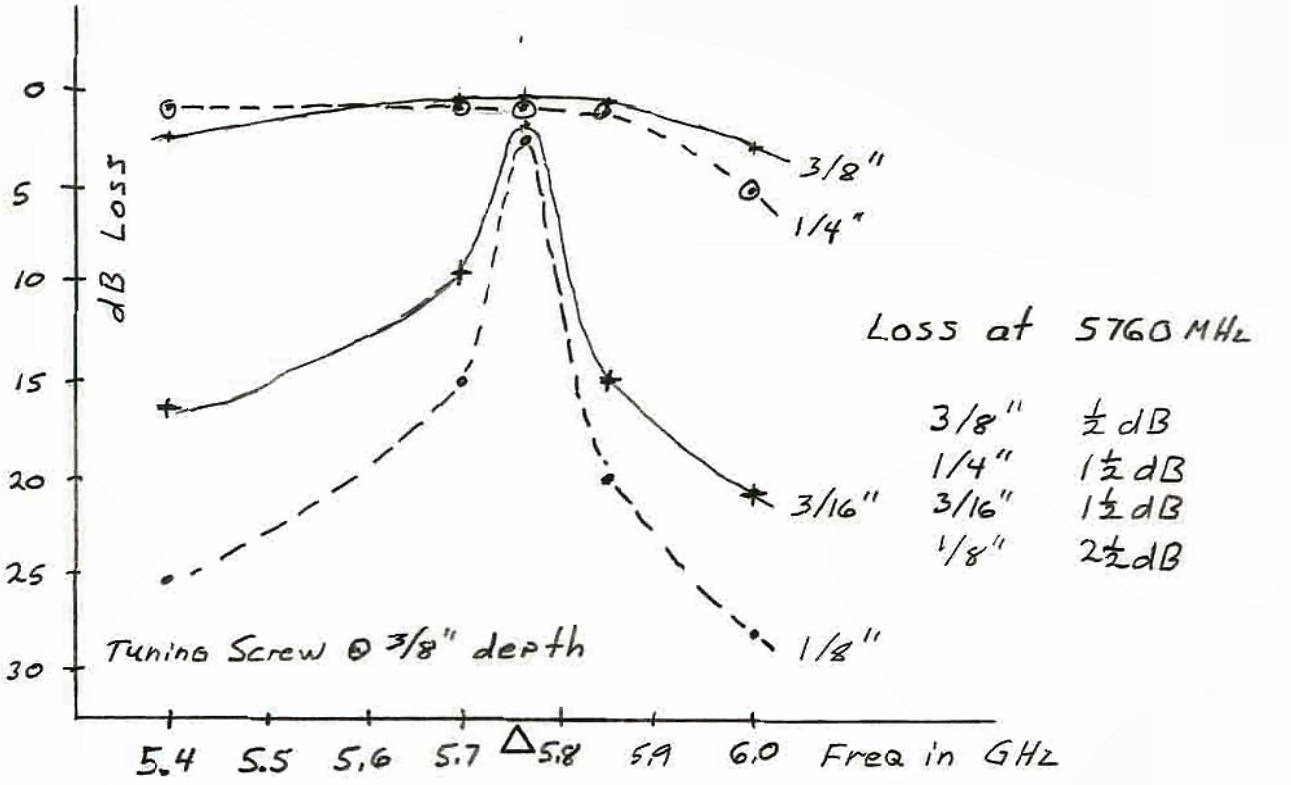
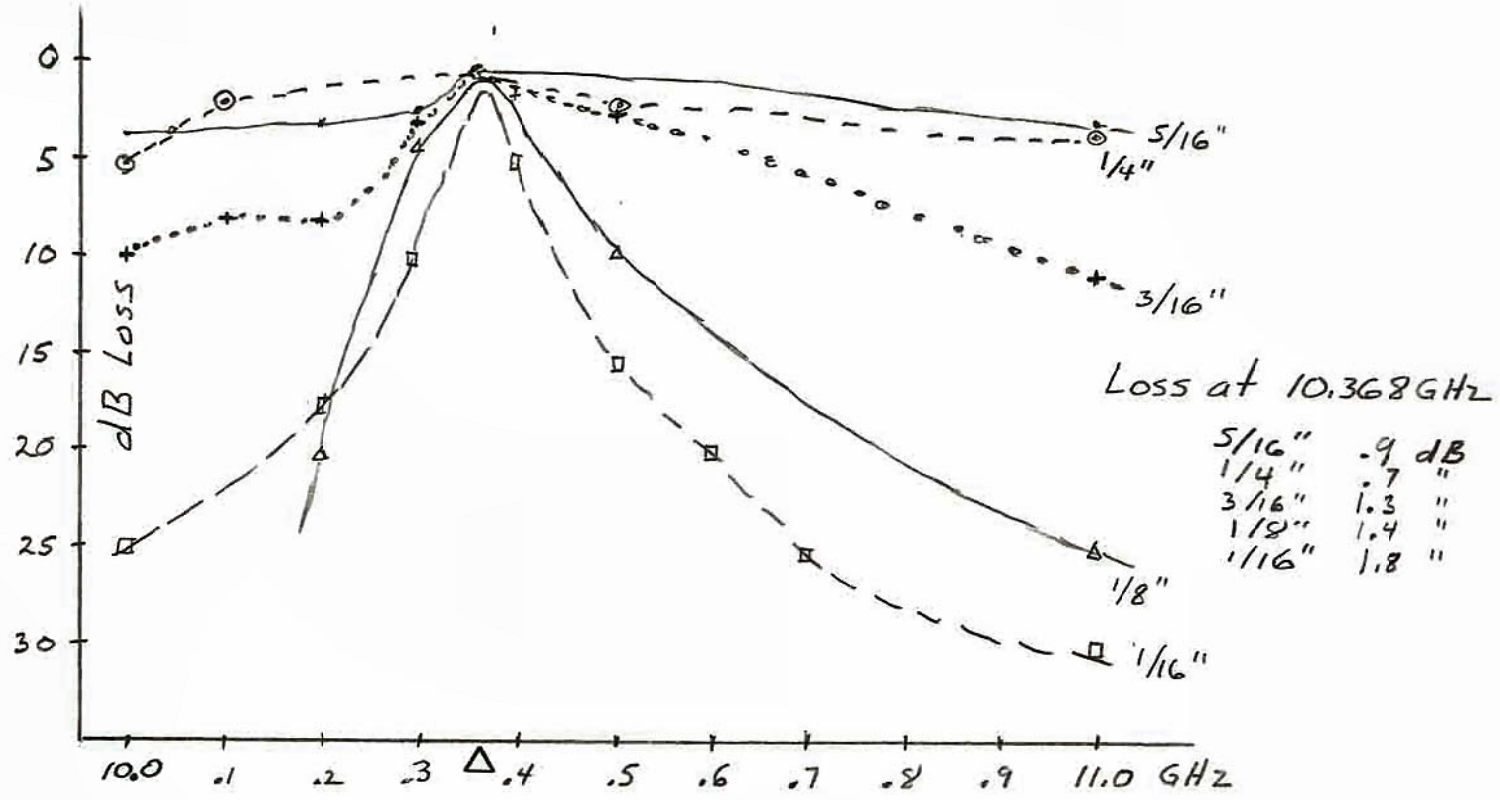

Loss @ 3456 MHz
3/8" 1 dB
1/4" 1 "
3/16" 2 "
1/8" 2½ dB
dB Loss
0
5
10
15
20
25
30
35
3/8"
1/4"
3/16"
1/8"
Tuning Screw @ 5/8" Depth
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
Freq. IN GHz


0
5
10
15
20
25
30
dB Loss
3/8"
1/4"
3/16"
1/8"
Tuning Screw @ 3/8" depth
5.4
5.5
5.6
5.7
5.8
5.9
6.0
Freq in GHz
Loss at 5760 MHz
3/8" ½ dB
1/4" 1½ dB
3/16" 1½ dB
1/8" 2½ dB


0
5
10
15
20
25
30
dB Loss
5/16"
1/4"
3/16"
1/8"
1/16"
10.0
.1
.2
.3
.4
.5
.6
.7
.8
.9
11.0 GHz
Loss at 10.368 GHz
5/16" .9 dB
1/4" .7 "
3/16" 1.3 "
1/8" 1.4 "
1/16" 1.8 "