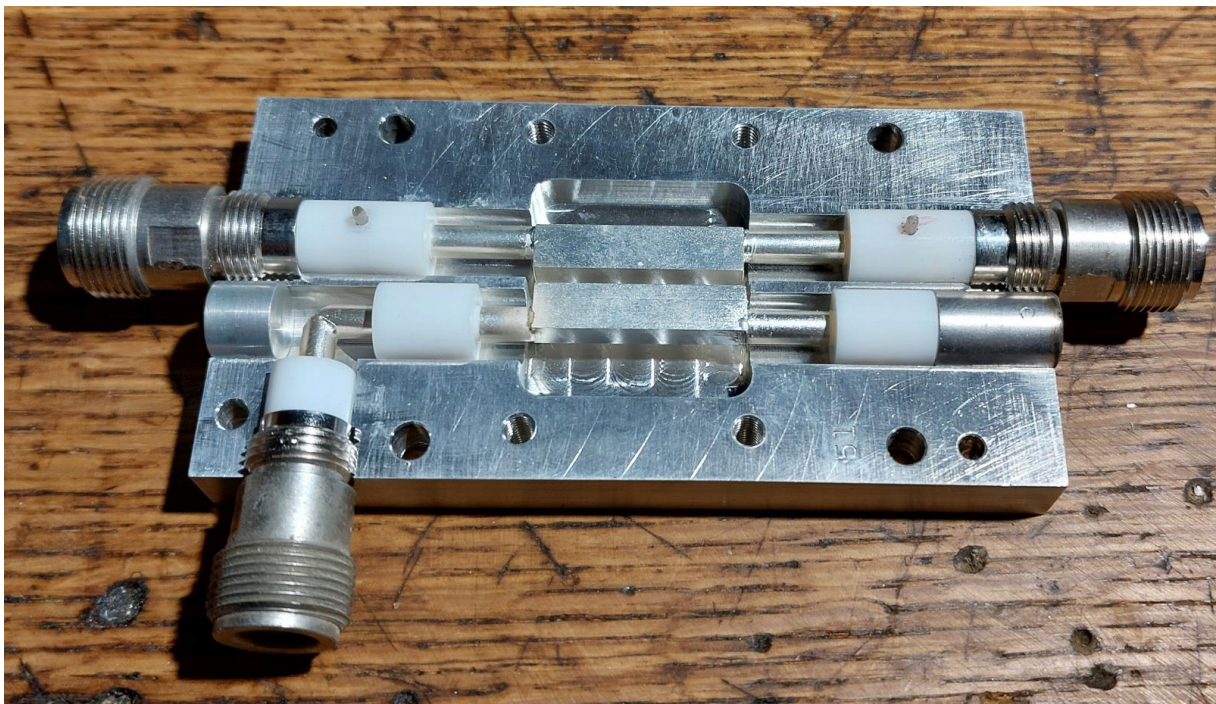
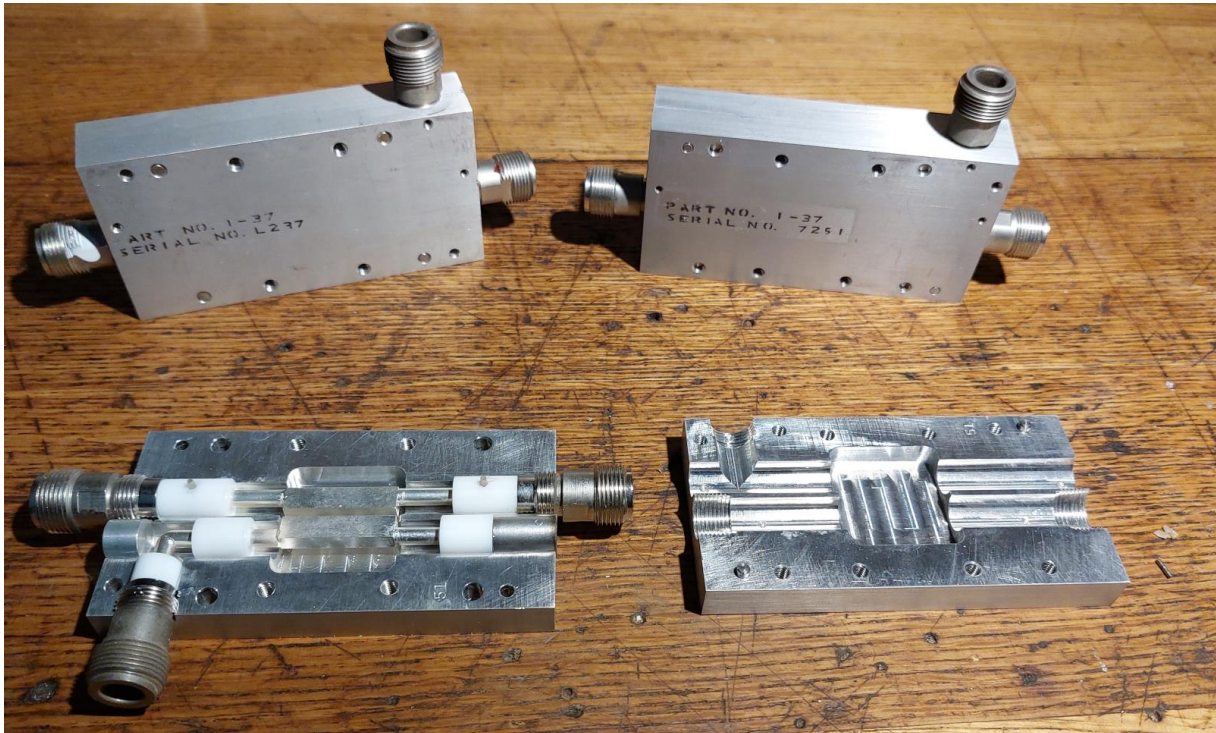
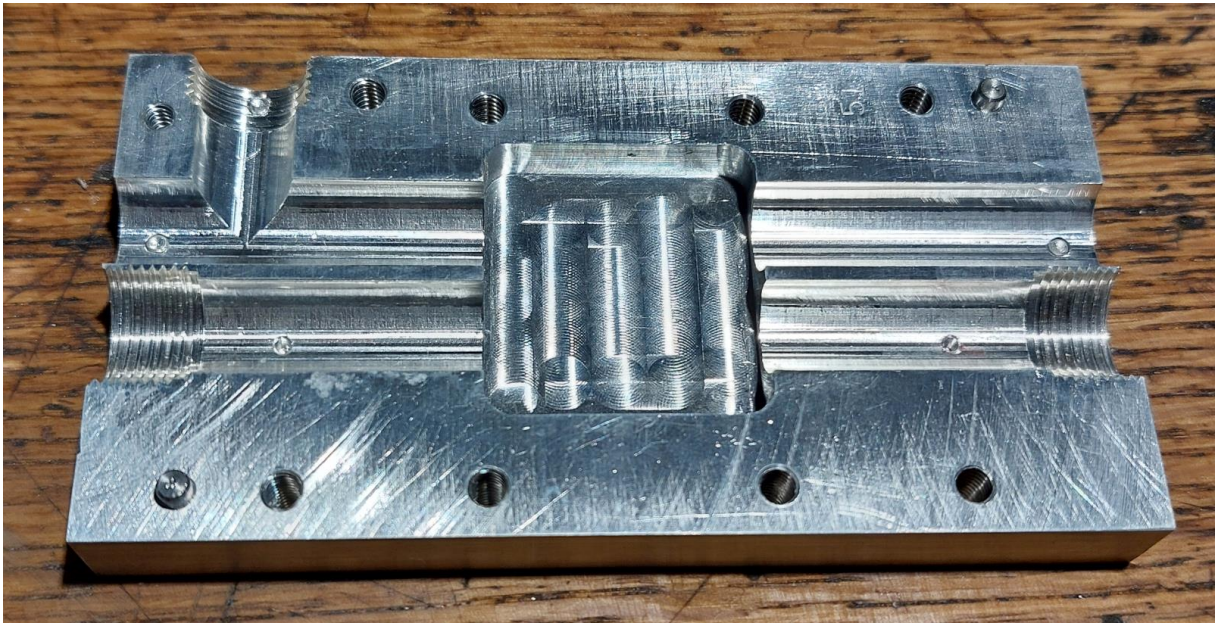
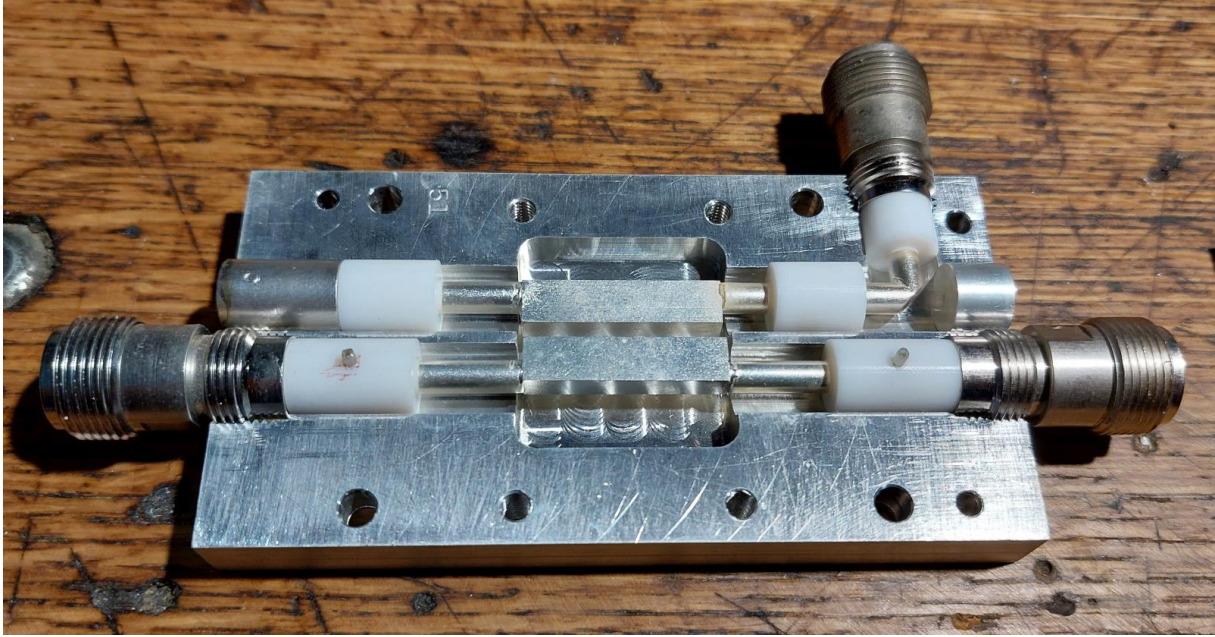


Evaluation of unknown unidirectional coupler **in the 2m up to 13cm bands**

Matthias, DD1US, May 1st 2024, Rev 1.0

Cleaning out some older boxes I found three directional couplers which I had not yet tested. There is no company logo or name on it, only a part number which is 1-37 for all of them. In addition, each coupler has a unique serial number. The couplers are in a solid milled aluminum encasing with N-jacks used for all three ports. I have no data and thus I decided to open one of them to have a closer look inside.



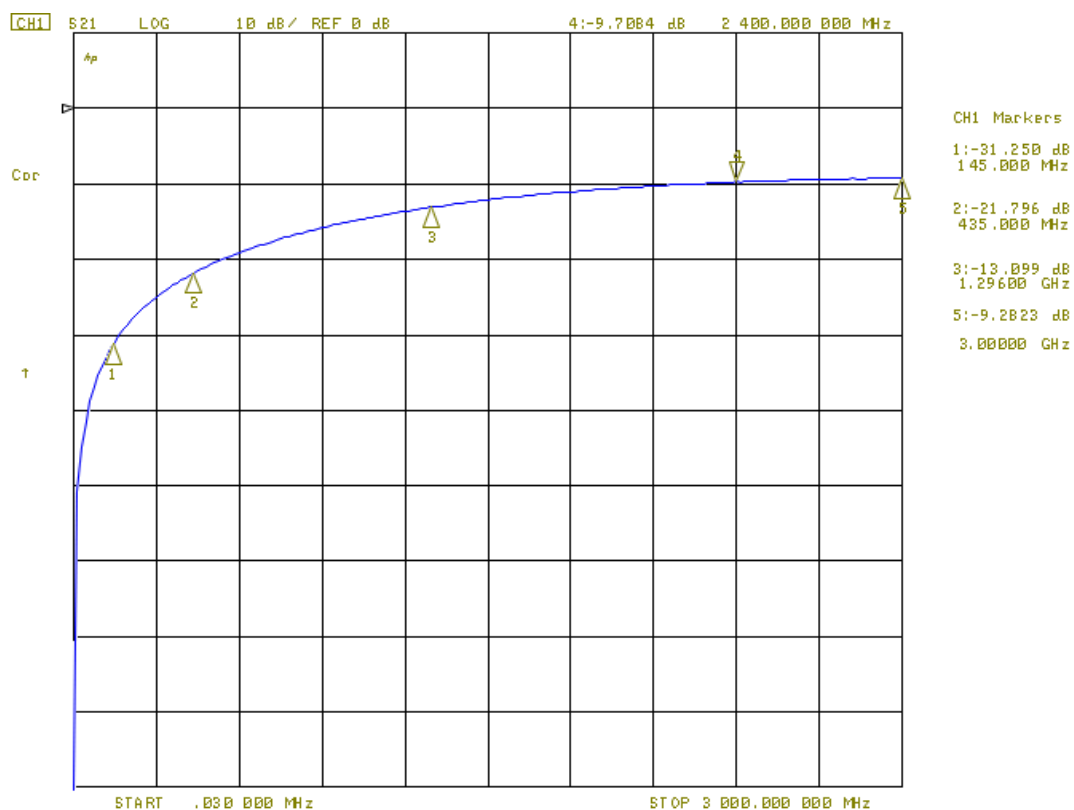
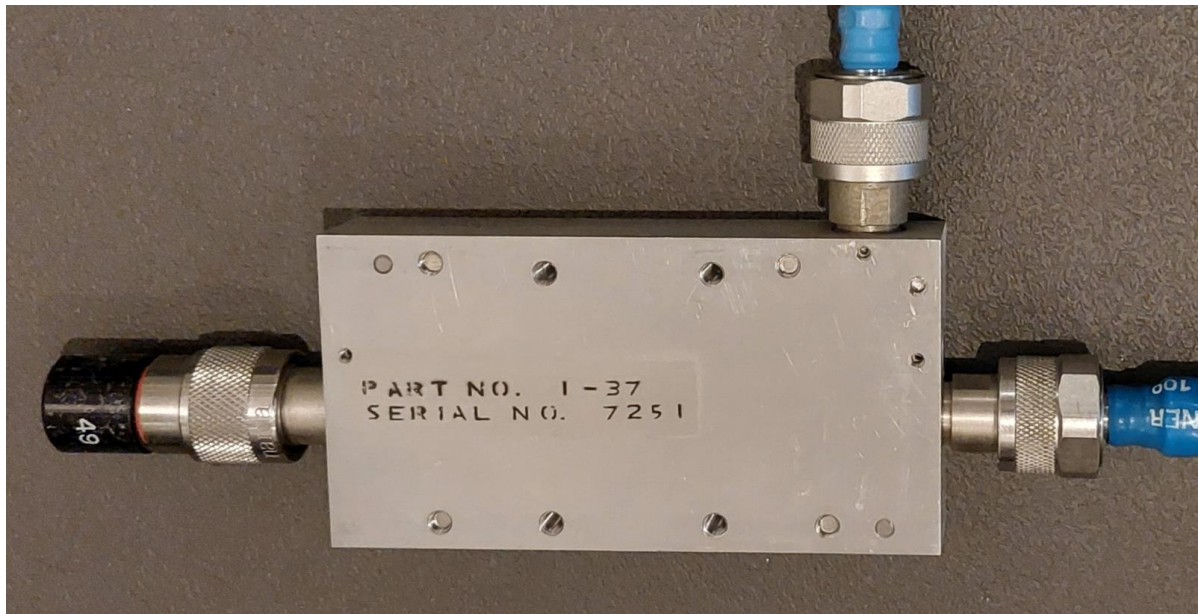


The inside of the coupler looks very professionally made. All parts fit tightly in the milled-out cavities and there are dowel pins which make sure that everything fits perfectly during assembly.

There is a 50Ω termination in a metal cylinder which is completely clamped in the milled aluminum housing. I do not know what the maximum power of this termination is but the thermal resistance to the encasing and a possible additional heatsink is certainly very low.

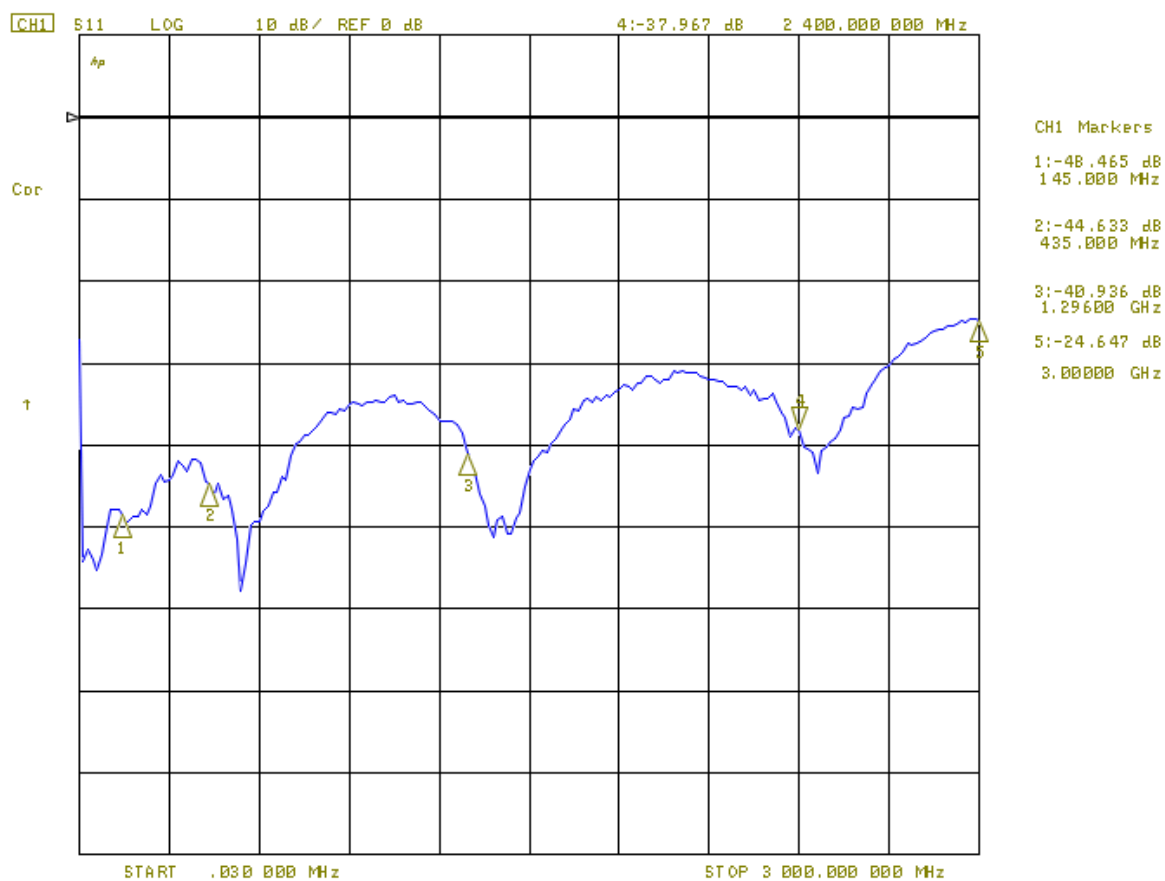
I measured the S-parameters of the coupler in the frequency range 0 to 3GHz.

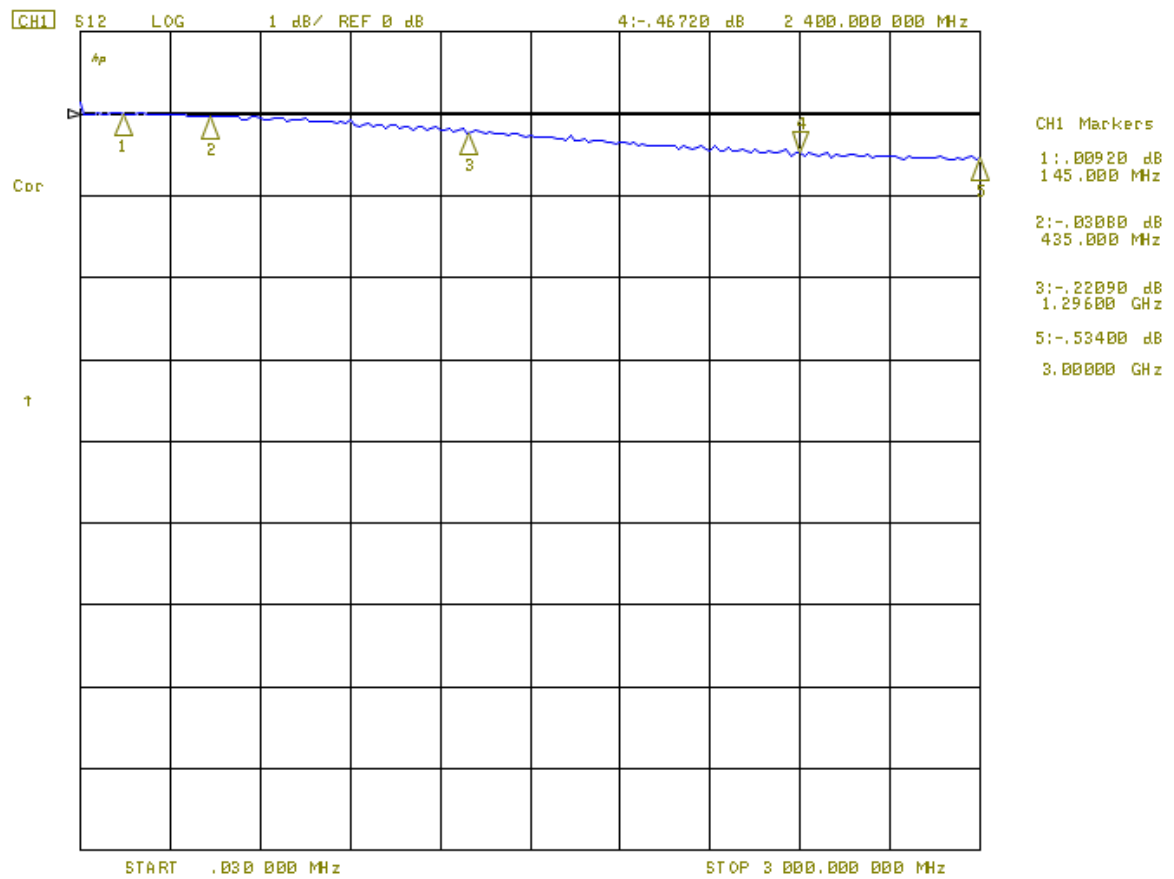
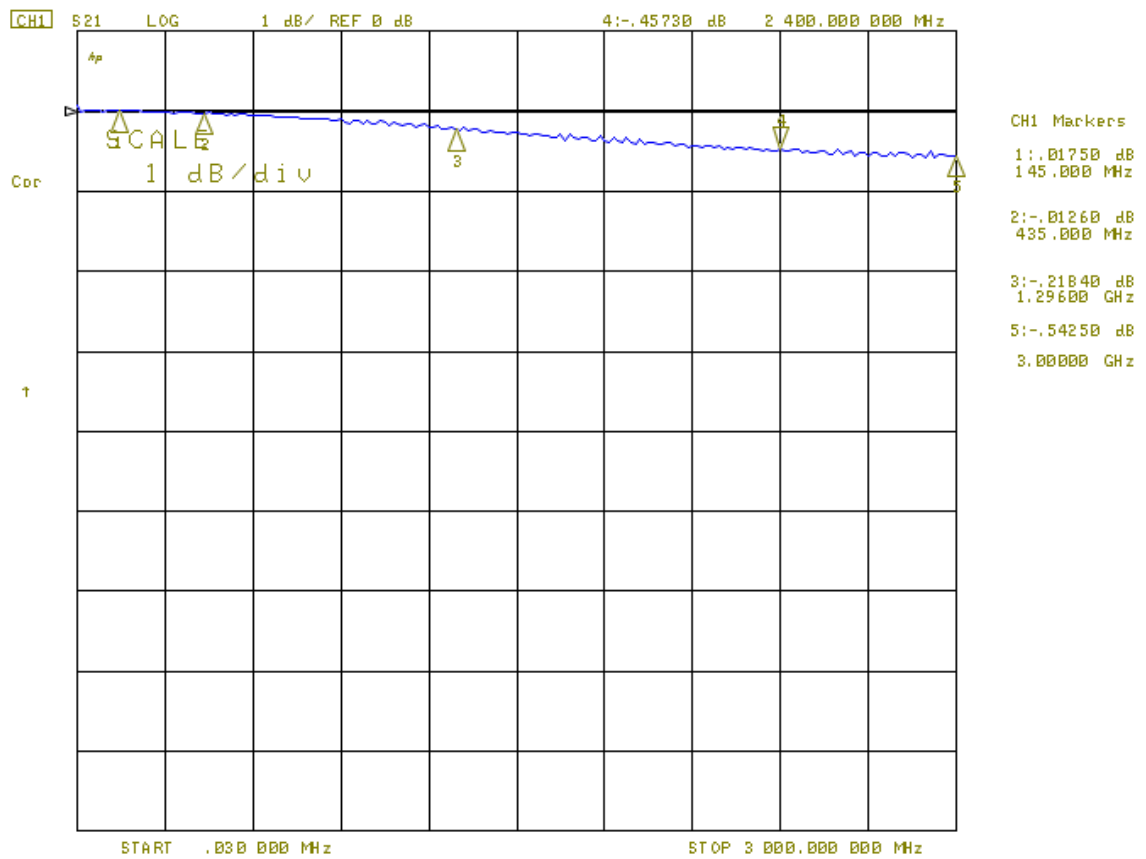
First, I measured the coupling factor by injecting a signal at the input port (right) and measuring the signal level at the coupling port (top). The output port was terminated with 50Ω during this measurement.

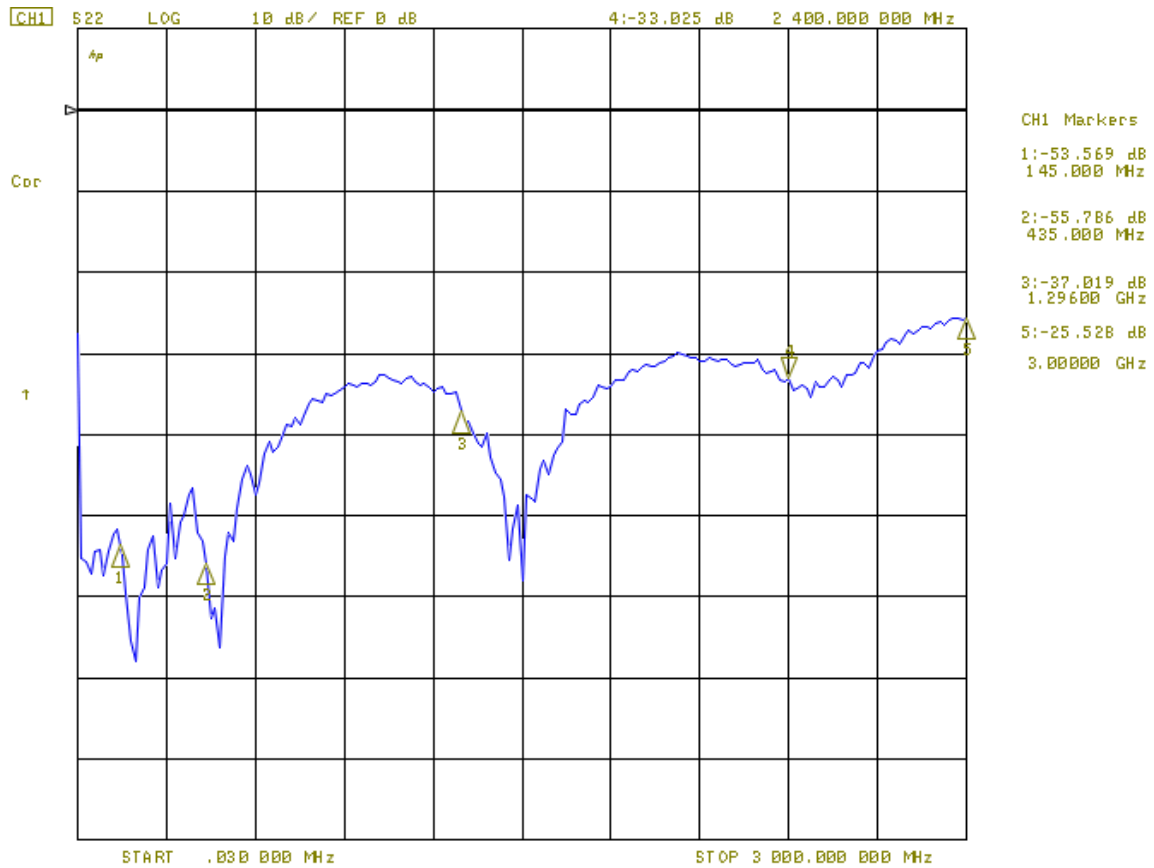


The coupling factor is highly frequency dependent: 31.3dB@145Mhz, 21.8dB@435Mhz, 13.1dB@1296Mhz, 9.7dB@2400MHz

Next, I measured all S-parameter of the path from the output (left) to the input (right) of the coupler with the coupling port (top) terminated with 50Ω.

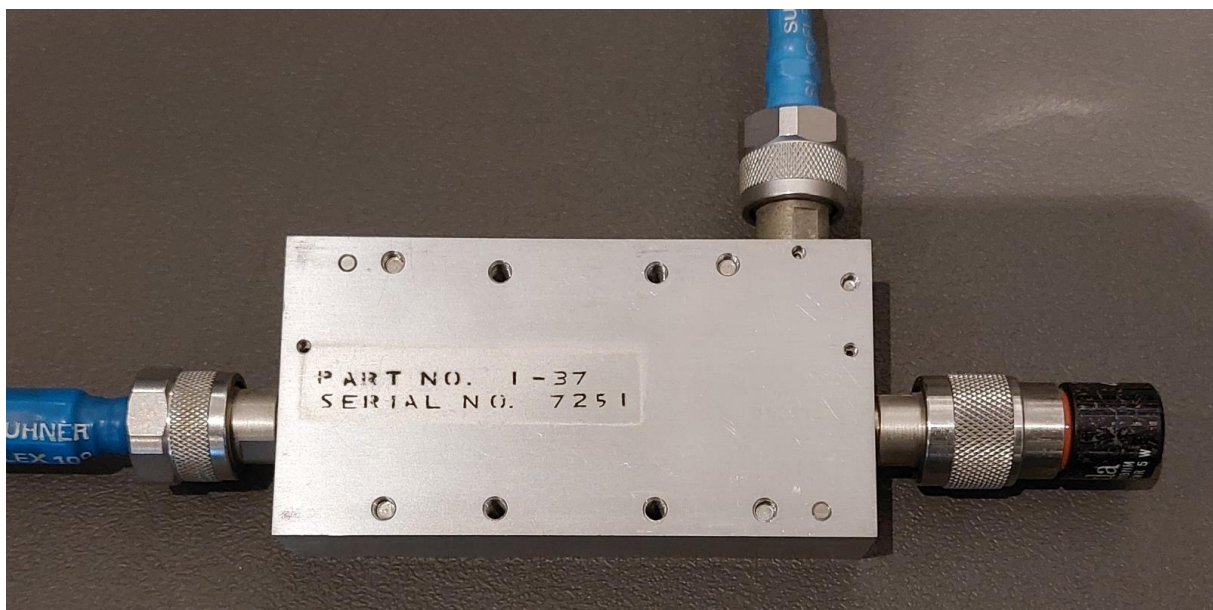


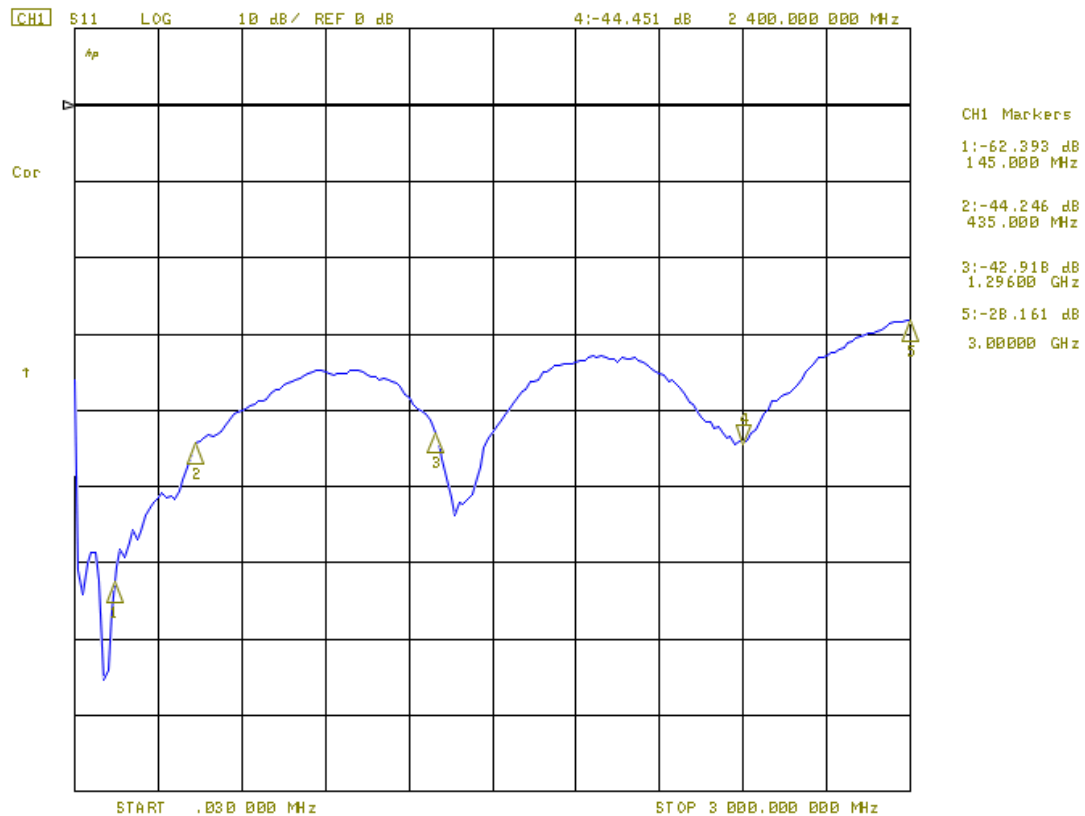




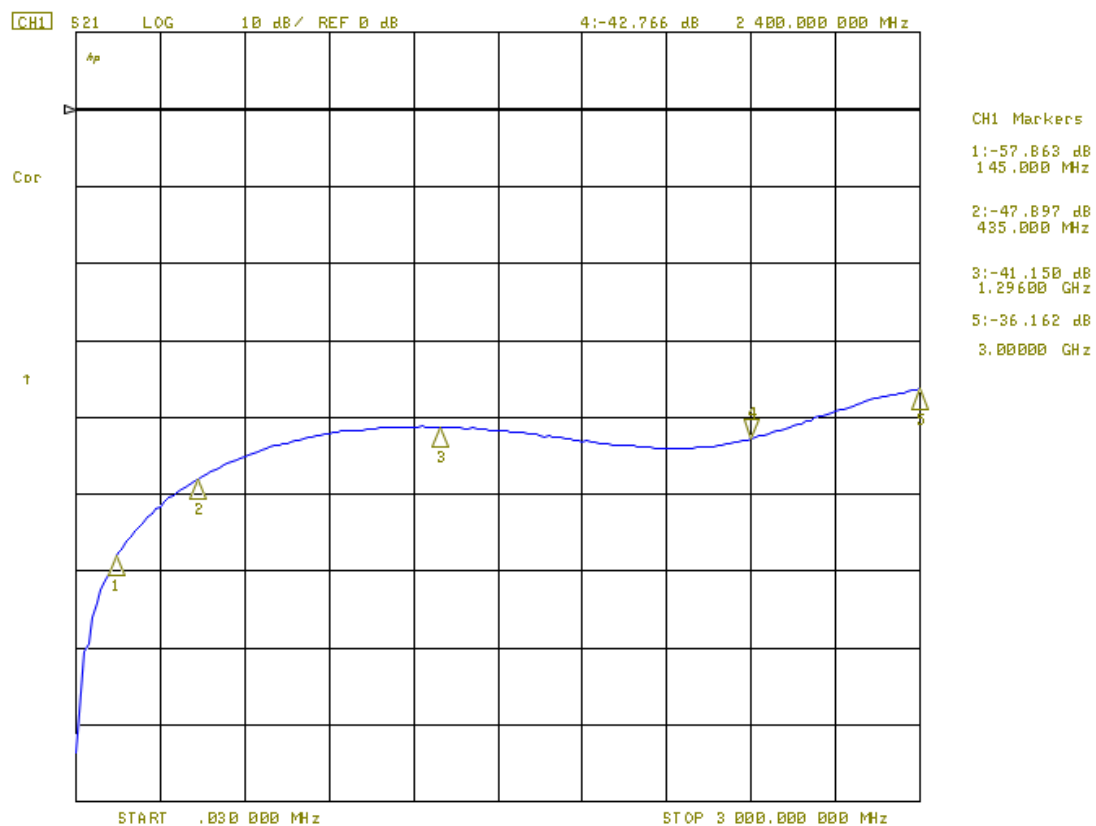
Input and output return loss is better than 30dB in the frequency range up to 2.7GHz. Insertion loss S21 and S12 is below 0.5dB in the frequency range up to 2.4GHz. Most of the increase of the insertion loss at higher frequencies is due to the lower coupling factor. At 2.4GHz this directional coupler has a coupling factor of 10dB which means that 10% of the signal gets coupled to the coupling port and only 90% of the signal reaches the output port. This 90% corresponds to an insertion loss of 0.46dB which is pretty much what was measured.

Finally, I measured the path from the output port (left) to the coupling port (top) with the input port (right) terminated with 50Ω.

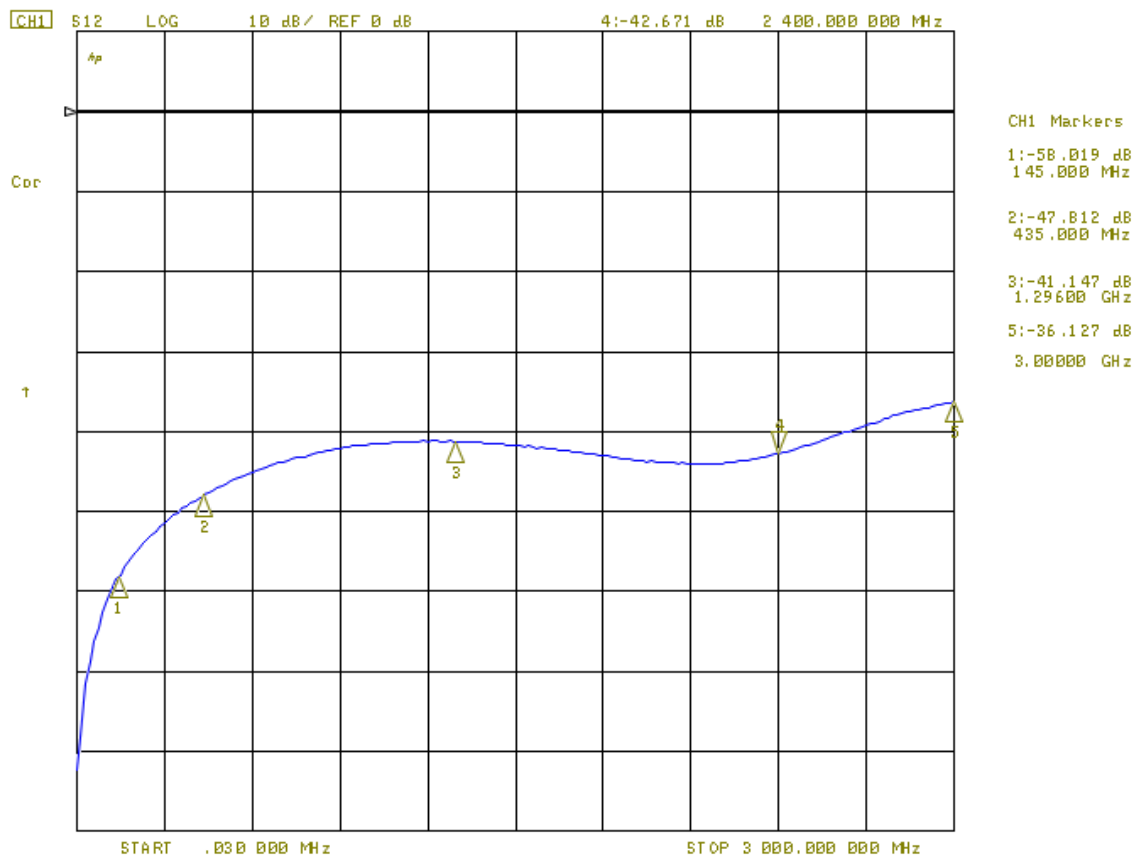




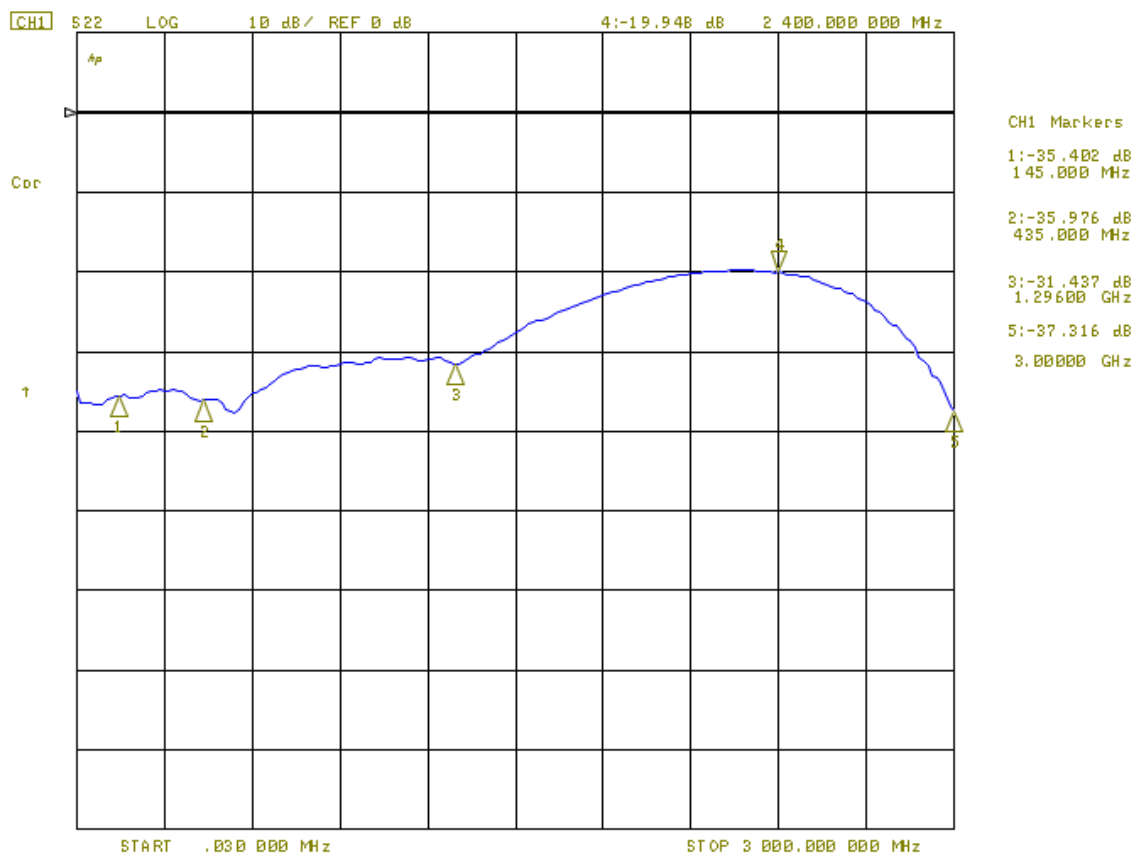
As to be expected output matching is again better than 30dB up to 2.7GHz.



S21 shows how much power gets to the coupling port when a signal is coming from the output port. This is an indication of the directivity. Actually, directivity is calculated by subtracting the coupling factor from this value and will be shown later. The simple subtraction is possible due to the logarithmic measurement scale (in dB).

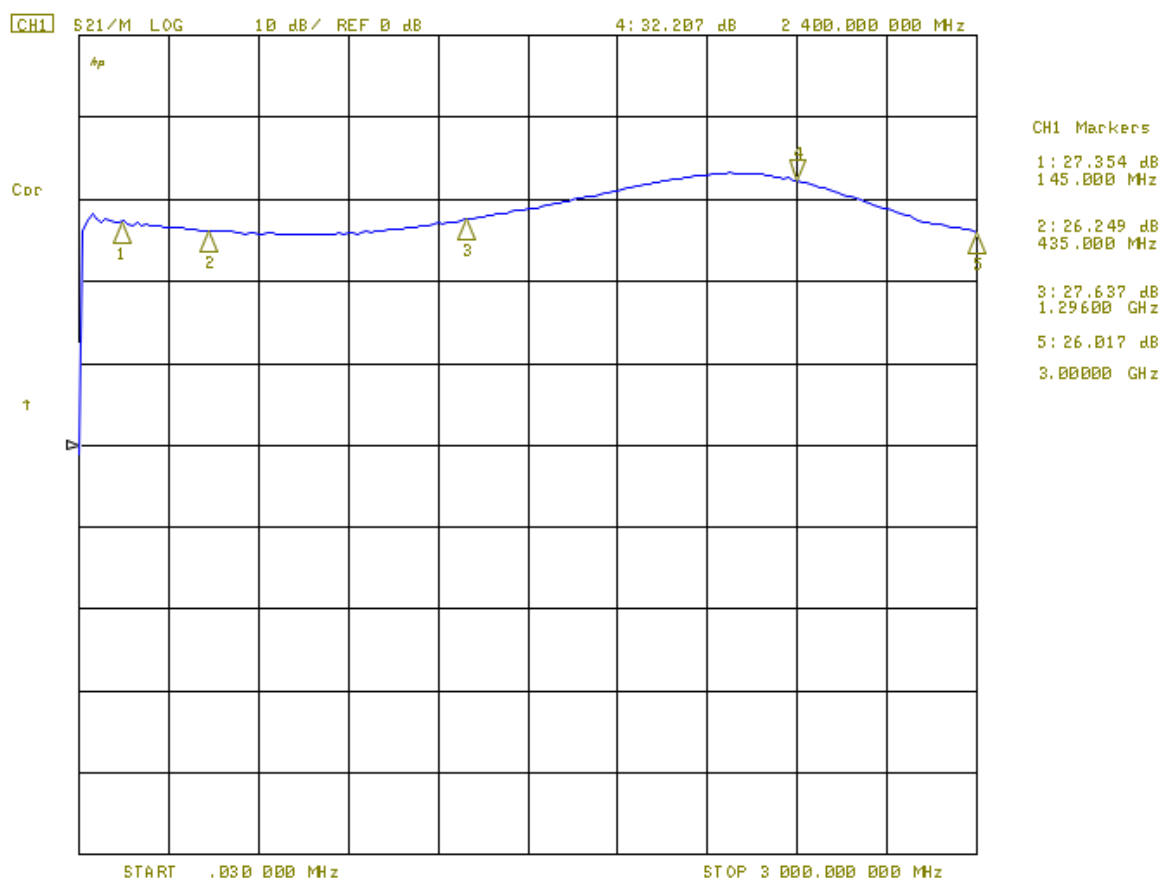


As to be expected S12 is almost identical to S21.



S22 shows how well the coupling port is matched to 50Ω. The return loss is better than 20dB in the full frequency range.

The final graph shows the directivity of the directional coupler which is the difference of the coupling factor to the coupling port when injecting a signal at the output port versus injecting a signal the input port.



The directivity is better than 26dB in all Amateur frequency bands from 2m up to 13cm.

Due to the professional construction of these couplers the insertion loss and the coupling factor are amazingly identical at all three units which I evaluated. Here is a corresponding table.

#L237				
f/MHz	IL/dB	Coupling/dB	Return/dB	Directivity/dB
145	0.015	31.4	60.9	29.5
435	0.02	21.9	49.8	27.9
1296	0.2	13.2	46.1	32.9
2400	0.45	9	41.2	32.2
#774A				
f/MHz	IL/dB	Coupling/dB	Return/dB	Directivity/dB
145	0.01	31.4	62.6	31.2
435	0.018	21.9	51.4	29.5
1296	0.23	13.2	48.4	35.2
2400	0.46	9	45.7	36.7
#7251				
f/MHz	IL/dB	Coupling/dB	Return/dB	Directivity/dB
145	0.01	31.3	58.1	26.8
435	0.01	21.8	48	26.2
1296	0.23	13.1	40.8	27.7
2400	0.49	9.7	42.8	33.1

In summary these are excellent directional couplers for the frequency range 2m up to 13cm especially if the coupler is used in only one of the bands or if the variable coupling factor can be calibrated out.

I wonder from which vendor these couplers are. If you have any idea, please let me know.

Also, I am always grateful to get feedback and will be happy to answer questions.

Please direct them to the Email address which you will find below.

Best regards

Matthias DD1US

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