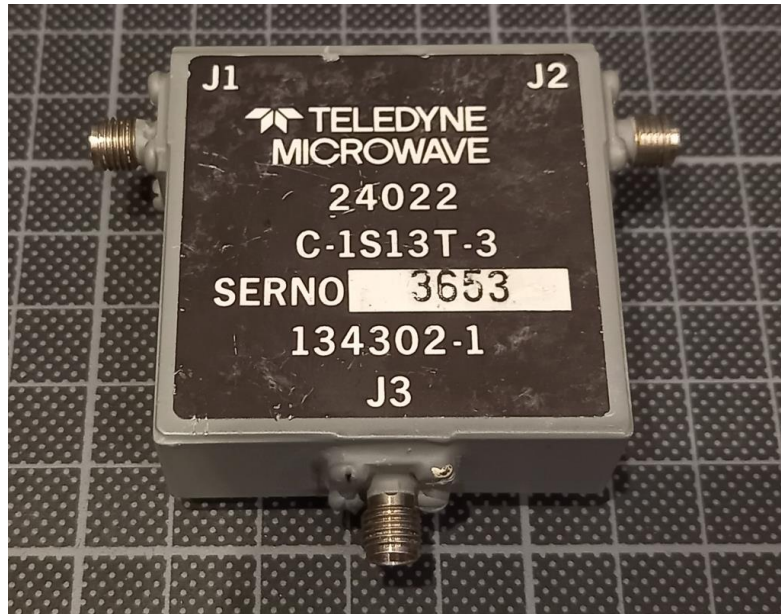


Retuning Circulator Teledyne C-1S13T-3 to 868MHz

February 5th 2023, Matthias, DD1US

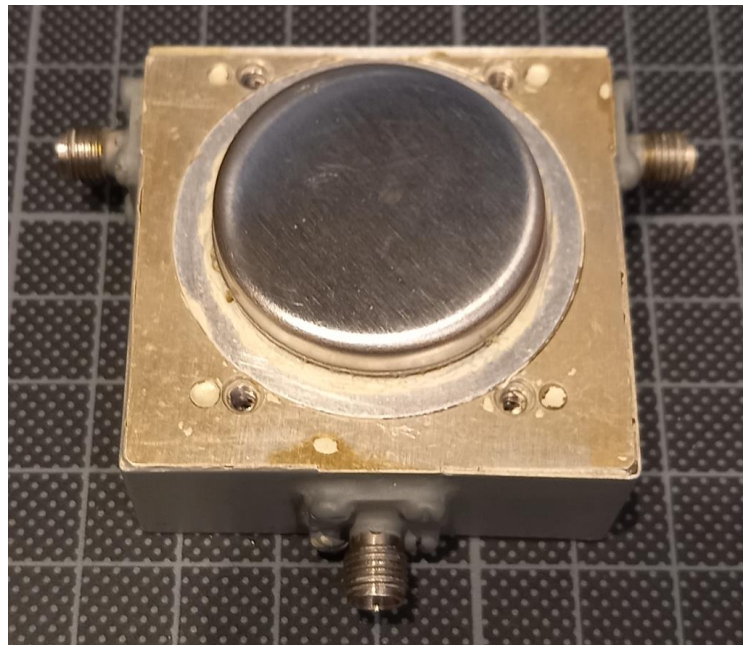
Hello,

Recently I needed a circulator for some tests at 868MHz. As I did not have one at hands but found one for the frequency range 950-1150MHz, I decided to try to retune it. The device I had was a Teledyne C-1S13T-3 with a specified isolation of 20dB. Here is a picture of the circulator:

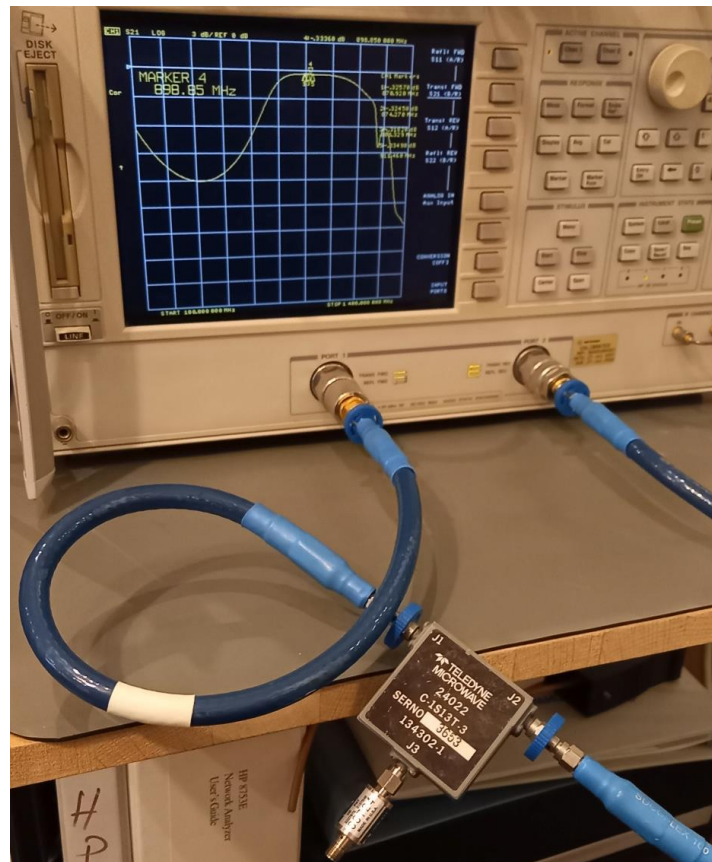


All 3 ports of the circulator have SMA jacks.

As the unit is hermetically sealed, I tried to retune it by bringing various magnets close to its broadsides. Finally, I found a suitable magnet shifting the frequency down towards 868MHz and I glued it to the bottom of the device. Here is a picture of the magnet, which has a stainless-steel cover:

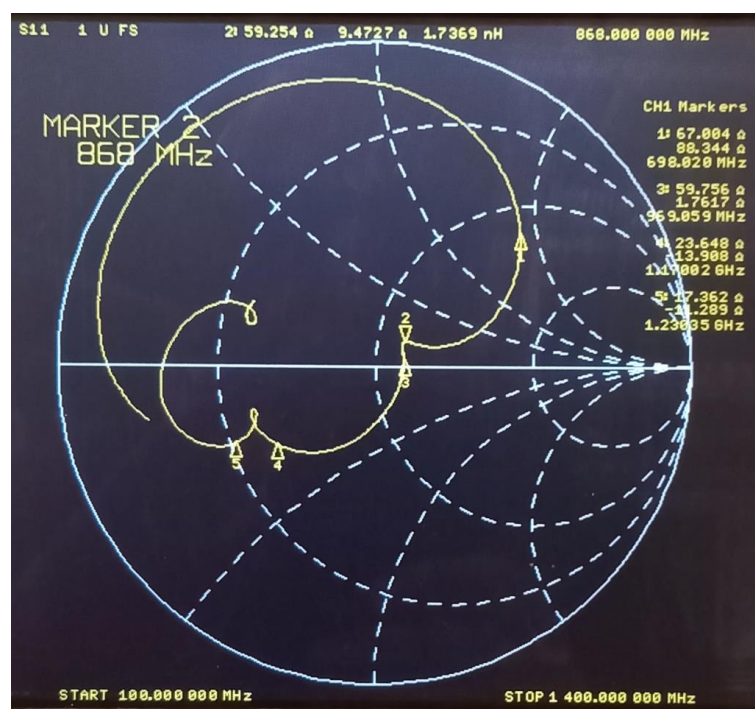


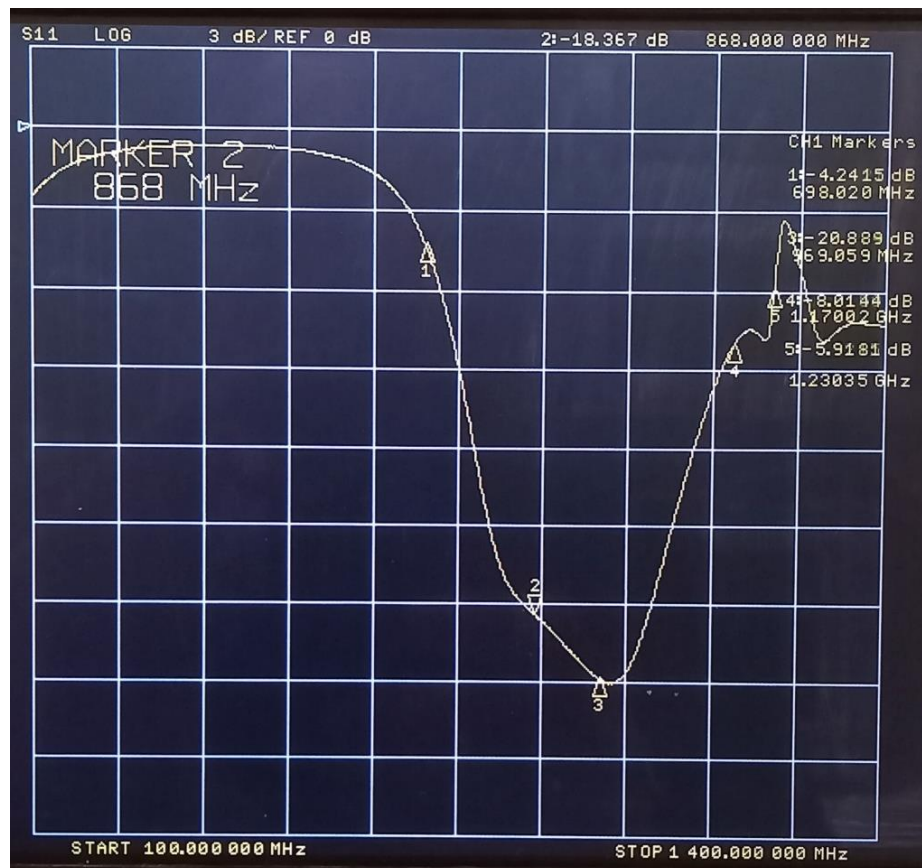
I tuned the circulator for minimum insertion loss compromising a bit the other parameters, as IL was the most critical parameter in my application. This is a picture of the circulator connected to my network analyzer during the tuning:



Below please find the measurement results of the S-parameters in the frequency range 100 – 1400MHz. As all 3 ports show an almost identical behaviour, I will present here only the measurement results from port J1 to J2.

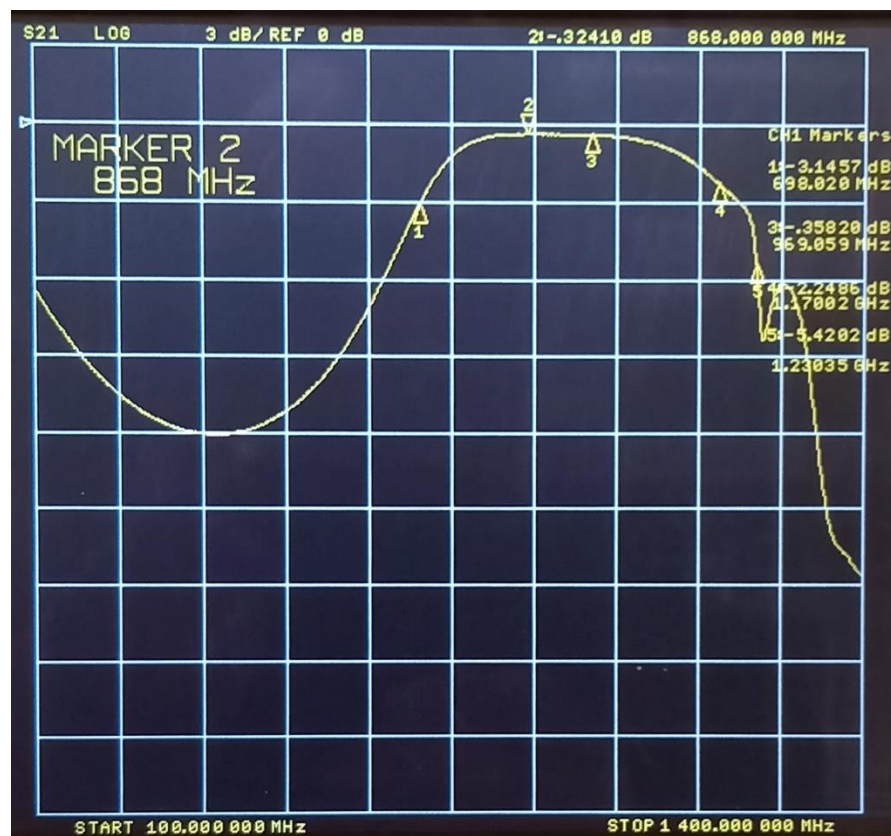
Input matching S11:

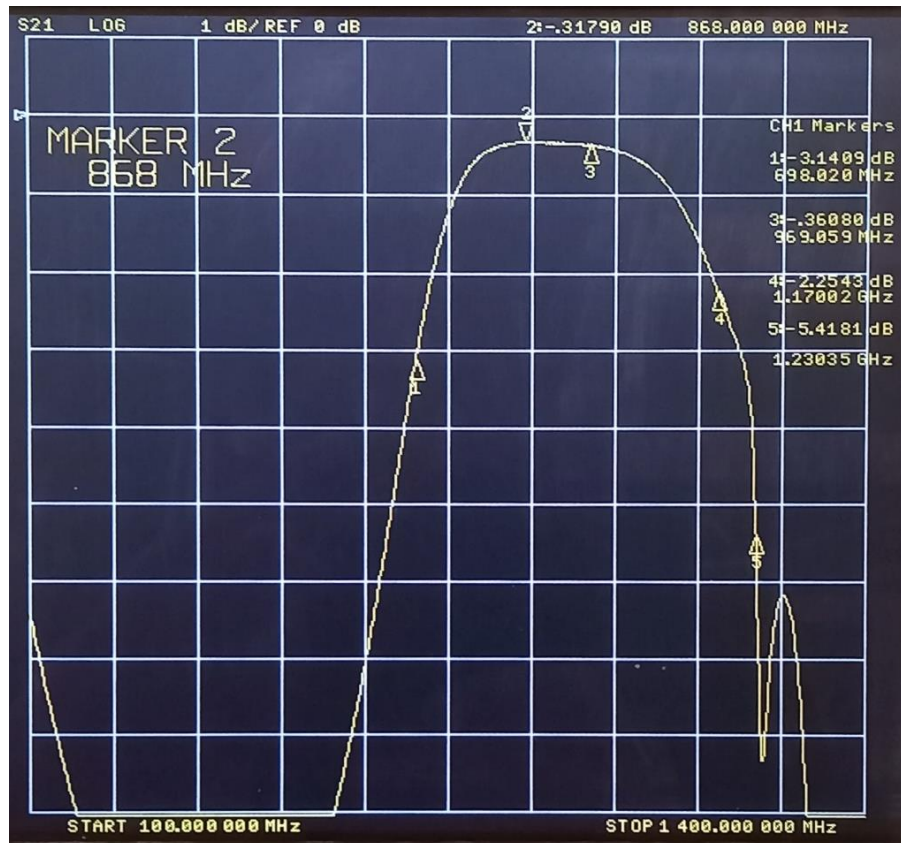




The isolator shows a return loss at port J1 of $S_{11} = -18.4\text{ dB}$ at 868 MHz. The optimum return loss is at 969 MHz with $S_{11} = -20.9\text{ dB}$.

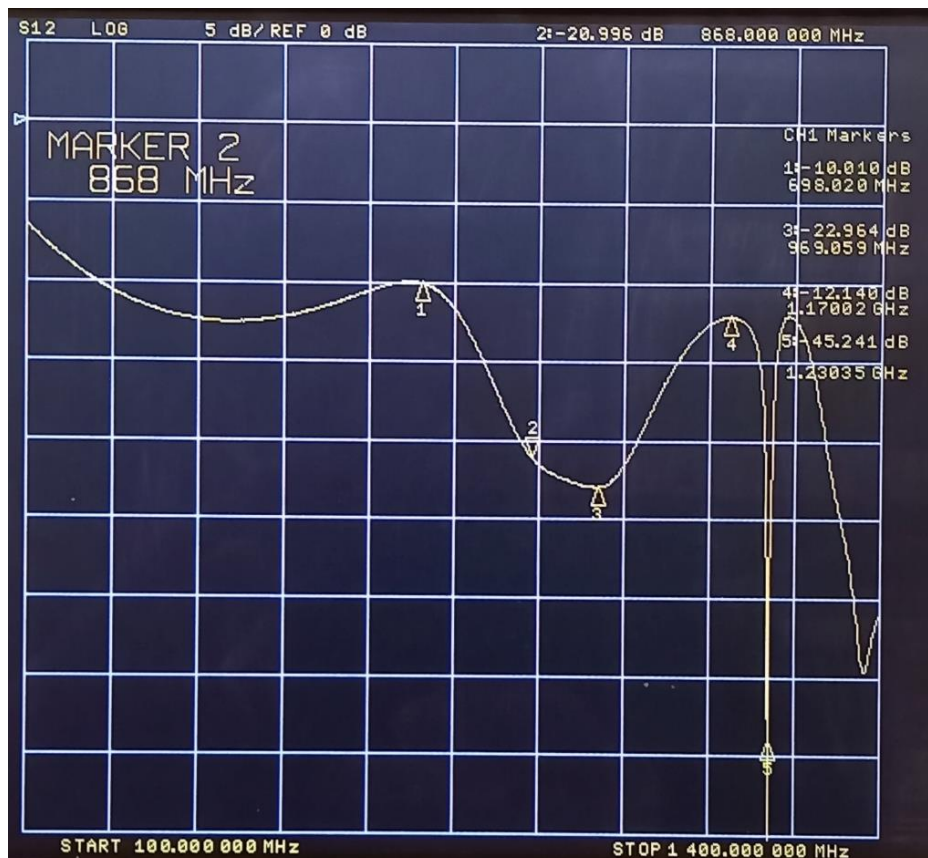
Transfer Characteristic / Insertion Loss S_{21} :

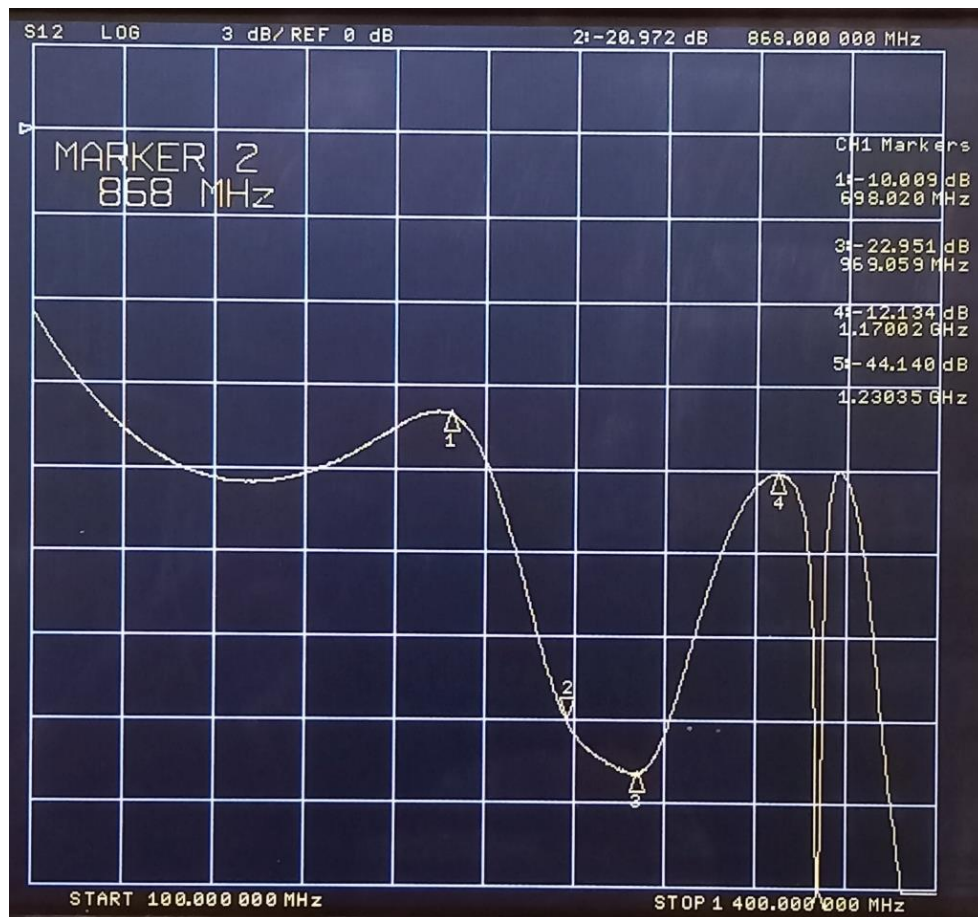




The center frequency of the transfer curve S21 from port J1 to J2 is approximately $f=900\text{MHz}$. The insertion loss at 868MHz is $IL=0.32\text{dB}$. This is excellent.

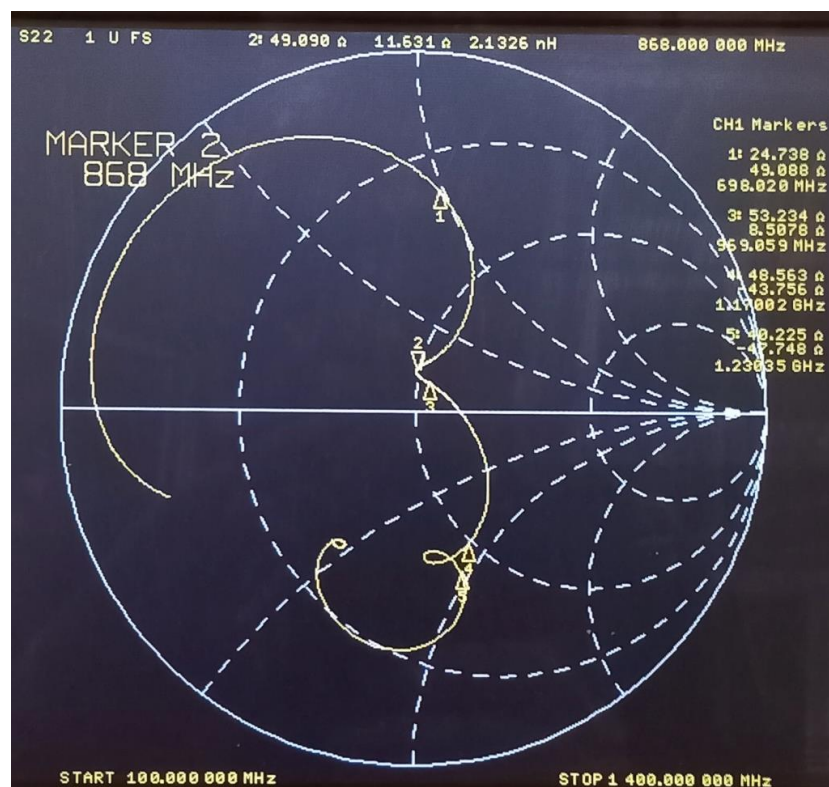
Isolation S12:

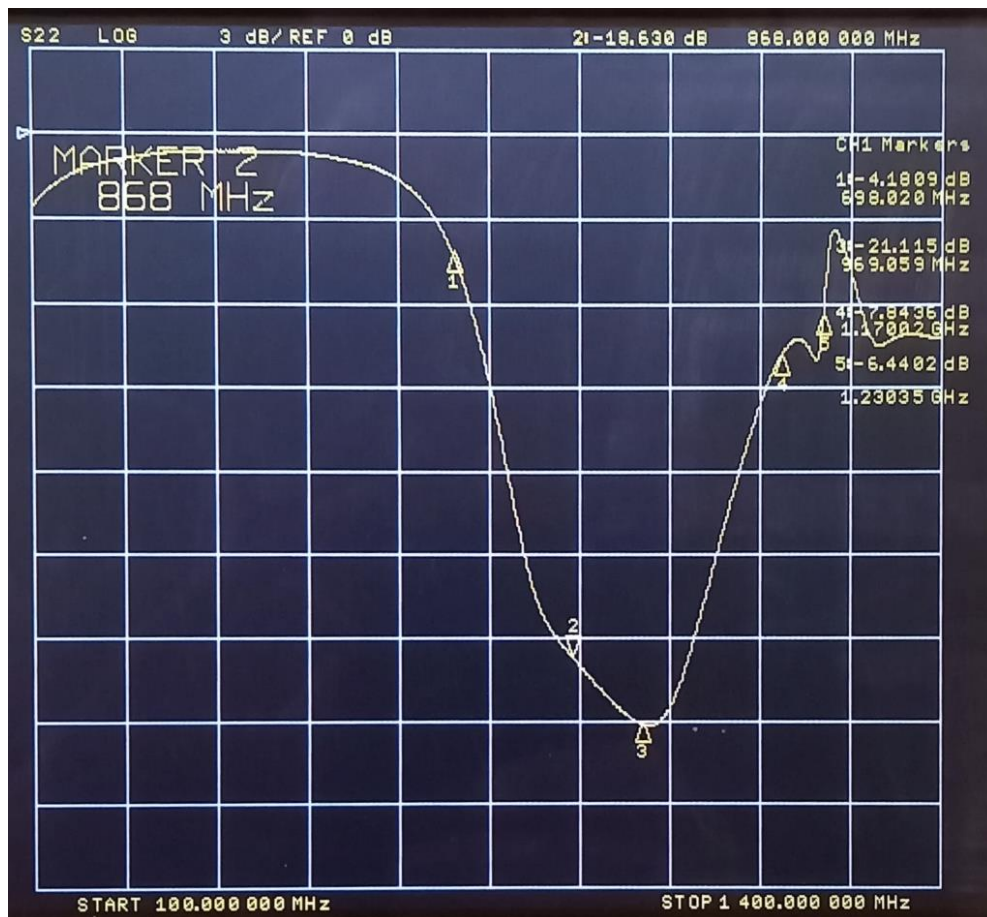




The maximum isolation $S_{12}=23\text{dB}$ is reached at $f=969\text{MHz}$. At 868MHz the isolation is $S_{12}=21\text{dB}$, which is good enough for my application.

Output matching S22:





The maximum return loss at port J2 is achieved at $f=969\text{MHz}$ with $S22=21.2\text{dB}$. At 868MHz I measured a return loss of $S22=18.6\text{dB}$. The $S22$ curve and the measured values are very similar to $S11$.

The results show that circulators and isolators can be easily retuned by applying an external magnetic field. Maybe you have also some surplus devices which do not fit your target frequency range. I recommend to give them a try.

If anyone has a datasheet or experience with such a unit, I appreciate any information.

I will also be happy to answer any questions.

Please send it to my Email address given below.

Kind regards

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