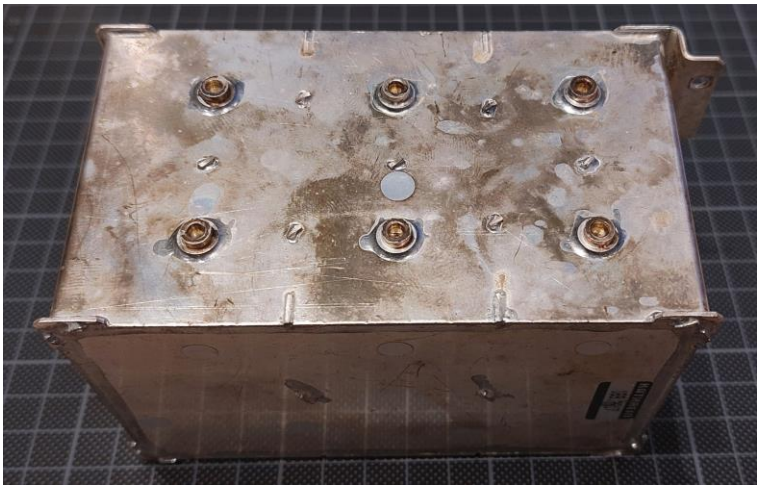
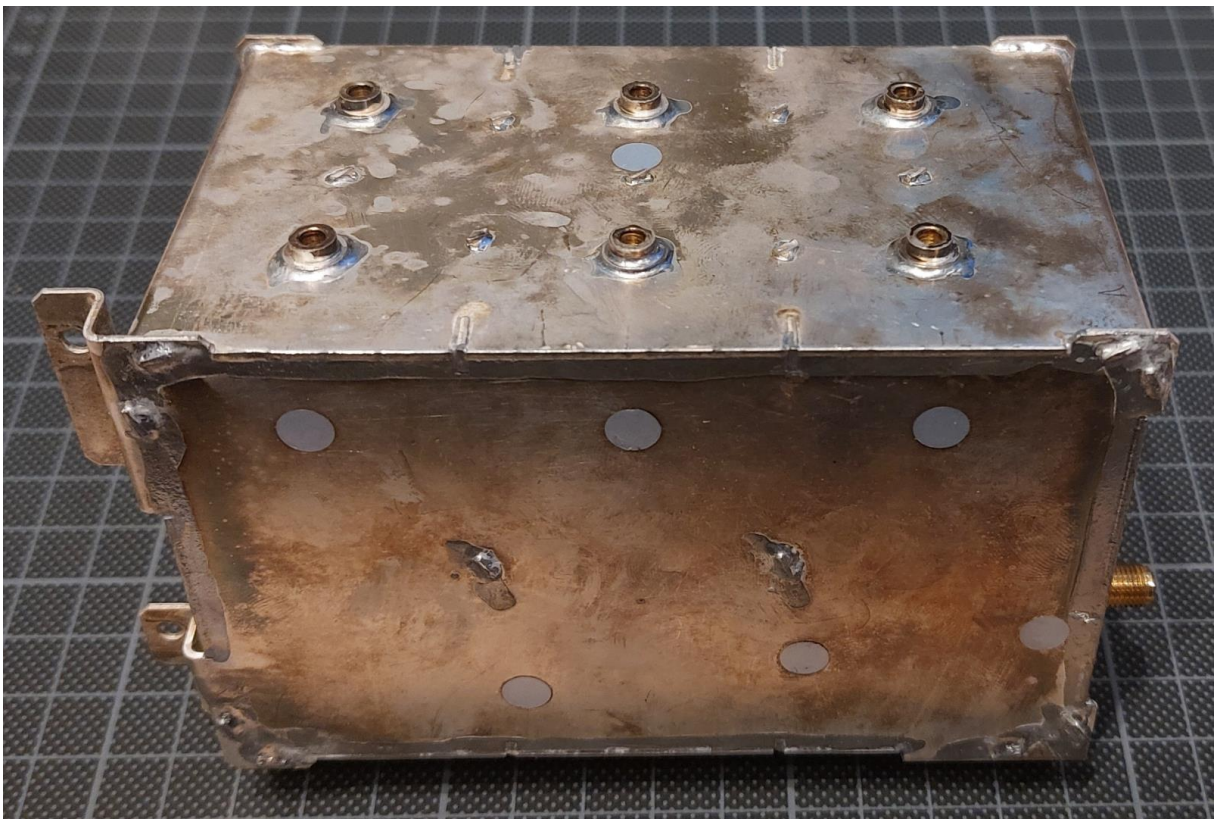
869.4 MHz bandpass filter for a MESHTASTIC node

Matthias, DD1US, October 9st 2024

Recently some ham radio friends convinced me to setup a MESHTASTIC node in order to improve the local network coverage. As I will place the node close to many other antennas and quite some of them are used for transmitting, I decided to look for a filter to be inserted between the omnidirectional antenna and the transceiver.

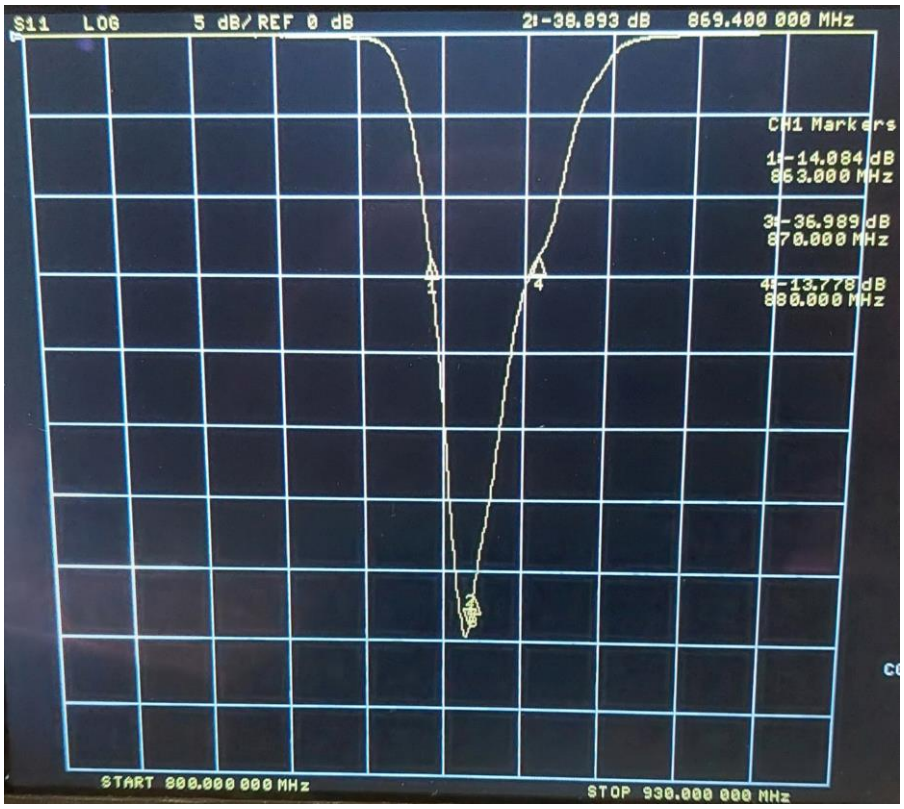
I had some resonator filters from Kathrein probably originally used in GSM base stations. They were tuned to the frequency range 887-917MHz. Thus, I decided to give them a try and retune them to the target frequency of 869.400MHz. Here are some pictures of the filter:



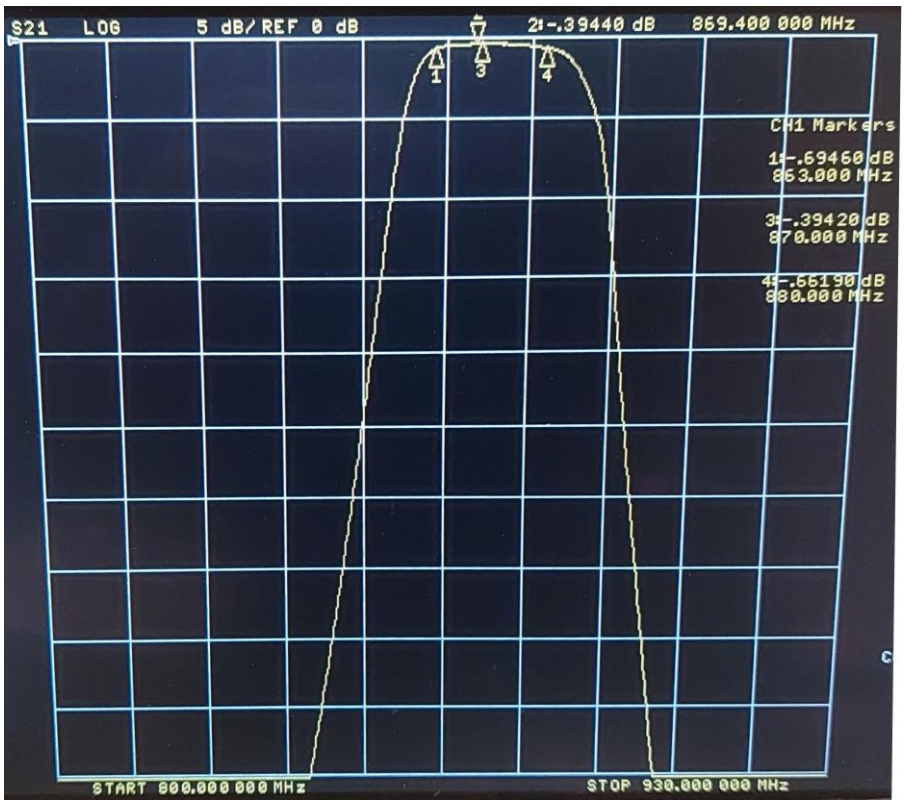


The filter consists of six resonance circuits with respective tuning screws on the top side. The filter has SMA jacks at the input and output.

On the next pages you can find the measurement results after retuning the filter it to a center frequency of 869.4MHz. I optimized the filter for minimum insertion loss and maximum return loss and not best selectivity.

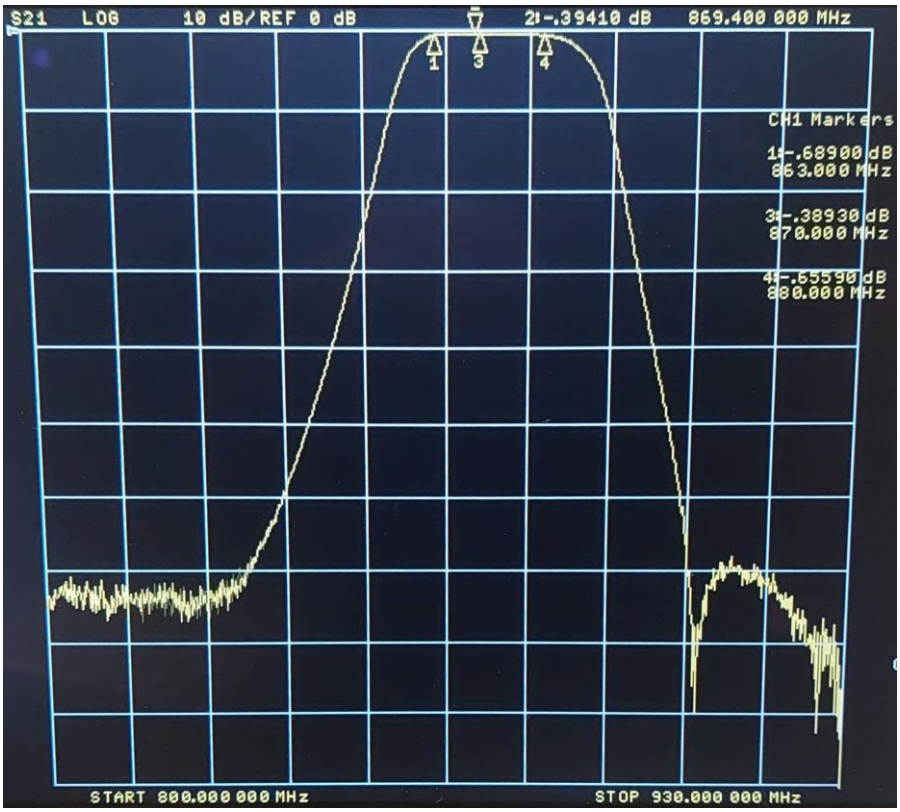


S11 log mag: return loss 38dB @869.4MHz

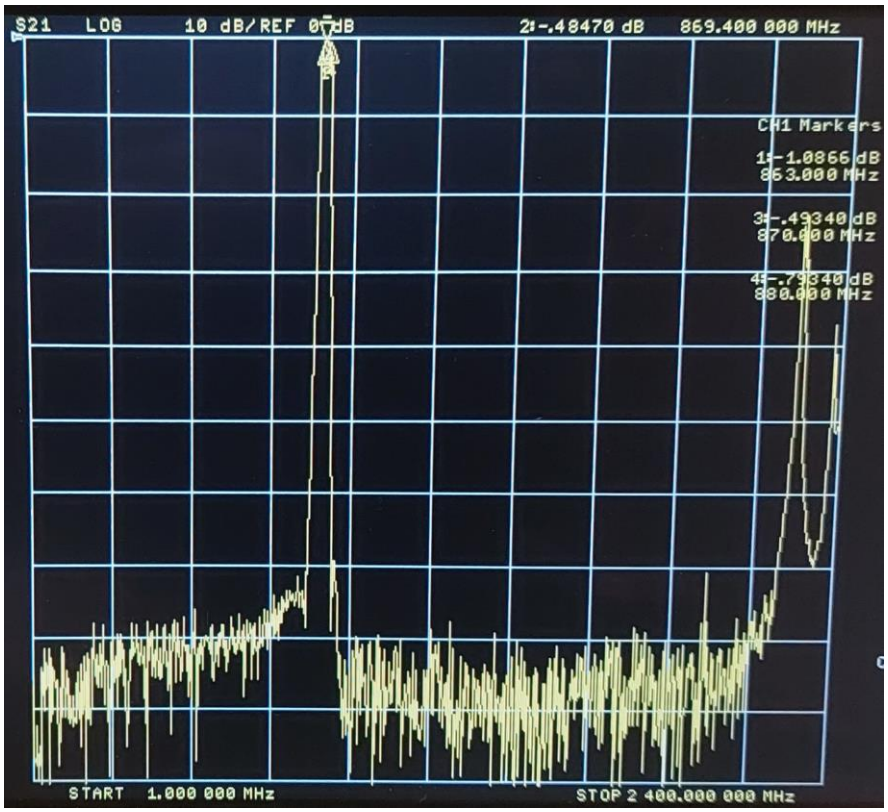


S21 log mag 5dB/div: insertion loss about 0.4dB @869.4MHz

The filter features a 3dB bandwidth of about 28MHz and an insertion loss of 0.4dB.

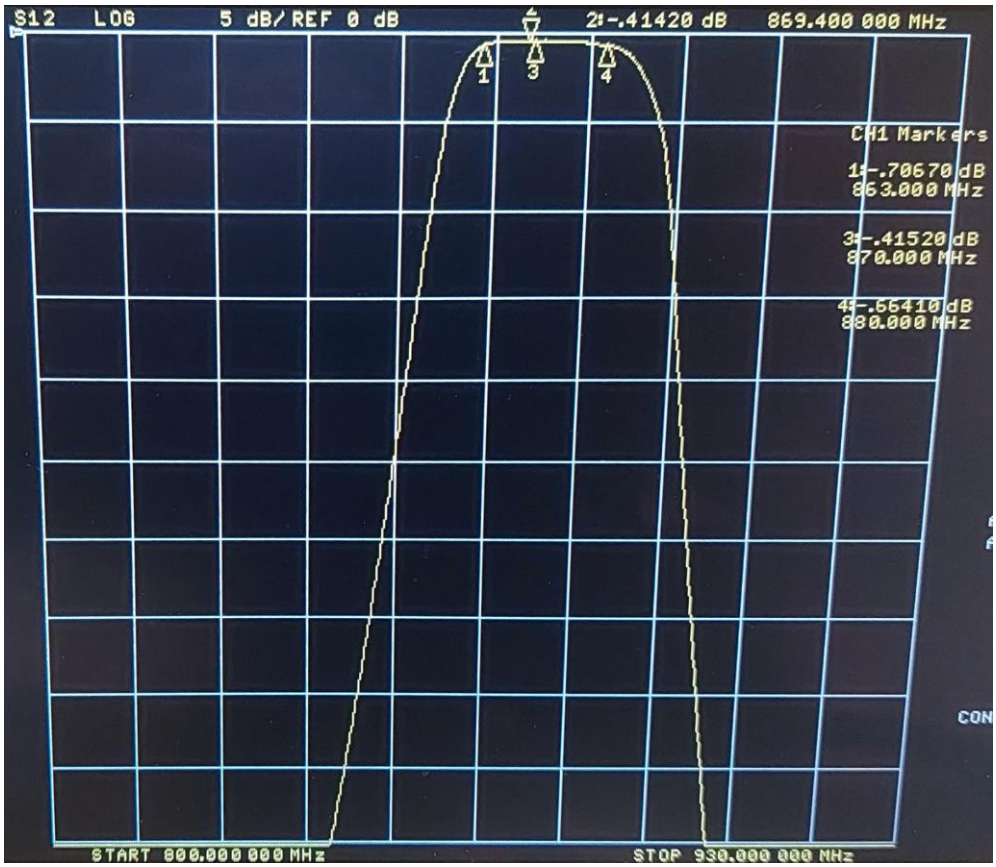


S21 log mag 10dB/div: the 60dB bandwidth is about 63MHz

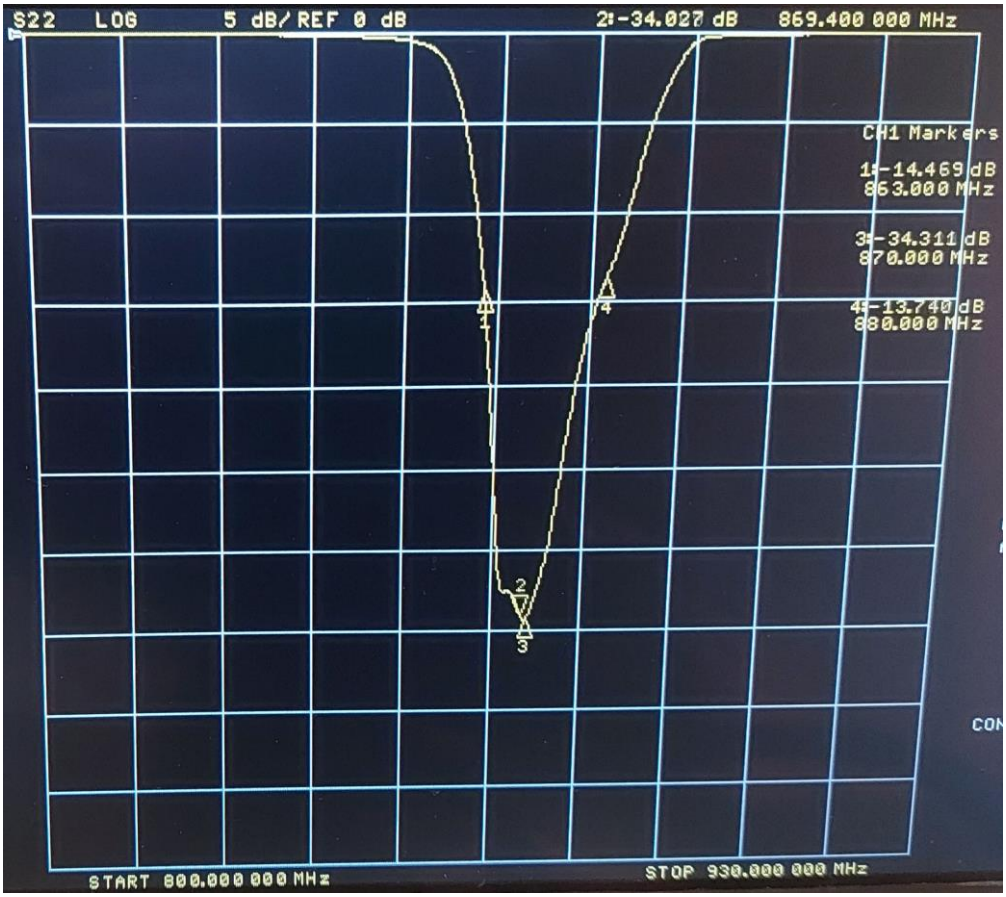


S21 log mag: frequency 1 – 2400MHz, 10dB/div

S21 log mag: in this chart a wider frequency span was used. As can be seen the filter shows a rejection in the 2m and 70cm ham radio bands of more than 70dB. At 1080MHz (ADS-B) the rejection is about 80dB as well as in the 23cm ham radio band. Above 2200MHz the filter shows spurious responses, probably the resonators are operating at their 3rd harmonic.



S12 log mag: essentially the same as S21



S22 log mag: return loss 34dB @869.4MHz

I retuned another filter of the same type and the results were almost identical. For instance the insertion loss was also 0.4dB at 869.400MHz.

In summary this retuned Kathrein filter makes a nice RF filter for the 868MHz ISM band.

It was tuned for minimum insertion loss in order to provide maximum sensitivity and transmit power of the hotspot. The insertion loss is 0.4dB and thus very low.

The 3dB bandwidth is about 28MHz and thus covers the complete European ISM band including MESHTASTIC and LORAWAN. The selectivity is very high resulting in a high rejection of signals outside the 868MHz ISM band, especially in the ham radio bands 2m, 70cm and 23cm.

I always appreciate feedback and will be happy to answer questions. Please send them to the Email address given below. Many thanks in advance.

Best regards

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