Peripheral Mode Isolator WMI PMI-4444-2

Matthias, DD1US, rev 2.0, updated: January 28th 2020

Hi,

Recently I found an Isolator on a flea market and as I was curious to see what its performance was, I bought it and now found the time to characterize it.

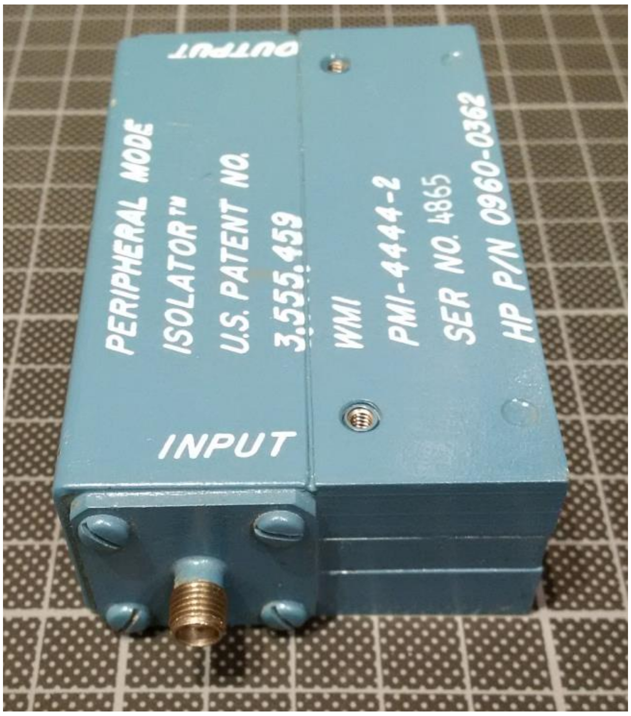
The isolator is from Western Microwave Inc. and the part number is PMI-4444-2. It was also rebranded by HP with the part number 0960-0362.

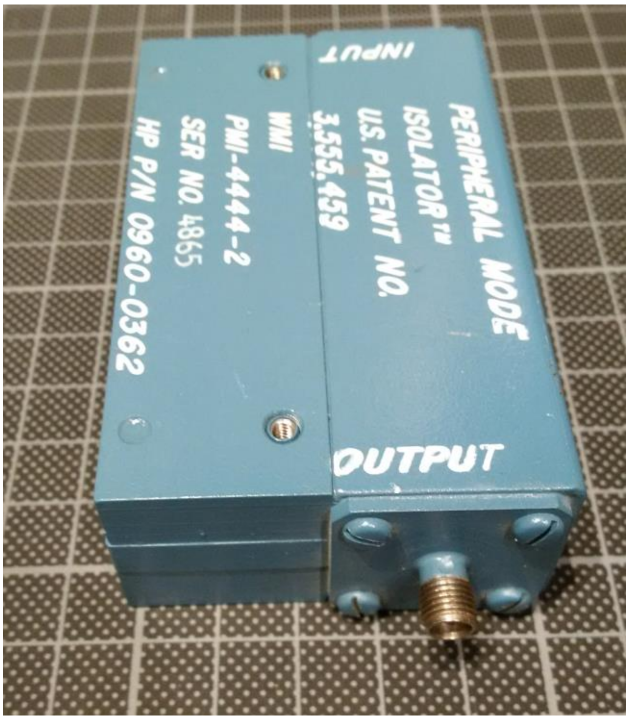
Until the sale of substantially all of its operating assets in 1995, Western Microwave, Inc. engaged in the design, development, manufacture, and sale of a range of microwave devices, components, and subsystems, which were used in both military and commercial microwave electronic systems. In May 1996, Western Microwave, Inc.'s Board of Directors approved a plan of liquidation and dissolution of the company.

I did not find any datasheet online. I only found some second-hand information on the internet which are:

Frequency range 2-7 GHz, Isolation min. 20dB, low insertion loss, input and output connectors SMA

Here are some pictures of the device:



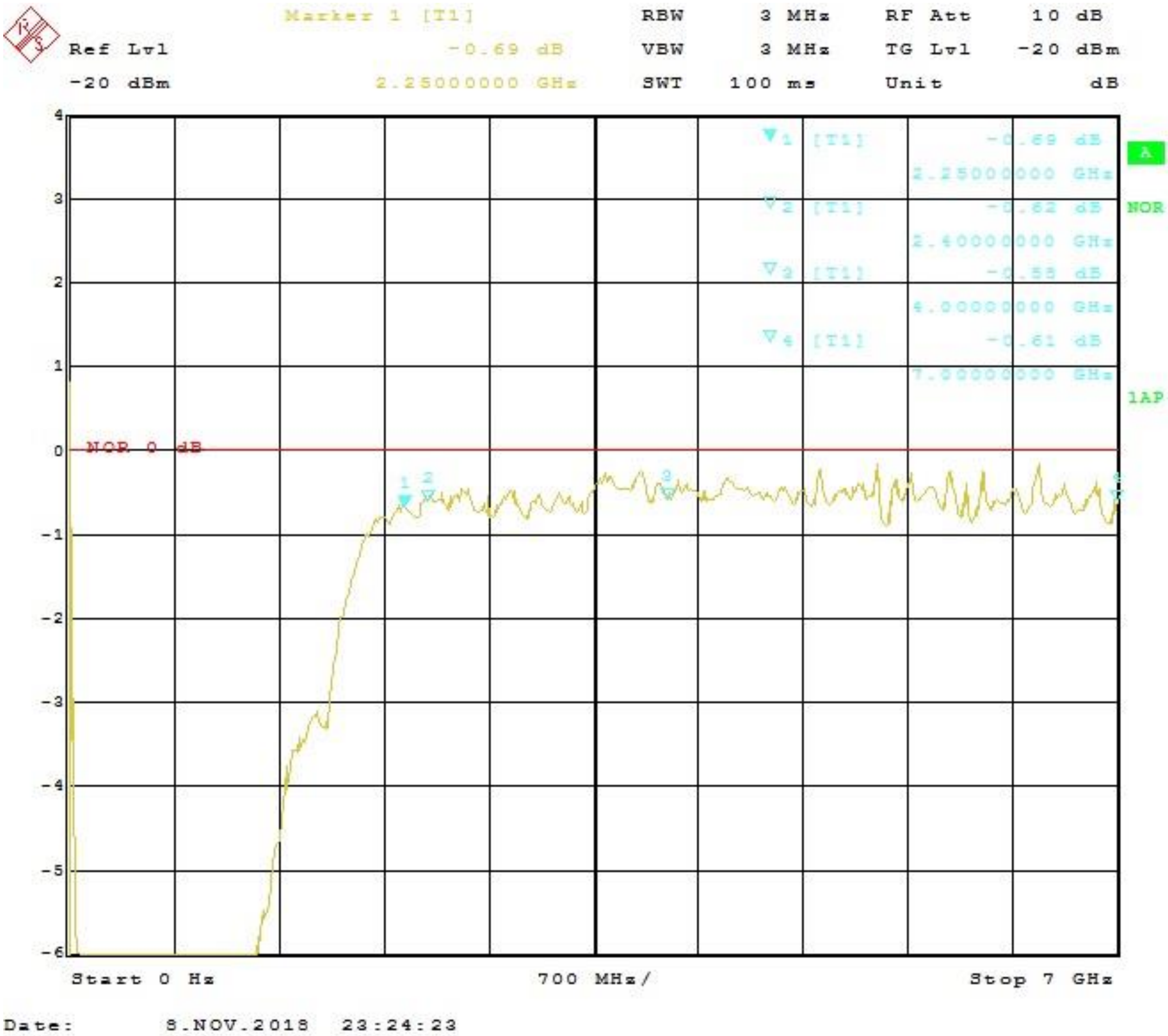


Wondering what a "Peripheral Mode Isolator" is I found some explanation in the book "Microwave Circulator Design" from Douglas K. Linkhart. Peripheral Mode Isolators are coaxial (stripline) field-displacement isolators which feature a very wide bandwidth of 2 octaves and wider. This technique cannot be used for circulators as the RF energy incident from the output port is dissipated in an internal resistive element. The internal structure is a wide, asymmetrical strip transmission line in contact with ferrite. The energy concentrations are different on opposite sides of the transmission line. Usually a Mylar film metalized with a resistive coating is positioned on one side of the transmission line in order to absorb the RF energy incident from the output of the port. The RF energy entering the input port does not become concentrated near the resistive material and thus the insertion loss from input to output is low. Insertion loss and bandwidth of the isolator are a trade-off because the RF energy cannot be kept out of the resistive material entirely over a wide bandwidth. The power handling capabilities of a field-displacement isolator is limited as all the reverse power has to be dissipated in the resistive film.

Next, I performed some measurements at the device measuring the transfer S21 and isolation S12 characteristics in the frequency range 0 – 7 GHz.

Transfer Characteristic S21:

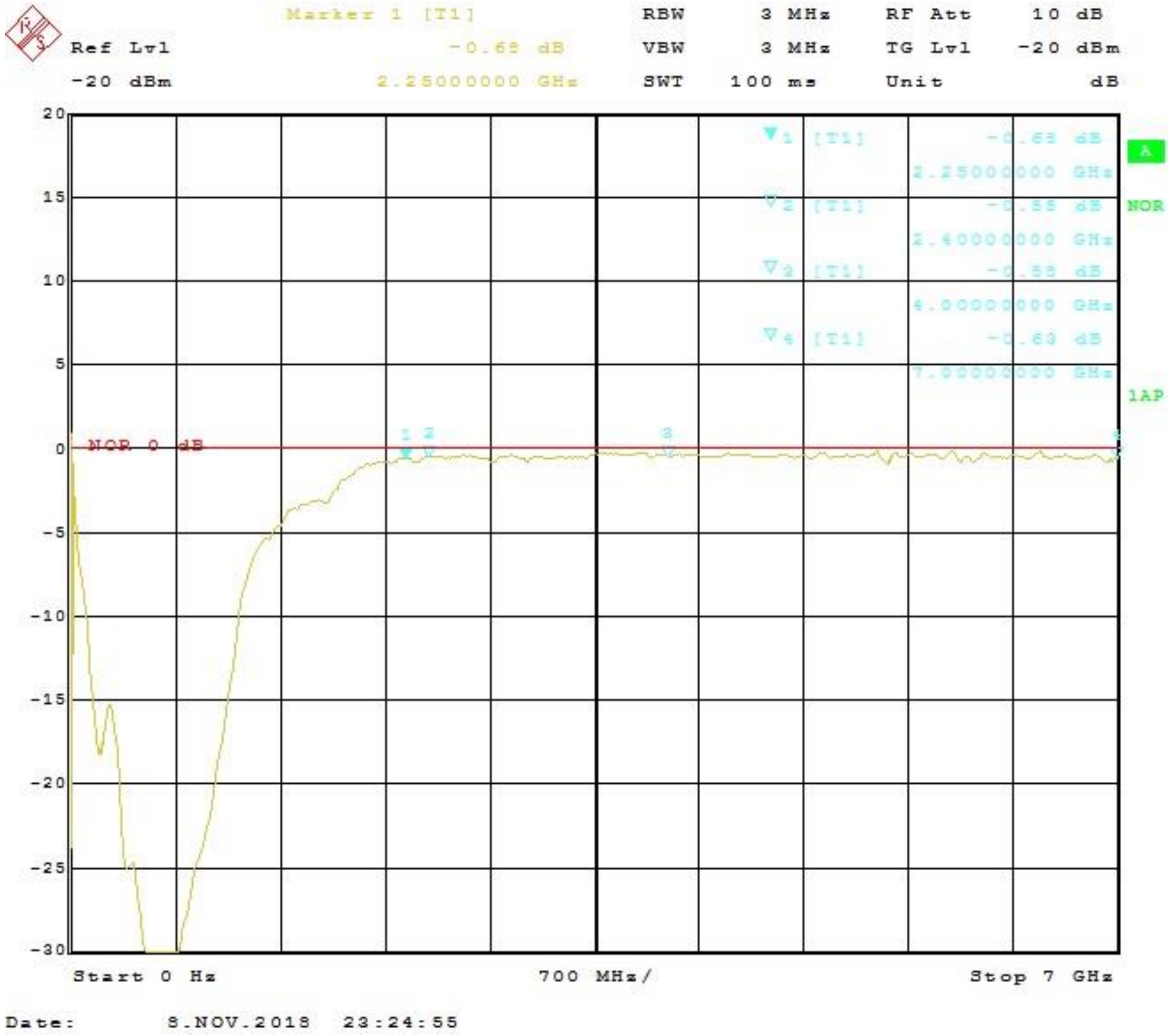
The first measurement of the transfer characteristics from the input to the output port was performed in the range 0-7 GHz with a vertical scaling of 1dB/div.



The insertion loss in the range ~2 GHz to 7 GHz is below 1dB. Here are some measurement points:

2.25 GHz	0.69 dB
2.40 GHz	0.62 dB
4.00 GHz	0.59 dB
7.00 GHz	0.61 dB

The next measurement was done over the same frequency range with a vertical scaling of 10dB/div.



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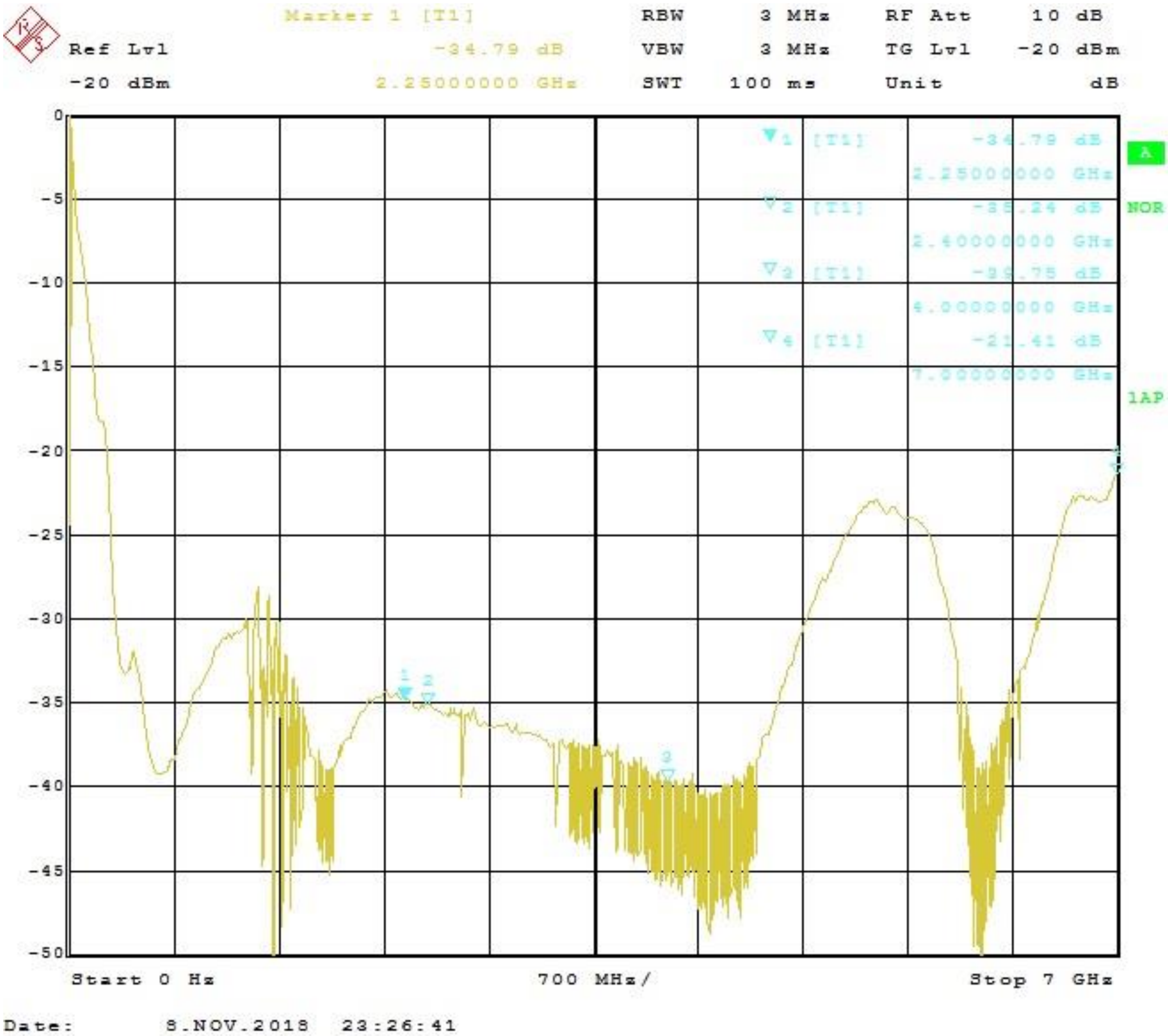
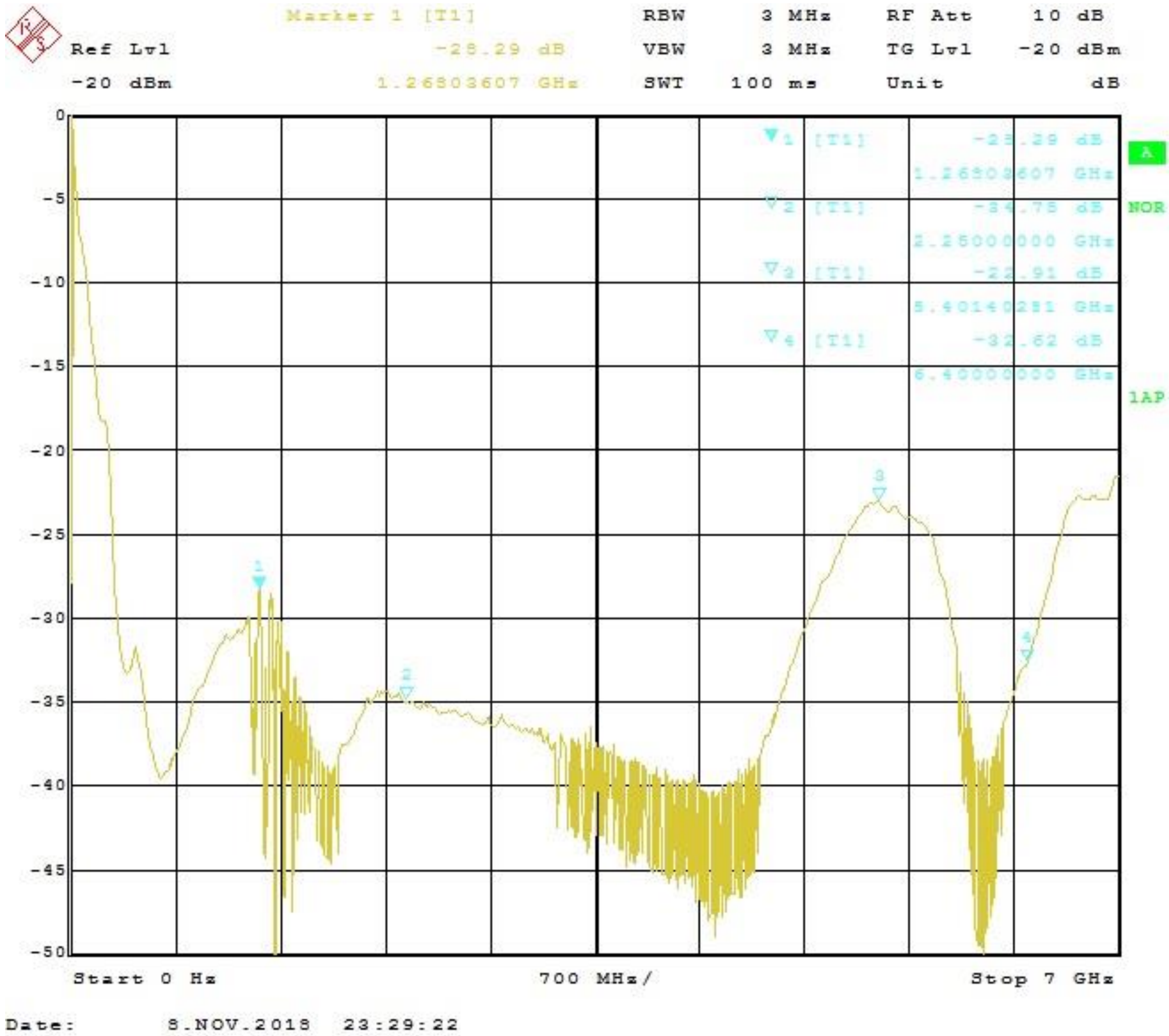
Isolation S12:

Next, I made some measurements of the Isolation from the output port to the input port.





Here are some measurement points:

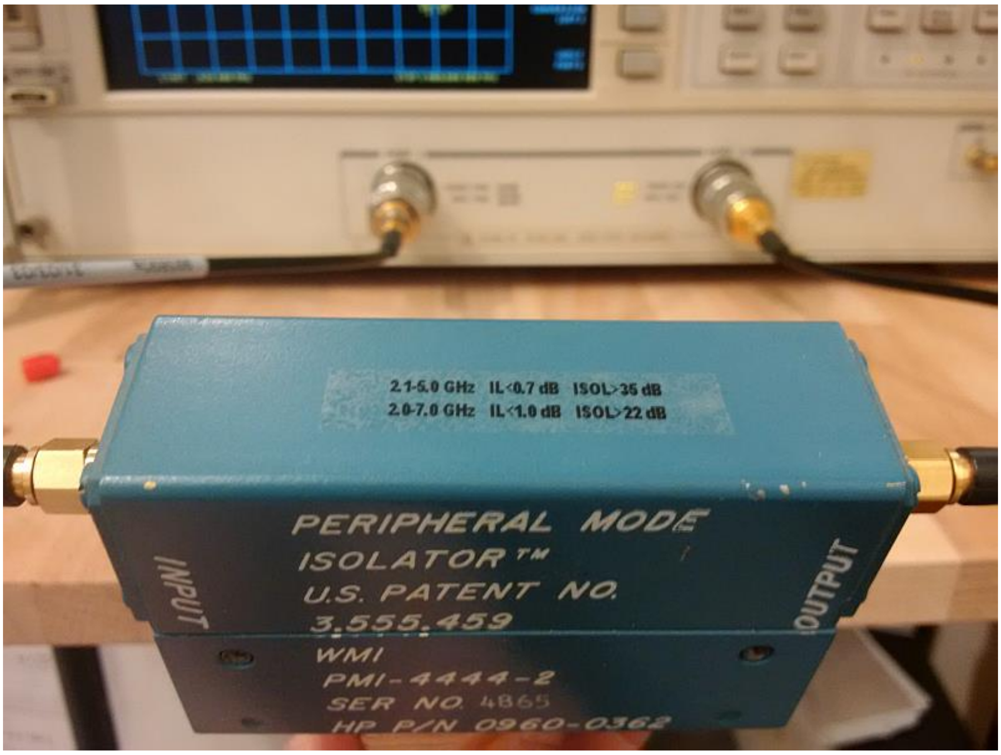
1.268 GHz	25.3 dB
2.25 GHz	44.8 dB
2.40 GHz	35.2 dB
4.00 GHz	39.8 dB
5.40 GHz	22.9 dB
6.40 GHz	32.6 dB
7.00 GHz	21.4 dB

In the frequency range from 2.1 to 5.0 GHz the insertion loss is lower than 0.7 dB and the isolation is higher than 30 dB.

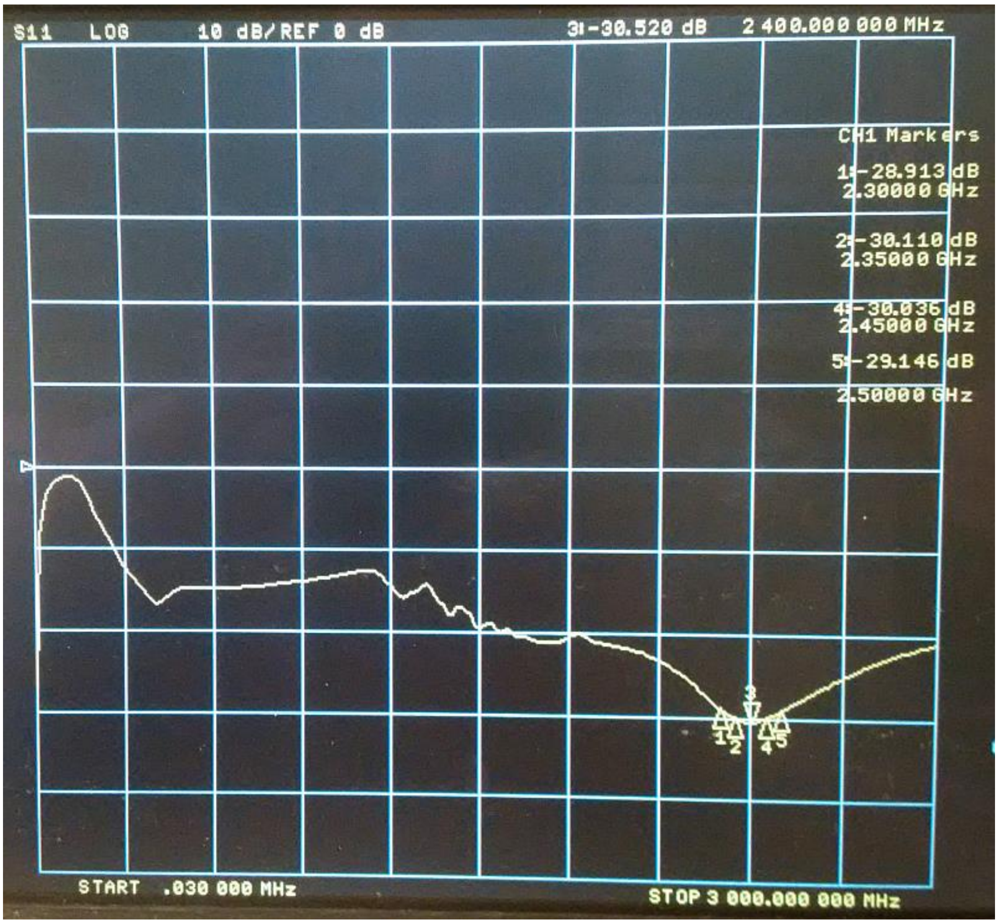
In the frequency range from 2.0 GHz to 7.0 GHz the insertion loss is lower than 1.0 dB and the isolation is higher than 22 dB.

These results fit nicely to the few specifications I had mentioned at the beginning of this description.

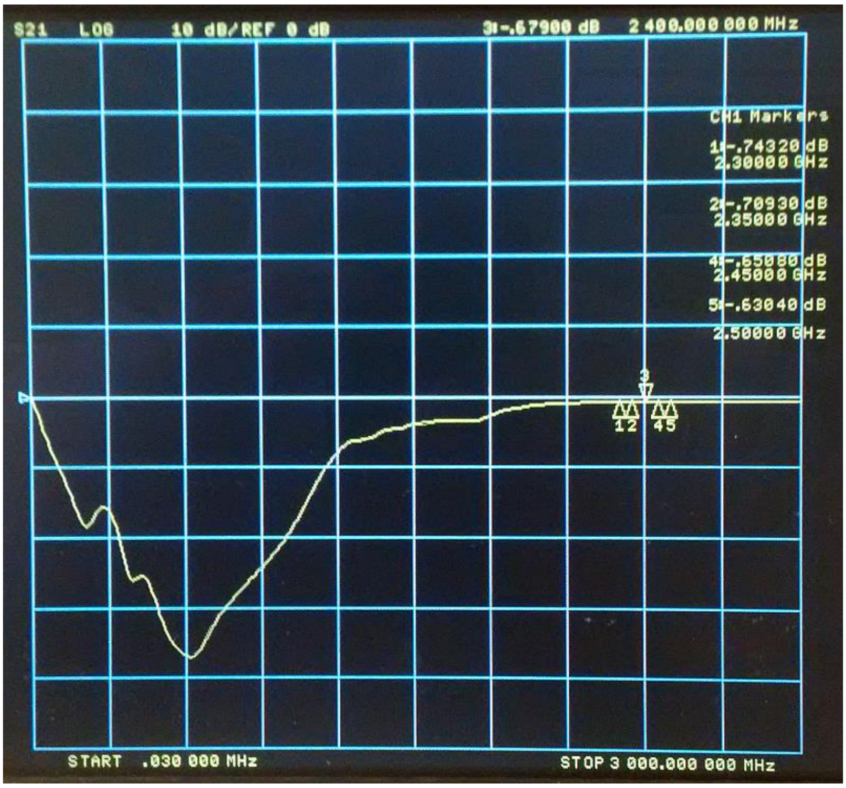
Update 01/2020: Measurements with VNA from 30kHz to 3 GHz



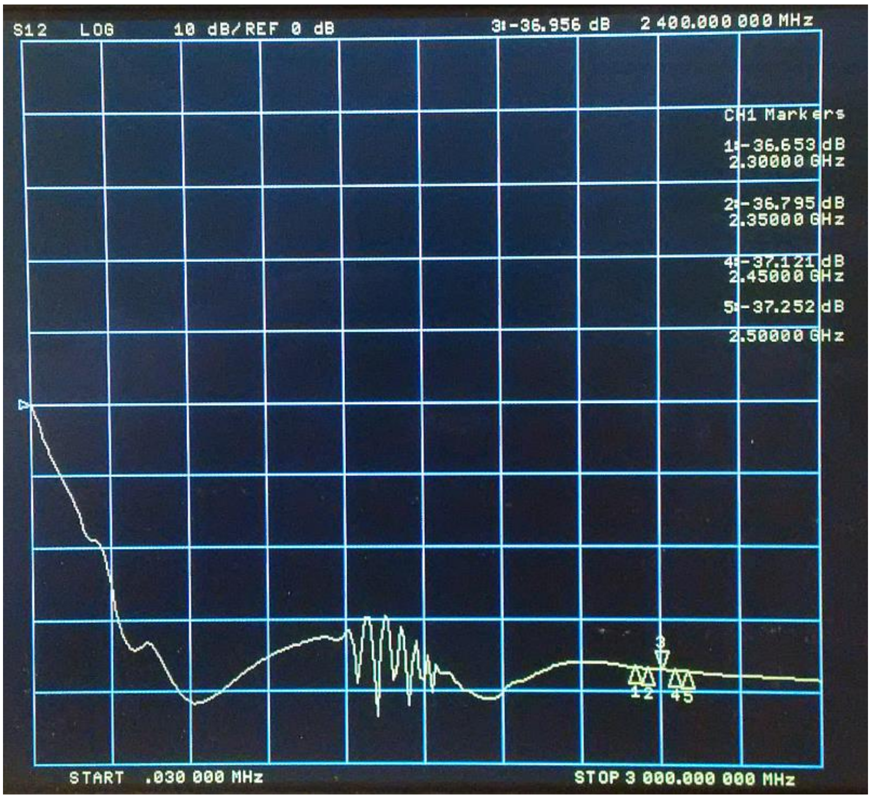
S11 Input return loss (28.9dB@2300MHz, 30.1dB@2350MHz, 30.5dB@2400MHz, 30.0dB@2450MHz, 29.1dB@2500MHz)



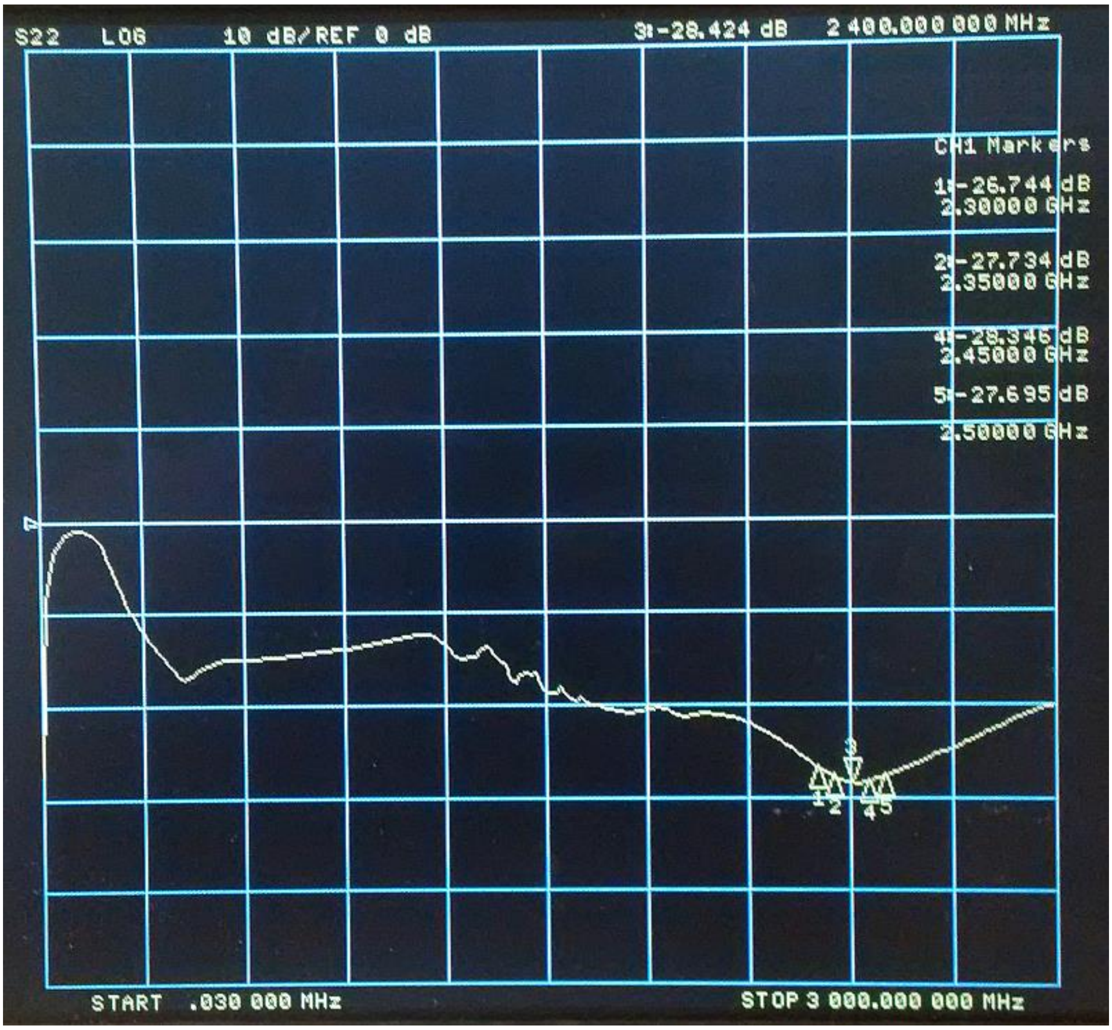
S21 insertion loss (0.74dB@2300MHz, 0.71dB@2350MHz, 0.68dB@2400MHz, 0.65dB@2450MHz, 0.63dB@2500MHz)



S12 reverse isolation (isolation 36.7dB@2300MHz, 36.8dB@2359MHz, 37.0dB@2400MHz, 37.1dB@2450MHz, 37.3dB@2500MHz)



S22 output return loss (26.7dB@2300MHz, 27.7dB@2350MHz, 28.4dB@2400MHz, 28.3dB@2450MHz, 27.7dB@2500MHz)



The measurements with my VNA confirm the measurements I had done before with my spectrum analyser with integrated tracking generator.

If you have more information about this type of device or feedback on this description please send it to the Email address given below. Many thanks in advance.

Kind regards

Matthias DD1US

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