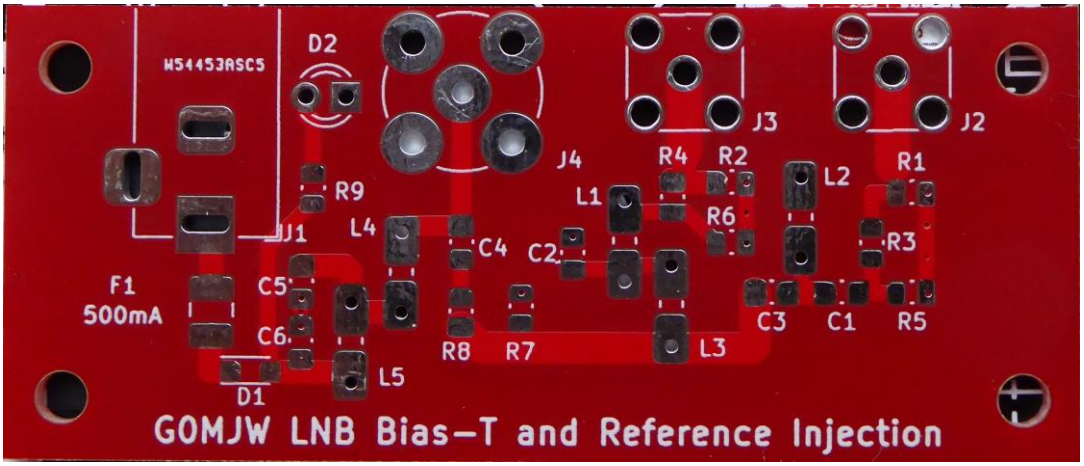
Characterization of the G0MJW
LNB Bias-T and reference injection board

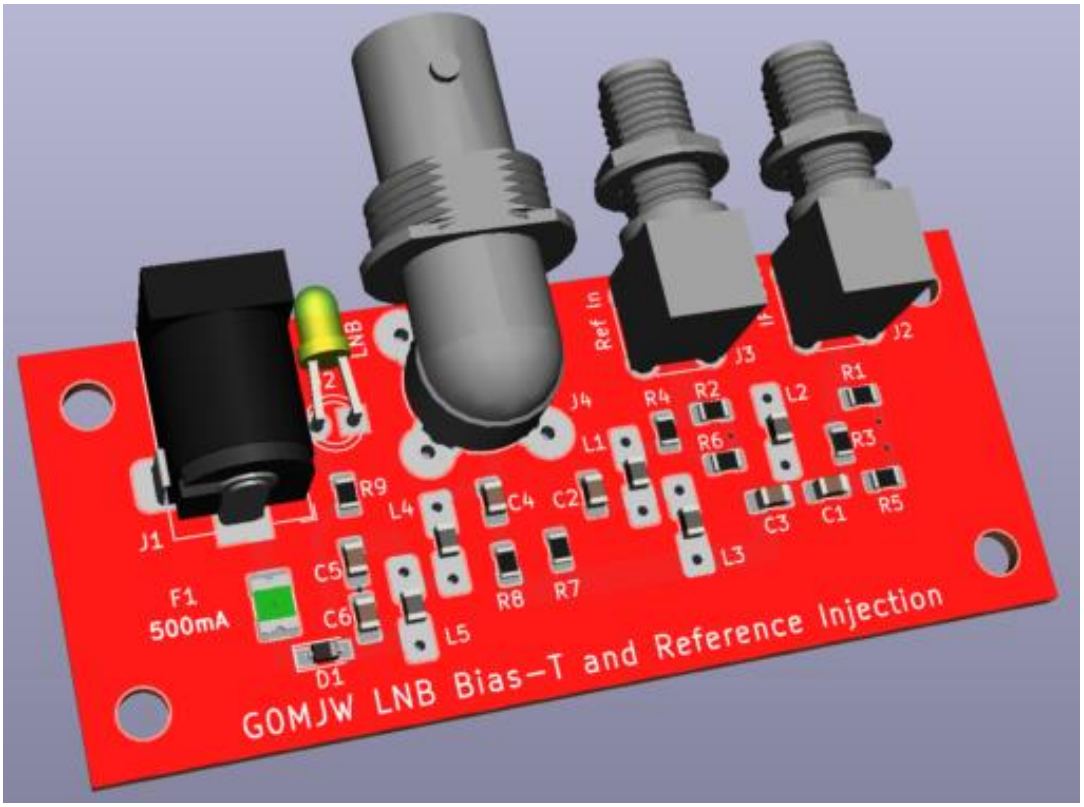
Matthias DD1US, May 9th 2021, Rev. 1.2

Some time ago Mike Willis G0MJW sent me some blank PCBs for a LNB Bias-T and reference injection module we he had designed. Details about his module can be found in the BATC Forum at:
https://forum.batc.org.uk/viewtopic.php?f=15&t=3122&p=17416#p17343

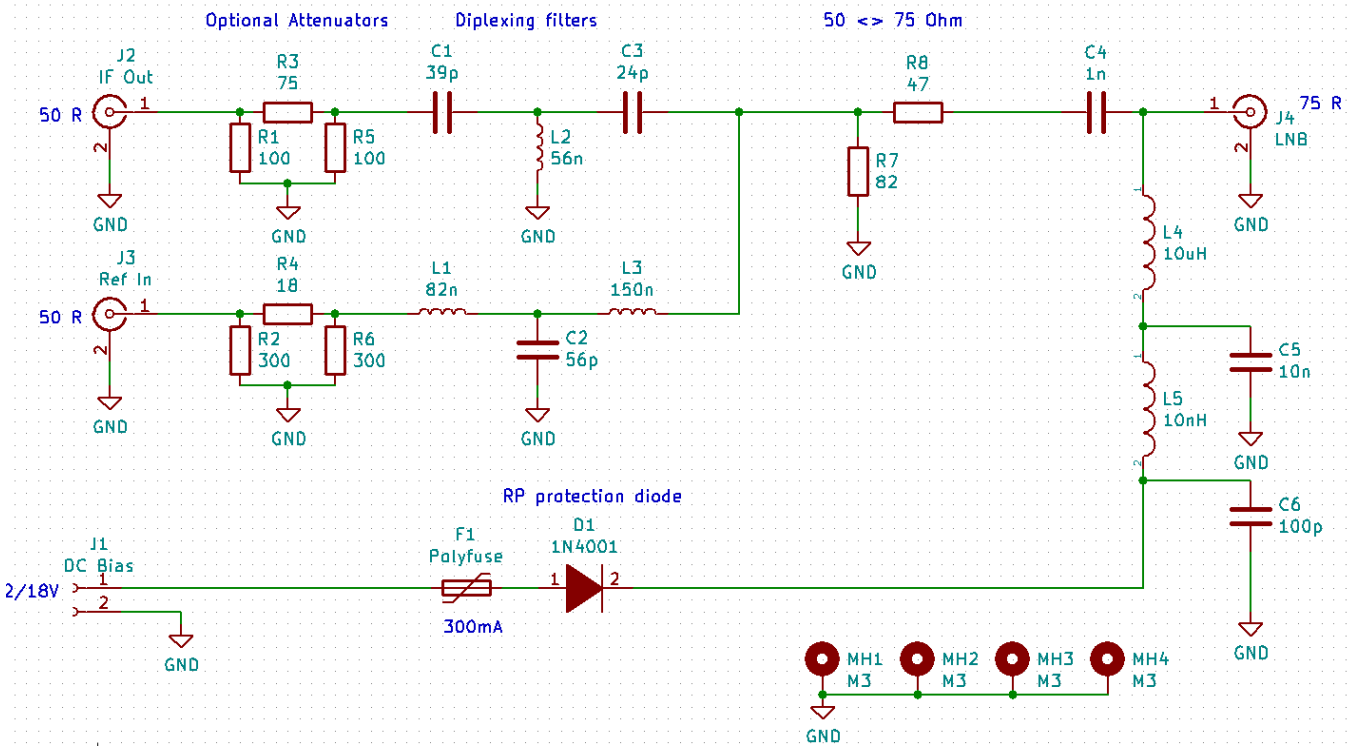
Later Mike G0MJW described the board also in CQ-TV262.

Meanwhile his board can be bought for £3.50 in the webshop of BATC (only for members):
https://batc.org.uk/shop/lnb-bias-t-and-reference-injection-blank-pcb/
Please note that this is for the blank PCB only, not the assembled unit.

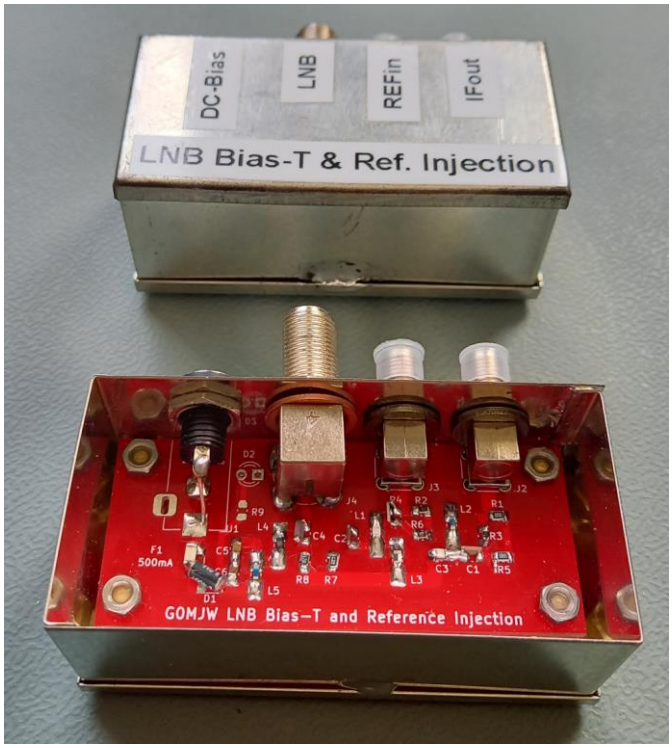




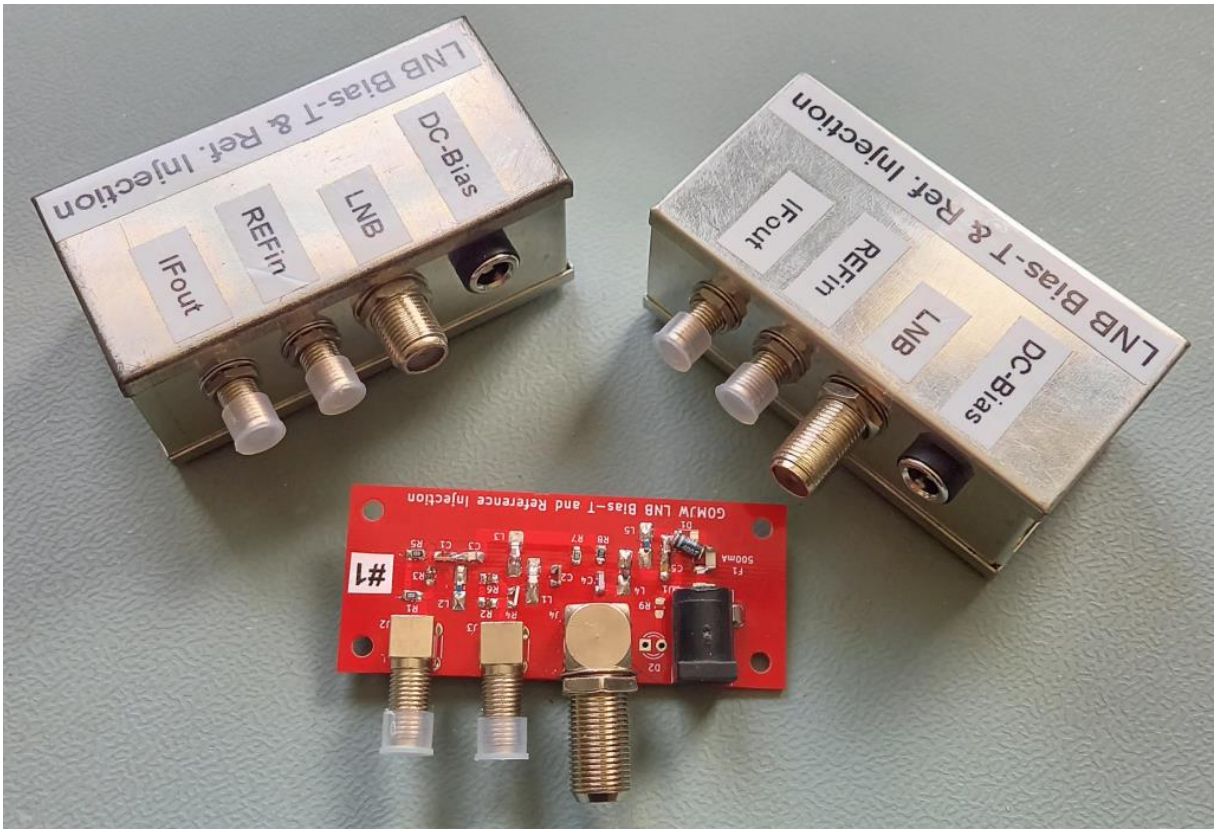
The idea is to “phantom feed” a reference frequency signal of 10, 25 or 27 MHz and 12 to 18 V DC to the LNB and get back the IF signal, all on one cable. At the LNB end one filters off the reference signal and uses it to lock the PLL in the LNB and powers the LNB with the DC supply. Here is the schematic of the module. I have assembled both optional attenuators, which introduce an additional attenuation of 10dB in the LNB-to-IFout path and 3dB in the REFin-to-LNB path.



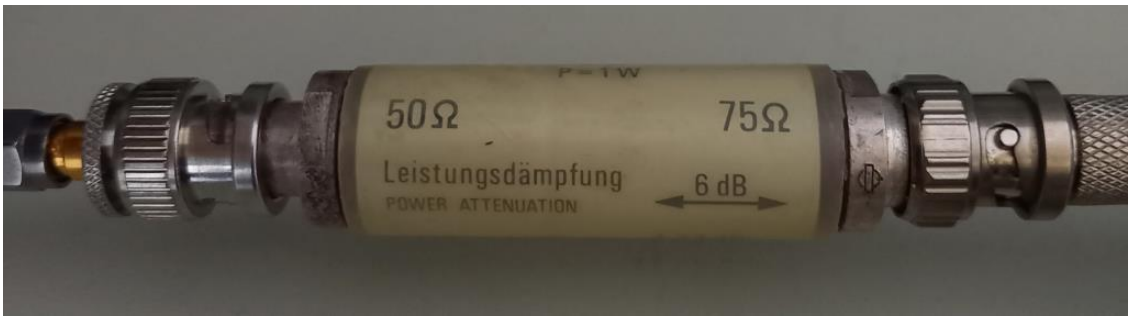
Here are some pictures of the 3 modules which I built. Please note that I did use the SMD parts I had at hands and thus sometimes not the proper size. As I will integrate the modules with other modules in a larger encasing, I have not assembled the optional LED indicating that supply voltage is applied.




LNB Bias-T & Ref. Injection
IFout
REFin
LNB
DC-Bias
#2
LNB Bias-T & Ref. Injection
IFout
REFin
LNB
DC-Bias
#3
#1
GOMJW LNB Bias-T and Reference Injection


LNB Bias-T & Ref. Injection
IFout
REFin
LNB
DC-Bias
LNB Bias-T & Ref. Injection
IFout
REFin
LNB
DC-Bias
#1
GOMJW LNB Bias-T and Reference Injection

Finally, I found the time to characterize the board. As the LNB port is matched to 75 Ohms and my measurement setup is all 50 Ohms I used a 50 Ohm – 75 Ohm matching pad:



This matching pad provides proper impedance matches but also introduces an insertion loss of 6dB. Thus, the measurements below have to be corrected by 6dB (you can find this in the columns "corrected".

First, I measured the path from the LNB input to the IF output.

The input matching pad from 75 Ohm to 50 Ohm consisting of R7 and R8 is introducing a nominal loss of 6.1 dB. The PI-attenuator consisting of R1, R3 and R5 has a nominal loss of 10.1 dB.

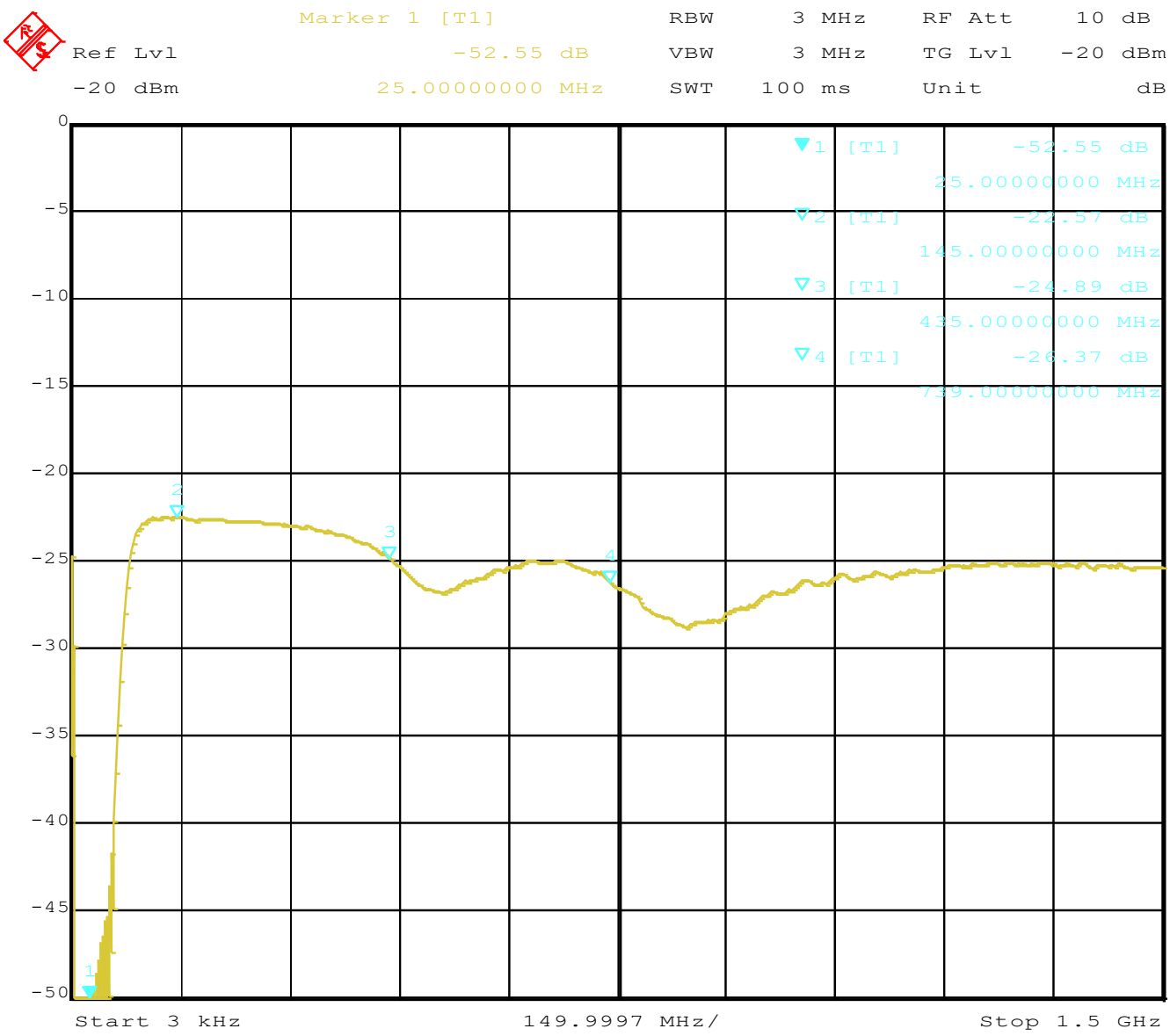
The actual insertion losses between the LNB port and the IFout port are:

frequency	measured	corrected	nominal	additional losses
25 MHz	-52.5 dB	-46.5 dB		
145 MHz	-22.6 dB	-16.6 dB	-16.2 dB	0.4 dB
435 MHz	-24.9 dB	-18.9 dB	-16.2 dB	2.7 dB
739 MHz	-26.3 dB	-20.3 dB	-16.2 dB	4.1 dB

The additional losses are introduced by the various duplexing filters.

Because of the high pass filter consisting of C1, L2 and C3 the frequency range from DC to about 50 MHz is strongly suppressed.

Here is the measured frequency response of the path from the LNB input to the IF output.

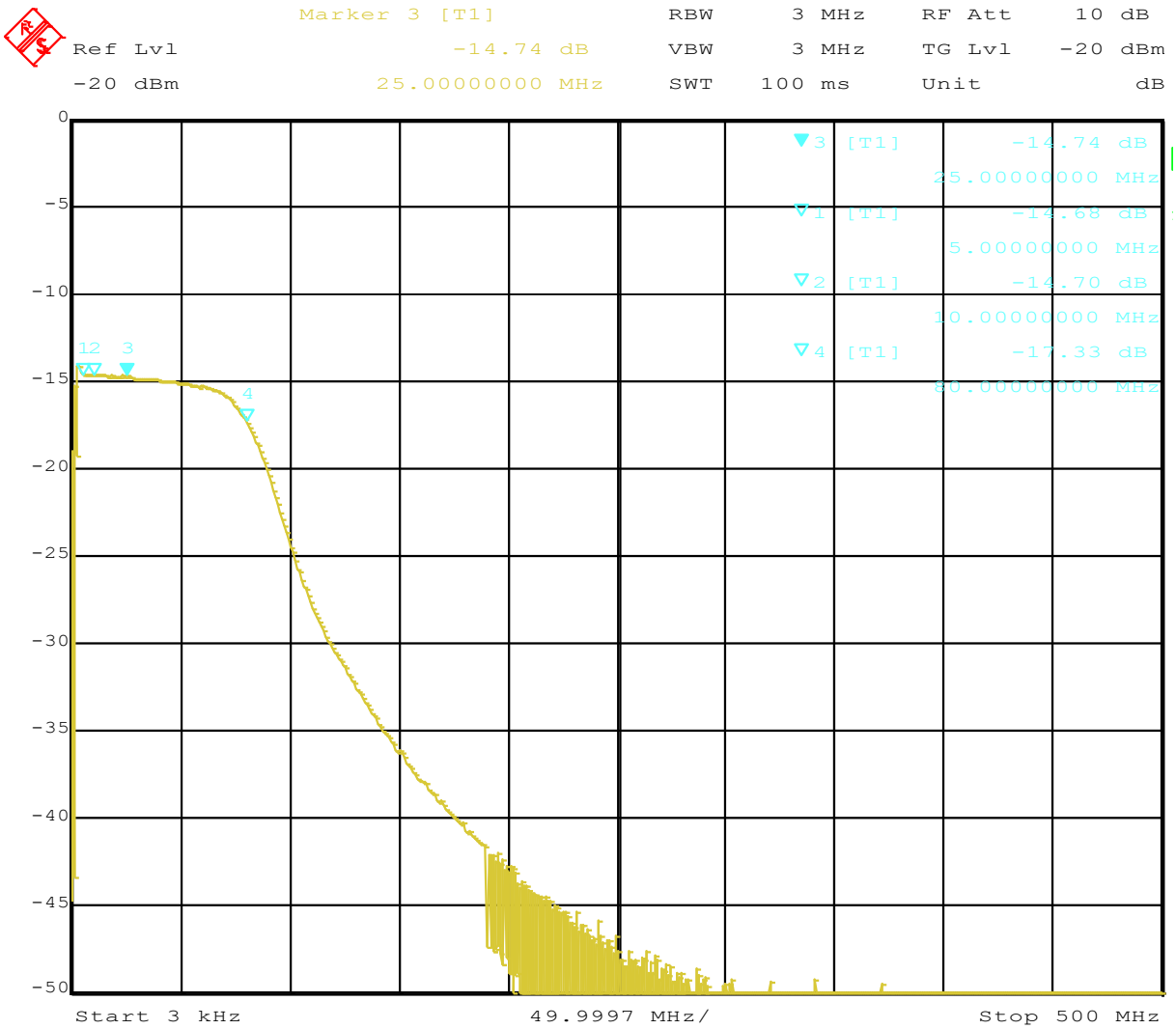


Next, I measured the path from LNBinput to REFin.

The input matching pad from 75 Ohm to 50 Ohm consisting of R7 and R8 is introducing a nominal loss of 6.1 dB. The PI-attenuator consisting of R2, R4 and R2 has a nominal loss of 3.0 dB.

The actual insertion losses between the REFin port and the LNB port are:

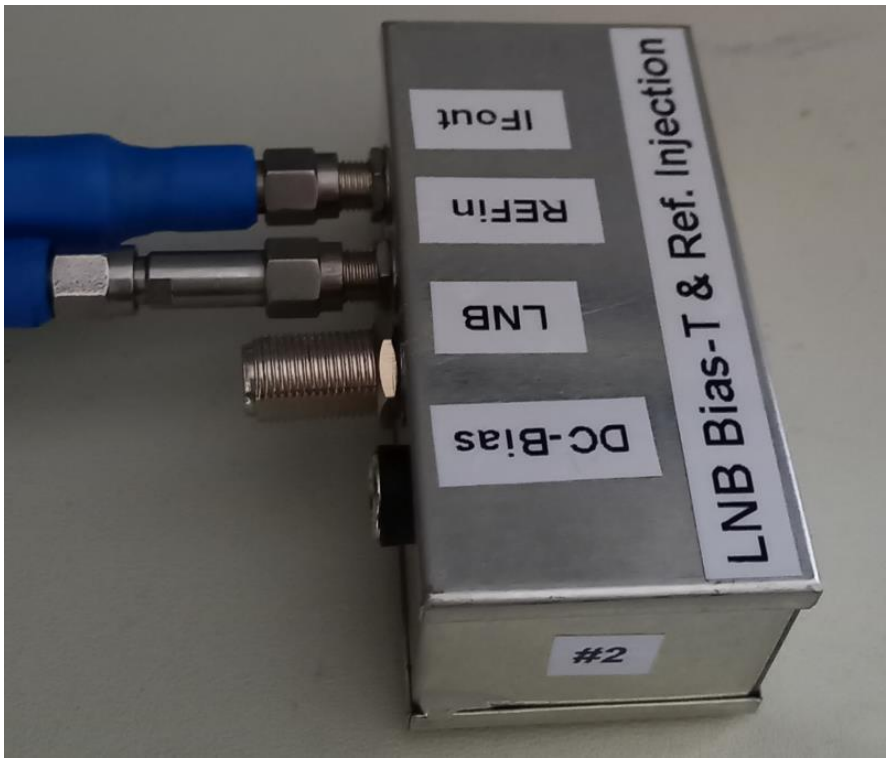
frequency	measured	corrected	nominal	additional losses
5MHz	-14.7dB	-8.7dB	-9.1dB	0.4dB
10MHz	-14.7dB	-8.7dB	-9.1dB	0.4dB
25MHz	-14.7dB	-8.7dB	-9.1dB	0.4dB
80MHz	-17.3dB	-11.3dB		
145MHz	-36dB	-30dB		
>300MHz	<-50dB	<-44dB		



The low pass filter consisting of L1, C2 and L3 has a 3dB cutoff frequency of about 80 MHz and rejects and IF signals coming from the LNB port adequately.

I measured also the reverse direction injecting the signal to the REFin port and measuring the output signal at the LNA port. The results were almost identical.

Finally, I measured the path from the REFin port to the IFout port.



In this path we can find the two before mentioned attenuators of 3 dB (R2, R4, R6) and 10dB (R1, R3, R5) nominal attenuation. In addition, the cascaded high pass filter (C1, L2, C3) and the low pass filter (L1, C2, L3) result in a band pass filter characteristic.

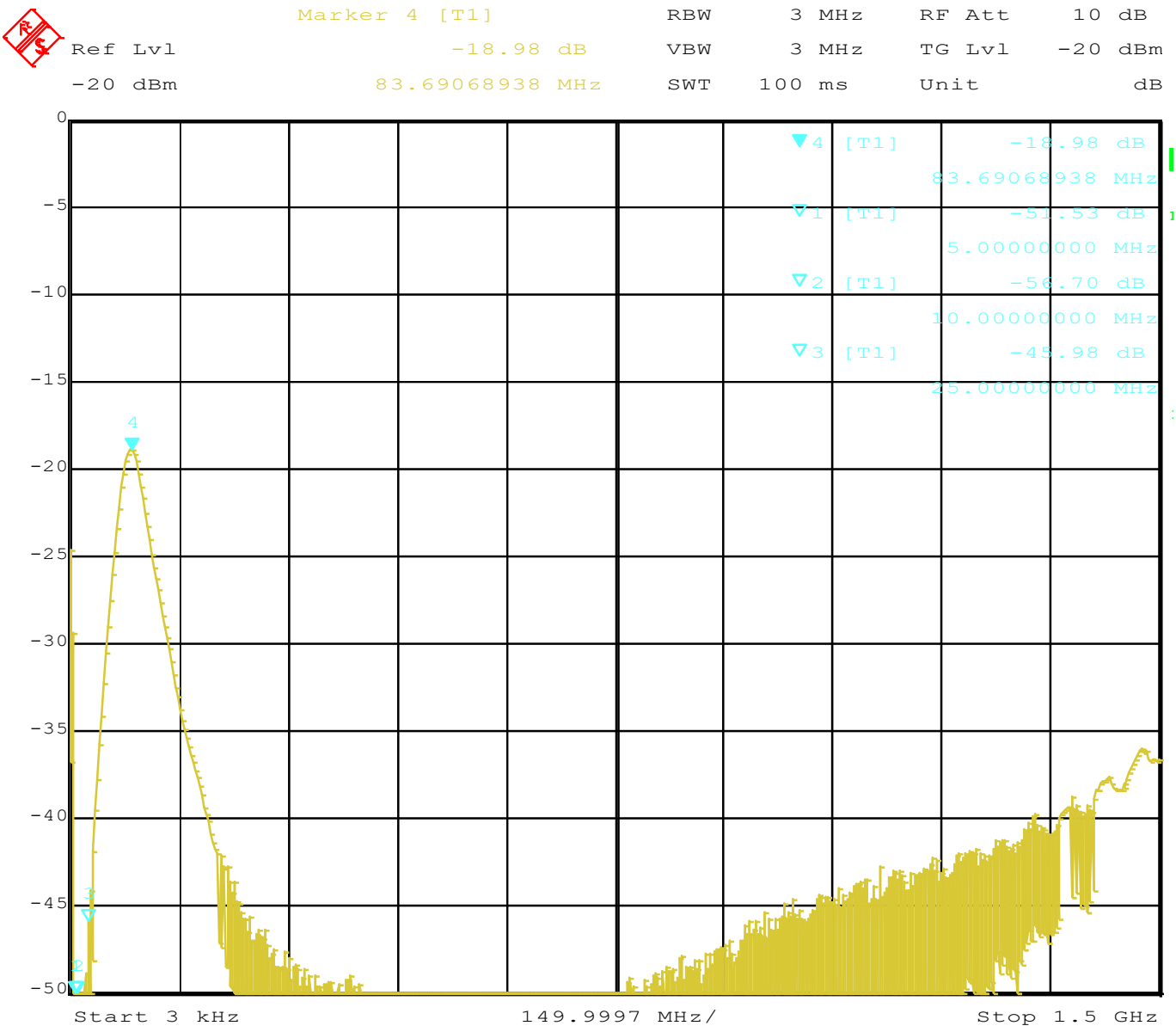
The actual insertion losses between the REFin port and the IFout port are:

frequency	measured
5 MHz	-51.5 dB
10 MHz	-56.7 dB
25 MHz	-46.0 dB
84 MHz	-19.0 dB

A correction of the measured values is not needed as the external 50 Ohm to 75 Ohm matching pad is not needed in this measurement.

In inserted reference frequency signals at port REFin are adequately attenuated at the IFout port to avoid any blocking, intermodulation or other interference in the receiver.

Here is the measured frequency response of the path from the REFin port to the IFout port.



In summary I am very pleased with the performance of this LNB Bias-T and reference injection board.

I would like to thank Mike G0MJW for making his design publicly available and providing me the sample boards.

I appreciate any feedback and will be happy to answer questions. Please send them to my Email address given below.

Kind regards

Matthias DD1US

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