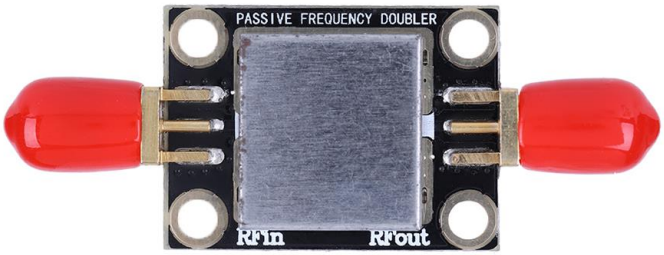
Frequency Doubler 4-8 GHz based on HMC204MS

Matthias, DD1US, November 7th 2018, Rev 1.0

Hello,

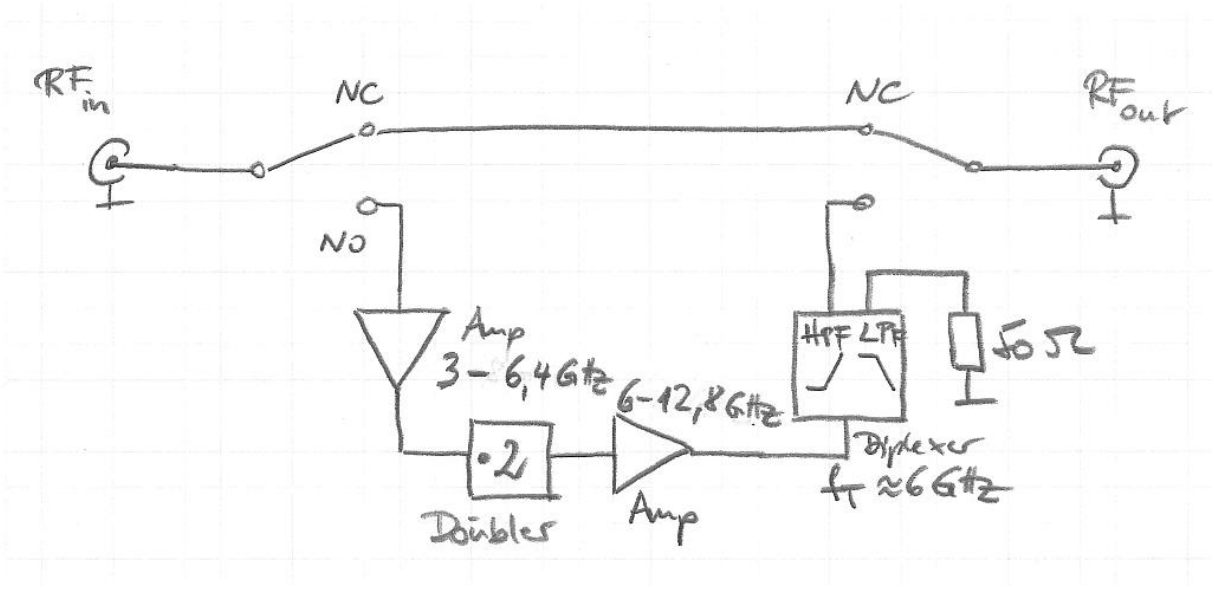
recently, PCBs with the Hittite HMC204MS passive frequency doubler became available for very low cost on Ebay. As I just finished refurbishing a R&S SMIQ06 signal generator, which covers the frequency range up to 6.4 GHz I decided to build a frequency doubler based on such a board. The boards are available as a PCB with a tin-plated lid for shielding or embedded in a milled aluminium encasing. Both units are using female SMA connectors for the input and output ports. Here are pictures of the 2 versions:



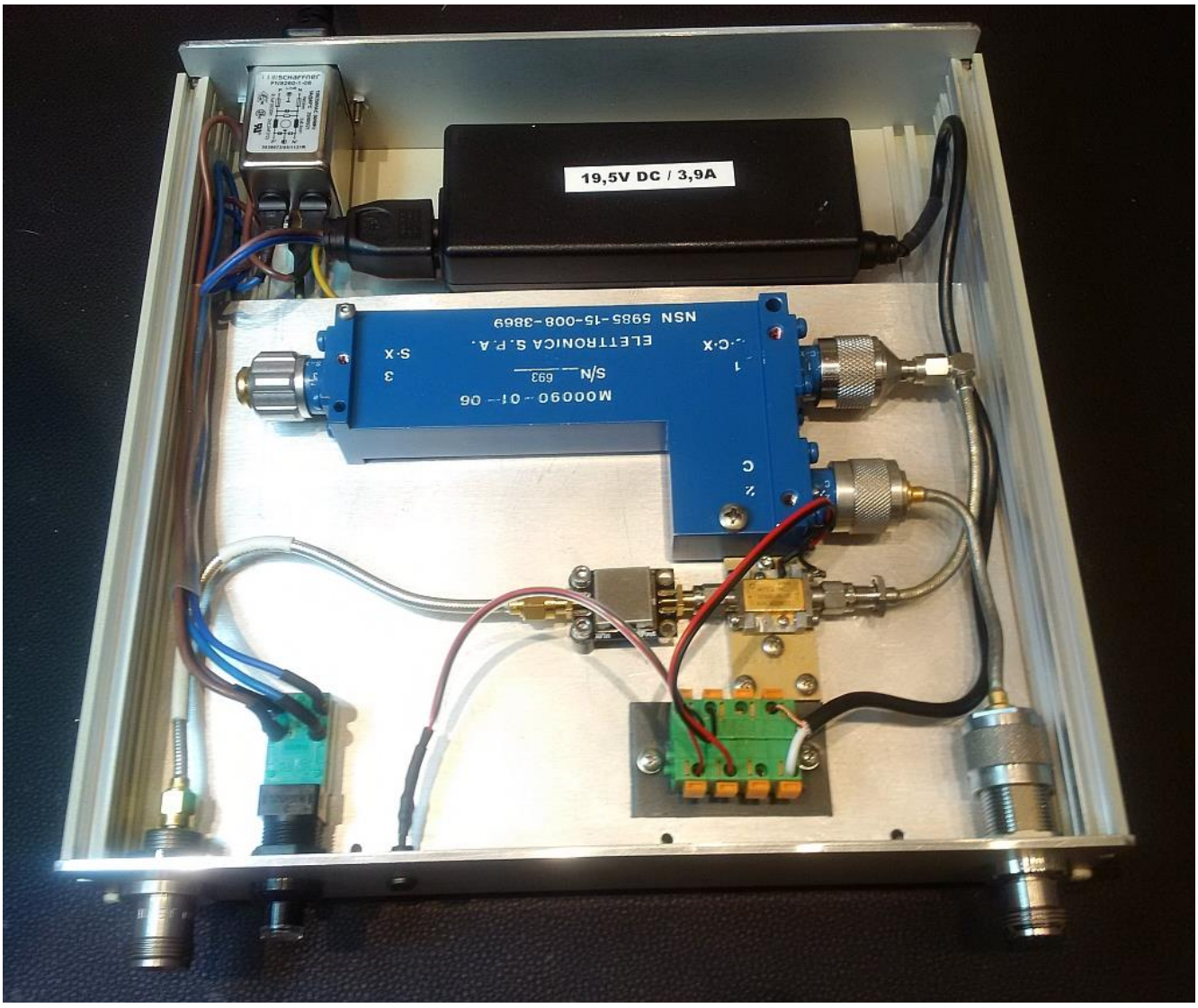
As I planned to integrate the doubler together with other components in a larger encasing I decided to go for the cheaper PCB with the simple lid for shielding.

The HMC204MS (from Hittite, which is now part of Analog Devices Inc.) is a passive frequency doubler for an input frequency range of 4-8 GHz with a conversion loss of typically 17dB (max. 21dB). The suppression of undesired fundamental and higher order harmonics is typically 42 dB (min. 35dB) with respect to the input signal level. The optimum input drive level is +15dBm.

Here is a sketch of the block diagram of my planned setup:



As I was lacking a suitable input amplifier I build the setup above also omitting the bypass relays, which I might add at a later stage. Here are pictures of my setup:

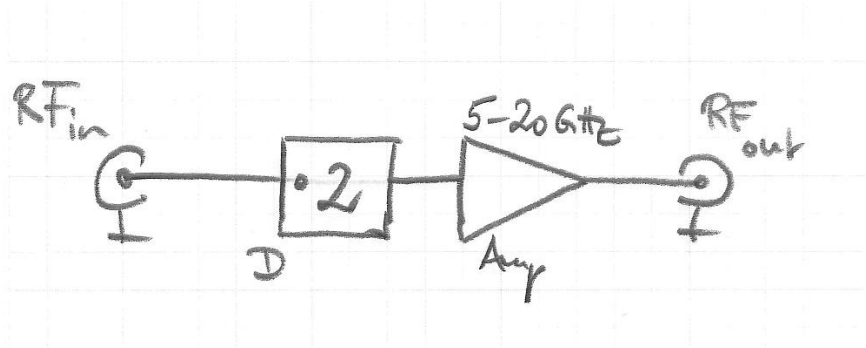



RF input
Power
DC on
Frequency Doubler
Input Frequency 3 - 8 GHz
Output Frequency 6 - 18 GHz

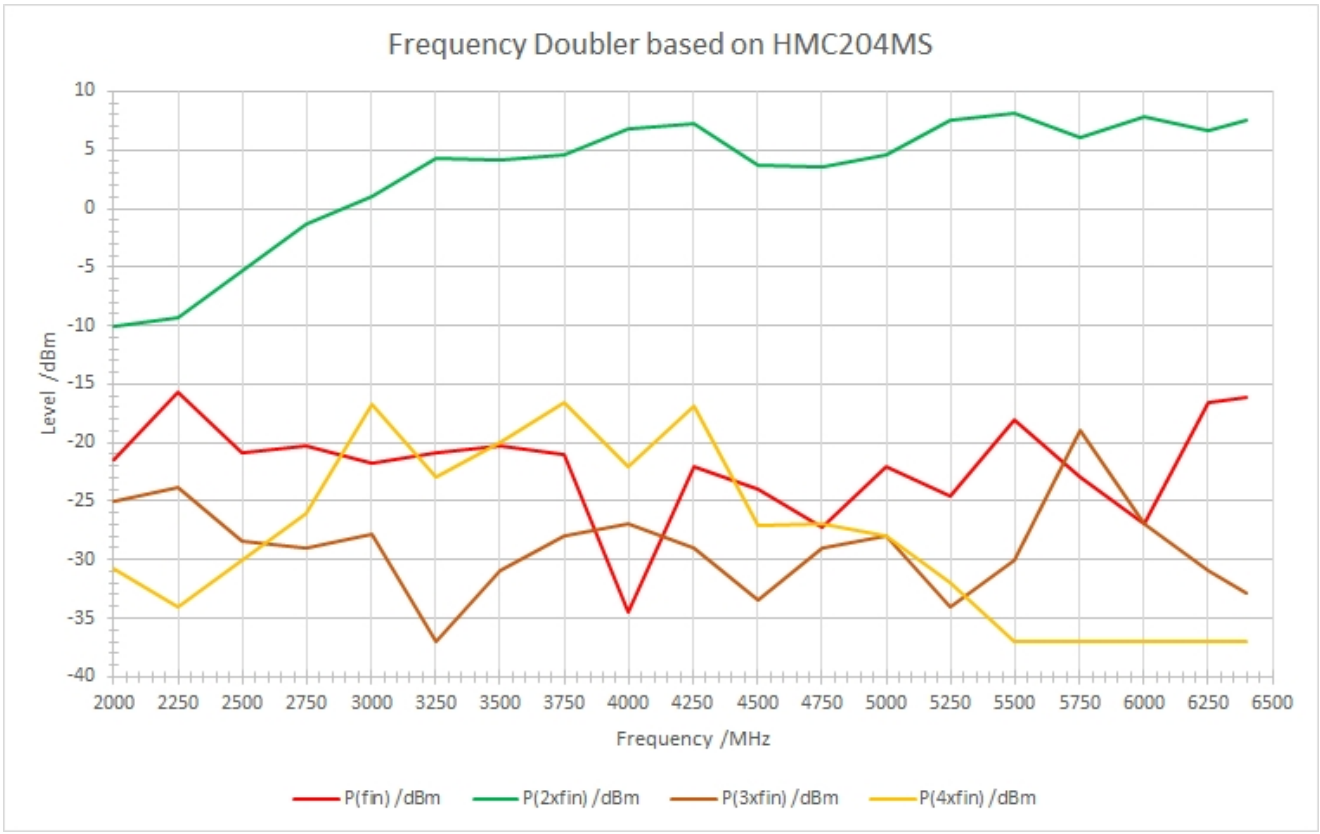

RF input
Power
DC on


RF output

Unfortunately, it turned out that the diplex filter at the output, which I wanted to use to terminate the unwanted subharmonic signal and filter out the frequency doubled signal, was not suitable. The part number is P/N M00090-01-06 and they were produced by a company in Roma/Italy called Elettronica S.p.A. Roma. You can find a detailed description of the diplexer in a separate document on my website. The high pass section of the diplexer was in fact a band pass filter which did strongly attenuate signals already at 6.5 GHz and above. Therefore, I removed this diplexer and the subsequent measurements were only done with the passive doubler and a broadband amplifier (MITEQ 121643-10-17) boosting the output levels by about 12-14 dB at 5 GHz and above. You can also find a description of this amplifier in a separate document on my website.



Here is a diagram of the measured output signals:

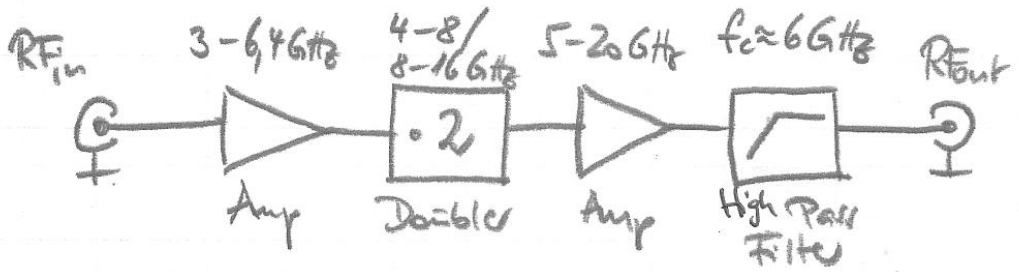


The green curve P(2xfin) shows the output level of the wanted output signal (at twice the input frequency) as a function of the input frequency. Please note that I did not calibrate out the losses of the coaxial cable between the output of the unit and the input of the spectrum analyser which I used for the measurements. Thus, the real output level will be a bit higher, I estimate 0.5 dB at the lower frequencies (4 GHz) and 2dB at the higher frequencies (13 GHz). The red curve P(fin) shows the residual input signal of the doubler measured at the output port. The input level was always set to

+16 dBm (minus the losses of the coaxial cable between the signal generator and input of the doubler which I did not calibrate out). The brown and the yellow curves show the corresponding output signals at 3x and 4x of the input frequency. The measurement limit was about -37dBm.

The measurement results are in line with the datasheet parameters of the HMC204MS.

In the next step I plan to add an amplifier before the doubler in order to reduce the needed input power and also add a high pass filter before the output of the setup to reduce the level of the subharmonic signal.



Both parts are ordered and I expect them to arrive in the next weeks. I have not yet decided whether I will add bypass relays as originally envisioned.

I am always interested in feedback. Please send it to the Email address given below.

Best regards

Matthias

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