Improving SDR based on QSD at low frequencies (typically 50 – 500 Khz)

SDR (Software Defined Radio) receivers widely use direct I&Q direct baseband conversion .
The typical circuits used are QSD (Quadrature Sampling Detectors) .
This circuits allows high IP3 values but they are built with switches driven from square waves .
This means that the conversion process works not only at the fundamental frequency but also at all the harmonics .
The square waves have very rich harmonic odd content .
For example the third harmonic is only 17 dB below the fundamental .
This means that a receiver based on QSD receive at the third harmonic of the OL with only17 dB of attenuation !
At frequencies from around 1.5 to 30 Mhz , to avoid this problem , it could be easy to design a good internal preselector with double tuned tracking bandpass filter , and this was done in designing Ciao Radio H101: http://www.comsistel.com/Ciao%20Radio.htm .
Under this frequencies , the coils and capacitors become quite large (in value and dimensions) , lossy , and expensive .
Fr this reason there is only one lowpass filter at 1.6 Mhz , for receiving the frequencies under this limit that allow very sharp receptions till around 560 Khz .
To avoid the problem of odd harmonics at lower frequencies , the best way is to use a bank of low pass filters .

Some examples :

Band definitions :

LF Broadcasting Band : 153-279 Khz .
NDB (Non Directional Beacons) : 190-535 Khz
MF Broadcasting Band : 535-1705 Khz

1) If you want to receive 75 Khz or 77.5 Khz , time and frequency stations , the third harmonic lie at 225 and 232.5 Khz , where very strong LF broadcasting signals are present .
2) If you want to receive in the LF band , at 270 Khz ,the third harmonic lies at 810 Khz , where very strong MF broadcasting signals are present .
3) If you want to receive at 535 Khz , the third harmonic lies at 1605 Khz , where other very strong broadcasting signals are present .

A possible solution :

For several other uses , I have a blackbox on the table of the lab where some lowpass filters are switched between two BNC connectors .
This could be a solution and the drawing is attached .
I have used the common values I had in the shack approaching the values calculated from the Software RFSIMM99 .
For improving the performance of Ciao Radio H101 between 50 and 600 Khz , of course only the first four low pass are eventually needed if not using at this frequencies antennas with passband behaviours .
A special filter tailored for the NDB band as been designed on the side .

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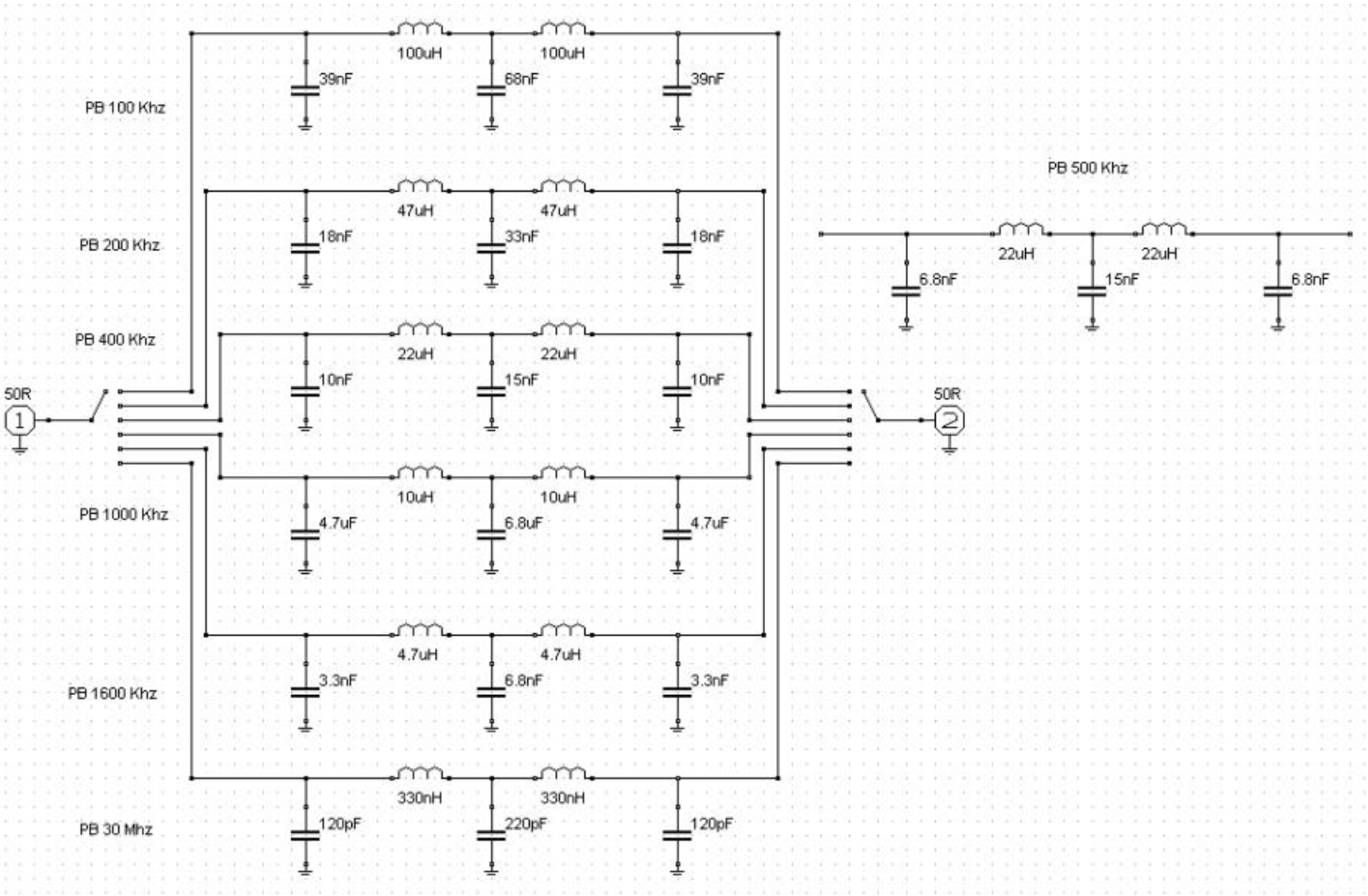
PB 100 Khz
100uH
100uH
39nF
68nF
39nF
PB 200 Khz
47uH
47uH
18nF
33nF
18nF
PB 400 Khz
22uH
22uH
10nF
15nF
10nF
PB 1000 Khz
10uH
10uH
4.7uF
6.8uF
4.7uF
PB 1600 Khz
4.7uH
4.7uH
3.3nF
6.8nF
3.3nF
PB 30 Mhz
330nH
330nH
120pF
220pF
120pF
50R
1
50R
2
PB 500 Khz
22uH
22uH
6.8nF
15nF
6.8nF