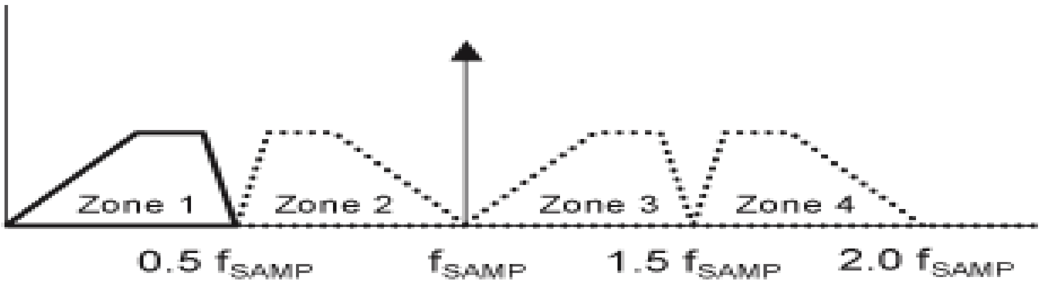
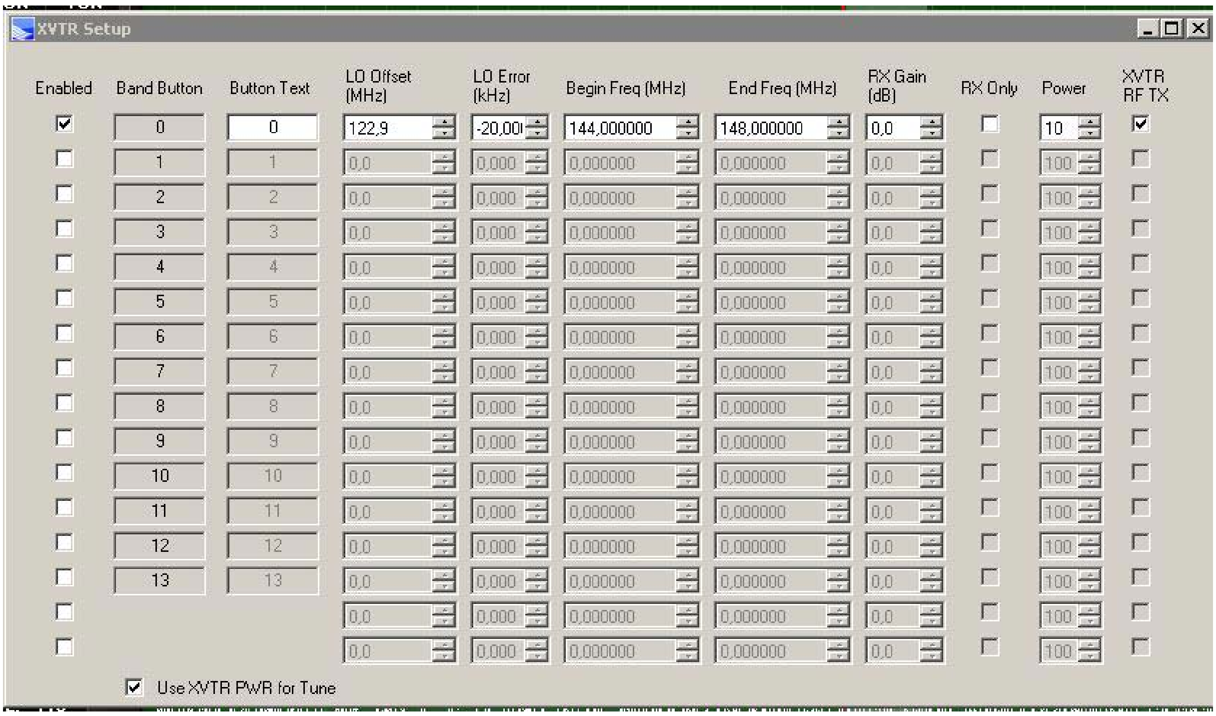
VHF DDC/DUC Extension of HPSDR systems

The HPSDR concept uses for the HF frequency range the principle of oversampling, i.e. the sampling frequency is at least twice of the maximal operating frequency. This frequency range between 0 and 66.44 MHz is called 1. Nyquist zone. To avoid that signals from the higher zones can reach the ADC an anti-alias LPF is necessary in front of the ADC.
On the other hand signals from the higher zones can be also processed, if appropriate BP filtering is provided. This principle is called undersampling.



Zone 3 is including the attractive 2m ham radio band and is offering the advantage of no side-band inversion. In the settings of e.g. PowerSDR a 2m DDC/DUC can be easily ‘programmed’ in the same formal procedure as an analog transverter:


XVTR Setup

Enabled	Band Button	Button Text	LO Offset (MHz)	LO Error (kHz)	Begin Freq (MHz)	End Freq (MHz)	RX Gain (dB)	RX Only	Power	XVTR RF TX
☑	0	0	122,9	-20,00	144,000000	148,000000	0,0	☐	10	☑
☐	1	1	0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐	2	2	0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐	3	3	0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐	4	4	0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐	5	5	0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐	6	6	0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐	7	7	0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐	8	8	0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐	9	9	0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐	10	10	0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐	11	11	0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐	12	12	0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐	13	13	0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐			0,0	0,000	0,000000	0,000000	0,0	☐	100	☐
☐			0,0	0,000	0,000000	0,000000	0,0	☐	100	☐

☑ Use XVTR PWR for Tune

The following describes a 2m band DDC/DUC undersampling extension for experimenters, easily to connect especially to ATLAS-based HPSDR configurations. The simple circuit combines good VHF performance with the well-known features of HPSDR:

The VHF signal path contains a HPF, an ultra-low noise E-PHEMT MMIC amplifier and a surface mount BPF with high rejection. Total noise figure of the array is around 1.5 dB, absolutely sufficient for terrestrial operation.
The TX path consists of a HPF, 2 standard 20 dB MMIC amplifiers and a BPF as in the RX path to provide the necessary stop band performance. The VHF output level is around +17 dBm (50mW) and can be amplified to a couple of watts using cheap MOSFET modules. This level is also sufficient for some microwave TRVs with 144 MHz IF of Michael Kuhne, DB6NT.

I used PENELOPE as TX signal source because the access to the DAC is very comfortable via JP3. Unfortunately on PENNYLANE and HERMES this socket is not available, but may be somebody has a good is idea for appropriate access.

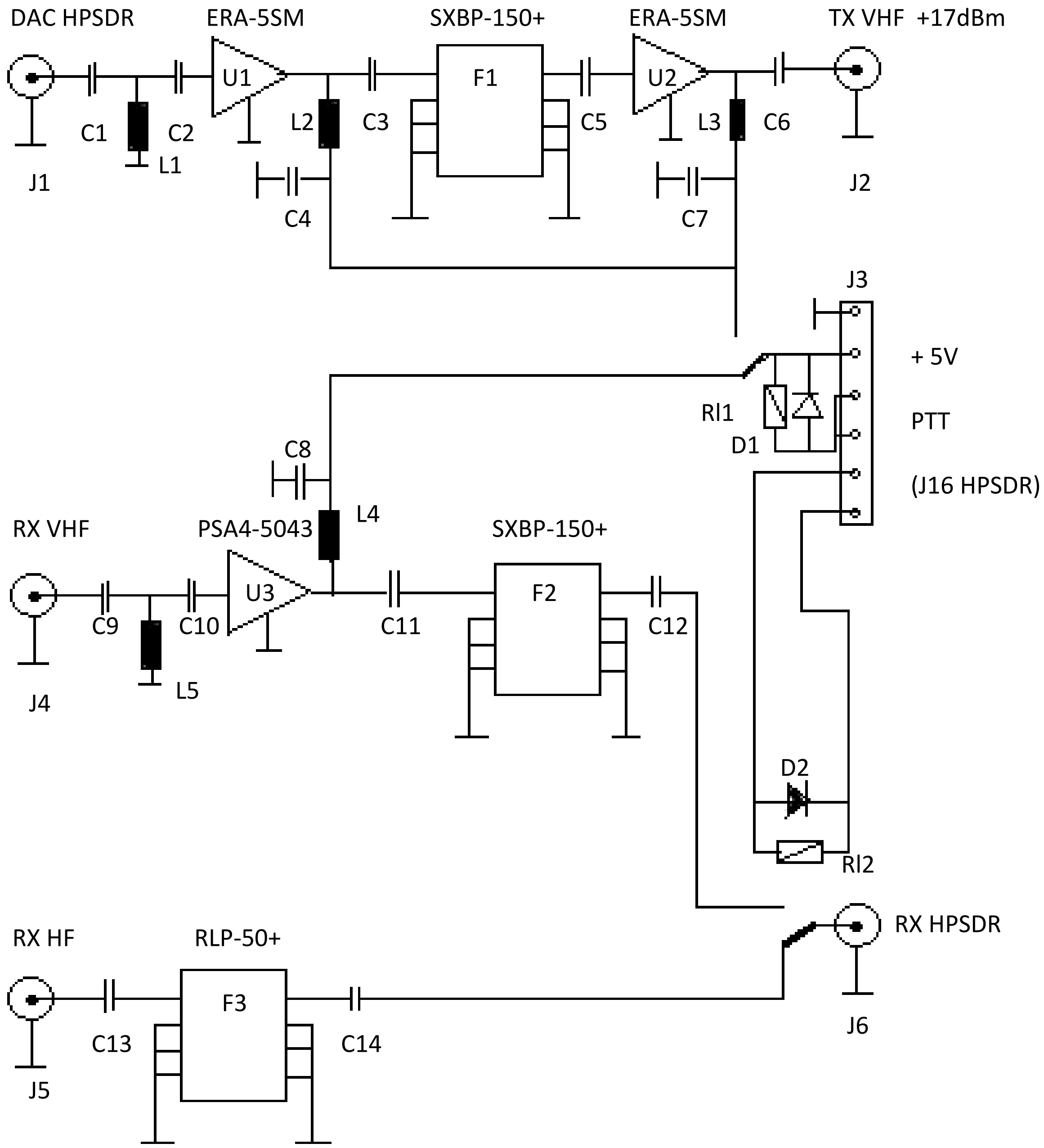
As the RX signal path on MERCURY etc. is blocked for VHF signals by the anti-alias LPF, this filter has to be bridged by short piece or wire. Out of this reason an additional switchable anti-alias LPF for the HF band operation is provided on the extension board (controlled via J16 open collector).

A simple double-plated PCB carries the SMA right angle jacks and the Molex connector on one side and all other SMD components on opposite side. No galvanized through-holes are necessary.

This little project should be an approach to test undersampling performance of the HPSDR configuration. I think the HPSDR philosophy obligated to DDC/DUC technique for the higher bands too. Schematics and BOM are attached.

Any comments, suggestions and improvement would be appreciated.

73, Helmut, DC6NY



VHF DDC/DUC Extension Board for HPSDR concepts

Rev.1.2 18/9/2013 *copyright DC6NY*

Description	Value	Foot print	Manufactorer
C1, C2, C9, C10	15 pF	805	
C3, C5, C6, C11, C12	1 nF	805	
C4, C7, C8, D13, C14	100 nF	805	
D1, D2	LL4148	Mini-Melf	
F1, F2	SXBF-150+		mini-circuits
F3	RLP-50+		mini-circuits
J1, J2, J4, J5, J6	SMA (right angle		Emerson
J3	5/6 pin		Molex
L1, L5	47 nH, Q< 45	805	
L2, L3, L4	choke. R< 0.15 ohms	1210	
Rl1	5V SMD relay		Fujitsu FTR B3CA4,5Z
Rl2	12 SMD relay		Fujitsu FTR B3CA012Z
U1, U2	ERA-5SM		mini-circuits
U3	PSA4-5043		mini-circuits

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