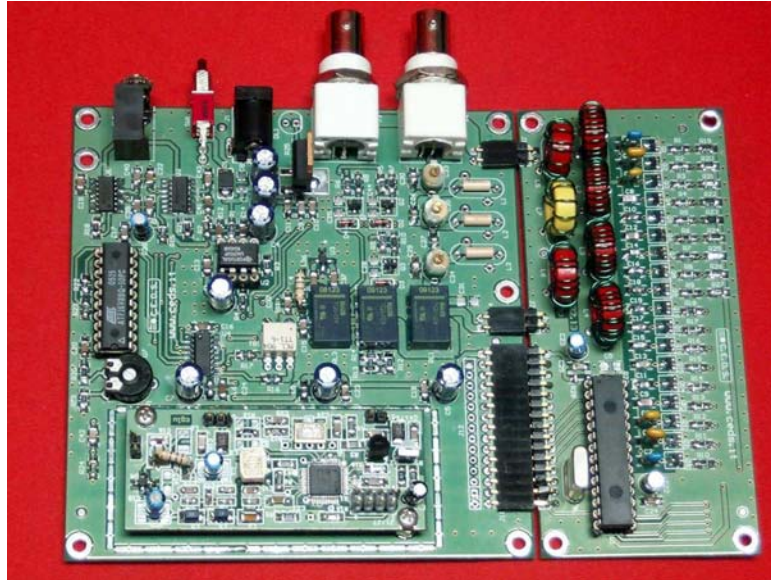# Features of the I0CG SDR-X receiver

The **SDR-X** receiver, in its full version is capable of continuously tuning the entire H spectrum, 6m (50- 52 MHz) band included. SSB, AM etc. demodulation, bandpa filtering, noise reduction etc. are performed by ad-hoc programs on a PC, among whic **PowerSDR** by *FlexRadio Systems* and **Winrad** by *I2PHD*. The aforemention programs are freely downloadable from the Internet

The Local Oscillator of the receiver uses a high performance **DDS** with a 14 bit DAC converter that sports a **SFDR** (*Spurious Free Dynamic Range*) greater than 80 dB (**AD9951**). The control panel, in addition to displaying the Rx frequency on a 2-row, 16-character LCD display, implements many other functions as:

- Tuning via an optical encoder
- Tuning steps selectable between 1 Hz and 1 MHz
- Auto-step for quick frequency excursions
- Attenuator optionally selectable
- Preamplifier optionally selectable
- Dedicated keys for the HAM o SWL bands
- Two VFOs (VFO-A and VFO-B)
- Memory read and memory write
- Scan mode between two programmable limits
- Memory scan
- RIT
- Frequency SPLIT (when used with the upcoming TX module)
- Frequency directly settable via the PC keyboard

Short description of the circuit

Just after the antenna connector, there is a preselector tunable over the entire HF band, synchronously with the frequency received. This preselector is implemented on a separate module, with its own microprocessor, pluggable into the side of the main PCB. A second antenna connector is provided for the 6m (50 MHz) band. This input has its own dedicated preselector on the main PCB, that, optionally, can be modified to tune a specific HF band should a mono-band receiver be all what is needed. In this case, the plug-in preselector can be omitted .

After the preselector there is a selectable 10dB attenuator, followed by a selectable 11dB preamplifier, operative on the entire HF band up to 50 MHz.

Then it follows a **QSD** (*Quadrature Sampling Detector)* type mixer. Its characteristics are a very low intermodulation, low insertion loss and suppression of the unwanted image frequency in NZIF (Near Zero IF, < 100 kHz) receivers. This type of mixer outputs I/Q components that are then processed by a **DSP** (*Digital Signal Processor*) or a **PC**, and this limits the max value of the IF to 100 kHz. After the mixer the two I/Q channels are amplified by low-noise differential amplifiers with about 40dB gain. The amplified I/Q signals are then sent to the output connectors for the PC to process them.

The two quadrature LO phases needed by the QSD are generated by a **PL** (*Programmable Logic Device*) that divides by 4 the frequency of the signal generated l the **DDS (**Direct Digital Synthesizer) , which operates at a frequency 4x that of recepti (e.g. 200 MHz for the 50 MHz band).

The DDS used is presently the best offered by the market, with a SFDR > 80 dBc and a phase noise > 130 dBc/Hz at 1kHz. The DDS module is plugged on the main PCB, and this allows for an easy substitution with a future, better model. For a simple, fixed frequency implementations of the receiver, the DDS can be substituted by a crystal oscillator at 4x the frequency of interest. As an example, as the PC software, with the right sound card, can tune a segment from -48 to +48 kHz across the LO frequency, using a 28,200 kHz crystal it is possible to tune almost all the European 40m band.

Analysis of the front-end filters of the preselector

Here following the plots of the 50 MHz filter, implemented with three coupled L resonators. Then the response curves of the automatic preselector at 3.6 MHz and ? MHz. The insertion losses are below 3 dB on almost all the HF spectrum

As you can see, the selectivity decreases going from low to high bands, which means that is very good on bands where intermodulation is a problem and instead a good bandwidth is obtained where such problem is less relevant and the Ham bands are more wide (2-3 MHz)
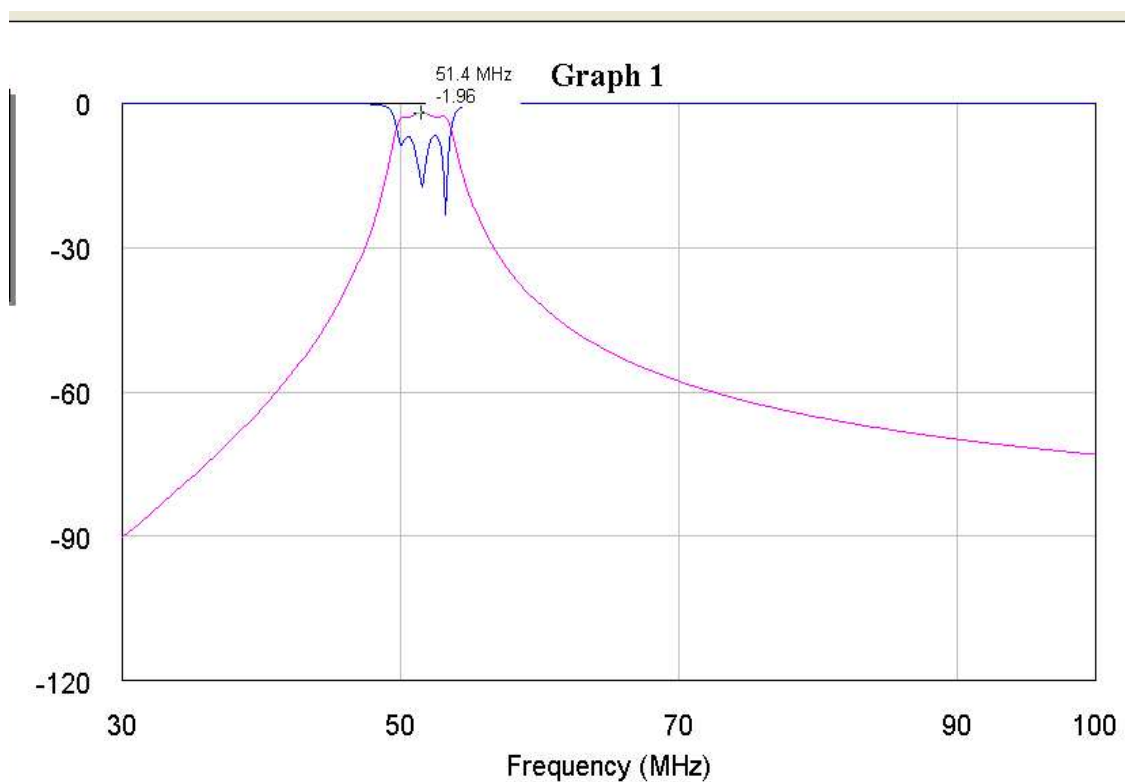
Response curve of the filter specific for the 6m band

Graph 1
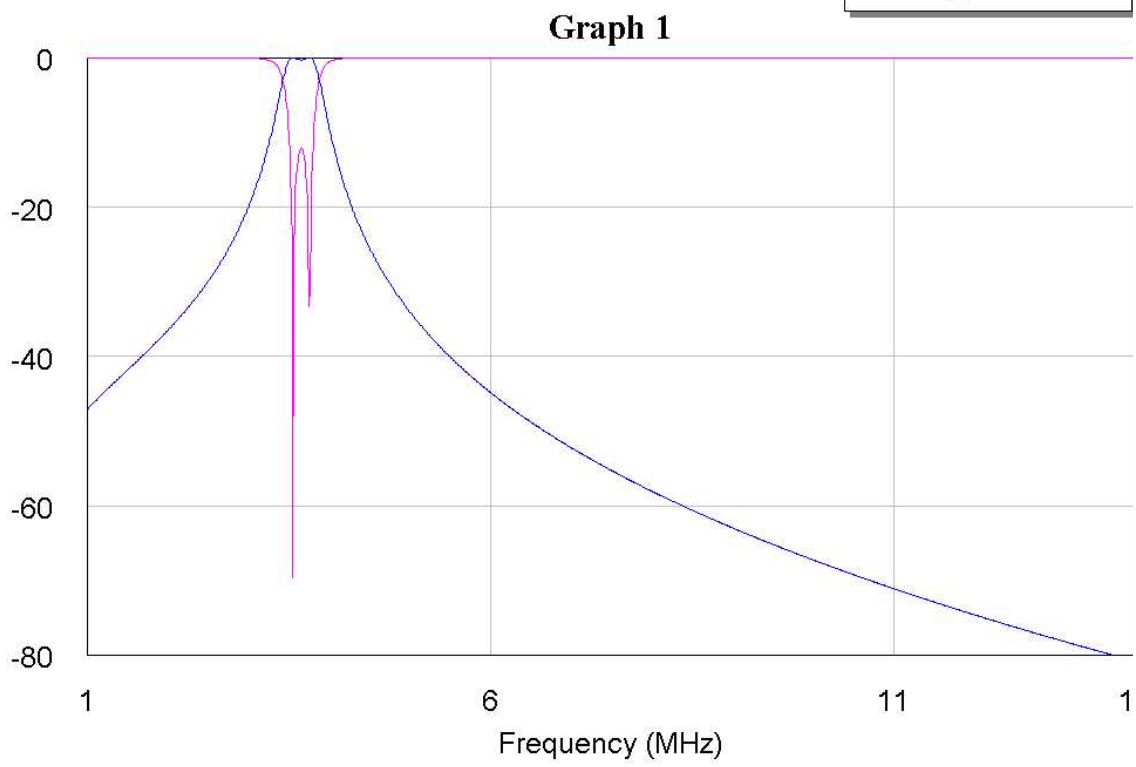
Response curve of the preselector on the 80m band (bandwidth = 400 KHz at 3 dB)

Graph 1
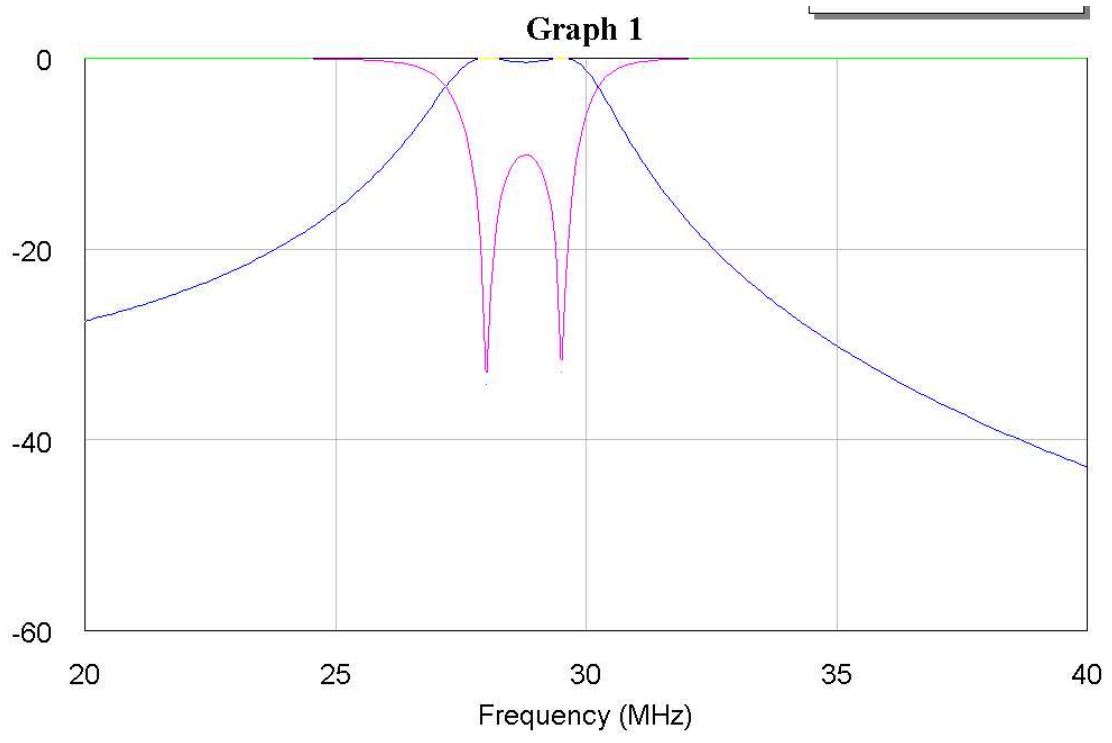
Response curve of the preselector on the 28 MHz band (3 MHz at 3 dB from 27 to 30 MHz)

Electrical characteristics:

- Frequency range : 1.8 – 30 MHz + 50 MHz
- Optional preselector, with autotuning over all the HF band
- Dedicated antenna connector for the 6m band, with its own dedicated filter
- 11dB preamplifier optionally insertable
- 10dB attenuator optionally insertable
- QSD (Quadrature Sampling Detector) type mixer
- Post mixer amplifier with 0.8 nV/sqrt(Hz) noise and > 40dB gain
- I/Q outputs on a stereo 3.5mm connector for the PC sound card
- sensitivity : MDS better than – 125 dBm (500 Hz bandwidth)
- IP3: > T.B.M.
- Image frequency rejection > 60 dB (with a properly adjusted PC software)

Note: T.B.M = to be measured

Possible versions:

1. Monoband receiver on a frequency between 1.8 and 50 MHz (without LCD panel).
2. General coverage receiver, controlled by the PC (WINRAD-RX)
3. General coverage receiver with control panel, LCD display, optical encoder, with F max of 30 or 50 MHz (the 50 MHz version requires the optional 500 MHz clock for the DDS module)
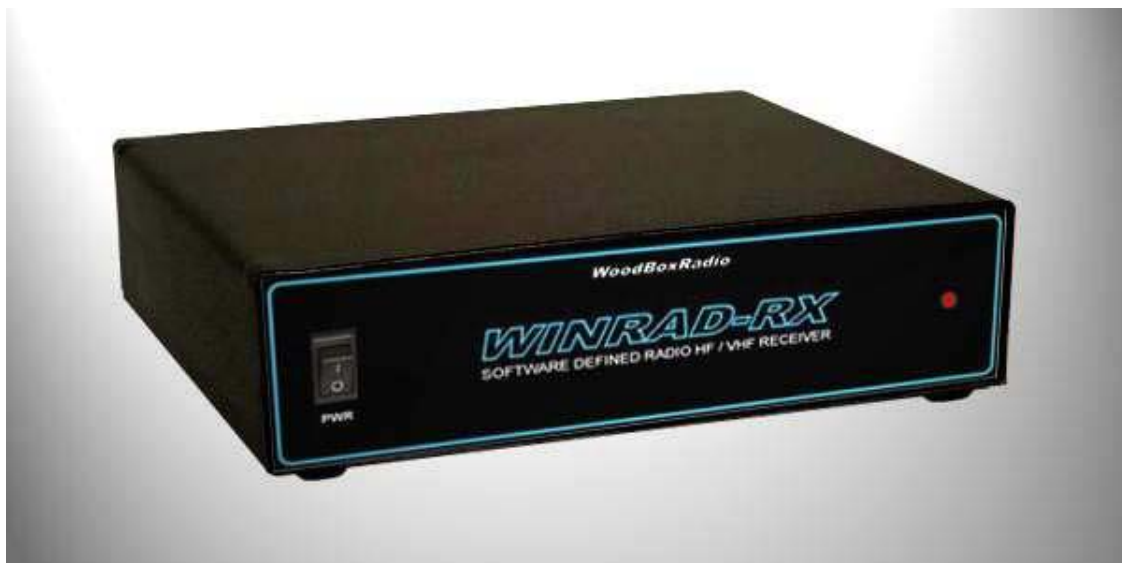
See more informations at http://it.geocities.com/giulianoi0cg/sdrx.html

SDR-X CONFIGURATIONS
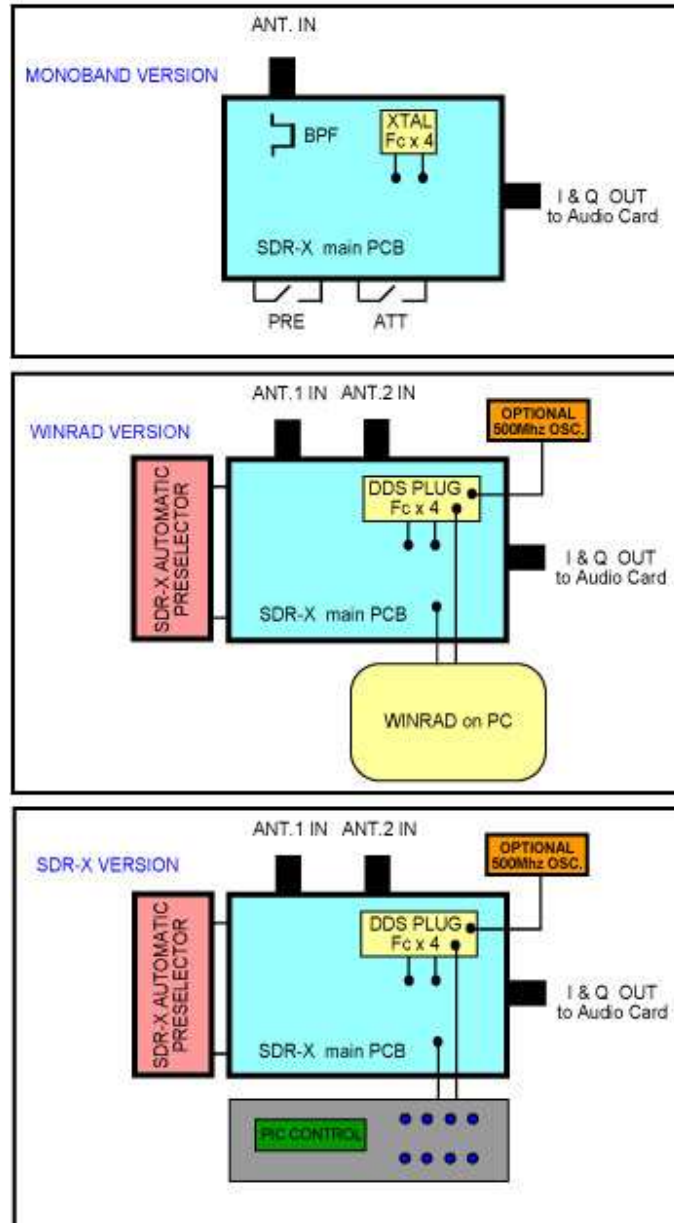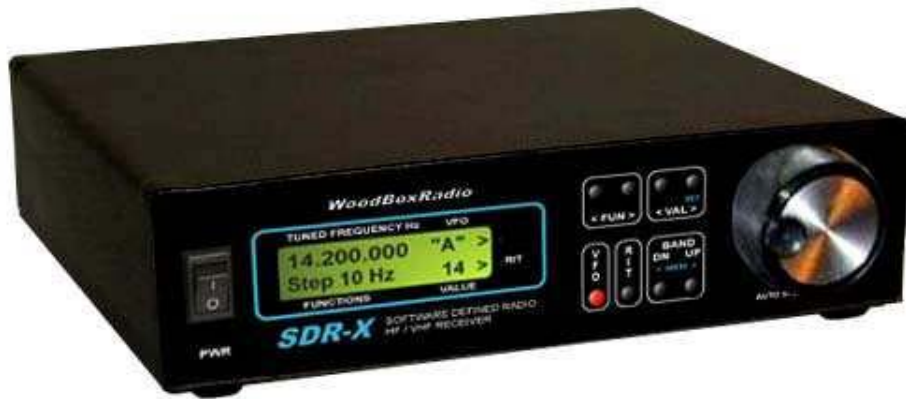
SDR-X GENERAL PURPOUSE HF+50 Mhz SDR Receiver

WINRAD-RX HF+50 Mhz SDR Receiver