



Softrock Software Defined Radio Receiver

What sort of performance can you expect from a HF receiver that costs less than £20? Peter Hart investigates.

HISTORY. In June last year I reviewed the FlexRadio SDR-1000, a fully featured high performance HF transceiver implemented using SDR techniques. At the opposite end of the price scale lies the Softrock series of single band receiver kits which are ideal for the homebrew experimenter and for those wishing to have a dabble and a play with Software Defined Radio, perhaps prior to the purchase of the SDR-1000.

The Softrock receivers are the brainchild of Tony Parks, KB9YIG, and Bill Tracey, KD5TFD. They use essentially the same quadrature down-conversion principle as used with the SDR-1000 but in a single band crystal controlled receiver. The original Softrock-40 design has evolved rapidly through a number of versions and the current one, V6, is sold in the UK by Waters and Stanton PLC. Last summer I obtained v6.0, which is switchable between 80 and 40m. The most recent design is v6.2-lite, available as separate units for 160, 80, 40 or 30m, at a remarkably low price of £19.95. Each kit is provided with a PCB and all components together with a CD containing several assembly instructions and several soundcard receiver software programs. Although for the purposes of this review, I used v6.0, the circuitry is virtually identical to v6.2 and the same performance can be expected.

HOW IT WORKS. The Softrock receiver uses the same pair of

quadrature sampling detectors (FST3253) as is used in the SDR-1000, with simple front-end tuning. A crystal oscillator with dividers operating at 4 (or 8) times the centre frequency provides quadrature local oscillator drive to the mixers. The I and Q mixer outputs are buffered and fed to the PC soundcard inputs. Hence a slice of the band extending either side of the oscillator frequency is presented to the soundcard, the wanted and the image. Frequency selection or tuning is performed in software together with selecting the relevant band

sector either above or below the oscillator frequency. Note that there is a notch exactly at the oscillator frequency as this frequency corresponds to 0Hz input to the soundcard. The notch in practice is about 100Hz wide and limited by the values of the coupling capacitors. The performance of the radio is largely determined by the soundcard resolution (16 bits or 24 bits for best results) and the maximum tuning range is determined by the soundcard sampling frequency. For a high performance soundcard with a 96kHz sampling frequency, such as the M-Audio Delta 44, the soundcard will accept inputs up to 48kHz. Hence the tuning range of the radio will be 48kHz below to 48kHz above the divided crystal frequency (total 96kHz) with a small notch in the middle. Soundcards with 48kHz sampling will have half this tuning range.

There are a number of SDR programs freely available from various websites for use with the Softrock receiver. Of particular note are Rocky developed by VE3NEA, PowerSDR developed primarily for the SDR-1000 but adapted for use with the Softrock, and KGKSDR developed by MOKGK. All have their particular characteristics and features, but are not discussed in detail here.

CONSTRUCTION. The hardware is all contained on a small double sided PCB measuring just 38mm square (38mm x 48mm for v6.0). The four integrated circuits and a number of capacitors use surface mount technology and the remaining components are wire ended. Assembly is fairly straightforward providing you have the right tools. A fine tipped soldering iron (1mm diameter tip) and fine solder are absolutely essential, as are a bench magnifier and tweezers. Great care should be taken in soldering the surface mount components to avoid solder bridges. The toroidal inductors are a bit fiddly to wind and would benefit from self-fluxing enamelled wire. The resistor colour bands (red and brown in particular) are difficult to identify and should be checked with an ohmmeter. I found

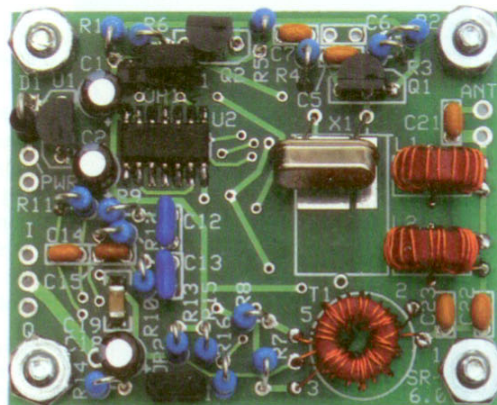


Photo 1: The diminutive SoftRock V6.0 board component side, with one penny piece for scale. Version 6.2 is similar but slightly smaller, and only has two mounting holes.

the assembly instructions very explicit and practical and it took me about 5 hours to complete the assembly. It worked first time.

PERFORMANCE. When I embarked on this project, I had it in mind to see just how well such a simple receiver could perform when compared with typical amateur receivers. In particular I wanted to compare results with different sound cards, different PCs and different software programs. My first check was using the onboard Sigma Tel soundcard in my Dell Inspiron laptop. This was a complete failure, resulting in no image rejection as the input (microphone only) did not appear to support dual channel operation.

All further tests were made using my Mesh desktop PC (1.8GHz Pentium). I used two software programs to support the hardware - Rocky 1.5, which is the Softrock recommended package, and PowerSDR 1.6.2 which will only function in Windows XP. I used two soundcards - the onboard C-Media card (16 bits with 48kHz sampling), and the M-Audio Delta 44 (24 bits with 96kHz sampling), which is the preferred soundcard for the SDR-1000. The following measured results were obtained using the Delta 44.

TEST RESULTS. Sensitivity for 10dB s+n:n measured $0.7\mu\text{V}$ (-110dBm) in 2.4kHz bandwidth LSB and $0.3\mu\text{V}$ (-117dBm) in 500Hz bandwidth CW. Strong signals can affect the receiver in a number of ways. Conventional two-signal intermodulation testing yielded a 3rd order intercept of +19dBm, or about 93dB dynamic range in SSB bandwidths. This holds for all signal spacings down to about 1kHz, similar to the SDR-1000. However more significant strong signal effects occurred when tone spacings were equal to the soundcard input frequency, yielding a reduced dynamic range of about 82dB, and other beat frequencies were also noted at about this level. When signal levels reached around 98dB above the noise floor there was a sharp onset of a large number of spurious beats. Reciprocal mixing noise is virtually non-existent due to the use of a crystal oscillator. Both the Rocky software

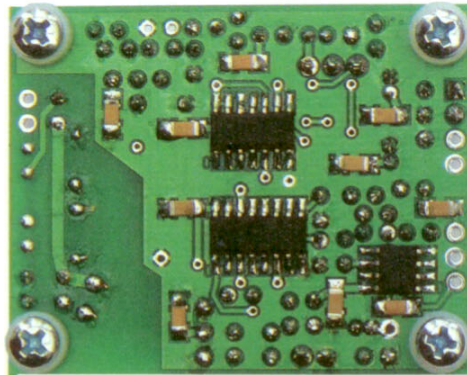


Photo 2: Underside view of the SoftRock V6.0 board, showing the remaining surface-mounted ICs and capacitors.

although the image from broadcasters and SSB was noticeable on the bottom end of 40m. The PowerSDR software has a host of features but many are not applicable to the Softrock receiver. The Rocky software is simple and straightforward with an excellent spectrum display that allows point and click tuning.

CONCLUSION. The Softrock receiver is an excellent introduction to SDR

and the PowerSDR software gave similar measurements. These are very impressive results indeed.

Image rejection measured around 50 to 60dB using the Rocky software but the PowerSDR software provides image nulling and could achieve 80dB rejection, although this would not hold to better than 50dB over the band. LO leakage out of the antenna socket was -36dBm, a respectably low level.

Results using the C-Media on-board soundcard were disappointing. The sensitivity was quite good but there were many spurious beats and a large number of spurious signals were generated with signals only 40dB above the noise floor. No further measurements were taken.

Connected to an antenna, the results were impressive for such a simple receiver. The audio quality was excellent, a characteristic of SDR. The receiver was very clean. The receiver was sensitive and generally coped well with strong signals,

and could form the basis of a high performance receive set-up, with a separate module for each band. The price is remarkably low. A good sound card is an important consideration: on-board sound cards in PCs gave poor results. PCI-bus based cards would probably prove a better proposition. The professional high performance cards such as the M-Audio Delta 44 give excellent results and although some five times the cost of the receiver would prove a good investment for anyone interested in SDR. The Softrock range continues to evolve. Apparently transceiver versions are in the pipeline, and there is an active Yahoo group that is well worth checking out.

The current version of SoftRock, V6.2, is available in separate versions for 160m, 80m, 40m and 30m for £19.95 each (+ P&P) from Waters and Stanton, 08000 737388, www.wsplc.com. My thanks to Waters and Stanton PLC for providing the review items.

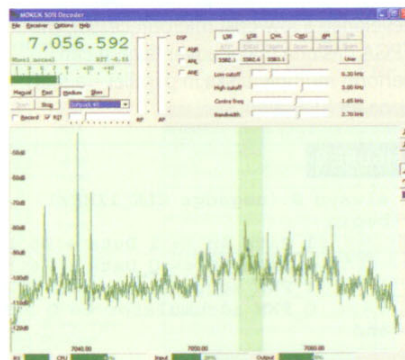


Photo 3: Screenshot of the receiver using Rocky software.

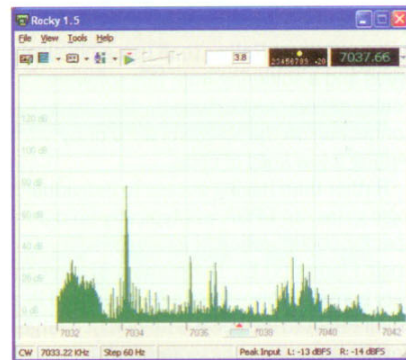


Photo 4: Screenshot of the receiver using KGKSDR software.