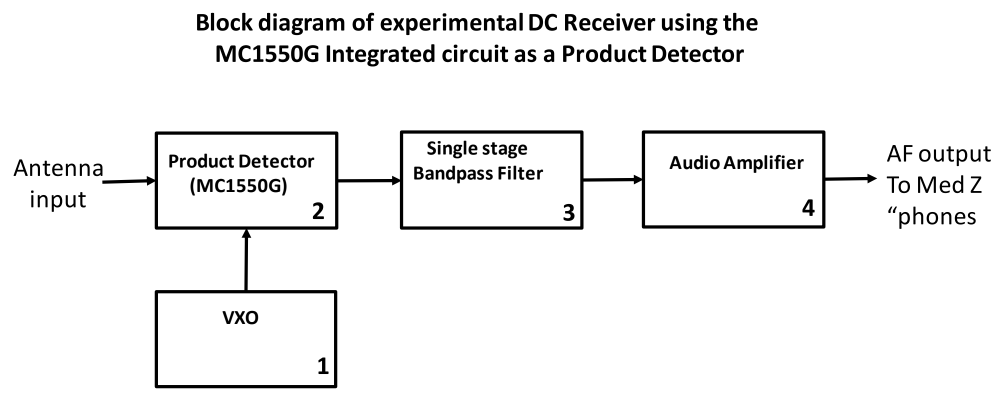
The “BITSA” 40m Direct Conversion Receiver

de ZS6AZP

The inspiration for the “BITSA”, the bits and pieces receiver, came about when I was sorting out a bunch of experimental PC boards I had constructed at different times over the years into various categories such as “receiver projects”, “filter projects”, “amplifier projects” and “VXO projects” etc and wondered what I could concoct from them for a bit of fun.

The “BITSA”, shown in block diagram form in Figure 1 was the result.

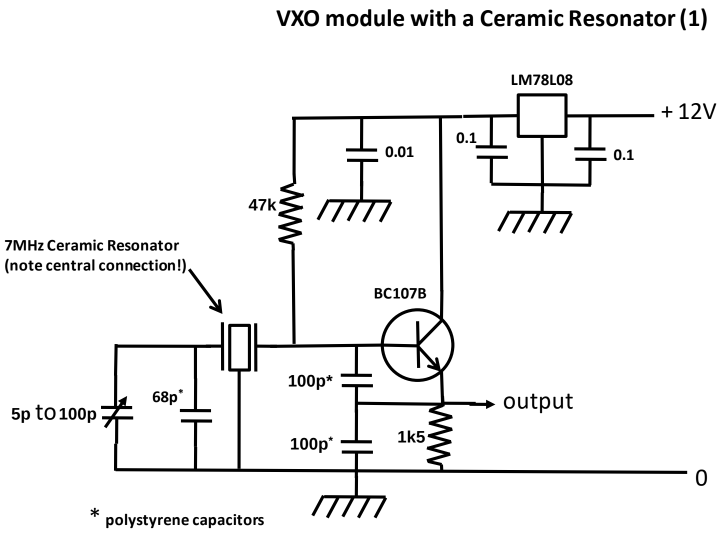
Figure 1: Block diagram



The diagram shows that the receiver, in line with the typical direct conversion receiver functional blocks, is made up of four separate circuit boards, namely a VXO for the local oscillator, the product detector, a single stage bandpass filter as well as the audio amplifier stage. While the complete receiver can also be built on a single board, my preference has always been to do things in modular form – if one module does not perform satisfactorily, remove it and try a different design. This approach avoids having to rebuild the whole unit if just one part of the design does not meet performance expectations. The ultimate in flexibility- or a sign of laziness one might say!

The VXO Module

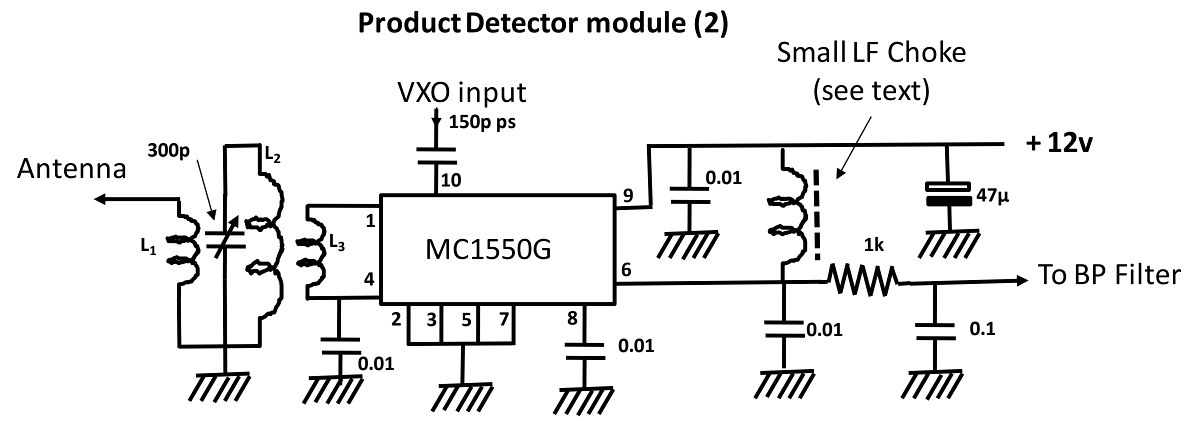
Figure 2 : VXO



This circuit, the local receiver oscillator, makes use of a 7MHz ceramic resonator (type 720cM305) kindly given to me by Daryl, ZS6DLL (sk), as the frequency determining component, which permits a much wider tuning frequency range to be obtained than can be attained from a normal crystal, but still provides reasonable frequency stability. The tuning range has deliberately been limited to 7000kHz to 7040kHz by judicious selection of the 68pF capacitor in parallel with the 100pF tuning capacitor. Frequency stability has been further enhanced by the use of polystyrene capacitors where appropriate and by powering this standard Colpitts oscillator circuit from a regulated 8 volt supply.

Product Detector Module

Figure 3 : Product Detector



L_1, L_2 & L_3 all wound on single T50 – 2 toroid

ps : polystyrene cap.

L_1 - 4 turns

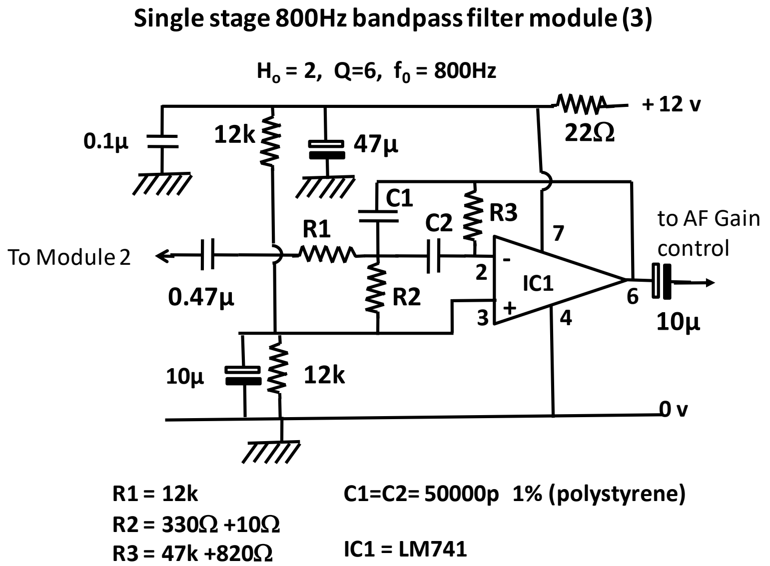
L_2 - 24 turns

L_3 - 6 turns

The key element of the Product Detector module is the MC1550 integrated circuit, which, originally designed to be used for RF-IF amplifier applications (Reference 2), has been configured as an active product detector. I first saw this particular form of application originally described by Doug DeMaw, W1CER (better known as W1FB but now sadly silent key), in Reference 1. As I had a few of these devices in my jewel box (purchased from the Club's "Component Cabinet" many years ago (for just in case I could use them sometime!), I built up the module some years ago but never got around to tying it out, so I thought it would be interesting to give it a try and see how it performed in comparison to the CA3028 single balanced mixer circuit used in the "VXO controlled 40m Portable DC Receiver" detailed in Reference 3. The only noteworthy component is the Low Frequency choke which presents the Audio Frequency load for the MC1550. I was fortunate enough to find a suitable iron cored inductor in my junk box, but the primary winding of a transistor driver transformer would do the job just as well. If using a driver transformer, the secondary winding remains unused. The internal circuit of the MC1550G is detailed in Appendix 1. The capacitor coupling the VXO to pin 10 of the product detector was specifically chosen for a signal input to the MC1550 of 1 volt peak as recommended by the late W1FB.

Single Stage Bandpass Filter Module

Figure 4 : Bandpass filter

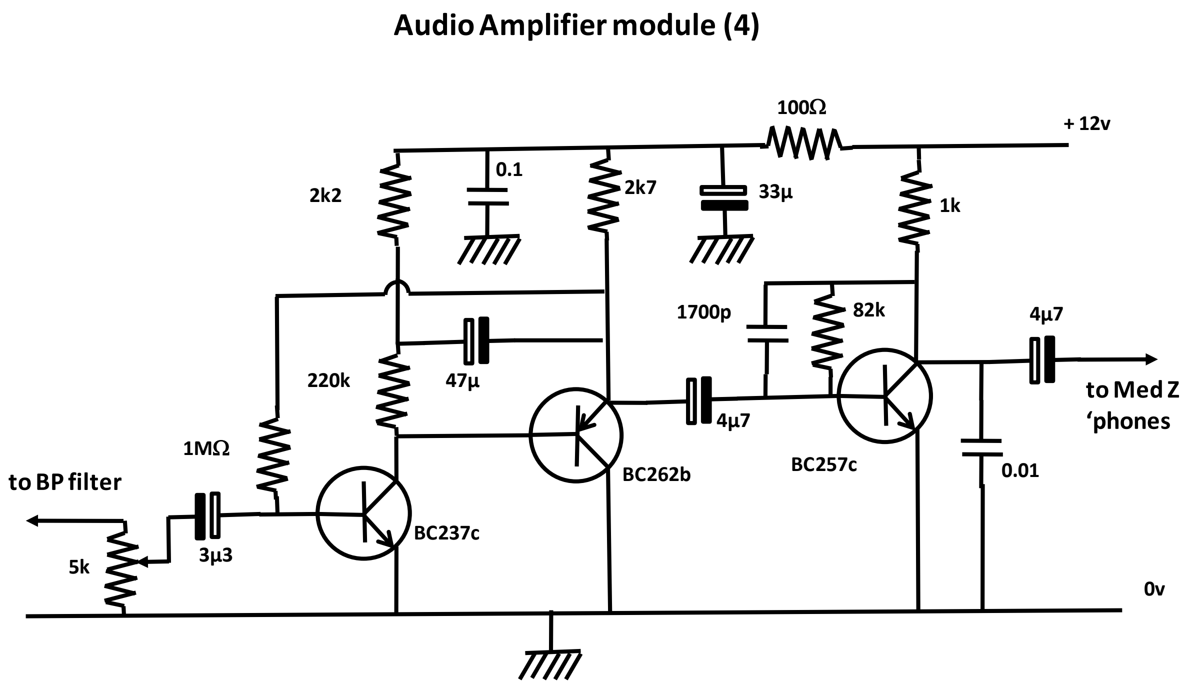


This conventional design is described in Reference 4, but for those without access to this, now out of print publication, the equations involved are also detailed in “The DCS401 40m QRP Transceiver Revisited”, ZS6AZP, on page 12 in the September 2014 edition of “CQ Centurion”, the official magazine of the Centurion Radio Amateur Club..

The filter was designed for a circuit gain of 2, a Q of 6 and a centre frequency of 800Hz, using 1% tolerance polystyrene capacitors I had to hand. It should be noted that both R2 and R3 in the circuit have been made up of 2 resistors in series to attain the correct values needed for optimal performance.

Audio Amplifier Module

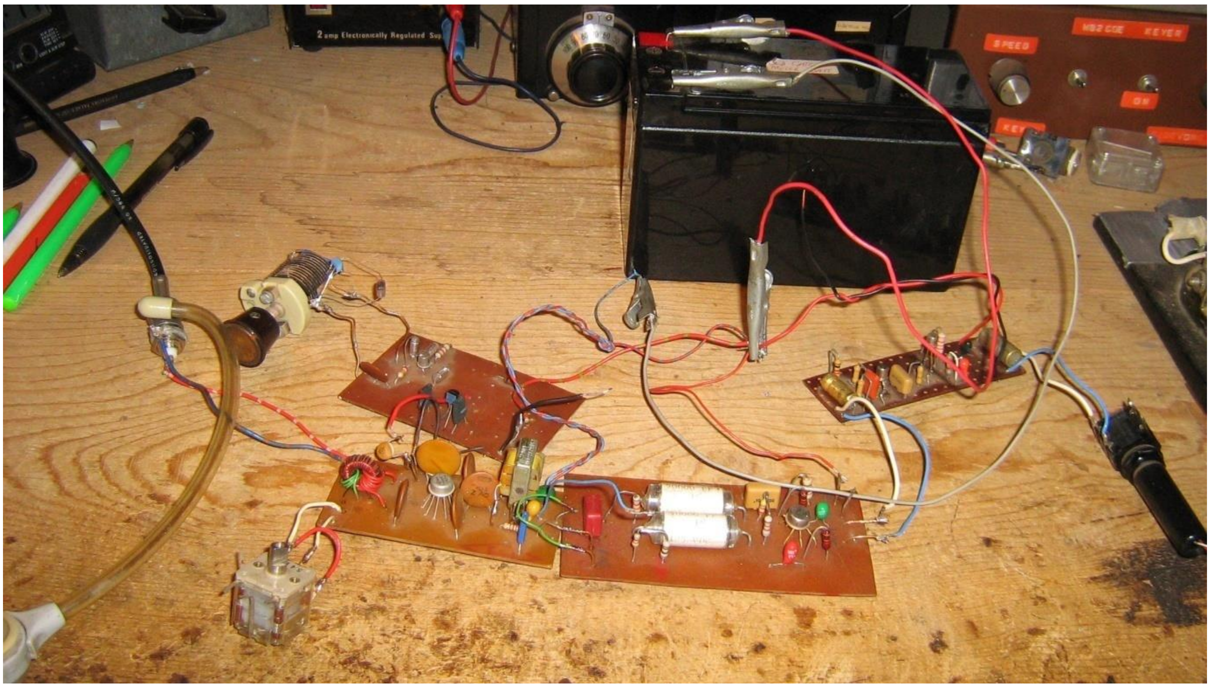
Figure 5 : AF Amplifier



The circuit of this simple, high gain, low noise, amplifier was initially published in Reference 5. The only modifications to the design was the use of different transistors than those applied in the original, and the addition of a capacitor in parallel with the 82k ohm bias resistor on the final output transistor to add a small amount of low pass filtering.

Does it work you may ask? The answer is “extremely well”, in fact even better than the CA3028 based version mentioned earlier. As the reason for building the receiver in the first place was to have a bit of fun and to see what could be cobbled up out of bits and pieces of existing circuitry, I did not take the trouble to mount it in an enclosure of any form and the picture shows the set in operation, listening to the AWA CW net on a Saturday afternoon. I must however point out that the audio amplifier in the picture was only a two transistor job, and was subsequently replaced with the three transistor version detailed in the article – just in case some eagle eyed individual notices that there are only two trannies and not three on the board!

Picture 1 – the set in service



<u>References</u>

1. “Some notes on Solid-State Product Detectors”, Doug DeMaw, W1CER, QST, April 1969

2. “Motorola Semiconductor Products” – Data Book

3. “South African QRP Circuit Handbook”, Dave Smith, ZS6AZP, First Edition 1989, page 58

4. “Solid State Design for the Radio Amateur”, W7ZOI & W1FB, ARRL Publication , page 82

5. “The EBOR 3.5MHz Transceiver”, G3GWI : G QRP Club, Compilation from SPRAT 1974-82, page 11

APPENDIX 1

Internal Circuit of MC1550G with pin-outs