THE WEST RAND AMATEUR RADIO CLUB

May 2009
Volume 9, Issue 11

ANODE

Inside this issue:

Editor's Comments

May 2009
Volume 9, Issue 11

Diarise and Prepare Now!

The Club AGM will take place on the 4th of July this year.

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What started this Anode off…

When Phillip asked about an article in the Anode about a Diplexer, I started looking for the issue. This turned out to be from the May/June/ July 2002 issue. Quite a long time ago. So I thought I would do a current search on Google.

Well none of the pages had a design or procedure for a Diplexer / Duplexer. And the search turned up some other interesting articles, some of which are presented here.

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There used to be so many AOL users

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30m Receiver Project

Special points of interest:

- Contact details on back page (corrected & updated)
- Ham-Comp Latest on web site.

A lot can be learned when using strict design criteria to build a project.

I set out to build an entire receiver using only 2N3904 transistors and at the end settled upon the design shown above. This design resembles that of the Ugly Direct receiver on this web site in a lot of ways and is also a low-cost popcorn project. A great deal of time was spent building and testing various VFO designs and investigating an interesting single-balanced mixer using two 2N3904 BJT's.

The design process and reasons for abandoning my original criteria in the case of the mixer and VFO will be discussed.

Band pass Filter

A band pass filter was designed for low insertion loss to help maintain the receiver noise figure. In keeping with this, NP0 ceramic capacitors were used for the 68 pF and 5 pF fixed-value capacitors. The trimmer cap was a 5 -20 pF ceramic variable with a Qu of 300.

(DigiKey bottom-adjusted SG20016-ND). The leads were bent so that each trimmer cap could be adjusted from the top. The L1 and L2 inductors were wound using 27 turns of #26 AWG enamel coated wire on T50-6 powdered iron toroids. A tap was made four turns up from the grounded end.

Qu is ~ 250 for these inductors. The centre frequency is 10.125 MHz, the bandwidth is 0.88 MHz and the loaded

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Editor's Comments

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and so many Radio Amateurs there. But AOL has gone the way of all the other bulletin boards…

Hometown Has Been Shutdown

Posted on Nov 6th 2008 1:30PM by Kelly Wilson

Dear AOL Hometown user,

We're sorry to inform you that as of Oct. 31, 2008, AOL® Hometown was shut down permanently. We sincerely apologize for any inconvenience this may cause.

Sincerely,
The AOL Hometown Team

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Hope this makes it clear…

Diplexer
From Wikipedia, the free encyclopaedia

A diplexer is a passive device that implements frequency domain multiplexing. Two ports (e.g., L and H) are multiplexed onto a third port (e.g., S). The signals on ports L and H occupy disjoint frequency bands. Consequently, the signals on L and H can coexist on port S without interfering with each other.

Typically, the signal on port L will occupy a single low frequency band and the signal on port H will occupy a higher frequency band. In that situation, the diplexer consists of a low pass filter connecting ports L and S and high pass filter connecting ports H and S. Ideally, all the signal power on port L is transferred to the S port and vice versa. All the signal power on port H is transferred to port S and vice versa. Ideally, the separation of the signals is complete. None of the low band signal is transferred from the S port to the H port. In the real world, some power will be lost, and some signal power will leak to the wrong port.

Television diplexer consisting of a high-pass filter (left) and a low-pass filter (right). The antenna is connected to the screw terminals to the left of centre.

The diplexer, being a passive device, is reciprocal: the device itself doesn't have a notion of input or output.

The diplexer is a different device than a passive combiner or splitter. The combiner combines frequencies adjacent to each other, from different equipment, for example say a GSM 900 and a CDMA 900 signal. There is also a power "loss" difference - a combiner takes all the power delivered to the S port and equally divides it between the A and B ports. A diplexer does not.

A diplexer multiplexes two ports onto one port, but more than two ports may be multiplexed: a three-port to one-port multiplexer is known as a triplexer.

Duplexer
From Wikipedia, the free encyclopaedia
For other uses, see duplex and duplex printing.

A duplexer is a device that combines two or more signals into a common channel or medium to increase its transmission efficiency.

In radar and radio communications systems, it is a device that isolates the receiver from the transmitter while permitting them to share a common antenna. Most radio repeater systems include a duplexer.

Note 1: A duplexer must be designed for operation in the frequency band used by the receiver and transmitter, and must be capable of handling the output power of the transmitter.

Note 2: A duplexer must provide adequate rejection of transmitter noise occurring at the receive frequency, and must be designed to op-

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30m Receiver Project

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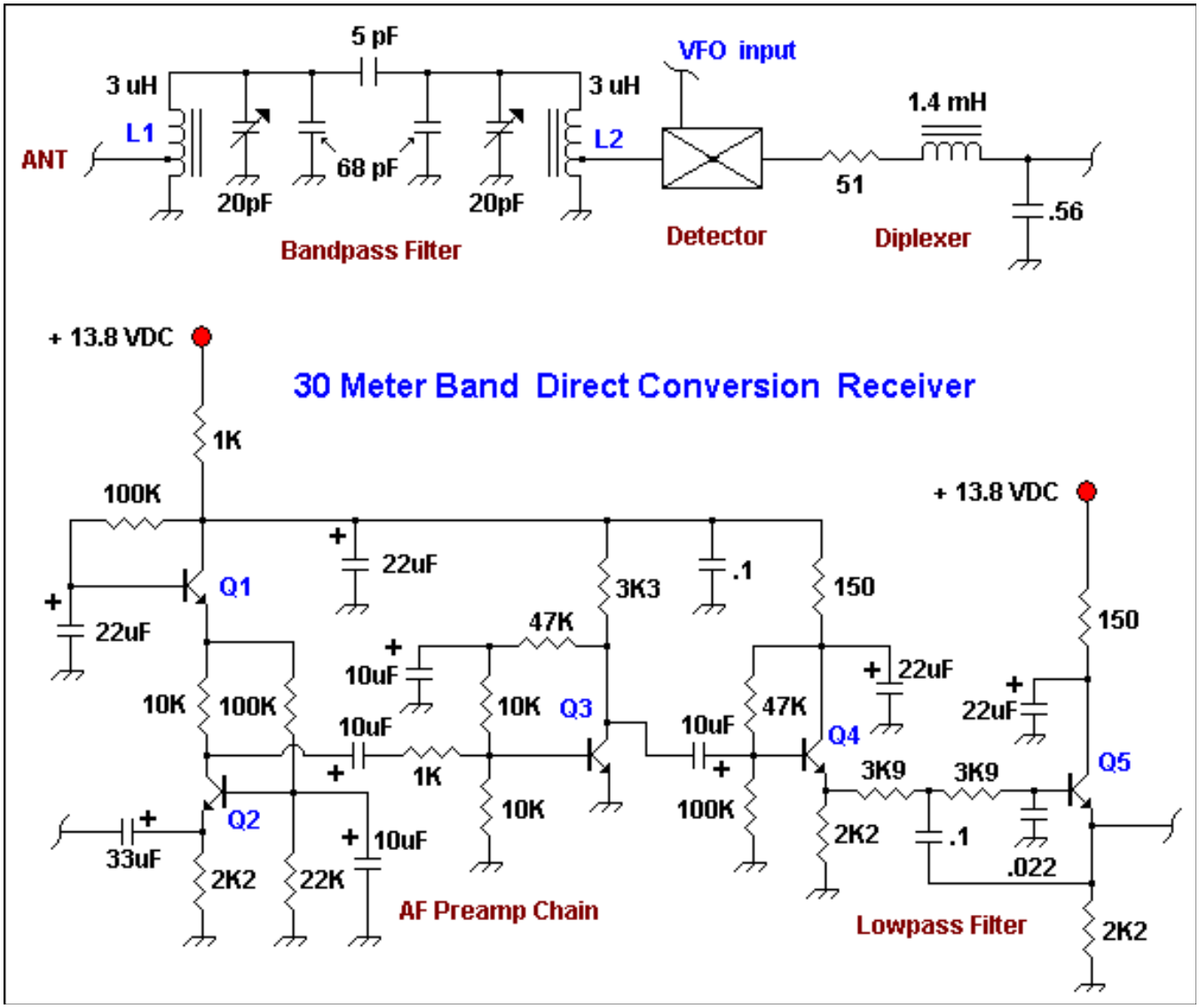
Q of the resonators is 11.5. The easiest method to tune the resonators is to peak the trimmer caps for the greatest measured output voltage using an oscilloscope.

used. The trimmers were adjusted on each resonator to obtain the highest measured voltage possible. The filter was then placed in the receiver after removing the temporary alterations used during calibration. If you do not have access to test equipment, tune the resonators at



I used the receiver VFO temporarily terminated with a -10dB, 50 ohm pad to obtain the correct filter input impedance and connected it to the input end of the filter. I temporarily terminated the output of the filter with a 51 ohm resistor to ground. The VFO was tuned to the centre frequency by placing it next to a receiver set on 10.125 MHz. A frequency counter can also be

the centre frequency while listening to the receiver in the headphones to obtain the greatest possible band noise. Confirm your adjustments by tweaking the trim caps while listening to a QSO as well.

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30m Receiver Project

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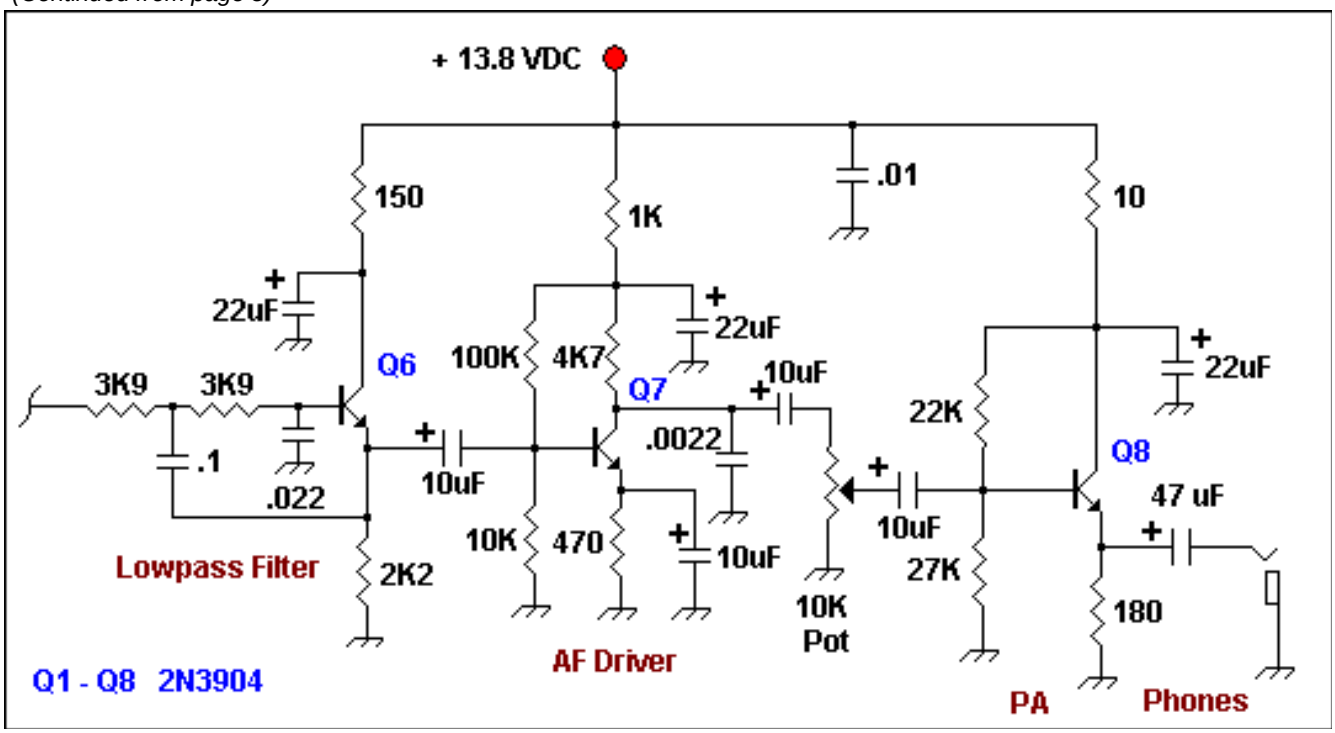
unnecessary.



Product Detector

A product detector using either one or more 2N3904 transistors was originally planned and indeed, four designs were built and tested. The 2 favourite detectors were a single-ended detector built with a single BJT which maybe used in an future novelty transceiver project and a passive mixer invented by Dr. Ulrich Rohde. The original mixer called for 2N5179 transistors and used a 0.1 uF coupling cap to the diplexer stage for RF output. It should have a VCC of 9 volts DC.

The mixer as built for this project is shown to the right..

The mixer as designed by Rohde had a reported IP3 of 33 dBm with a LO drive of 15-17 dBm and an insertion loss of ~ 6dB. This mixer operates in push-pull and the 22 ohm resistors on the transistor emitters provide degenerative feedback which makes component matching

The schematic and brief write up can be found in QST for June 1994 in an article entitled Key Components of Modern Receiver Design-Part 2.

I built 2 versions of Rohde's mixer and tested them both in the receiver shown in the main schematic. I later discarded this design and replaced it with the familiar diode ring mixer for the following subjective reasons; I noted a greater insertion loss, more hum and noise, higher LO drive level requirements and more WWV AM interference when compared to a diode ring mixer.

No quantitative measurements of the mixer were made. Listening tests and observations were only performed. Careful shielding of one version of the mixer resulted in a major improvement in hum and obliteration of an audio feedback problem noted when the AF gain was increased maximally when compared to the unshielded second version of the mixer. In ad-

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30m Receiver Project

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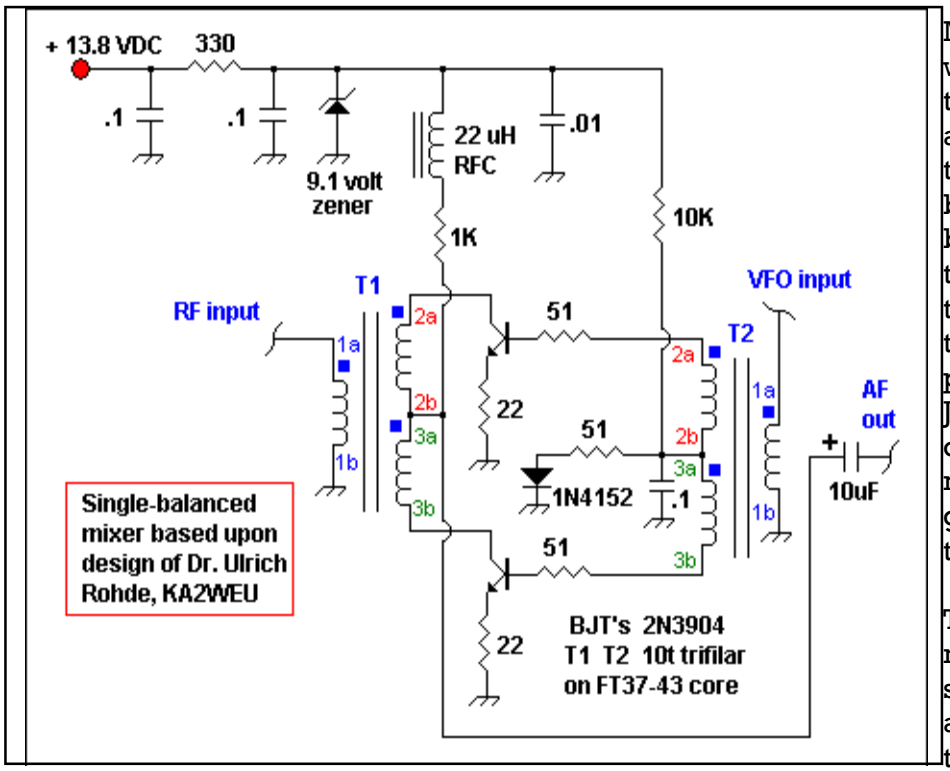
dition, better performance would most certainly be realized if 2N5179 BJT's had been used instead of 2N3904's. Rohde's mixer certainly warrants further and better analysis with quantitative testing for use in home built receivers. If you build and test this mixer, please forward or publish the results for use by the Amateur Radio community. The trifilar wound transformers are identical to those shown elsewhere on this site and have phasing dots and coil numbering included for reference. Ugly constructing this mixer is extremely easy to do. The diode ring mixer ultimately used has 50 ohm ports and can be a homebrew or commercial unit such as the popular SBL-1 from MiniCircuits.



VFO Design

Reviewing the Amateur Radio literature revealed that JFETS enjoy tremendous popularity as the active device in LC local oscillators during the past ten years. To conform to the original design criteria of this project it was decided to build the VFO from only 2N3904s for the oscillator and the buffer sections. Four different VFO's were built and tested for short and long term frequency stability. Two partial schematics are shown below. Each design used the same buffer/amplifier for some sort of control. I found that it is possible to build very stable oscillators using the 2N3904, providing good quality, temperature-stable components are used. Careful attention to the design guidelines published by people like W1FB, W7EL and W7ZOI are mandatory. Electrical engineering knowledge would also be very helpful as I found biasing and feedback resistance values, coupling cap values and inductor Q all can have an effect on frequency stability and output noise.

My tests failed to determine why the JFET is so popular; there are just too many variables to factor in both electronically and through building techniques. Possibly, the easiest no-fail VFO to build is the tapped inductor Hartley using a JFET and this may help explain the popularity of the JFET. A JFET is probably a better choice with regard to phase noise because of a generally good noise figure and extremely low flicker noise.

This design was by far the most stable design for both short and long term drift and is the most stable VFO that I have ever built. The VFO will see duty as a lab oscillator for use in future projects built for the great QRP band, 30 meters.

Despite the fact that the oscillators built with the bipolar transistors were very stable, one VFO stood out and was used. I have it displayed on this website as the project entitled:

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30m Receiver Project

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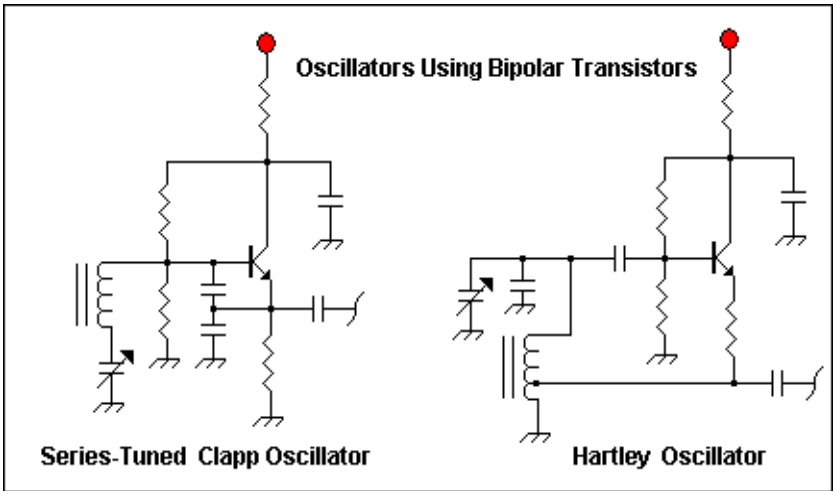
An (LC) VFO for 30 Meters [link]



http://www.qrp.pops.net/VFO.asp

Diplexer

Presented is a Roy Lewellyn, W7EL diplexer design which provides a 50 ohm termination for the product detector at all frequencies. This single-pole filter has a 3 dB cut off design for 5.6 KHz. This diplexer design is used by permission. The 1.4 milliHenry inductor is easily wound using a single layer on a FT50-77 ferrite toroid. Wind 38 turns of #26 AWG enamel coated wire with close spacing. If the builder only has access to the more common FT37-43 ferrite core, a 1.4 mH inductor can be wound using a 26 inch piece of #30 AWG wire. To construct this inductor, cut the 30 gauge wire exactly 26 inches long and place one end of the piece of wire one inch through the ferrite toroid core. Begin wrapping the core with the other end of the wire in the usual fashion, proceeding carefully around the core avoiding knots and tangles. When you reach the original end of the wire continue winding past it and proceed around the core until you have a one inch length remaining. The second winding only partially covers the core. Use fairly tight loops on each winding to avoid getting a low inductance. The one inch leads should be ample for connecting to the circuit.

The wound inductor should be cemented face down onto the PC board after removing a small portion of copper big enough to fit the inductor on so that it is not touching any of the PCB copper surface. I used a hobby tool and sanded off the copper in a circular shape about 3/4 inch in diameter. The inductor was glued on with epoxy. The Qu of these home spun audio inductors is very low and consequently have very low loss. The 0.56 uF cap I used was a miniaturized metalised polyester film (DigiKey EF2564-ND) which is an expensive part at 95 cents Canadian currency.

AF Preamp Chain

Following the diplexer is the familiar grounded base amplifier popularized by Roy Lewellyn, W7EL. This stage presents a low noise, wideband ~50 ohm input impedance to the diode ring detector and diplexer. An active decoupler is used to help prevent any hum getting into this stage.

The 22 uF capacitor in the decoupler circuit is capacitively multiplied by the beta of Q1 and has an effective filtering value of 22000 uF. The second stage is an amp designed by Wes Hayward, W7ZOI. The DC negative feedback provides bias stabilization for this stage.

It is interesting to note that W7ZOI made a break in the DC feedback loop with a 10 uF cap to ground so that there is no negative AC feedback around the amplifier and it operates at maximum gain.

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30m Receiver Project

(Continued from page 6)

Low Pass Filters

The source follower and two low pass stages were pulled from Solid State Design for The Radio Amateur published by the American Radio Relay League. The original article had the a ~1 KHz cut off frequency using 3K3 ohm resistors. The above schematic uses two 3K9 ohm resistors in each low pass stage for a cut off frequency of 870 Hz. Other cut off frequencies can be set by adjusting these resistor values as desired. The low pass filter stages serve to improve QRM copy ability and attenuate a lot of the wideband noise generated and/or boosted in the preceding stages.

AF Amp and Driver

Driving the final amp is a high gain common-emitter amp with its output connected to a 10K pot for volume control. The 0.0022 uF bypass cap is used as a high pass filter to help remove hiss. The final AF amp is a simple common-collector amp set for approximately 37 mA of emitter current. The 180 ohm resistor could be dropped to 150 ohm (~45 mA Ie) providing a heat sink is used on the BJT. A piece of PC board glued to the flat part of the transistor could be used to fashion a heat sink if you decide to stand more current than the original design. The 10 ohm resistor and the 22 uF capacitor on the collector of Q8 form an RC filter to decouple the AF stage from the positive voltage supply. I have found this amp sufficient to drive a pair of Walkman style headphones with reasonable volume. Do not expect ear-shattering volumes levels however. Three sets of cheap headphones were tried and one pair gave very low volume when compared to the other sets. Keep this in mind if your not getting reasonable volume to your ears.

The headphone jack used for this rig is a 1/8 inch (3.5 mm) stereo jack with both channels connected together for monaural output.

Construction Hints

Like all electronic projects, this receiver should be built and tested one section at a time. Ugly construction easily allows this to be done. I started with the final amp and then worked backwards through the schematic until the antenna input was reached.

Build the 2 low pass filters and the source follower as one section as the source follower is needed to bias the low pass filter stages. The AF amp stages can be tested with a homebrew AF oscillator such as a free-running multivibrator.

Conclusion

Although this receiver did not end up as I had first intended it to be, the learning experience was profound. This is a good and fun popcorn receiver which can be built relatively inexpensively.

Taken From:-
http://www.qrp.pops.net/

Editors Comments

(continued from page 2)
erate at, or less than, the frequency separation between the transmitter and receiver.

Note 3: A duplexer must provide sufficient isolation to prevent receiver desensitization.

Source: from Federal Standard 1037C

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144/432MHz Homebrew Antenna Diplexers

Designed by John Stockley G8MNY

It consists of 2 paths of low & high pass filters, each path built on a wall of a double sided PCB BOX on opposite sides.

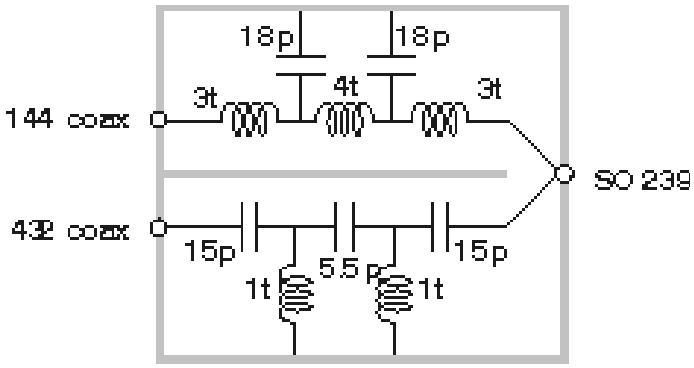
The UHF pass filter consists of 15pF 1 Turn to ground 5.5pF (2.2//3.3) and another 1 turn to ground, & finally a 15pF to the aerial socket at the end of the Box. The coils are about 5mm diameter in 0.5mm dia Wire (22SWG).

The VHF pass filter consists of 3 Turns with 18pF to ground, then 4 Turns and another 18 pF to ground, & finally a 3 Turns to the aerial socket.

The box is 1" square soldered to the socket, & about 3-4" long. The component connections are soldered to knifed up 6mm square pads. The exact coil sizes needed are dependent on the real Cap values & box layout. So adjust the coil shapes (& size if needed) in the RF path for best SWR on each band.

The centre separator is soldered in after all SWR coil adjustments are made.

Then re-tested, then a lid is soldered.



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Some Links

http://www.qrp.pops.net/default.asp

http://www.southgatearc.org/techtips/diplexer.htm

JB 2009

The West Rand Amateur Radio Club
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1725

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Email: zs6wr.club@gmail.com
Web page: www.jbcs.co.za/ham_radio

Bulletins (Sundays at …)
11h15 Start of call in of stations
11h30 Main bulletin start

Frequencies
439.000MHz 7.6MHz split
Input: 431.4MHz (West Rand Repeater)
145,625 MHz (West Rand Repeater)
10,135 MHz (HF Relay)

Radio Amateurs do it with more frequency!

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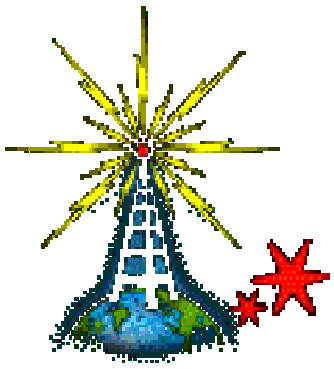
West Rand members - we need your input!

To make this the best ham radio magazine in South Africa we need your input. Please submit articles, comments, suggestions etc.

Please send plain text with no formatting to the email address below.

In July 2003, we re-published an Anode Compendium on CD. It has the issues from July 2000 until June 2005. This included the new Adobe reader. It has been updated, check with the chairman for details.



We need your input! Email us articles, comments and suggestions please.
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