May 2012
Volume 12, Issue 12

ANODE

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Anode Editor's Comments

Volume 12, Issue 12
June 2012

I have had the flu all [bl**dy] weekend and Monday. I seem to be on the mend but won't be going out at night for a while...Nurses orders.

Sorry about the raffle tickets
I went looking on Google for ""open office" spreadsheet raffle tickets". I got 17,400 hits. I admit I didn't have a lot of time but the bunch I did download, did not work for a variety of reasons. Mostly it was the page format of LETTER a U.S. format. (US means unserviceable.) Macros that do not work with Open Office or with veteran versions of Word. When I have some 'spare time', I shall look into writing our own macro in Open Office Writer.

Certificate of Appreciation awarded to the club at the 'Bring and Fix' meeting.

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Super Regenerative H.F. Spectrum Analyser

Special points of interest:

- **Contact details on back page UPDATED 2011-11-14**
- **Ham - Comp Latest on web site. Still under construction...**

[A long time ago, far far away in London, Super-regenerative receivers had a very bad press. They were very popular for they were cheap to build and economic of active components. In those days the active component was a valve. When the valve went into super-sonic oscillation, the entire neighbourhood would be blotted out from receiving the "Home Service" or another Medium Wave Station. Now in the 21st century, Alan comes along and turns the concept around for us…]

Taken from Alan's Lab - 2011-01-30 with permission.

555 Super-Regenerative IF HF Spectrum Analyser
This is another of those crazy ideas that have been rolling around in my head for a while now. I have previously used super-regenerative circuits as logarithmic detectors, and built super-regenerative super-heterodyne receivers - it wasn't a huge leap to build a swept front-end and turn the combination into a simple spectrum analyser. The recent announcement of a 555 Contest by Chris Gammell and Jeri Ellsworth had me playing with 555 circuits and this was all the encouragement I needed to finally go ahead and

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Editor's comments - Club News

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National Amateur Radio Day
The South Africa Radio League has named 16 June as National Amateur Radio Day, celebrating Amateur Radio as a National Resource and its diversity as the most exciting of all scientific hobbies

Museums Day
National Museums Day is held annually in May. To recognise this event the Zululand Amateur Radio Club will be operating as **ZS5ZLB** from the Nongqayi Fort in Eshowe on Sunday, 20th May 2012

Digifest 2012
The annual 'Digifest' will be held as usual on the 1st full weekend of June (2012 dates are June 2nd and 3rd). This is going to be Digifest's 5th year, and its popularity is growing with last year's received Logs number of more than 200.

The peculiarity of this Contest is the great variety of different categories of the participants in 5 digital modes: RTTY 75, BPSK 63, MFSK 16, HELLSCHREIBER, OLIVIA and the most fair points calculation based on the distance between the stations.

The Contest consists of 3 convenient periods (8 hours each) during the weekend. To add more adrenalin into this competition a special feature will be offered to those who like competing in real time Â online results will be presented on a server. And, of course, a lot of real nice prizes, mostly RigExpert AA-230 and AA-30 Antenna Analyzers and RigExpert USB Interfaces. All prizes sponsored by RigExpert Ukraine Ltd.

Since the number of the participants is relatively small and the most populated competing area is Europe, the "far away" stations from NA, SA, Africa, Asia and Australia are at great advantage. From the last year's experience those stations were the most prize winners. Considering this and also to support growing participation from Europe, the sponsors "double" the prizes Â i.e. separate main prizes are now available both for Europe and for the "rest of the World".

But wait, that's not all! For those of you who won't be able to win "main prize" in respected category, there will be a lot of small gifts, like T-shirts and paper awards. All the prizes will be mailed to participant's home addresses.

The results are usually available just 2 weeks after the end of the Contest, So, let's just meet on the 1st weekend of June and have fun! Complete rules can be found at:

`http://www.mixw.net/misc/DigiFest/index.html`
`http://www.rigexpert.com/index?s=main&f=digifest`
`http://ut7fp.kiev.ua`

{—}

Amateur Radio Software in the 21st Century

There are a lot of programs out there, that help a Radio Amateur. There are programs that calculate the components for filters, matching stubs even aerials. Some programs were written to train you in Morse reading by sending tones from the loudspeaker. Others help by telling you which heading your H.F. Beam should be set to, to 'connect' with another H.F. or satellite station. Most of the (old) "legacy" programs mostly used a 'command line interface'. The newer programs mostly use a 'graphical user interface'. One of the most useful and recent ones plots H.F. beacons on a world map based on the 'time of day'.

Most of today's software functions on the 'bleeding edge' of PC's. Many are used as 'Software Defined Radios'. The sound card has

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Editor's comments - Club News

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become a the interface of choice and the PC a very capable 'Digital Signal Processor'.

For 'rig control' or CAT, most software today, uses USB (Universal Serial Bus). For simplicity though it may use the parallel port ('printer port'). Or one or two bits (control pins) of the 'serial port'. USB has one limitation that can give rise to interface issues. The highest voltage generated can only be approximately +/- 5 Volts. This can be a problem when trying to drive an interface.

Do you know where you are?

The West Rand Amateur Radio Club's coordinates are 26.14122 South, 27.91870 East

Amateur Radio Software from 'last century'

What is 'my complaint' about these 'legacy' programs?

1) I can get them to 'run' and perform their functions. But there are 'input/output errors', 'user interface errors' and 'calculation errors'. So many that I think a complete re-write is in order.
2) This 'methodology' should be used as an example for other (younger) software developers.

The 'Maidenhead' Programs

All three programs, M1, M2 and M3.BAS are related. Written by **J.M. Howell (REW 1984)** they exhibit the 'economy of programming' style that was standard in the 1980's. Not bad examples of programming but sparse of 'help' or 'reassurance' or even 'worked examples'.

With the current abundance of GPS receivers, these calculations could provide vital information to the Radio Amateur. e.g. Point your ZL special 'over there' to get this station. Or to report your new QTH as KG33FU (Maidenhead Locator).

So a re-write is necessary for today's computing environment. The programs specification should allow for its use on Windows™, Linux and MAC/iPad with a possible 'web server base' as well. So that the "Muppies" can use it on their new 'smart-phone'.

This is a 'tall order' for any 'software developer' but recently the advent of an Open Source version of BASIC has changed that. FreeBASIC is a 'compiler' that functions as a generator of 'executable programs' for all of the above 'Operating Systems'.

[*I have just downloaded an 'Open Source' service/daemon called 'gpsd' for using a PC connected GPS. It allows for the 'background' collection of data from the GPS and collection of the location data by multiple programs. So 'real time' updating of 'where you are' (QTH) is now easy.*]

A 'New and Improved' Maidenhead program

This 'new and improved' version should both function on all the 'Operating Systems' mentioned. It has to take input of Degrees, Minutes, Seconds, North, South, East and West. Alternatively it should allow input of 'decimal Degrees, Minutes and Seconds'. The other format is probably going to be in GPS decimal readings. e.g. 26.14122S.

The program should also allow input of 'Maidenhead Locator' and calculate the Longitude and Latitude or GPS coordinates.

[This is a 'work in progress'. It should be appearing on the Ham-Comp web site soon. JB]

Super Regenerative H.F. Spectrum Analyser

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do it. The end result is a toy SA adapter for your CRO, but is still useful instrument (and it fits in an Altoids tin).

[**http://en.wikipedia.org/wiki/Altoids**]

Architecture

The circuit is a high-side injection single-conversion super-heterodyne receiver mixing up signals in the HF region to a VHF IF around 150 MHz. The IF is amplified and detected directly in a self-quenched super-regenerative detector. Log-linear signal strength information is extracted from the detector quench frequency.

RF Part

The VHF local oscillator is a JFET Hartley with varactor tuning allowing it to be swept by a ramp generator. The front-end consists of an LC low-pass filter with a cut-off around 55 MHz, followed by a JFET cascode mixer being fed from the filter and LO. The mixer drain inductor is loosely coupled to the super-regenerative detector tank by proximity (but is itself untuned). The detector provides the only selectivity of the circuit, but achieves about 100 kHz 3 dB selectivity. The skirts are poor however (as one would expect from a super-regenerative detector), and the final resolution bandwidth is at best 250 kHz. This is still a fair bit better than what might be achieved (say ~1% BW) with a much bulkier LC filter at the IF frequency.

LF Part

The linear ramp generator uses a LM555 with a

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Super Regenerative H.F. Spectrum Analyser

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PNP current source to linearise the capacitor charging. This helps linearise the RF tuning sweep (but some non-linearity remains due to varactor properties). As the 555 in astable mode normally keeps the capacitor voltage between 1/3 and 2/3 Vcc I added a green LED to the threshold line to shift the high-water point closer Vcc and give more voltage swing for varactor tuning. With the particular supply and varactors and LO design about 22-25 MHz of sweep range is achieved, a little bit more would be nice, but adjustment of the detector or LO offset tuning capacitor allows tuning right up to (and beyond) the input LPF cut-off.

The super-regenerative detector quench frequency is around 35 kHz when quiescent, but rises to beyond 40 kHz when detecting large signals. The frequency is almost linearly proportional to the log of the signal strength due to the basic exponential nature of the signal growth during regeneration. To convert this FM signal to a DC voltage suitable for display with the CRO a 7555 is used in monostable mode to generate constant width pulses on each quench cycle. These rectangular pulses are integrated in a capacitor and the resulting voltage shifted and amplified with an op-amp for easy integration with the CRO Y channel.

The Circuit

Yes I could have just biased control higher rather than using a LED dropper on threshold, but it costs less current and just happens to work almost perfectly at the 9V Vcc with the drop of the green LED I had sitting on the bench. Two diodes instead of a diode + resistor is probably rather evil, temperature stability wise. Replace one or both with a resistor if this becomes an issue. I should probably use the other half of the LM358 as a follower to buffer the output and stop external loads affecting it; don't put low-impedance loads across the X output. Hopefully your 10 uF electrolytic capacitors are low leakage...

The CE-NPN inverter is needed because of the -ve (negative) level triggering of the 555. I did at one point remove the inverting transistor and run the time constant longer, effectively inverting the F2V slope, but the extra sensitivity of the inverting stage doesn't hurt, and it is more obvious how it works. You can switch the time constants in the integrator if you want to control the video bandwidth.

The mixer is a bit of a hack. I measured the Idss and Vp of the J310's in question and picked the source resistor to give about 2 mA. The 56 ohm gate resistor terminates the filter in something close to its design impedance. Was going to use pads either side, but this works reasonably well as-is. The gate capacitance makes the match worse at higher frequencies, not a major deficiency. Tuning the mixer drain upsets the detector a bit (as it is moderately coupled to the detector tank), with less coupling some selectivity at the mixer drain couldn't hurt?

Half-wave input filter is not as sharp as possible of course, and perhaps adding a notch at the IF is a good idea? I tune the IF to move the region of interest (instead of tuning the LO set-point as this changes its tuning range because of the relative capacitance change), so a notching trap would need to be tuneable, but you can fix-tune the IF if you like.

The 5p6 value suited my particular circuit best. I selected it using a trimmer try-it-and-see... Perhaps not the best approach. Other topologies should work, as long as you can get them to squegg at something near 40 kHz.

The coils are 90-100 nH, the LO coil stretched out a little more than the mixer and detector one so it is perhaps closer to 80-90 nH. You could use toroids, which might give you better control of the mixer/detector coupling.

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Performance

Here is a video I shot shortly after finishing construction, it has a few shots of my DSO screen while using the SA adapter and a signal generator. [Link to Video on YouTube **http://www.youtube.com/user/vk2zay**]

IP3 has not been measured yet but it is not expected to be very good because of the simplistic mixer used. LO leakage should also be measured but should not be too bad because of the LPF in the input. Precise log-linearity has not been measured either, but I did test it with a step attenuator visually confirming its better than 50 dB dynamic range, good linearity and 10 dBm input handling. No doubt it is not especially sensitive and probably has a terrible noise figure.

None of this makes it a completely useless instrument however, and it is quite good at quantifying harmonic energy from homebrew transmitter projects. With a noise source or a tracking generator it might be useful for sweeping HF filters.

It pulls 21 mA from its 9 volt supply.

Notes

The circuit was originally envisioned using a discrete ramp generator and tachometer one-shot. The use of 555s simplifies the design - and makes it a candidate for the 555 contest utility category of course. ;) Honestly though, I doubt I would have been able to get it going in the 2 days of the weekend if I had not used ICs.

There is no retrace blanking circuit. I did consider adding one driven from the output of the ramp generating 555. If you are using an analogue CRO you might like to add one, either railing the Y output during retrace to take it off screen or providing a Z output. A simple transistor switch pushing the level shifter intercept point (or the output directly) should do the trick.

While the vertical output intercept is variable the slope (gain) is fixed. You may wish to change part of the feedback resistance to a pot to allow slope adjustment for calibration against your CRO graticule. This would make the in-

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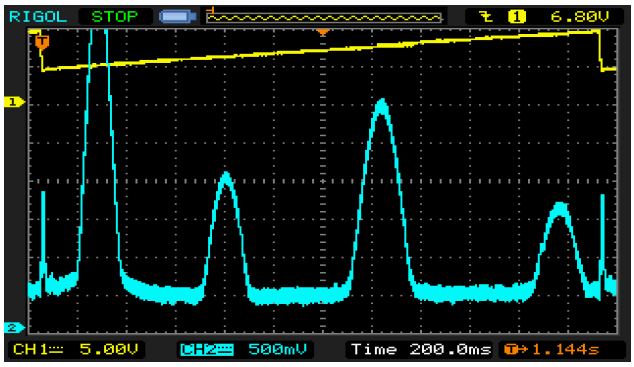
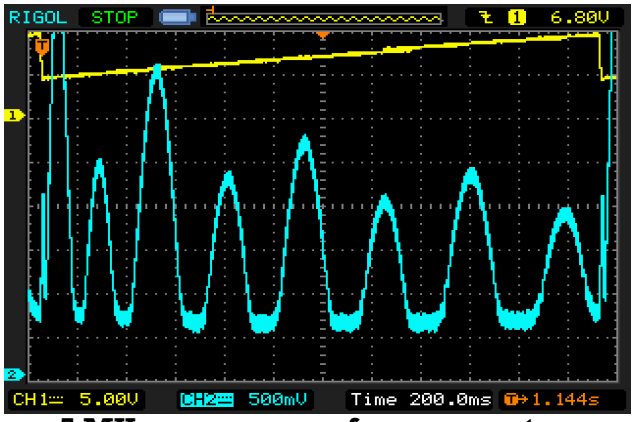
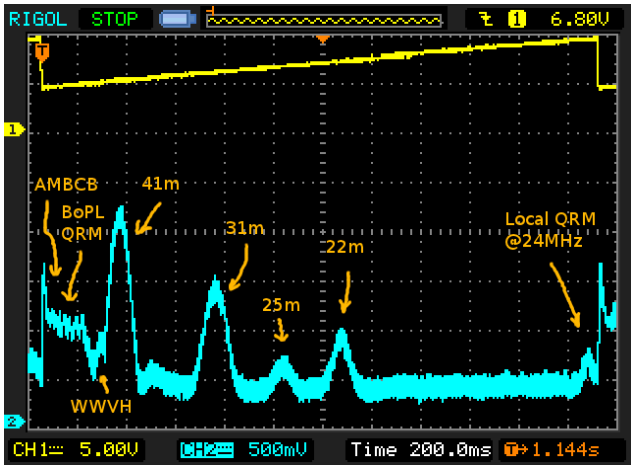
Some Screenshots



2.5 MHz square wave from generator.



5 MHz square wave from generator.



DC-24 MHz from random-wire short-wave antenna.

Super Regenerative H.F. Spectrum Analyser

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strument more useful for absolute measurements, but as the mixer frequency response is anything but flat this would be frustrating. I use a step attenuator and power meter on my generator to confirm measurements.

Naturally more complicated VCO control schemes can allow width and centring controls. It is debatable if this is worthwhile with the relatively narrow sweep and wide resolution bandwidth. I find its "HF overview" nature is what makes it less of a toy and useful for quick assessment of harmonic energy and filters.

The sweep is quite slow, especially if you are using an analogue CRO with short phosphor persistence rather than a DSO. The time constant of the vertical tachometer can't be reduced too much, as it is essentially sampling the RF signal level at 35-40 kHz. The process is also quite noisy and the grass will grow rapidly without heavy integration. This kind of detector doesn't really have the capability to provide high video bandwidth, and increasing the quench will just compromise the selectivity and sensitivity.

Some of you are no doubt thinking "Why not use the xtal super-regenerative detector to get excellent resolution bandwidth?". You could, in fact I have tried this in a lash-up with a DDS LO and a DBM. It works wonderfully, except for the image problem which could be dealt with using an extra conversion step. However the xtal super-regen detector is very slow, it samples at about 100 Hz max. This is not a major problem for a scalar test instrument, but for a general purpose SA it makes wideband scan times frustratingly long. It also pretty much mandates a digital interface - which is a feature IMO, but you may disagree.

It is quite easy to use an MCU and USB interface to make this PC-based.

The IF frequency is not limited to VHF, you could build UHF or higher RF systems controlled the same way. It might be fun to have a DC-1 GHz version, maybe in USB-stick format? But perhaps at that point you may as well build one using an Analog Devices Log chip and a real resolution filter.

The IF detector might integrate quite well with an old analogue TV tuner front-end…

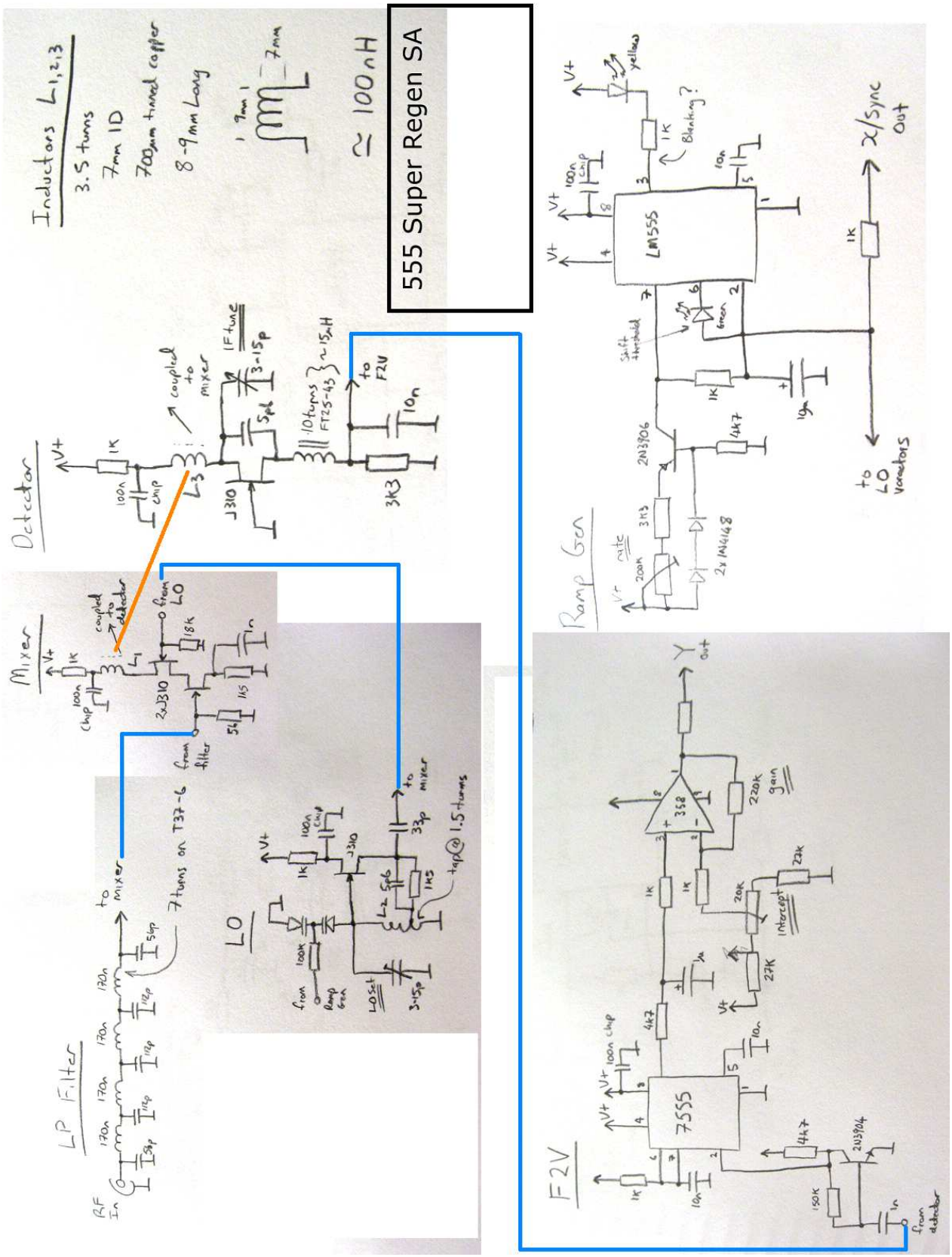
Links and Information

http://www.vk2zay.net

J310 FET information
http://www.qsl.net/ko6bb/j310_fet.html

The Circuit (complete) is over the page…

Super Regenerative H.F. Spectrum Analyser (circuit)



The West Rand Amateur Radio Club
Established in 1938
KG33XU 26.14122 South - 27.91870 East

P.O. Box 5344
Weltevreden Park
1715

Phone: 083 267 3835 (Chairman)
Email: zs6wr.club@gmail.com
Web page: www.zs6wr.co.za

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

Frequencies
Output: 439.000 MHz 7.6 MHz split
Input: 431.4 MHz (West Rand Repeater)
145,625 MHz (West Rand Repeater)
(HF Relay when possible)

Radio Amateurs do it with more frequency!

Chairman (technical)	Phillip van Tonder	ZS6PVT	083 267 3835	zs6wr.club@gmail.com OR zs6pvt@gmail.com
Vice Chairman	Geoff Levey	ZS6GRL	082 546 5546	glevey@gmail.com
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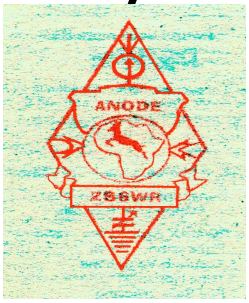
West Rand members - we need your input!

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.

See Club website at www.zs6wr.co.za for all ANODE back issues.



We need your input! Email us articles, comments and suggestions please.
zs6wr.club@gmail.com