THE WEST RAND AMATEUR RADIO CLUB


October 2006
Volume 7, Issue 3

# ANODE

**Inside this issue:**



## Editor's Comments

**Volume 7 Issue 3 October 2006**

**A Gloomy Day**

As I write this the day is as gloomy as it can be in England. This has to be one of the 365 - 300 days of sunshine in South Africa. It is overcast and cool with the threat of rain later. It was very sad to report the death of Lance this last week. I hope you will all keep him in your thoughts in the future.

**Lance Edmunds ZS6ZN**

**"Wake Up!"** [Not an advert]

The small amount of lightning that occurred recently should have woken you up to the possibility that your station is in imminent danger. Take all the usual precautions, please

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## Rock Solid R.F.

*Get pinpoint precision with this PLL-based frequency synthesizer.*

**Special points of interest:**

- Contact details on back page (updated)
- New email address for Anode and ZS6WR. See back page

The main problem radio amateurs face in constructing a receiver or transceiver is ensuring constant frequency of the receiver heterodyne or the transmitter frequency. It is not so difficult to ensure stable operation of a v.f.o. operating on a relatively low frequency and within a fixed range. The problem lies in ensuring constant frequency of an oscillator, which has to operate within various bands (10, according to the latest band plan) and on a relatively high frequency.

The problem may be solved by using switched crystal oscillators in the band generator or by using the PLL (phaselocked loop) method when constructing the band oscillator.

The use of this method under non-professional conditions is difficult since the system is quite complex and involves the use of proper-programmed dividers and a filter in the v.c.o control system, which is difficult to optimize, and which has to operate over a large frequency range.

My solution is to use the FLL (frequency-locked loop) method for frequency stabilization of the band oscillator. The advantages of this method are a relatively simple system

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# Editors comments

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unplug when not in use. This includes modems and computers. Inspect your lightning protection units for damage and replace when necessary. A lot of the phone line units go partially open circuit and cannot protect against further surges.

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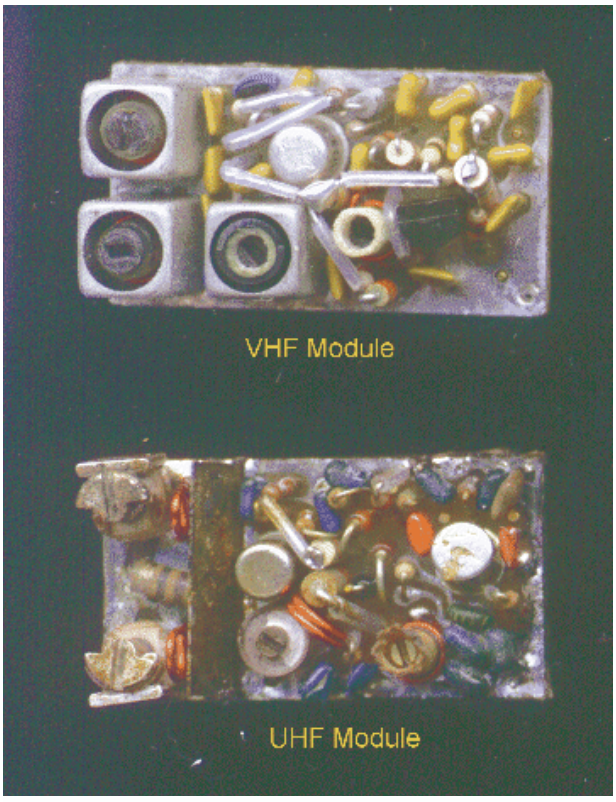
Thanks to OM Stuart, I shall be listening to the bulletin in future. So be careful what you say about me!

{—}

You may recall the pictures of the UHF portables, I printed in the Anode a month or two ago. I have had some time to investigate these modular units further. With the use of the cooker hob, I was able to remove the small printed circuit boards from a few of the modules. [Kids don't try this at home, without adult supervision. Or at least another youngster acting as an adult]




I got the solder to run and then used a pair of pliers to pull the printed circuit board loose. I immediately dropped it into a cup of water to cool. When cool I placed it onto some kitchen towel to remove the water.

As can be seen from the pictures, the modules consist of 20+ year old components. Fortunately these can be seen by most of the club members with the aid of reading glasses. Modification to the modules can be carried out by us and the units put to use by amateurs. Virtually all of the exposed modules are still in working order. Which says something for the manufacturers of the radios.

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**Letter to the editor Anode.**
**18 September 2006**

Dear Mr. Editor.

Please publish the following as a matter of information to all club members and users of the West rand 145.625 repeater.

Up until 4 weeks ago the West rand club members and users of the 145.625 MHz repeater experienced interference. The repeater sharing the frequency, located in Villiers Free state could be clearly heard. This repeater was recently refurbished with new antennas and low loss cable. Furthermore the repeater was linked to the 145.6625 being the Sasolburg club repeater.

It was most irritating to be able to hear both repeaters especially during bulletin time on a Sunday.

Several calls and e-mail's to the Sasol club ZS6SRK seem to have fallen on deaf ears. At long last the band planning committee was formed as a sub deviation tasked by the SARL.

This was the ideal place to take the matter for resolution. Emails were sent out to informing the

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# Editors comments

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parties involved as well as Peter Herst ZS6PHD heading the committee.

Ron Eva ZR6RON and myself went to the first division 6 band-planning meeting. The problem was lead out and quickly identified. The representatives of the Sasol club had stated the repeater location and the intended coverage. Shortly thereafter it was established that the Villiers 145.625 transmission reached way beyond its field of reception capability.

The Sasol club ended up backing off, saying that the frequency will have to change. This brought about the first and foremost task of the Band planning committee namely to create order in the crazy repeater and 2 meter band as no correct frequency could be identified from the record presently used for repeater allocation.

Six weeks later and the Villiers 145.625 repeater seem to have vanished into thin air. We cannot hear transmissions from it any more.

This brings me to the big request to all members of the club and repeater users of the West Rand 145.625 repeater. Please ensure that the minimum power required to key and operate the repeater is used. Especially when working from home and using antennas with high gain which are mounted high up. We might not hear the Villiers repeater but it is quite possible that they can hear us. This results in interference on the Sasol and Free State side of the repeater and links. [In other words your transmission coverage area might well include the Free State]

I would say that this is the least we can do in a good ham radio spirit to accommodate the Sasol club after they did the best they could to accommodate us.

Yours truly,
Phillip van Tonder
De ZS6PVT

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Check out the following:

Batteries to be replaced by miniature engines. Kick start your laptop? http://news.bbc.co.uk/2/hi/technology/5386004.stm

Software Defined Radio - the future? http://news.bbc.co.uk/2/hi/technology/5382086.stm

# Rock Solid R.F.

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and the possibility of applying it to already constructed equipment. The use of the FLL method for frequency stabilization of LC generators in the already-constructed equipment involves minimum system alterations while it considerably improves frequency stability.

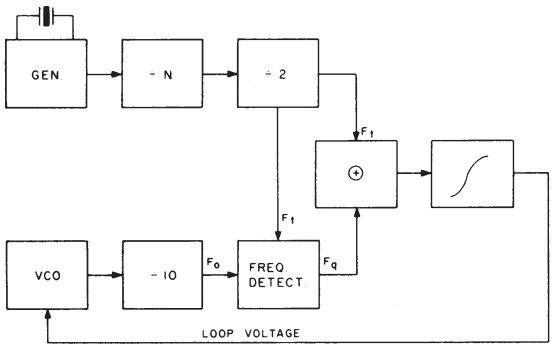


*Fig. 1. Principle of operation of FLL synthesizer.*

Fig. 1 explains the principle of operation of the FLL system. The essential part is a flip-flop, type D, which functions as a harmonic mixer. Signals FO from the v.c.o and the clock signal, Ft, obtained from the quartz generator are supplied to its inputs D and C. The output signal of the flip-flop element, Fq, is expressed by the formula: Fq = Fo -k * Ft, where k is a positive integer.

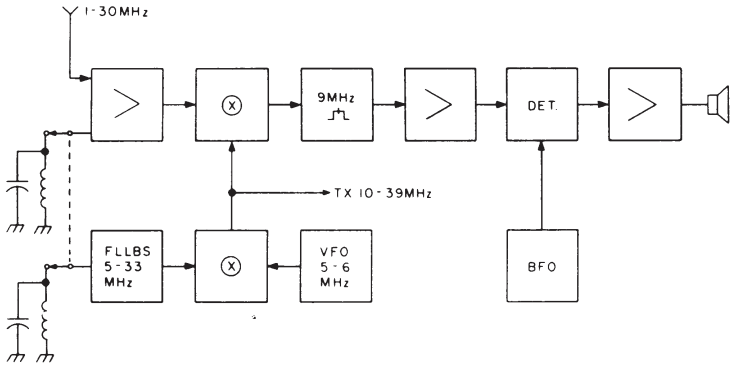


*Fig. 2. Block diagram of radio receiver.*

Obtaining the values of Ft and Fq as constants, we can change the frequency FO in a function of the harmonic number k. In order to ensure constant frequency Fq, this frequency was compared with frequency Ft from the quartz generator. Both signals, Ft and Fq, are transformed into impulses with opposite polarization; added, their mean value is formed in the integrator, and they are amplified. From the amplifier output, the voltage of error is taken to adjust the frequency of the v.c.o. Frequency Fq was, in my case, set at 50 Hz. Since frequencies Ft and Fq differ substantially, voltage levels Ft and Fq when added were also differentiated.

## The Radio Receiver

The synthesizer constructed by me with the help of the FLL method is thought to be part of a radio receiver (and a transceiver in the future). A block diagram is shown in Fig. 2. As can be seen, the receiver system is of a conventional type. Single-frequency conversion was used with an i-f of 9 MHz.

The v.f.o operates in the frequency range of 5 to 6 MHz. The receiver has ten bands. The determination of basic frequencies according to the formula

FR = (FH1 + FH2) - Fi-f

and the determinations of the FLLBS synthesizer frequencies are given in Table 1.

The v.f.o is of a conventional construction: It is an LC generator. I intend to build a v.f.o. also based on the FLL method, however. When constructing the whole receiver or transceiver, it is also possible to use the microprocessor v.f.o's described in 73 (June, 1982); that output frequency is also 5-6 MHz.

## The FILLBS Synthesizer

A block diagram of the synthesizer is presented in Fig. 3, while its schematic diagram is shown in Fig. 4 (digital part) and Fig. 5 (the

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# Rock Solid R.F.

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vco). As can be seen from the drawings, the synthesizer is of a simple construction: All that is needed are several standard elements, and the cost of this system should not exceed ten to fifteen dollars.

The operation of individual parts of the system is as follows:

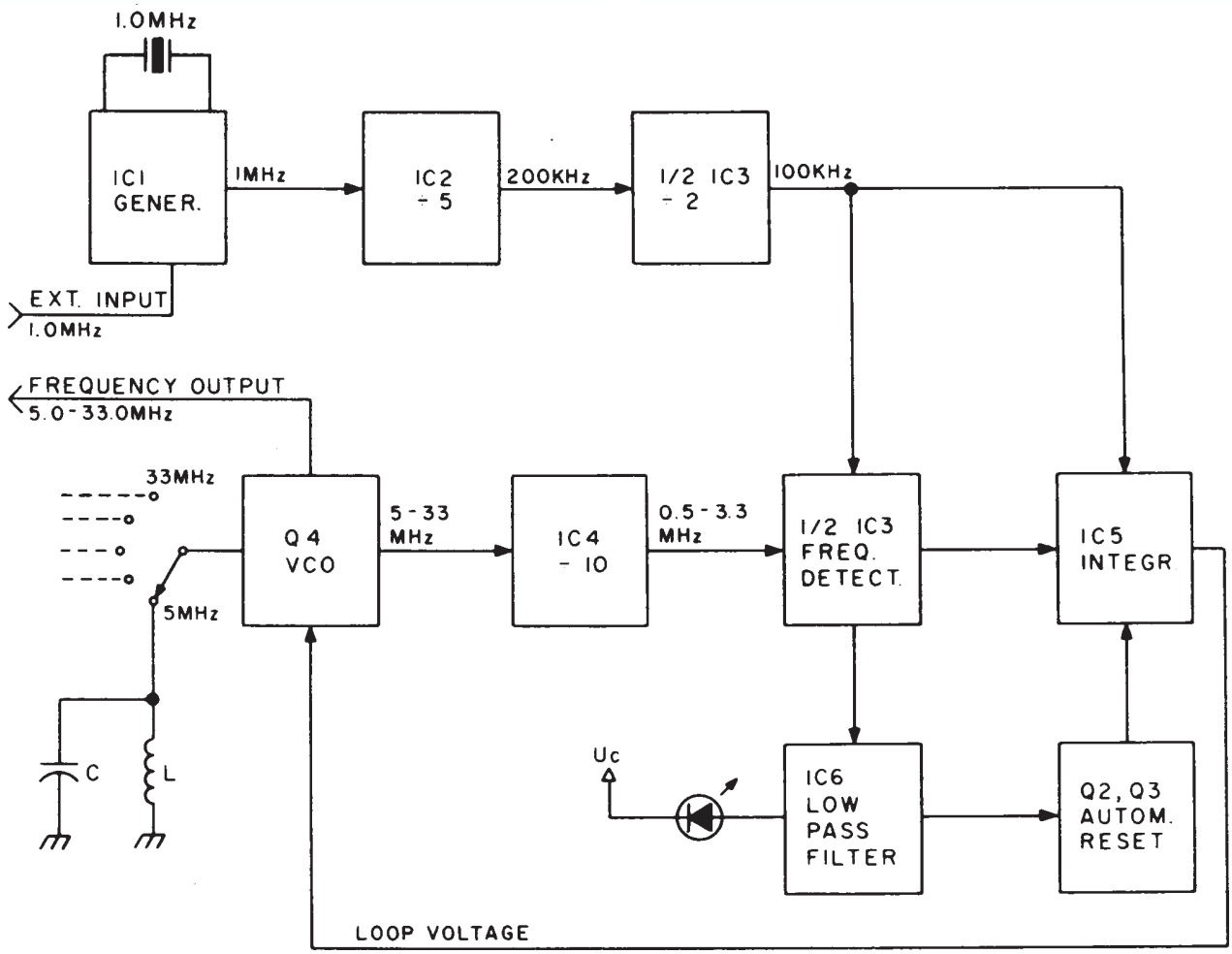


*Fig. 3. Block diagram of band synthesizer.*

The 1.0-MHz crystal oscillator is a typical one; it can operate on its own crystal or from an external 1.0-MHz generator.

The next element (IC2) operates as a divider by 5; at its output (pin 11), a frequency of 200 kHz is obtained.

The frequency detector (IC3) is based on a 7474 flip-flop. At its clock input (pin 11 0 1 C3), a frequency of 100 kHz is supplied, obtained by dividing 200 kHz by the first flip-flop of 10. To the input D of the detector (pin 12, IC3), a frequency obtained from the v.c.o, preliminarily divided by 10 in the IC4 counter, is supplied.

IC5 operates as an integrator; due to high resistances in the adding circuit, 1 constructed it with the use of an FET amplifier with high input

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resistance.

IC6 functions as a low-pass filter; it has to detect and signal through the diode LED the state of de-synchronisation of the frequency locked loop. Transistors Q2 and Q3 serve to neutralize the integrator when the vco is desynchronized and restore the state of synchronization of the loop.

De-synchronisation often takes place when changing the bands of the v.c.o.

The v.c.o (Fig. 5) operates in a standard system. For individual operating bands (see Table 1), separate resonance circuits were used, changed by selector switch together with the corresponding input circuits of the receiver. The function of the switch may be also performed by contacts of relays. For tuning the v.c.o, a varicap diode was used. At the generator output, a voltage follower from which the output signal is taken was used. The signal from the follower is amplified by transistors Q6 and Q1 and supplied to the counter from IC4.

**Construction and Alignment of the FLLBS**

The digital part of the system and the v.c.o were placed on separate printed circuit boards. The purpose of this was to eliminate disturbing pulses from the digital part, which could reach the receiver input through the v.c. o. Depending on the actual mechanical design of the receiver, it might be necessary to enclose the digital part of the synthesizer in a shielded casing.

The v.c.o, the voltage follower, and one stage of the amplifier were placed on a plate with the resonance circuits and the band-selector switch. Figs. 6 and 7 show the digital part of the synthesizer. The construction of the v.c.o depends on the type of the band-selector switch used and the coil casing of the resonance circuits. The design of the v.c.o PC board should be worked out individually, depending on the needs.

For the same reasons, am not giving here the data for the LC circuits for individual bands; they should be selected according to the generally-known principles. All transistors and diodes used in my construction may be replaced by their more recent equivalents.

When aligning the crystal oscillator, pins 5 and 12 of IC1 should be properly connected. When working with a built-in crystal, pin 12 should be connected to ground and pin 5 left free; when using an external oscillator, it should be connected to the proper terminal pins of the PC board and pin 5 should be connected to ground, while pin 12 should be left free.

When aligning the synthesizer, a voltmeter should be connected to output 6 of IC5 and then controlling the v.c.o frequency meter or a calibrated receiver, the v.c.o resonance circuit of the v.c.o should be tuned by means of the coil core to a frequency close to the required frequency until the v.c.o is synchronised. When synchronizing the oscillator, the LED should go out.

To obtain a maximum range of loop synchronization, the v.c.o resonance circuit should be tuned in such a way that the voltmeter shows about 11 V. The above method of aligning should be repeated for all operating bands of the synthesizer.

**Other Applications of FLLBS**

The FLL band synthesizer described above operates with an interval equal to 1 MHz. In case it is used for oscillator stabilization with a different frequency interval, the frequency Ft should be selected accordingly. For instance, in

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# Rock Solid R.F.

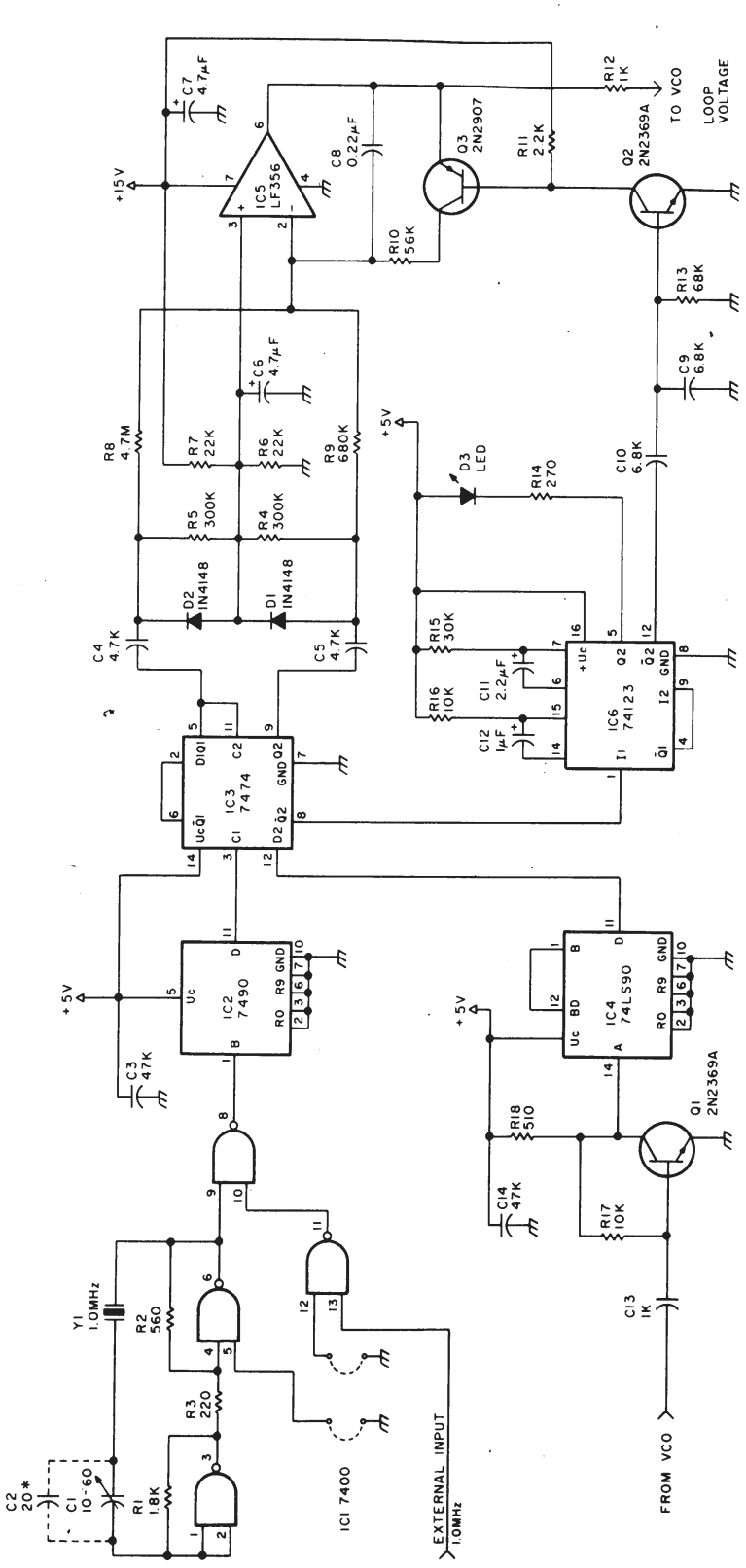


*Fig. 4. Digital part of band synthesizer (FLLBS).*

# Rock Solid R.F.

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a generator operating with an interval equal to 500 kHz, the frequency Ft should be reduced at output 3 of IC3 from 200 kHz to 100 kHz (IC2 should be changed so that it could divide by ten). No other change is needed.

When the FLLBS is used for oscillator stabilization in the already-constructed equipment, besides choosing the correct frequency, Ft, a varicap diode should be built into the existing oscillator through the correct padding capacity and the resonance circuits should be tuned into the loop synchronization range. The loop synchronization range depends on changes in the capacity of the varicap diode and the value of the padding capacitor, C15.

A capacitor with a relatively low capacity was used here to make impossible any accidental synchronization of the v.c.o with the frequency different by ±1 MHz from the desired frequency. The operation of the v.c.o and its synchronization were tested up to about 60 MHz; synchronization was correct within the whole range. If we want to use the FLLBS for operation at higher frequencies than 60 MHz, IC4 should be replaced with a fast-series IC. Capacitor C15 should be reduced and the v.c.o resonance circuits should be selected and tuned; no other changes are necessary.

**Parts list**

| Component | Value | Quantity | Component | Value | Quantity |
|---|---|---|---|---|---|
| R1 | 1.8k | 1 | C4, 5, 21 | 4.7k | 3 |
| R2 | 560 | 1 | C6, 7 | 4.7 uF | 2 |
| R3, 24, 25 | 220 | 3 | C8 | 0.22 uF | 1 |
| R4, 5 | 300k | 2 | C9, 10 | 6.8k | 2 |
| R6, 7, 19 | 22k | 3 | C11 | 2.2 uF | 1 |
| R8 | 4.7 Meg | 1 | C12 | 1 uF | 1 |
| R9 | 680k | 1 | C13, 17 | 1k | 2 |
| R10 | 56k | 1 | C15, 22 | 10 pF | 2 |
| R11 | 2.2k | 1 | C16 | 18 pF | 1 |
| R12 | 1k | 1 | C18 | 27 pF | 1 |
| R13, 22 | 68k | 2 | C19 | 33 pF | 1 |
| R14 | 270 | 1 | C23 | 47 pF | 1 |
| R15 | 30k | 1 | C24 | 100 pF | 1 |
| R16, 17 | 10k | 2 | C25 | 0.1 uF | 1 |
| R18 | 510 | 1 | Q1, 2, 6 | 2N2369A | 3 |
| R20 | 47k | 1 | Q3 | 2N2907 | 1 |
| R21, 23 | 330 | 2 | Q4, 5 | 2N3819 | 2 |
| R26 | 120k | 1 | D1, 2 | 1N4148 | 2 |
| R27 | 680 | 1 | D4 | ZC826 | 1 |
| L1 | 100 uH | 1 | D3 | LED | 1 |
| Y1 | 1.0 MHz | 1 | IC1 | SN7400 | 1 |
| C1 | 10-60 pF | | IC2 | SN7490 | 1 |
| | var. | 1 | IC3 | SN7474 | 1 |
| C2 | 20 pF if | | IC4 | SN74LS90 | 1 |
| | needed | 1 | IC5 | LF356 | 1 |
| C3, 14, 20 | 47k | 3 | IC6 | SN74123 | 1 |

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From *73 for Radio Amateurs April, 1986*

# Ham-Comp

**Some excerpts about Linux**
**& Amateur Radio**
**by Bruce Perens AB6YM**

Linus Torvalds, a Finnish graduate student, wrote a clone of the 25-year-old Unix operating system "kernel" a few years ago. Linus and others combined the kernel with utility programs that had been written at U.C. Berkeley and others that had been contributed to the Free Software Foundation's GNU project, and the result was an entire operating system, compatible with Unix, that could be distributed for free, with all of the source code included.

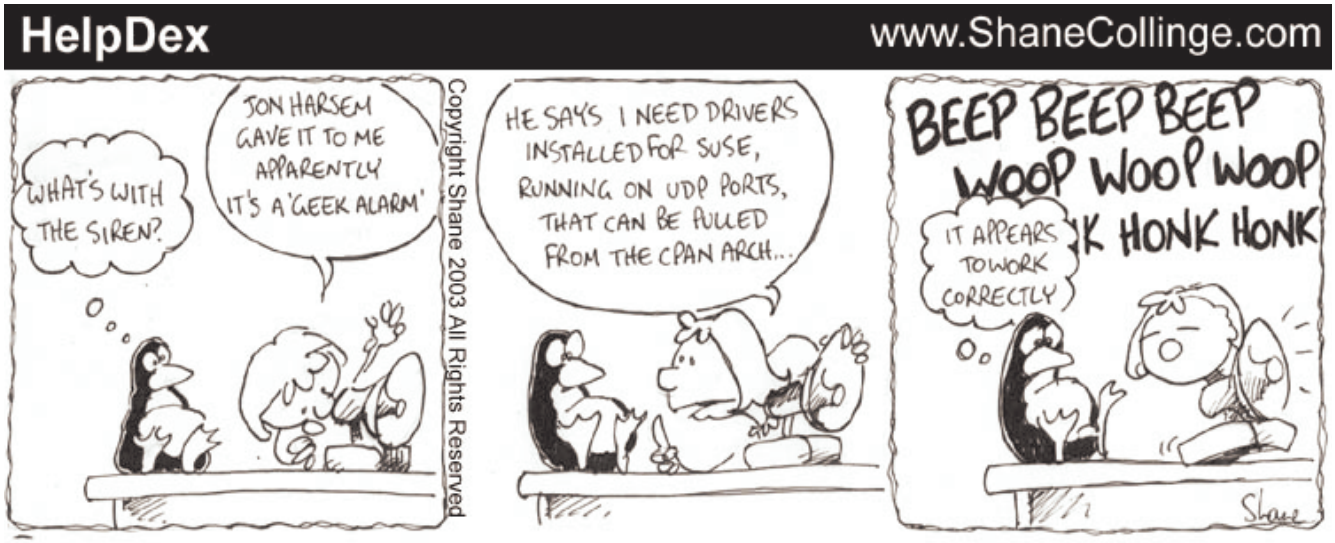
Unix and Linux are the most comfortable platforms for the development of sophisticated software that communicates, controls hardware, does complicated math. What I'm trying to say is that it's the best platform for developing the kinds of software that Radio Amateurs need.

If you're an applications programmer, or a hardware engineer, you might want to learn how to become an operating systems programmer. Linux is very good for that, because you can turn a cheap PC into a full-fledged Unix workstation and make all of your mistakes on it at home where your boss can't see.

Well, on most systems you run a Packet program to communicate via packet. Under Linux, packet radio is part of the "kernel", which is the central part of the operating system. In fact, the packet radio functionality uses the same software interface as the Internet communications component of the system. The result of this is that any program on the system that can communicate on the Internet is also a packet radio program.

If you want to write software, there are compilers for C, C++, Objective C, SmallTalk, and Fortran. All of these come with Linux - they aren't expensive extras as they would be on a Microsoft system. There are interpreters for the languages Python, Perl and AWK.

You can download Linux from the net. I'd only suggest this if you have a way to download hundreds of megabytes without going broke - otherwise, you can get Linux on an inexpensive CD-ROM. If you'd like to download the entire system, start with the World Wide Web site www.debian.org . That site is the home of the Debian Linux Distribution, which I recommend because I helped write it. You can also buy a CD-ROM containing Slackware or Debian for as little as $15 - you'll find one of those at the "Computer Nut" table out in the hall.



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1725

Phone: +27 11 475 0566
Email: **zs6wrmail@mweb.co.za**
**[NEW EMAIL ADDRESS]**

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

**Frequencies**
439.000MHz 7.6MHz split
(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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| Chairman/Treasurer | Dave | ZR6AOC | 475 0566 (H) | zr6aoc@mweb.co.za |
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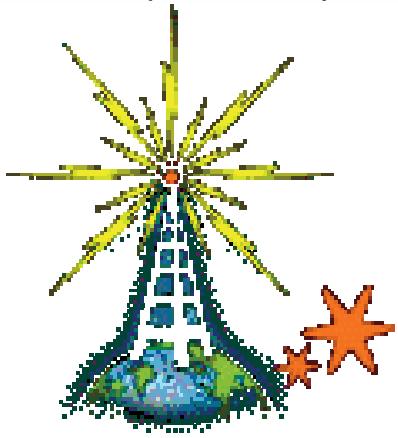
# West Rand members - we need your input!

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.**
**john_brock@telkomsa.net**