Radio ZS

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July - August 2007
Julie - Augustus 2007

Introduction to Software Defined Radio
ZS1HELL, a la Gamkaskloof
An APRS Enthusiast's Dream Rig

Amateur Radio - Communication Technology in Action

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SUID-AFRIKAANSE RADIO-LIGA

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Strubensvallei 1735 Strubensvallei 1735
South Africa Suid-Afrika

Telephone 011 675 2393 Telefoon
Facsimile 088 011 675 2793 Faksimilee
Email *admin@sarl.org.za* E-pos
secretary@sarl.org.za
Website *www.sarl.org.za* Webwerf

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Editor / Redakteur
Dennis Green, ZS4BS
082 770 9126 (H) 051 446 2039
zs4bs@netactive.co.za
radiozs@sarl.org.za

Afrikaans Taalversorging
George Honiball, ZS6NE

FRONT COVER / VOORBLAD

Douglas, ZS1DUG and Con, ZR1CE busy working the DX from ZS1HELL in the Gamkas Kloof!!

Douglas, ZS1DUG en Con, ZR1CE fluks aan die DX vanaf ZS1HELL in die Gamkaskloof!!.

Radio Technology in Action

SOUTH AFRICAN RADIO LEAGUE
SUID-AFRIKAANSE RADIOLIGA

Address / Adres:
National Amateur Radio Centre, P. O. Box 1721, Strubensvallei, 1735
Nasionale Amateurradiosentrum, Posbus 1721, Strubensvallei, 1735

Tel: 011 675 2393 Fax / Faks: 088 011 675 2793
Email / E-pos: *admin@sarl.org.za* Website / Webwerf: *www.sarl.org.za*

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BHF/UHF Bandplan en Herhalers
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ARMI and Intecnet / ARMI en Intecnet
armi@sarl.org.za
Hans van de Groenendaal, ZS6AKV
Laurie Devereux, ZS5DL

Radio ZS / Radio ZS
Dennis Green, ZS4BS
radiozs@sarl.org.za

Administrator at NARC
Administrateur by NARS
Vee Antal, ZS6ZEN - admin@sarl.org.za

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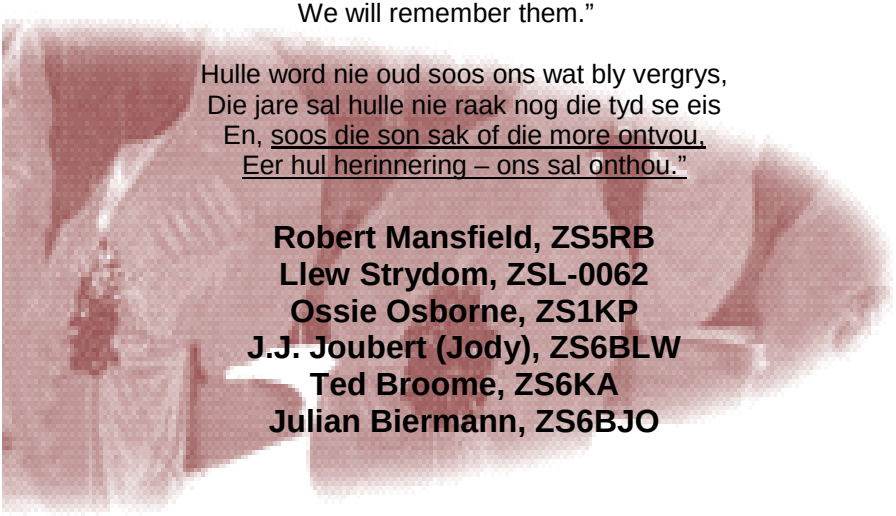
Silent Keys Stil Sleutels

They shall grow not old as we that are left grow old
Age shall not weary them nor the years condemn
At the going down of the sun and in the morning
We will remember them."

Hulle word nie oud soos ons wat bly vergrys,
Die jare sal hulle nie raak nog die tyd se eis
En, soos die son sak of die more ontvou,
Eer hul herinnering – ons sal onthou."



Robert Mansfield, ZS5RB
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Ossie Osborne, ZS1KP
J.J. Joubert (Jody), ZS6BLW
Ted Broome, ZS6KA
Julian Biermann, ZS6BJO

CQ de ZS6GJH

The Council of the SARL recently held a very fruitful one-day strategic session at the National Amateur Radio Centre recently to plan activities for the current financial year, which started on 1 July.

One of the many subjects on the agenda was the question of member versus non-member benefits. This question was raised by many members during discussions on the President net and in letters to Council.

There has to be a balance between information available to members only and to non-members. As the National Body for Amateur Radio, we have to ensure that important information about Amateur Radio is disseminated to all radio amateurs. Council was unanimous in its decision that we cannot shirk our responsibility in this regard and that we will continue to act responsibly.

Council also agreed that some services offered, such as upgrades from ZR to ZS and the issuing of HAREC documentation will be free of charge to members while non-member will be charged an administration fee.

Over time, non-members will have fewer privileges on the SARL web site and will not be able to participate in forum discussions, while members will get more information, which will be added over the next six months.

Another important discussion was around the issuing of membership cards. This has already been implemented and members who have already renewed their membership should have received the letter and cardholder. Please cut out the card, fold it, place it in the holder and keep the card safe in your wallet.

Council also reviewed the examination fees and agreed on a major reduction from R475 to R300. This has been made possible after agreement with ICASA that the SARL will in future issue the examination certificate. The fee includes the examination fee and ICASA license fees for the first year or part there of. Candidates who fail the first attempt will get a free rewrite at the next examination. Regrettable there will be no refunds. Students and learners under 25 years of age will only pay R200. The new fees are for the same for Class A and Class B examinations

We are also planning a number other events such SARL@home, activities as part of Space Week in October and the introduction of ARDF – Amateur Radio Direction Finding.

Stay tuned to SARL News and our monthly President Net for regular updates on these and other initiatives.

73, Graham Hartlett, ZS6GJH

Ham Pride: Our Legacies and Traditions

By Dave Ingram, K4TWJ

One in a Series

Amateur radio organizations around the world are working on restructuring license exams and operating privileges, and the change is renewing widespread interest in our internationally famous service/pursuit. Existing amateurs realize that fact and understand the important role new/next generation amateurs play in carrying our proud legacies and traditions forward in time. We welcome newcomers and we also encourage you to include full HF band operations in your activities, even if it requires studying for a higher class license or you do not expect to purchase HF gear anytime soon. Why?

The HF bands support person-to-person communications with other radio amateurs across the country and throughout the world. HF is the heartbeat and the "bright lights and glamour" side of amateur radio, and becoming HF active may be easier and more affordable than you think. Three special (and easily overlooked) factors make that possible: using Morse code, working CW and operating QRP.

Maybe it is reverse psychology, but studies have confirmed Morse code is more popular and widely used when it is not mandatory for licensing. Studies also confirm CW reaches out better and farther than voice modes like FM or SSB. Indeed, 5 or 10 watts on CW continuously exhibits more communications power than 100 watts on SSB. Numerous amateurs have proven that fact by contacting over 100 countries while using battery powered QRP gear - and you can do it too! Future Ham Pride articles will look more closely at some exciting varieties of keys and QRP gear plus overview some helpful hints for new HFers. This time however let's focus on the benefits of knowing Morse code.

A common problem in contacting amateurs in distant/foreign lands is language differences. Using Morse code, CW and universally known "Q" codes, however, help overcome language barriers and let you understand amateurs of all lands and tongues. A few short years ago, Morse code taps on the hull of a submarine that sank in the Barents Sea was the sole means of communicating with crewmembers. Previously Morse code has also been used for passing messages by the severely handicapped and prisoners of war by straw sips, eye blinks and more. In one of many examples, a nurse at a major U.S.

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(Ham Pride from page 7)

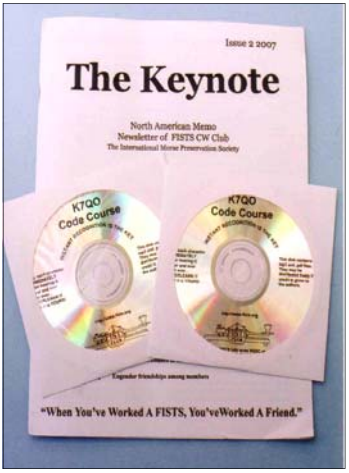
hospital helped a totally paralyzed lady learn Morse code in only two weeks. Within two months, the lady was eye blinking beautiful poems. A few months later, the paralyzed lady was eye blinking a full book of religious poems for worship. There's more!

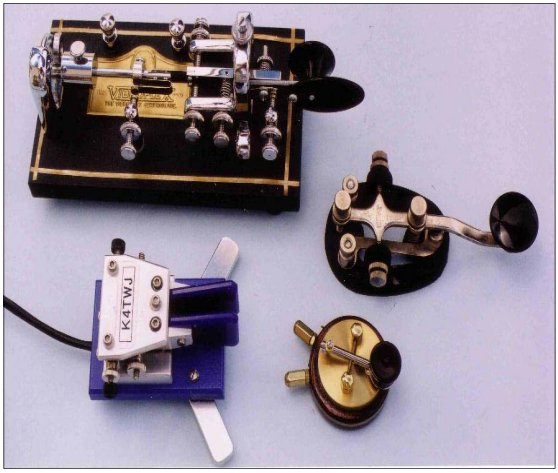
Realizing Morse code's endless capabilities, an increasing number of radio amateurs are carrying Medic Alert cards showing the Morse code and explaining if severely injured but able to move any body part, they can communicate by Morse code. Could Morse code someday prove useful for helping save your life or the lives of others? No one knows for sure, but we know it is definitely worth considering! Watch for more encouragement to try HF in future Ham Prides. Meanwhile, check www.k4twj.blogspot.com for more information on keys, CW, QRP and Getting Started in HF Fun.

73, Dave, K4TWJ

Photo 1. An excellent way to learn Morse code and become proficient in its use is by joining FISTS, the International Morse Preservation Society. Their Morse code study CDs and Code Buddy program (learn code with a friend) are top-grade and their "KEYNOTE" newsletter is always filled with good encouragement for operating CW. More details at www.fists.org.

Photo 2. Illustrating the four main categories of keys is: left top - a world-famous semi automatic key or "bug" (available from www.vibroplex.com), right top - a classic Speed-X hand key available from www.MorseX.com, lower left - a dual lever paddle (hand made by WB9LPU) and lower right - a round based miniature key hand made by K6VDH.





ZS1HELL, a la Gamkaskloof

Karl Canitz, ZS1KC

27 April 2007, vroegerig die oggend het die hele entourage vanuit die Agter-Paarl koers gekry Gamkaskloof toe met die voertuie toegerus met uittrekveselglaspale, rolle draad, ‘n 1 000 m rol baaltou, ‘n Kenwood TS450S, kragbron, kragopwekker, twee 102 Ah Gelbatterye, logstate, eetgerei en leë slaapsakke!

Harde DX-ing eis sy eerste slagoffer!!

Die manne met hul maste en antennas!

Bennie, ZR1JHD was getaak om na die eetgoed om te sien en dus kon die balans van manne, 11-stuks van hulle, hul met meer “belangrike goed” besig hou! Vergewe my Bennie! Elkeen het pligte gehad met die voorbereiding van hierdie toer, sy dit gereedskap, koakse en passtukke, ankerpenne vir die maste tesame met ‘n 4 lb hamer asook ‘n sakrekenaar om sommetjies te maak. Olivier was verantwoordelik vir die hout (nie harde hout nie!) en glo my daar was meer as genoeg daarvan gewees. Die vuur het vir 4 dae pal gebrand. Jean, nou ZS1HJC, het selfs sy hand aan brood-bak probeer en die finale resultaat was, nadat dit met ‘n boesmansaag op-“gesaag” was, nogal baie lekker gesmaak. Knap gedaan, Jean en ook die dosyn of wat gekookte krewe wat hy as voorspyse voorgesit het! Julle moes daardie Mac, ZS1XX, aan die goeters sien smul het. Dit was slegs sy ore wat gekeer het dat die “smile” reg rondom kon trek nie!!

Die antennas wat ons op-gerig het, onder die bekwame leiding van Derrick, ZS1DUP, Johan, ZS1GP asook Doug, ZS1DUG en Con, ZR1CE, was heel eerste ‘n 40 m omgekeerde V-antenna wat wild en wakker die eerste aand gewerk het en waarmee wyd en syd kontakte

(Na bladsy 10)

Karl, ZS1KC tells about the Expedition by members of the Boland ARC to ‘The Hell’. The radio communications was top class, the food was excellent and the camaraderie was very special.

ZS1HELL set out to obtain the Top Band Award and the Worked All ZS and they achieved both. Well done!!

(ZS1HELL van bladsy 9)
gemaak is. Die volgende oggend het ons die bouoefening herhaal met ‘n 80 m V-antenna en later die namiddag ene vir 160 m. Laasgenoemde was sowat 80 m van punt tot punt – ‘n reuse stuk geskiedenis! ‘n Rooster was vir die 12 lede vooraf uitgewerk en elkeen moes per dag 1 uur voor die radio deurbring. Dit was só lekker dat sommiges sommer 2 - 3 uur lank kontakte gemaak het.

Die doel van ZS1HELL was in die 1ste plek om die “Top Band”-toekenning vir 160 m te kon verwerf – hier was Olivier die lig in die hel en het alreeds die volgende oggend al ses roepseinareas in die RSA gewerk, trouens hy het 33 kontakte op 160 m gemaak. Sommiges se seinrapporte van ons was tot 59+30. Dit was lekker om in ‘n area te DX waar daar geen QRM of elektriese geraas was nie. Dié 33 kontakte was met 400 W uitsetkrag bewerkstellig. Alle ander kontakte was slegs met 100 W gemaak. Die tweede doel was om ‘n “Worked all ZS” te probeer verwerf. Dit is seker een van die moeilikste take hier plaaslik aangesien ‘n sekere roepseinarea nie baie betroubaar QSL nie!! Teen Maandagmiddag was daar meer as genoeg kontakte gemaak om ook hierdie doel te kon bereik.

Soms het ons die krag-opwekker afgeskakel en slegs van die parallelgekoppelde hoëstroom-gelbatterye gewerk gekoppel aan ‘n sonpaneel – slegs met 100 W uitsetkrag. Ons kon geen noemenswaardige verskil tussen 12 en 13.8 V opmerk nie. Alle kontakte, behalwe dié op 160 m, is met 100 W uitsetkrag bewerkstellig. ‘n Baie interessante aspek van die naweek was ook dat die 40 m-band NOOIT toegemaak het nie. Ons was daar bedrywig vanaf soggens tot saans laat sonder pouse. Twee QRP-stasies het ons ook gewerk. Die een was ZS1WP uit Bellville wat ons met sy 1,5 W en met sy roteerbare 40 m-dipool, gewerk het. Ons het vir hom ‘n korrekte 5/8 seinrapport gegee. Die ander QRP een was uit ZS5.

‘n Paar nuwerige amateurs het ook sommer hulle vuurdoop voor die radios en die “ou manne”, gehad en hulle self besonders goed van hul taak gekwyt. Hulle was: Jean Coetzee, ZS1JHC, Graham Butler, ZS1GVB, Douglas Defty, ZS1DUG, en Con Esterhuizen, ZR1CE. Clyde, ZS1CS, mankvoet en al het lekker ge-Dx, terwyl Johan Aucamp hom goed met liefde en uitsoekkos bemoeder het. Derrick du Plessis, ZS1DUP, Bennie Haarhoff, ZR1JHD en Mac McKenzie, ZS1XX het die balans uitgemaak. Rassie Erasmus, ZS1YT het ‘n puik job gedoen met al die voorafreëlings vir verblyf, roepsein ens. Dankie Rassie.

Con, ZR1CE en Derrick, ZS1DUP het die logstate gedurig op die skootrekenaar op datum gehou – flink en vrolik! Bennie se kos was uitstekend, die onderdak lekker en laastens die uitgelese geselskap was die beste ooit.

What do you do when you see an endangered animal eating an endangered plant?

An Introduction to Software Defined Radio

Eric Stockenstrom, ZS6BUJ

Software Defined Radio (SDR) has opened up a whole new field of interest in amateur radio. For those of us who became a little bored, suddenly here was a fresh and substantially different way to deal with and process signals. While Digital Signal Processing (DSP) has been around for a long time in specialist applications, the breakthrough for amateurs came when PC manufacturers included fairly decent yet affordable analogue/digital/analogue capability in the form of soundcards. In addition, the PC provided a reasonably standard platform for amateur software development to take place.

From humble beginnings, individual and often very clever and innovative applications have proliferated, and gradually functionality is being integrated into a more unified experience for the operator. Think about it. Twenty years ago, everything you needed was in the rig. Well almost. You still needed and antenna and you still needed a source of power. Today, very few hams choose to operate without the benefit of DX clusters, propagation prediction, logbook databases, CAT, eQSLs, and of course, the growing class of digital modes. In fact, for many hams, the operating experience has been transformed from a mostly auditory one, to a high-bandwidth visual, auditory and tactile experience. (Yes, CW has always been highly tactile). Readers who operate digital modes through advanced graphic user interfaces like Ham Radio Deluxe and DM780 will know exactly what I mean.

What has this all got to do with SDR? Consider the communication experience from end to end. An idea originates in a human mind (or machine – do not go there), is encoded in words or symbols, propagates across space/time on a "carrier," is decoded and hopefully understood by a recipient. For example, a rag-chewer on 40 m decides to tell a listener 1 000 km away that his tea has arrived. The idea is articulated into words at audio frequencies, amplified, mixed with an RF frequency and a product selected through filtering, the carrier and one sideband is removed for SSB, the encoded signal is further amplified and then properly coupled to the ether through an antenna. The signal propagates from the antenna according to fairly well understood laws of physics, growing weaker as the wavefront moves through space. The usually weak electromagnetic wave front, together with background thermal and other noise, induces tiny electrical currents in a resonant receiving antenna system. The tiny, noisy signals are selected in the frequency domain by filters, amplified at RF frequency, mixed to an intermediate frequency for very sharp filtering and mixed again to produce a baseband audio signal. If the signal to noise ratio is good enough, the recipient hears the words and the human mind decodes the meaning. Therefore, a meaningful notion, or information, has been transmitted from one location in space to another.

(Continued on page 12)

The complete article will all illustrations is available (A4 size) from radiozs@sarl.org.za

(Intro to SDR from page 11)

The meaningful notion could, of course, be encoded into text, pictures, video, mathematical expressions or some other form. The purpose or job of the intermediated technology is to get the encoded notion from one end to the other. The voice modulated transceiver example is simple and clear. However, when we get into other modes, important stages in the journey of the notion from end to end, require processing of some sort. These days such processing usually, but not always, requires a CPU and an algorithm rendered in software. (Early RTTY harnessed Newton's mechanical laws to encode information).

Of course, the "carrier" could be TCP/IP over the Internet, or string between two tins, but this article is about radio.

Therefore, software has been creeping into radio for years, and has recently especially been creeping into the end-to-end signal path. As pointed out before, many modern communication appliances include DSP of some sort. The trend is towards as little hardware as possible and increasingly sophisticated software providing flexibility and easy upgradeability. You download the new model from the Web, and do not need a new tin box. Of course, marketers will always try to sell you the shiny new box as well. This scenario is already a reality in established industries like cell phones, aeronautics & space, military and so on. It is easier to upgrade the communication module of a spacecraft by downloading new software, than going up there and replacing the box. However, this article is about amateur radio.

At a practical level, an amateur software defined receiver can be assembled with a handful of ICs and the free download of a variety of supporting application software. Add a few more components, and you have a software-defined transceiver "that will outperform much of the commercial gear on the market" (ref: A Software Defined Radio for the Masses – ARRL web site, author Gerald Youngblood). The amateur construction of SDR hardware and the integration of supporting software can be immensely satisfying, is affordable and still produces stunning performance. What better way to learn about these new technologies and have a great deal of fun in the process?

The simplest SDR comprises a broadly tuned front-end, feeding into a mixer to create a direct conversion receiver. However, there are some interesting new wrinkles. Firstly, the mixing is done by a Quadrature Sampling Detector (QSD) in the form of a multiplexing bus switch, which is closed momentarily at the mixing frequency. The incoming signal, say 7.040 MHz, is "sampled" at the mixer frequency of say 7.056 MHz; producing a baseband audio output centred around 7.056 MHz – 7.040 MHz = 16 KHz. Of course, when you mix two frequencies, you not only get the difference, but also the sum, and higher order mixing products. The primary signals, and their images are what concern us here, as the sum signals fall outside the bandwidth of our baseband processing capability.

Now let us discuss the concept of Quadrature. Quadrature is a big deal in SDR. In fact, quadrature is the deal in SDR. In 1933, Harry Nyquist proved that to accurately recover all the components of a periodic waveform, a signal must be sampled at twice the maximum bandwidth. That minimum sampling

(Continued on page 13)

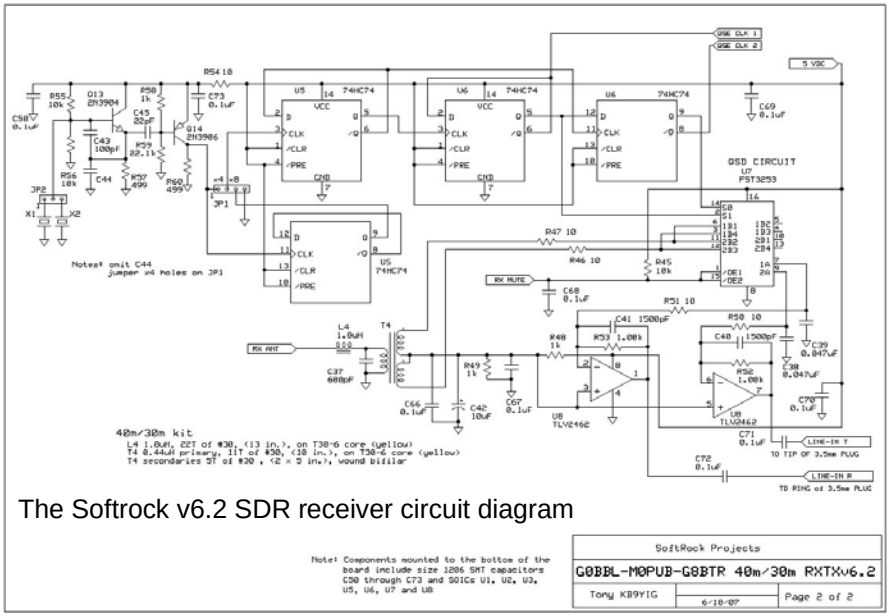
(Intro to SDR from page 12)

frequency is called the Nyquist criterion. It also transpires that if you measure the instantaneous amplitude of a signal, and measure again 90° of phase later, you can derive the amplitude at any phase angle, essentially by employing Pythagoras' theorem on the phasor diagram. The sample signal therefore consists of two series of numbers representing amplitude and phase measured at time intervals derived from the sampling rate. One series for in-phase (I) samples and another series for quadrature (Q) samples.

Let us go back to the QSD. Imagine a stable local oscillator (LO) injecting a signal into a series of flip-flop dividers, which in turn produce two clock signals at the required mixer frequency, one clock in phase (I) and the other quadrature (Q). Now use those clocks to "switch on" the QSD bus switches momentarily to sample the (I) and (Q) components of the input RF signal. The resulting output is two analogue channels (I) and (Q) of baseband audio, which can be individually fed to a dual low-noise op amp for amplification before going to the soundcard via a standard stereo cable.

Dan Tayloe, N7VE developed and patented an elegant and high-performance QSD design characterised by its very low component count. The Tayloe detector essentially operates as a four-position switch rotating at the carrier frequency, feeding sampling capacitors for 0°, 90°, 180°, 270°. Each capacitor tracks the input carrier amplitude for a quarter of a cycle, and holds the amplitude for the rest of the cycle. If we differentially sum the 0° and 180° amplitudes with an op amp, the output amplitude (voltage) would be twice that of the individual samples, delivering a noise free gain of 6 dB! This is the (I)

(Continued on page 29)



The Softrock v6.2 SDR receiver circuit diagram

Is There Still A Future For Amateur Radio In This Modern Space Age?

By Mike Bosch, ZS2FM

The onus is now on the younger generation to protect Amateur Radio and lead it to a new golden age of activity. They too could rise to the occasion, once they have been inspired and accepted the challenge just like their predecessors have done before, and conquer the exciting new Amateur Radio world that lies ahead!

The First Radio Amateur

Guglielmo Marconi is the father of Radio-Telegraphy and the first Radio Amateur in the world. When Marconi spanned the Atlantic Ocean by radio on 12 December 1901 using a wavelength of 1 000 metres (300 KHz), many electrical enthusiasts were inspired world-wide and constructed spark transmitters and coherer or crystal detector type receivers. During the years that followed Radio Amateurs became great experimenters, pioneers and researchers. Hams were willing to try things that more learned people would have said to be impossible. They contributed a great deal to the advancement of radio science, and were later rewarded for their efforts with the allocation of dedicated amateur bands during the Washington Radio-Telegraph Convention of 1927.

Electromagnetic radiation covers radio waves from ELF, VLF, LF, MF, HF, VHF, UHF up to Microwaves, followed by the newly discovered Terra-rays, Infra Red rays, Light, Ultra Violet rays, X-rays and the extremely dangerous Gamma rays. Marconi as well as the early Radio Amateurs began their experiments on long waves. When AM broadcasting started in 1920 on LF and MF the authorities forced amateurs on to the useless wavelengths below 200 metres, where they discovered short-wave DX propagation (F-layer) at night on 160 metres and later also daylight DX (F2-layer) on 20 metres. In time, the amateurs also explored VHF, UHF and finally ended up on Microwaves reaching a frequency of 403 GHz. Now they are also experimenting with light wave communications on 474 THz and 678 THz.

The golden era of Amateur Radio began after World War II when thousands of radio technicians and operators were demobilized from the army, navy and air force; many of them became Hams and it boosted amateur activity world-wide. Low cost war surplus radio equipment also became available and gave beginners a kick-start. The 20 metre band was packed with numerous DX CW signals with some AM signals higher up the band; in the late afternoon you had to queue up to find a spot on the 40 metre band which stretched from 7.0 to 7.3 MHz at the time; at night the 80 metre band was full of stations from

(Continued on page 15)

(Future for Amateur Radio from page 14)
3.5 to 4.0 MHz. This was truly the golden age of amateur radio that lasted for many years; it also started the exploration of VHF and above.

The First Moon Bouncers

The US Signal Corps bounced radio signals off the moon on 111, 5 MHz as early as 1946. In 1953, Ross Bateman, W4AO and Bill Smith, W3GKP were the first radio amateurs to pioneer moon bounce (EME) on 144 MHz when they transmitted and received a series of pulses from the moon on 144 MHz. But the first two-way EME contact was only recorded in 1960 between W1BU and W6HB on 1 296 MHz.

The first EME contact from the RSA only occurred in 1979 when Gary Howarth, ZS6ASO worked Dave Olean, K1WHS on 144 MHz CW. Gary's EME array consisted of four 19 element Yagis.

Ivo Chladek, ZS6AXT of Krugersdorp is the doyen of EME in the RSA and pioneered many EME records on Microwaves up to 5.7 GHz. Ivo constructed his own microwave equipment including several parabolic dishes. Currently ZS6AXT still shares a world EME record with NU7Z on 2.3 GHz.

The Dawn of The Space Age

Fifty years ago the space age dawned, when the Russians launched the first artificial earth satellite, Sputnik 1, on 4 October 1957. Sputnik transmitted beacon signals on 20 and 40 MHz that were received worldwide and lasted for about three weeks before the batteries ran flat. The number of beeps per minute indicated the temperature on board the spacecraft. Reception reports of Sputnik by amateurs were rewarded with a special QSL card from Moscow. Sputnik 2 with Laika the dog was followed by a few military satellites as well as a commercial satellite Telstar.

The first Orbiting Satellite Carrying Amateur Radio, OSCAR 1, was launched by AMSAT in 1961 and transmitted 'HI' in Morse code. Since then around 70 amateur satellites have been launched by 22 countries including South Africa and currently only 16 are still active, as well as the 33 year-old Oscar 7. Greg Roberts, ZS1BI pioneered amateur satellite operation in the RSA; later Greg and Hans, ZS6AKV founded SA AMSAT. Around this time, numerous commercial and military satellites were placed in orbit including analogue satellite TV on C-band i.e. 4 GHz.

Why Has Amateur Radio Lost Some of its Magic?

It appears that experimental Amateur Radio has degenerated merely into a chat show. Why?

The Digital revolution affected Amateur Radio in many ways. With the advent of microprocessors, main frame computers were developed that ultimately led to home PC's. Then Digital Data modes followed including Packet Radio and PSK31. Eventually we ended up with Cell phones, Space Radio, the Internet and Digital Satellite TV on the 11 GHz KU-band.

During the 21st century, we saw the introduction of Weak Signal Digital Data modes such as FSK 441 up

(Continued on page 18)

DIAMOND ANTENNA

Radio Accessorie

Incorporating SAM'S RADIO AC

bhi

bhi NES10-2 Noise Eliminating Speaker
Incorporates Digital Signal Processing to remove unwanted noise and interference
Fully adaptive noise cancelling
Noise cancellation 9-35dB
4-65dB tone reduction
8 user selectable noise cancelling levels

MFJ259B SWR/RF Analyzer
Read SWR and impedance 1.8-170MHz
Determine Velocity Factor, coax cable loss in dB, length of coax and distance to short
Built-in frequency counter
Ni-CD charger circuit

MFJ

ICOM

Icom IC-7000 HF/VHF/UHF Mobile Tran

03-199 MHz Receive	503 Alp
RIT	Preamp
VFO A/B	1 Hz Dis
Digital IF	Twin PB
S/RF/SWR Meter	100 Wa
50 Watts 2M, 35 Watts 440	Manual
All band Multimode	Remova
CW Receive Reverse	Mini Spe
Memory Keyer	2.5" Col

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s & Data Modems

CESSORIES CK88/18657/23

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New, two-touch repeater access
High grade waterproof materials (submersible 1m/3ft. for 30 min.)
Rugged polycarbonate body resists dirt, dust and moisture
Highly visible backlit alphanumeric display
Direct frequency input through illuminated keypad
200 Memories and one call channel
VFO, Memory and Scan modes

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Kenwood TH-F7E Dual Band Handheld Transceiver
Simultaneous 2 frequency RX, even on the same band
0.1~1300MHz high-frequency range RX (Sub B band)
FM/FM-W/FM-N/AM plus SSB/CW receive
7.4V 1550mAh lithium-ion battery for 5W output and extended operation
1200/9600bps packet function (ext. TNC)

nsceiver
ha memories
/Attenuator
splay
IT
tts HF+6M
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our TFT

YAESU

Amateur Radio Division of Vertex Standard

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Gallo Manor
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(Future for Amateur Radio from page 15)
to the JT65c series for Radio Amateur communication. Today's Digital operator does not have to listen or read weak digital signals, the computer decodes and displays it on the monitor screen. In the early days of amateur radio, Hams had to copy weak Morse code signals in the noise to establish a two-way contact. Today's Hams buy their black boxes complete and only have to learn how to drive it. In the early days of Amateur Radio, Hams had to build their own black boxes with everything inside; they had to learn how it worked and how to fix it. This has removed the degree of difficulty and challenges from modern amateur radio. Today millions of non amateurs and children world-wide are equipped with miniature handheld transceivers and can talk to each other via digital repeaters – it is the cell phone era!

Our younger generation of radio amateurs have the duty to continue with the Amateur Service and this grand hobby; they should try and uplift it to its former glory. Most of today's young people are very sharp and clued-up with the latest developments in computers, cell phones, the Internet, ADSL, blue tooth, wimax, broadband, 3G, ipods, wifi, GPS, Google Earth etc. The question is can amateur radio offer them something as fascinating and exciting as what they now experience in the cyber world? The answer is a definite YES – MICROWAVES; but there is still a place for VHF and UHF in the near future.

The Moon

Fortunately, just behind the horizon lies a new golden age of amateur radio! It may take ten years or longer to materialise but it is coming! So stop being negative!

Apollo 17 was the last of six manned moon landings by NASA on the Sea of Serenity, a barren and airless world. Currently NASA and the European Space Agency are planning the first moon base. It will open the way for lunar settlers and a vast field of scientific research. Some of these settlers could be radio Hams and they would certainly like to talk to us Earthlings in their spare time.

When we study the Earth/Moon/Earth path, it becomes clear how little energy is actually reflected back to the Earth during an EME transmission. It is estimated that about 17% of a radio signal is reflected from the surface of the moon but scattered in all directions. If we take a typical kilowatt EME transmitter on 144 MHz producing an output of 600 watts into a Yagi array with the gain of 20 dB (i.e. a gain of 100 over a dipole), it radiates an ERP of 60 Kw, but the reflected signal to Earth is only about a ¼ watt. By the way, ERP is the output power multiplied by the antenna gain. Although EME is a very high tech and challenging system, it is nevertheless very waste full in power and a very inefficient communication system.

EME signals reflected from the moon are very weak and CW was the desired mode of communication. Digital modes made it considerably easier to operate EME and with less ERP. But this whole picture changes completely when you transmit directly from the Moon to Earth. Radio signals from the Moon would be a great

(Continued on page 19)

(Future for Amateur Radio from page 18)
deal stronger, therefore efficient amateur equipment on VHF, using high gain Yagi beams that could track the Moon, should provide phone contacts on SSB and maybe even FM. So do not throw away your 2 metre analogue equipment it could still provide many of you with 400 000 km Lunar DX phone contacts!

The Future Moon Base

You may ask of what value is a moon base? Moon bases would permit the exploration of the lunar surface, the mining of rare minerals and ice (the water supply) from polar craters where the Sun never shines. The establishment of laboratories would enable important research to be conducted in a natural vacuum and low gravity environment. Large optical telescopes could be built where celestial images will not be blurred by an atmosphere, as well as the construction of radio observatories on the far side of the moon, which will be shielded from radio pollution emitted from mother Earth.

But how would they communicate with each other on the surface of the moon when there is no air or ionosphere present? Therefore, the lack of air cannot produce Tropo or Meteor Scatter, and because of the absence of an ionosphere Sporadic-E, Ionospheric Scatter or F2 propagation can not exist; only line of sight propagation is possible. If you should become trapped in a crater with a cell phone or any other portable transceiver then you would be lost! Local communication could be provided via satellites orbiting the moon or powerful earth-based repeater stations. Later this century there could be a number of international settlements on the Moon sponsored by NASA, European Space Agency, China, India and Japan. The lunar surface could become a hive of activity, but underground pressurized residences would protect the lunar settlers from extreme temperatures, meteor showers, meteorites and solar flares.

A Yagi array is the most efficient and compact beam antenna up to about 900 MHz, but above this frequency, it becomes the domain of the parabolic dish antenna. AMSAT or some other group might erect a number of moon repeaters operating on VHF and/or UHF that could permit us Earthlings to talk to each other for 12 hours daily, and would cover the whole world between moonrise and moonset. But future broadband microwave Digital repeaters could open up a more efficient form of world-wide communication and cover thousands of channels. It would encourage long distance QSOs between Earth stations on digital voice and data modes as well as high definition digital video transmissions. This could make us less dependant on our ionosphere and its vagaries during the Sunspot Cycles. Earth/Moon communication could inspire experimental work on microwaves and a learning curve for deeper space communications in the future.

Mars

Mars is the fourth planet from the Sun and about the diameter of the Moon. Maybe within the next twenty years or so the exploration of planet Mars could also begin. More sophis-

(Continued on page 20)

(Future for Amateur Radio from page 19)
ticated and high power microwave equipment, using klystron or Travelling Wave Tube amplifiers would be required operating on a frequency around 10 GHz. A 6 metre parabolic dish with a gain around 50 dB over a dipole on this frequency might do the trick; but advanced digital modes would be a prerequisite. At closest approach to the Earth, i.e. 56 million kilometres, Mars will have an apparent diameter of only 26 arc seconds and call for accurate tracking of the dish.

When we start transmitting deeper into space then we are confronted with a new set of problems. The Galactic noise emitted by the stars in our Galaxy the Milky Way, including the water vapour and oxygen noise that is created in our atmosphere will affect all space communications from Earth. Minimum noise level is experienced between 1 and 10 GHz ranging from 6 to 8 Kelvin, but the water vapour noise rises rapidly above the latter frequency. This low level noise area is referred to as the waterhole where SETI originally listened for alien radio signals. Also inside the waterhole is the hydrogen emission line on a frequency of 1 420 405 MHz and no transmissions are allowed on or near this frequency. The water vapour and oxygen noise would not be a problem on the Moon.

Just in passing: way back in 1965, two scientists were testing a very sensitive microwave receiver and a large horn antenna on 7 cm, when they picked up a faint hiss with a temperature just under 3 Kelvin. It turned out to be the microwave background radiation that stretched all the way up to 300 GHz and originated from the Big Bang – the birth of our Universe 13 700 million years ago!

A Martian Base

In 2009, NASA is planning to launch the Mars Telekom Orbiter that will arrive there in 2010. Its main purpose is to test the first interplanetary laser link which will transmit digital data ten times faster than an RF link, but it has the disadvantage of not penetrating clouds. On the RF side, the spacecraft will be equipped with a three metre dish and a 35 Watt TWT microwave transmitter operating on the 3 cm band. Also on the drawing board is Germany's AMSAT Phase 5-A satellite to be launched during the same window of 2009 to orbit the planet Mars. Amateurs who are well equipped to operate on 10 GHz will be able to track the satellite and monitor the beacon and telemetry signals on digital modes.

When the Martian base is established then amateur signals could share the NASA dish on the planet by attaching the amateur feed horn on to their feed horn cluster. Radio and light signals could reach Mars, during its closest approach to Earth, in about 15 minutes and a complete over could take half an hour, enough time for a coffee break. By the turn of this century, space exploration should be well on its way in the Solar System and visits to the satellites of the big planets like Jupiter and Saturn or beyond could be envisaged. Of course, Amateur Radio will follow! Space DX expeditions could become possible in the distant future to most

(Continued on page 21)

Sukses met Veldstasies

Jan Botha, ZS4JAN

Jan, ZS4JAN gives tips on how he prepares for a field station - contesting or emergency. Jan explains the maintenance he does on his equipment, the planning for the contest, notes he makes as he goes along, what he does following the contest and gives an example of his checklist.

Een van die opwindendste datums op die radiokalender is beslis velddagkompetisies. Veldstasies kan ook gebruik word tydens geleentheidstasies of selfs noodkommunikasie (HAMNET). Om `n veldstasie te bedryf kan baie kopsere tot gevolg hê. Na aanleiding van my veldstasiesukses wil ek `n paar punte deel om sodoende jou veldstasiegeleentheid `n sukses te maak.

Onderhoud

✓ Die draadantennas (multiband omgekeerde V) met sy veselglaspaal, balun en voerlyn moet as `n eenheid geberg word. Ek slaan die volledige antennastelsel op in `n groot oop veld, weg van strukture. Toets die stelsel se SWR, impedansie en bandwydte. Maak `n nota van die antennas se toetsresultate op jou notalys. As jou antennas reg is, benodig jy geen aanpasser nie. Oefen om die antennas suksesvol op te slaan in `n minimum tyd.

✓ Twee mikrofone word nagegaan. (Mikrofoonkabels breek altyd voor `n kompetisie).

✓ Spaar sekerings (fuses) met kragkabels.

✓ Radio met eksterne SWR/ Wattmeter en kort koppellyne word getoets.

✓ Die loodsuurbatterystel word nagegaan vir korrekte spanning, kapasiteit en skoon pole. Onthou om altyd die batterye op `n sypellaaier (trickle charger 13.8V) te stoor. Nog `n wenk is om isolasiemateriaal in die bodem van die batterykas te plaas (ek gebruik “soft board”of notabord). Die bord dien as termiese isolator tussen die battery en die grond en voorkom dat die battery rondgly in die

(Na bladsy 22)

(Future for Amateur Radio from page 20)

of the solar planets. Just imagine when the old-fashioned DXCC award is replaced with a WAP – Worked All Planets certificate!

Finally, it must be pointed out to the younger generation that Amateur Radio will also need protection in the future. The South African Radio League, which is a member of the IARU, is the only local institution that can fight for our rights, therefore give them your full support and do your bit for the SARL and Amateur Radio.

A fascinating, exciting and thrilling future awaits the younger Radio Amateurs of today. So, go for it!

(Veldstasies van bladsy 21)
batterykas tydens vervoer.
✓ Om elektriese koppelings te vergemaklik tussen die batterye, radios en ligte het ek dik geleistawe vasgebout op die batteryterminale. Die stawe het `n paar boute met vleuelmoere (wing nuts) wat help met vinnige netjiese koppelings. Verf `n rooi en swart strepie onderskeidelik op die stawe om verkeerdom koppelings te voorkom.

Beplanning
✓ Die omgewing en ligging van jou veldstasie is baie belangrik. As jy `n QRP-stasie bedryf, moet die oriëntasie van die dipole in ag geneem word. Ek soek maksimum uitstraling na die noorde en suide. Hoogte is nie `n belangrike faktor vir Suid-Afrika en sy buurlande nie. Kyk of dit moontlik is om geen bome, pale, geboue en bergtoppe naby aan jou stasie te hê nie. Neem die uitstraalhoek en uitstralingspatroon van jou antenna in aanmerking.
✓ Skaduwee en beskutting teen die elemente moet ook oorweeg word.
✓ Veiligheid teen kriminele is `n baie belangrike faktor! Gebruik omgewings soos bv. militêre basisse, sportvelde, museums, universiteite, skole. Die agterplaas van jou stadshuis is beslis nie `n veldstasie nie!
✓ Besluit vooraf in watter kategorie jy die stasie wil bedryf, bv. enkeloperateur QRP.
✓ Met genoegsame oefening sal jy weet hoe lank dit neem om jou volledige veldstasie op te slaan. Beplan jou tyd so om so vroegtydig moontlik klaar te wees voor die aktiwiteit begin.

Notalys
✓ Maak vir jouself `n lys van benodigdhede.
✓ Bêre die lys in die radiokas vir die toekoms. Die lys sal verander en verbeter soos wat jy meer ondervinding opdoen met veld-stasies.
✓ Merk die lys in kolomme van radiotoerusting, kampeertoerusting, eetgerei, ens.
✓ Die effektiwiteit van jou lys sal jou baie help om vinnig te reageer tydens`n noodsituasie (HAMNET).

Terug by die huis
✓ Maak alles skoon.
✓ Die radiotoerusting word nagegaan en verpak. As daar enige radioprobleme was, moet dit onmiddellik herstel word.
✓ Antennas en voerlyne word netjies op `n plastiektol gerol. (As jy slim is kan jy die antennas en voerlyn toets voor jy dit afslaan, maak `n nota van SWR, impedansie en bandwydte op die notalys vir toekomstige verwysing).
✓ Stoor jou volledige stasie in houers om sodoende te verseker dat alles bymekaar is.
✓ Vervang jou skryfbehoeftes nl. logpapier, notapapier, penne en potlode. Potlode word ingepak omdat penne nie kan skryf as die lug en papier baie vogtig is nie.
✓ Dateer jou notalys op as daar enige veranderings is.

Voorbeeld van my Notalys
✓ Radiokas: radios, kragkabels,
(Na bladsy 23)

(Veldstasie van bladsy 22)
mikrofone, spaar sekerings, oorfone, swr/kragmeter, koppelkabel (flylead), stoflap, frekwensiekaarte.

✓ Antennas: tol omgekeerde V dipole, veselglaspaal, balun (x2), rooi/wit noodband (om antennas sigbaar te maak), wasgoed-pennetjies, tentpenne, hamer, spantou, voerlyn (koaks).

✓ Batterykas.

✓ Gereedskap: multimeter, sterpunt- & platpuntskroewedraaiers, tang, sykniptang, hamer, tou, binddraad, matmes.

✓ Skryfbehoeftes: logpapier, penne, potlode, blokpapier, kompetisiereels.

✓ Kampeertoerusting: tent, tafel, stoel, lugmatras en pomp, ligte, vuurhoutjies, flits, insekgif, reënjas, spaar klere, hoed.

✓ Eetgerei: koelhouer met ysblokke, baie water, kos, beker, koffie en ketel, gastoerusting, hoofpynpille, Rennies.

✓ Identifikasie/inligting: vlag, groot inligtingbord (om my stasie te adverteer), kamera.

Dit is `n kort weergawe van hoe my veldstasielys lyk. Die belangrikste is om die lys aan te pas soos nodig en te bêre in jou noodradiokas, wat op sy beurt jou sal help om vinnig en effektief te ontplooi vir `n suksesvolle veldstasie.

The Digital Modes

Kenwood TH-D7A(g)

An APRS Enthusiast's dream rig

By Eddie Leighton, ZS6BNE

In June, I went down to Natal and took my Kenwood TH-D7A(g) along with a simple magnetic mounted rubber duck talkie antenna on the roof of the car as an APRS experiment. My Garmin Legend GPS was mounted on the front window with a suction cup bracket, its serial cable attached and connected to the GPS input of the TH-D7A(g) via a homebrew cable. This is one amazing little rig! Not only is the GPS used to provide the radio with your position information to be transmitted on a regular basis on the APRS frequency, 144.800 MHz, with "Waypoints" set to "On," there is two way communication between the GPS and TH-D7A(g). With every APRS station heard, its GPS co-ordinates are stored in the GPS's memory for display! With that, you can easily see on the GPS's screen, where ham APRS stations are in relation to yourself! This info I could later import into the GPS mapping software to be able to see where the stations were located.

Figure 1 shows APRS concentra-

(Continued on page 24)

(Continued from page 23)

tion points as received by the handheld with waypoint data being sent to the GPS for waypoint storage. Note the limited physical coverage for a trip from Natal to the Northwest Province! A lot of involvement by all hams in South Africa is necessary to improve on this. It is easy to establish an IGate to send APRS data from RF to the Internet and visa versa. I will write an article on establishing your own IGate in future publications in Radio ZS. Radio ZS should and could be used as your personal guide in setting up software for the digital modes, any digital mode. I try to write my articles with this in mind. Simple and easy to use instructions.

Instant messaging

I was surprised to see an envelope icon of sorts on the TH-D7A(g)'s display, Gert, ZS5GHK in Newcastle had sent me a message, "Hi Eddie, I see you're mobile" and it was stored in the talkie's memory. The ham's own SMS system!

Figure 2 shows Kwazulu-Natal, they also have their concentration points too, mainly on the N3 highway. I found walking around on Botha's Hill while supporting alongside the road at the Comrades Marathon in June that no APRS signal could be received from my backpack. I could hear signals pretty well but the power levels were probably a lot higher than the TH-D7A(g)'s 5 watts. Limited APRS coverage for the Comrades marathon route presently, but an exercise I would like to do next year may require better coverage. The hams in Natal, I am sure from experience, will do their utmost to make it a success.

Figure 3 shows Newcastle and Dunblane farm 20 km west. On the 18th of

(Continued on page 25)

(Continued from page 24)

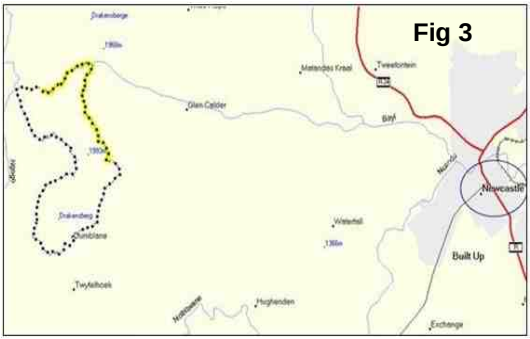


Fig 3

August 2007 , if all goes well , I will take part in the Donkey's Pass Mountain Challenge, a 24 km run through the Drakensburg Mountains with a cut-off time of 7 hours. An ideal opportunity to use APRS as "Man in the field" sending signals via RF and an APRS Internet gateway hosted by Gert, ZS5GHK to relay APRS signals on to the Internet. Feedback in the next edition of Radio ZS.

The TH-D7A(g) and Garmin Legend GPS mounted on a small chopping board, which is easily slipped into a pouch on the mountain running Hydration back-pack. The antenna is the slightly smaller, not the original dual band antenna , I use the small Alinco DJ-C7's dual band antenna screwed onto the SMA adapter. The Serial cable between the two are home brewed. The THD7A (g) has a built in TNC which it uses for APRS. The rig can be used for standard 1200 or 9600-baud packet operation too together with a PC or laptop. Being a dual bander with a duplex setting makes it an ideal rig for working FM satellites too like the AO-51 , even decoding the ISS's packet transmissions as it flies over mother earth. APRS queries can be done on up to 40 stations recently heard which are stored in the rig's memory. What is also a nice feature is that an alarm can sound if there is activity on the receive frequency. The rig has excellent audio and an easy to use menu system. An APRS computer and dualbander all in one.

One or two things from the Editor...

Readers, please take note that any article publisher in your journal is available from the author and the editor. The journal is printed in A5 size and this means illustrations and circuits must be reduced to make them fit into the available space. Send me an e-mail requesting an A4 size copy of the article and I will send it to you.

There is a steady flow of articles, which is most appreciated, and I request readers to write something for your Radio ZS.

Dankie ook vir die Afrikaanse items.

73 & 88, Dennis ZS4BS

Radio Scouting

by Dave Gemmell, ZS6AAW and the Broomstick Warriors

100th Anniversary of Scouting

JOTA 20/21 October 2007. An Update

A big word of thanks to Evan Davies, ZS6EVD and the Lichtenburg ARC for the hard work that they are putting in to the preparations for JOTA and Sunrise Ceremony on 1 August.

There is another ham in Mafikeng, George Kinsey, ZS6GHK who is assisting Evan on the spot. Other shining light from Lichtenburg is Eddie, ZS6BNE. If I have left body out, I do most humbly apologise. Their efforts are concentrated at Mafikeng and the use of the call signs ZS50MAF and ZS100MAF have been approved by ICASA. Many thanks to Vee as well for checking the forms and getting through to the authorities.

More on JOTA

This year I am advocating that all interested hams organize a JOTA event by themselves and not wait to be approached but the scouts and guides. I'm sure that many youngsters will attend to help you get things going. Perhaps you can get a few scouts to construct a mast or tower. Many boys are keen on pioneering, that is, building structures with ropes and poles. It is surprising how many girls would join in such an occasion. Therefore, it should not take much to persuade them to take part! All the same, you will have to take your equipment to the nearest Scout Hall. Yet the fact remains and I see no reason why the average branch or club should not build one themselves. In other words, use the JOTA weekend as an Antenna Weekend event. There are quite a few wire antennas, which can be, build fairly quickly and tested. Give it a go and let me know about your results. JOTA could be a good time for your club to have an antenna field day!

So why not organise one. I am sure some of the members are interested in trying out a few new antennas. Simple wooden masts built by hams themselves could support wire antennas.

Another activity, which could fit in with JOTA, is having a museum, vintage, veteran contest or event using AM/CW as modes with your old valve/transistor rigs. This will illustrate that one does not need expensive equipment to begin a "career" in ham radio.

So do not wait to be asked by the Scouts. Go ahead, get on the air on 20 and 21 October 2007 and tell the scouts you will be representing them.

(Continued on page 28)

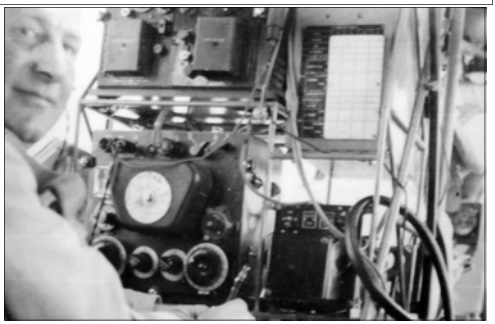
Museum News

by Dave Gemmell ZS6AAW and the Old Timers

Many Thanks!!

In reply to my request for Brian, ZS5AZH sent some photos of his late father Mauritz Burger sitting the wireless operator's seat of an Anson. In fact, the front panels and knobs of the 1083 transmitter and 1082 receiver (and the power supply) are clearly visible. I believe the receiver of this combination was a regenerative type were the reaction had to be adjusted almost every time you QSYed. On top of that, the wireless operator was the gunner as well! Mauritz was an air mechanic flying so, to it seems he had three jobs!

I recant what I said that photographs would be a poor second as these shots show the wireless operator (Dad!) as well as the "bath tub" morse key. Many thanks Brian, we do appreciate your efforts! These photos will be well received by John Howie, a friend of Cliff ZS6BOX, who is restoring the ANSON.



More Information Required.

Sarel Rossouw, ZS6APO is also looking for names and stories of hams who took part in WW 2 or any other conflicts involving SA forces. So please gentlemen, if you have details and photos of these chaps please contact Sarel at SarelR@bankserv.co.za

The SA Armour Museum, ZS4AFV

The SA Armour Museum is housed in the unit lines of the School of Armour at Tempe in Bloemfontein. It is housed in three buildings, the main building dates from the Anglo-Boer War, various power packs and other heavy equipment is housed in "Hull Down" and most of the vehicles are housed in "Lesakeng". About 23 of the vehicles are in a running condition, from a 1942 Ford, a T-34 tank to the Tank Technology Demonstrator.

In the "Hull Down" venue there is a radio table with a B26 HF transceiver and B56 VHF transceiver and the various harness boxes as was mounted in the Eland Armoured Car. This is ZS4AFV or ZS4 Armoured Fighting Vehicle. Our editor, Dennis, ZS4BS is in charge of ZS4AFV. Dennis says the power supply must be replaced

(Na bladsy 28)

(Radio Scouting from page 26)

JOTA Logbooks

No, not the actual "list" of contacts made, but the scout type logbook, which is actually a short summary of the important happenings of the weekend! Yes, a list of the spectacular QSOs plus short accounts of happenings plus funny incidents, which occurred, is very welcome. Of course, a photo or two will be ideal! Remember to sent the logbooks to me at the address below well before the 30th November 2007. I have to edit and send them to World Scout HQ, Geneva, before the end of December

Oops!

A slight error the Russian satellite SPUTNIK was launched on the 4th October 2007. It was round, 58,3 cm diameter and weighed 83,6 kg. Sputnik means "fellow traveller" in Russian.

Please me news of your Guiding or Scouting activities of a radio nature to davegemmell@bmknet.co.za or PO Box 77, Irene, 0062 and Tel/Fax 012 667 2153

(Museum News from page 27)

to get ZS4AFV active again.

The Museum is open week days during working hours.

Youth! What's Happening

So why mention this in the Museum Column? Well, because it is the same OLD story!

Individual Hams should realise that the subject of radio and electronics is so vast and ham radio is the hobby where we can try our latest constructional masterpiece live on the air.

Well people, my opinion is that we must emphasize that ham radio is not "just chatting on the air"!! There are other subjects, which go with it. Remember the public relations for ham radio you are providing when helping out with comms or just a running a demo station at any event. The list is only limited by our imagination or lack of it!!

The first example that springs to mind is the ZS0AWA net on 7070 kHz, 08:30 Saturday mornings. This net has encouraged quite a few hams to restore and use old or ancient equipment. Here are a couple of others: Contests, (especially the local SA ones); Home construction – the building and trying the rigs out; Field days – such as JOTA, Kon-Tiki, communications at Rover and Senior Scout night hikes. As I said, the list goes on but YOU must complete it! (that is, if it can be completed!)

If the average age of the SARL membership is more than 50% how come is this "history" column so short???

Please me news of your Museum, Veteran, Antique, Vintage or JUST PLAIN OLD activities of a radio nature to PO Box 77, Irene, 0062; Tel/Fax 012 667 2153 or e-mail davegemmell@bmknet.co.za

(Intro to SDR from page 13)
channel. The 90° and 270° samples differentially summed in the same way deliver the (Q) channel. Neat!

An economy 16-bit stereo PC soundcard usually has a maximum sampling rate of 44,100 Hz. (Be aware that some notebook/laptop computers have only mono/single channel soundcards). Premium soundcards sample at 96 KHz or even 192 KHz with 24 bits of resolution and with up to 4 input and 4 output channels. One analogue input channel is used for (I) and the other for (Q). The analogue signals are digitised in the soundcard hardware and firmware, and the device driver presents an interleaved stream of (I) and (Q) numbers to the application software. Remember, these numbers fully represent the complex waveform of the input RF signal. Once you have an I/Q stream you have enough data to demodulate anything, anywhere in the pass band.

Once our I/Q data stream enters the PC proper (or any Von Neumann computing arrangement with CPU, memory, input/output) we are into the realm of Digital Signal Processing (DSP).

No discussion on DSP can really be meaningful without reference to the Fast Fourier Transform (FFT). FFT is an efficient algorithm for determining the discreet Fourier transform (DFT) and its inverse. So what does this mean? Simply put, an FFT algorithm converts the I and Q discreet time signals into the frequency domain, or put another way, it paints an amplitude and phase picture of the pass band in memory. It does this by dividing the pass band into "bins," and dropping the I/Q values into the appropriate bins. Imagine that our 44 KHz pass band is divided into 4096 bins, each bin about 11 Hz wide. Effectively we have 4096 very sharp band-pass filters measuring the instantaneous spectral energy in each 11 Hz bucket on a continuous basis. Very neat!

Imagine what we can do with this data at our disposal, provided our CPU is fast enough. Firstly, we can remove the image of incoming signals in the pass band. The major drawback of a direct conversion receiver is the fact that the incoming signal, mixed with the LO signal, produces a real baseband (audio) signal, and an image on the other side of the LO frequency. For example, a strong incoming signal on 7.040 MHz, mixed with a LO/clock signal on 7.056 MHz, will produce a real baseband signal -16 KHz from centre, and an image on +16 KHz from centre (apparently on 7.072 MHz). Therefore, our DSP image removal algorithm, having been told the I/Q relationship to the pass band, finds the signal in the "real" bins, calculates where the "image" bins are, and subtracts the exact amplitude of the real signal out of the "image" bins. This is a simplification of the process, but nevertheless illustrates the general idea. The calculation is done quickly enough by our fast-enough CPU so that the apparent visual and audible output has no image. In a conventional receiver, we would filter out the image frequencies, resulting in less signal energy for the same noise energy.

In similar fashion, through manipulation of the bins at very high speed, DSP algorithms allow us to demodulate AM, SAM, FM, SSB, CW, DRM and almost any other digital mode you choose to invent. We can switch sideband, select brick-wall (vertical sides) filters with infinitely variable bandwidth, or automatic notch filters, very effective noise reduction or noise blanking. We can enable frequency conversion, fre-

(Continued on page 30)

(Intro to SDR from page 29)

quency-selective squelch and graphic equalisation of audio. We can infinitely alter AGC characteristics, engage RIT or store and remember any number of bands/frequencies/modes at the click of a button. The processed output can simply by listened to, or the entire pass band viewed in different formats such as panadapter, spectrum, histogram, phase or waterfall displays. The displays can be stretched or shrunk, or panned, and chunks of the pass band can be magnified. Signal amplitude is easily calibrated in dBm or uV or S units, and signals are easily visible and identifiable, and selectable with a mouse click. Signal frequency is easily calibrated to a very high degree of accuracy. Multiple receive channels can be supported. Microphone input can be compressed according to a variety of variables, and/or companded, and/or voxed or gated. Different operating profiles can be selected for DX or contests, and RX and TX settings can be selected according to band and mode. Yes, top-of-the-line commercial rigs can do these things, but not for a R200 handful of components.

Output digital audio is fed back to the soundcard and turned into (analogue!) sound. With two channels available, this could be in stereo, binaural or any sound effect you may choose. Alternatively, digital modes can be demodulated, decoded and presented in their appropriate visual or audible form.

Virtual Audio Cable (VAC) drivers on your PC allow you to feed digitised but apparently analogue audio to and from your favourite CW or digital mode decoder/encoder.

Virtual Com Port (VCom) drivers on your PC allow you to drive an SDR application like PowerSDR from your favourite interface like Ham Radio Deluxe via CAT, and enables PTT capability for RX/TX switching.

Just as the receive signal went from RF, to baseband I/Q, to bins, through DSP algorithms, and to audio, so too can the process be reversed for transmission. Audio signals from a microphone or digitally modulated audio is digitised and sent to the DSP algorithms. Alternatively, keyboard text or graphic input is encoded and processed by DSP. Reverse FFT (RFFT) algorithms produce I/Q signals out through the soundcard. The I/Q output goes via stereo cable again to the handful of components comprising our SDR transmitter. Here they are amplified by op amps, and fed to the Quadrature Sampling Exciter (QSE) chip, another bus switch clocked in-phase (I) and in quadrature (Q), mixing “up” to producing modulated RF output. The RF output signal goes through one or two stages of linear amplification and is put through a low pass filter before or after going through a FET RX/TX switch. At this stage, you have 1 W to 2 W of very cleanly modulated RF to do with as you please.

An example of the Softrock v6.1 RX/TX kit in assembled form

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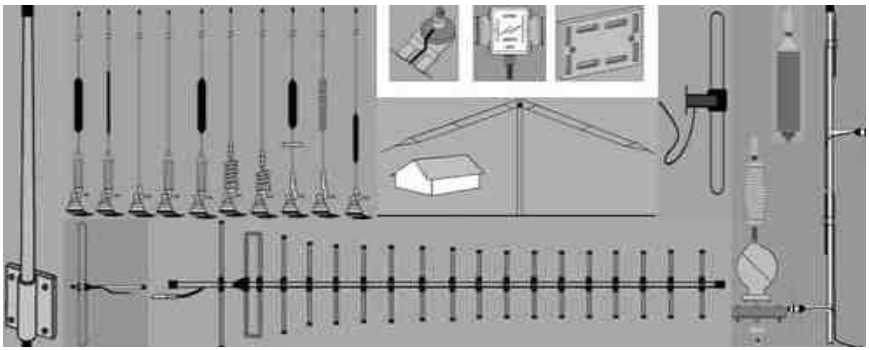

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JAN PIENAAR @ THE ICOM HAMSHACK 012 345 1801 / 082 447 7823

Multisource Telecoms (Pty) Limited Head Office Johannesburg (Registration No. 1947/024435/07)
Multisource House, 639 Old Pretoria Main Road, Bramley, Johannesburg. PO Box 663, Bramley, 2018.
Tel: +27 (0) 11 321 0333 Fax: +27 (0) 11 440 3539 Website: www.multisource.co.za Email: info@multisource.co.za