FREQUENCIES VHF, UHF, SHF NEWSLETTER NZ

This newsletter is compiled by Kevin Murphy ZL1UJG to promote operational and construction activity on the VHF, UHF and SHF Amateur Radio allocations in New Zealand (and overseas).

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Editors note

Over the past year, I have been editing (co-editing along with Bob, ZL3TY) the **VHF Scene** column in the "**Break In**" magazine, produced by the New **Zealand Association of Radio transmitters** (NZART). There has been some interest by overseas groups, in publishing material from the VHF Scene.

I had some discussions with the editor of Break In, which included using material from the VHF Scene column. I have decided to resurrect the newsletter after its hiatus. After the NZART "Break In" magazine is in the readers hands, the VHF Scene Column, will be republished in the **FUNewsletter**, (with ackowledgement to NZART/Break In/VHF Scene)

NZ readers (already members of NZART) will already have seen the material but non - NZART members (Support your National Society…) will not. Also foreign readers of this newsletter will also have access to the latest NZ news. During the quieter months, activity wise, I include technical material in VHF Scene (to fill the gaps).

As some RF/VHF material will not be suitable for publication in "Break In" due to its specific nature, this newsletter will also act as an avenue for that.

"Break In" comes out every 2 months so I will try to publish the newsletter soon after. If there is no other material, the newsletter will be like a reprint of the VHF Scene column.

To the New Zealand readers:- Please send material/ activity/ projects/images for the VHF Scene column. This makes writing the column far easier. Also other readers overseas find it interesting.

If any material is used, for republication from this newsletter, please acknowledge the FUNewsletter as the source. If the material from this newsletter is from NZART/Break In/VHF Scene column please acknowledge that as the source.

Material is available in word.doc format if requested.

Due to a terminal illness in close family, and commitments associated with that, some VHF Scene's and issues of this newsletter may be "thin". I ask for your co-operation at this time.

Thank you,
Kevin ZL1UJG

VHF SCENE JULY 2004
Source:- NZART/ BREAK IN/ ISSUE JULY/AUGUST, 2004

This seems a quiet time of the year for input to the column. I hope that people are taking the opportunity to complete projects, or start new ones. A simple project might be a diode detector for alignment of RF projects. One built on a connector is usable to about 500 MHz whereas a SMD version on a PCB can be used to 1300 MHz. (See Component list at end of column.) For a club project, perhaps it is an opportunity to build a transverter for 1296 or 2424 MHz to give that extra band for VHF/UHF Contests and non-contest contacts.

Microwave

Simon, ZL1SWW, Auckland is building a 1296 MHz transverter, using a DF8QK transmit strip (old VHF Communications article) and a Microwave Modules RX converter (comprising of an oscillator strip, Ring mixe r and IF amplifier). Under recommendation from Kevin ZL1UJG, Simon has built a replacement LO strip, as the one in the MM RX converter is certainly not usable for transceive purposes (as is), The replacement strip is similar to the G4DDK type oscillators.

Some instability was noted with initial oscillator alignment of the replacement oscillator. On removing the crystal and replacing with a RC network, comprising of a 47 Ω resistor and 100 pF capacitor, (R to simulate the Equivalent Series Resistance (ESR) of the crystal and C for a DC block) it was noted that the oscillator was free-running at 110 MHz and not 96 MHz. Changing values so that the oscillator tuned to 96 MHz removed the instability. (This is an important note for others building oscillators, a s gain around the crystal oscillator often sustains oscillation even though the tuning may be many MHz's off frequency.)

Ross, ZL3DC, Tokoroa is looking at building up an old DEM 23cm transverter kit to become operational on the band.

Steve, ZL1TPH is hard at work improving his capability on 10368 MHz SSB. He is using a DB6NT Transverter, plus 6 watt PA with a elderly Icom IC402 as the IF transceiver. A Wellington VHF Group 1.2 metre dish (estimated gain 38 dB).should give an Estimated Radiated Power (ERP) in the 30 kW region. Sun noise measurements indicated about 5 dB of sun noise. He noted the antenna was very sharp. The gear is being built to attempt the ZL 10 GHz record.

To facilitate the first ZL/VK Trans-Tasman 2.4 GHz contact this summer, Steve, ZL1 TPH has sent a complete 2424 MHz transverter to a VK2 station. This station is active on 144, 432 and 1296. Steve has worked this station often on 1296 MHz and of note is the very rapid QSB that occurs on 1296 as compared to 432 and lower.

Please note the distance between VK to ZL is over 2000 kms. Signal levels to ZL stations in the past, on 1296 MHz have been very strong. What is required is a slow stationary high pressure system that will provide the ideal conditions - a wide and low height waveguide duc t. There are at least 10 stations active on 2424.1 MHz in ZL. So hopefully this season the Tasman will be crossed on 2.4 GHz. (Steve ZL1TPH)

Equipment Testing

The Waikato VHF Group held a Meeting on the 30th May, which included basic testing of mobile type transceivers from HF through to 70 cm. The receiver portions showed excellent sensitivity, and TX deviations were well controlled. TX powers extended up to 70 watts or so, however the scribe felt that the heatsinks were rather small for dissipating powers of that order!!

Beacons

The ZL2WA 70cm beacon on 432.275 MHz at Hawkins Hill is now operating again, at about 500 mW into a Horizontal dipole. (Leon ZL2AOC). Is there any information on any other VHF/ UHF beacons in NZ? If you receive a beacon outside yo ur local area then let the club operating the beacon know (and me as well).

APRS

Michael, ZL1ABS stated that the number of APRS stations peaked at 104 while he monitored his UI -View screen in late June. He also mentions that the Auckland VHF Group is loo king at a new batch of Tinytrak kitsets for mobile transmitting

General

Outside the sphere of amateur radio there are a number of interesting areas in which our abilities as active VHF'ers can be used. Neil ZL1BNG, in Hamilton is developing an interest in weather forecasting using the Weather Satellite RX EME117 developed by Mark VK5EME of Minikits. (www.minikits.com.au). The software used was SATSIG and WXTRAK. He has observed the day/night greyline on some passe s Another weather satellite receiver unit has recently been published in Silicon Chip magazine. For those who wish to homebrew their own, Tom ZL1THG has tuned his elderly Wellington Walkie RX to the Weather Sat frequencies around 137 MHz.

Another interesting area is Radio Astronomy. The scribe lives about 1 km from the Optical/ Radio Observatory in Hamilton. This was the location of the previous Technology Conference. Some work is being done on the 1400 MHz Astronomy RX. Some amateurs have an interest in R adio Astronomy and also SETI, as the RF requirements are not too dissimilar.

As of July 1st, 2004 the "RSGB Microwave Newsletter", edited by G3PHO and G8AGN, will cease to be an RSGB publication and instead will be published by the UK Microwave Group under the logo "SCATTERPOINT" for around 6 Pounds for a yearly subscription (newsletter by email). See www.microwavers.org/ for further information. Another site of interest is the North Texas Microwave Society at www.ntms.org

Propagation/DX

Amateurs around the world use rain scatter/ snow scatter on microwave frequencies to good advantage during the wetter/colder months. W7SZ, W7LHL and a number of others have participated in CW /SSB contacts using upper tropospheric scattering. Sources of further information are www.arrl.org/qex/larkin.pdf and also http://members.ispwest.com/kd7ts/ (see 10 GHz forward scatter)

Nick, ZL1IU has heard some long meteor bursts on 2M, but it was generally quiet on other propagation modes. Meteor scatter bursts and pings weaken and shorten in duration as the frequency increases. 6M is a good band to monitor as amateur beacons and commercial transmitters can be received using Meteor scatter. UHF TV channels can also be used as a propagation indicator for UHF frequencies.

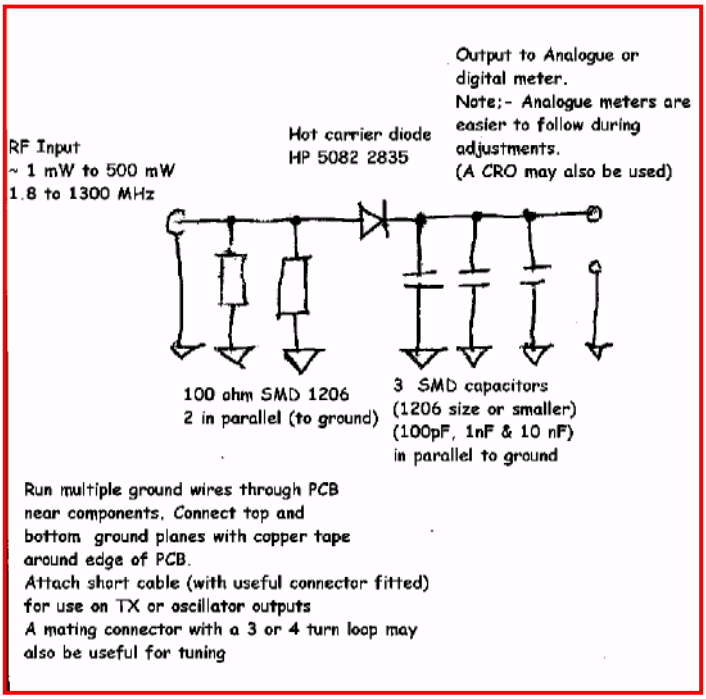
Component list for diode detector

Hot carrier Schottky diode HP5082-2835 (or similar)
100 ohm SMD 1206 resistors. (2 off)
100 pF SMD 1206
1nF SMD 1206
10nF SMD 1206
Offcut of double sided PCB 1.6mm
(Run wires through PCB near the resistors and capacitors)

Parts are commonly available via the VHF Groups/ RS/ Farnell/ scrap pcbs and other sources. Contact the scribe if you have difficulty locating suitable components.

The detector can be connected to the output of an oscillator/TX via a short coax cable and connector or used with a multi-turn loop to detect oscillator/ multiplier operation. The detector works from ~1 mW to 500 mW (maximum dissipation of the 1206 resistors. The detector may be used from 1.8 MHz up to 1300 MHz. Adding a further capacitor will lower the LF limit. If required a chart can be drawn to convert the volts to power in mW, using the formula.

P (in mW) = $1000 \times [(V + 0.25)^2 / 100]$



Thank you those who have sent information for the column

Input for the column may be sent to Kevin ZL1UJG at rfman@xtra.co.nz

Crystal Oscillators

One of the most common building blocks for both HF and VHF/UHF communication systems are crystal oscillators. The most common usage of crystal oscillators are as clock oscillators (used with CPU's and synthesizers) and also conversion oscillators (used with mixers/ modulators).

In VHF/UHF/SHF transverters (Transmit/ Receive converter) the crystal oscillator, normally runs in overtone mode. The oscillator together with its associated amplifiers or frequency multipliers provide a signal which is fed into the mixer(s) to enable the incoming signal to be downconverted to most commonly a 144 MHz IF or 28 MHz IF. Upconversion on transmit being a reverse of this process. The oscillator is often called the local oscillator or LO.

The important parameters of the crystal oscillator and its associated circuitry is to provide a stable, clean signal. Sounds easy doesn't it!! It's down to good basic design.

Stability generally means frequency stable (with voltage, temperature changes) but it not only encompasses the crystal oscillator itself but the overall stability of the amplifiers and multipliers as well.

Some designs of crystal oscillators have no voltage regulation on either the crystal oscillator or the multipliers, leading to not only frequency changes but unstable multipliers. On TX this is often apparent as warbles on output signals as the crystal oscillator FM's as supply voltages varies under drive, while on RX the frequency of other stations/ beacons change as the supply/ battery de creases. If the frequency multipliers go unstable then the output of the oscillator chain can be a mass of unwanted frequencies where the multpliers themselves can actually oscillate. (The oscillations can cover many 10's,100's or even 1000's of MHz depen ding on the output of the multiplier chain.

One important point then, is to regulate both the oscillators and the frequency multipliers.

To enhance the temperature stability of the oscillator/ multiplier, enclose the oscillator in a box so that temperature changes from PA's or outside variations are minimized. Higher frequency designs sometimes have heaters over the crystal and even the complete crystal oscillator to elevate the temperature above ambient variations.(The crystal should be purchased to operat e at this higher temperature).

Crystasl should be ordered "preaged" as this will reduce the crystal aging of up to +/ - 5ppm per year. The crystals are specially stressed at elevated temperatures of the order of 100 to 125 degrees C.

In recent years designs have appeared which phase lock the VHF crystal oscillator to a lower frequency reference derived from a 10 MHz frequency standard. The 10 MHz may be derived from a TCXO, Rubidium standard or GPS.

A clean oscillator has a low level of spurious coming from the local oscillator (LO), using good design, with multiple filters in each frequency multiplier stage and good supply decoupling.

Another important criteria (in clean signals) is having low composite noise (made up of phase noise and AM noise). High composite noise can be the result of having Voltage regulators with minimal filtering on the regulator output. (See http://www.wa1mba.org/noise2.gif).A second important point is to adequately filter the regulator output. A 10 uF Tantalum capacitor is the minimum value that I personally recommend for use with 3 terminal type regulators.

An additional source of noise is having high order multipliers (x4, x5, xN) resulting in low RF levels which have to be re-amplified to achieve usable output.

A number of common overtone crystal oscillator circuits are seen in the amateur designs (and also professional equipment) Some of the circuits are Butler Emitter follower (seen in Down East Microwave transverters), Butler common base (gate) (seen in DB6NT transverters), and also the 2 transistor Butler oscillator which is often seen in designs by G4DDK, G3WDG, G8ACE, DF9LN and DB6NT (12 GHz LO and most recent 2M and 70 cm transverters) and also VK5EME (Minikits).

Some of these oscillators are multiplied up, to frequencies in excess of 100 GHz so the criteria mentioned before help with producing a stable and clean signal.

These oscillators may have a number of uses, such as a local oscillator as mentioned before. The oscil lator may be used in a Beacon or a TX. A low power TX, up to a few 100mW could be useful for antenna checks or as a companion to some modern handhelds or mobile transceivers for 50, 33, 23cm communications around the city or town . Note that some handhe lds/ mobiles have RX coverage up to 1300 MHz or higher.

The oscillator circuits may constructed at home either from available parts, or they may be purchased either as a kit, (or assembled) from the equipment/kit suppliers mentioned earlier. The oscillator kit EME65, from Minikits in Australia (www.minikits.com.au) is reasonably priced and well documented. The unit is capable of covering from less than 400 MHz to frequencies in excess of 600 MHz with 2 kit options. I have added some feedback to Mark VK5EME, which is now posted to his site

Note:- The 2 transistor Butler oscillator circuit is popular but not necessarily the best. There are a number of other circuits such as those by DK1AG (4/81 VHF Comms) which may offer superior performance. Image left is of the Minikits EME65 Oscillator

END OF VHF SCENE COLUMN

GENERAL

Coax Terminations

The termination of coax leads to the PCB is critical at higher frequencies. (Read Above 30 MHz). If the termination is unsatisfactory, high losses due to excessive inductance in the leads or high VSWR can deteriorate circuit parameters and can even lead to instability.

I remember many years ago a qualified enginner complained that his 1296 MHz converter had lower than expected gain. I pointed out that although the RF input connector inner had a nice short path to the PCB, the earth had to travel down the case and up a 25mm PCB standoff before it reached the PCB. After a simple modification a significant improvement was achieved.

The use of pigtail leads on coax terminations is not recommended . At 2424 MHz replacement of a coax lead (with leads for both inner and outer) with a coax with the braid soldered to the PCB gave improvements in the region of 2 dB. This improvement was gained in both the RX and TX sides . Both images in newsletter show suitable method of attachment.

Microwave Projects Book

Kevin ZL1UJG

I ordered the book from the RSGB using the cheaper £4 P&P option (expecting it to take a while) and within a week it was delivered! (I can't guarantee that it will be delivered that quickly.)

The articles are from around the world, with chapters on Signal Sources, Transverters, Power amplifiers, test equipment and design. The design chapter has sections using formulae and also software such as PUFF and "Ansoft" TRL85.

Articles cover from 1296 MHz to 47 GHz using a mixture of home construction, ex-commercial (Qualcomm) and other sources. The material is relatively new with good graphics, however I felt the International Microwave Handbook (also edited by Andy Barter G8ATD) is a better purchase and covers more practical material and appears more organised.

A small amount of material is common to both books.