

VK4RTT and VK4RBB – Mixing it up

Presented at Gipstech 2019 by Peter Schrader (VK4EA / KQ4PS) – vk4ea@wia.org.au –

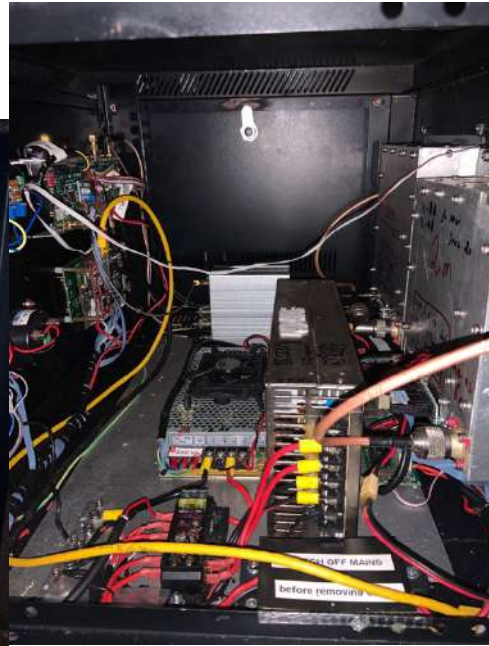
On behalf of the Brisbane VHF Group – vk4if@qsl.net .

The Brisbane VHF Group have been in existence for nearly half a century and has been evolving from purely VHF activity and FM repeaters to our current focus on the microwave bands.

VK4RTT, previously located at Mt Mowbullen (Bunya Mountains) was upgraded a few years ago, thanks to Adam Maurer (VK4GHZ), based on a FM828 chassis and a Microchip based controller. Unfortunately, the transmitter ended up being not all that stable given it is a 30+ year old crystal locked design. Eventually the 2m beacon tended to drift quite considerably and was turned off when it started to generate spurious artefacts. Additionally, the decommissioned ex-Channel 0 tower where the antenna was located, is due for demolition. It was time to move and update, as a result, a combined effort from a number of skilled constructors have created a new 6m/2m beacon using modern componentry.

The new beacon is based on 2 x ZL2BKC ZL-PLL blocks with JT65, JT4 and CW idents coordinated using a ZL2BKC beacon controller. The 6m PA brick produces 100W while the 2m PA brick produces 75W. Both PA bricks are capable of much more power, however drive levels have been wound down to ensure longevity. Thanks to George McLucas (VK4AMG) for the enhancements to the beacon box which now include remote control ability, upgraded PA pallets and driver amplifiers running well under maximum output to ensure spectral purity and service longevity.

The planned location of VK4RTT was to be Broadcast Park, Mt Coot-tha, located near the main broadcast site for Greater Brisbane. However due to ongoing access issues the location may change to Oceanview shortly.



VK4RTT Grid — QG62Im ——— QTH — Mt Coot Tha [Standby for new details]

GPS frequency and time locked

Band	Frequency	Modes/ID	Power	Antenna
6m	50.285	Carrier : CW : JT65a	100watts	Crossed dipole
2m	144.440	Carrier : CW : JT4d	75 watts	Dipole

VK4RBB was located in the suburb of Murarrie, in that form the transmitters operated on 70, 23, 13, and 3 cms. That device provided years of service to the amateurs in the area.

Visiting what we had first, located near the Gateway Bridge at a members home QTH that is HF active only.

VK4RBB was old technology using traditional mixer stages on 432, 1296, 2403 and 10368 MHz, all crystal locked which result in some frequency drift over time.

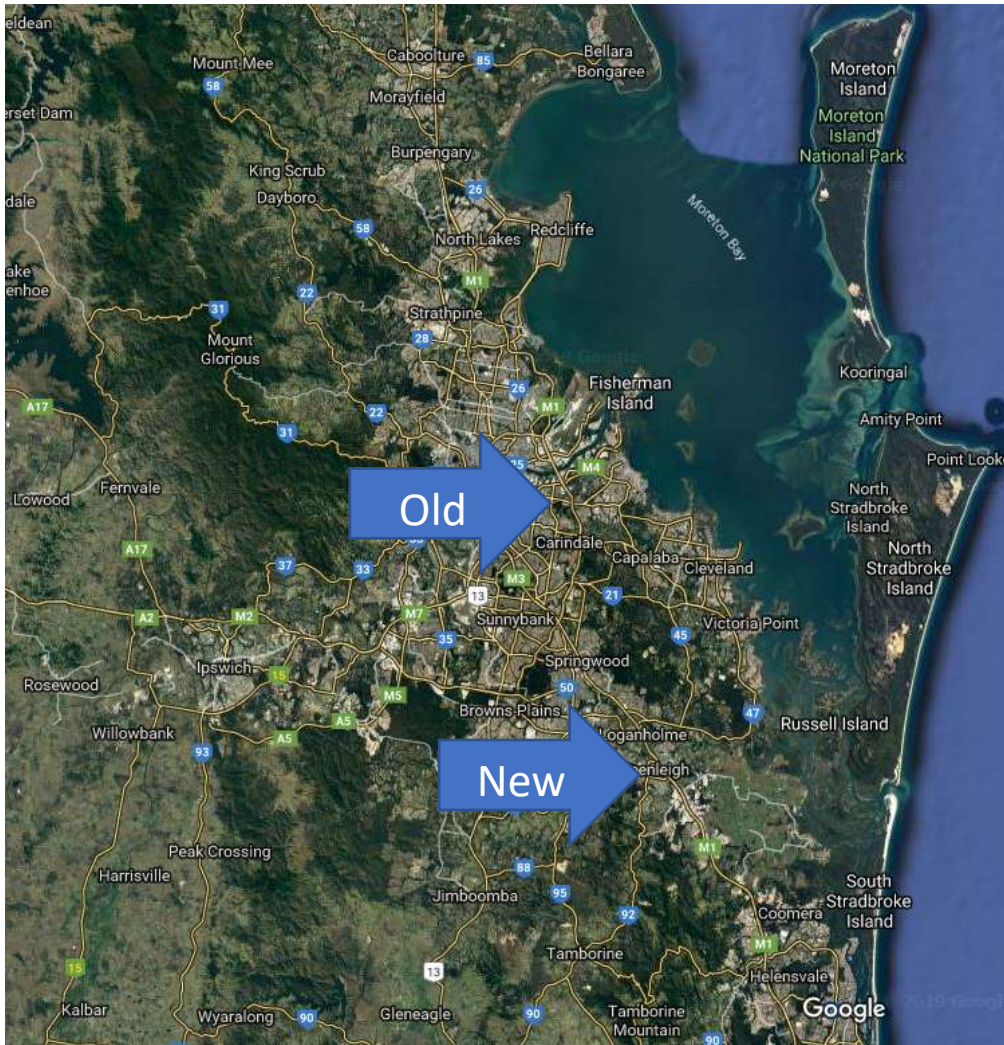


Old VK4RBB location at VK4NEF, Eric's place, large 1.2 GHz Alford slot prominent next to the 70cm crossed dipoles.

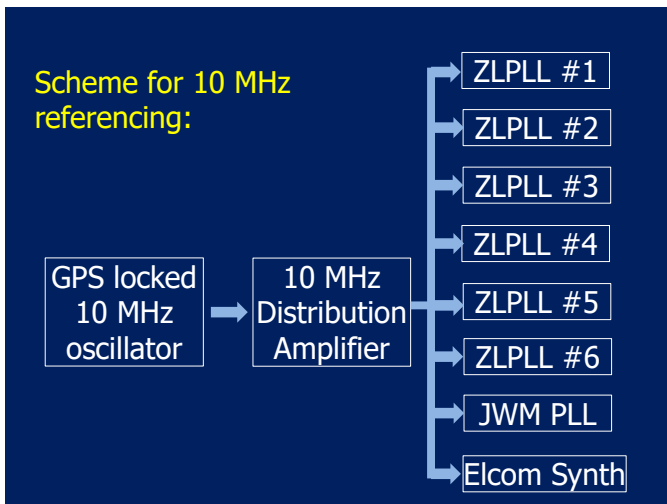
Hanging down is the 10GHz and 2.4 GHz slot antennas enclosed in protective PVC tubing.

All RF was generated at ground level and antennas fed with appropriate grades of coaxial cable.

Thanks to our ever-enthusiastic president, Doug Friend (VK4OE), the Brisbane UHF and microwave beacon chain has had a significant upgrade. The ever-reliable ZL-PLLs were employed to provide a number of base frequencies which are mixed, multiplied and massaged into 432.440, 1296.440, 2403.440, 3398.440, 5760.440, 10368.440 & 24048.440 MHz outputs.



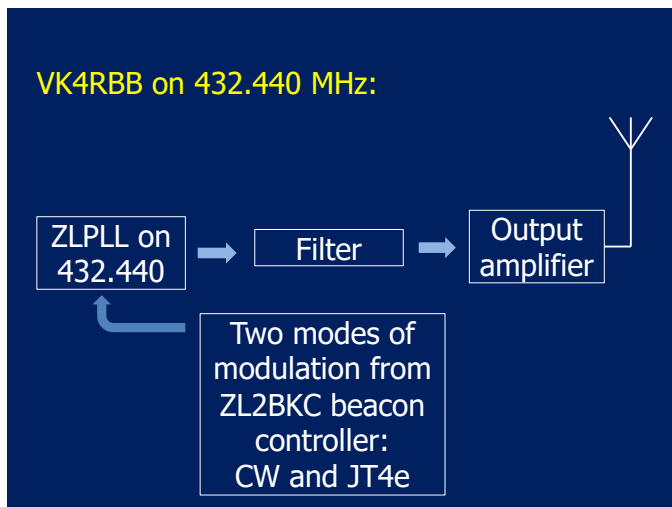
There is some clever stuff happening to rationalise the number of local oscillators and incorporating Wayne Knowles's ZL-Beacon Controller to coordinating the frequency locking and modulation.



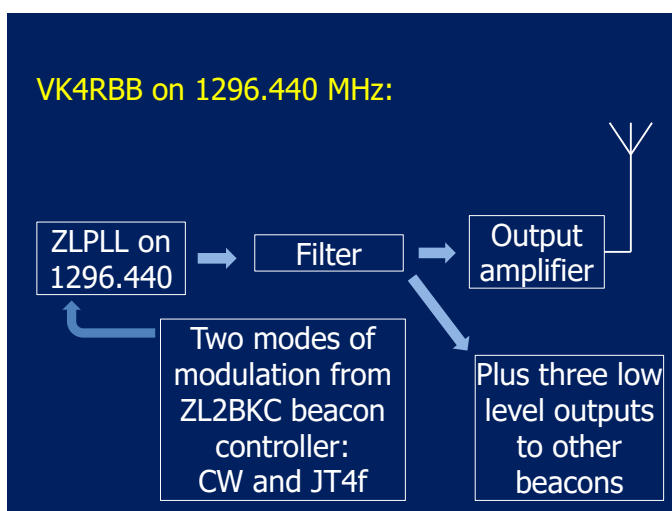
Eight signal sources in total frequency disciplined by a single 10 MHz source distributed amplifier.

The JWN and Elcom synths are utilised for the 10 and 24 GHz beacons.

Not shown on these slides is the ZL1BKC Beacon Controller that also use the GPS for time to ensure that the transmit windows are accurate and the time stamps sent with the JT TX windows, are as accurate as the GPS satellite atomic clocks.

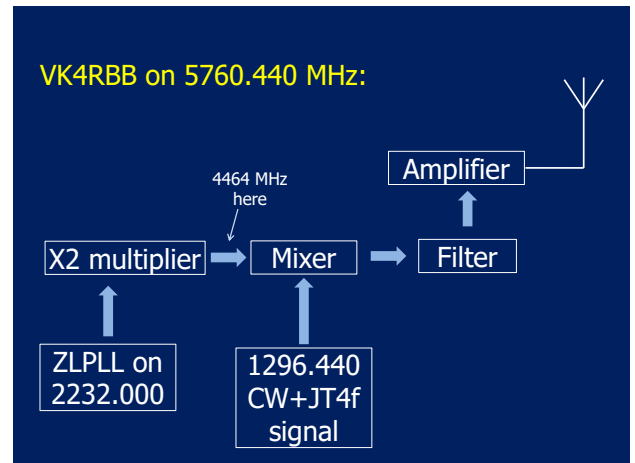
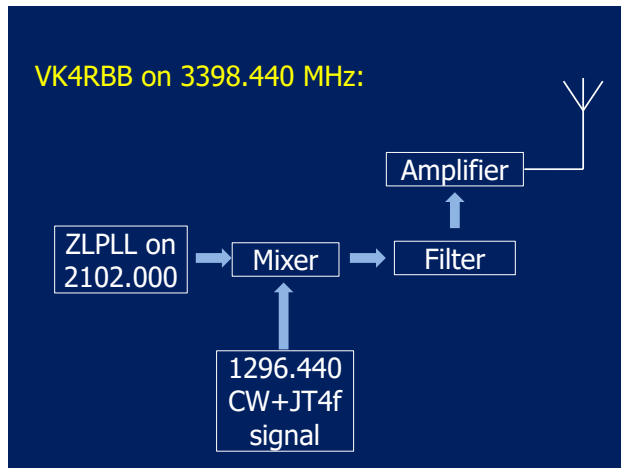
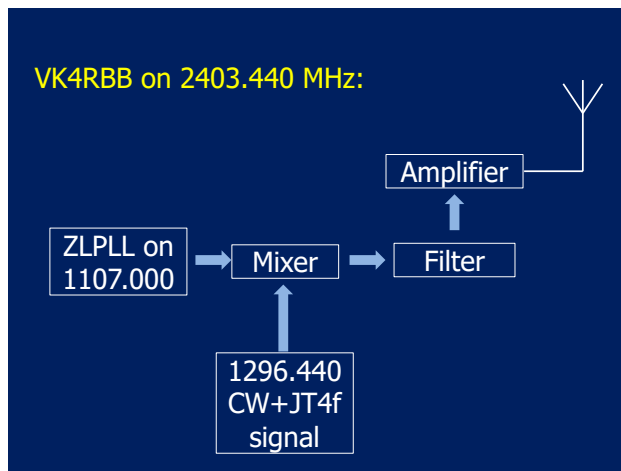


The simplest block is a direct output from a ZL-PLL into an amplified via a low pass filter.



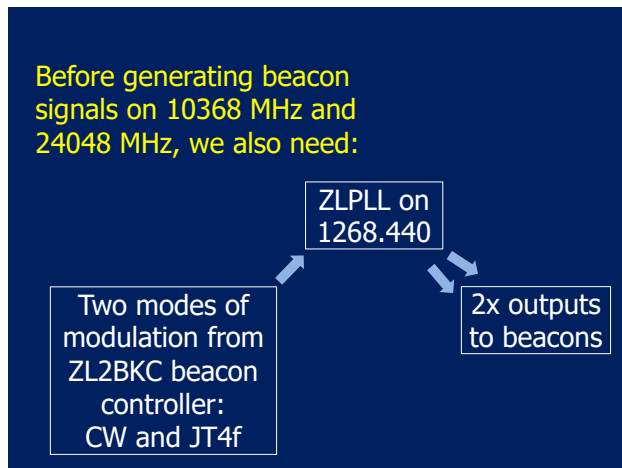
This is where it starts to get interesting, Doug got clever by using the output from the filter to mixers for the 2403, 3398 and 5760 frequencies.

For the 2403, 3398 and 5760 stages the 1296.440 artefact is mixed with two more ZL-PLLs on 1107, 2102 and 2232 to produce the 2403.440, 3398.440 and 5760.440 outputs.

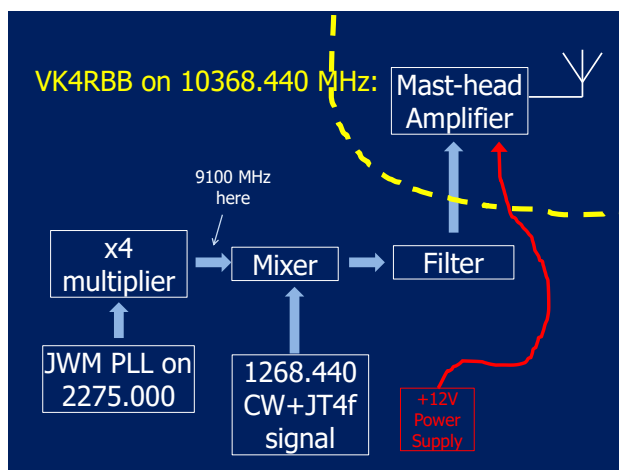


So there you have it, using three ZL-PLLs and one 1296.440 source there are 3 new frequencies produced that are not available for direct synthesis.

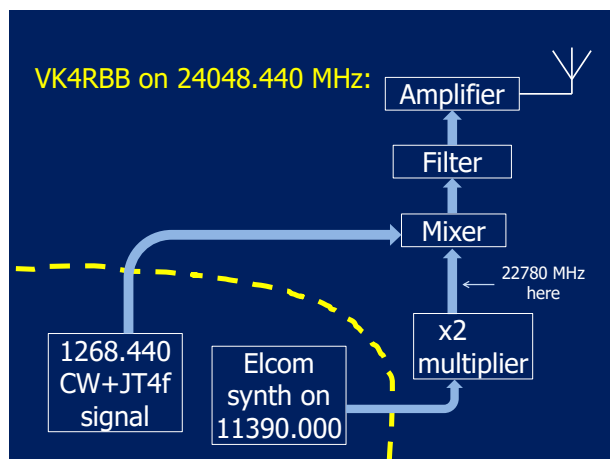
Moving onto 10368 and 24048, we need another LO frequency.



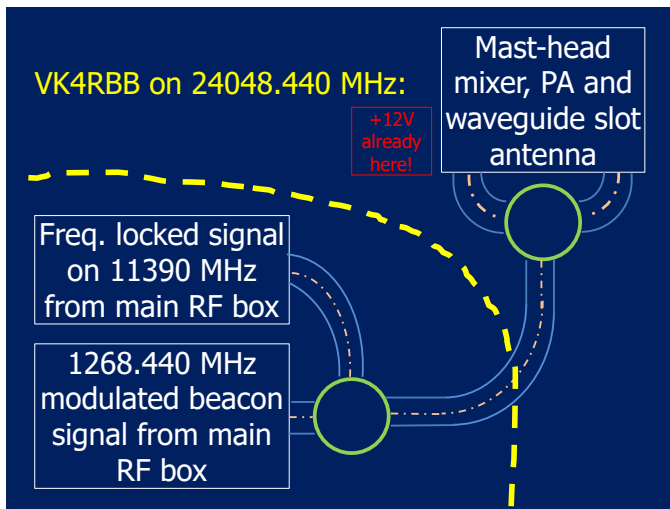
A separate ZLPLL generates 1268.440 for use by the 10 and 24 GHz stages



The 10 GHz masthead amplifier power is feed into the low loss coaxial feed.



Similarly, as per the 10 GHz stage, the 1268.440 is mixed with the doubled output of the Elcom synth to produce 24048.440 MHz. However, compared to the 10 GHz the final mixing and amplification is done at the antenna to avoid the substantial coaxial cable losses at 24 GHz.



Power requirements for the masthead mixer and PA supplied via the coax.



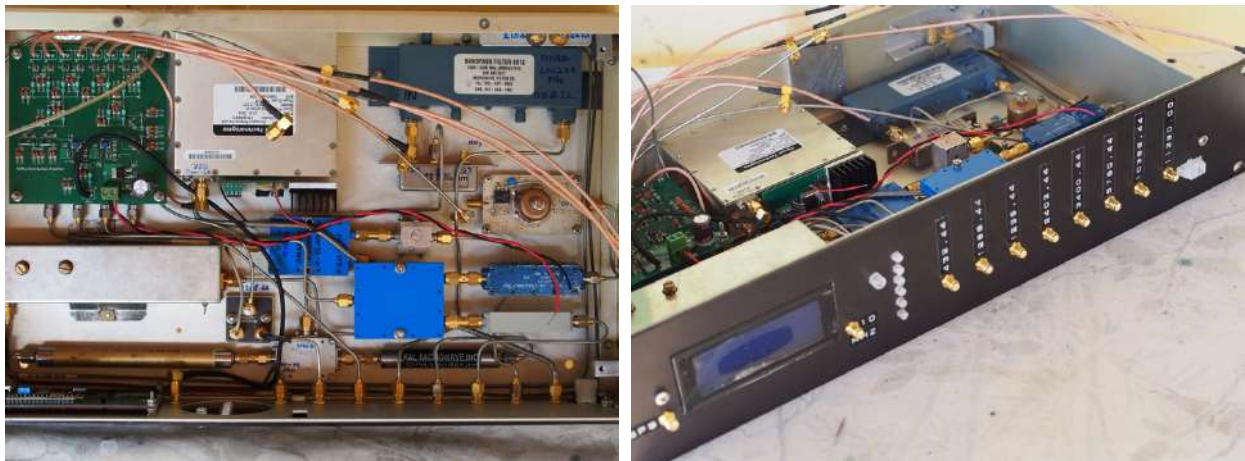
Closeup photo is the 24GHz PA and slot antenna.



Also pictured is the complete array of antennas located below Rob's 2m and 70cm yagi antennas.

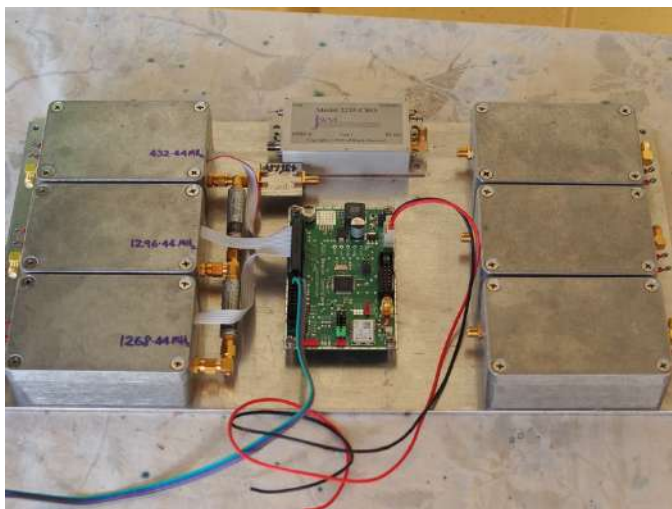
Rob, VK4ZDX, kindly provides room on his One Man Tower, allowing easy access for any maintenance or upgrade activities. Thanks to Rob, VK4ZDX, for hosting the beacons at his home QTH.

Now some wiring and layout porn, Doug has done a beautiful job, he didn't follow the VK3XPD style of construction ☺, sorry Alan.



The photos above show the main box containing the 10 MHz distribution, Elcom synthesiser and all of the ground level mixing stages. The LCD is connected to the ZL2BKC beacon controller.

The SMA flyleads connect to the ZL-PLLs and JWN synthesisers mounted on a plate that is normally located on top of the pictured assembly.



Separate 2RU boxes contain the ground level located power amplifier stages.

Performance to date has exceeded expectations with good reports from microwave enthusiasts in the Northern NSW and South East Queensland.

VK4RBB	Grid	QG62nh	QTH	Eden's Landing
GPS frequency and time locked				
Band	Frequency	Modes/ID	Power	Antenna
70	432.440	Carrier : CW : JT4d	10 watts	Crossed dipole
23	1296.440	Carrier : CW : JT4f	10 watts	Alford Slot
13	2403.440	Carrier : CW : JT4f	3 watts	Slotted waveguide
9	3398.440	Carrier : CW : JT4f	5 watts	Slotted waveguide
6	5760.440	Carrier : CW : JT4f	5 watts	Slotted waveguide
3	10368.440	Carrier : CW : JT4f	1 watt	Slotted waveguide
1.2	24048.440	Carrier : CW : JT4f	0.5 watt	Slotted waveguide

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References

[Multi Beacon Controller Update | z12bkc](#)

[ZLPLL | z12bkc](#)

[Brisbane VHF Group Inc.](#)

[\(2\) VK4RTT 2m Beacon Upgrade - YouTube](#)

<https://youtu.be/5VnoS2wfuHE>