VK9LL report

Why VK9L

An idea of returning to VK9L was bugging me a few years after my earlier VK9LL operation in 2010, as 160m band operation in 2010 has left more questions than answers. Also, I felt that recent DX-peditions to VK9L did not address 160m demand.

This time I wanted some noticeable improvements over 2010 VK9LL 160M setup (this may look like a Christmas List):

- A better transmitting antenna (in terms of a radial system, RX detune, feed, band switching)
- A more efficient way of having 80m and 160m bands out of one antenna
- Receiving antenna that works, or even better – multiple RX antennas
- A better RX radio, or better, diversity RX/ antenna arrangement
- A technical solution to deal with a broadband noise that dominated 80m band in 2010
- A better TX power balance
- A better time at radio/ field experiments balance

A better transmitting antenna

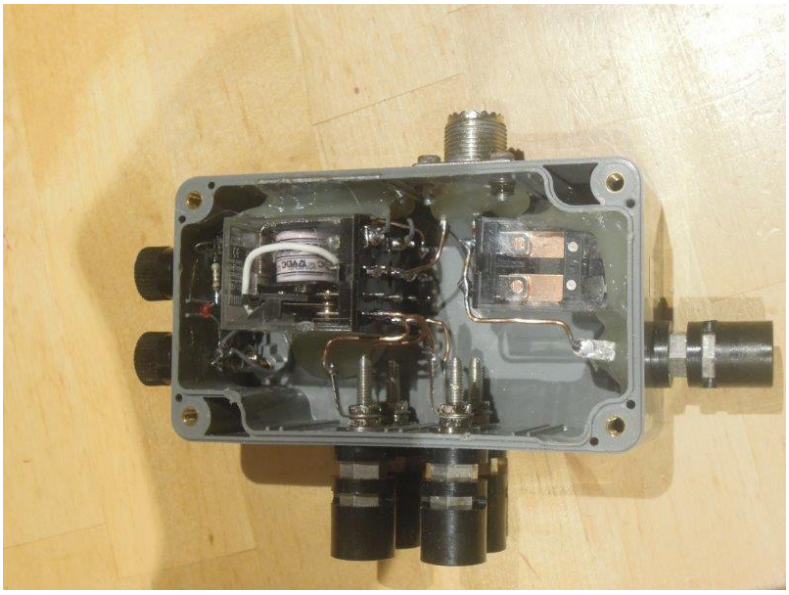
Radial system

In 2010 VK9LL operation an inverted L with 52 ground radials has been used. Having analysed other DX-expeditions typical setups for 160m TX antennas, it is difficult to wish a better radial system than this. However most of operation locations at VK9LL are far from salt water and even worse, some of transmitting directions are screened by mountains. In VK9L there is also a 14kg airline baggage limitation, so cutting off the handle of a toothbrush does not help. Decision this time has been made to ship equipment and hardware upfront, prior to the operation, including hundreds of meters of radials. As a result this time I had more radials than in 2009, however the strategy kept changing depending on other factors. I did not like an idea of wasting a complete day trying to fence off a secure area for TX antenna, as I did in 2010. Reason for fencing: the only paddock at the back of the cottage – although sufficient in size for 160m Inv L – had two monster bulls, that had to be kept away from antennas somehow. This time I have decided to go with a lower number of elevated radials, and keep them clear of bulls, 3-5 m above the ground level. My approach was to start with 4 elevated radials initially, and then play by the circumstances.

TX antenna detune in RX mode

Various sources on internet indicate receiving antennas S/N and directivity factor may suffer from TX antennas reradiating noise if they are not detuned. None of dedicated RX antennas tried in 2010 (beverages, K9AY, loops), seemed to work (better than TX antenna on receive). Among the multiple things I suspected was no detune on TX antenna. A pair of ¼ wave radials becomes a low dipole re-radiating the noise into dedicated RX antennas. The elevated radial system introduces some

complexity for TX antenna detuning. Multiple detuning options have been discussed on the TopBand Reflector. In discussion with W8JI and others I have settled on the most simple solution that required no further experimentation in the field as I wanted to maximise my time at the radio. The solution is based on disconnecting the vertical radiator at the feedpoint and also isolating each of the quarter wave radials from each other. I have built a switching box with 2 DPDT relays for 4 elevated radial system, and a relay to disconnect the vertical section.



A twisted-pair CAT-5 cable (I have taken a few hundred meters of it) was going to be used to power the relays remotely from home-made TX-RX sequencer. There were going to be some challenges with this arrangement, more on this later.

TX antenna feeder losses

In 2010 the feeder cable consisted of 3 sections of 31, 33 and 38 meter long RG213 connected together in the field using 'barrel connectors'. While this has brought the TX antenna into a clearer RF visibility horizon, and made it better 'see' the path to Central Europe, the excessive length of cable and connectors had unnecessary loss (measured it with a VNA in 2010, albeit rather minor on 160m, I have decided that every fraction of a db counts in the path from VK9LL to I4EAT !). For 2013 operation I have settled with an option of running a single 38m length of existing cable to a nearby palm tree that supported 18m SpiderMast pole. I did read the previous reports about trunk conductivity etc. but I had little options to choose from. This seems to have worked in YJ0CCC, A35MT operations so I thought it had to work in VK9L.

80m/160m bands out of one antenna. (Trap or no trap).

Some boring history first. Multiple options have been exhausted, going in a circle a few times. The key options briefly covered below.

In A35MT expedition (2008?) I had antenna replicating the Battle Creek Special with a trap made of coax cable. While it seemed to work (using 100w) it did not impress me as I was hearing stations on 160m more often than working them!

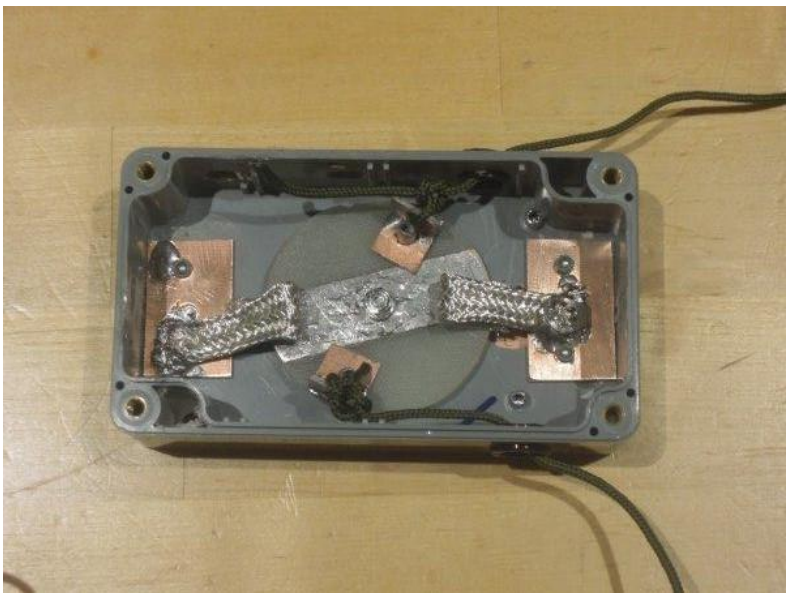
In 2009 YJ0CCC expedition instead of 3.5Mhz trap a DC relay was installed at the very top of the 18m Spidermast pole to switch in the horizontal loading section when working on 160m. No more losses associated with Trap! Loudspeaker twin-lead was supplying DC power to the relay, as well as working as a vertical radiator. At the bottom I had a circuit with UHF radio controlled relay and SLA battery to power the band switching relay. More details can be found here http://www.qrz.lt/ly1df/YJ0CCC.pdf . Such trap-less antenna at YJ0CCC worked wonders. With 100w I worked European stations when half of my TX antenna was laying on the ground as a result of a rain storm one night (IV3PRK says it was a year of exceptional propagation…).

For 2010 VK9LL operation I used a modified YJ0CCC solution – the DC relay was replaced with a 'proper' vacuum relay (28V DC coil), at the feedpoint I had a home built ATU/ switching box which was remotely controlled from the shack through injected control voltages on the feeder cable.

Some of the readers that have tried their muscles in the field, will know that ‘simple solution is a good solution’ because anything else just tends to fail in the field. In 2010 VK9LL expedition the 28V DC power supply has failed, lightning has smoke-proofed half of the ATU contents, and lastly my circuit design errors prevented operation in manual by-pass mode.

When 160m/80m band switching seemed to have failed in 2010 VK9LL, I have tried an option of using a vacuum tuning cap in conjunction with a massive coil at the feedpoint to use 160m quarter wave Inv L as a half wave antenna on 80m, while using it as Inv L without any matching network on 160m. Some people claim good results with such antenna, however it has proven to be very touchy to tune on 80m, even with computer controlled VNA.

For 2013 VK9LL operation I have initially built a simple Arm-Strong rope controlled switch. A simplified version of DC relay, capable of QRO voltages.



The last night before the departure I have reassessed the convenience (or the lack of it) of walking to the field to change bands and reverted back to an LC trap option, but this time I built it using QRO style Russian transmitting caps. There is plenty of research on the internet suggesting an LC trap will represent lower losses if it is tuned outside the operating freq. I did mine to resonate on 3.7Mhz. This was going to be a major puzzle for me in the field (more on this later).

Receiving antenna that works

In 2009 YJ0CCC multiple QSOs have been made on 80m with European QRP stations running 5w, some stations used low hung dipoles with shoulders as low as 6m above the ground. You have to try it to believe it. In 2010 VK9LL operation, the propagation seemed to have turned upside down. In 2010 I have tried the following RX antennas:

- Beverages in different directions, terminated and unterminated, with different ground systems,
- K9AY, at different locations, different ground system (rods, radials or both), single and dual loop configuration
- Larger perimeter loops

None of those RX antennas that I tried in 2010 offered discernible benefit over the Inv L transmitting antenna, at least in terms of noise/signal ratio and directivity. Among the many things I was suspecting:

- TX antenna influence (no detune),
- RX antenna being too close to other metal structures (i.e. the property is surrounded by electrical fences),
- No considerations for preventive measures for RX antenna feedline picking up various rubbish
- Lack of coffee

For 2013 VK9LL operation I have decided to look closer at RX antenna designs that required no earthing system. A shielded coax loop of N6RK design, as described in the NCJ, in A/B tests seemed to provide superior S/N ratio to that of Inv L or Dipole at my Sydney backyard. However needing to have a bands switching or freq fine-tuning mechanism seemed like another unnecessary weight that I would need to carry to the island.

Through some discussion on the Top Band reflector and in consultation with Carlos, N4IS, I built a Delta Flag receiving antenna, similar to what T6LG used in Afganistan. It used 100 ohm feedline, made from CAT-5 twisted pair cable. Having tried it in my backyard in VK2, and compared in A/B tests to a Shielded Coax Loop, I realised I did not hear half of NA DX stations on the coax loop that appeared as a clear and readable copy on Delta Flag. Delta Flag has made its way to one of my backpack pockets (picture below, as installed in VK9LL – please note 12m high Spidermast pole and 2 x 3m wooden posts that support the antenna wires).

In addition I also built two sets of BOG transformers to experiment with BOG antennas, as this was a new territory for me and I wanted to try it (big thanks to W0BTU for publishing best turn ratios http://www.w0btu.com/Beverage_antennas.html). I built one set for using with 50 ohm feedline, the other for 100 ohm feedline (CAT-5).

(picture above – BOG transformer)

For BOGs I needed a preamplifier, and a well-known W7IUV preamp http://www.w7iuv.com/ was my obvious choice, I have built it using all-SMD components with a through-hole 2N5109 on a massive heatsink. I could not find an off the shelf TO-39 heatsink solution for better than 48C/W cooling (if you have any – send me an email with your price - I need a few of them for further experimentation) so I bought a laser LED heatsink from E-bay measuring roughly 50 mm in diameter and 25mm in height and drilled a suitable size hole in it. Preamp measured 14.58db gain on 160m band. Little did I know at that point in time that W7IUV preamp was going to make a day/night difference in VK9LL operation on low bands. A few hundred meters of CAT-5 based 100 ohm feedline has been taken to the island.

A better RX radio, diversity receiver / antenna arrangement

In 2010 operation I used IC-7000 transceiver. Later, in A/B tests with K3 on the same bench, IC-7600 was miles behind on the racing track, so it quickly found a new home with someone else.

For 2013 trip much of space in the backpack was reserved for Elecraft K3, and I have also taken with me KX3 which I was going to use as diversity receiver. I really like the AF/ IF filtering capabilities of KX3, although I would not want to use it in a crowded band environment.

Since all the final preparations for the trip have been done over the last nights before the departure, my diversity receive arrangement had a set of in-ear phones connected to KX3, and regular ear covering phones on my head, sitting over the in-ear phones, connected to K3. KX3 used a separate RX antenna, providing a real physical diversity. On the main radio, K3, I was able to switch between the dedicated RX antenna(s) and the TX antenna.

It is interesting to observe that with exclusion of a very few instances, for most of the operation time there were no traces of signals whatsoever on the TX antenna, while there were readable signals on the dedicated direction BOGs. The same applied in a quiet band condx.

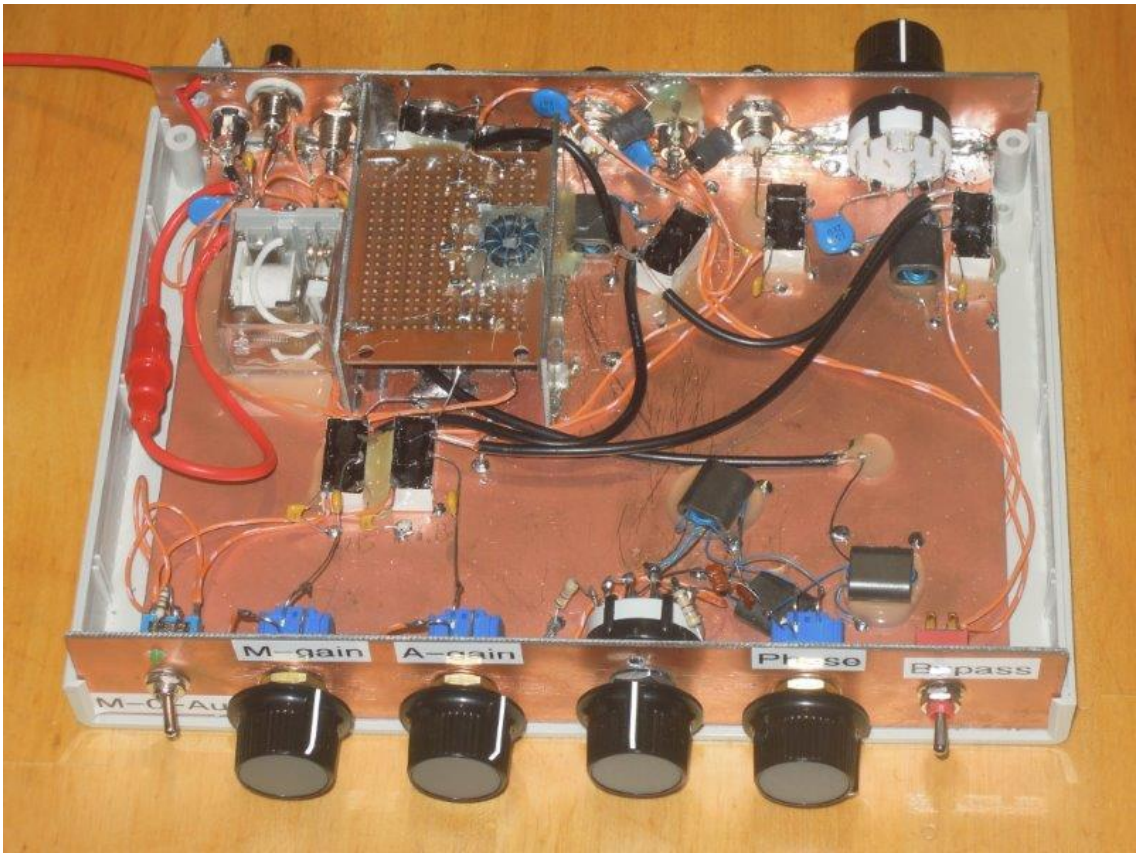
More on receiver performance. In busy 40m pileups K3 did not perform to expectations. With a dedicated narrow band roofing filter and the DSP at work, despite of trying to spread the pile up over a segment of approx. 15 Khz or so, I was hearing a continuous mass of garbage in my headphones. I want to do some more A/B tests with K3 and crystal filter based radios. I certainly

long the days of Drozdov transceiver [1], circuitry of which in the early 80s implemented some of today's K3 good ideas with a difference this has been done in crystal filter environment.

A technical solution to deal with a broadband noise on low bands

In 2010, a broadband noise on 80m dominated the band, making 80m completely unusable. To challenge this I have decided to use a noise sensing antenna and a bit of phasing circuitry to eliminate the noise out from the main receive antenna signals. I have read loads of good ideas on the net, including an excellent article by W8JI on MFJ-1025/1026 mods: http://www.w8ji.com/mfj-1025_1026.htm and a fine collection of circuits on this subject by G8JNJ: http://g8jnj.webs.com/rfnoisecancellation.htm

After some research I built a passive phaser to OE6ZH circuit with some mods: http://www.qsl.net/o/oe6zh//EN/projects/noise%20phaser.pdf



The main differences in my version:

- Preamp circuit in my version was as described on W7IUV website,
- Switchable transformer turns option for Input circuits,
- Usage of separate relays for Preamp IN and OUT circuit switching to avoid any feedback.

A better TX power balance

While I am generally into QRP side of things, the only good use for Tino VK3EGN so generously gifted FL2100Z PA I could find, was shipping it to the island prior to the operation, thus improving the power balance on the transmit path. The PA has survived the trip for exception of the Plate Meter which has been broken into smallest pieces – if you have a spare one please let me know the price!

Good beginning = half of the job done!

Where I come from, we have a saying that translated into English sounds something along these lines: "Good beginning is half of the job done".

Before departure I have taken Friday as a day off, to have all the stuff packed in time and weighted for 5AM departure next morning. Of course I have been nice enough to pick a call from the office and been called to attend emergency. The packing exercise was completed after 1 AM that night. A few hours of sleep and we were 15 min late at Sydney airport to catch a connecting flight to Port Macquarie, so the flight to VK9L was missed. *One day less on the air.*

Upon arrival at VK9L one day later than scheduled there was a massive rain storm and I had to postpone antenna installation until around 11 :30 PM the same evening. VK9LL Inv L antenna with elevated radials has been erected in complete darkness, by the help of an LED head-torch, and accompanied by a few spiders and mosquitoes. Around 2 AM local time I had a working TX antenna with 4 elevated radials. Unfortunately it was a daylight in NA, JA stations fully asleep, and too early for European SS opening. I went to sleep in preparation for 6 AM regular wakeup call to report for family duties.

The next day my football team has taken a horizontal position due to suspected drinking water poisoning (rain water in use), while I had a day time duty of taking care of kids, etc.

There was no time for RX antennas and setting up the rest of the operating position during the day time because of family duties, as this was supposed to be a family holiday. All VK9LL antenna work and experimentation in the field has been done over the coming nights in the hours of darkness between 12AM local time (end of NA opening) and 3 AM (beginning of European opening), for exception of the daily inspection of antennas before the sunset, and regular removal of BOGs and Delta Flag in the morning (or more precisely the pieces of wire left after the bulls had a good night at the paddock). This has provided approximately 2 hours of rest every night and 1 to 2 hours in the morning, over the complete duration of operation, with exception of the second night when we had a massive storm and I lost my TX antenna!

(picture below – removing what's left from my BOG. The 'bad guys' did not leave any fingerprints)

Finally, on the air (the easy part, or so I thought)

TX antenna detune

The first QSO has been logged with K4KJ evening of 23 September. There was no time for champagne, as there was an intermittent failure on TX Detune circuit. Detune would work and then it would not. The things always appear more complicated and dramatic at night when you are fatigued.. Apparently the CAT-5 twisted pair in a 40 meter run of CAT-5 had such a massive resistance that the 12V DC voltage supplied at the shack, dropped to 8.6V at the relay box in the field (3 x relays 70ma each), causing unreliable pickup of relay contacts.

Delta Flag

During the first QSOs with NA practically nothing has been heard on Delta Flag. In comparison, the NA BOG antenna worked just great. The things have changed when the first 70m of CAT-5 feed (of the total 120m feedline or so) has been replaced with a run of RG-6. It seems like the problem was the attenuation of CAT-5. *Or maybe it was the coax feedline that was receiving the signals?* The tests at home at VK2 using a relatively short run of CAT-5 did not indicate that this was going to be an issue.

More preamp gain!

The signals on the BOGs would completely disappear if / when W7IUV preamp would be switched off. I am more used to switching Preamp OFF and the Attenuator in when I work on low bands! If not

the W7IUV preamp, most of VK9LL QSOs would not exist. In comparison, neither K3 nor KX3 preamps did the same good job as W7IUV preamp circuit.

TX antenna 80m band trap

The 80m LC trap did not work as expected. As per 'best Internet practice' it has been built to resonate slightly outside the operating freq range 'to minimise the losses' (I built it to resonate on 3.7Mhz). On the CW segment of the 80m band my VNA was showing 9 Ohm Z at the feedpoint; while the SWR curve had a dip at 3.7Mhz (measurements done with 18 elevated radials). I thought PA Pi filter will deal with this. However after a couple of CQs on 80m the PA has released a bit of flame and smoke and I had to halt the operation. Practical experience suggests by simply adding some wire to extend the section below the 80m trap would bring the SWR dip to a slightly lower freq range. Not quite so. Adding various lengths of wire did not change the freq of low SWR range. Rather it was changing the Z at the same fixed 3.7Mhz resonance point. However since I had taken no additional transmitting caps or coils I have not been able to design & build an external matching network to feel PA happy about the load that antenna represented on the CW segment of 80m band. I have bypassed the PA and used the K3 inbuilt antenna tuner to deal with the Z mismatch and was running the show on 80m band with 100w, a debatable portion of which was getting into the antenna. Hence the poor RST reports for 80m operation. The time has been prioritised to stay on 160m as the main band, although I did work on 80m, 15m, and 40m where majority of VK9LL QSOs come from.

BOGs – Terminated vs Unterminated

There were 2 BOGs in the field, one fixed to JA/ Northern EU, unterminated, receiving from the opposite end where the terminating resistor would normally be; and the second unterminated BOG for NA, which after the NA SR hours I would rotate towards southern Europe direction (or so I thought).

Terminating the second BOG with a 470 ohm resistor (sorry that's what I had in hand), resulted literary NIL stations heard on that antenna. Not sure what was happening there, I leave it for you to go and sort this out. For now I am happy to conclude that unterminated BOGs worked well.

The propagation & statistics

A big thanks to Luis, IV3PRK who has done a sterling job in analysing VK9LL 160m band operation statistics and propagation anomaly . I don't want to take any credit for all the hard work that Luis has done, so please refer to Luis website. http://www.iv3prk.it/vk9ll---2013.htm . Just a note the 25 of September graph shows no QSOs with Europe – this is when I lost TX antenna in a storm after the midnight (local time), hence not a single EU QSO has been logged that night.

I will only summarise that if I thought I knew quite a bit about the propagation on 160m, I no longer think so. Ducted / spot modes of propagation have been experienced. What has been observed one night was different the next night.

Over 5.5 nights or so, the count of 160m QSOs totalled to over 370. There are very few NA stations on that list - mainly Europe – I find it very difficult to understand as VK9LL had a direct visibility horizon to NA, not screened by any hills, unlike in most other directions.

Most of the strongest signals were received on BOGs, not Delta Flag. There was one night when some European stations were peaking 599 plus. Some of the truly unbelievable signals experienced in VK9L: SM2LIY, DL1XX, DL2MWB, OH5KW, RN1CM, RZ3AM, RN3QN, UT5MB, RW3DD, RW3XW, US6EX. There were not a single NA/ JA station worked with such outstanding signals. However such propagation did not repeat itself over any of the following nights.

References

1. V. Drozdov, Lyubitel'skie KV Transiveri (Amateur HF Transceivers), Moscow, 1988.