

The CQWW SSB Contest – Zone 29 Expedition 2006

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This years' operation was planned with doing something I had never before attempted or experienced, both in antennas and operating challenges. Having explored some interesting remote island operations for the past 3 years (google VK9XD), the infrastructure and support needed on this operation was not (economically) available at VK9X, VK9C and VK9L.

Having a lot of support hardware still in storage with Mark Sellers VK8MS, Darwin became a focus due to the small incremental amount of effort needed to carry off something large. Practically the only challenge was to tackle a larger antenna.

Establishing the venue at the Darwin Surf Lifesaving Club was pretty straightforward, and securing the construction crane from Sitzler Brother constructions proved more challenging. Darwin is in the grip of a major construction boom, and it came down to my prior experience as a client that tipped the scales to get this handy temporary tower for a weekend.

Next was to work out what the something interesting and challenging was.. Always wanting to use a 40m beam of any description, a few commuting trips to work with the laptop established a full size 40m beam was OK. Projecting my 65' long yagis design I had used in Sydney (on the 10m band), I worked out that a 5 element yagi was the target performance I wanted.

The design came down to the design shown in Figure 1. The design shown in Red was implemented. While the design shown in black is marginally better, it turned out that there was not enough open real estate to assemble it. Finding over 600 square metres of open space is more difficult in cities than you think.

Darwin is arguably the only airport in Australia not subject to a curfew, so logically arriving or departing Darwin is mostly midnight through to 3am. Arriving at 00:30 local on Thursday 23rd, it wasn't until 2am before getting into bed with bags and rental car in hand. Sleep deprivation day 1.

Getting the material to site and access to the Lifesaving Club venue happened around 3pm, and managed to get the boom assembled by dark. Ninety five percent of materials were sourced locally in Darwin in the previous months, with a major delivery of small aluminium tubing from Adelaide.

Friday 24th, the measure and assembly of the 5 elements sounded easy. With around 100m of elements to be made in the blistering tropical sun and 9 litres of sports drink consumed, the balun, hairpin and feed cable happened literally with the crane rumbling onto site. In 20 minutes, the antenna was in the air at around 80' ... BUT, the droop on the all elements meant it was not possible to lower the antenna to perform a mechanical balance adjustment OR a feedpoint match adjustment.

The mechanical design of the yagi concerned me more from getting things physically balanced and not introducing yet more stress into an already heavily stressed structure.

A lateral approach to getting a 'automatic' balance with 5 degrees of horizontal worked out perfectly once it was in the air. Note – it was simply not possible to lift the yagi beforehand to even do a test balance.

For those of you who have worked in the tropical heat, you will understand that the mind plays serious tricks.. the result was having to re-work a couple of elements due to jamming, mis-measurement, errors and other silly mistakes. I will discuss these only over a beer.

Having read of others having real hassles with yagi matching on 40m, I applied what I'd learned of this simple match on the 10m and 15m bands. The result was a flat VSWR response from 7150 thru to 7300khz. Down at 7020 however, the VSWR was about 2.5:1 – so mental note to keep that as my lower SSB limit. [I know many CW pundits will scream at this point, but here in VK, SSB at 7020 is still legal, and as CW is no longer officially recognised here, so too the CW segments will become softer].

Saturday 28th. Arrive on site around 7am after a breakfast of watermelon, mango, banana and coffee. Manage to setup a low dipole for the 40m band about 100m away from the big yagi with an A/B switch. I know I had promised YT6A and CN7J some time on 75m, but that antenna succumbed to the tropical brain fade I had yesterday.

Setting up the gear, I had borrowed a tired TL922 amp from Mark VK8MS to keep transport issues simple. One tube was effectively black and a quick power test showed it was struggling to make 300watts output – just a fraction too much to be classed as low power. At this stage of exhaustion from Friday, I was entirely grateful to have any amplifier. Sleep deprivation day 2.

Contest kicks off at 09:30 local.. signals from EU require pre-amp to hear and then gone by 10:30am. Flick to 15m for a few QSO's on the low dipole and manage 2 QSO's on 40m by 3pm. By 4.00pm local, I have 12 countries and 8 zones in the log from Central & North America – and the sun is still way up in the sky !

Manage around 270 QSO's the first night, I still did not have a feel for how the yagi played. It was evident however, that I was working anything that I cared to point the yagi at. The gravity of this observation had not yet sunk in until I wanted zone 38 and 39.. which I got within 5 minutes of 'walking' the yagi toward Africa.

There is a fond term used by the RAAF at Jindalee near Alice springs where they coin the term "Walk the Array".. effectively a 3km running track around the OTHR array. Walking this 40m 5 element yagi around with ropes was remarkably similar, where I think I walked about 3 km in circles under the big yagi holding a rope over my head. The yagi inertia was also much higher than imagined too, no sharp movements, gradually nudging, almost like manoeuvring a 90' sail boat in a harbour – by hand.

Sunday 29th. Make the realisation that I could compete with the big guns on 40m [NQ4I, VE7SV and others], I decided to hold a frequency in a couple of sessions in the US band and later the JA/EU band area. After being subject to the worst verbal abuse ever heard in a contest by the ZL6QH station, I figured I had annoyed him somehow, but as I do not accept being spoken to in such a fashion, deserved or otherwise... well lets say they did not get zone 29 on 40m from me...

Also witnessed the stress of a 'top' USA station 40m operator from the 3 district who actually tried to push me off 7080 ish.. and actually responded to by QRZ's on 7080 ish by activation his callsign voice keyer for about 40 seconds !! That would have needed deliberate "CHANGE" or VFO swap action... so it was far from the accidental out of band incursion which happens... I know I would not be afforded similar courtesy if I tried to keep 2 frequencies clear on 40m during any contest !.

The correlation of big M/M station operators being courteous is now in ruins on the noise floor of my receiver. mmm... ZL6QH was also a big M/M station too... maybe they do not screen their operators skills..

Moving to positive experiences, I managed close to 600 QSO's in 5 hours after dusk, defending my run frequency, and working key targets like JT. The IC756pro3 suffered some weird behaviour too... competing with full scale signal (60dB) over S9 signals in the broadcast segment and that was with 18dB of front end attenuation made the rig need a power on reset a few times! Not sure if this is normal.

Unfortunately many stations had me logged as VK9AA even with persistent attempts at correcting it. VK9AA was not active on 40m at all during the event. I wish big stations would take less notice of their super check partial database... probably more their loss once they realise.. I wonder how to say 8 in Italian.. there it is again.. big stations !!

With about an hour before the big yagi came down, I still did not have traditionally easy Countries like France and Croatia. Focussing on EU in pounce mode, I rounded them out... missed other easy nearby countries, VK9's, Maldives, Solomons, Papua New Guinea, New Caledonia and Vanuatu.

The crane needed to be back on site by 7:00am Monday, so the yagi was on the beach at 6:15am, with 3 hours left in the Contest. Weigh up making a handful of QSO's on the dipole – or – use the cool morning twilight to dismantle the yagi before the scorching sun comes up. Dismantling the yagi by 9:00am without heat exhaustion was the best decision. Sleep deprivation day 3.

On dismantle, little things were observed with the yagi being in the air for 60 hours.. some pop rivets had sheared, two of the elements had shifted position about 50mm – and all unexplained. The clamps were very tight, pop rivet joins were all duplicated or triplicated.. left me wondering..

With nowhere to store the big yagi parts, I had to cut up about 25kg of aluminium and toss it, hairpin, some clamps, 40m wire dipole etc in the metal re-cycling bin. Managed to keep some parts to bring back to Sydney, but saddening none the less.

Flying out of Darwin at 00:30 local on Tuesday morning took me into Sleep deprivation day 4, where I slept like a lamb.

Initial tallies look I have touched or possibly surpassed the Australian record on 40m SSB.. I guess it will come out in due course. What's next ??

YAGI TECHNICAL OVERVIEW (added on 10 November 2006)

Resulting from some direct queries about this antenna, here is an expansion of the more technical side of the 5 element full size yagi assembled for 40m.

Boom

The boom was assembled from four, 6.5m long aluminium tubes. The two outer tubes were 60mm OD, the two inner tubes were 80mm OD. Wall thickness for all tubes used on the boom was 2mm. I used 4 reducer sleeves to join the 60mm OD tube inside the 76mm ID hole of the large tube.

The two 80mm tubes were joined using a clamp manufactured from two aluminium plates, 12mm thick, 500mm long and 230mm wide. There were eight, 10mm bolts used in the clamp and eight "C" sections to cushion the 80mm tube. This clamp weighed over 17kg just by itself !!

Elements

All the elements used 32mm OD tube for the inner 6.5m, and 15.88mm OD tube for the outer 5m lengths. The telescopic transitions between these two were pop riveted to get the final element lengths.

Working with elements around 20m long was also a challenge, they are seriously long !

Two types of element to boom clamps were used, mainly to trial each variant. Two elements used 1 and a quarter inch U bolts (~32mm) for fixing with DC earth continuity, and the remaining all used 32mm plastic industrial pipe clamps typically used on hydraulics fixings, HVAC plant etc. The U bolt fixings were actually the ones that moved in the 60 hours the antenna was in the air.

The driven element used 4 of these industrial pipe clamps (they are plastic and insulate very well). The current balun was fixed with some 5mm stainless bolts thru the driven element halves, fitted with wing nuts for fast assembly. The hairpin made from 6sqmm electrical cable also was fitted on the same terminals. The hairpin used some plastic strips (hacksawed from a nearby old plastic rubbish bin) with cable ties to stand it off the boom.

Balancing Act

Working out how to design a lifting mechanism for this structure to balance automatically took lots of time. It was so simple in the end... I won't go into the detailed logic, but the photo shows it 'live and working'.

Fully Rotatable

Making this yagi fully rotatable 360 degrees was also a challenge, and again from the photo's, I had to sacrifice overall height for clearance to do this. The yagi was at the 19m level (Half wave) above ground, and the overhead 'Null' was around 40dB !!

Option two was to get it to 40m elevation (full wavelength) above ground, but then I would be restricted to the sector of 300 degrees to 90 degrees azimuth... eliminating South America and Africa.. no go.

I had attached two ropes to either end of the yagi to steer it. One had a house brick tied to it, the other was tied off on whatever was appropriate for the beam heading, boats, trailer, posts, car etc..

Strain on these steering ropes worked against the overall yagi balancing mechanism used, so virtually no load could be placed on the ropes.

Electrical Performance

The antenna gain on the laptop showed 10.1dB with sidelobes better than 20dB down. (probably better given it was over salt water). While it was designed to cover the full band, the matching gave me a 1:1 match only over 7150 to 7300khz band... maybe the antenna was too low. (raising yagi driven elements with this type of matching actually lowers the match frequency.. counter to what first impressions tell you).

Messing with the calculator showed this antenna had an “Aperture” of 2,200 square metres !!.. around 85% of the Aperture of the Australian 64m diameter Parkes radio-telescope !! ...→ this scared me a little, see lessons learned below.

Weight

Best estimate was the array weighed in at 135kg (300 pounds), but too light to register on the crane load cells.

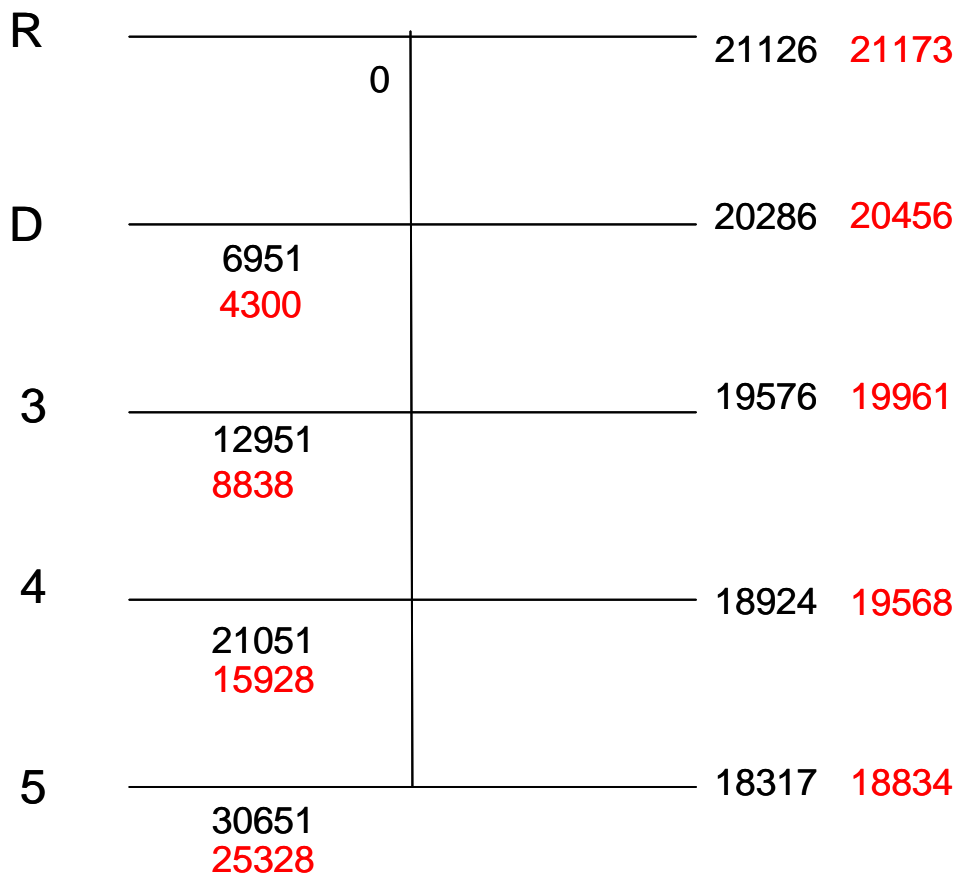
Lessons Learned

- This antenna rocked.. I only wish I had built it a day or two earlier and got some rest. Going into the contest with mild heat exhaustion was not a good move.
- Realising that the antenna rocked only on day 2 made me kick myself that I was only on air the first day for just 8 hours.
- The yagi is useless on local signals.
- Going for the full length 32m long (108') 5 element yagi next time with more open real estate to assemble it, bigger machine like an 80ton or maybe 100ton with 60m (200') lift and element strength tweaks. The reflector technically failed mechanically (permanent deformation), but not catastrophic and didn't affect performance or obvious appearance.
- During wet season tropical operation, take twice as many sports drinks than you think plausible !!
- Having a huge Rottweiler in the compound was the best security. We are friends now.

40M YAGI Layout

VK8AA – DARWIN 2006

Add 14mm to non-insulated elements



S40M5C.ant 10.15dB gain, broadband with OK pattern
for 4 section boom @25.4m long.

AC40M5A.ant 10.30dB gain, broadband with Excellent pattern
for 5 section boom @ 32.2m long

Figure 1. 40m Yagi. Dimensions in millimetres.