Brisbane VHF Group 10 GHz shootout 16 July 2017

On 16 July the Brisbane VHF Group ran a 10 GHz shoot out at the clubrooms of the Redcliffe and District Amateur Radio Club. 20 hams were present and we had a great day.

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Receiver tests

To test the receive systems we had a weak signal source radiating on 10368.124 MHz. This was produced from the 10th harmonic of 103.681 MHz generated by a ZLPLL. The signal was radiated by an open waveguide transition. The 10 GHz signal was about -85 dBm. The antenna was placed on the ground so as to eliminate any ground reflection issues.

The signal source was set up at 30m. This was to make sure we were in the far field. Far field can be defined as = $2D^2$/wavelength where D equals dish diameter.

Each station peaked up their antenna on the weak signal source, then the SINAD (Signal to Noise and Distortion) was measured from each receiver. This gave us a numerical comparison between the various systems. The SINAD was measured with Spectrum Lab software. Each station had to adjust the beat note to 1 KHz to match the filter in the SINAD software. The table below gives the results. I have included details of each rig and an estimate of the antenna gain based on the size of the antenna. This allows a better comparison to be made.

Callsign	Name	Rig	Antenna	Theoretical dish gain	Measured SINAD
VK4KJJ	Geoff	VK3XDK Transverter Kuhne Preamp	66 cm offset dish Dual mode horn feed	35.6 dBi	17.5 dB
VK4GU	Gary	Home Brew NEC preamp	66 cm offset dish Dual mode horn feed	35.6	12.3
VK4EA	Peter	Kuhne G3 Transverter Kuhne Preamp	120 cm prime focus Directive systems Dual Band horn	40.7	10.4
VK4UH	Kevin	Kuhne Kuhne Preamp	60 cm prime focus Home made penny feed	34.7	9.6
VK4YR and VK4CZ	Campbell and Scott	Kuhne G3 Transverter VK3XDK Preamp	60 cm prime focus	34.7	8.9
VK4CDI	Phil	Home Brew	60 cm prime focus	34.7	8.6
VK4EMS	Mark	Home Brew	60 cm prime focus	34.7	8.2
VK4NE and VK4MJF	Mick and John	Kuhne Transverter	66 cm offset dish Dual mode horn feed	35.6	7.1
VK4OE	Doug	???? Kuhne preamp	Horn	29.5	5.3
VK4LHD and VK4FSCC	Robert and Glenn	Kuhne G3 Transverter	50 cm prime focus	33.1	1.7

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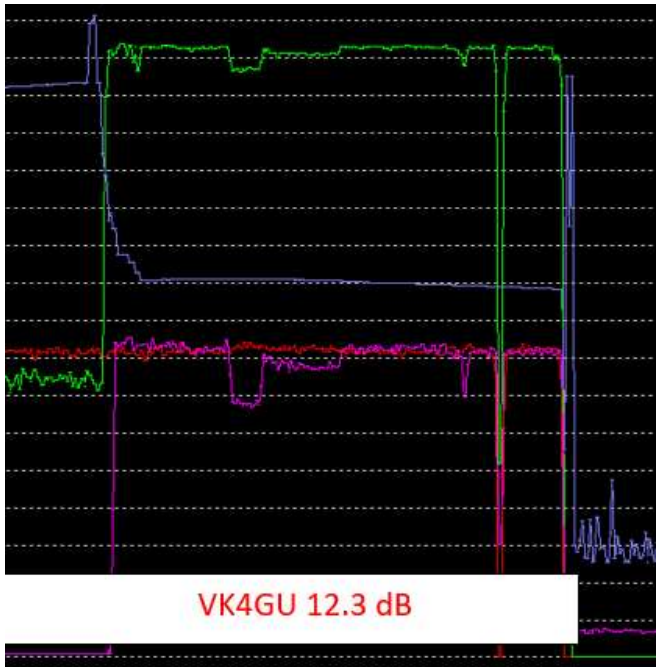
Not all stations were at the same distance from the signal source. However a quick path loss calculation showed the increased path length only amounted to about 0.5 dB for Peter VK4EA who was at the greatest distance.

Another useful comparison was the frequency stability of each station. Because the Spectrum Lab software was plotting the audio frequency (as well as the SINAD) it was possible to compare the short term frequency stability. 3 stations were found to be wondering around 100 Hz or so while the rest were very stable.

Below is a screen shot of Gary, VK4GU's measurements as an example. The horizontal axis is time, Red is Noise, Green is Signal level, Blue is Frequency and Magenta is SINAD. You can see at the start the frequency is a bit high so the dial was adjusted to bring the frequency down to 1 KHz. Then you can see Gary tweak his dish to get the best SINAD first horizontally then vertically although he had it spot on from the start.



Brisbane VHF Group 10 GHz shootout 16 July 2017

Issues found with receiver test

Far field distance of 30 m was adequate for dishes up to 0.66m but for Peter with his 1.2m dish the range should have been 99m. This was not practical.

There may have been some signal variation with height of the receiving antennas. The most sensitive station also had the highest antenna height – is this a coincidence? This needs further investigation as we had hopped to not have this problem by placing the source antenna on the ground.

The source antenna was an open wave guide. One reference suggests it would have a gain of 11 dBi giving it a half power beam width of about +/- 25 degrees. All stations were within about 16 degrees so no errors were expected due to azimuth location on the receiver tests.

Using a laptop running Spectrum Lab was a great way to measure performance but it did have issues. The screen was hard to read in sunlight although the stations set up under the tent were OK. A better method is needed for next time. A tablet App would be ideal but we could not find one that does SINAD.

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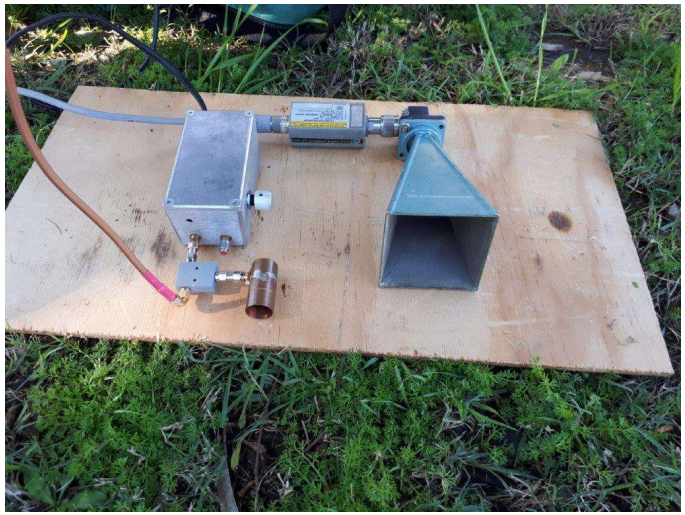
Transmitter tetst

This year we also ran transmitter tests. Each station transmitted in turn and the relative radiated power was measured at a distance of 30m. The power was measured with a HP 435A power meter and HP 8481 sensor fed from a horn antenna that was placed on the ground becide the open waveguide used for the receiver tests.



To be able to read the power meter, a special 30m long sensor cable was kindly supplied by Doug. This allowed the sensor to be at 30m and the power meter near the set up stations. So that everyone could see the power meter and thus could peak up their dish, a very large analogue meter was connected to the recorder output of the power meter.

In addition to the power meter, we also had a spectrum analyser connected to the open wave guide used for the receiver tests via a power divider.

Callsign	Name	Tx Power (Watts)	Theoretical dish gain dBi	Estimated relative power based on Tx power and Antenna gain	Measured relative Tx power
VK4UH	Kevin	8	34.7	0 dB	0 dBm
VK4GU	Gary	1	35.6	-8	-2
VK4OE	Doug	10	29.5	-4	-5.3
VK4EMS	Mark	1	34.7	-9	-10.7

Brisbane VHF Group 10 GHz shootout 16 July 2017

VK4KJJ	Geoff	0.25	35.6	-14	-11
VK4LHD and VK4FSCC	Robert and Glenn Supervised by VK4KJJ	3	33.1	-6	-13.5
VK4YR and VK4CZ	Campbell and Scott	3	34.7	-4	-15.2
VK4EA	Peter	3	40.7	+2	-15.8
VK4CDI	Phil	0.15	34.7	-17	-15.9
VK4NE and VK4MJF	Mick and John				Not tested

Issues found with TX tests

The horn antenna connected to the power meter has a gain of about 20 dBi. This gives it an azimuth half power beam width of about +/- 9 degrees. This means Robert, Scott and Peter who were located to the side suffered extra loss.

Gary's results seems to have out performed expectations. I'm wondering if I miss read the power meter range and it should have been one range lower ie -7 dBm.

Because the horn antenna was laying on its side it was actually aiming up a few degrees. This gave a slight advantage to those who had higher transmitting antennas. I calculated an extra 0.5m in height gave an advantage of about 1 dB.

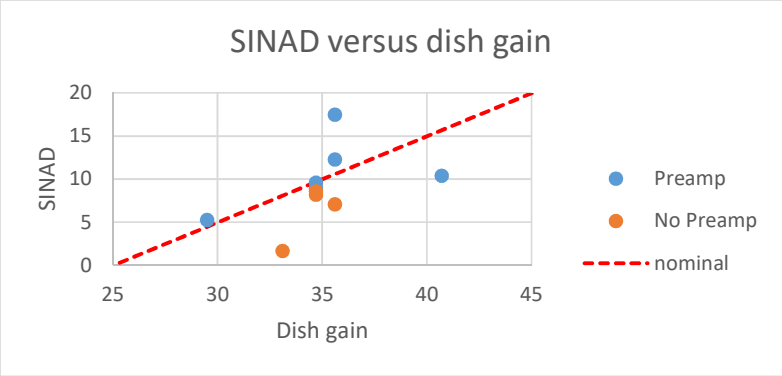
It is recommended that for next time a lower gain antenna is used to address these two issues. This would require the use of a more sensitive sensor like a HP 8484.

In the end the spectrum analyser was not used but it was a good backup.

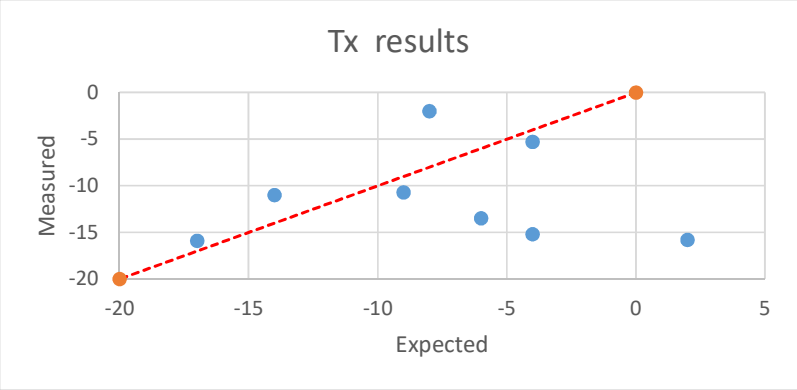
Brisbane VHF Group 10 GHz shootout 16 July 2017

Conclusion

So what accuracy did we achieve? On the receive tests the results for most staions matched their dish size within 3 dB . My result is not consistant possibly due to extra height. Peter and Robert are below par but both of them had frequency stability issues so the SINAD measurement may not have been accurate.



For the transmitt test, all results are within 3 dB of the expected value given the antenna size and Tx power except for the 3 previously mentioned stations that had an azimuth issue. Roberts seems to have sufered about 6 dB penalty, Scott 10 dB and Peter 18 dB.



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Also present VK4RF, VK4BTC, VK4ZLQ, VK4FKEN, VK4MIL, VK4TFN, VK4OA

Thankyou to Redcliffe and District Radio Club for the use of their club rooms and putting on lunch for us.

There has been much interest in holding another shoot out for 2.4, 3.4 and 5.7 GHz in the future.

73 Geoff VK4KJJ