NASA's JPL, Moonshine and The GARC

Late in February, notification was posted to the VK-VHF email list advising that NASA's Jet Propulsion Labs (JPL) would be conducting an experiment involving a microwave radio transmission in the 2 GHz band beamed at the moon. JPL would be utilising the 34 metre dish at their Goldstone Deep Space Communications Complex in the Mojave Desert in California.
The Goldstone antennas are normally operational 24 hours a day bringing in data from missions to the outer limits of our solar system and have a receive sensitivity of ***one billionth of one billionth of a watt***.
However for this project, the dish would be used to beam at the moon a 20 kW ***carrier power signal (*** not the Effective Isotropic Radiated Power) at the designated frequency of 2.115 GHz . The test **(Test # 1)** was scheduled for the evening of Tuesday 3rd of March (AEST) when the moon would be above our horizon for most of the proposed transmission period.

Fig 1 The Goldstone 34m dish (Courtesy of NASA/JPL-Caltech.)

With only a couple of days lead time before the event Chas VK3PY, David VK3QM and Bert VK3TU put together a plan to take advantage of the opportunity offered them to monitor the Earth Moon Earth (EME) transmission.
Two problems identified were firstly that the designated frequency of 2.115GHz was outside the capability of their microwave transverters but Bert VK3TU was able to access a suitable spectrum analyser which proved to be a far better solution. The second issue was that they had to design and build a low noise amplifier chain to bring the system noise figure down to an acceptable level. This latter activity was completed on the Sunday preceding the transmission.
The main receiving antenna was to be the 1.2 m diameter dish they normally use on field days on the 2.4 GHz and 3.4 GHz bands when operating as VK3UHF. They also took along a 60cm dish for comparison and Ken VK3AKK also made available his grid pack dish for further comparison.

Tuesday the 3rd of March - EME Day

All four members of the GARC team gathered at the agreed location at Lovely Banks after work at around 5:30 p.m., giving them plenty of time to set up the equipment prior to moon rise at 6:27 p.m. An issue that they had not been aware of, until on site, was the high noise level that inhabits the 2 GHz spectrum that necessitated some extra filtering and careful adjustment of antenna polarisation to reduce it to an acceptable level.

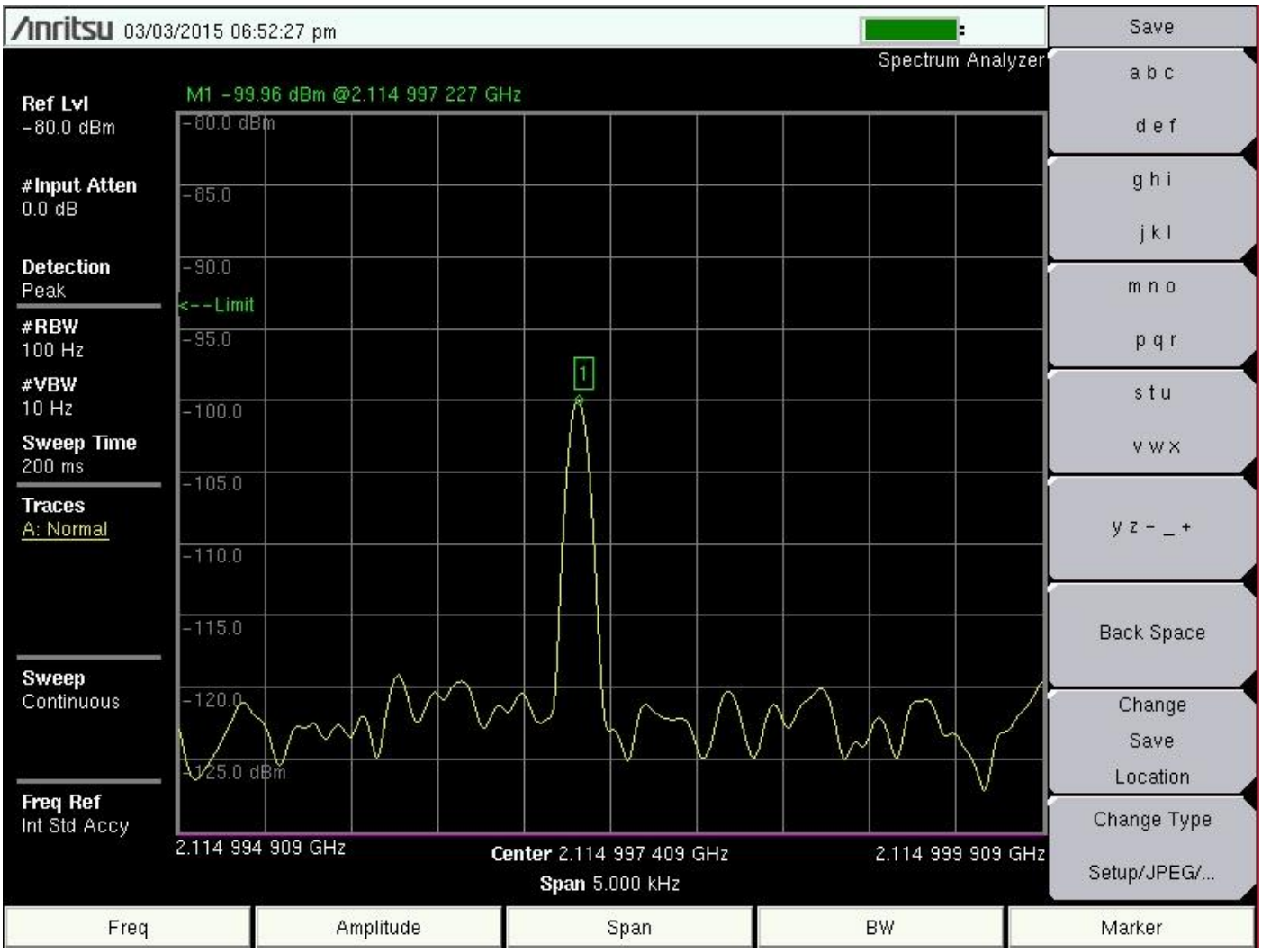

Fig 2 Spectrum Analyser EME Signal Detection

With the moon just poking above the horizon, at the appointed time, the signal from JPL appeared. With some adjustments to the antenna pointing and the spectrum analyser settings they recorded the EME signal at the predicted frequency. Fig 2 is a screen shot from the spectrum analyser displaying the received signal. They continued to monitor the EME transmission as the moon moved across the sky until JPL switched it off at precisely 0900UTC.

To have achieved this in such a short time line was nothing short of remarkable and the success was further embellished after exchanging e-mail's with Jim Lux W6RMK (The engineer at JPL involved in the experiment) who replied with these comments after Chas VK3PY sent him their results :

" Your measurements were actually quite useful, because in these situations , you never are sure they're are radiating what you think they are supposed to be radiating . It's an experimental operation, not a

regular spacecraft communication link that is all nice and scripted and bullet proof and you saw more signal than we did"

In regard to the latter comment the team copied JPL's transmission 20db above their noise floor in a 100Hz bandwidth. JPL copied the signal 10 - 15 db in a 1Hz bandwidth. Therefore correcting for their narrower bandwidth the GARC members signal to Noise ratio was 25dB better than JPL's. In simple terms that represents 4-5 S units or 300 times better ! Taking into account the limited time available to assemble all the equipment and get it up and running the whole exercise was an outstanding achievement.
Jim W4RMK remarked ***" in a 1 Hz bandwidth we should have been about 35 dB above the noise floor (we were not and I am running that down). Our receiver is not very hot, 4 - 5 dB Noise Figure."***
As it transpired the GARC team had better reception than the NASA JPL team which gave rise to another input from a JPL engineer.

"***Jim forwarded your (VK3PY) e-mail and your "Moonshine" observations. Very nice measurement…….. I am glad to hear you saw the signal until 9:00 p.m. UTC. Since after 8:30'ish we could not see the signal at JPL on the scope. Although there is a chance that Jim will be able to extract the signal in post analysis. With your permission I would like to show your pictures in my Management Report. Having collaborators such as yourself is always great PR"***
This was as a consequence of Jim W6RMK forwarding chuck the GARC observations. Subsequently Jim made the following observations to Chuck:
"We need a better spectrum analyser next time. The GARC team was using a newer Anritsu... note they were using a 100Hz bandwidth (so covering the Doppler spread), with 200ms sweep time, so you would be able to see it move.
Jim Lux "

It is of interest to note that from JPL's engineer's point of view the GARC has access to better equipment than NASA's Jet Propulsion Laboratory!

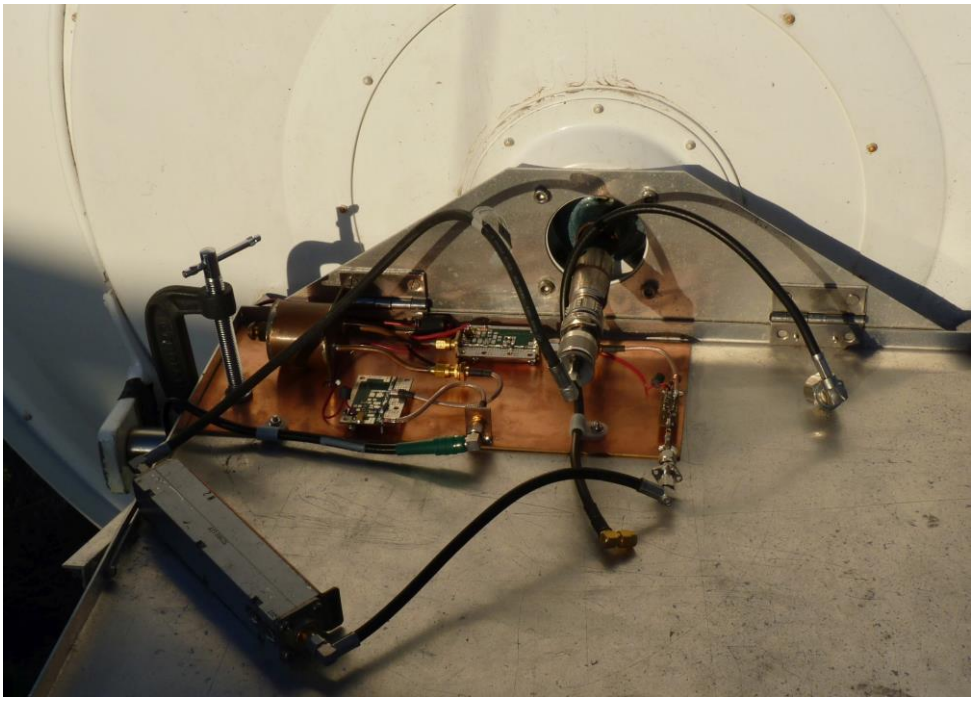

Fig 3 The feed to the 1.2 m dish showing the low noise preamplifier.

Fig 4 The On-site Set Up at Lovely Banks

The above was adapted from information provided to the GARC Forum by Chas VK3PY

Confirmation of New Microwave Records

In the January / February edition of the AR Magazine the GARC VK3 column all the achievements of the VK3UHF team were identified as **subject to confirmation**.
Chas VK3PY now confirms that the Lara UHF and Microwave Experimenters Group , (LUMEG) comprising Chas VK3PY, David VK3QM, Ken VK3NW and Charlie VK3NX can now add the following distance records to their established VK5 and VK7 microwave records :

VK1
3.4 GHz, 5.7 GHz and 10 GHz bands at 501.3 km
VK2
2.4 GHz, 3.4 GHz and 5.7 GHz bands at 501.2 km

These are bi directional awards as David VK3QM travelled to ***' the other end'*** to establish the communication path on behalf of LUMEG.

Contact

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