Field Comparison of Single Photo-diode Mirror Dish Receiver with 35 Diode Fresnel Receiver

By Rex Moncur VK7MO, Justin Giles-Clark VK7TW and Ken Sulman VK7DY

On 18 November 2007 we ran field tests to compare the performance of the Single Photo-diode Mirror Dish receiver with that of the multi-photo diode Fresnel Receiver. The tests indicate that the 35 photo-diode receiver improves system performance by around 9 dB.

Background

Both the Mirror Dish and the 35 Photo-diode receivers are based on the high performance KA7OEI circuit. The mirror dish uses a 320 mm diameter parabolic mirror. The 35 Photo-diode receiver uses an array of 6x6 photodiodes (one is used for a reference) behind a 320x400 mm Fresnel lens. More details on the 35 Photo-diode unit are at:

http://reast.asn.au/optical/VK7MO_VK7TW_VK7DY_Multi_Photodiode_200711.pdf

These tests were conducted over the 27 km path from the QTH of VK7MO to that of VK7DY. VK7TW travelled to the QTH of VK7DY with his Mirror Dish receiver.

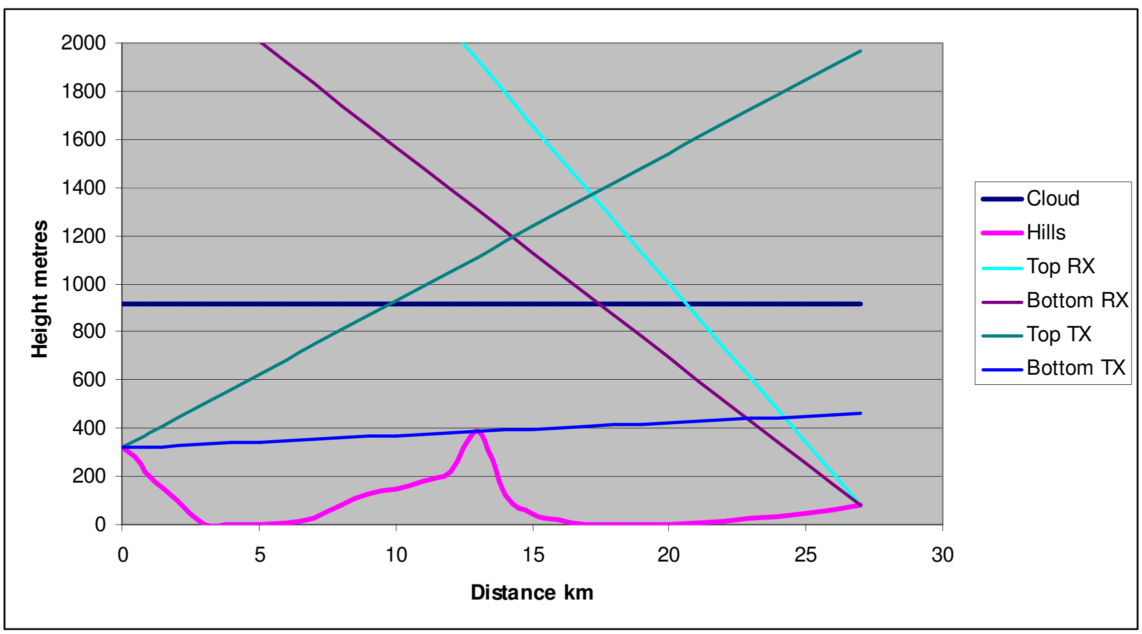

Figure 1: Path Geometry with VK7MO at zero distance and VK7DY at 27 km for 35 diode receiver.

At the VK7DY end the elevation is restricted to 5 degrees and above due to local trees. At the VK7MO end elevation is restricted to 0.3 degrees due to distant Hills. As a result if the cloud is around the typical height at 600 to 1000 meters the point of scattering must be closer to the VK7DY end of the path. Also as the energy scattered from the TX beam is restricted to a very small angle of that beam and is smaller at low angles then at low cloud heights the signal will necessarily be reduced. Of course at high cloud heights both the TX and RX beams would need to be raised.

With the single photo-diode and mirror dish the beamwidth of the receiver is reduced to around 0.5 degrees.

In both cases the azimuth and elevation angles were adjusted to maximise the signal to noise ratio. It was found that such adjustments were critical with variations of 10 dB and more with just a few degrees variation. There were times when both receivers gave similar results, times when the single diode gave 10 dB more signal and times when the 35 diode receiver gave around 10 dB more signal. These differences were all seen to be a function of the azimuth and elevation adjustments showing how critical that correct alignment is and its implications on measurement accuracy.

Results

Once the azimuth and elevation angles were optimised signals reached -4 dB on the WSJT on the 35 diode receiver. WSJT gives compressed readings below -10 dB so it was necessary to reduce power and with figures of around -12 dB on the 35 photo-diode unit the Mirror dish produced figures of -22 to -24 dB or about 10 to 12 dB difference. After a further re-alignment of the Mirror dish the following figures were obtained:

35 Photo-diode	Mirror Dish	Difference
dB	dB	dB
-8	-17	9
-9	-17	8
-9	-18	9

As it was by now well after mid-night no further testing was undertaken so we could move to try out voice communication. With hindsight it is seen there 35 diode figures were below the WSJT 10 dB compression point so it is possible the actual difference was a dB or so greater than -9 dB. Also as noted above the results are extremely critical in terms of azimuth and elevation so one cannot rely on these results to better than a few dB.

Assessment

Separate tests comparing a single diode in the 35 diode array show a gain of around 14 dB in dark room situations and 11 dB in field testing. With the difficulty of obtaining accurate field comparisons the 8 to 9 dB obtained in this case could well be of the same order due to experimental error. However, other tests have suggested that the Mirror dish does a few dB better than a single photo-diode with a Fresnel lens, which is consistent with these results.

CONCLUSION

These results suggest that in the field situation the 35 diode receiver gives a very useful improvement in performance over the mirror dish, which is our best receiver to date, and that this is of the order of 9 dB. It is further noted that adjustments of Azimuth and Elevation can make dramatic differences to such results.