Some Observations on Sun Noise Measurements

Neil Whiting, G4BRK

Introduction

Sun noise is an accepted way to gauge system performance on microwave frequencies, but apart from EME station reports there are few indications of what is a reasonable result on typical amateur microwave systems.

In the course of checking and optimising feed positions on a selection of dishes I made a number of measurements, which may be of interest to others.

Set-up

Several home-built transverters were used to convert the various microwave bands down to 144MHz. My RATS system (G4PMK design) was used as a sensitive level meter on the transverter 144MHz output – the optional MAR-6 amplifier was required between transverter output and RATS receiver in order to get sufficient signal.
A calibrated attenuator (0-11 dB in 0.1dB steps) after the transverter served to give an accurate measurement of the Y-factor (difference between cold-sky and sun noise).

Measurements

The measurements were made by aiming the dish away from the sun and setting the RATS offset to get a convenient, low scale reading (cold sky) with the attenuator set to 0dB. The dish was then pointed at the sun and the reading maximised. The attenuator was then adjusted to give the same reading as the cold sky. The attenuation used gives the Y-factor.

Antenna gains for the dishes and theoretical Y-Factor come from the Ed Cole (AL7EB) spreadsheet available on the WWW. Dish efficiency of 55% is assumed. For the estimates of 23cm Yagi gains, the Tonna is based on simulation and the Wimo on manufacturers claims. RX noise figures are estimates.

Antenna	Frequency	RX NF at ant dB (?)	Antenna gain dBi	Y-factor dB	Theoretical Y-Factor dB
1.2m prime focus, 0.5f/d, RMX feed	2320	2.2	27.9	2.0	3.9
	5760	3.5	35.8	0.8	2.5
90cm prime focus, 0.4f/d, RMX feed	2320	2.2	25.4	2.0	2.6
	5760	3.5	33.3	0.5	1.6
90cm prime focus, 0.6f/d, RMX feed	2320	2.2	25.4	1.5	2.6
	5760	3.5	33.3	0.5	1.6
80cm offset, 10/24G feed	10368	1.5	37.1	2.0	2.2
	24192	3	44.5	2.5	0.8
80cm offset, RMX feed	2320	2.2	24.1	0.5	2.1
60cm offset, Amstrad feed	10368	1.2	34.8	3.5	1.8
35el Tonna yagi	1296	1.2	17	1.5	2.6
	1296	1.2	17	2.0 (horizon)	2.6
67el Wimo yagi	1296	1.2	22	1.6	5.3
	1296	1.2	22	2.6 (horizon)	5.3

Conclusions

I set out to confirm feed positions for my dishes, and this was successful. It was noted that the deeper dish was more critical on feed position – 10% movement in distance from the dish is quite noticeable in the measurements, though only fractions of a dB. This contrasts with results by others which suggest position needs to be correct to a few mm – I needed 4cm on the 1.2m dish before I could see the Y-factor drop by 0.1dB.

The measurements also raise a number of questions, some of which I can attempt to answer:

On 2320MHz – why is the 90cm,0.4f/d dish as good as the 1.2m?
The WA3RMX feed is designed for deeper dishes, 0.3-0.4f/d, so over-illuminates the 1.2m dish. This adds ground noise from behind the dish to the cold-sky reading and less increase is therefore seen when aiming at the sun.

On 5760MHz, why is the 1.2m dish showing an improvement?

In this case I can only guess that the RMX feed gives a narrower pattern on 5760 and is relatively better on the shallower dishes.

Why is the 60cm dish better than the 80cm dish on 10368MHz?
The Amstrad feed on the 60cm is obviously working very well. The 10/24GHz feed on the 80cm uses a piece of 24GHz waveguide let into the back wall of a G4DDK feed. The 'DDK feed is designed for ~0.5f/d, so will be over-illuminating the 80cm dish, reducing the Y-factor due to ground noise contribution. There may also be a reduction is efficiency due to the 24GHz guide. The 24GHz figure, on the other hand, seems very good – it looks like this feed is accidentally working quite well!

How come the 67el Yagi is not much better than the 35el?
I don't know. The difference in claimed gains is ~3dB and the 35el simulates as worse than claimed. There may be a matching difference causing a change in the effective noise figure – I seem to get a higher background noise on the 67el. Some more investigation is required. It is interesting that I see more Y-factor when the antennas are mounted horizontally and moved towards the setting sun. I would have expected less due to part of the beam including the ground and increasing the off-sun background noise. It may be that I am seeing the effect of ground-gain – something that is seen by 2m EME stations. Any other ideas?

I learned something from making these measurements and can use them in the future to check the effect of improvements in each of the systems.