

## TX5S Satellite, EME and Tropo operation (6M, 70cm, 23cm)

By Andreas Junge, N6NU

How does one get to be the Satellite Captain for a major DXpedition?

Satellite operators and 6M EME groups had reached out to us about possible activity. When the expedition co-organizer Gene, K5GS, asked the team as to who has Satellite equipment or some knowledge about it, I raised my hand. The result was: “Great, you got it, it’s your project!”

After discussing this with the team co-leader Steve Dyer, W1SRD, the decision was made to dedicate 100% of my time to activate Satellites, EME for 6M and 23cm as well as 6M tropo when the station was not pointed at the moon. This was now a full-time effort and not an afterthought anymore. We had to plan for a separate operating tent, generator and fuel.

### Satellite Planning

I had been active on Satellites over a decade ago, however Satellites get launched and deactivated over time. Which Satellite to support? Clipperton Island is 1700 miles south of San Diego and about 900 miles west of Mexico in the Pacific. The only Satellite that can reach US, JA, ZL/VK, EU and AF is GreenCube (IO-117). It has an orbit altitude of 5000Km/3100 Miles and allows for QSO’s of up to 13000Km/8000Miles distance when the conditions are right (Figure 1). Typical passes are well over an hour at the time.

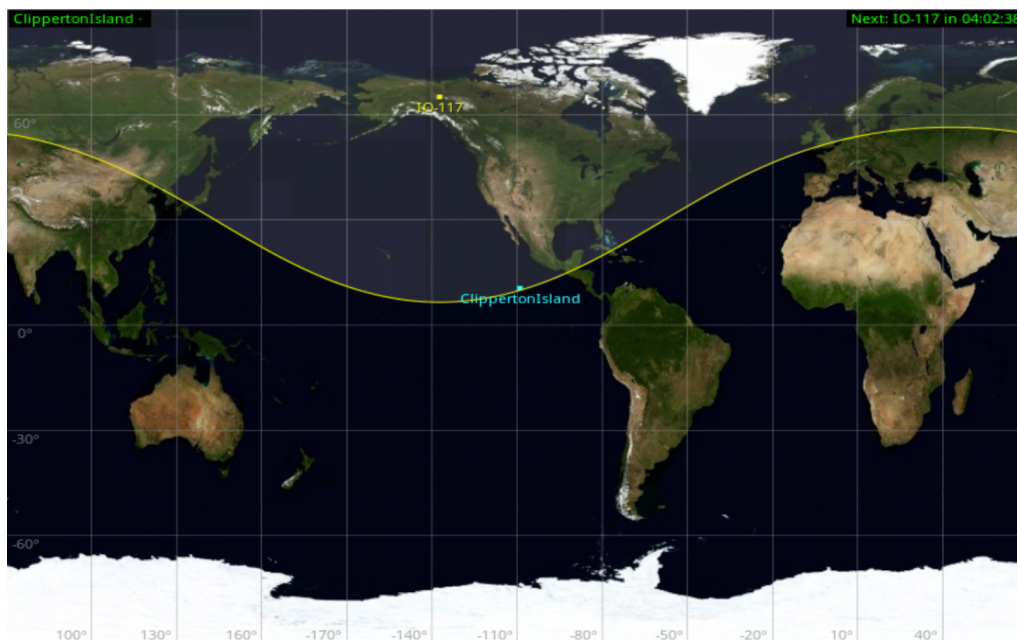


Figure 1 IO-117 Footprint Example

Other Satellites like RS-44 are workable and were considered, but the orbit at an altitude of 1200-1500km results in a much smaller footprint and would have excluded JA and EU (Figure 2).

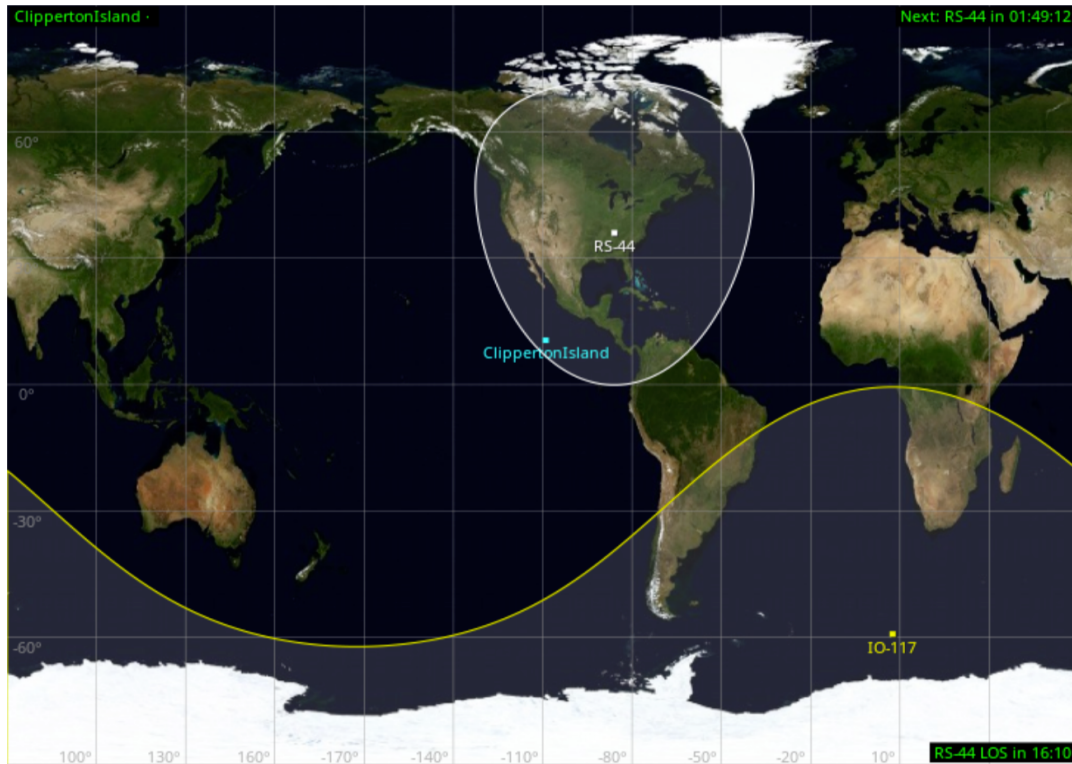


Figure 2 RS-44 Footprint Example

### Working GreenCube (IO-117)

GreenCube is basically a digital repeater (digipeater) for packet radio on a single frequency of 435.310MHz. I found the UZ7HO combination sound modem software and a generic AX25 Packet Terminal program that can use the built-in sound card of the ICOM IC-9700 radio to do the encoding and decoding. No additional separate hardware modem was required! Focusing on GreenCube also simplified the setup since only a single relatively small 70cm antenna was required.

I started to assemble a 11 Element Yagi, mast mounted LNA, Alpha Spid Mini-Ras AZ/EL rotator with Green Heron RT-21 controller and IC-9700 (70w out). The rotator was mounted on a cross shape base with a short 5 foot mast. Satellite tracking, rotator control and Doppler correction were all handled by PSTRotator. This is truly the Swiss Army Knife of rotator control!

After the first successful satellite QSO's in June of 2023 it became clear that the single frequency operation was a very limiting factor for the QSO rate. Since none of the ground stations can hear each other, they often transmit at

the same time, causing the signals to “double” in the satellite’s receiver. Both signals are lost and nothing is digipeated. You can imagine the chaos when hundreds of stations are transmitting at the same time – nobody wins.

### **Optimizing the QSO rate**

I was contacted by Jeff Schwartz, KI0KB, and we had a few discussions on how to solve the hidden transmitter syndrome problem. Jeff pointed me at the much more advanced Terminal program that was specifically created for QSO’s through GreenCube by Carsten Groen, OZ9AA.

Carstens “GreenCube Terminal” was a gamechanger. It added a feature to be able to acknowledge RR73 to many stations in one transmission. It is similar to WSJT-X when responding to multiple stations in the Fox/Hound mode. The QSO rate went up considerably.

Carsten kept improving the Terminal functionality and reliability for the next couple of months. Both Jeff and Carsten were very active on Facebook groups to get the word out to as many users as possible to switch over to the improved way of making QSOs.

### **6M EME**

While I am very active on 23cm EME, 6M is a completely different experience. Antennas are bigger and more power is required. I had a lot to learn. After a few phone calls with Lance, W7GJ, who had operated 6M EME from Clipperton before, I had a better understanding of what I was up against. He usually has a loaner M2 6M8GJ antenna, but in this case, it was already on the way to another DXpedition, so I had to source my own.

I approached Petr, AG6EE, who is a well-known 6M EME rover to see if he has advice for me and equipment that I can use. He offered his 2x6el horizontally stacked phased array which is optimized to be easy to assemble and break down and fits into two ski bags. He also built a custom 1100W SSPA for me that has a sequencer and a PGA-103+ based LNA built in. Very compact and easy to hook up. The SSPA can be driven to full output with 5W from a ICOM IC-705.

To test the complete setup and get some operating experience on 6M Petr and I activated DM09 during the ARRL EME Contest near Middlegate, NV about 1 hour east of Carson City. I used the latest version of WSJT-X 2.7.1 to be able to run Q65-60A in Pileup Mode. Signals were heard, contacts were made, I had a working setup.

## **23cm EME**

As with everything EME or ham radio in general, the bigger the antenna the more stations you can work. Having a few thousand 23cm EME QSO's in my log, it was clear that the minimum meaningful equipment required was a 2.4M fabric foldable dish for easy transportation and setup, a AZ/EL rotator for accurate moon tracking, a high performing LNA and about 300-500W at the feed. The Dish and positioner were sourced from Sub-Lunar and the owner Paul Andrews, W2HRO, was very helpful all the way. Fabric dishes are light and very wind sensitive. After many emails and phone calls Paul suggested that I take a wire mesh conversion kit with me to the island – thanks Paul, good call – I needed it.

After setting up the AZ/EL positioner with a N8CQ WinTrack controller and mounting the dish on a sturdy camera tripod I correctly oriented it by either using the sun or sun noise. After that it would follow the Moon automatically.

Next was the radio setup. Petr, AG6EE, had built a 23cm 700W SSPA and LNA for me. The LNA is mounted right at the feed in front on the dish and the SSPA served double duty as a counterweight for balance. The power output was kept to 300-400W to keep the hybrid combiner at the feed from overheating. The whole system was driven by a ICOM IC-905 which allows for having the actual rf unit of the radio being placed at the dish for low loss connections. The control head was linked with a 100-foot CAT-6 Network cable. Again, signals were received, QSO's were made at good signal levels, and I had a great portable 23cm EME setup.



## **TX5S on the Island operations**

Satellite operations on the island were a great success with 375 QSOs and 47 countries worked. The OZ9AA terminal software worked well and Jeff Schwartz, KI0KB, ended up being the ad hoc pilot for us staying in contact with the Facebook group. We managed to focus on some geographic areas during different passes and I would like to thank the satellite community for standing by and allow us to work the hard ones at the edges of the coverage areas.

The first Moonrise operation yielded a handful of 6M EME Q65 QSO's. The second session the following day brought a surprise. After working a few EME contacts in the beginning the WSJTX screen started to show tens of strong signals coming in directly/tropo. The band had opened, and we worked as many stations as we could to make use of the opening. Final EME count was 17 QSOs and 3 countries.

Throughout the next few days, we added 197 6M Tropo QSOs and 13 countries to the log. The band was open to NA, SA, AF, ZL and VK.

The last band to be setup was 23cm/1296MHz. Due to the constant wind the 2.4M dish had to be converted from fabric to wire mesh. We made a total of 55 initial contacts in 17 countries.

I want to thank Dave, K3EL, for helping on 6M and the Satellite station as well as Arliss, W7XU, working many 23cm QSO's.

A great bonus were two 70cm EME Q65 QSO's utilizing the 11 Element Satellite Yagi and a barefoot IC-9700 with 70W.

## **Equipment**

**6M EME:** ICOM IC-705, AG6EE 1100W 6M SSPA with built in PGA-103+ preamp, 2x 6EL phased Yagis by AG6EE

**70cm Satellite and EME:** ICOM IC9700, 70W, ICOM AG-35 mast mount LNA, 11 Element Yagi, RAS Mini AZ/EL rotator with Green Heron RT-21 controller.

**23cm EME:** ICOM IC-905 , AG6EE 700W SSPA (running at 400W), AG6EE LNA with built in protection relay, 2.4M W2HRO folding dish, W2HRO SL-1 AZ/EL rotator with N8CQ WinTrack Controller.

## Additional pictures

Satellite Antenna



EME Dish



6M phased array

