Using the G3PHO Feedhorn with Coax feed.

When my satellite system was upgraded to digital I kept the old Amstrad dish with the expectation of putting it to use when I got going on 10GHz. I chose to use the G3PHO “Plumbers Delight” dual mode horn, as this looked like it would illuminate the dish reasonably efficiently, although my dish appears to have a shorter focal length. The G3PHO design uses waveguide feed with a transition from WG16 to the 22mm copper pipe at the rear of the feed horn. I wanted to build an entirely coax based masthead mounted system, as I already had a Sivers Lab coax relay and all the modules used SMA connectors. It also looked to be easier to engineer the feed to come to the rear of the dish with coax than waveguide, and saved having to find various bits of WG, bends, flanges and transitions. Losses in coax are higher but it looked feasible to keep the cable length short enough to keep within acceptable limits. I ended up using 70cm of Andrews FHJ2 cable for the feeder, with a measured loss of about 0.5dB.

The coax feed design is based closely on the W5LUA dual band feed horn design from Volume 2 of the ARRL UHF/Microwave Projects Manual, optimised for the dimensions of the G3PHO horn.

The diagram below should be self explanatory. The shorting plate at the end of the 22mm diameter copper pipe is generally to be found in your pocket, and cost the princely sum of £0.01 each! The 22mm pipe is 60mm long and has 44mm exposed beyond the end of the Yorkshire reducer. A piece of brass about 10mmx10mmx15mm was filed with a half round file to fit the profile of the 22mm tube. This acts as strain relief for the semirigid cable emerging from the horn. A 3mm hole was drilled through the middle of this brass block and through one side of the 22mm tube, and they were then temporarily bolted together with a plated steel 3mm screw. The 22mm tube, brass block, and end plate were then silver soldered in place. Silver soldering is more robust than standard tin-lead solder, and because it has a much higher melting point it means that subsequent soft soldering operations on the feed will not cause it to fall apart. When cool the 3mm screw was removed and the assembly cleaned up with wire wool. A 3mm drill passed through the block and tube was gently tapped with a mallet to make an impression on the far wall of the tube, and a 1.6mm hole drilled at this point, then tapped with an M2 thread for the tuning screw. The 3mm hole was opened up to 4mm to accommodate 0.141 inch semirigid cable. Two examples of the horn were made, one with a cable mounted SMA socket soldered directly to the brass block, the other with a tail of semirigid cable emerging from the brass block and formed to bring an SMA connector in line with a feeder running along the feedhorn mounting arm. The semirigid cable is soft soldered into the 4mm hole after checking that the feed probe dimensions are correct, with 1.8mm of PTFE dielectric extending into the tube, and 7.5mm of inner conductor extending beyond the dielectric. Use plenty of flux to ensure the solder gets right down to the bottom of the hole. The 22mm tube, the Yorkshire reducer, and the 42mm coupler were then soldered in one operation over our domestic gas cooker. Once cool the assembly was cleaned up as far as possible and the outside spray painted to protect it and make it more neighbour friendly.

A 12mm long M2 screw is used to tune the horn, and should have about 5mm penetration into the tube. The two horns I built were tuned up courtesy of Sam G4DDK’s excellent test facilities, but can be set up using a microwave power meter and a circulator and tuning for a minimum on the power meter, as per figure 2 below. No matter how poor the initial match the TX will see 50 ohms thanks to the circulator. Take care not to look into the horn if using more than a few milliwatts for this.

The first feedhorn achieved over 25dB return loss over about 200MHz, and could be easily tuned to 10368MHz. The tests were done before soldering the reducer and coupler so that these could also be optimised. The second horn was soldered to the same dimensions as the first before testing so the only adjustment was via the tuning screw, and and achieved 20dB return loss at 10368MHz, with best VSWR slightly higher in frequency. I have not made any measurements of the overall dish gain, but the results obtained so far indicate that it seems to work well.