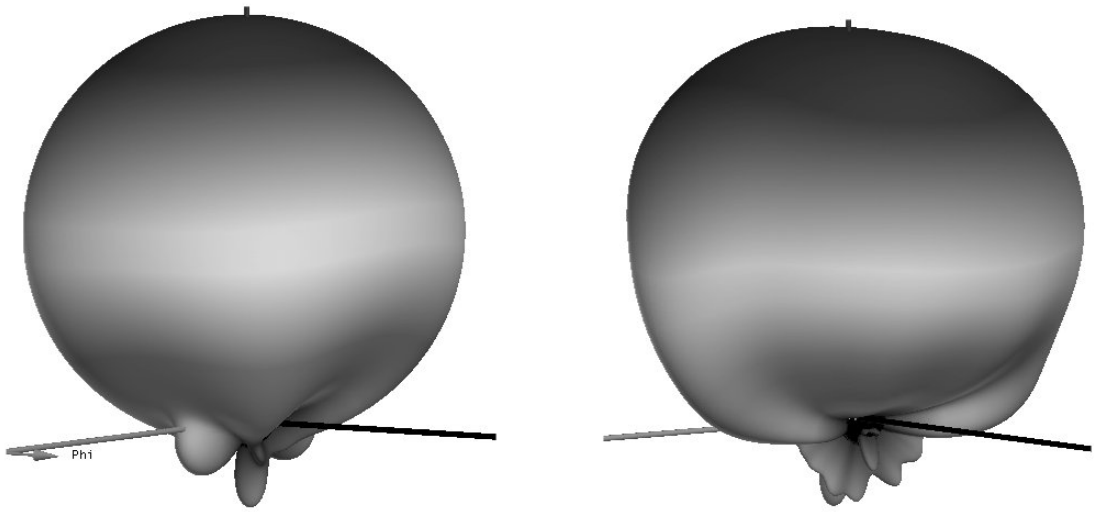
Analysis of the G3LTF Dual Band Feed for 23cm and 13cm

Paul Wade W1GHZ ©2004
w1ghz@arrl.net

In the March 2004 edition of the RSGB Microwave Newsletter, G3LTF described[1] a dual band feed for the 23 cm and 13 cm bands. The feed is a combination of two proven designs: an EIA dual-dipole feed for 23 cm, with a cylindrical waveguide horn, or "coffee-can," feed for 13 cm. The dipoles are backed with a 1λ diameter GP (ground plane); the cylinder fits in a hole in the center of the GP, so that the GP acts as a flange at the aperture of the cylinder. Each dipole is fed with a stripline balun arrangement from a remote power divider, and the cylindrical waveguide is excited by a probe.

Taken separately, each feed is known to work well; radiation patterns and calculated dish efficiency may be found in the *W1GHZ Microwave Antenna Book — Online*[2]. What remains to be seen is how well the combination works. Is the dual band feed as good as the individual feeds, or are there unexpected interactions that spoil the performance?

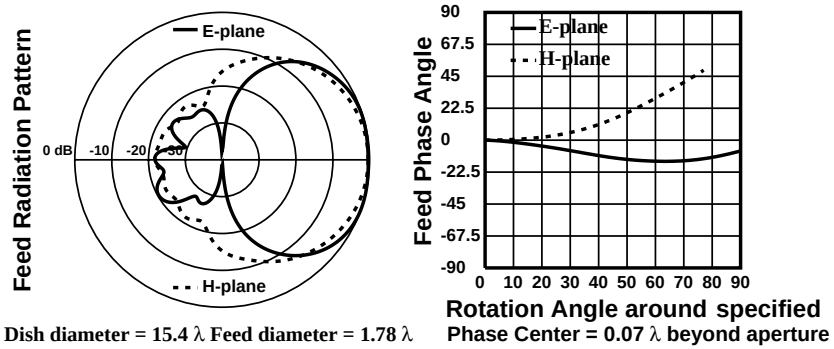
Figure 1



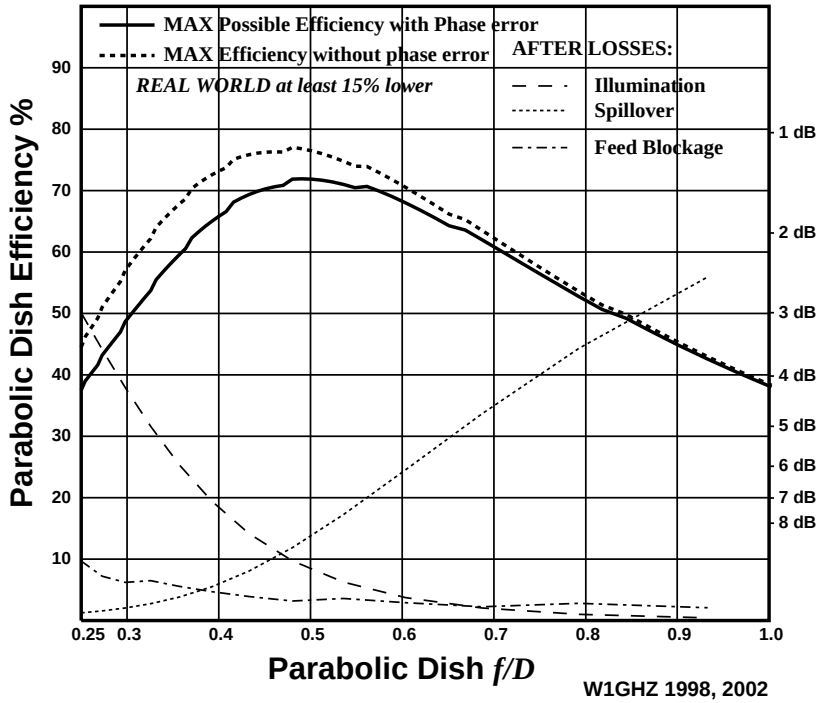
The radiation patterns were calculated using Ansoft **HFSS** software[3] and plotted in 3D in Figure 1. Performance as a dish feed was estimated using my **PHASEPAT** software[2]. The calculated dish efficiency at 2304 MHz is very good, as shown in Figure 2. Best ***f*/D** is around 0.5, just right for the two-meter diameter dish at G3LTF. The phase center is 0.07λ beyond the aperture of the cylindrical horn, or about 9 mm above the GP. Since the phase center is most critical at the higher frequency, the 1296 MHz dish efficiency in

G3LTF L&S Dual Band Feed at 2304 MHz

Figure 2



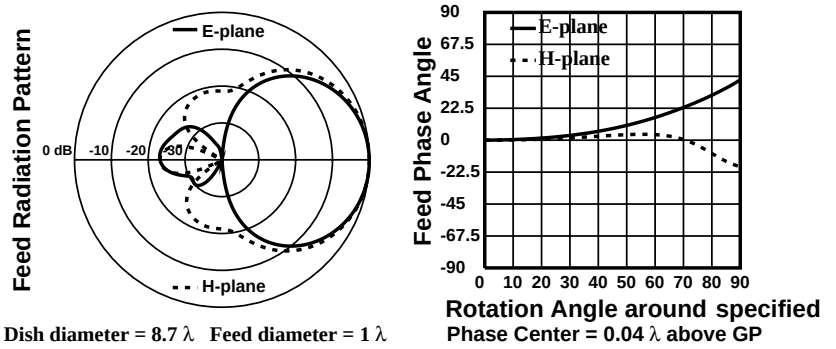
Dish diameter = 15.4 λ Feed diameter = 1.78 λ



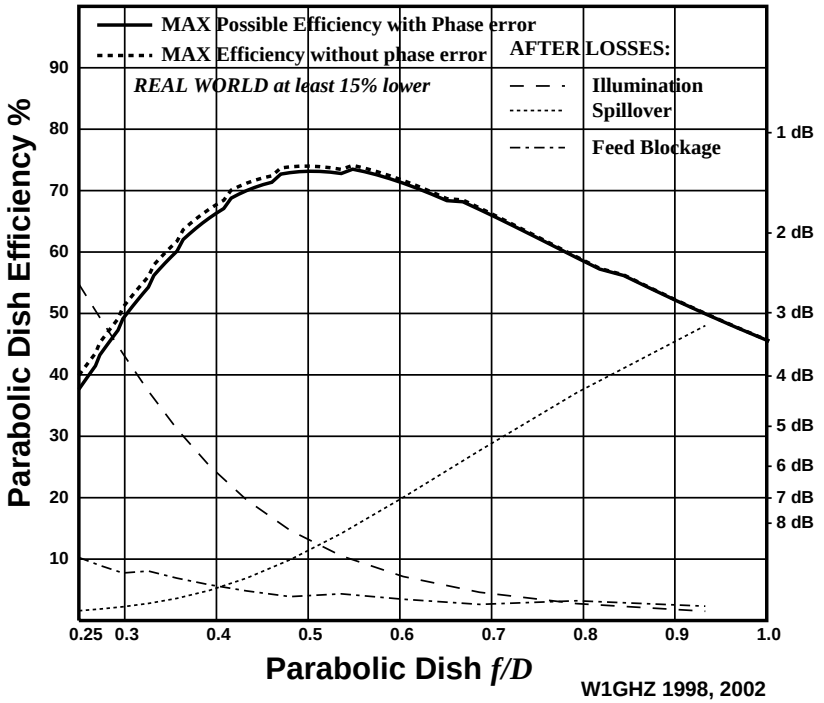
W1GHZ 1998, 2002

G3LTF L&S Dual Band Feed at 1296 MHz, 13cm Phase Center

Figure 3



Dish diameter = 8.7 λ Feed diameter = 1 λ



W1GHZ 1998, 2002

Figure 3 is calculated at the same phase center (best phase center at 1296 MHz would be 0.14λ above the GP). Efficiency is also very good, with only a tiny phase error due to the phase center compromise. Best ***f*/D** is again around 0.5, so this is a good feed on both bands for the G3LTF dish.

Since the two dipoles for 23 cm are fed separately, it is important to keep them in phase, by using a good power splitter and identical cables. Figure 4 illustrates the radiation pattern resulting from feeding the dipoles 180º out of phase — the beam splits into two lobes with a null in the center.

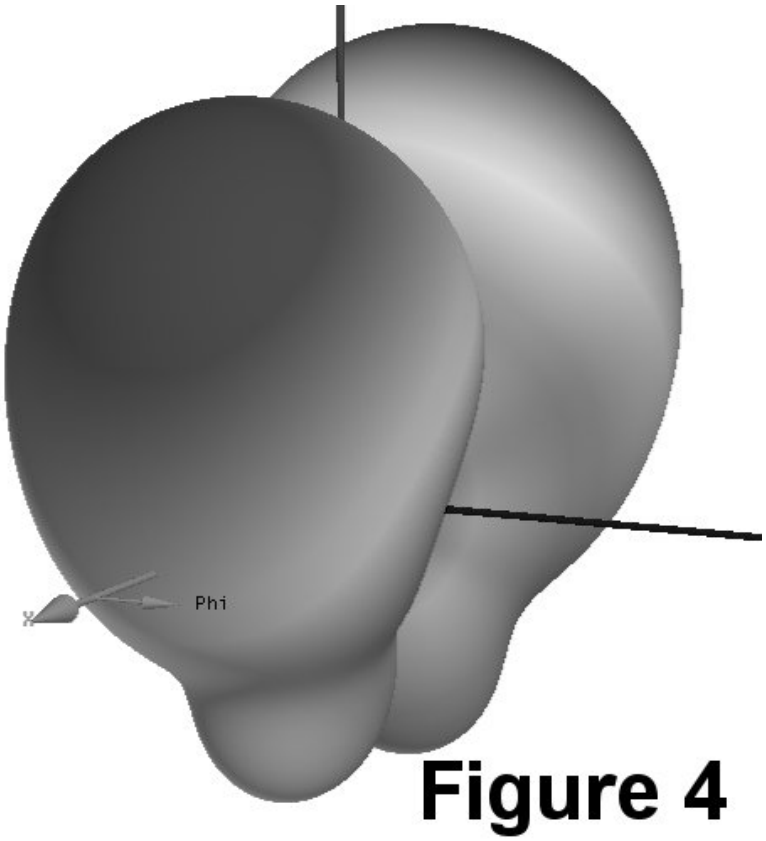


Figure 4

Isolation is always a problem with multi-band feeds. The 13cm cylindrical waveguide is beyond cutoff at 23cm, so isolation at 23cm is better than 30 dB. At the higher frequency, there is nothing to isolate the two feed except spacing, so the isolation at 13cm is on the order of 20 dB. At any reasonable power level, additional protection will be necessary.

References:

1. Peter Blair, G3LTF, "A Dual Dish Feed for 23cm and 13cm," *RSGB Microwave Newsletter*, March 2004, pp. 7-8. [copy attached, courtesy of G3LTF]
2. www.w1ghz.org
3. www.ansoft.com

A DUAL DISH FEED for 23cm and 13cm

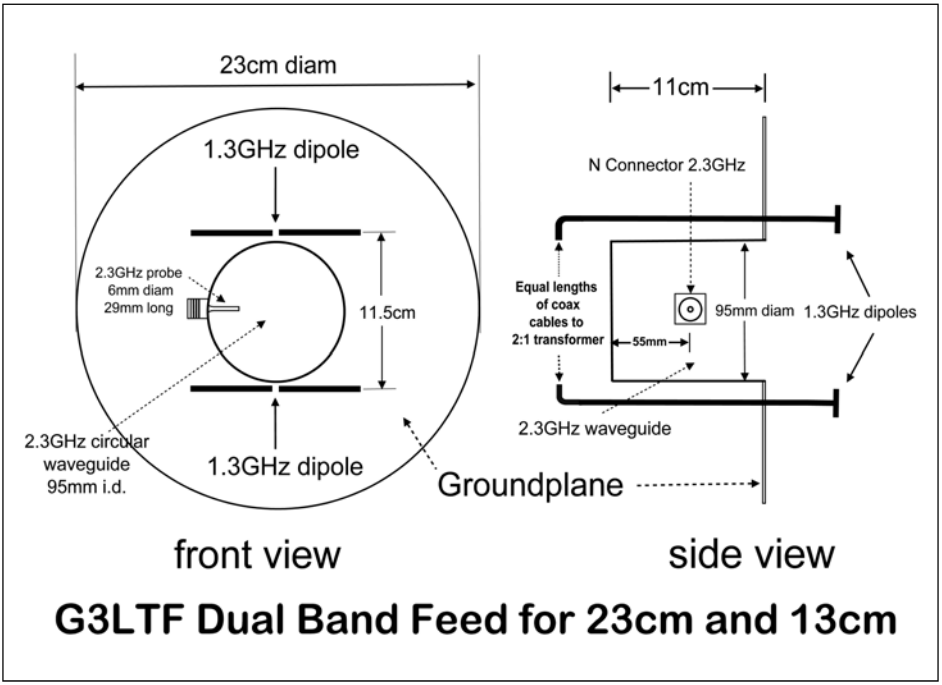
… by Peter Blair, G3LTF

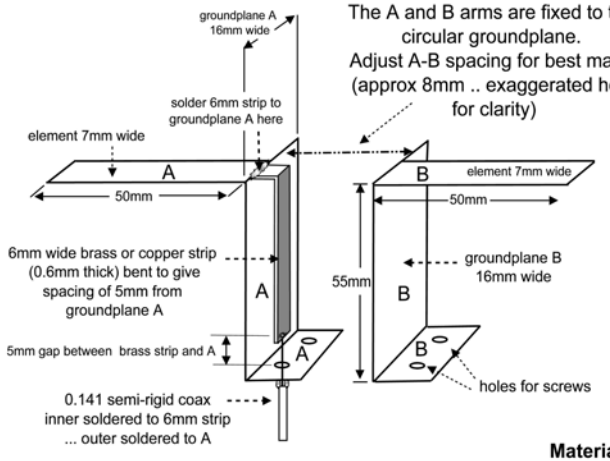
The diagrams that follow are self-explanatory. A copper or brass disc, 23cm diameter, is soldered to the outer lip of a 95mm i.d. copper or brass tube *(or suitable soup can!…editor).* The tube forms a waveguide feed for the 2.3GHz amateur band while the disc becomes the reflector for a pair of 1296MHz dipoles. The rear of the copper tube is, of course, blanked off. A 29mm long probe made from 6mm brass rod or tube is soldered over the end of an N socket centre conductor and the resultant assembly is fixed to the 2.3GHz feed horn so that the probe is 55mm from the horn's backplate and in the horizontal polarised position as shown in the first diagram. That is the 2.3GHz (13cm) section of the dual feed completed.

The 1296MHz feed consists of a pair of stacked dipoles, each made as shown in the second diagram on the next page. They are mounted so that they are in front of the 2.3GHz feedhorn and critically spaced from the circular reflector or groundplane. **Identical** lengths of UT141 semi rigid coax, terminated in sma connectors and fed from the main 1296MHz feedline (eg heliax or similar) via a 2:1 transformer (see final diagram), are fixed through the groundplane and rigidly mounted to it. By varying the centre spacing between each arm of each dipole, as shown in the third diagram, a good match can be obtained.

This feed has been very successfully used for several years on a 2m diameter dish whose f/D is 0.5.

The feed can be suitably protected from the weather by the judicious use of plastic boxes and sealing compound.





23cm dipole assembly

Materials:

Element and groundplane is 0.6mm brass or copper sheet cut and bent as shown in "one piece construction". Note the vertical sections are 16mm wide and the horizontal dipole sections are 7mm wide

2:1 transformer

(enclose in suitable waterproof box)

L1 : 13mm wide copper or brass strip spaced 5mm over ground plane