Microwave Dish Feeds for Circular Polarisation

There has been considerable interest in CP feeds over the past few years for EME applications - in part this is due to the decisions at recent EME conferences that CP should be the norm on bands between 23cm and 3cm - although there is still a lot of debate about the merits of CP at 3cm!

My interest was kindled when Zdenek, OK1DFC, presented his paper at EME 2002. That this was a significant publication can be in no doubt, as 5 years down the road, at the end of 2007, there is still research taking place and new material being published on a regular basis.

There is now so much material available, that I have not attempted to try and keep track of it all on this page - probably the best source to start with is Paul Wade's W1GHZ Antenna Notebook pages, where he publishes his presentations and updates.

In popular parlance, these have become known as Septum feeds - which is, in fact, inaccurate. The septum transformer is a well documented (although not fully understood mathematically) concept, and has been used for many years to transform linear to circular polarisations in waveguides. Its use in a feed horn is simply that - to create CP from linear wavefronts. It is independent of the wave launching method (waveguide, probes etc), and of the horn matching to the dish f/d. In this way it is an alternative CP production method to the polarising screws used by VE4MA and W2IMU, or the 45 degree dielectric used in orthognal mode transformers.

For this reason, I have coined the terms Rectangular Waveguide Septum Transformer (RWST) and Circular Waveguide Septum Transformer (CWST) for feeds that utilise this method of Linear to CP conversion.

CWST Feed for 10GHz | RWST for 23cm | RWST for 13cm | RWST for 9cm | resource links

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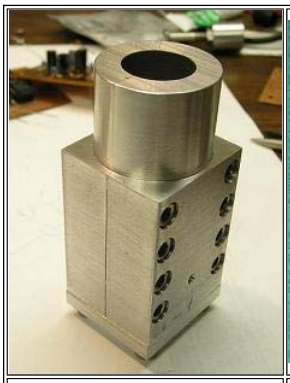
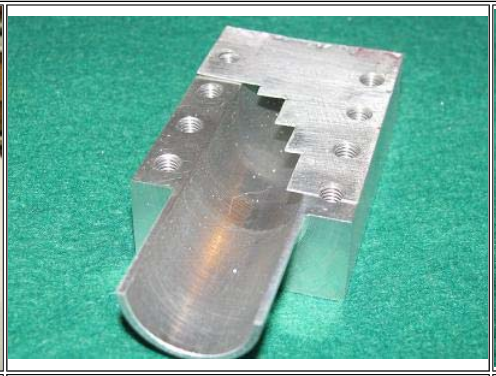
CWST feed for 10GHz

Here is an example of a 10GHz feed for CP, using a circular waveguide (hence the CWST acronym), and using a septum transformer to achieve the circular polarisation. The machine work was carried out by Jim, N8ECI, to my dimensions. These were derived from Zdenek's Excel sheet and Paul Wade's (W1GHZ) published articles. At the time this design was done (Oct/Nov 2006) the most recent data was that presented by Paul at MUD2006, in Dayton.



Original machined feed



Internal view showing septum plate

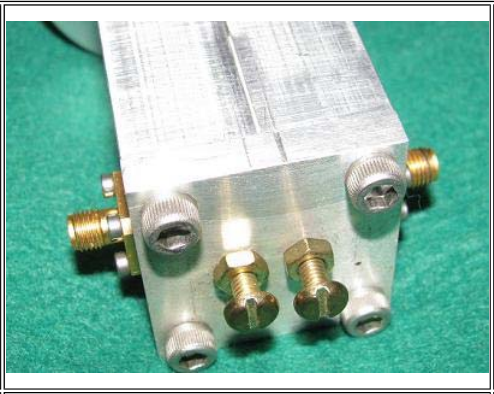


Rear view of assembled feed body

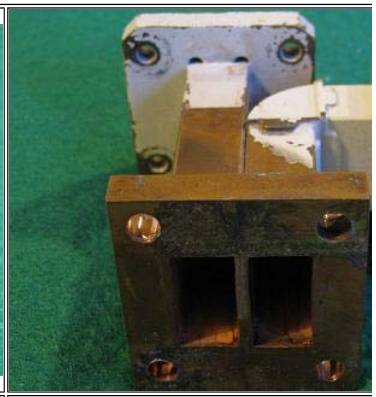
It was fabricated from two pieces of aluminium plate, lapped together. The central hole is bored out, and the septum plate is cut from 0.5mm Al - a 0.25mm recess is machined into each side of the seam to accomodate the thickness of the plate. A back plate was used to close the cavity for SMA launchers.



SMA Launchers

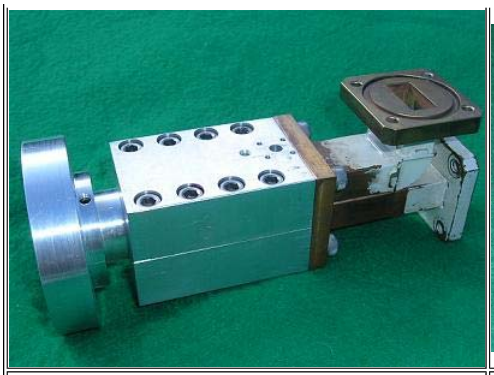


Rear of SMA feed, with tuning screws

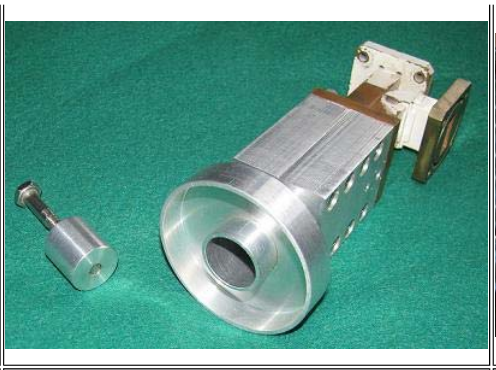


2 x WG18 adaptor

Initially, the feed was built with SMA probes on each port, but during 2007 it has been modified to WG18 on each port - because my 'best' 3cm preamp is a waveguide design (CT1DMK, <0.6dB), and this avoided using a WG/coax transition with extra loss. This example achieves a VSWR of 1.3:1 in the waveguide version - no tuning screws have been found necessary. The SMA probe launching gave an SWR of approx 1.5:1 at best.



Assembled WG feed



Feed with test plug



CT1DMK WG preamp

The plug shown in the final row of photos is a close fitting metallic plug for transmission loss testing of the feed. Making a through measurement between the Tx and Rx ports, slide the plug into the feed mouth, and adjust its position for minimum indicated loss. The transmission loss is half of the value you measure - typically <0.1dB.

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RWST Feed for 23cm

OK1DFC Septum Feed for Circular Polarisation

This feed was published at EME2002, in Prague, by OK1DFC. It is a design that has been in use by various OK stations, on a number of microwave bands from 23cm to 3cm, for some time.

The design claims better than 1.1dB cicularity, with around 27dB isolation between Tx and Rx ports, without the use of polarizing or matching screws (c/f VE4MA circular and N7ART diagonal waveguide feeds).

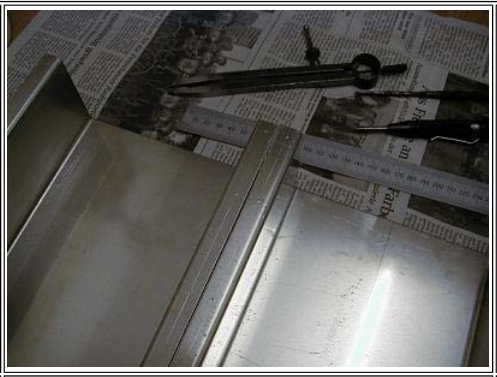
I have constructed a model, to the dimensions given by Zdenek, OK1DFC, in the presentation. The photos below show various stages in the construction.

Measurement Results

Using 6mm dia monopoles, and 15mm tuning discs, a Return Loss of better than 30dB can be achieved on each port (= SWR<1.07:1)



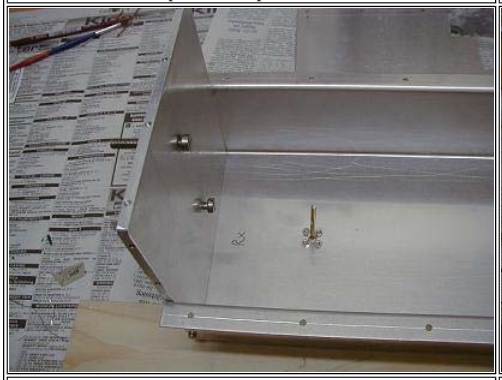
parts for Septum feed



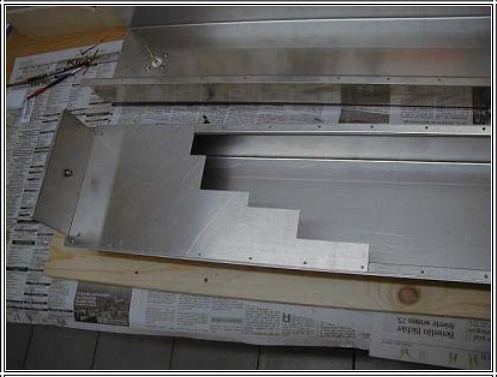
marking out the side joints of the casing



Rx port and monopole mounte



first assembly stage - rear plate mounted



second assembly stage - laying the septum plate and packing pieces on lower half casing



view into finished assembly



RWST mounted in adjustable feed box



Feed and box mounted on 2.4m dish



Feed fully installed

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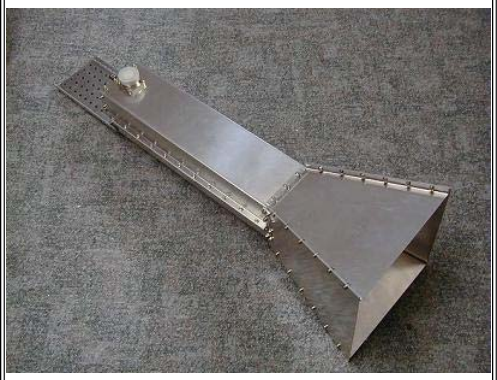
RWST Feed for 13cm



13cm RWST with flare for 0.7f/d dish



Tuning screws and preamp support



Rx port with relay

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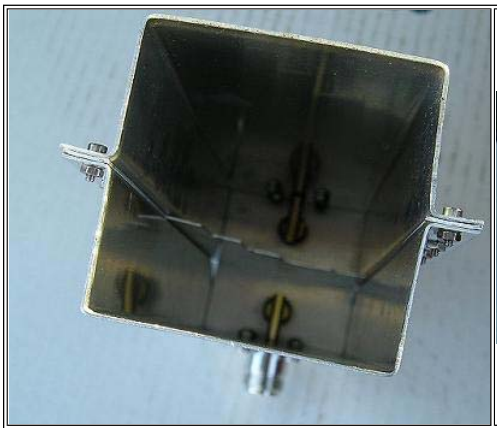
RWST Feed for 9cm



9cm RWST inner view



Side view



three quarter view

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click here for link to EME2002 Presentation

and you can get the Excel calculation sheet here!

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