An Inexpensive 10 GHz Dish System

The plumber's delight!

by Jerry Jensen WTØW

This design for a 10 GHz dish and feed system was born of necessity. There are few sources of microwave components here in the Midwest, so construction projects have to use available non-microwave parts. The only microwave part used for this system is one WR90 waveguide flange. Even that could be made of scrap material if you can't locate one easily.

The dish is an old 18″ surplus HBO dish left over from the days when premium channels were broadcast. It has a focal ratio of 0.4, providing a focal length of about 8.1″. The dish I found has a 1″ hole, conveniently located at its center, that permits the 10 GHz source to be mounted behind the dish and fed through it to a modified "penny feed." A chassis punch or drill could be used to make the hole on a solid dish. One of the old "flying saucer" dish snow sleds would also work if you modify the feed's length to meet the new focal ratio.

The feed system starts out as a 12″ piece of ¾″ copper pipe. Anneal one end of the pipe by heating about 2″ of the end until the surface looks very clean (don't get it red hot), then plunging the hot end into cold water. This will make the annealed end of the pipe very soft and easy to work. Place about ½″ of the end in a vise and squeeze the pipe with the vise until the pipe is an ellipse about ½″ wide. Next, rotate the pipe 90 degrees and do the same thing, but stop at 1″, at right angles to the first squeeze. By repeating the operation a few times, you will end up with an end on the pipe that fits the WR90 flange. Pliers and careful hammer tapping (with a sharp right angle piece of steel held inside the pipe) will make the corners of the squeezed pipe perfect. Be careful not to strike the copper hard enough to stretch it or you will end up with too large an opening.

Once the end of the pipe matches the flange, force a ¾″ outside pipe coupling (just a copper tube that fits over the joint of two ¾″ pipes) down the pipe to as near the flange end as possible. This will act as a spacer for the next plumbing piece, a 1″ male pipe threaded to a 1″ copper pipe adapter. Put the adapter over the pipe coupling with the male threaded end away from the waveguide flange. Some adapters fit over the coupling tightly, others are a bit sloppy. A layer of clean copper wire can be wrapped around the coupling, or a single turn used at the end(s) for spacers as needed.

Before the assembly is soldered, mount a 1″ galvanized pipe flange on the back of the dish over the 1″ feed hole in the center. Screw the copper adapter about halfway into the flange and measure the length of the pipe sticking into the dish. Check to be sure that the end of the pipe goes into the dish at least far enough to be within an inch of the focal point. If everything checks out, solder the waveguide flange to the pipe and the pipe coupling and adapter assembly. If you get any solder inside the end of the waveguide at the flange, use a small file to remove it.

Screw the feed assembly about halfway into the pipe flange, mark and then cut the copper pipe to make it about 1½″ short of the focal point.

At this point there is an option. If you want to be able to tear down the system into its most portable state for backpacking or such, you can make the splash feed removable. This will allow you to pull the feed system out of the dish. The feed system and splash plate can then be packed inside the dish.

The splash plate assembly is made from a male ¾″ pipe threaded to a ¾″ copper pipe adapter, a PVC (plastic) ¾″ female pipe threaded to a pipe adapter, and a 3¼″ copper disk. The PVC adapter is epoxied to the center of the copper disk. This is then screwed on to the pipe thread of the ¾″ copper adapter and the disk. For a completely portable system, drill and tap the copper adapter for a set screw to hold it to the feed system (an extra nut soldered to the outside might be wise). For fixed operation, solder the copper adapter to the radiating end of the feed system.

Tune Up

Tune up is simple: The radiating end of the feed has to be set to the dish's focal point. Then the separation between the end of the waveguide and the splash plate is adjusted for maximum radiation.

You will need some sort of power or signal strength measuring device to make these adjustments. It can be as simple as an unpowered Solfan unit. Just measure the mixer diode current of the unpowered unit when it is placed a few feet away from the dish with a sensitive current meter. Another Gunn transceiver could also be used to peak the signals.

The feed system can be adjusted by screwing the assembly into or out of the dish. The splash plate can be adjusted by screwing the PVC adapter further on or off the ¾″ pipe thread. These adjustments interact and should be made to optimize the gain of the system.

If you have built the portable system with set screws, be very careful not to distort the ¾″ copper pipe waveguide when you tighten the screws. If everything has been done correctly, the polarization of the output will be within a few degrees of the original source. If small dents or distortions are introduced into the pipe, the polarization of the output will rotate.

An 8-32 screw can be inserted into the center of the copper disk and adjusted to scatter the RF energy better as it hits the disk. The copper disk can be made from a piece of single or double-sided PC board. The PVC adapter could be machined from a better microwave plastic for lower losses. During the machining, a dielectric lens structure could be formed to optimize the scatter from the disk.

This disk and feed system may not be perfect, but it is a usable system that can be made from hardware store plumbing parts. Total cost, without the dish, should be less than $5. The feed illumination is good, and there is very little measurable radiation escaping the dish. Measurements taken across the dish (built with the dimensions shown) show a reasonable illumination pattern. 73

Contact Arthur J. (Jerry) Jensen WTØW at 10900 Ewing Ave. S., Bloomington MN 55431.

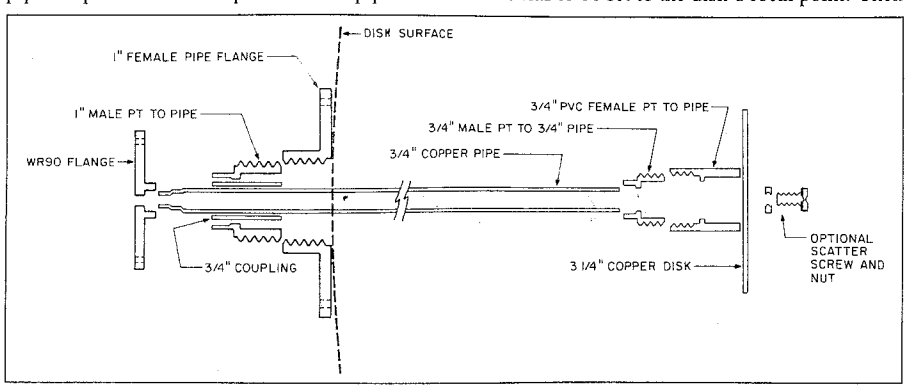

Figure 1. Assembly of the 10 GHz dish and feed.

Parts List

1	12″ length of ¾″ copper water pipe
1	¾″ male pipe thread to ¾″ pipe adapter
1	¾″ female—female pipe coupling
1	¾″ PVC female pipe thread to PVC pipe adapter
1	1″ copper male pipe thread to pipe adapter
1	1″ galvanized iron female pipe flange
1	WR90 waveguide flange
1	3¼″ copper brass disk

Note: 18″ and 24″ dishes are available from Satellite City, 2663 County Road I, Moundview MN; (612) 786-4475. Costs are about $20 and $30 respectively.