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# More Fun with Off-set Dish Antennas

by

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# Parabolic Review

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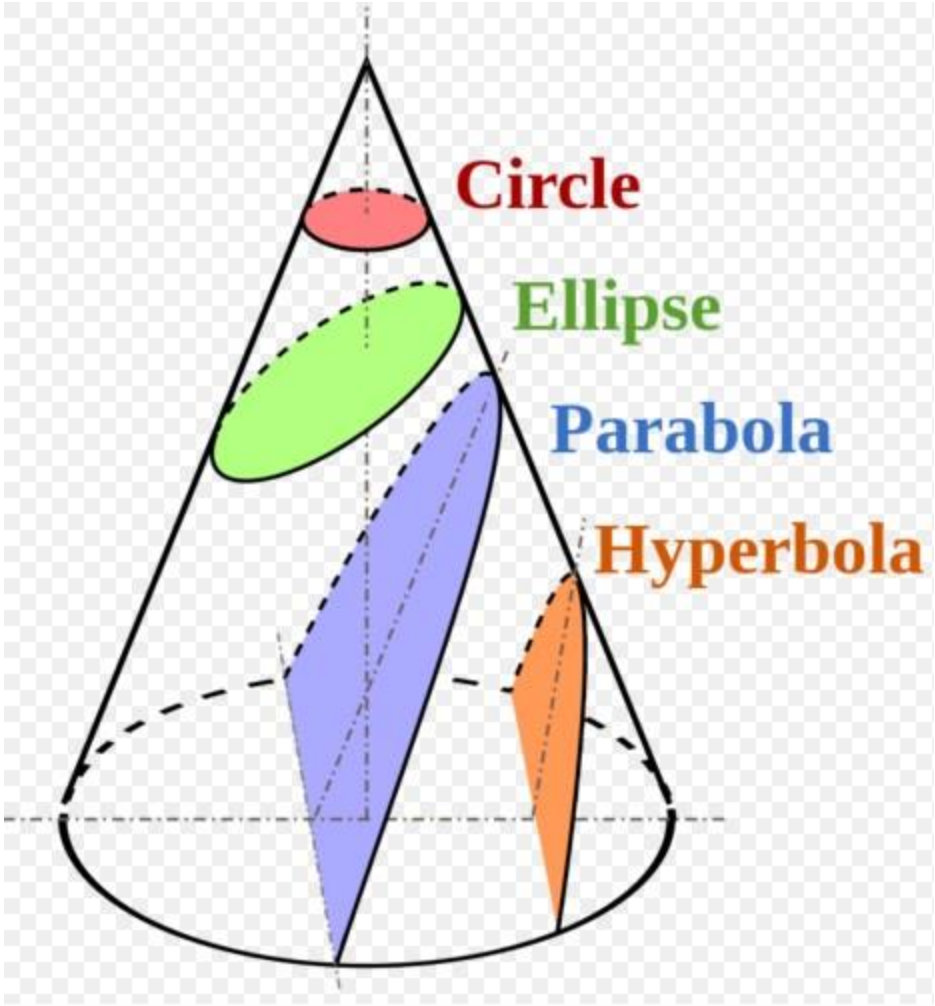
This presentation will focus on offset dish antennas for use on the 10 GHz band.

Let's think back to our Algebra 2 class. I know it's been a long time for most of us.

Stop your moaning! This might be fun.

Let's start with some basics…

# Conic Sections




Remember these?

Since were interested in dish antennas, lets focus on the Parabola.

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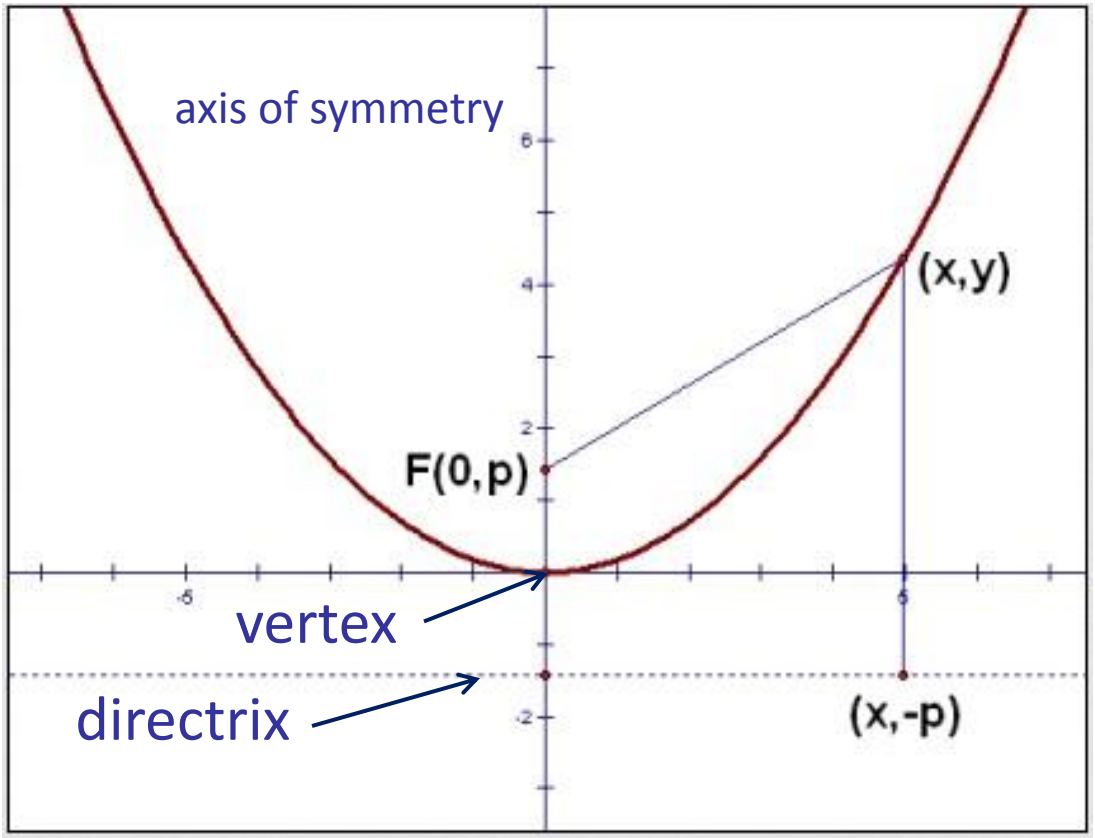
# The Parabola




Simplest form:

$$y = \frac{1}{4p}x^2$$

# Prime Focus Parabolic Dish Antenna

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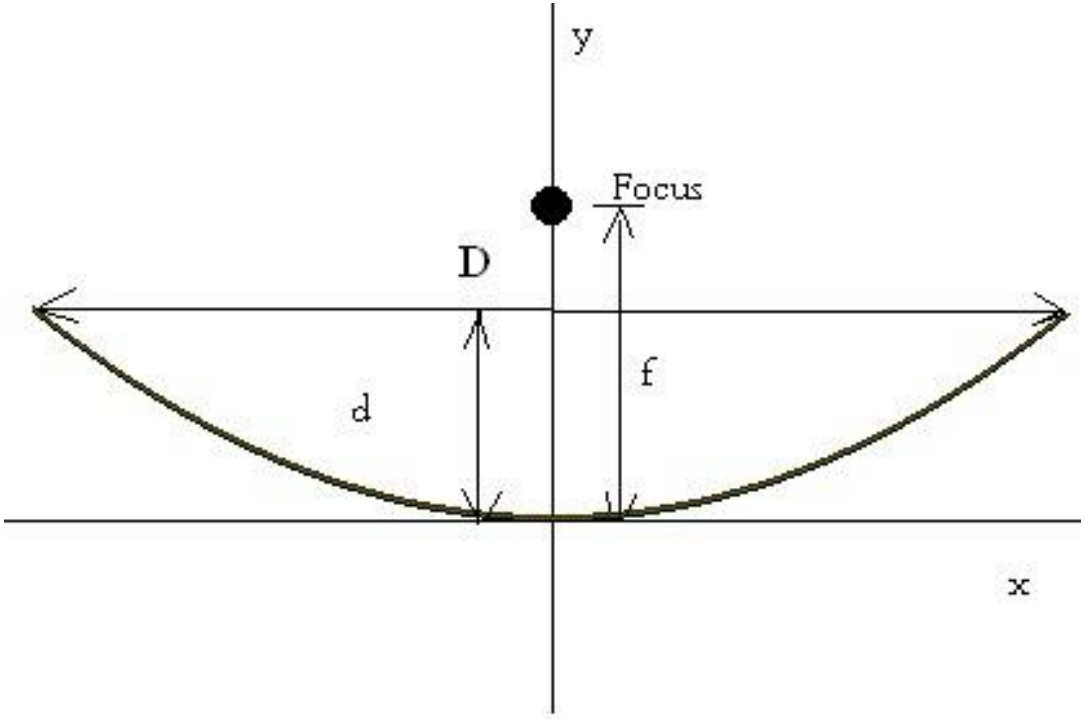


Find the focus:
Measure Diameter
Measure depth

$$f = \frac{D^2}{16d}$$

# Offset Dish Antennas

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Oval Shaped

Single LNB feed

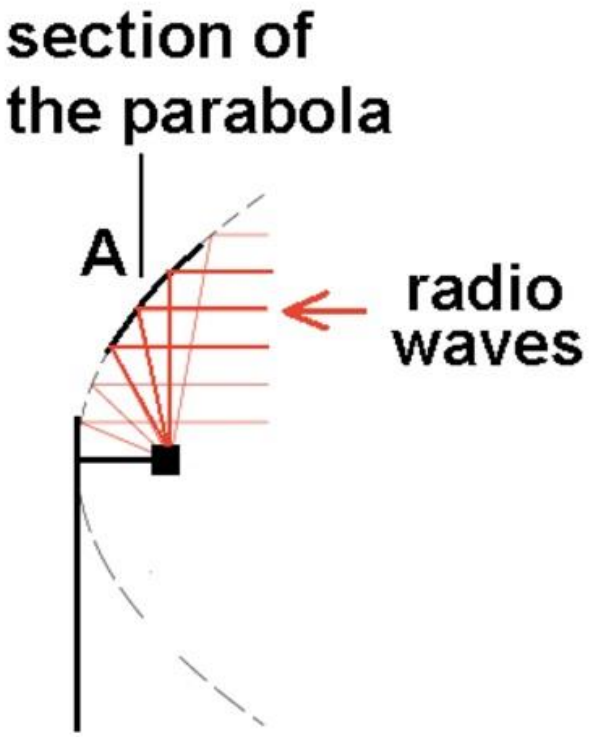
Oblong Shaped


Multiple LNB feeds

Both antennas work on 10 GHz

# Offset Dish is Still a Parabola






The offset dish antenna is nothing more than a section of a full parabola or a prime focus dish antenna.

The beauty of the offset dish antenna is the focus is outside the reflecting surface.

# Surplus Offset Dish Antennas



Every time a satellite TV company installs a dish antenna on a home with an existing dish antenna, that antenna is discarded and a new antenna is installed.

These antennas are available for free! Most of the time, they end up in the landfill or metal salvage yards.

# You Find an Offset Dish Antenna What next?

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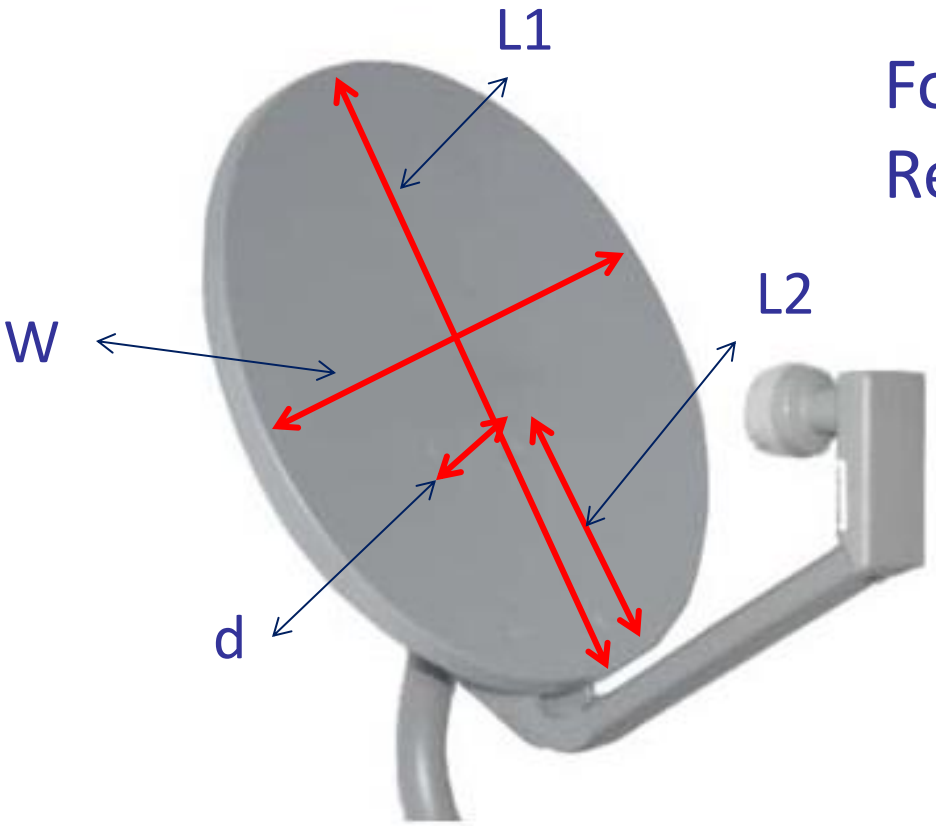
The first question is: will it work on 10 GHz?

YES it will!

Where's the focus and what kind of feed do I need?

# Measuring for Focus on an Oval Dish




(Assume LNB not present)

Four Measurements Required

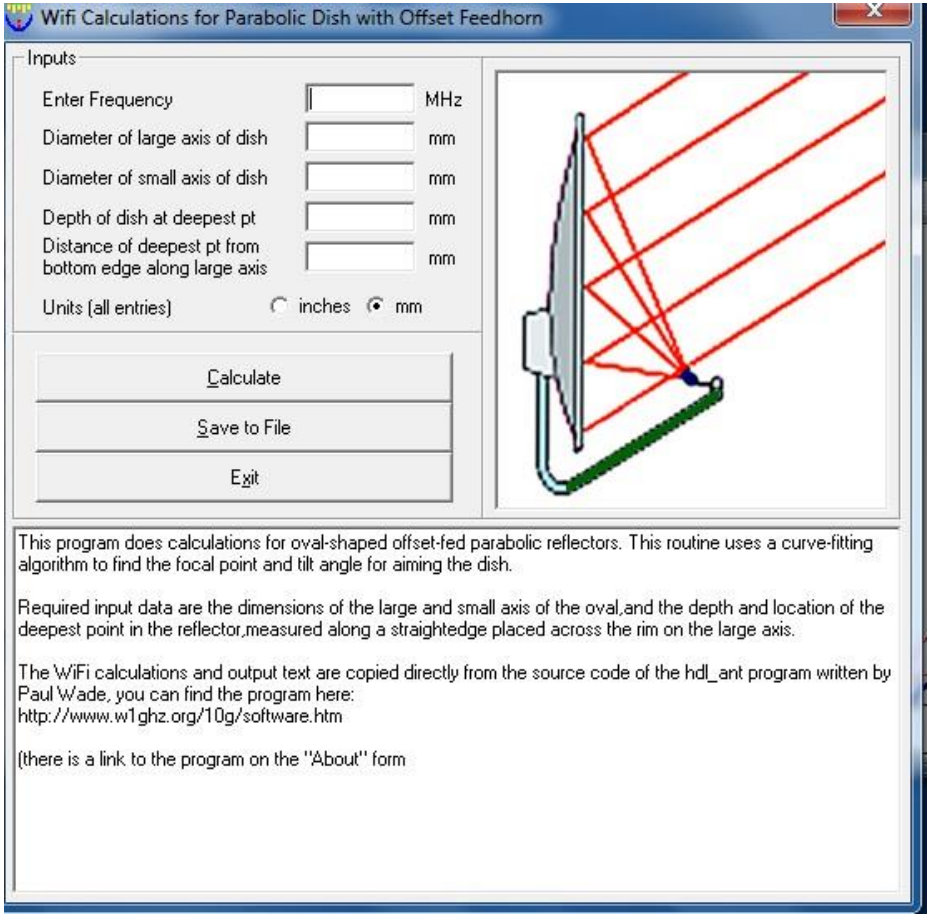
L1: Length

W: Width

d: Depth

L2: Length to bottom rim from depth

# Offset Dish Calculator




http://www.electronicecircuits.com/electronic-software/parabola-calculator-for-satellite-dish-antenna-design

# Do All Offset Dishes Work with the Calculator?

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The offset dish calculator works with measurements from an oval offset dish.

If you have an oblong offset dish, the calculator will not work if the width is greater than the length.

But, the oblong dish will work if you take a few extra steps to obtain new measurements.

# Measuring an Oblong Offset Dish

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Lay dish on flat surface and level it in both length and width plane. Add water until it spills over the top and bottom edges. Carefully mark new diameter with pencil.

# Measurement Tips



Use a straight edge such as aluminum angle stock to make Length measurement. Mark dish edges on straight edge.

Use a string and tape to measure the new Width. Mark string with marker pen on edges. Remove string and measure with tape.

# Finding Lowest Spot on Dish

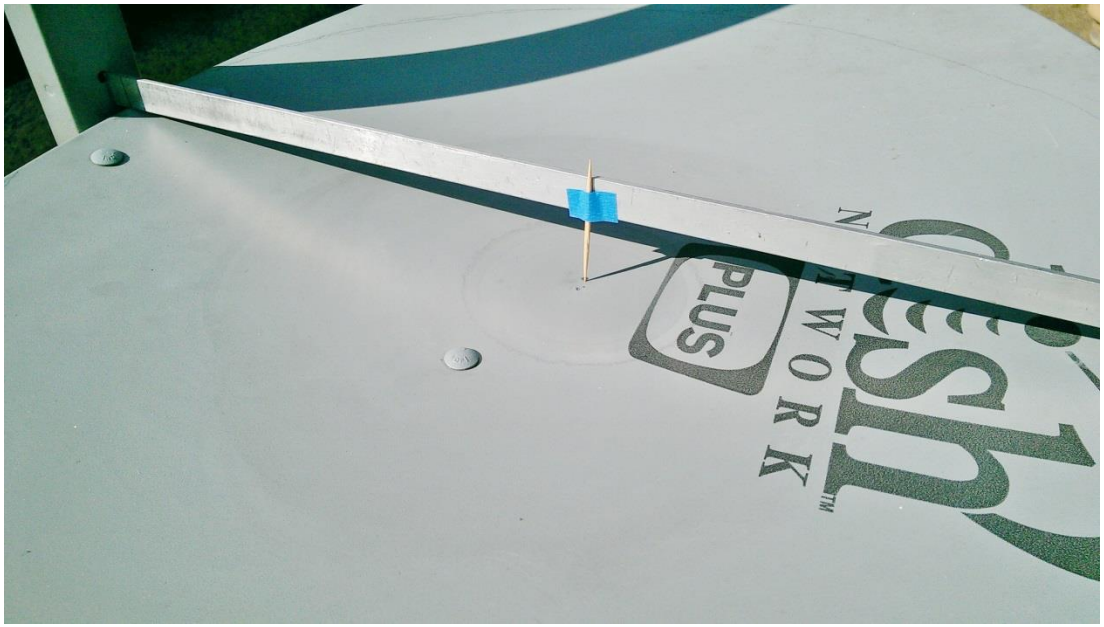


Roll a big marble or ball bearing around dish to find the deepest spot. It may take numerous attempts to determine exact spot due to dish irregularities. Mark spot with a pencil.

# Measure Depth



Use straight edge with Length marks on each end. Tape a toothpick to straight edge and lower it to the depth pencil mark. Mark straight edge at toothpick. Remove straight edge and measure length of toothpick. Measure from toothpick mark to bottom edge mark to obtain Length “L2”.



# Apply Measurements to Offset Dish Calculator

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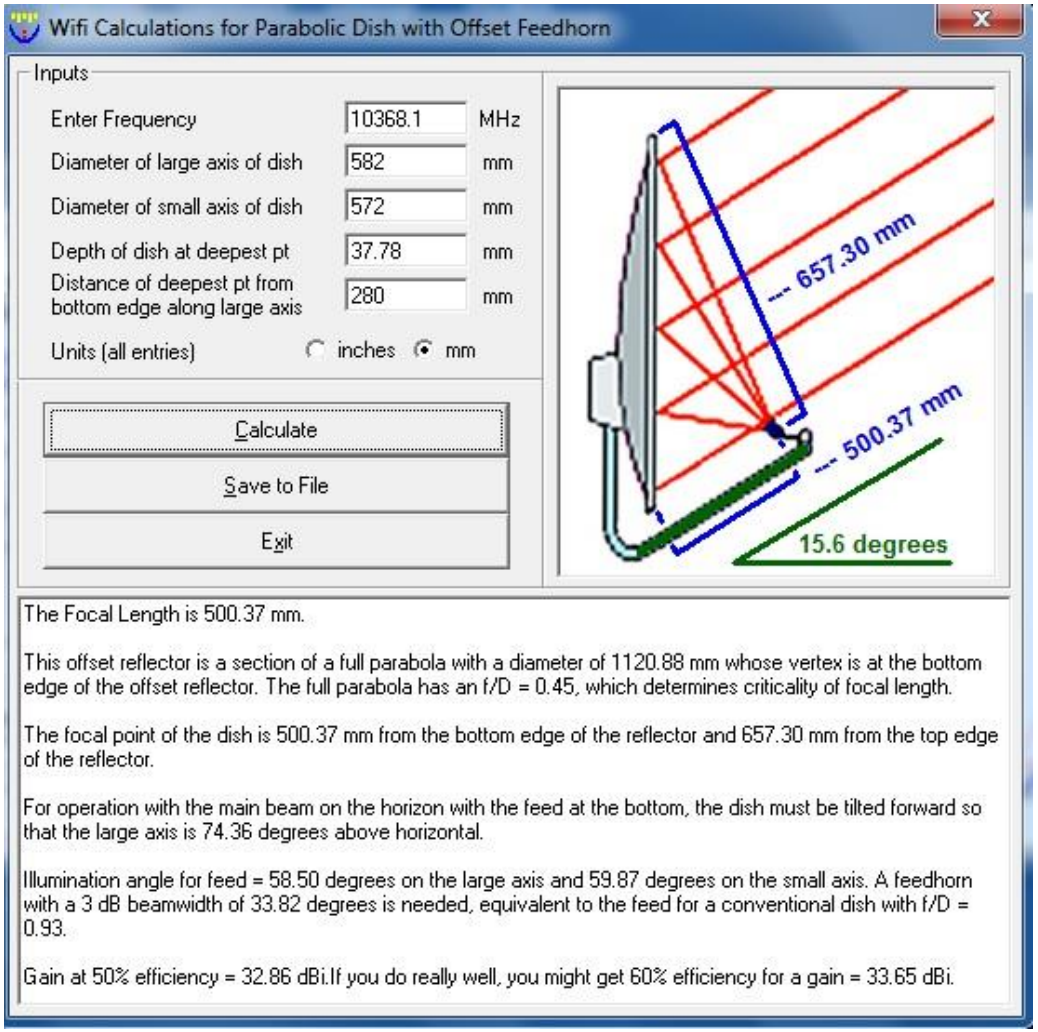

# Dish500 Measurements with and without Water

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## Dry Measurements

L1: 554 mm
W: 514 mm
d: 49.75 mm
L2: 255 mm

Focal point: 300.99 mm
Top string : 517.11 mm

## Water Measurements

L1: 535 mm
W: 514 mm
d: 46.5 mm
L2: 244 mm

Focal point: 306.32 mm
Top string: 507.04 mm

# String and Knot Technique to Find Focal Point

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The calculator shows two lengths in the dish picture. One from the top edge to the focus and one from the bottom edge to the focus.

Take a length of string and tie a knot in the middle. From the knot, measure the long distance and mark the string. Then mark the other end of string with the short distance.

Tape the string to the dish as shown in picture and pull knot to find focal point.

# Optical Method to Find the Focus

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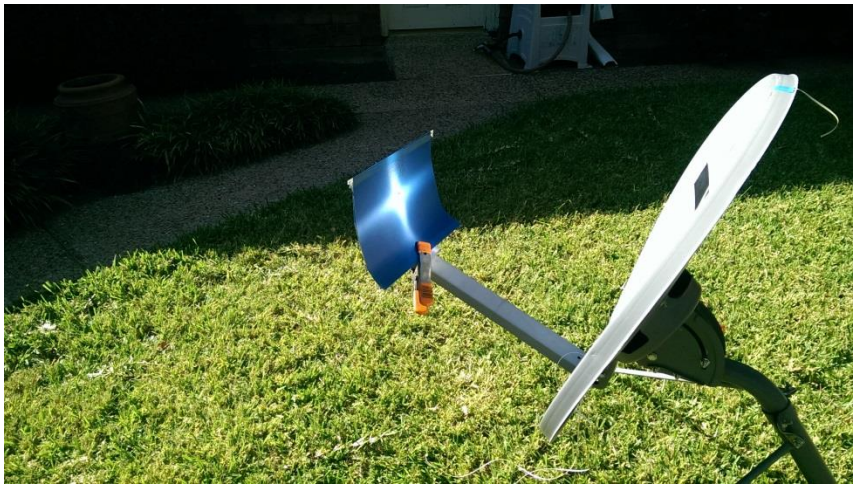
Put reflective tape on dish.

The focal point is very obvious.



# Feeding an Offset Dish Antenna



There are a couple of good methods to feed an offset dish antenna. The original LNB can be modified to work at 10 GHz by removing the PCB on the back of the unit and drilling out the circular waveguide to 0.75 inches. Installing a back short and a SMA connector works for many operators.

Another method is to fabricate a horn antenna. This has been described in detail by Paul Wade, W1GHZ in his On-line Antenna Handbook. Paul's on-line calculator called HDL-ANT generates a horn template for various common rectangular waveguides.

# Using HDL-ANT in a Windows Environment

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Paul Wade, W1GHZ On-line Antenna Book describes a calculator call HDL-ANT. This program is a dos based program that works with non-Windows based operating systems, such as XP. When downloaded and extracted, you will have a program called hdl-3b4.

If you are using an operating system such as Vista and Windows 7, you will need a dos emulator to use hdl-3b4.

# HDL_ANT Calculator

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Go to http://www.w1ghz.org/antbook/contents.htm .

Chapters 4 and 6 provides a great explanation of dish antennas.

Scroll down to “Software Page”

Download HDL_ANT to your hard drive and extract hdl_3b4 to a file of your choice.

# A dos Emulator for Windows Operating Systems

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A free dos emulator called DOSBox is available for download at: http://www.dosbox.com/ . Save to your desktop.

This tutorial will save you a lot of time figuring it out.

Launch DOSBox 0.74 from your desktop.
Z:\> (*type the following*) mount c c:*your file*\hdl_3b4
Drive c is mounted as local directory c:*your file*\hdl_3b4
Z:\> (*type*) c:\
(*type dir and see hdl_3b4.exe*)
(*type*) hdl_3b4 to launch program

# DOSBox and HDL_3b4

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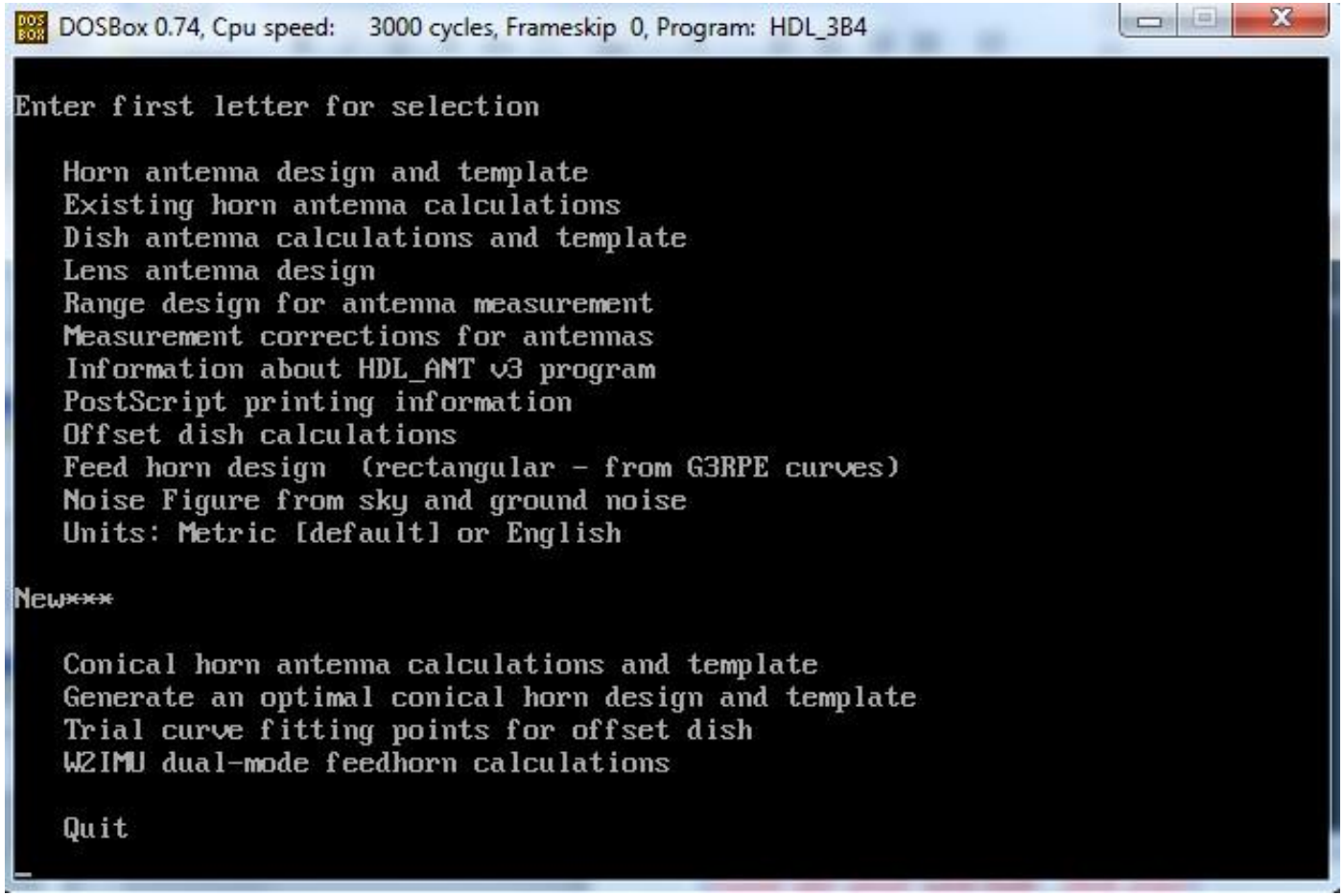


Type “H” to design horn antenna

# New Dish Calculator (coming soon)

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**Enter Offset Parabolic Dish Parameters**

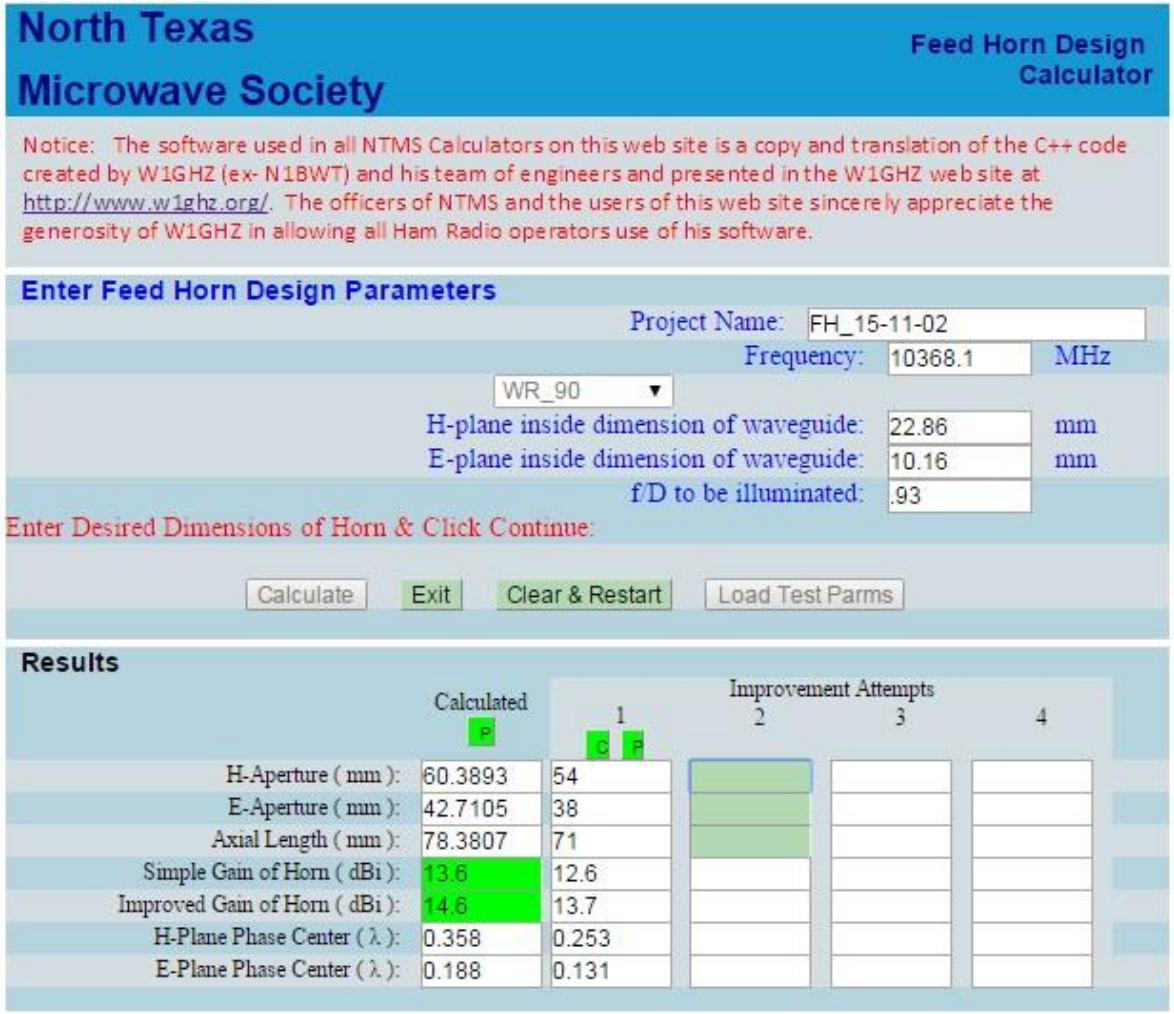
| | | |
|---|---|---|
| Project Name: | OPD_15-10-18 | |
| Frequency: | 10368.1 | MHz |
| Dish Length along Large Axis: | 582 | mm |
| Dish Length along Small Axis: | 572 | mm |
| Depth of dish at deepest point: | 37.78 | mm |
| Distance of deepest point from bottom edge along large axis: | 280 | mm |

Calculate | Exit | Clear & Restart | Load Test Parms | Xfer to Feed Horn Calculator

**Results**

| | | |
|---|---|---|
| f/D to be illuminated (Feed Horn Design): | 0.93 | |
| Focal Length: | 500.4 | mm |
| Equivalent Full Dish Diameter: | 1120.88 | mm |
| Whose vertex is at the bottom edge of the offset reflector: | | |
| Equivalent Full Dish f/D: | 0.45 | |
| OPD Focal Point - Distance from Bottom Edge of Reflector: | 500.37 | mm |
| OPD Focal Point - Distance from Top Edge of Reflector: | 657.3 | mm |
| OPD Tilt Angle above Horizon: | 74.4 | degrees |
| Feed Illumination Angle - Large Axis: | 58.5 | degrees |
| Feed Illumination Angle - Small Axis: | 59.9 | degrees |
| Feed Horn 3dB Beam Width: | 33.8 | degrees |
| Gain at 50% Efficient: | 32.9 | dBi |
| Gain at 60% Efficient: | 33.7 | dBi |

# Horn Calculation



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Feed Horn Design Calculator

Notice: The software used in all NTMS Calculators on this web site is a copy and translation of the C++ code created by W1GHZ (ex- N1BWT) and his team of engineers and presented in the W1GHZ web site at http://www.w1ghz.org/. The officers of NTMS and the users of this web site sincerely appreciate the generosity of W1GHZ in allowing all Ham Radio operators use of his software.

**Enter Feed Horn Design Parameters**

| | | |
|---|---|---|
| Project Name: | FH_15-11-02 | |
| Frequency: | 10368.1 | MHz |
| WR_90 ▼ | | |
| H-plane inside dimension of waveguide: | 22.86 | mm |
| E-plane inside dimension of waveguide: | 10.16 | mm |
| f/D to be illuminated: | .93 | |

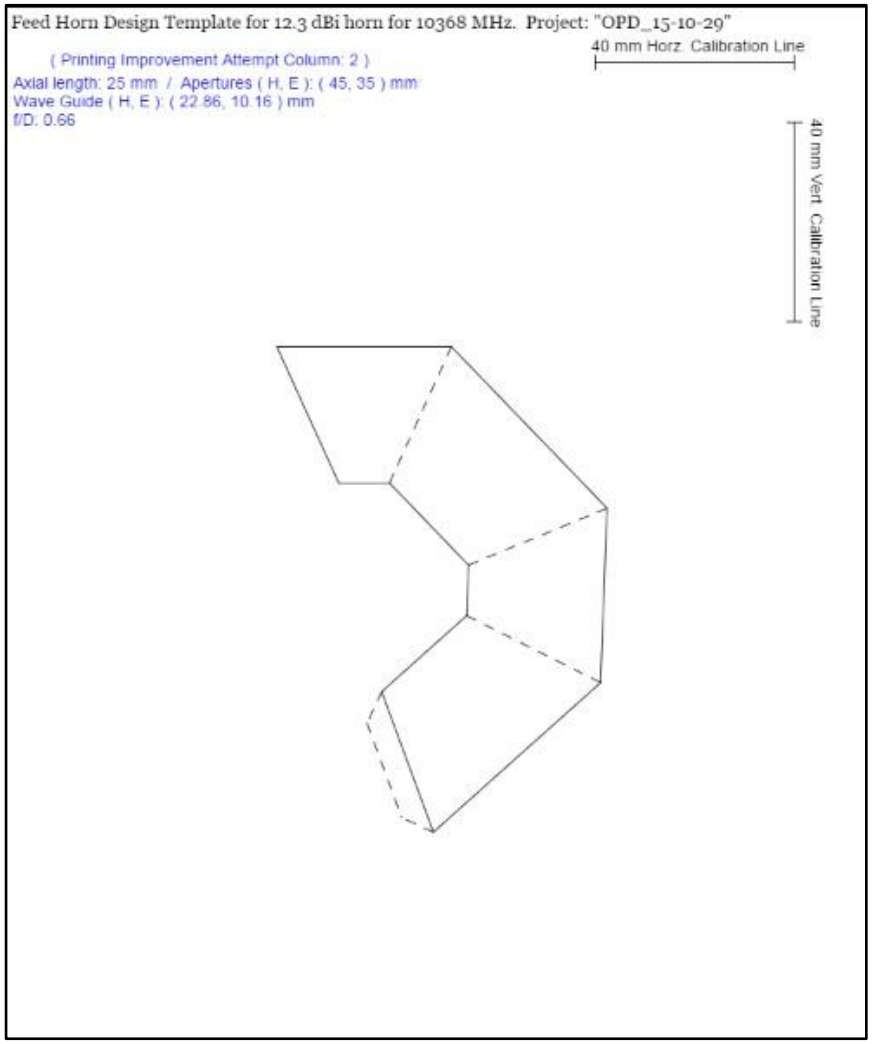
Enter Desired Dimensions of Horn & Click Continue:

Calculate | Exit | Clear & Restart | Load Test Parms

**Results**

| | Calculated (P) | Improvement Attempts 1 (C, P) | 2 | 3 | 4 |
|---|---|---|---|---|---|
| H-Aperture ( mm ): | 60.3893 | 54 | | | |
| E-Aperture ( mm ): | 42.7105 | 38 | | | |
| Axial Length ( mm ): | 78.3807 | 71 | | | |
| Simple Gain of Horn ( dBi ): | 13.6 | 12.6 | | | |
| Improved Gain of Horn ( dBi ): | 14.6 | 13.7 | | | |
| H-Plane Phase Center ( λ ): | 0.358 | 0.253 | | | |
| E-Plane Phase Center ( λ ): | 0.188 | 0.131 | | | |

# Horn Template

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# Horn Antenna Template from HDL_3b4

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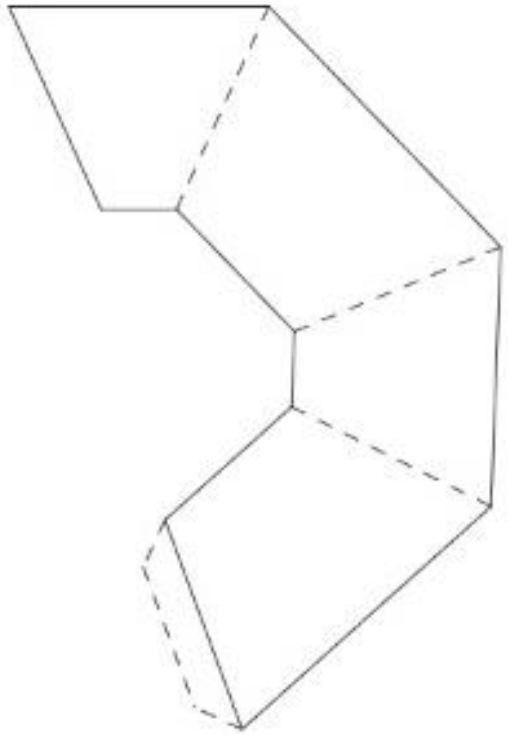

Your local craft store such as Hobby Lobby is your friend. The craft stores and maybe the local builder box stores will carry K&S Metals sheets of tin, brass or copper.

Cut out template and tape to sheet metal. Cut with scissors. Fold on dotted lines.

# A Horn Antenna for the Offset Dish

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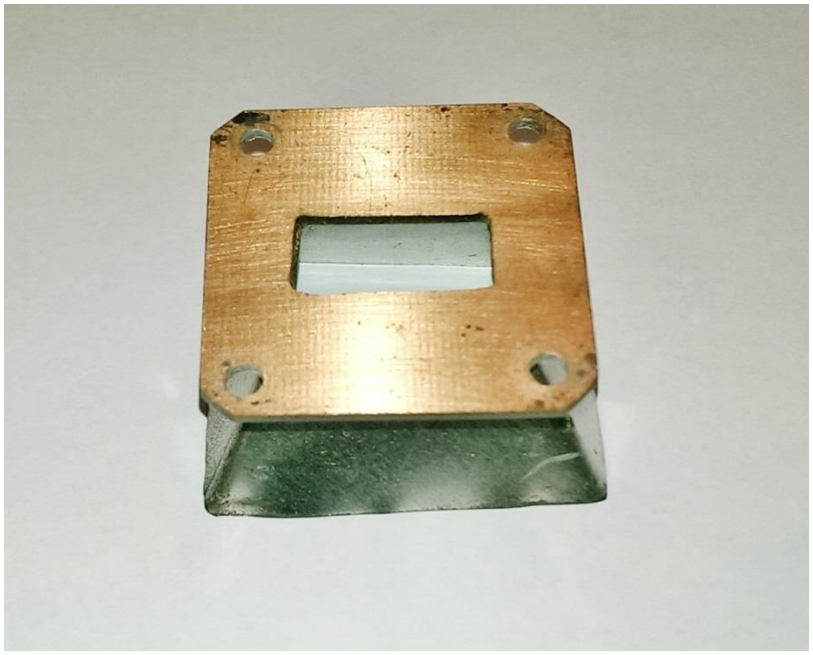
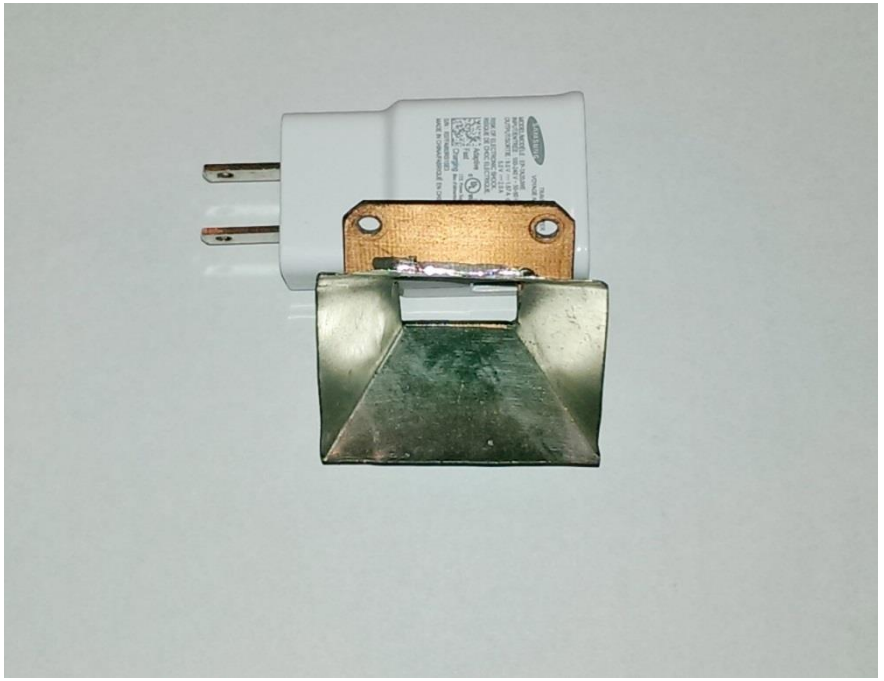


Double-sided PCB material for waveguide flange.



Solder folded tin horn to PCB waveguide flange.

# Mounting a Horn Feed



One method of mounting a horn feed using a waveguide transition.

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# Find Them and Use Them


Offset dish antennas are everywhere.
When you see a discarded dish, grab it!