MOTORIZED DISH INSTALLATION

A tutorial "HOW-TO" guide from AcWxRADAR

For offset, small diameter, Ku-band dish antennas

INTRODUCTION

This is a very rewarding hobby for anyone to engage. The various scopes of knowledge, skill, creativity and compassion for technical adventures that are required in this hobby serve to develop and enhance the hobbyist's knowledge base and technical expertise. The rewards are ultimately greater than just being able to watch television. It is the experience and knowledge that develops as you reach for one goal after another, one step after the next. In the end, if an end were to exist, you find yourself more knowledgeable about science, electronics, physics, geometry, mathematics, people, history, economics, legislation, computer programming, and so much more! This is the ultimate hobby for those who seek knowledge. Even if a person does not consider that they are able, they soon find themselves engaged in pursuits of knowledge and facts! The enticement to pursue such endeavors is so great, that they rarely detect it as work. It is this benefit that provides the hobbyist with the ultimate satisfaction!

So, sit down with a bowl of popcorn and some chips and watch a good ole' classic movie and smile!

PREFACE

As you read this, please be aware that I used Kansas City, Kansas for an example location. Therefore, do not use the latitude, longitude and dish/motor settings mentioned throughout this text for your setup as they are only appropriate for someone in the Kansas City area. The specific coordinates and angles are for illustration purposes only.

This procedure addresses a ground based installation – a pole or mast set within concrete at ground level. I recommend a ground based installation above any other, if it is feasible for you. This installation method will provide the most convenient accessibility to the dish and motor in order to perform the alignment and maintenance. You won't have to climb any ladders and crawl around upon a steep roof during winter and risk your neck to install, adjust or maintain the dish.

However, depending upon the buildings, trees and the overall landscape specific to your location, a ground installation may not always be your best possible option. A rooftop mount may be the only option that is appropriate or even available to you. A rooftop installation does provide a benefit as it elevates your mounting platform and this may improve your dish's view of the entire horizon. However, there are drawbacks related to the accessibility to the dish and motor and other equipment with a rooftop installation.

The decision of where and how to mount your dish must be made through a careful analysis of the site. Every site is unique and the installation must match in a case by case manner. Hopefully you will be able to use this ground based installation method.

I recommend specific equipment throughout this guide. There are many makes, models and sizes of dishes, motors, switches and cables available to you. I am merely describing the installation process with reference to the equipment that I have personally found to work exceptionally well through careful and intense testing as well as trial and error. The equipment recommended has proven very successful and reliable for general Ku band FTA reception. In most areas, these components will serve you well.

If you find or already have something better, by all means use it! If you are on a budget, you can use lesser quality items as well and they certainly should not pose any major restrictions upon the setup or the operation of your system.

Referring to the dish itself, I would not recommend anything smaller than a 76cm dish or larger than a 90cm dish if you can avoid it. I am personally using a 76cm dish and I find it to be just about the perfect size, it performs wonderfully. The next size dish above this is 90cm, then a 1M and then a 1.2M dish. As you increase in size, you will find that it rapidly becomes more cumbersome to handle and difficult to align. I have attempted to use a 1M dish and I did not like how it handled. It was awkward due to its size and weight and my older motor was being overtaxed by the additional weight of the 1M dish. The larger the dish is, the more it acts like a sail in the wind, and this is hard on your motor and mounting structure as well.

I recommend sticking with either the 76cm or 90cm dish, based upon personal experience. If you reside in Canada and especially in the more northern locations, you might be required to use the larger dish sizes to amplify the signal sufficiently. You might not have the convenience of choice in this matter. The 76cm dish may be too small and you will have to use a dish of a larger diameter to get everything you desire.

I hope that everyone will benefit from this guide. I have attempted to include as many details that I possibly can. Please read it thoroughly before you begin. There are some steps that may not follow an orderly chronological sequence.

CHAPTER 1 EQUIPMENT

Recommended Tools, Equipment and Supplies:

Screwdrivers (Standard flat blade and Philips head), assorted sizes
Allen wrench set (US/English and Metric)
Open end wrench set (US/English and Metric)
Side cut pliers or dikes, Needle-nose pliers and Standard pliers
Cable stripper and crimping tool (for RG-6 coaxial cable)

A magnetic compass or GPS unit
Quality bubble level (preferably with a magnetic base and 8-16" long)
Quality dial inclinometer

Spade and Post hole digger (or a power auger if you have access to one)
Drill and Drill bit set
Extension cord (length as necessary) with three grounded outlets minimum.
Small portable television set
Preferably a flat screen LCD about 8-12" diagonal with a high intensity screen for viewing outdoors (in the sunlight)
Audio video cables

DS-2076 Winegard 76cm dish
QPH-031 Invacom LNBF
DG-280 PowerTech motor or SG-2100 DigiPower Motor
DN SW21 or Chieta HD 4X1 DiSEqC switch
5000 Coolsat receiver (4000 or 6000 may be substituted)
Walrus' elevation adjustment adapter.
NOTE: The elevation adapter is a specialty item. Designed and manufactured by Walrus Manufacturing Inc.

RG-6 coaxial cable
F-Type coaxial connectors for RG-6 cable
Dielectric grease to prevent or deter corrosion and oxidation and moisture entry at connectors.

Grounding rod, cable, clamps, terminals and blocks (as recommended by NEC)

8 to 10 foot 1 ¼" to 2" diameter galvanized water pipe (for ground based installations only)
3 bolts – 5/16" diameter x 4 ½" (to install through the pipe to anchor the pipe securely in the concrete)
3 nuts (5/16") to match the bolts listed above
6 washers (5/16") to match the bolts listed above.

60 – 120 lbs concrete mix (this is for ground based installations only)

FreeHostia on-line angle calculator (http://satcalculator.freehostia.com)
Google Earth downloaded to your PC (free version is fine).
Lyngsat.com
Channel Master
Coolsat ProLoader 2.4 or equivalent

Here is a picture of the Walrus Elevation Adapter that I mentioned in the equipment list. If you do not notice it right off, there is a piece of flat steel stock that is positioned along the rear spine of the motor tube where the dish clamps sandwich it in place. The other fixed point of this assembly is attached to the LNB support arm at the rear of the dish, just below the bottom of the motor tube. The knurled knob at the center, bottom of the picture is attached to a screw jack that connects the two fixed points (also located just below the bottom of the motor tube).

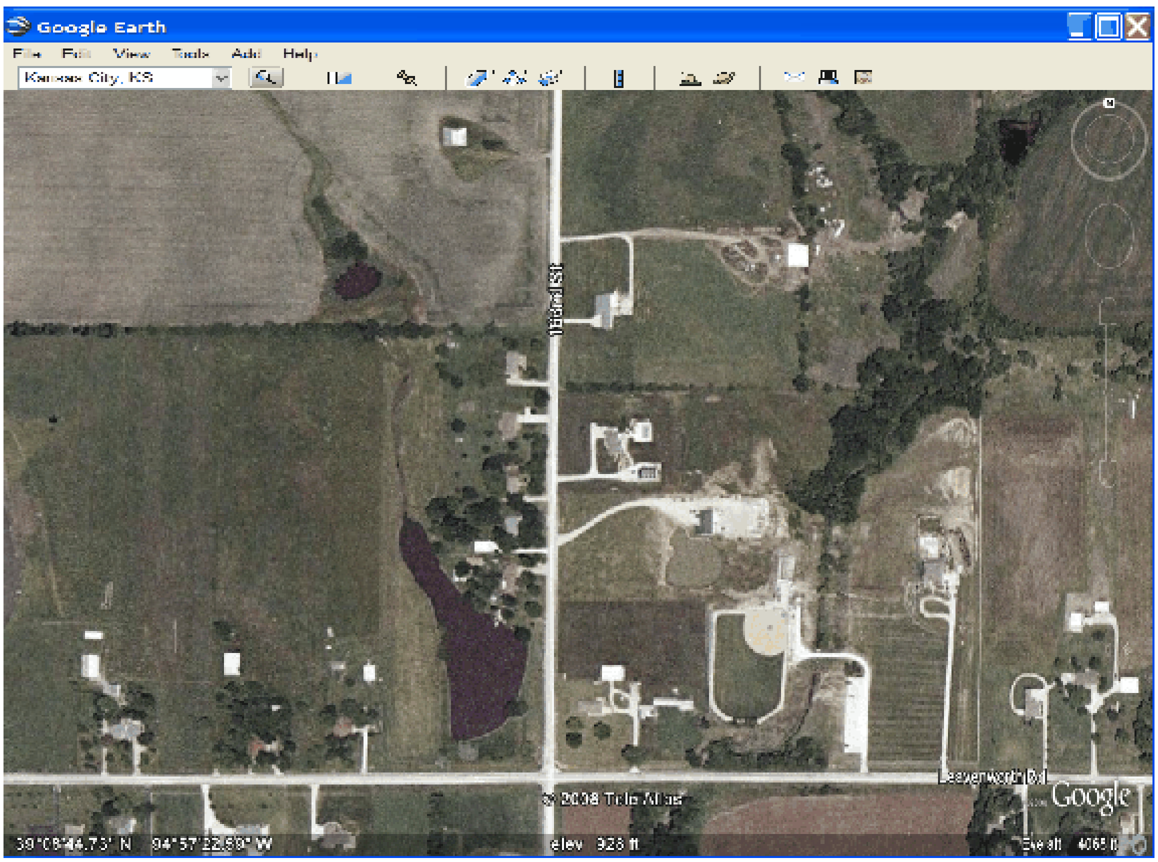
The screw jack is attached to a pivot point at the bracket that attaches to the LNB support arm at the rear of the dish. There is a threaded pivot point or pin at the other end, behind and below the motor tube.

If the dish elevation bolts are loosened slightly, the screw jack will hold and maintain the dish elevation in place (prevent the dish elevation from falling) and you can make minor adjustments to the elevation by adjusting the knurled knob. This is excellent for controlling fine adjustments of the dish's elevation. The concept is very simple, but the benefit is so important that I must recommend it.

CHAPTER 2 DETERMINING YOUR SITE COORDINATES

Knowing your site's precise Longitude and Latitude coordinates is critical. You will need this information to calculate the motor and dish angles properly. You also need this information to program your receiver's motorized setup and to assist you in a few other endeavors that will prove highly important and beneficial for the overall process.

Google Earth is an excellent tool to determine this information. You may know where you live address-wise, but you may not know the exact Longitude and Latitude coordinates. Using the example of Kansas City, Kansas USA (simply because it is centrally located in the USA), you can enter your city, state and street address into Google Earth and it will locate your home. Refer to the image below:



If you zoom in on this location, notice that down in the very bottom left hand corner of the map, the coordinates are displayed.

Notice that at the center, bottom of the image, the site elevation is also displayed (928 feet). This is a nice perk, too. You won't require this elevation for anything that we are discussing here, but you might like to know where to find it for other hobbies or concerns.

The coordinates are displayed in the format of DEGREES (d) MINUTES (‘) SECONDS (“). For this specific example from Kansas City, Kansas the coordinates are **39d 05’ 25.56” N and 94d 35’ 01.15” W.** You cannot enter these coordinates in your Coolsat receiver in this format. You must convert them to decimal degrees first.

Longitude and Latitude coordinates are treated similarly to time when it comes to the minutes and seconds portion. There are 60 minutes in a degree and 60 seconds in a minute (therefore 3600 seconds in a degree).

To convert them easily to decimal degrees, simply take the MINUTES portion and divide by 60 (i.e. 5/60 = 0.08 and 35/60 = 0.58) and add the results to the DEGREE portion. Therefore the decimal coordinates would become **39.08 N and 94.58 W**.

This is sufficiently accurate. The seconds portion of the coordinates may simply be ignored. However, if you wished to determine the full accuracy of the location, you would divide the seconds portion by (60 x 60 or 3600) and add it.

For example:
39 + (05/60) + (25.56/3600) = 39 + 0.08 + .0071 = 39.0871 degrees and
94 + (35/60) + (1.15/3600) = 94 + .0.58 + 0.0003 = 94.5803 degrees

You must enter these coordinates in receiver’s motor setup menu. Follow this menu tree:

MENU > INSTALLATION > MOTORIZED SETTING > DiSEqC MOTOR

Set the motor control type to **USALS** here. Then scroll down to the option for **ANTENNA POSITION** and enter the coordinates:

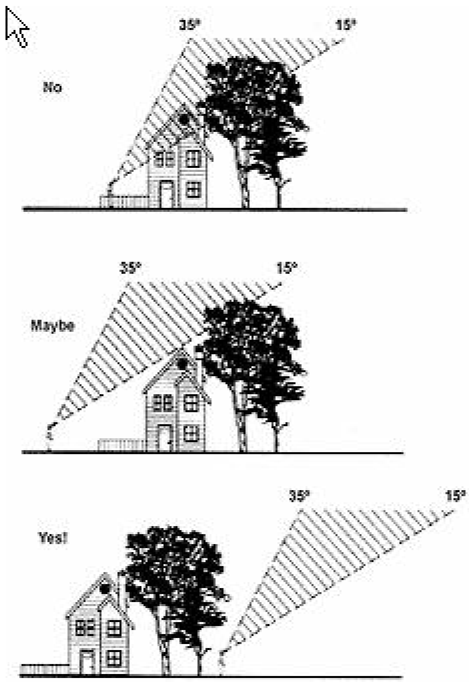
Longitude 094.6 W
Latitude 039.1 N

Remember that these specific coordinates are for our example location, Kansas City, Kansas. You must use your own coordinates. If these coordinates are not entered, the motor will not move to any location as it will have no reference point.

Ensure that all satellites that you are trying to locate are setup to use the USALS positioning control. The DiSEqC 1.2 motor control mode should not be used. DiSEqC 1.2 control has some advantages, but you should not require this if you set everything up properly. When you get to the end of this guide, you may use DiSEqC 1.2 control to compensate for any satellite that is imperfectly aligned or that is out of range for the USALS control. Otherwise, USALS is the motor positioning program that we will want to use exclusively.

CHAPTER 3 SITE ANALYSIS

Perform a site survey. Take a walk around the area and determine the best installation location. Survey your southern horizon from east to west and take note of any buildings, trees, hills or ridges and any other large objects that may pose an interference problem. Refer to the diagram below for a quick and simple visual representation.



Notice the shaded reception zone or field. If any object intrudes into this zone you may incur reception problems. The greater the amount of this zone that is occluded, the greater the signal interference or loss will be. The conception for this picture was a specific, single, fixed point dish and not a motorized dish, so disregard the angles shown. It is an excellent depiction, but not entirely accurate for a motorized system. We will need to be more elaborate for a motorized dish.

Be sure to analyze your landscape for obstructions from east to west over your entire southern horizon. Remember that your dish/motor will angle lower when it pans to the far west or east on your horizon. Therefore, locate the dish mount or pole at a position or an elevation where you will obtain a clear view of all satellites that are desired across the greatest span of the southern horizon.

If you question whether a tree, a building, a hill or some other obstruction is going to occlude your view of a satellite, you should consult this special online calculator:

http://www.satellite-calculations.com/SUNcalc/SUNcalc.htm

During a brief period twice a year, in the spring and then again in the fall, the sun will align itself precisely with a given satellite at a specific time for about 4 to 7 days. This solar calculator will reveal when this perfect “window” in time occurs for a specific satellite. It works for all satellites.

For a period of about one week prior to this window, at the same approximate time of day, the sun will be near to the satellite, but slightly to the east and lower.

For a period of about one week after this window, at the same approximate time of day, the sun will be near to the satellite, but slightly to the west and above the satellite.

Later in the summer, the sun’s arc will pass too far above the satellite and in the winter, the sun’s arc will be too far below the satellite to determine where the satellite is. So this anomaly only occurs twice a year.

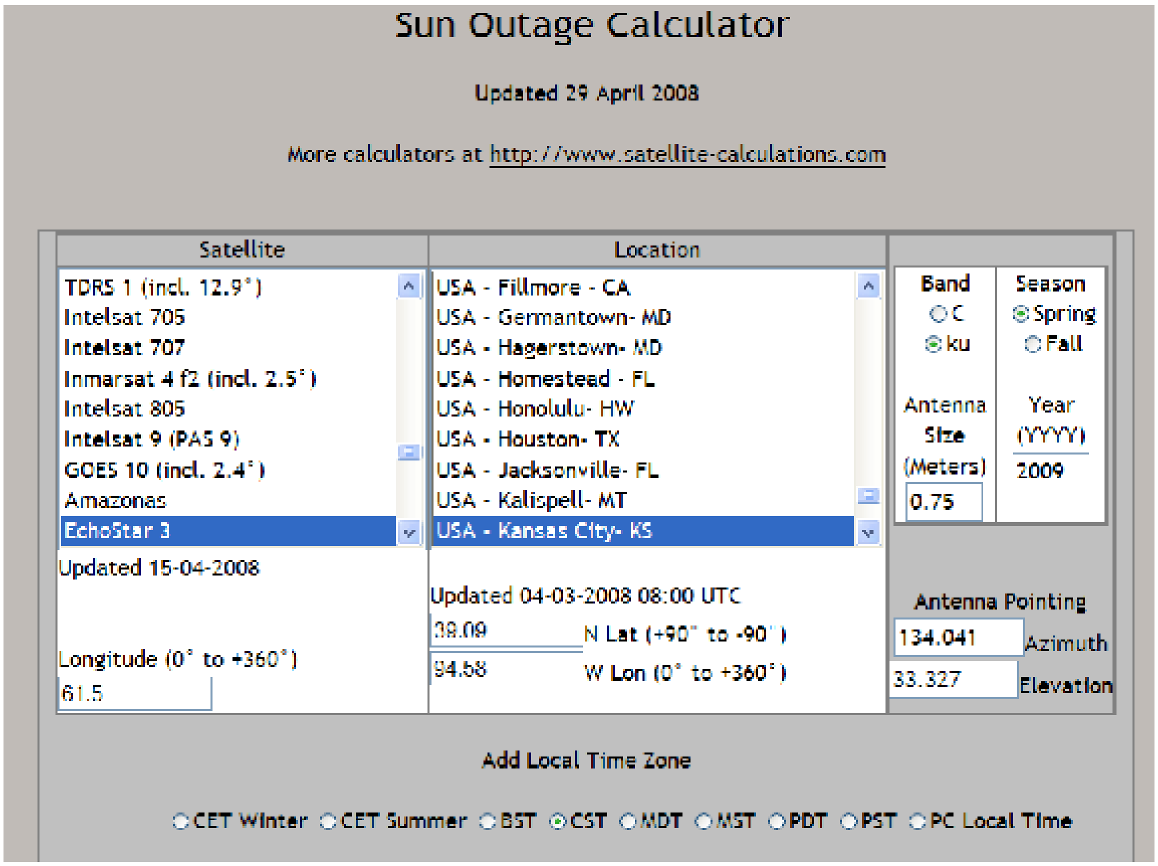
You can utilize the information from this calculator to pinpoint the location of any satellite and determine whether it is behind a tree or a building or a hill. If your view of the sun is not obstructed, then the view of the satellite is clear as well. This will help you determine where to locate your antenna on your property.

In the solar calculator’s entry fields, you enter your latitude and longitude coordinates or select a specific city from the list. Then select a specific satellite, the transmission type (C or Ku), the dish size, the time zone and then the year and season (spring or fall). Once you have all this information entered, you may click on the CALCULATE button.

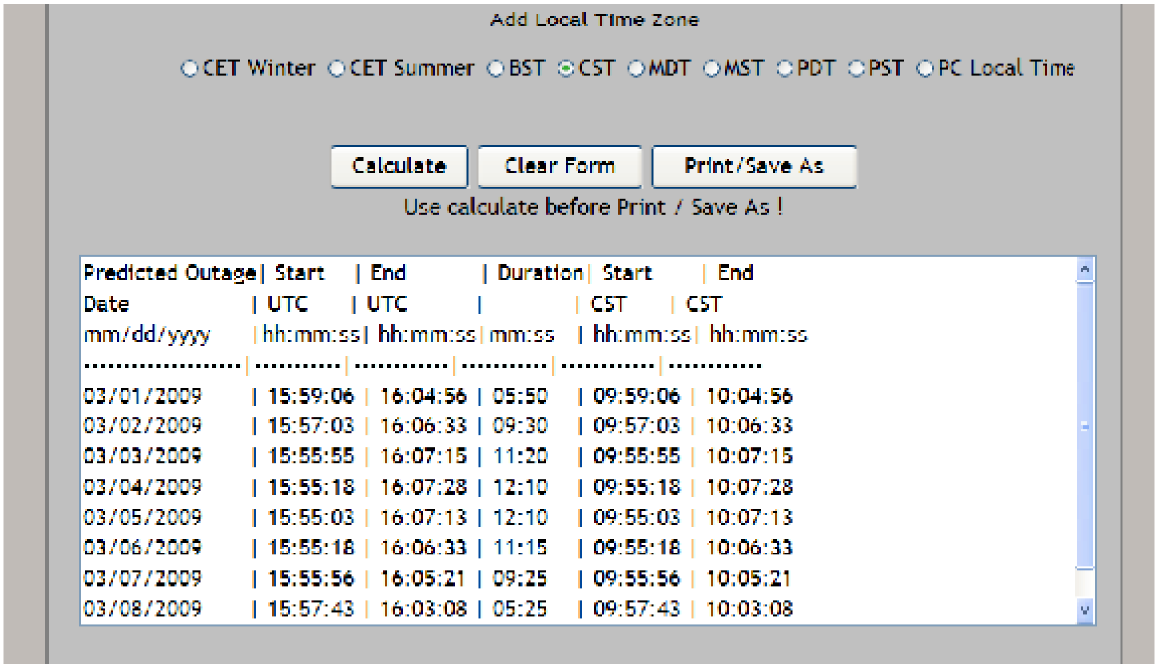
I used KC as an example location once again and from the results of this example you will notice that on March 4th or 5th of 2009 the sun will be in perfect alignment with satellite Echostar 3 (61.5W) at approximately 10:00 am CST. Therefore, if you go outside and observe the sun’s position at that time, you will know where satellite 61.5 is in the sky.

You will have approximately 10 minutes to observe the position of the sun to determine the precise location of the satellite. This sounds like a rather tight window to work within, but notice that you have several days to catch this at the most precise time.

Here is a snapshot of the data selection and entry areas of the calculator:



Here is a snapshot of the results of the solar time window calculations:


Add Local Time Zone

○CET Winter ○CET Summer ○BST ●CST ○MDT ○MST ○PDT ○PST ○PC Local Time

Calculate | Clear Form | Print/Save As

Use calculate before Print / Save As !

Predicted Outage Date mm/dd/yyyy	Start UTC hh:mm:ss	End UTC hh:mm:ss	Duration mm:ss	Start CST hh:mm:ss	End CST hh:mm:ss
03/01/2009	15:59:06	16:04:56	05:50	09:59:06	10:04:56
03/02/2009	15:57:03	16:06:33	09:30	09:57:03	10:06:33
03/03/2009	15:55:55	16:07:15	11:20	09:55:55	10:07:15
03/04/2009	15:55:18	16:07:28	12:10	09:55:18	10:07:28
03/05/2009	15:55:03	16:07:13	12:10	09:55:03	10:07:13
03/06/2009	15:55:18	16:06:33	11:15	09:55:18	10:06:33
03/07/2009	15:55:56	16:05:21	09:25	09:55:56	10:05:21
03/08/2009	15:57:43	16:03:08	05:25	09:57:43	10:03:08

To help you understand this better, I simply researched the Kansas City site for some of the satellites available. On March 4th or 5th in the spring of 2009, the sun will align with the following satellites at the following approximate times of the day:

30W @ 7:45am
43W @ 8:40am
61.5W @ 10:01am
72W @ 10:47am
74W @ 10:56am
89W @ 12:04pm
91W @ 12:12pm
97W @ 12:40pm
103W @ 1:07pm
119W @ 2:20pm
123W @ 2:37pm
129W @ 3:05pm

Let us say that you have several locations in your yard where it would be convenient to install a dish. You don't want the dish to be too far from the home because that would require a greater length of cable. You don't want the dish to be in your way too much when mowing and you don't want it to be too aesthetically displeasing, either. Therefore, select the best locations from the sites that remain and mark them. I would suggest those little flags for marking telephone cables or gas lines.

Mark the flags with a waterproof marker as site A, B, C, D, E, F, G, etc. Create a table with each location as a column and each satellite as a row. Then, when the solar outage calculator tells you that the sun is aligning with the satellites, go out to each prospective site at the appropriate time and record whether the satellite is viewable or not from each site.

When your check list is completed, you will be able to compare the qualifications of each proposed location and decide which location is best suited for your reception desires. If one satellite is blocked, but it is an unpopular sat or has very few channels, you might just ignore that satellite. The satellites that you select are purely discretionary. Of course, it is best if you can find a site that allows all the satellites to be viewed. I will leave the selection up to you.

NOTE: Select the PC LOCAL TIME time zone and ensure that your computer time clock is accurately set to local time and this calculator will work very well.

CHAPTER 4 INSTALLATION OF THE MAST

Once you have located the best possible location for your dish and motor, you may begin the installation process. It is now time to get the shovel and the post hole digger out of the shed and do some manual labor. If you happen to have access to a power auger, you can save yourself some labor and time in this endeavor. Dig the hole deep enough to avoid any effects of “heaving” from ground frost in your location. Heaving would be detrimental to the alignment of your satellite mast. Normally, a depth of 48” is sufficient. The diameter of the hole should be approximately 12”.

The overall length of the pole (or mast) should be sufficient so that it extends above ground so that you may mount the motor to the mast at a height that will allow the bottom of your dish to clear the ground and any snow accumulation. If it is feasible, try to set the dish and motor at a height which makes it convenient to adjust them without stooping down, reaching too high or using a ladder.

Drill three holes through the mast pipe (through both walls). Install three bolts through these holes and secure them with nuts and washers. These bolts will anchor the pipe in the concrete and prevent the pipe from rotating or moving up and down. The bolts should protrude about 3”. Three bolts set at least 3 inches above one another and opposing each other at 120 degree angles is optimum. The very bottom bolt should be no less than six inches from the bottom of the pipe and all bolts should be encased within the concrete when complete.

Drop the pole into your hole and give it a few light taps with a soft head mallet to drive the end of the pipe into the hard dirt at the bottom of the hole to help keep it in position while you prepare the concrete.

Mix up your concrete and pour it into the hole around the pipe. One 60 lb bag may be sufficient, but if you were required to dig your hole deeper or wider, you might want to use the second bag.

After the concrete is poured, attach your level to the pole and manually adjust the pole so that it is level in all directions (east – west & north – south). Be very critical with this! This is your most important step! Once the concrete has set, you cannot alter it, so ensure that it is absolutely perfect right now. Do not cut corners at this step! Keep double checking the pipe's verticality until the concrete begins to set up and the pipe remains fixed in a perfect vertical position.

Within 4-6 hours the concrete ought to be set enough to hold the mast in position on its own, but allow at least 24 hours before you continue with any further work. Backfill around the pipe with the remaining dirt from the hole and taper the slope away from the pole. Once the mast is set, cover the top of the pipe with a cap to prevent rain and snow from collecting in the pipe.

CHAPTER 5 ATTACHMENT OF THE MOTOR BRACKET

After the concrete has set, you may attach the motor bracket to the mast. Before you do this, I recommend that you install a collar clamp or ring that fits your mast diameter perfectly. The collar ring should have an inside diameter just slightly smaller than the outside diameter of your mast, so that it will tighten down on the mast good and snug. The outside diameter of the collar ring should be at least ½" larger than its inside diameter, the wider the better. This collar ring will provide a "shelf" for the motor mounting bracket to rest upon to prevent it from sliding down the mast when you have the motor bracket bolts loosened to adjust the motor in the azimuth angle. This is highly recommended.

Without this collar or shelf, it is a common mistake to loosen the top bracket too much and rely on the bottom bracket to prevent the dish and motor from sliding down the mast when adjusting the azimuth angle.

If you make this mistake, you may be allowing your dish to tilt downwards while you are making your azimuth adjustments. When you retighten the motor clamps, you will pull your dish and motor back up to the level position where it should have been and you will find that your alignment has been changed.

If you are able to do so, you could make etchings on the top surface of this collar for guides. Etching hash marks on the collar will serve to help monitor how far you move the dish/motor in the azimuth (east to west) angle. This would be very helpful and informative, especially if you can make the etchings accurately to one degree increments. This is not necessary, but it would be extremely helpful.

Attach the motor bracket to the mast and tighten the mounting bolts so that it is secure, but not completely tight. You will be moving this in a later step so you just want to eliminate the slop or play in the bracket where the clamp attaches to the mast.

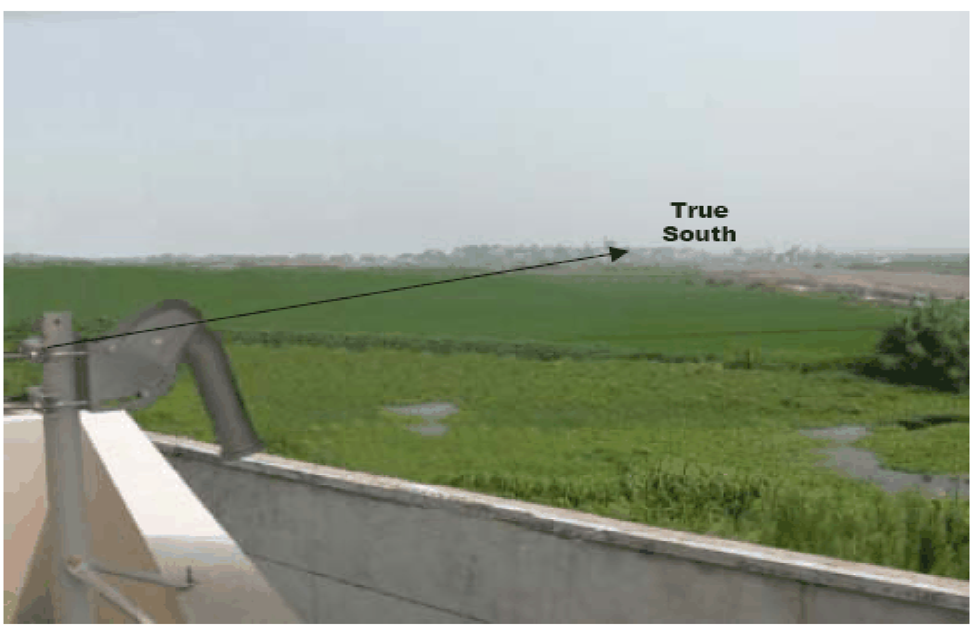
Next attach the motor to the motor bracket and tighten the four side bolts that screw into the motor housing.

With the bolts securely fastened, check the sides of the motor bracket with your level or inclinometer. Ensure that the motor bracket is level from both sides.
If it is not, double check your mast to ensure that it is still perfectly level. If the mast is level, but the sides of your motor bracket are not, then your motor bracket is not attached properly or squarely to the mast or it may be bent or deformed in some way. You must correct this before continuing.

Any discrepancy in your setup that alters the plumb of the mast, motor or dish is detrimental. Be very critical of this. It will save you a major headache in the long run. It is important that you regard this information with extreme care

CHAPTER 6 TRUE SOUTH VERSUS MAGNETIC SOUTH

Determine true south (geographic south) as best as you are able to estimate and align your dish and motor to this direction. You do not have to be extremely accurate, being close will be sufficient for now. As we proceed, we will refine this direction. The rest of this chapter is devoted to explaining how to determine true geographic south accurately.



In the process of aligning a satellite dish, we are concerned with the true geographic south, not magnetic south. However, a magnetic compass does not point towards the true geographic poles. The compass needle aligns itself with the magnetic field lines that are present at the location where you are standing.

Just FYI: The magnetic North pole is located on Prince of Wales Island in northern Canada (at approximately latitude 73° N, longitude 100° W).

The magnetic field surrounding the earth is not uniform, stationary nor perfectly aligned with the geographic poles. The magnetic lines are curved, varied and imperfect. In some locations, a magnetic compass is actually unusable. In others it is erratic and unreliable. Iron deposits and other local anomalies may interfere with the compass reading.

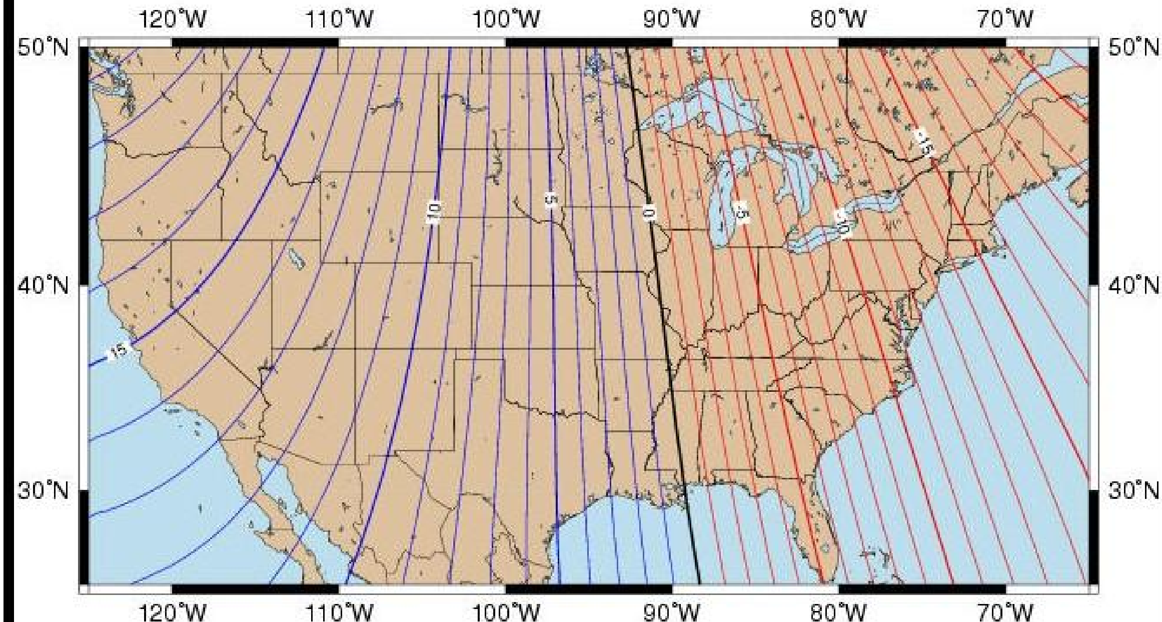
Since there are imperfections in the magnetic field surrounding the earth, we must use a system of correction angles, referred to as **magnetic declination** to compensate for this. It is basically a cheat sheet that informs us how to correct for these discrepancies and allows us to determine a true geographic position.

Here are a couple of maps which illustrate magnetic declination angles. These maps are outdated, so don't rely upon them for any degree of accuracy. I only utilized these pictures because the image quality was good and they provide a good illustration of the magnetic declination lines.

Notice that the magnetic declination angles indicated by these two maps are also in slight disagreement. This is because these two maps were created for different years and the orientation of the magnetic lines of flux and the position of the magnetic poles of the earth have moved over time.

Understand that these maps and the information are orientated towards locating true geographic North. The dish and motor need to be pointed towards true geographic South. Obviously, if you locate true north, you can determine where true south is.

Magnetic Declination for the U.S.
2004



Mercator Projection

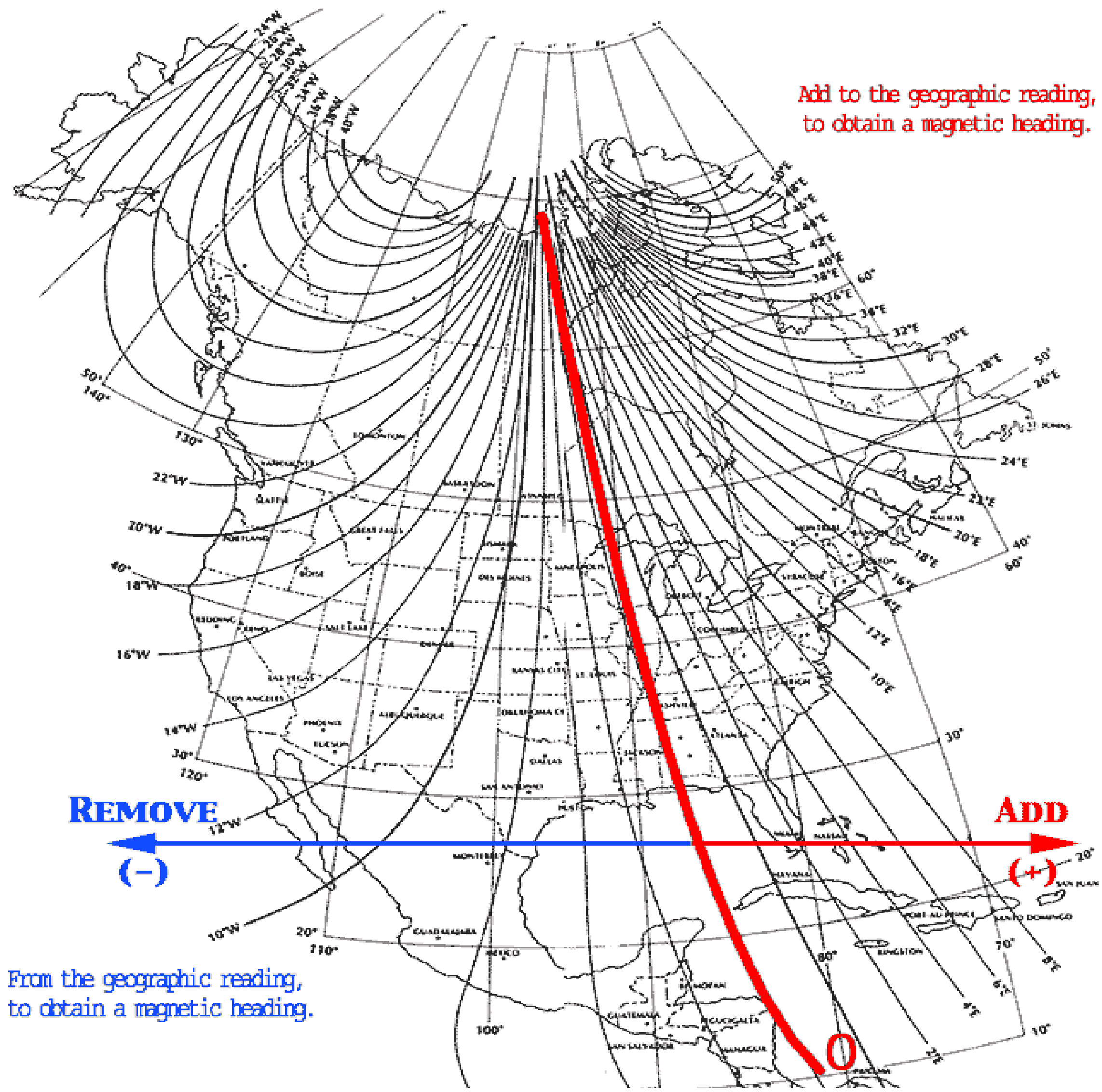
Contours of Declination of the Earth's magnetic field. Contours are expressed in degrees. Contour Interval: 1 Degree (Positive declinations in blue, negative in red)

Produced by NOAA's National Geophysical Data Center (NGDC), Boulder, Colorado

http://www.ngdc.noaa.gov

Based on the International Geomagnetic Reference Field (IGRF), Epoch 2000 updated to December 31, 2004

The IGRF is developed by the International Association of Geomagnetism and Aeronomy (IAGA). Division V



On this second map, notice the red line running down through the Midwest and out into the Gulf of Mexico and tagged as “0”. This is called an “agonic” line and it is where the magnetic declination angle is zero degrees. A magnetic compass will point to true geographic North/South along this line with no correction factor required. Remember that this map is somewhat outdated, so this line has likely moved from the location shown on this map by several degrees.

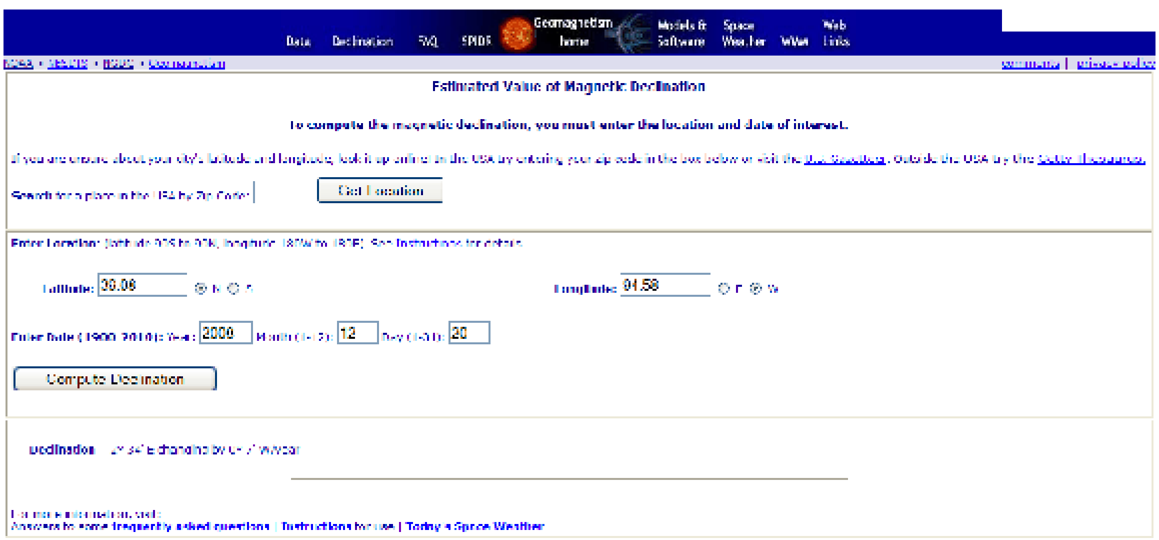
Also notice that to the west of the agonic line, you need to subtract the declination angle from the true geographic heading in order to determine what your magnetic compass reading should be. Conversely, for all positions to the east of the agonic line, you must add the declination angle to the true geographic heading in order to determine what the magnetic compass reading should be.

Since these declination maps are slightly outdated, you will want to consult a source that offers updated and accurate magnetic declination angles. This can be found through the following link from NOAA:

http://www.ngdc.noaa.gov/geomagmodels/Declination.jsp

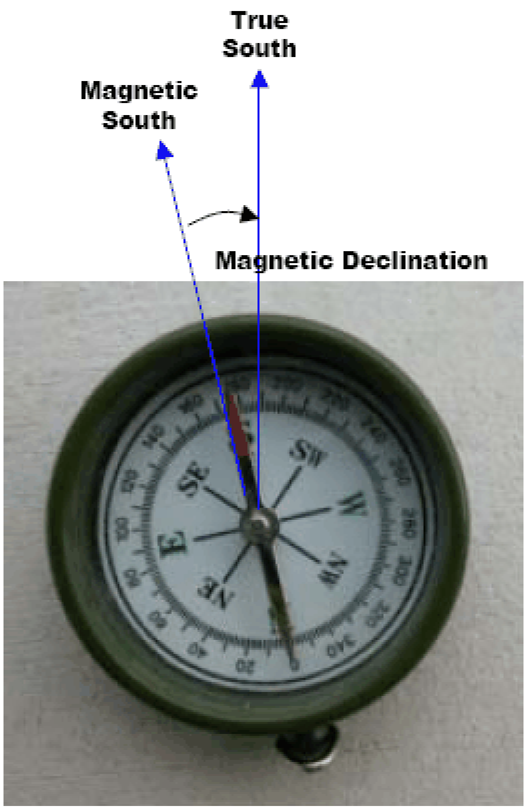
Here you will find an online calculator that will provide you with the current, accurate magnetic declination angle for your position. By entering the correct coordinates for your location, and then clicking on “COMPUTE DECLINATION” your correct magnetic declination angle will be presented. You will not have to rely upon trying to read charts or maps like the ones above, but I would recommend that you familiarize yourself with these charts as it helps you to visualize what is being discussed and the theory behind it all.

The snap shot below is how the NOAA Magnetic Declination screen appears:



From this screen, after the latitude and longitude data have been entered and the “Compute Declination” button has been clicked, it reveals that for this particular location, a magnetic declination angle of approximately 2.57 degrees should be used (**Declination** = 2° 34' E and moving 0° 7' West per year), this is indicated in the lower right hand area of the screen shot above, directly below the “Compute Declination” radio button.

In the western U.S. or Canada (or to the west of the agonic line), true North is always the larger number. Conversely, in the eastern U.S. or to the east of the agonic line, true North is always the smaller number. In the example below, true geographic South appears to be approximately +15 degrees from magnetic South. True geographic North is therefore also approximately +15 degrees from magnetic North.



From the example compass above, I can surmise that this compass is located somewhere near and along a curved line from the central California coast, through NW Nevada, central southern Idaho, western Montana and slightly west of Saskatoon, Saskatchewan, Canada.

Understanding this will make you one hell of a sailor! But, do you really need to know this information in such detail to set up a satellite antenna? The answer is basically no. We can get by without all this information. Today we have Global Positioning Systems that can inform us where north and south is without doing all this work. However, it was information like this that led us to developing a GPS system in the first place. It is really fantastically awesome to learn that the ancient Chinese, Romans and Vikings realized this and were able to determine and apply this knowledge without computers and Microsoft!

Regardless, you now have now learned something that is highly important. This is a learning enterprise and now you understand just one more aspect of this hobby. I hope that you relish this fact. It is pretty cool.

CHAPTER 7 ATTACHMENT AND ALIGNMENT OF THE MOTOR

Attach the motor bracket to the mast and align it to face as near to true geographic south as you can judge. You do not have to be perfect at this point (like I was describing in the previous chapter). You just want to get as close as you possibly can. However, the closer you can estimate this, the better.

Attach the motor to the mounting bracket and secure it with the four side mounting bolts. Tighten all four bolts just sufficiently so that the motor does not move and so that the sides of the mounting bracket are flush with the motor housing. Not too tight, just sufficiently so that the side brackets are pulled against the motor.

Double check your motor mounting bracket for levelness at this time. Place your level against the vertical sides of the motor bracket and ensure that it is perfectly level. Anything less than perfect is NOT acceptable! If it is not perfect, you must ascertain where the problem is and correct it. Check your pole or mast first and ensure that it has not moved. If the mast is still level, then ensure that you have the motor mount bracket attached to the mast straight, square and level. If there are no defects here, then your motor bracket may be warped or deformed in some way. If the inclinometer shows it to be less than 0.2 degrees in error, you may be able to get by with this, but any error more than this is cause for concern.

Next, loosen your motor bolts just enough so that you can adjust the motor elevation/latitude. Some motor brackets have a latitude scale on one side and an elevation scale on the other. Some motors have a latitude scale on both sides. Ensure that you are reading the angle from the latitude scale only. Set the motor so that the pointer marker is pointed at your location's latitude angle.

If the lower base (bottom) of your motor – the side that the motor shaft protrudes from - has a perfectly flat surface, attach the inclinometer to that surface and read the angle indication from the inclinometer. The angle that you read will be the ELEVATION angle, <u>*NOT the LATITUDE angle.*</u>

The latitude and elevation angle scales are inverse of each other and they add up to 90 degrees:

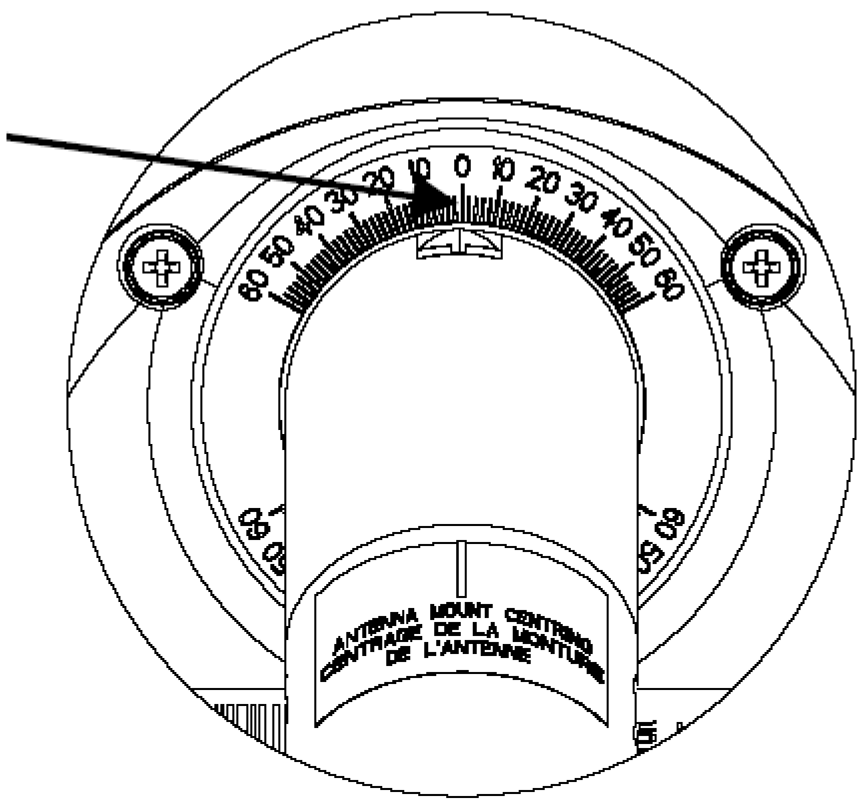
Elevation + Latitude = 90 degrees
90 degrees – latitude = elevation
90 degrees – elevation = latitude

If your site's latitude is 39.08 degrees, then your elevation should be 50.92 degrees. i.e. 39.08 + 50.92 = 90.0. Therefore, the reading on the inclinometer from the bottom of the motor should be equal to the elevation angle or 50.92.

Obviously, you cannot discern this degree of accuracy from your motor's scale. However, the scale on the inclinometer is more finely marked for better resolution, so this is an advantage. You can be at least within 0.2 degrees accurate with a high quality inclinometer. This is a critical angle, so try to ensure that you have it set as precisely as possible at this stage as you will not readjust this angle ever again. It is just as important as setting the mast to be perfectly level.

Before you proceed any further, ensure that your motor is positioned at its reference position or zero degrees on its scale (see the diagram below). If the motor is brand new (right out of the box), it should be set there from the factory.

If the motor is not set to the reference position then connect your receiver to the motor and turn the power on. Follow the menu tree shown below:
MENU > INSTALLATION > MOTORIZED SETTING > LIMIT > Goto Reference
Highlight the Goto Reference option, press OK then press EXIT. The motor will then drive to the zero degree reference position. Turn power OFF and disconnect your cable from the motor. Now your motor will be at the zero degree reference position and you are ready to attach the dish to the motor.



CHAPTER 8 ATTACHMENT OF THE DISH

Now attach the dish assembly to the motor tube. Here is a good time to point out the fact that some motors come with different diameter motor tubes. They are either 42mm or 50mm in diameter. This is usually specified in the motor specifications and an option to order a different tube is usually denoted somewhere on the seller's web site. You will want to ensure that you have the proper motor tube to fit your dish. If your motor tube does not match your dish, stop and order the correct motor tube before proceeding. Do not attempt to shim it to fit or modify the dish in any manner. You may impose some errors that will hinder you from aligning to the arc properly and it truly isn't worth the trouble.

Before you proceed, it would benefit you to look at your motor tube closely. There should be a seam running vertically up and down the front and back of the tube. Take a felt tip, permanent marker and highlight this seam so that it is highly visible. You might need to use this line to assist you in centering the dish on the motor tube as the vertical axis of the dish and the vertical axis of the motor tube must be in perfect alignment. This reference mark may prove extremely helpful.

Now slide your dish onto the motor stem and install the center pivot bolt and tighten it and all the other bolts just enough to remove any play and keep the dish stationary.

Use your inclinometer or bubble level and affix it to the vertical sides of the dish mounting brackets. Ensure that both sides agree to level. If they are not, recheck your pole once again to ensure that it is still level. Then check your motor brackets to ensure that the motor is also still level. If these are both level, then your dish elevation bracket is twisted to one side or the other within itself or your dish is not centered on your motor tube properly or both.

Because of the thin gauge metal used in the fabrication of the dish mounting and elevation bracket assemblies and the weight of the dish reflector, the assembly can "twist" within itself enough to cock the dish slightly left or right. You want to eliminate this twist as much as is possible.

Also, there is enough play in the center pivoting bolt that goes through the motor tube and this may allow the dish to be moved left or right of center a degree or two. With the line on the motor tube that you made using the marker, you should try to judge the centering of the dish on the tube to eliminate this error as much as possible, then confirm this with the level on the sides of the dish brackets.

Once the dish has been affixed to the motor and these errors are resolved, you may continue to the next step.

CHAPTER 10 DETERMINING YOUR DISH ELEVATION ANGLE

Go to:

http://satcalculator.freehostia.com/

Select your motor type from the list provided on this entry area of the menu:

Select your setup:

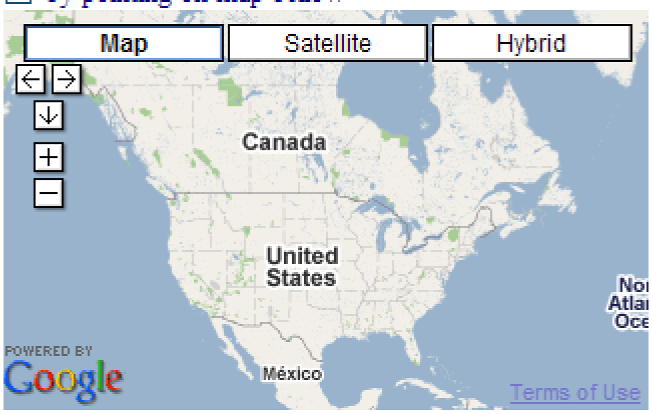
- [ ] Single Satellite
- [ ] Dual Satellite
- [ ] Multi Satellite
- [ ] ExpressVu Double (82-91)
- [ ] Dish Network Dish500 (110-119)
- [ ] Dish Network Dish1000 (110-119-129)
- [ ] Dish Network SuperDish 121 (110-119-121)
- [ ] Dish Network SuperDish 105 (105-110-119)
- [ ] StarChoice (107.3-111.1)
- [ ] Satcontrol SM3D12/SM3D22 Motor*
- [ ] STAB Motors (HH100 & HH120)*
- [ ] STAB Motors (HH90)*
- [ ] Pansat PM900 S Motor*
- [ ] Moteck SG2100 Motor*
- [ ] GeoSatPro GS120 Motor*
- [x] PowerTech DG240/DG280 Motor*

*(When pointing for a motor, use the map to the right to find your house with the satellite pictures, the results page will give you a reference line to point your setup to true south)

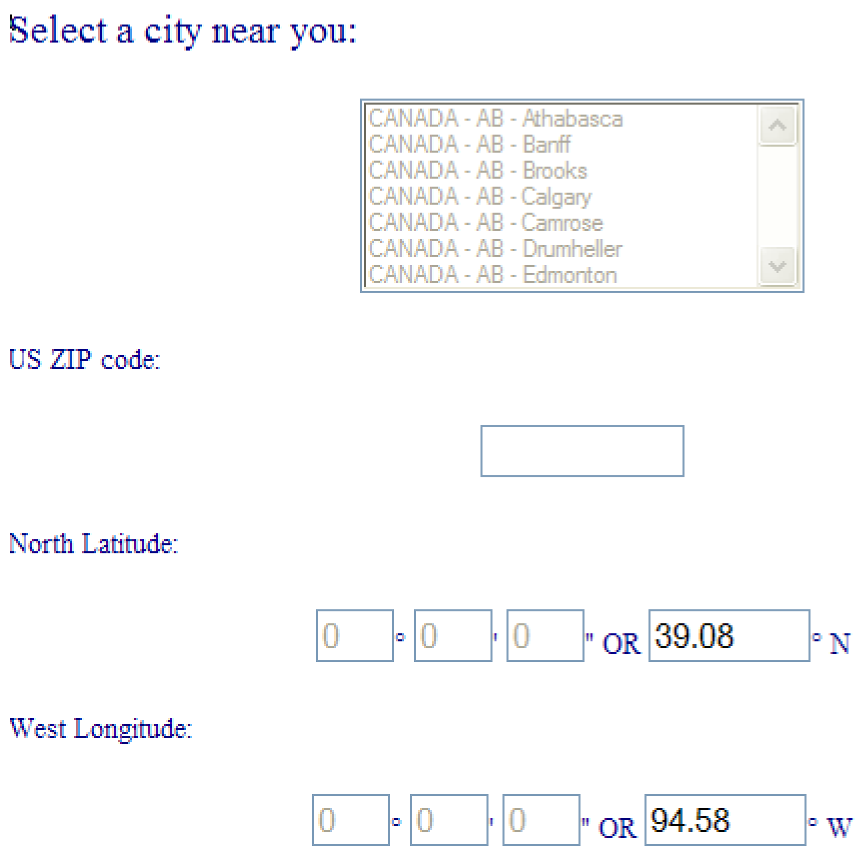
I recommend using the latitude/longitude coordinate entry to determine your most precise angles. Select your coordinate entry method from this entry menu:

Select location entry type:

- [ ] by City Name
- [ ] by US ZIP code
- [ ] by Deg/Min/Sec
- [x] by Decimal Degrees
- [ ] by pointing on map bellow



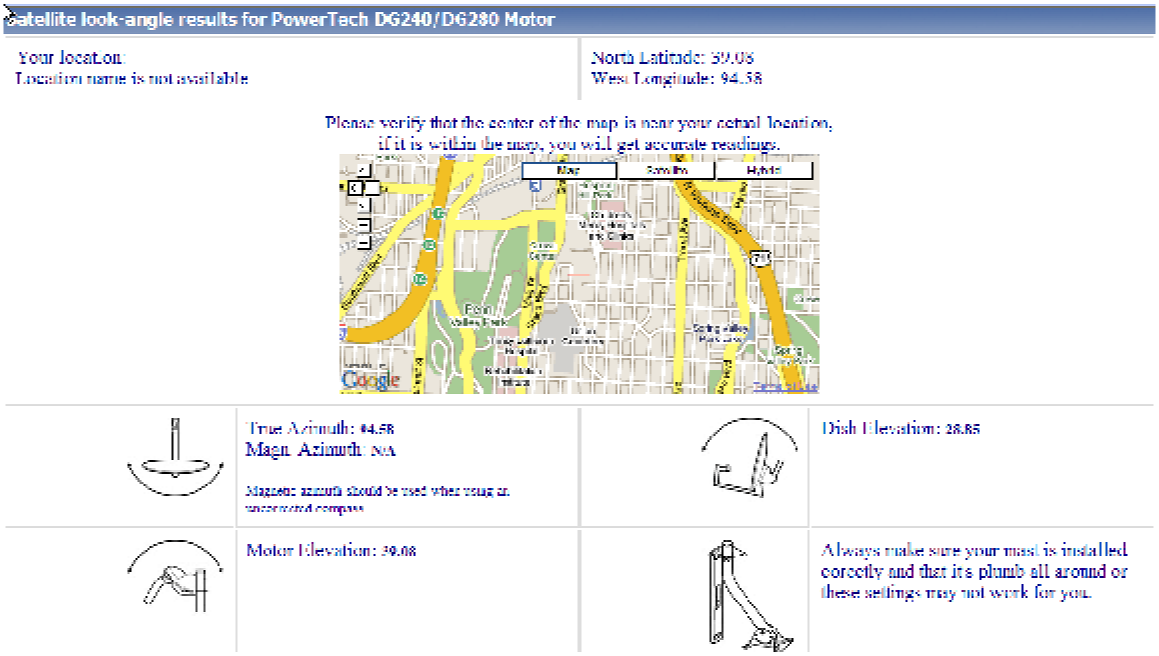
Next enter your coordinates on this entry area of the screen:



For example: Let us say that you live in Kansas City, Kansas and your site coordinates are 39.08 degrees N and 94.58 degrees W. Enter these coordinates.

Just to add a note, I have been informed that you may use a Canadian postal code as well as the US ZIP code, instead of the Latitude and Longitude coordinates if you are so inclined. However, I recommend the use of the geographic coordinates. That is more accurate.

Then, click on the CALCULATE button at the bottom of the main screen and you will acquire this image:



Here you are informed that your dish elevation should be set to 28.85 degrees. It also informs you that your motor elevation (this should actually state motor latitude) should be set at 39.08 degrees. We have discussed your motor latitude previously, so that should already be set. You only need to set the dish elevation angle to 28.85 degrees.

If your motor is not listed at FreeHostia, then you may need to apply some math to determine what your dish elevation should be set to. This depends on three items: 1) Your site's latitude. 2) The declination angle for that latitude. 3) Your motor tube bend angle.

You already know your site's latitude. That was easy. There is a table below to determine the declination angle for your latitude, so that is simple as well.

The problem arises in not knowing what the bend angle is for your motor tube. Most motor tubes have either a 30, 35 or 40 degree bend. If you are not sure of what this angle is, you need to measure it.

The easiest method to measure this angle would be to mount the motor so that the base (the side where the motor stem protrudes from the motor) is aligned to 90 degrees, or vertical. Then the motor stem will be horizontal or aligned at zero degrees. Then place the inclinometer on the motor tube and measure the angle. The reading on the inclinometer will indicate the motor tube bend angle. You should do this before you align your motor latitude, otherwise you will be backtracking and performing additional steps out of sequence.

Finding the declination angle is simple. Just use the chart below. All motor manuals reference the same chart, so the declination angles are always the same for any motor. The only variables are your motor tube bend and latitude.

DECLINATION ANGLE TABLE

Latitude (deg)	Declination Angle (deg)	Latitude (deg)	Declination Angle (deg)	Latitude (deg)	Declination Angle (deg)	Latitude (deg)	Declination Angle (deg)
1	0.18	24	4.07	46	6.92	68	8.47
2	0.36	25	4.23	47	7.01	69	8.51
3	0.53	26	4.38	48	7.11	70	8.54
4	0.71	27	4.53	49	7.21	71	8.56
5	0.89	28	4.67	50	7.30	72	8.59
6	1.06	29	4.82	51	7.38	73	8.61
7	1.24	30	4.96	52	7.47	74	8.63
8	1.41	31	5.10	53	7.55	75	8.64
9	1.59	32	5.24	54	7.63	76	8.66
10	1.76	33	5.38	55	7.71	77	8.67
11	1.94	34	5.51	56	7.78	78	8.67
12	2.11	35	5.64	57	7.85	79	8.68
13	2.28	36	5.77	58	7.92	80	8.68
14	2.45	37	5.90	59	7.99	81	8.68
15	2.62	38	6.02	60	8.05	82	8.68
16	2.79	39	6.14	61	8.11	83	8.67
17	2.95	40	6.26	62	8.16	84	8.66
18	3.12	41	6.38	63	8.22	85	8.65
19	3.28	42	6.49	64	8.27	86	8.64
20	3.44	43	6.60	65	8.31	87	8.62
21	3.60	44	6.71	66	8.36	88	8.60
22	3.76	45	6.81	67	8.40	89	8.58
23	3.92						

Normally, the motor tube bend will be addressed in your manual, but you must use the manual that came with your motor and not an on-line manual or a friend's manual as they may differ. There are deviations in the motor tube angles for the same motor, so be careful. If you are in doubt, measure the angle yourself to be certain.

For our Kansas City example, the latitude is 39.09 N, so the declination angle from the table is 6.14 degrees. Subtract the declination angle from the motor tube bend angle, which will be the dish elevation angle that you need to set.

For the motor that I am using, the tube bend is 35 degrees, so if I subtract 6.14 degrees from that, I get 28.86 degrees for the dish elevation. That is a pretty damned good match for what FreeHostia tells me, which is 28.85 degrees, you don't get much better accuracy than that.

CHAPTER 11 CONNECTING THE COMPONENTS

At this point, you should take your portable television and your receiver out to the dish and set everything up on a small table so that you can monitor the signal while standing directly behind the dish. Ensure that everything is set up as conveniently as possible. You will desire the most comfort and ease during this process. It will make your duties from here on out more pleasant.

Run your extension cord out to the area and set everything up so that it is convenient for you to see the monitor screen and so that the remote has a good line of site to control your receiver.

Ensure that power is OFF on your receiver. Connect your cable between the receiver and the motor and connect your switch in between the motor and the LNBF.

You can use a 22KHz switch, a DiSEqC 4X1 switch, an SW21 or an SW42 switch here, all will work. I recommend the DiSEqC 4X1 switch most because it allows for future expansion and the settings are not affected when you edit the channel list with Channel Master.

There are no rules here as to which switch port that you hard wire to the linear or the circular port of the LNBF, so connect them in the manner which is most convenient. Just be certain that you set the DISH SETTING configuration menus for the switch type and port assignments to match the hardwiring of your system.

When you attach the LNBF to the mounting bracket, make sure that you set the LNBF polarization angle to zero degrees. The motor and dish movement will automatically adjust for the polarization that is required.

CHAPTER 12 SELECTING YOUR DUE SOUTH SATELLITE

When you begin to align your dish, it is important to align it to the nearest due south satellite. For our example of Kansas City, Kansas, USA, the nearest due south satellite will be the satellite which is aligned with our site's longitude. Since the site longitude is 94.58W, the nearest satellite to this is 95.0W Galaxy 3C. This is a linear satellite. There is also 91.0W Nimiq 1, which is a circular satellite.

Even though the circular satellite is further away from our longitude than the linear satellite is, it may be beneficial to seek out this circular satellite first. Circular satellites are much easier to locate on the fly. Circular satellites usually transmit with higher power and because of the circular polarity we can be in error by a pretty fair margin and still detect the signal. If we locate 91.0W first, we have a better chance to locate 95.0W. It is like taking a practice shot at a target. A circular satellite is like a bigger target, although the satellite itself is not any larger, the signal is much easier to detect. If we can find 91.0W, then we know which direction to aim to hit 95.0W.

Now we must select which transponders on these satellites to look for. There are several criteria that we want to be informed of and analyze. First of all, we want a CONUS transponder and not a SPOT BEAM transponder. CONUS stands for CONtinental US. This basically means that the signal is beamed to all locations in the continental or contiguous states, this also includes Canada and Mexico. A spot beam transmits a signal to just one, small specific area. Why they adopted this terminology eludes me, I guess I would have simply referred to them as broad beam and spot beam. But, now you understand the concept.

Next, we want the channels on the transponder to be consistently broadcasting. We do not want to use any transponders which have only WILD FEED channels or NEWS FEED channels. These are channels that only broadcast signals when news is breaking. ABC, NBC, CBS, FOX, CNN and others use these feed channels to transmit their news stories back to the news station home base, instead of making a video tape and driving that tape or mailing it back to the home station for editing. They do not use these channels all the time. When the news story is over, the channel goes off the air or the signal goes dead until the next news story presents itself. We may not be able to rely upon these channels to be broadcasting at the time that we are trying to align our dish and motor. Therefore, avoid the FEED channels while aligning your dish and motor.

It is best to consult with Lyngsat at http://www.lyngsat.com/ to determine the transponders and channels that are best to use. If you are uncertain of what you are looking for here, then you should consult with a FTA connoisseur who has a functional system and can inform you which channels and transponders are reliable for this purpose. They will usually be monitoring the satellites and channels often. I personally have a relatively good list for this purpose and I will share that with you shortly. Others may have similar information, if not better.

Here is a list of the nearest satellites, transponders and channels that someone in the Kansas City area would want to use for initial alignment purposes.

91.0W Galaxy 17

Occasional Use - 1

TP 12.059 POL V SR 26.700 SL 88% QL 87%

SAT ID BANNER = PowerVu Plus Network

VPID 1160 APID 1120 PPID 1160 SID 2811

91.0W Nimiq 1

OnHD

TP 12.414 POL H SR 20.000 SL 91% QL 95%

SAT ID BANNER = Bell ExpressVu 91

VPID 4386 APID 4387 PPID 4386 SID 1229

93.0W Galaxy 26

MACYS 4

TP 11.906 POL V SR 3.548 SL 87% QL 94%

SAT ID BANNER = May

VPID 0110 APID 0100 PPID 0110 SID 3029

95.0W Galaxy 3C

CCTV 4

TP 11.780 POL H SR 20.760 SL 90% QL 91%

SAT ID BANNER = CCTV

VPID 0512 APID 0650 PPID 0128 SID 2719

97.0W Galaxy 19

Al Jazeera English

TP 11.999 POL H SR 20.000 SL 88% QL 72%

SAT ID BANNER = Globecast

VPID 4025 APID 4035 PPID 4025 SID 2989

97.0W Galaxy 19

Globecast 813

TP 12.051 POL V SR 22.000 SL 91% QL 87%

SAT ID BANNER = Globecast

VPID 3728 APID 3729 PPID 3728 SID 2997

CHAPTER 13 ALIGNING THE DISH TO THE TRUE SOUTH SATELLITE

The motor is set on a plumb (vertical) mast. The motor is roughly aimed towards due south, 95W. The motor latitude is set at 39.08 degrees. The dish elevation is set at 28.9 degrees and the LNBF polarization is set to zero degrees. We also know which satellites, transponders and channels that we wish to search for.

Ensure that these satellites and transponders are listed in your receiver's database. If they are not present, you will want to add them manually before you begin the actual alignment process. You will need to consult with other instructions to learn how to do this. This process is a basic necessity and a prerequisite to setting up a motorized dish. You will be doing this often throughout your motorized dish experimentation so you must learn how to do this proficiently. For now, let us assume that these satellites and transponders already exist in your receiver's database and proceed from this point. Access the manual scan menu:

MENU > INSTALLATION > MANUAL SCAN > SATELLITE.

Press RECALL (the red button) to display the entire list of satellites. Navigate the satellite list to locate 95.0W Galaxy 3C, highlight it and press OK. Wait for the motor to pan to this position. When the motor stops driving and the message "MOVING TO 95.0W Galaxy 3C" is no longer displayed, the motor should be positioned properly.

Next, scroll down to the FREQUENCY line and press the RECALL (red button) to display the list of all transponders. Locate 11.780 GHz (H) and press OK. (Ensure that the Symbol rate is set to 20.760 MS/s.)

Now you are prepared to pan your dish to locate the satellite. If you have followed the instructions so far with meticulous accuracy, the alignment process will normally be quite simple. If you're setup is a little imperfect, you may not locate the satellite right off so easily.

Do not worry if everything does not fall into place without some effort. There are many inconsistencies in this endeavor that are not under our control. A few minor errors in the equipment and in our judgment of the mechanical settings may require us to do some fine tuning. This is normal and not of any extreme concern.

Manually rotate the motor east and west on the mast in very fine steps, about 1/16 inch or less. Pause and wait 5 or more seconds to allow the receiver to lock onto any signal that might be present. The signal may be weak, so allow the receiver sufficient time to lock on. If nothing appears, continue moving the motor on the mast in the same manner.

If you have panned east and west +/-15 degrees, and you did not detect any signal, then you should readjust your dish elevation and repeat the process. Check this over and over again with the dish elevation angle set higher (and lower) than the original elevation angle that was provided from FreeHostia.

Try to make the smallest changes in the dish elevation that you possibly can. One half degree or less is recommended. If you pan the dish east and west +/-15 degrees and up and down +/-5 degrees and still have not detected a signal, then you may have a greater problem. Somewhere in this range you should have locked onto some signal. Even if it was not the signal that you were searching for.

The angles from FreeHostia are perfect, but we may not be so perfect in setting up our equipment and our equipment may not be so perfect either. This is where we delve into fine tuning and "peaking" the signal. If there are any discrepancies in our equipment or in our setup, this is where we start to compensate for them.

Gross errors or mistakes cannot be masked by this process. If you cannot achieve positive results here, then there is a greater problem or mistake somewhere prior to this point.

You will want to consult the FTA site for assistance if this event arises. I simply cannot include all the troubleshooting information that may be needed in this instructional guide. I would like to, but it isn't feasible. If you run into problems, you will be able to explain everything that you did up to the point where the problem arose and someone will be able to follow your steps and determine where the problem lies.

Let us now get back to our alignment procedure.

Do not loosen the motor clamps too much. You only want them loose enough so that you can rotate the motor on the mast easily from east to west and back as required. If it is too loose, you might alter your elevation angle.

Remember that I mentioned it would be beneficial to locate the circular satellite at 91.0 W first. When you detect and lock on to this signal, continue adjusting the dish to fine tune the alignment (azimuth and dish elevation) so that you peak for maximum signal and quality levels.

CHAPTER 13 TRACKING THE ARC WITH YOUR DISH

The next step is to test how well your dish and motor will track the entire arc. Select one satellite that is roughly 5 degrees west of your home position and one satellite that is roughly 5 degrees east of your home position. Check the signal and quality level received from these two satellites. Then select a satellite that is roughly 10 degrees west of your home position and one that is roughly 10 degrees east of your home position and check the signal and quality levels from each of these two satellites. Continue driving the dish further east and west in two to five degree increments and testing the signal from those satellites.

You will want to refer to a list of satellites and transponders and channels that someone else has tested and proven to be accurate. Try “THE LIST” on Satelliteguys.us.

Now that you know most of the satellites to check, begin by driving your dish as far east and as far west as you are able until you can no longer detect a valid signal from any satellites.

When you can no longer receive a valid signal from a satellite that is furthest to the west or east, back up to the nearest satellite that you are able to receive a signal from. Now determine which direction your dish is off by monitoring the signal and quality levels. Stand behind the dish and very gently twist or pull on the dish (up, down, east and west, etc).

When you determine which direction your dish needs to be moved to improve the signal and quality levels, record this information for later use, but do not readjust your dish at this time, just record the data.

For every satellite that you are able to receive signal from, repeat this process and record whether you have to move the dish up, down, east or west to improve your reception. Make a logbook of your findings.

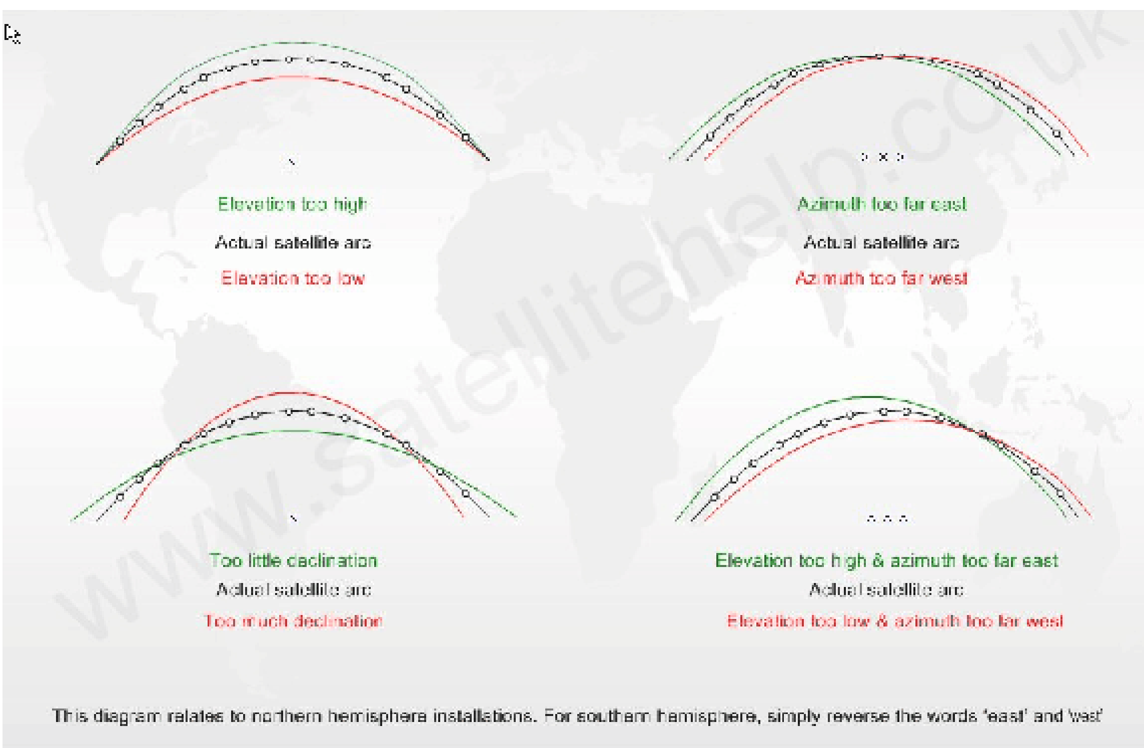
CHAPTER 14 ANALYZING ALIGNMENT ERRORS

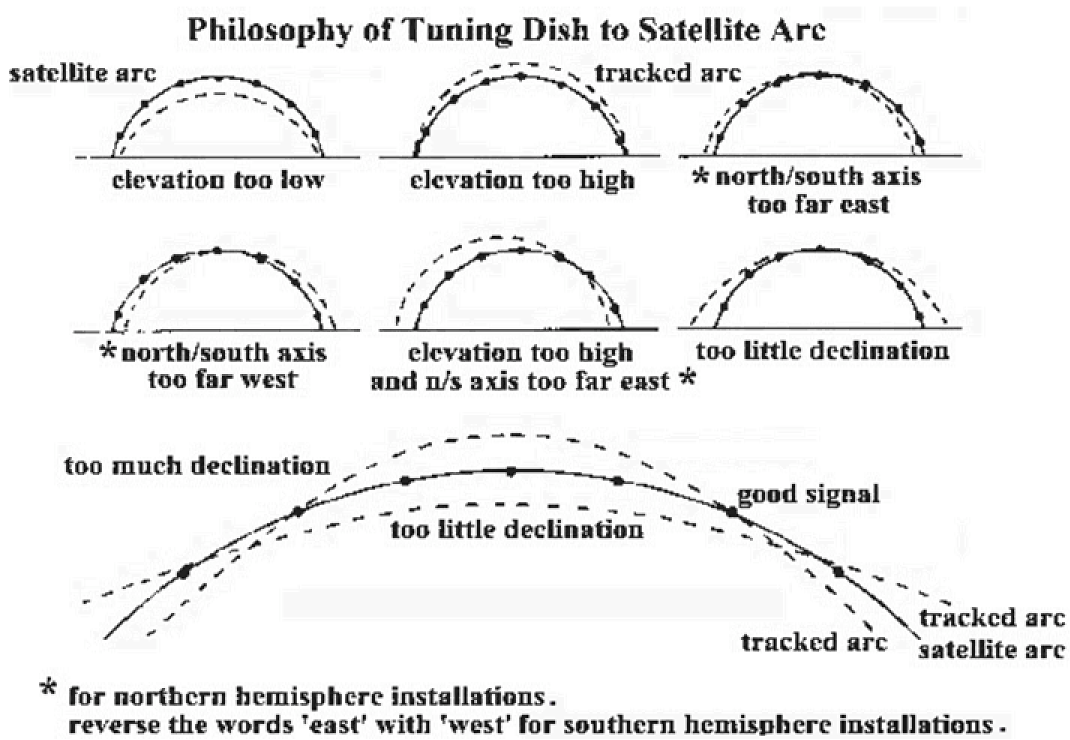
Next, refer to the diagrams below. Notice that the author of these diagrams refers to a “declination” angle. Do not confuse this with the magnetic declination angle that we discussed previously. The declination angle that this author is referring to is something entirely different. It is the actually the motor’s latitude adjustment.

Some terms are bantered about rather loosely, so be careful to take them in the context that they are presented to you so that you do not become confused.

The elevation angle is proper, that refers to the dish elevation. The azimuth angle is also proper, that is just the east/west position of the overall motor and dish assembly.

Compare your results from the earlier steps where you recorded which direction you were required to move your dish to improve your signal.





From your previous testing and recording of the information, you should be able to judge which angle is set incorrectly by comparing your results to these illustrations. You may have more than one angle that is not perfectly set, so be cautious not to over compensate for any one angle if that is the case.

Do your best to fine tune your system to eliminate these errors.

CHAPTER 15 FINISHING TOUCHES AND PEAKING THE DISH

The final step involves making minor tweaks and adjustments to your dish elevation and azimuth alignments to peak the signal from every satellite that you possibly can.

Drive the motor to the east most satellite that you can detect a signal from and adjust your dish **elevation (and only the dish elevation)** for the best possible signal. Then drive the motor to the west most satellite that you can detect a signal from and adjust your **azimuth (and only the azimuth)** for the best possible signal. Repeat this process until no improvements can be made in the signal strength.

The procedure above was recommended by Tim Heinrichs in January of 2008. Mr. Tim Heinrichs is the CEO of DMS International. DMS International is the manufacturer/importer of the SG-2100 motors. I personally trust his recommendations.

Remember, if you have done everything perfectly all the way through this guide, there should not be any reason to make any extreme adjustments to your adjustment angles at this point. A few **minor** tweaks should be all that is necessary. Anything more than a fine adjustment implies a greater problem elsewhere.

At this point, be certain that you have researched all the satellites with great scrutiny. Some satellites may not be perfectly aligned within the Clark Belt, so beware of those listed on Lyngsat or other sites that state “inclined x.x degrees”.

Normally, Lyngsat will inform you if the satellite is off course or has an inclined orbit, but some satellites may be experiencing problems that Lyngsat has not yet reported on. Consult with your friends here on this site if there are questions before you make any major adjustments to your dish and motor alignments.

CONCLUSION AND CLOSING REMARKS

There is a great deal of material covered here. With this information, you should be well informed regarding the setup and use of a motorized Ku band, offset dish.

By no means is this guide complete. There is a great deal of information available that is not covered here. There are so many topics in this hobby that a major novel sized book could be written. I don’t think that I can accomplish that just now.

This guide is a basic text with the general purpose of getting you started in this hobby. I believe that you will find it highly informative and educational. I hope that it helps you.

Sincerely

AcWxRADAR (AKA Gordy)