

FTA 17

Installing a Ku Band Satellite Dish Motor

Supplemental material to the book: ***How to Build Your Own Free-to-Air Satellite TV System*** by Dennis C. Brewer © McGraw-Hill, Dennis C. Brewer 2011 all rights reserved.

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First let me say: *"Thank you very much for buying and reading my book."*

In my book, detailed instructions for installing a horizon to horizon dish motor for your Ku band dish was left up to the individual motor manufacturers to provide. As I studied this more and more with different motors, it became clear that the motor manufactures' instructions left a lot to be desired as far as details that would facilitate an easy implementation of a horizon to horizon satellite dish motor by a novice installer. So I thought I could add some value for my readers by publishing this supplemental information on motor installations.

For this demonstration installation I selected the Motech model SG2100, which is a common, readily available, inexpensive, and very functionally sufficient motor for moving a 1.2 meter or smaller FTA satellite dish.

By now you may or may not have done enough with non-motorized dish aiming to realize that with compass aiming and localized elevation information that you have to be very close on dish azimuth and elevation to receive a sufficient signal at your receiver. You may also have recognized that "very close" leaves a little wiggle room and you can be off a little bit with azimuth or elevation and still receive a sufficiently strong signal for your receiver as long as the LNB skew is on target. Not so when installing a motor, if the initial elevation or azimuth is off the mark many of the satellites across the horizon arc simply cannot be received.

Two factors become critical when setting up the dish motor. The first is setting in the true north-south reference line and the second is getting the initial dish elevation to be right on target. The motor will make the adjustments automatically and correctly to the rotation angle and LNB polarization provided that the starting point is correct.

NOTE: *Along with proper alignment dish size will also play a role in how well, if at all, you can receive channels from the satellites on the far east or far west horizon. FTA Ku band optimum signals are achieved with a 1.2 meter dish. I use a 90 centimeter dish because it gives me the best compromise of size versus performance. The smaller 75 centimeter dish size reception is adversely impacted on distant horizon satellites and from poor weather conditions.*

Setting a True South (North) Azimuth to Align Dish and Motor

Once the motor has been unboxed and is made ready for installation on a perfectly vertical mounting mast it is necessary to strike in (for northern hemisphere residents) a perfectly (true) south azimuth for the initial set up and assembly of the motor to the dish. A true north initial setting is used for locations south of the earth's equator.

There are two practical ways to do a true south azimuth; one of those two ways being far superior in ease installation and in accuracy to the other.

Magnetic Azimuth Method

The most common method is to use a magnetic compass along with a source table for local magnetic declination to lay-in a true south azimuth line of 180 degrees as explained in Chapter 7 of my book "Build Your Own Free-to-Air (FTA) Satellite TV System. For example from Jacksonville, North Carolina the magnetic declination is + 9.6 degrees. So to point an azimuth line from locations in and around Jacksonville to the earth's rotational pole the compass reading to use would be 189.6 degrees magnetic (180 plus the 9.6 positive declination).

This method can be successfully used, however many people find using the magnetic compass method difficult to achieve 100% accuracy. Variations in the earth's magnetic fields, quality of the compass that is being used, and the user's skill level in striking an azimuth; all of which can impact the potential accuracy of this method.

Chapter 7 in my book presents specific techniques for successfully using a magnetic compass for dish aiming. The sun angle method covered in the next section is considered easier and more accurate than the magnetic method for many first-time installers.

Sun Angle Method

To use the sun angle method you have to be patient enough to wait for a day with sufficient sunshine and few to zero clouds in the sky. The sun angle is a most accurate and simple method using the sun itself to lay-in your true south azimuth line. In order to accomplish this with precision use the United States Naval Observatory Web Site to find the exact minute of the day when the sun at your location is exactly aligned with the Earth's south rotational pole.

The USNO website is: <http://www.usno.navy.mil/USNO/astronomical-applications/data-services/alt-az-us>

Below is a screen capture showing the blanks that must be filled in from the USNO site:

Sun or Moon Altitude/Azimuth Table: U.S. Cities and Towns

This data service provides a way for you to obtain a table of the altitude and azimuth of the **Sun** or Moon during a specific day, at a time interval that you specify. Simply specify the **object, date, tabular interval, and place** below and click on the "Compute Table" button at the end of the form. The altitude and azimuth values are tabulated as a function of the standard time (*daylight time is not used*) of the place requested on a 24-hour clock.

This form is for U.S. cities and towns only. For all other locations, in the U.S. or worldwide, specify the latitude and longitude using this form.

Please read the [Notes section](#) at the end of the form for details on the data and definitions of altitude and azimuth.

Object:
☒ **Sun**
☐ **Moon**

Year:

Month:

Day:

Tabular Interval (minutes):

City or Town Name:

State or Territory:

Figure 1: Screen Shot from USNO Web Site

Retrieving relevant sun time information for your installation location

First bring up the USNO web site on your Internet connected computer and enter the fields that identify your nearest city, the state and the day you will be using the information to cast a shadow for a true north-south line. Fill in the items on the web page as listed below for your web motor installation's location:

1. Select Sun for **Object:**
2. Select this year for **Year:**
3. Select this month for **Month:**
4. Select the day you will be setting in the north/south line for **Day:**
5. Select 1 minute for **Tabular Interval:**
6. Enter the name of the town/city you will be setting up the dish motor in for **City or Town Name:**
 - a. (If your city/town is not available in the data base select the one closest to you on a north south line that is in the data base. Selecting one too far east or west will skew the results.) In cases where you have to select a city way east or west of your installation location it is possible to calculate a correct time using a simple math calculation. At the equator the sun moves .25 or (1/4) degree of longitude in one minute. Use a map reference or GPS to find how many degrees of longitude separates your location from the reference city found in the USNO tables. If the reference city is located to the east of you then add the time difference from the calculation above. The result will be the time the sun moved to be exactly at the rotational South Pole. If the reference city is west of you, then subtract the time difference from the table results.
7. Enter the **State or Territory:** where you live.

Notice the button labeled "**Compute Table**" near the bottom of the screen capture shown in Figure 1. When you have all the data needed for steps one through eight above, click on the "compute table" button and the web application will return a table similar to the excerpt in Figure 2 below. The information in Figure 2 is an extract from the table generated for Kansas City, Missouri. The excerpt is abridged and edited to only show the necessary data points.

Astronomical Applications Dept.
U.S. Naval Observatory
Washington, DC 20392-5420

KANSAS CITY, MISSOURI

° ' ° '
W 94 33, N39 03

Altitude and Azimuth of the Sun
Jun 3, 2012
Central Standard Time

	Altitude	Azimuth
		(E of N)
h m °	°	°
03:43	-11.9	47.8
"table begins"		
12:04	73.2	170.0
12:05	73.2	170.8
12:06	73.2	171.6
12:07	73.3	172.4
12:08	73.3	173.2
12:09	73.3	174.0
12:10	73.3	174.8
12:11	73.3	175.6
12:12	73.4	176.4
12:13	73.4	177.2
12:14	73.4	178.0
12:15	73.4	178.8
12:16	73.4	179.6
12:17	73.4	180.4
12:18	73.4	181.2
12:19	73.4	182.0
12:20	73.4	182.9
"table ends"		
12:56	71.4	209.8

Figure 2: Extract of USNO data for Kansas City, MO

The table in Figure 2 shows; as will the information for your unique location, a minute by minute elevation (altitude) and azimuth of the sun. The point in time when you will want to cast your north-south alignment line is the time of the day when the reading for azimuth is 180.0 degrees. In the example there is no exact listing for 180.0. From the table extract in Figure 2 there is an entry for 12:17 showing 179.6 degrees and a 12:18 entry showing 181.2 degrees. A quick look at the table and doing some math shows that the sun is moving the azimuth angle at the rate of .8 degrees every minute. The example in the box shows a reading for azimuth of 180.4 at 12:17 PM. So backing off the .4 degrees requires using an exact time of 12:16 and 30 seconds as the precise time for the sun to be at 180.0 degrees. One of the best time sources to use is a cell phone from one of the major wireless phone networks showing local time. Alternatively use one of the on-line time sources to set a computer's clock and to match the time piece (clock, wrist watch, or pocket watch * use one with a seconds hand) you will be using to the computer's time, as long as the computer is logged on the Internet and is set to sync the computer's time with an on-line time source. Two of the on-line time syncs for your computer are either **time-a.nist.gov** or **time-b.nist.gov**. To check your computer in Window's operating system left click on the time clock in the tray to go to "change time and date settings", click on the "Internet Time" tab, and then click on "Change Settings" button to see if your computer is set up to sync its own time with a reliable Internet time source. Your location information and date from the USNO web site may yield an exact time for the 180.0 degree azimuth, making the extra calculations unnecessary. The information will be slightly different for every day of the year.

Tools and aids needed

To use this sun time method you will also need a few items to go along with a well sunlit day.

Those items are:

- (1) A piece of pipe or broom handle, or straight wood or metal tubing about 4 to 6 feet long
- (2) Something or someone to hold the straight pipe in a perfectly vertical orientation
- (3) An accurate watch or clock with minute and second hands or digital clock readout

Go to the location where you will be setting up the motorized dish and mark or stake the location center of the dish's vertical mounting mast as shown in Figure 1. In Figure one in the foreground notice the extra-large silver colored washer lying on the ground. This washer will provide the center mast location for the tripod mounted dish. In the distance, because I was working alone, you will see my vertical pipe setup with braces to hold it in place. I am using some extra dish mounting hardware to provide the exactly vertical reference pipe to cast the shadow at exactly the right time of the day.



Figure 3 Location for center of dish motor mounting mast is marked by fender washer.

The large washer is to the left of the blue masking tape roll in Figure 3. You could use another method to mark the mast's center such as a stake in the ground, or chalk mark if working on a concrete surface to mark where the center of the dish's mounting mast will be located.

Once you have the mounting mast center location marked, the next step is to set up your vertical reference pipe also as shown in Figure 3. The reference pipe will have to be moved frequently as the exact time for true south (180 degrees) approaches. The shadow will cast a reference line to true north-south only at the exact time from the USNO table data. Start about 15 minutes early to practice moving the reference pipe a few times being sure to retain a completely vertical orientation for the reference pipe. If the reference pipe is not vertical in both planes the shadow will not yield a true north-south line. Check each time you practice for verticality by using the bubble level at 90 degree offsets to maintain vertical in both planes.

Figure 4 shows shadow line approaching a few minutes before the marking time.



Figure 4: A few moments prior to time mark.

Once the exact time for 180 degrees is reached and you have a shadow cast by the reference pipe, then mark or stake the reference line. In the example shown in Figure 5, I used a second large steel washer and with some blue masking tape to temporarily mark my true north-south line.



Figure 5: Two washers connected by blue tape mark true north-south line

The true north-south line will be used later to align the dish and LNB with the dish motor set to zero (east/west) rotation. The motors, depending on manufacturer are able to rotate the dish mounting arm from zero to 70 (to 80 plus) degrees east or west. Look at the motor dish mounting are to ensure it is set to zero for your initial setup.

The vertical mast for the dish is set over the north end of the north-south line. In Figure 6 the mounting center tripod is exactly over the washer.



Figure 6: Mast setup exactly over mark (the washer seen in the center of mast mounting hardware).

The vertical mast is installed next and checked for level in both planes as shown in Figure 7.



Figure 7: Checking for vertical alignment with a level



Figure 8: Install motor to mast per motor manufacturer specifications using hardware provided.

Once all of the basic installation is completed again be sure the dish motor rotation arm is set to zero degrees on the pointer on the motor. On the 2100 motor there is a depression button that moves the motor when pressed and the cable is connected to the receiver and the receiver is powered up. The same button when depressed twice fast move the motor in the opposite direction, allowing you to quickly reset the pointer and motor to zero if necessary. Once the motor is assembled to the mast the motor angle indicator is on the bottom out of sight so use a small mirror to look at the motor's angle pointer to verify zero setting.

At this point be sure that the motor mounting bracket U-bolts are not tight and are free to rotate on the mounting mast. Also ensure that the dish is centered and straight on the motor's rotating arm. For many dish motor combinations the mounting bolt for the dish assembly will pass through the predrilled holes on the motor's rotational arm.

Finally line up the LNB mounting arm to be exactly centered on the north-south line; in this case the blue tape, as shown in figure 10.



Figure 9: Align LNB mounting arm to north-south line.

With the motor set to zero align the dish's LNB mounting bracket to be exactly over and in alignment with your true north-south line when the dish is oriented to south (for northern hemisphere locations) . At this point tighten the U-bolts that hold the dish motor to the mast and as explained in detail in the book, use one of the dish pointing web sites for entering the exact motor and location to find the required dish elevation for your dish/motor combination.

Set the dish elevation being careful to sum in the declination information for your motor and location to find the net off set.

Verify your dish elevation setting by using the receiver menu to move the dish to the nearest south satellite and fine-tune the elevation for optimum signal strength. It is necessary to complete blind scan and receive some channels in order to do the fine tuning.

As a reminder it would be wise to read the motor manufacturer's instructions booklet if you have one and compare and contrast those instructions with the one's presented here. There may be some synergy achieved by reading both before you begin. It may seem a little difficult doing this the first time but with a little persistence, it should work out.

Once you have the motor working on the nearest south satellite and fine-tuned if needed you can use the receiver's menu to select and blind scan all of the FTA satellites available across your horizon. Be sure to enter into the antenna setup routine on your receiver the correct frequency info for your dish's LNB. On some model receivers you may have to set enter the LNB information each time you blind scan a new satellite. It is wise to at least check it before proceeding.

Receiver Menu

From this point on the install and setup becomes dependent on the receiver's menu and software in your receiver. Essentially the steps include first selecting the nearest south satellite to your location and doing an FTA blind scan on the satellite to validate your setup. If you cannot get channels of a known FTA transmitting nearest south satellite it is very unlikely any others will work. If your setup fails recheck your work and begin again if necessary.

When a channel comes in on the nearest south satellite that can be verified as from that satellite from the info included with the signal or from verifying with a reliable source such as Lyngsat.com you may then fine tune the dish elevation manually to get an optimum signal before entering the rest of the satellite for your receiver to blind scan and capture channels.

The three things to check if you are having problems:

- (1) Ensure your North-South line is correct
- (2) Check the declination (elevation) and offset for that motor and dish combo
(note: declination offset value varies by your setup location)
- (3) Verify the (net value) dish elevation
*the dish elevation when checked with a Johnson Level and Angle Indicator should match the settings used for the same near south satellite when not using a motor.

Note: Net dish elevation setting takes into account the declination for you location with your particular motor and the angle of the motor's rotating arm.

Once you have the nearest satellite working well then it is time to blind scan in the other satellites you want to receive FTA programming from or all of them. I always set my receiver for FTA only and I can for video channels and radio (voice only) channels. Then I enter the PBS stations first into my favorites and then enter into favorites my other favorite channels such as The Pentagon channel and many of the news feeds.

Thanks again for buying and reading my book on FTA satellite. I appreciate your purchase and hope that the information in the book will save you money, provide a new hobby, and or greatly expand your TV viewing options.

My other books include:

Wiring Your Digital Home For Dummies by Dennis C. Brewer and Paul A. Brewer

Picture Yourself Networking Your Home or Small Office by Dennis C. Brewer

Security Controls for Sarbanes-Oxley Section 404 IT Compliance: Authorization, Authentication, and Access by Dennis C. Brewer

Green My Home!: 10 Steps to Lowering Energy Costs and Reducing Your Carbon Footprint by Dennis C. Brewer

How To: Quit Smoking In Only Three Days! A Personal Guide to End Tobacco Use by Dennis C. Brewer (Kindle Only Edition)

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