

Setup Procedures to Maximize a Ku-band Free-to-Air Motorized Positioner Antenna System
by David Huntington

PURPOSE OF THIS PAPER: The purpose is to introduce free-to-air legal digital satellite television and radio to newcomers in a detailed, step-by-step and easily understood set of instructions while attempting to answer related questions. This signal can be strongly received, even during hard rain, on all North American Satellites broadcasting free-to-air. Requirements include a precision-installed motorized antenna system using premium suggested equipment. The information below explains the how, why, and what while providing useful tips for both the beginner and veteran to help guarantee a successful installation.

KU-BAND FTA DEFINED: FTA stands for free-to-air digital satellite TV, radio, and music with no monthly charge. It is legal. FTA offers an excellent variety of stations in English and hundreds in foreign languages, featuring regular network programming, old classic TV programs, news programming, educational and sporting events, movies including old time classics, music, and talk radio programs. You must have an unobstructed view of the southern sky, purchase the necessary equipment, and either follow the enclosed detailed instructions or hire someone to successfully install a system. Your system must be capable of accurately aiming the antenna dish at satellites positioned every few degrees approximately 22,300 miles over the equator in geostationary orbits periodically adjusted to an accuracy more precise than .1 degree as required by the FCC. The earth is 7,918 miles in diameter and, when compared to the size of a 12 inch world globe, these satellites are about 33.8 inches away from the equator. As an evolving technology, Ku-band FTA should continue to yield even more program selections in the future. Some suggest a monthly search of selected satellites to check on possible new programming. The satellites beam their signal down to earth on individual transponders often carrying more than one station. The FTA signal is generally lineal, either horizontal (left and right) or vertical (up and down), and is circular (circular to the right or left- used by subscription only and generally exclusively encrypted, non-FTA) transmissions. An LNBF, front-of-dish feed horn is needed with the Invacom Quad LNBF being capable of switching between lineal and circular transmitting satellites when using a switching device indicated in the satellite receiver antenna set up mode. A "DISEqC" type switch or a 22KHz tone switch is needed to receive both lineal and circular signals. The satellite receiver has to be a high definition unit to receive high definition stations. A dish H-to-H (horizon-to-horizon) motor is necessary to aim at each satellite broadcasting FTA. Subscription-only companies, non-FTA, broadcast around 200 watts power down to earth. This is very strong and can be received using a dish antenna as small as 18 inches in diameter. Ku-band FTA may be broadcast with such strong signals though is often less, and sometimes as low as 25 watts. Ku-band requires a larger dish with recommendations being made later. The FTA receivers' functions include receiving, storing, editing, and researching for stations along with customizing various features and operating the dish motor.

TERMINOLOGIES DEFINED: "DISEqC", a trade name of "Stab" Positioner Manufacturer, refers to a satellite signal switch or a horizon-to-horizon positioner protocol.

1. A "DISEqC" multi-port switch, 1.0 or 1.1 protocol, installed between the LNBF and positioner allows the satellite receiver to switch between additional LNBF feeds and/or satellite dishes. Turn the 22KHz mode off when using a "DISEqC" switch, unless a second "DISEqC" switch is in use or the 22KHz switch is operating a Universal LNB built in oscillator switch (XXX explained later). Use a premium high end "DISEqC" switch for less signal loss.

2. "DISEqC" 1.2 or 1.3 is a memory protocol built into the horizon-to-horizon positioner to store satellite positions after manual (non-USAL) movement of the dish via remote control or east/west positioner buttons, under side of positioner, before storing the satellite position.

3. A 22KHz Tone Switch is a two port switch installed between the LNBF and the positioner used by a satellite receiver to switch between two satellite dishes*, LNBF feeds*, or "DISEcQ" switches. Another use of the 22KHz Tone Switch will be discussed later that applies to "Universal Type 1" LNBFs (XXX). *Turn "DISEcQ" switch mode off when using as indicated.

4. "Super Easy-Setup Elevation (SE-SE)*": This is a must have bracket designed for hanging a dish on a 42mm outside diameter (OD) positioner down tube top hole with a single mounting bolt precision east/west securing the dish on the positioner. The bracket resembles an open-ended tin can with 4 additional holes for carriage bolts: 2 for the mast clamping (eliminating a left/right dish tilt issue common to U-bolt mounts) and 2 for the dish angle setting. *Used by "Dish" and "Direct TV".

5. USALS is a satellite positioner locating protocol built into the satellite receiver. This requires the receiver to be programmed with the residing location latitude and longitude. This is to the nearest 10th or 100th of a degree to locate the first satellite*; the rest are automatically located. *The necessary "one time only" positioner and dish turning event with instructions on further positioner refinements covered later.

6. Satellite Scan or Scan all: This is a function of the receiver to scan all currently listed transponders for program materials on a satellite.

7. Transponder Scan: This searches for programming on an individual transponder.

8. Blind Search, Blind Scan, Smart Search, or Smart Scan : This is an ultimate absolute must have search engine feature for a Ku-Band Free to Air Satellite Receiver. This takes a little longer to use, searching a satellite for millions of possibilities including new unlisted transponders that may have been recently activated. This search engine is not recommended for Dish, Direct TV, and Nimiq Satellites as it may result in station duplication.

9. Setting East and West Limits prevents the dish from moving too far and perhaps striking an object. Set the East Limit for the most easterly satellite in use, and the West Limit for the most westerly satellite in use.

10. LNBF type: For North American satellites the antenna setting for linear reception (Horizontal and Vertical) is the frequency setting of "10750" for a "Standard" type LNB. Circular reception requires either a circular LNB or the dual feed (lineal and circular) LNB. The circular setup frequency is "11250" and LNBF type "Dishpro". The correct LNBF frequency to be entered in the antenna set-up mode is almost always printed on the LNBF body. A "Universal Type 1" (for lineal only) requires a different LNB type setup frequency setting of "9750/10600". The "Universal Type 1" LNBF in "blind search" can have an issue concerning an unnecessarily long blind scan that will be resolved later (XXX).

11. HD stands for high definition. Broadcast formats in 720i are considered near HD with 1080i transmissions accepted as being true HD. The satellite receiver must be a high definition receiver to receive HD. Progressive scan TVs de-interlace 1080i reception and up-convert from 30 frames to 60 frames per second providing the best picture quality in HD for 1080p, progressive scan format. High quality HDMI cables work best for HD. These cables are usually very expensive from brick/mortar stores and typically sell for less than a 1/3 such pricing from Sadoun Satellite Sales , phone 1-888-519-9595 or for more length options try "dCables", phone, 800-278-4002* (*State, **"Give me a break"**, and get an extra 10% off), with a web site "wwwdcables.net". Non-HD TVs will work with an HD satellite receiver, providing a non-HD picture.

12. 8 PSK is a new tuner modulation format compressing the broadcasted satellite signal band width for 720i and 1080i transmissions to near one-fourth of that necessary for the standard QSP format. Subscription satellite companies use 8 PSK Turbo and others use an 8 PSK S-2 tuner format. The satellite receiver must have a separate tuner board present or installed as an after-market accessory. A retro 8 PSK installation may need an updated bin file to open an operating menu and allow for proper activation.

13. AC-3 Audio: This is a digital audio format requiring an audio receiver capable of decoding 6 channel (5.1 digital) audio sound. The ".1" is the sub-woofer.

POSSIBLE HELPFUL SUGGESTIONS:

1. It is suggested that the dish carriage bolts and other hardware be changed to stainless steel, a modest cost improvement for superior weather resistance.

2. The positioner owner's manual suggested placing the positioner under the eaves of a roof out of the weather for best long term success. The same results can be achieved by cementing an upside-down dish pan to the mast top, wiring it in place, and color matching it with a special plastic spray paint.

3. Use RG6 compression, not crimp, fitting with a compression tool. Both are available from the internet. Make sure RG6 fittings have a rubber "O" ring inside for weather sealing, otherwise get the correct fitting "O" ring from a hardware store or plumbing supply. Caulking may be used over fittings to moisture seal.

4. My satellite receiver is hooked up to an L.E.D. power switch. When not in use, the power is completely cut off to extend the life of the unit's power supply. These receivers have a non-volatile memory which is immune to power outage memory losses.

5. Six in-line signal amplifiers were tested in an attempt to reduce the very small amount of signal loss in cable runs even as short as 50 feet out to the LNBF when using RG6 type wire (a better choice than the lesser RG59 type). **None made even a small improvement in the signal.**

6. **THE BRADLEY INNOVATION (an exceptional feature):** A Mr. Bradley of Maryland deserves credit for incorporating a simple modification to a positioner arm allowing for a more precise dish bracket angle adjustment. Assemble the entire dish and dish holding bracket on the ground while temporarily attaching both to the positioner. Mark a spot directly opposite the center of the LNBF arm that is free of any dish hardware (nuts, bolts, washers) that lines up within $\frac{1}{2}$ inch or higher, if necessary, from the bottom of the positioner down tube. Remove the dish and dish holding bracket from the positioner. Drill and tap the marked point on the positioner arm for a $\frac{1}{4}$ inch machine thread bolt (use #3 wire bit to drill and the $\frac{1}{4}$ inch by 28 thread per inch size tap). Now, install the dish holding bracket on the positioner down tube. Attach the $\frac{1}{4}$ inch machine bolt to the positioner down tube and turn in as far as possible. The bolt will serve as a precision signal tweaking device as will be described later.

7. **Pre-mount testing:** Before mounting the positioner and dish on the mast, attach the positioner via the RG6 cable to the satellite receiver and make sure the receiver will operate (run) the H to H positioner.

INSTALLING THE LNBF (the feed horn on the dish arm): The LNBF needs to be initially mounted such that the down-feed output(s) point down, neither left nor right with the antenna positioner in the zero position. Further tweaking will be later covered. The positioner zero position will become equal to true south after the upcoming "ANTENNA TRUING" procedure.

INSTALLING THE DISH MAST: A clear unobstructed view of the southern sky is a must. The dish mast needs to be very plumb, absolutely straight up and down (no lean at all, in or out or left or right), using a very accurate level. My personal preference in levels is the inexpensive Empire 12 inch True Blue Pro Torpedo Level (accuracy to .0005 per inch).

Warning: Not all levels are accurate enough; other very accurate brands are available at your local building supply store. Use one eye to view straight on. Incline-o-meters are simply too inaccurate compared to a good level. The offset mast included with a dish antenna has multiple angles, is difficult to get plumb, and is better changed to a straight heavy gauge metal 2 or 2 $\frac{1}{2}$ inch pole. Secure this pole in the ground with upwards to 10 cubic feet of concrete. There are other means of securing a straight metal mast than suggested here. Along with being perfectly plumb, the completed mast needs to be extra stout so it will not move even from high winds with the installation of upwards to 40+ pounds of dish and positioner hardware.

POSITIONER INSTALLATION AND ANTENNA TRUING: Click on the satellite receiver "menu" button with the TV on and switch to "installation mode". Then go to the "antenna set up

mode". Enter "OK" and use the up or down cursor to find the southern satellite you should use as a **DESIGNATED** satellite, preferably, close to your longitude (Allow for your declination when using a compass: The degrees of deviation from magnetic south to true south varies where you reside. The best source, NOAA, can be found by going to web site "Find your declination value".). The **DESIGNATED** satellite does not have to be one you will use to receive desirable FTA channel(s). Consult a channel guide as long as you have clicked on a known actively transmitting transponder for initial setup. Not all transponders listed on a satellite menu may be activated. FTA channel lists include web sites "North & South America - Lyngsat" (good), "FTAList.co.cc." (better), and "Sathint.com/america" (best). Click on each listed satellite for channels available. The table below was compiled for an initial setting of the positioner bracket elevation setting and the separate dish bracket angle setting.

The back of the dish bracket has degree markings referred to as the "Dish Bracket Angle" that can now be temporarily set and secured before installing the dish on the positioner arm as per your latitude listed next.

Ku Band Dish Bracket Angle and Positioner Elevation Table

<u>Your Degrees of Latitude</u>	<u>Positioner Elevation</u>	<u>Dish Bracket Angle</u>	<u>Your Degrees of Latitude</u>	<u>Positioner Elevation</u>	<u>Dish Bracket Angle</u>
70-----	20-----	21.5	40-----	50-----	23.7
68-----	22-----	21.6	39-----	51-----	23.9
64-----	26-----	21.7	38-----	52-----	24.0
62-----	28-----	21.8	37-----	53-----	24.1
60-----	30-----	22.0	36-----	54-----	24.2
58-----	32-----	22.2	35-----	55-----	24.4
56-----	34-----	22.2	34-----	56-----	24.5
54-----	36-----	22.4	33-----	57-----	24.6
53-----	37-----	22.4	32-----	58-----	24.8
52-----	38-----	22.5	31-----	59-----	24.9
51-----	39-----	22.6	30-----	60-----	25.0
50-----	40-----	22.7	29-----	61-----	25.2
49-----	41-----	22.8	28-----	62-----	25.3
48-----	42-----	22.9	27-----	63-----	25.5
47-----	43-----	23.0	26-----	64-----	25.6
46-----	44-----	23.2	25-----	65-----	25.8
45-----	45-----	23.2	24-----	66-----	25.9
44-----	46-----	23.3	23-----	67-----	26.1
43-----	47-----	23.4	22-----	68-----	26.2
42-----	48-----	23.5	21-----	69-----	26.4
41-----	49-----	23.6	20-----	70-----	26.6

The elevation needs to be set on the positioner mounting bracket attached to the H-to-H-motor and permanently secured (on the side of the positioner mounting bracket) to where the installation is taking place. This is based on latitude using the corresponding elevation number from the above table before proceeding. Use anti-seize bolt compound on the bolts. Positioner elevation and latitude are not the same number; however, several positioners list elevation on one side of the bracket and the corresponding latitude on the opposite side. Setting either the correct latitude on its scale or elevation on its scale provides the desired results.

The positioner tends to torque to the right or left when tightening the positioner U-bolts on the mast, throwing off the plumb antenna mast work. Critically important: Place an accurate level left/right on the top of the positioner bracket while tightening the clamps. Grab the positioner down tube (with the dish not attached) and move to assure an accurate reading of level while finger tightening the positioner clamp nuts. Then uniformly wrench tighten each nut 1/2 turn at a time to absolutely maintain the level

reading. AFTER securing, install the dish antenna on the positioner down tube. Locate the correct latitude and longitude figures for the **residing dish setup location** by doing a "Google" search for "Lat-Long Finder". Find the "Centre the map around" statement, and enter your address including the zip plus four, and "USA" in the provided box, then search. Make sure and use the decimal equivalent results. Zip plus four numbers are available from your local post office. Latitude and longitude figures are available from maps at your local outdoor outfitter or library, and are also found with hand-held GPS units. Another option is to purchase a "DeLORME State Map Atlas & Gazetteer" for **your state** detailing latitude/longitude values. Rounding reminder: 60 seconds = 1 minute and 60 minutes = 1 degree (**each 6 minutes = .1 degree**). Also remember to designate latitude as "N", for north, and longitude as "W", for west when entering the latitude and longitude figures **ONCE** into the USALS receiver mode. Send the positioner with the attached dish using USALS mode and the satellite receiver remote control (dish elevation should have been previously set) to reference or "0" position. Then send it to the **DESIGNATED** southerly satellite, and finally store this position in both USALS and motor* (* listed as manual or "DISEcQ motor mode) mode.

Set up to monitor the signal quality. If you intend to use the satellite receiver S-video or HDMI output to your indoor TV, then you will need to **temporarily** hook up an RG6 coax feed from the satellite receiver to this TV to perform the following setup procedures. Use a suggested **at the dish antenna handheld TV**, preferably color, **hooked up to the indoor TV on a signal splitter via an RG6 cable**. Please consider borrowing a handheld TV if necessary for safety reasons. Signal monitoring by a pricey satellite signal meter with a built-in TV and satellite receiver, as with the Trimax Satellite Meter, is another option and would eliminate the need for a temporary satellite receiver to TV RG6 coax hookup. A modestly priced audible or needle-pointing type satellite finder tool will not discriminate between satellites and may damage an LNBF hooked to an in-line amplifier.

Tighten a stainless steel hose clamp around the antenna mast up next to the bottom of the positioner mounting bracket to provide an antenna dish/positioner slide down mast stop before proceeding. **Now you are ready for the initial setup positioner and dish ONE TIME ONLY turning event.** Loosen each nut $\frac{1}{4}$ turn at a time on the back of the positioner bracket until the positioner with dish can be swung into where the highest **quality** of signal shows on the signal monitoring device. Make sure the satellite receiver is turned on and has been tuned to an earlier **DESIGNATED** southern satellite with a **KNOWN ACTIVE TRANSPONDER**. Carefully nudge the positioner with dish back and forth (east and west) with extreme precision to confirm the highest **quality** signal location with the dish angle adjustment slightly loosened to allow for an up and down dish tilt to locate its best spot. After placing a level on the top of the positioner. Re-tighten the positioner permanently to the mast $\frac{1}{4}$ turn at a time on each nut of the positioner bracket to avoid positioner bracket tilt. Re-check for positioner bracket level and correct if needed. Check the dish elevation signal hot spot and then tighten in place. The above swing into signal procedure in USALS mode automatically aligns the positioner "0" position to **true south**. This is the **only way** to be assured of locating the "0", also called "Go to X", position as being true south. Properly setting the true south position enables the positioner to drop the dish either side of the "0" position high point on the horizon assuring accurate tracking of the satellite arc over the equator. This will permit the positioner to locate all satellites in line of sight when using the USALS positioner mode based on satellite longitude location currently listed in the satellite receiver menu.

Re-check the dish bracket angle by using the **BRADLEY INNOVATION** bolt. Tune the satellite receiver for this adjustment and the below listed **tweaking procedures** to a moderate (see my channel guide) or weak **quality** lineal transponder. Rotate the **BRADLEY INNOVATION** bolt out to where it touches the back of the LNBF arm, loosen the bracket angle setting bolts, and adjust the dish angle elevation to thousandths of an inch ($\frac{1}{8}$ turn at a time) to assure the best **quality** of signal on the signal monitoring device. This precision is otherwise doubtfully attainable. When the highest **quality** of signal

has been confirmed, secure the original dish bracket angle setting bolts. Leaving the **BRADLEY INNOVATION** bolt touching the LNBF arm on the back side of the dish will now serve as a stop for potential elevation sag from any slippage of the original dish bracket angle setting bolts.

Some LNBFs do not have the internal horizontal and vertical signal receiving pins installed true to the "0" position on the top of the LNBF. This is either due to sloppy manufacturing or purposely as with Extreme Brand LNBFs. These LNBFs need a further adjustment described next to maximize the signal received. The LNBF position should be **tweaked** by carefully loosening the top of the LNBF clamp just enough to allow the LNBF to be slowly slid in and out and rotated left and right (skew setting) in a very firm clamping mechanism in precision increments to find the highest **quality** signal with the monitoring device before securing. An additional **tweaking** to the LNBF arm may also improve signal. Torque the LNBF arm several thousands of an inch up or down to confirm the best signal spot. It is **now time to install dish ribs** to precision secure the LNBF arm to accommodate heavy bulky LNBFs.

The **outdoor installation work** has been completed. Move indoors to use the USALS automatic positioning mode to initially locate and store the position of each satellite. Exit this mode and go into the "DISEcQ" manual* antenna position mode to tweak the antenna position for each satellite in use for the strongest signal using the in-house TV. ***(WARNING: Some receivers will list this mode as simply "motor" or other designation than the automatic "USALS" positioner mode.)** The procedure for finding the highest **quality** signal is to use the "DISEcQ" 1 step manual mode using the satellite receiver's remote control to go east until the signal starts to fall off; then go west until it does the same; and then go back to the mid-point of the high signal and store this location. The exception to this rule is when using the incredibly accurate USAL mode on the Openbox S 9, S 10 and subsequent models of this satellite receivers that keeps the positioner true to its satellite positions for extended time periods. Once the hottest signal has been confirmed and stored for the first satellite being used, it is best to do a "blind type" scan (unless as earlier explained you are on a Direct TV, Dish, or Nimiq Satellite), if available, or satellite "scan all" for "FTA only" designated stations. "FTA Only" avoids unavailable scrambled signals listed that would only have to be deleted. Otherwise your receiver may not hold the satellite location as a stored position.

RE-CALIBRATING THE HORIZON-TO-HORIZON POSITIONER USING THE "go to" function. Once a week I suggest that you go back into the "antenna position" mode, locate a signal on a satellite at least 20 degrees from the "0" position, and go to the caption "go to 0 position" (or reference position). Click on the remote control "OK" button and wait until the dish has stopped moving to the "0" position (due south from your residence). Use the positioner control instructions indicated as "go to satellite position" and again click on the "OK" button while waiting for the signal to return. Dish antenna has returned to your selected satellite. The antenna positioner has just been re-trued for all satellite locations stored. The above procedure assures continued accurate operation.

RECOMMENDED FTA SATELLITE RECEIVER: My personal preference is the Openbox S 10 HD PVR Receiver and subsequent newer models. This receiver is one of a very select few, perhaps the only, that operates a positioner to absolute precision in the automatic USAL mode. It also uses the latitude and longitude, other receivers use 1/10th degree, to 1/00th degree. Unlike most competitors, it draws such a small amount of power (less than 10 watts), heat is not an issue, omitting the need for the typical noisy cooling fan. The reliability of this receiver is incredible.

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