

# Installation Manual

## DIRECTV® Ka/Ku Multi-Satellite Dish Antenna with 5 LNBS and Built-in Multi-Switch

### Introduction

This Ka/Ku Multi-Satellite Dish requires specialized tools and equipment for successful installation, therefore we recommend professional installation only. This manual is a guide for the professional installer.

The DIRECTV Ka/Ku Multi-Satellite Dish antenna is primarily designed for use with up to four independently operating DIRECTV Ka/Ku MPEG 4 HD Receivers but will function with other DIRECTV receivers as well. Along with the receiver User Manual, this guide will provide the information needed to successfully install and operate the DIRECTV System. Throughout this manual, the DIRECTV Multi-Satellite Dish antenna will be referred to as the "antenna."

For best results, we suggest you read carefully through these pages first before beginning installation. The guide is intended for individuals experienced in performing the various tasks described, including:

- Determining an antenna location with a good southerly view of the satellites
- Climbing a ladder and working on your roof
- Observing safe working practices around heights and electrical hazards
- Determining if there are water pipes, gas lines or wiring hidden in walls where you are going to drill
- Using a power drill to drill holes into a structure
- Routing coaxial cable(s) through foundation, wall, under-floor, attic or interior walls
- Safely lifting and securing the 30-lb. antenna assembly
- Grounding the antenna and cable(s) as recommended in the National Electric Code (NEC)\*

### Safety Information

Local and National electrical codes (NEC) require the antenna and the coaxial cables to be connected to a grounding electrode. Improper installation may seriously damage the equipment or the building, as well as cause injury or death to you. For your own safety, follow these important safety rules or contact a licensed inspector or electrician in your area for assistance:

- If you will be mounting the antenna in a location where it will be difficult or dangerous to view the attached bubble level (see page 6), use a small mirror or plumbing level instead. DO NOT risk falling.
- Perform as many functions as possible on the ground.
- Do not install the antenna on a rainy, snowy or windy day.
- Make sure there are no people, pets, etc. below when you are working on the roof.
- Watch out for power lines which may be overhead, underground and/or hidden behind walls, keeping safely clear of them with ladders, antenna and tools during installation.

The Federal Communications Commission (FCC) has ruled that a local government or homeowner's association may not prevent the installation of satellite antennas one meter or smaller in diameter, unless legitimate safety restrictions such as fire codes are in effect.

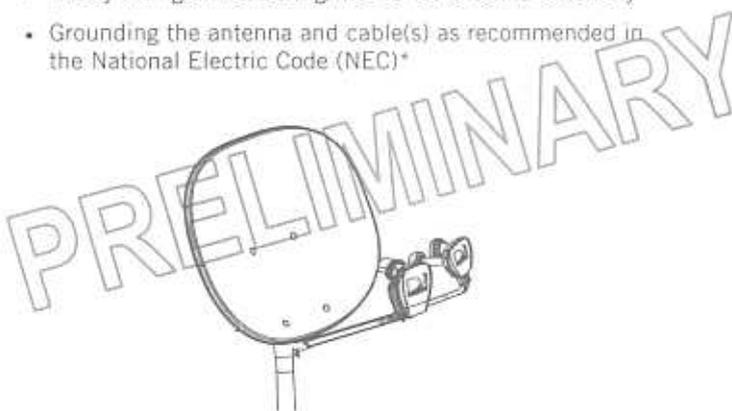
Call FCC tel: (202) 418-0163; See FCC Web sites at

<http://www.fcc.gov/cgb/satellite.html> or

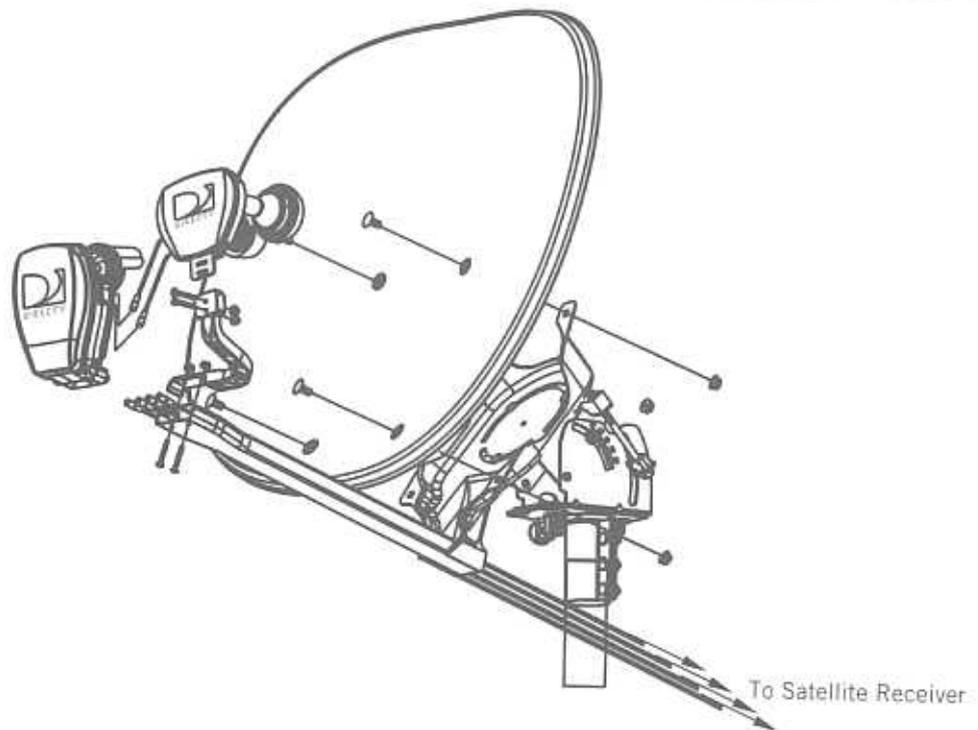
<http://www.fcc.gov/mb/facts/otard.html> for more information.

ACTIVATION OF PROGRAMMING MAY BE SUBJECT TO CREDIT APPROVAL AND REQUIRES VALID SERVICE ADDRESS, SOCIAL SECURITY NUMBER AND/OR MAJOR CREDIT CARD. DEPOSIT OR PREPAYMENT MAY BE REQUIRED. Programming subject to change. You must be physically located in the U.S. to be an authorized DIRECTV customer. DIRECTV services not provided outside the U.S. DIRECTV programming is sold separately and independently of DIRECTV System hardware. A valid programming subscription is required to operate DIRECTV System hardware. Activate your DIRECTV programming today at 1-800-DIRECTV (1-800-347-3288).

\*NEC is published by the National Fire Protection Agency, 1 Batterymarch Park, Quincy, Massachusetts, 02269-9101 and may be available at your public library.



## Antenna Assembly Overview



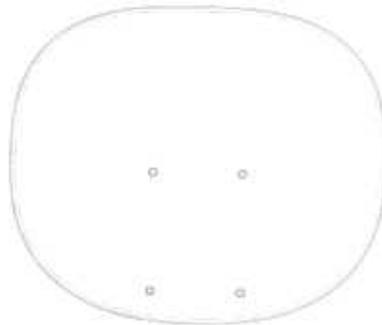
## Contents of Package

### Dish Mounting Hardware

1/4"-20 UNC\*3/8"L screw 4EA  
1/4"-20 UNC NUT 4EA



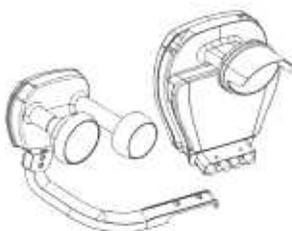
### Multi-Satellite Dish Reflector



### LNB Arm/Antenna Back Assembly

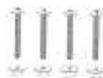


99°/101°/103° Ka / Ku  
LNB with built-in Multi-Switch  
and 110°/119° LNB.



### LNB Mounting Hardware

#8-32UNC\*1-1/8" screw 2EA  
#8-32UNC NUT 2EA



### EZALIGN™ Mast



### Grounding Screw

#10-32UNF\*1/2L screw 1EA



36" RG 6 jumper cable and  
F female barrel adaptor

110°/119° LNB Mounting Bracket

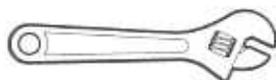
## Tools Required

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1/2" Nut Driver



Adjustable Wrench



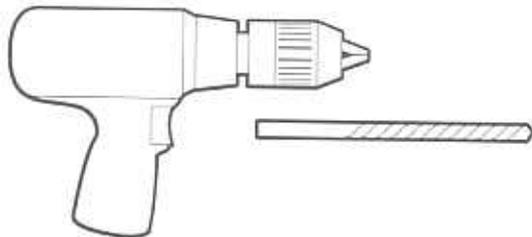
Screwdriver (Phillips)



Magnetic Compass



Electric Drill and Bit



## Steps for Installation

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- 1 Determining Coordinates for Aiming Antenna.....page 4
- 2 Finding Suitable Antenna Site .....page 5
- 3 Installing EZALIGN™ Mast .....page 6
- 4 Assembling/Adjusting Antenna on Ground.....page 7
- 5 Attaching Antenna to Mast.....page 7
- 6 Routing RG 6 Cable(s) .....page 7
- 7 Grounding Cable and Antenna .....page 8
- 8 Attaching LNB to Antenna.....page 8
- 9 Aiming and Fine-tuning Antenna.....page 9

### Information Also Included:

- Loss of Signal/Rain Fade.....page 11
- Installation with Long Cable Run.....page 12
- Troubleshooting Check List for Initial Installation.....page 12
- Appendix: Adjustable Beam Separation for 101&119...page 13

## Optional Accessories (not included)

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Typical installation kits (sold separately) include:

- Mast base mounting hardware
- RG 6 coaxial cable(s) with F connectors
- Grounding hardware, grounding wire, wire clips, etc.
- Monopole (mast stabilizing arm).



Depending on the receiver model, the display may look different from shown. In this example, a Southern California ZIP code "90732" is entered and receiver outputs:

- Azimuth- 137°
- Elevation- 47°
- Tilt- 116°

Azimuth  
(horizontal, side-side)



\_\_\_\_\_

Azimuth

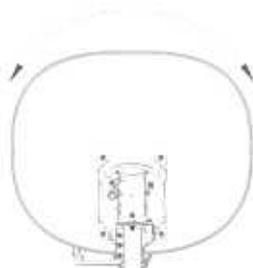
Elevation  
(vertical, up/down)



\_\_\_\_\_

Elevation

Tilt  
(dish reflector rotation)



\_\_\_\_\_

Tilt

## STEP 1 Determining Coordinates for Aiming Antenna

The coordinates (Azimuth, Elevation and Tilt numbers) are based on the local ZIP code and can be determined easily by using the receiver. You will need these numbers for the site survey and antenna adjustments.

**NOTE:** The antenna does not need to be installed for this step:

Connect the receiver to the TV.

Consulting the receiver manual, connect the receiver's video or Channel 3/4 outputs to the corresponding TV input. Turn on the TV and the receiver.

### Set the antenna type

Navigate to the antenna installation screen menu. Select installation as a "Ka, 5 LNBs".

### Find the coordinates

Navigate to the antenna-pointing menu screen. Enter the local ZIP code, then write the numbers in the space provided below.

## STEP 2 Finding Suitable Antenna Site

A suitable antenna site requires an unobstructed view of the southern sky, a stable antenna mounting surface, a distance of 100-ft or less for RG 6 cable from the antenna to the receiver, and grounding nearby.

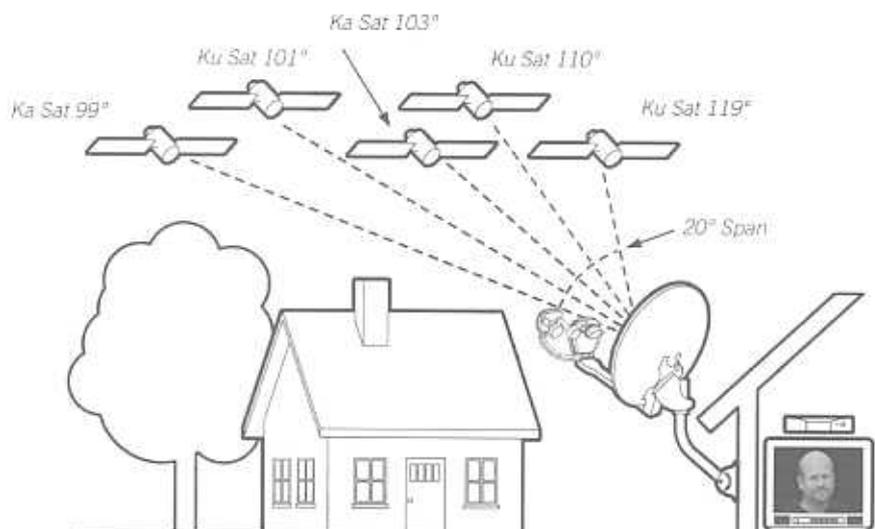
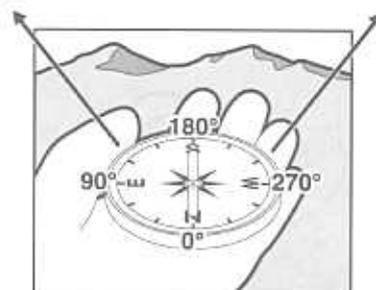
**NOTE:** It's important to estimate the cable length at this point.

The DIRECTV satellites are located in the southern sky above the Equator. The location for the antenna must have elevation-angle clearance (above the horizon) and a 20° span clearance (from 99° to 119°) for an unobstructed view to all five satellite locations. Northern border states have elevation readings toward 30° and southern border states have elevation readings toward 60°.

**NOTE:** If you are replacing an existing 18" or Triple head dish you will need to install a new mast and hardware to support this larger dish. An optional Monopole is recommended for all Ka/Ku installations.

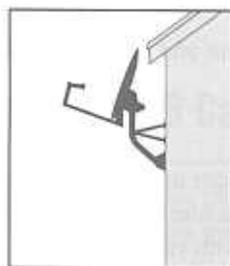
*If you are on the West Coast, the satellites will be to the south-southeast.*

*If you are on the East Coast, the satellites will be to the southwest.*

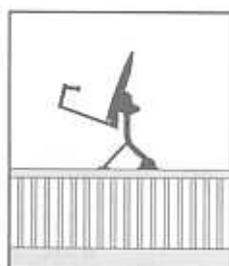


*No trees, leaves, buildings can be in the line-of-sight between antenna and satellites.*

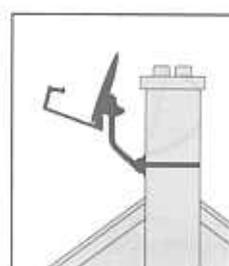
*Due to the many configurations possible, mast-mounting hardware is not included. Be sure you have the necessary mounting hardware before you begin. Optional Monopoles are available and recommended for all installations. Below are potential mounting sites.*



*Stucco Exterior Wall  
(With two optional Monopoles)*



*Wooden Rail  
(With one optional Monopole)*



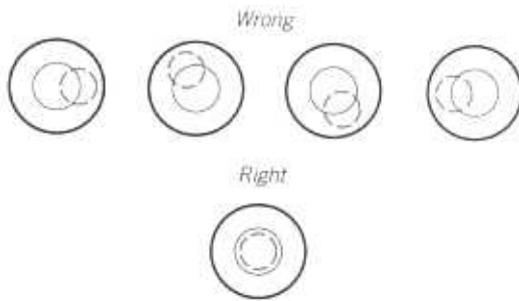
*Chimney*



*Ground*

## STEP 3 Installing EZALIGN™ Mast

View of bubble level on top of mast

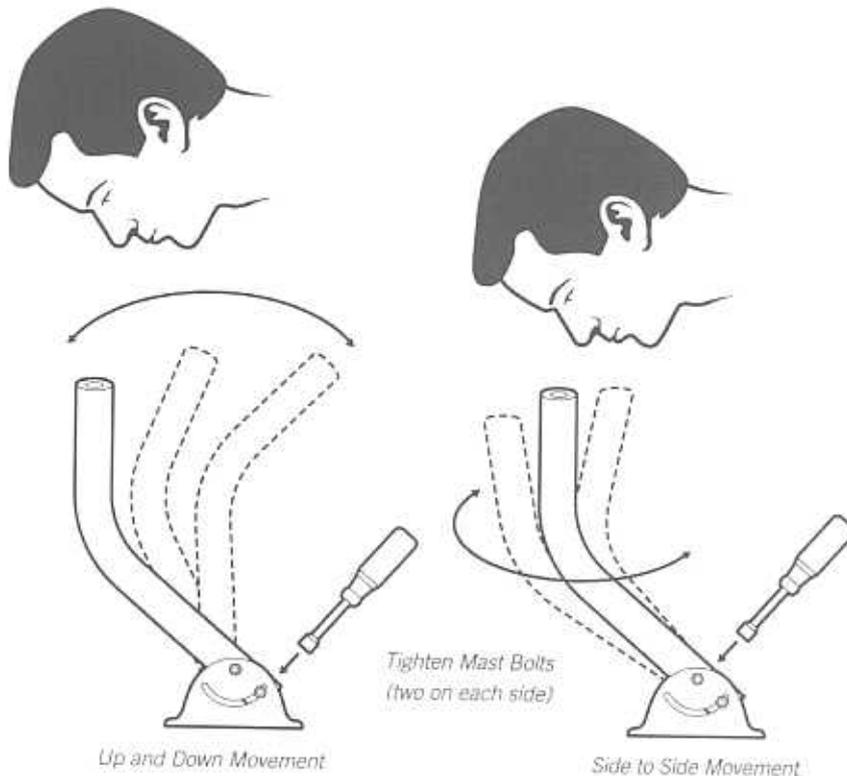


Side view of bubble level in the mast



Looking down into mast

The patented mast has two slots at the bottom that allow it to move up and down and side to side. This aids in centering the bubble level even when the mast base is mounted on an uneven surface.



Now, you're ready to install the antenna mast at the location you've chosen in Step 2 and align it to be plumb (perfectly straight up). Plumbing the mast is critical for the Multi-Satellite Dish antenna to receive optimal signals. Failure to align it properly will result in difficulty acquiring signals as well as a greater tendency for signal outages in adverse weather.

**NOTE:** Optional Monopole is recommended for all installations.

### Mount the base securely

The mast base must be sturdy so antenna does not shift under various weather conditions and its own weight. Mounting is preferable on wood or masonry. Unsuitable sites may be handrails, aluminum or vinyl siding, composite paneling, and fiber/particle/strand boards.

**Caution!** When installing mast base, avoid placing finger between mast bottom and base to prevent being pinched or cut.

### Align the mast

- The EZALIGN Mast pivots up and down, and side to side. A bubble level is located in the top of the mast to assist in alignment.
- Loosen the four mast bolts slightly. Then move the mast up/down or twist side-to-side until the bubble in the bubble level is centered as shown at left.

**Caution!** If the mast is mounted in a location where it is difficult or dangerous to view the bubble level, use a small mirror or plumbing level instead.

DO NOT reach out and risk falling from roof or other high place.

### Tighten mast bolts

When mast is straight up (plumbed), and while still keeping hold of the mast, tighten the four bolts with a 1/2" nut driver with your other hand. Make sure bolts are secure. You may want to tighten further with an adjustable wrench.

## STEP 4 Assembling/Adjusting Antenna on Ground

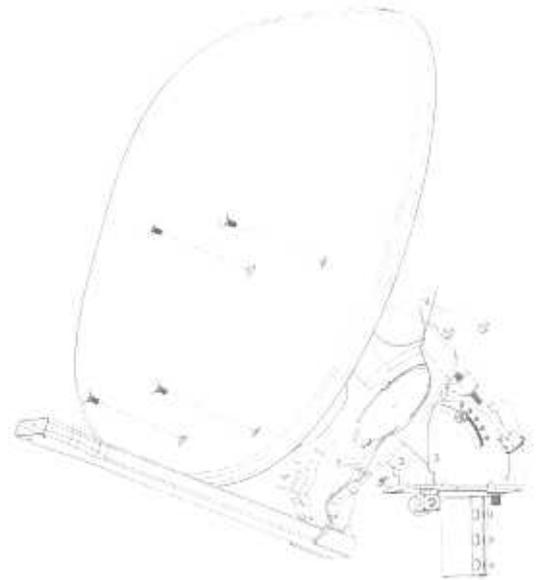
On even ground, attach dish to the LNB Arm/Antenna Back Assembly as shown. Leave off the 5-head LNB until the antenna is mounted on the mast and you've routed cable through the LNB Arm.

### Set the Tilt

- At the back of the antenna assembly, loosen the Tilt nuts and then set the Tilt adjustment according to the coordinate number you obtained in Step 1.
- Loosely tighten the Tilt nuts as the tilt will be fine tuned in a later step.

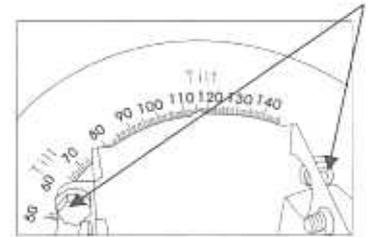
### Set Elevation Adjustment

- At the side of the antenna assembly, loosen the two Elevation nuts (one on each side) and preliminarily set the Elevation. In this example we show adjustment, per the coordinate number obtained in Step 1.
- Tighten the left side Elevation nut only (as viewed from the rear of dish). You will fine tune Elevation in a later step.



Tilt Nuts

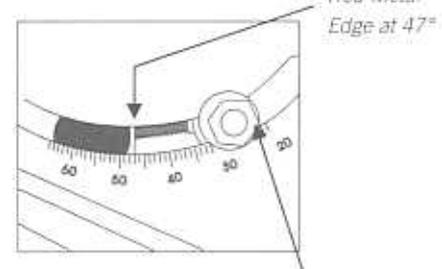
This example shows a Southern California ZIP code 90732, the Tilt setting is 116°.



## STEP 5 Attaching Antenna to Mast

- Slide the AZ/EL mast clamp onto the top of the mast until it bottoms out inside the AZ/EL mast clamp base. If necessary, slightly loosen the mast clamp bolts so the AZ/EL mast clamp will slide fully onto the mast.
- Tighten the mast clamp bolts just enough so the antenna has only side-to-side movement (rotational swing around the mast) for later Azimuth alignment in Step 9.

This example shows a Southern California ZIP code 90732, the Elevation setting is 47° (use the position of the metal edge to the Elevation scale; do not use the washer or the bolt as reference).

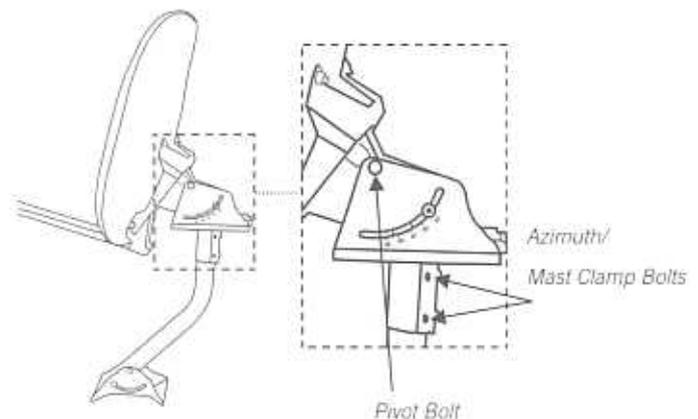


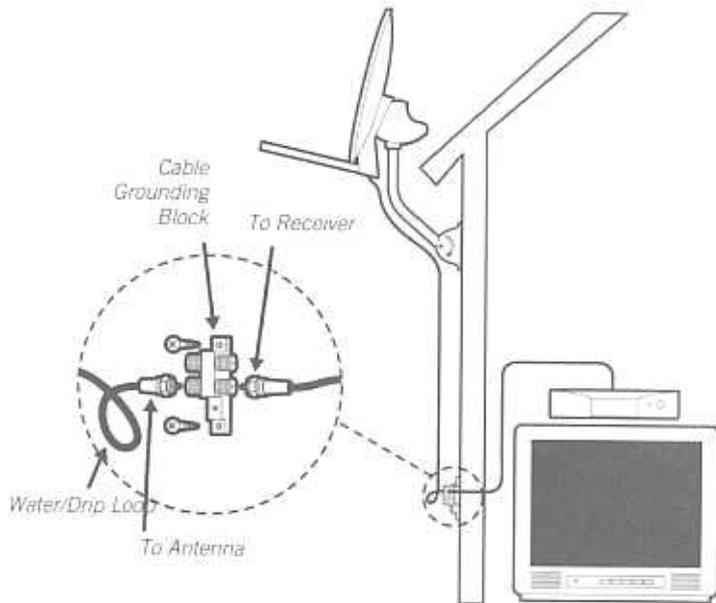
Red Metal Edge at 47°

Elevation Nuts, one on each side

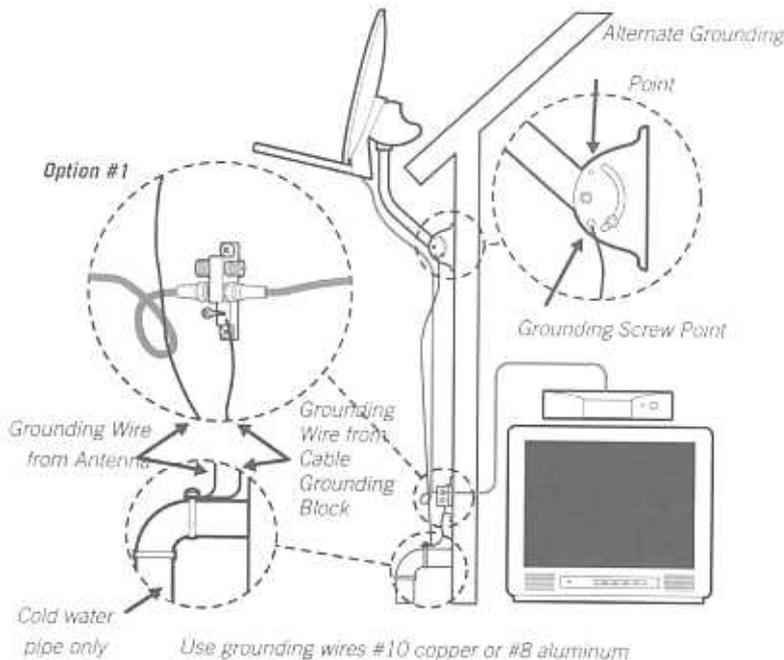
## STEP 6 Routing RG 6 Cable(s)

You will route RG 6 cable from the receiver to the cable grounding block, then from the grounding block to the 5-head LNB. Before starting, inspect the inside of each cable connector for foreign materials and/or short. Make sure that the copper center conductor is straight and centered in the connector.

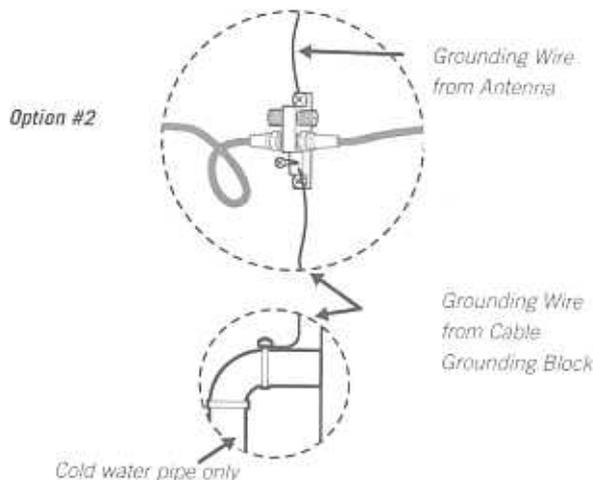




Dual grounding block, one receiver hook up shown



Use grounding wires #10 copper or #8 aluminum



### Run cable from receiver

Verify that there are no wires or pipes blocking the location where you want to feed the coaxial cables into the home. Drill a 1/2" inch hole for each cable. Connect cable to the "Sat In" jack on the back of the receiver. To prevent short, leave receiver unplugged until Step 9.

### Connect to grounding block

Mount the grounding block close to the point of cable entry into the house. Connect cable to grounding block as shown.

## STEP 7 Grounding Cable to Antenna

Grounding the antenna and cable grounding block help protect the satellite receiver system and other components from lightning damage.

- Ground wire can be attached anywhere on the metal part of the antenna, but there is a convenient grounding screw at one side of the mast base. *Installation should comply with local codes and the National Electric Code (NEC, Sections 250 and 810).*
- Grounding point can be an outside metal cold water pipe at point of entry (**no** gas or hot water pipes), 8-foot ground rod, grounded metallic service raceway, grounded electric service equip enclosure, etc. **Option #1:** Both ground wires go to the same ground point. If the two grounding points are different, a #6 copper wire should be connected between them. **Option #2:** The dish antenna grounding wire goes to the grounding block first, then to the grounding point.

## STEP 8 Attaching LNB to Antenna

The 110°/119° Ku LNB bracket has three mounting holes that correspond to three different zones across the country. **See the Zone Chart included with this manual and follow instructions carefully.**

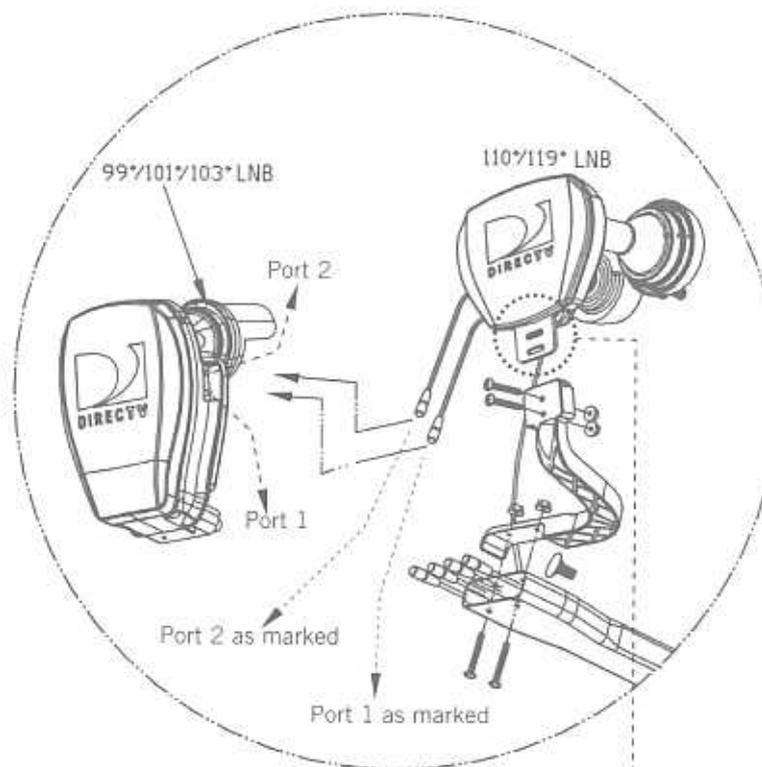
It is recommended that the LNBs are attached to the LNB Arm/Antenna Back Assembly after the antenna is mounted on the mast.

The 99°/101°/103° main LNB has four identical outputs. Each output supports one independently operating receiver. To simplify future installations of additional receivers or other components, it may be desirable to route more than one cable to the antenna at this point. However, only one cable is needed for antenna fine-tuning and alignment.

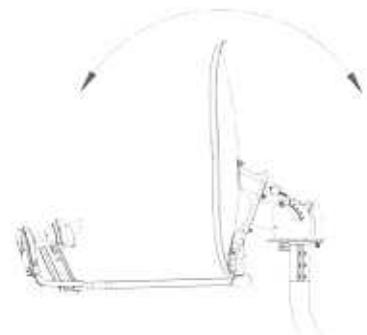
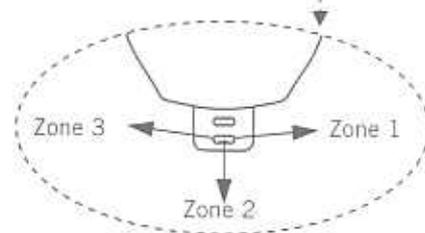
A 36" RG 6 pigtail is provided for connection from one main LNB output to an external in-line signal meter. After antenna alignment, this pigtail can be connected to the RG 6 down-lead to the customer's receiver using the supplied "F" barrel adaptor. Attach all RG 6 cables to the LNB and assemble the LNBs to the dish before attempting alignment.

- Assemble the 110°/119° Ku LNB to the 110°/119° bracket as shown. Set per zone chart (see Appendix).
- Route all RG-6 cables through the Antenna Back Assembly and LNB Arm and connect to the 99°/101°/103° LNB outputs. **Mount this LNB to arm first.**
- Connect the supplied coaxial jumper cables from Port 1 of the 110°/119° LNB to Port 1 of the 99°/101°/103° LNB. Also connect Port 2 of the 110°/119° LNB to Port 2 of the 99°/101°/103° LNB.
- Attach the 110°/119° Ku LNB with bracket to the 99°/101°/103° LNB Arm/Antenna Back Assembly using the two supplied screws and nuts.
- Make sure all needed RG-6 cables are attached at this point. **It is important to not remove the LNB from the dish after antenna alignment.**

**NOTE:** 99°/101°/119° LNB is keyed at the bottom to prevent mix up of LNB & Dish from different suppliers. Do not attempt to defeat this feature.



Hooking up cables (one shown) to the LNB and attaching the LNB to Antenna — up to four cables can be connected this way.



## STEP 9 Aiming and Fine-tuning Antenna

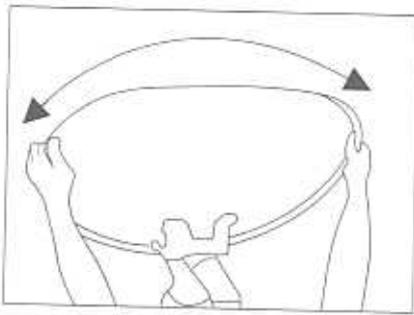
The DIRECTV 5-LNB Ka/Ku Dish must be installed with greater precision and accuracy over previous Ku only systems. This is due in part to close spaced adjacent satellite orbital slots which may not be in use at the time of this installation. Misalignment problems may not show up right away.

An external, in-line signal meter is required for antenna alignment. Alternate instructions are provided for in-line signal meters that do not have voltage and tone options and use the customer receiver as the LNB power source. **Use of a DIRECTV receiver as a signal meter for antenna alignment is not an acceptable method for peaking the antenna.**

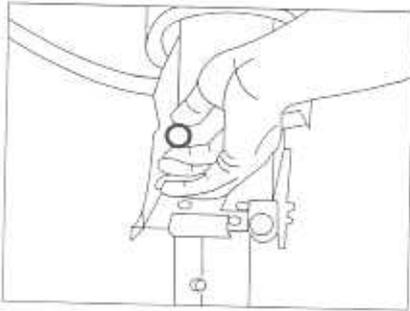
Some steps require counting turns and recording signal levels. A pen or pencil is recommended and space is provided in this manual to record data.

### Coarse align Azimuth and Elevation

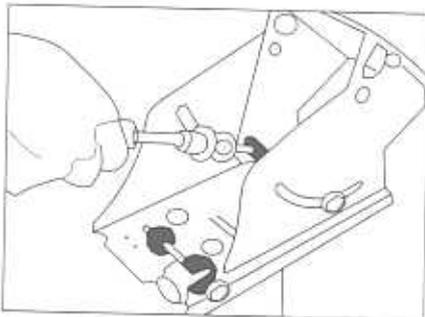
- Set the in-line signal meter for 101° RHCP reception (13 volts with no 22KHz tone). Alternate method is to select 101° satellite and an odd numbered transponder on the customer's receiver to power the LNB.
- Slowly rotate the antenna around the mast in the Azimuth direction until a peak is obtained, and then lock down the mast clamp bolts.
- Using a 1/2" Nut Driver, adjust the fine elevation screw for maximum signal level. If the fine elevation screw runs out of range, or is not centered in its range of movement, loosen the elevation lock down screw and move the coarse elevation slightly to keep the bolt centered.



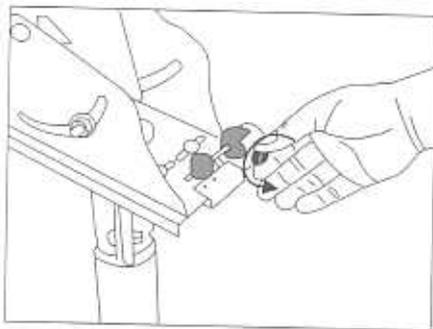
With the Tilt lock down nuts slightly loose, grasp the outer edges of the dish to peak the tilt



Start Elevation Fine-tune by grasping the black Elevation readout dial and rotate until "0" is lined up with the indicator



Use a 1/2" Nut Driver to turn the Elevation Fine-tune screw. Accurately count turns during this step



Rotate and pull out the Dither Lock Pin to enable Dither side-to-side movement

- Record the coarse alignment signal level at this point for comparison during a later step

Signal Level \_\_\_\_\_

After coarse alignment, verify reception of a DIRECTV 101° satellite with a meter capable of positively identifying a satellite or use the customer receiver. Broadband signal meters may respond to satellites other than DIRECTV so this is an important step.

#### Fine-tuning the Tilt

- Set the in-line signal meter for 119° RHCP reception (13 volts with 22kHz tone). An alternative method is to select 119° satellite and an odd numbered transponder on the customer receiver to power the LNB.
- Slowly rotate the dish (left and right), around the tilt axis, in order to peak the 119° signal, then carefully tighten the Tilt lockdown nuts.

#### Fine-tuning the Elevation

- Set the in-line signal meter for 101° RHCP reception (13 volts with no 22KHz tone). An alternative method is to select 101° satellite and an odd numbered transponder on the customer's receiver to power the LNB.
- With the Elevation having been coarse peaked previously, now grasp the plastic Elevation readout dial and rotate until 0 is lined up with the indicator. Be careful not to turn the Elevation fine adjustment bolt during this step.
- Using a 1/2" Nut Driver, rotate the Elevation fine tune screw exactly **2 full turns COUNTER CLOCKWISE** and record the level from the signal meter. (This level will be lower than that obtained in the Elevation coarse peak.)

Signal Level \_\_\_\_\_

- While counting the exact number of turns as well as fractions of a turn, rotate the Elevation fine tune screw **CLOCKWISE** (through the peak) and continue until an identical signal level is reached as recorded above (This is typically between 5 and 7 turns). The numbers will be incrementing in reverse order, thus the number displayed on the dial will not correspond directly to the total distance turned. Example: If you stop on 6, you actually moved 4 increments clockwise past zero, not 6.

Record # of turns \_\_\_\_\_

- Divide the number of turns just recorded by 2. Then rotate the Elevation fine-tune screw **COUNTER CLOCKWISE** by this amount. It is convenient to re-zero (set the dial back to 0) at the beginning of this step to make turns counting easier.
- Tighten the Elevation lock down nut.

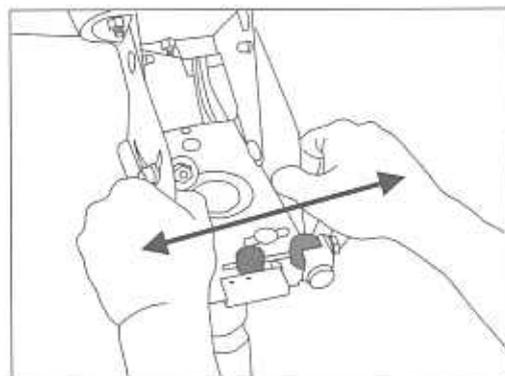
#### Fine-tuning the Azimuth

The Azimuth fine-tuning procedure uses identical signal readings either side of peak in order to arrive at precise alignment. Please follow the next few steps very carefully.

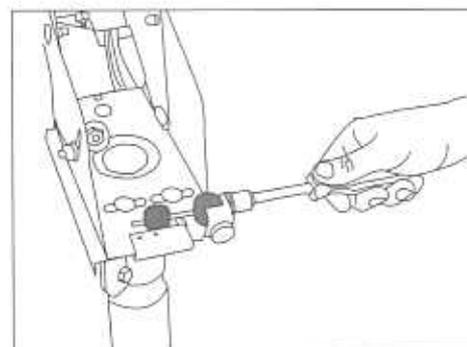
- Verify that the Azimuth lock down bolts are slightly loosened so as to allow free movement of the dither mechanism.
- Unscrew and pull out the dither lock pin and verify the dish will move slightly side to side without binding.

### Fine-tuning the Azimuth (continued)

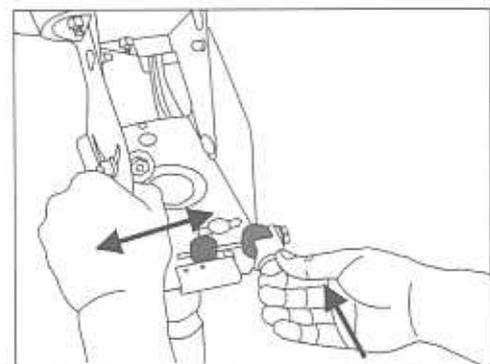
- Set the in-line signal meter for 101deg RHCP reception (13 volts with no 22KHz tone). An alternative method is to select 101deg satellite and an odd numbered transponder on the customer's receiver to power the LNB.
- Move the dish fully to the **LEFT** against the dither stop and read the signal level. This level will be lower than that obtained and recorded during coarse Azimuth peak.
- Move the dish fully to the **RIGHT** against the opposite dither stop and compare the signal level to the previous reading.
- Turn the Azimuth fine adjustment screw to increase the lower of the two signal levels and repeat left/right dither process until **IDENTICAL SIGNAL LEVELS** are achieved for the **LEFT** and **RIGHT** stops. You may have to make several adjustments to achieve identical signal levels.
- When signal levels are exactly the same at the left and right dither stops, then move the dish to the center of the dither range and replace the dither lock pin. You may need to move the dish slightly side to side until the lock pin is fully engaged.



When moving the Dish to the Left and Right Dither stops, grasp the rear of the mount, not the Dish



Use a 1/2" Nut Driver to adjust the Azimuth Fine-tune until the exact same signal level is reached at the Left and Right Dither stop



When replacing the Dither Pin, center the mount and rock side-to-side while pushing in and turning the pin.

### AZ/EL offset adjustment

A slight Azimuth or Elevation offset from peak may be required depending on your location and configuration of the DIRECTV satellites. This offset adjustment will involve turning the Azimuth and/or Elevation fine-tune screws by a specific amount after the antenna is aligned. Please see the attached "Azimuth/Elevation Offset Adjustment" addendum to this manual or visit [www.DirectTV.com](http://www.DirectTV.com) equipment manual section for the latest information. If no adjustment is required, proceed to the next step.

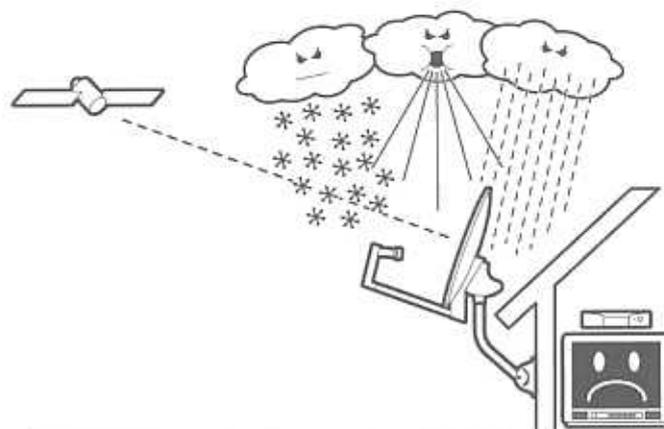
- Tighten Azimuth lock down bolts.
- The current signal level should now be equal to or greater than what was recorded for coarse alignment. A lower level would indicate a possible alignment problem and will require repeating the Fine-tune steps.

### Verify satellite signals

Use the Guided Setup in the customer's receiver to verify reception on all available satellites. Consult the receiver manual for this step.

## Loss of Signal/Rain Fade

- The satellite signal may be lost temporarily due to unusually heavy rainfall. An optimally aligned antenna, along with the shortest possible cable run, minimizes the chances of "rain fade".
- Make sure the antenna is mounted securely to prevent it from being blown out of alignment in a heavy wind.
- Heavy snow accumulation on the LNB and the antenna may reduce the satellite signal strength; snow should be swept away as soon as possible.
- Tree foliage growth into antenna's line-of-sight to the satellite may result in gradual loss of picture.



## Installation with Long Cable Run

- For installations where the RG 6 cable runs from the receiver(s) to the LNB far exceeds 100 feet (150 feet or more), as encountered in a commercial or multi-dwelling building, you need to use an AC power booster module to bias the LNB.
- You will also need an additional RF signal amplifier to compensate the signal amplitude loss. Otherwise, your antenna and receiver may not work properly and be subject to frequent outages in adverse weather. Contact a professional concerning such installations.

## Troubleshooting Check List for Initial Installation

- Make sure all cable connections are correct and each connection is seated/tightened properly.
- Inspect the inside of each cable connector for dirt or possible connector to case/shield short.
- Verify the Azimuth, Elevation and Tilt angles for your location by ZIP code.
- Make sure the Tilt and Elevation pointers are aligned correctly to the scales. Do not use washer or bolt as reference.
- Make sure the Tilt adjustment is *not changed* from the recommended setting for the antenna location.
- Make sure the bubble level frame inside the mast is seated properly, then check the mast alignment again. The mast not being plumb/up straight is a major cause of alignment difficulty.
- Remove existing TV-specific components, such as TV splitter, etc; reduce the installation to the basic connections called out in this guide. Such components may not work with the satellite signal and they may be in the wall where you can't see them. When in doubt, run RG 6 cable directly to the receiver.
- Make sure there are no obstructions (trees, buildings, windows, corner or overhang of your roof, your body or hands) — the signal does not pass through leaves, branches, glass, etc. Also, keep in mind the 22° span clearance to receive all three satellite locations. This required clearance may also mean you'll need to consider a new location when replacing an old 18° dish with this new Multi-Satellite Dish Antenna.
- Make sure the Access Card from your receiver is fully inserted into the Access Card slot and oriented correctly.
- The 5-head LNB depends on the receiver to supply power; the longer the cable length to the LNB, the greater the DC voltage drop. The receiver depends on the antenna to supply signal; the longer the cable length, the greater the signal amplitude attenuation. Therefore, RG 6 cable length much longer than 100 feet (from each receiver to the antenna) should be avoided.
- RG 6 cable with solid copper center conductor is highly recommended because it has much lower DC voltage drop compared to RG 6 cable with a copper-coated, steel center conductor.
- Standard RG 59 cable causes too much DC drop and signal drop; it can not be used to pass the satellite signal. RG 6 coaxial cable must be used.
- Some after-market, off-the-shelf add-on components may not be as advertised. They might not work or could cause additional DC drops and signal amplitude attenuation. Remove such components, go back to the basic connections called out in this manual and re-verify.
- Any additional in-line components must be approved for use with a DIRECTV Ka/Ku Dish with a specified frequency range of 250 MHz to 2150 MHz.
- Make sure the satellite cable is connected to the "Sat In" jack, not the "Antenna In" jack. The "Antenna In" jack at the back of the receiver is for off-air antenna input or cable TV input.
- If all are done correctly but the signal is still not found, change the Elevation adjustment of the antenna slightly ( $\pm 2^\circ$ , then  $\pm 4^\circ$  from the called-for setting) and repeat the procedure.

## Appendix

# Adjustable Beam Separation for 101 & 119

