PACIFIC SATELLITE
INTERNATIONAL LTD.

Large Dish Installation Guide

Pouring The Pad

IF you elect to proceed with the installation of a large aperture antenna yourself, you will need to construct a foundation for the mount. In the case of a pole-mount antenna, a steel pipe is placed in a hole in the ground and embedded in concrete, Because it will take a few hours for the concrete to harden, it is a good idea to set the pole the day before you construct the antenna. You also can buy quick drying concrete products which will set up in less than an hour. Be sure to use a level to ensure that the pipe is “plumb” before the concrete sets. Other types of dish mounts will requite a concrete pad for the foundation. Concrete piers extending well below any frost line should be incorporated into the pad design. Certain types of antenna mounts merely need a level surface. Detailed instructions are supplied by the dish manufacturer.

For rooftop installations, the roof structure must be able to support the weight of the dish, as well as withstand the uplift forces of several thousand kilograms resulting from moderate and high speed winds. After all, nobody wants the roof torn off and the dish flung through the sky.

Because roof top installations are more susceptible to microwave interference than those on the ground, a site survey with a spectrum analyzer or an on-site rooftop demonstration with a small potable dish is an absolute necessity in any country where microwave interference is a major potential problem. If several of your neighbors have antennas, you can check with them to see if they experiencing any interference problems.

Mount Alignment

The pivotal axis of a polar mount antenna must be accurately aligned to true north. Even when this alignment is done with an engineer’s transit, slight inaccuracies in the measurement may result, causing uneven tracking of the geostationary satellites. Corrected compass readings may be even further off the mark. While compass readings may be useful during the site survey for locating a clear view of the satellites, the real test of your polar mount’s alignment is the video reception which you obtain.

When mounting the antenna onto the pole, tighten the bolts just enough to hold the antenna in place. Tightening the bolts down firmly on the pole should be one of the very last things you do, and should be one of the very last things you do, and should be done only after you have gotten the dish to track the

satellites properly. Tightening beforehand can dimple the pipe, making it more difficult to make subtle adjustments in alignment.

Mounting The LNB And Feedhorn

Extreme care should be taken when bolting the LNB to the feedhorn. Do not touch the probe inside the mouth of the LNB. This probe can be adversely affected by grease or dirt. Also make sure that the neoprene gasket that goes between the feedhorn's flange and the mouth of the LNB is "seated" properly in the groove provided. Otherwise, moisture can seep into this opening and disrupt your reception.

The center of the feedhorn must be supported exactly at the focal point of the dish. The focal distance between the center of the dish and the mouth of the feedhorn will vary between different models of antennas, depending on whether the manufacturer has used a deep or shallow dish design. The exact distance will be provided in the instructions.

There are two fed support styles available, one of which will be supplied with your antenna. A "button hook" support, sometimes called an LNB tube, is a single piece of tubing which extends from the center of the dish outward. The button hook support, which is curved so that it resembles a hook, allows the feed to be mounted looking back at the center of the dish. Guy wire kits are available for button hook supports that will provide the additional stability required for reception of both C- and Ku-band signals. Ku-band signals are much higher in frequency and there fore are beamed Earthward in much smaller wave lengths. Consequently, the antenna curvature and location of the feed for Ku-band reception must be much more precise than what C-band systems commonly require.

We recommend that you check to that the feed is centered over the dish by measuring from the lip of the antenna to the edge of the feedhorn's opening at four equally spaced intervals around the antenna's rim. This is especially important if you are using guy wires to anchor the button hook support. If the feed is centered, these measurements will all be equal. If they are not equal, you will have to adjust the tension if the guy wires until the feed is properly centered.

The second type of feed support uses a multi-legged structure to hold the feedhorn and LNB (or LNBs for dualband systems). These are made up of three ("tri-pod") or four ("quad") straight, equal length pieces of aluminum or steel. Quad supports are inherently more stable than button hook supports, offering better Ku-band reception. When mounted at the recommended

locations on the antenna's surface, these supports should accurately position the feed at the correct focal length: the distance between the center of the dish and the opening of the feedhorn. The correct focal length for your dish is provided in the manufacturer's assembly manual.

Once your system is up and running, you can fine tune the focal length for its optimum position by moving the feed in and out in small increments while watching the receiver's signal strength meter. This is easier to do with a button hook than a quad support. This adjustment is particularly important if you are having trouble receiving Ku-band satellite signal.

You can compute the focal length if you know the diameter of the dish along with its f/D ratio. Focal length = the antenna diameter times the f/D ratio. For example, the focal length of a 10 foot antenna with an f/D ratio of .45 equals 10 x .45 = 4.5 feet (54 inches).

To determine the antenna's diameter, measure across the surface of the dish from one side to the other. The radius equals one half the diameter. The depth of the dish is the distance from the center of the dish to the plane of the rim. Stretch a string across the antenna's rim so that it crosses in the center of the dish. The depth will be the distance from the antenna's center to the string.

Many feeds today have adjustable scalar rings. These feeds can be broken down into two parts: a round flat "scalar" plate with concentric circles on its surface and the wave guide onto which the LNB is mounted. This wave guide fits into the center of the scalar plate and can be adjusted inward and outward. The distance that the wave guide extends beyond the surface of the scalar plate must be set correspond to the f/D of the antenna. Consult with the manufacturer's assembly directions or use the formula provided above to determine the correct f/D ration of your antenna.

The wave guide may be marked to indicate the various f/D ratio settings. Alternatively, the feedhorn may come with an adjustment gauge for setting the correct location of the scalar rings.

Another thing to check: the plane of the feed opening should be the same as the plane of the rim of the dish. You can use your inclinometer to check to be sure that both the feed opening and the antenna's rim are parallel with each other.

Running The Cable

In most cases it will take three sets of wires to hook up your system: the coaxial cable from the LNB to the receiver, a three conductor wire from the servo motor of the feedhorn to the servo motor control on the back of the

receiver, and a four or five conductor wire from the actuator motor at the antenna to the control terminals on the back of the receiver or actuator power supply. We will examine each of these wires in detail in the following sections.
The best way to acquire these wires is to purchase an all-in-one direct burial satellite cable from your retailer at the time you purchase your system. Bury the cable in a trench deeper than any frost line and you are ready to go.
Make sure that you purchase more than enough cable to complete the run all the way from the feedhorn on the antenna, down the pole, in the ground from the pole to the house, up the wall, through the attic, and down an interior wall, while leaving enough left over to easily reach to the back of the receiver. It is possible, but not desirable, to splice an extra few feet onto your cable if you do come up short or decide to rearrange the furniture in the future.
Before connecting all of these cables, however, self-installers should consider temporarily using a short piece to connect the receiver and TV to the outdoor electronics right out at the dish. This method for aligning the dish allows you to make tracking adjustments to the antenna while viewing TV signals and watching the receiver's signal level indicator. If you are going to have a technician during the final stages of the installation he will have a portable meter to use at the dish. Two people also can talk back and forth via walkie talkie or portable phone while one makes adjustments to the dish and the other keeps an eye on the quality of the reception.
Direct burial satellite cable is available containing either one or two coaxial lines. The direct burial cable with two coaxial lines is essential if you intend to use either a hybrid feed or a dual C-band feed. If you intend to have more than two LNBs at the dish, you will need to run separate coaxial lines for each of them.

Coaxial Cable And Connectors

You already may be familiar with the cable used for connecting your TV set to the home's master antenna system, a shielded wire called coax. Coax is made up of an inner wire covered with a plastic or foam sheath, and an outer mesh that is in turn surrounded by an outer plastic covering.
A single coaxial cable is used to carry the signal from the outdoor electronics to the indoor receiver. A shorter piece of coax also is used to connect the receiver to the antenna input on the TV. If the programming is to be viewed on other TV sets, the coax cable will first go to a splitter and then on the various TVs.
A unique type of cable TV connector, called an "F" connector, is crimped onto

each end of the coaxial cable. It mates with complementary connectors on the LNB and indoor receiver. Your local electronic supply house can provide you with the special tool used to crimp “F” connectors onto the cable, Or you can purchase standard lengths of cable with the connectors already installed. The quality of the F connector is important as some cheaper F connectors break when crimped, providing an additional entry point for moisture as well as a less reliable connection.

When screwing an F connector onto mating connectors on the back of the receiver or LNB, you should take care to avoid bending or breaking the cable’s inner conductor, thereby shorting out the connection. There also are right-angle F connectors which can be used whenever space limitations prevent a straight-on connection.

The block 1F signal coming from the LNB is no longer a microwave signal. That’s why a relatively inexpensive and readily available coaxial cable of small diameter can be used to carry the signal to the indoor receiver. The type of cable commonly used in satellite TV installations has a characteristic impedance rating of 75 ohms. The type of cable used by CB radios and other two-way radio equipment has a characteristic impedance rating of 50 ohms and is not suitable for satellite TV use. Be sure that the cable you buy is 75 ohm coax.

There are several different kinds of 75 ohm coaxial cable available. RG-59U coax can be used to span distances of up to 100 feet. For longer lengths, lower loss RG-6 or RG-11 are used. Direct burial satellite cable contains one or two spans of RG-6. Since RG-6 is slightly larger in diameter than RG-59, it also requires a slightly larger F connector. To span distances of several hundred feet, special UHF line amplifiers with +10 or + 20 dB gain also may be necessary to compensate for the amount of signal loss or attenuation that occurs as the signal passed along the length of cable.

As the block IF frequency range produced by the LNB may extend upwards towards 2,000 MHz, the losses in most types of 75-ohm coaxial cable is very high. These losses can be minimized by using high quality coax from a major manufacturer from Europe or the United States. Some of the cheaper coaxial cable now manufactured in Asia, for example, does not meet the higher performance requirements for satellite TV applications.

The power required to operate the LNB is supplied by the receiver and sent to the LNB via the center conductor of the coax cable. The power stays on even if the receiver is turned off. This keeps the LNB at a more consistent temperature and prevents moisture from condensing inside it. Also available: snap-on

waterlock devices which provide an effective way to keep moisure away from the LNB's F connector.
The receiver should be unplugged from the a.c. wall receptacle before connecting or disconnecting the coax cable from the LNB or the receiver. This eliminates the chance of a short circuit across the coaxial connections.
The connection to the LNB also should be weatherproofed to keep moisture out. This can be done by flooding the connector with a dielectric silicone sealer or wrapping the connection with a sticky waterproof compound such as Coax-Seal. It is also a good idea to use a plastic LNB/feedhorn cover to give your outdoor electronic components added protection from the elements.

Wiring The Feedhorn

The feedhorn line of the direct burial cable is comprised of three color-coded 22 gauge (or larger) stranded wires. These wires also are shielded and jacketed. The three wires provide power, pulse, and ground connections for the feedhorn. Each of these wires connects to corresponding terminals on the back of the receiver. The wires are color-coded to help identify them when connecting to the three servo motor wires at the feed (usually red for power, white for pulse, and black for ground).
A stranded wire is used because it is more flexible and won't break as easily as a solid wire. The shield, an aluminum foil wrapped around all three wires, keeps impulse noises from entering the line and giving false pulses to the receiver. The receiver uses pulse to keep track of the position of the feedhorn's pick-up probe. You therefore can adjust, or "skew", the position of the probe and program the optimum polarization for any given satellite transponder into memory.
The feedhorn's servo motor rotates the pick-up probe, which swings back and forth while switching between the horizontally and vertically polarized transponders (odd and even channels). Keep in mind that there are limits to the pick-up probe's clockwise and counter-clockwise movements. The feedhorn must be aligned on the antenna a that the probe can swing the 90 degrees from horizontal to vertial (or left-hand to right-hand circular) polarization without reaching the limits of its travel. Several manufacturers include a directional guide with their feedhorns to show the proper alignment of the feed when installed on the dish. If you find that you cannot skew the probe beyond a good picture on both the odd and even channels on all satellites, you will need to loosen he clamp that holds the feed onto its support and physically rotate the feedhorn until it is possible to do so.

Wiring The Actuator

The direct burial cable's actuator line is comprised of five stranded wires. Two 14 or 16 gauge stranded wires are used to power the motor and three color-coded 22 gauge shielded wires connect to the sensor. These actuator wires should be connected to the appropriate terminals on the back of the receiver (or a separate actuator power supply).

Like the servo motor wires, the three shielded motor sensor wires also provide power, pulse, and ground. The vast majority of actuator motors do not require power to be hooked to the sensor. Look inside the actuator housing. If there are only two wires connected to the sensor, then hook up pulse and ground to their respective terminals. IF there are three wires connected to the sensor, and pulse and ground interchangeably to the other two sensor wires.

The two large stranded wires connect to the large wire terminals at the actuator motor and to the motor wire "1" and "2" terminals on the back of the receiver or power supply. Now try to move the dish to the east or west; if the dish moves in the direction opposite to the on intended, reverse the wires connected to the motor wire "1" and "2" terminals.

Some satellite receivers have an external power supply that puts the large transformer outside of the receiver chassis. This reduces the receiver's size as well as its operating temperature. The power supply is actually a large transformer that turns 110 or 220 volts a.c. into 24 to 36 volts d.c. to power the actuator's d.c. motor.

Grounding The System

If your home's a.c. electrical ground is close to the dish, use a No. 10 AWG or larger solid copper ground wire to connect it to the pipe supporting the antenna. If your dish is physically removed from your dish is physically removed from your home, pound in a separate grounding rod and use a No. 10 AWG or larger solid copper ground wire to connect the pole to it. You should also install an antenna discharge unit or ground block, a passive electrical device that connects in-line between your outdoor electronics and the indoor satellite receiver. To work properly, the ground block should be connected to a ground rod or to the a.c. ground of the house. For added protection prior to a lightning storm – or whenever your system is left unattended and unused for long periods of time – you should first unplug the satellite receiver from the a.c. wall outlet and then disconnect the incoming coaxial cable(s) from the IF input of the receiver. After the storm has passed, reconnect the coaxial cable to the

receiver's IF input port before plugging the receiver back into the a.c. wall outlet. This will help prevent damage due to lightning or related power surges. There are quick disconnect adapters available which allow you to quickly and easily disconnect all of your indoor components from the rest of the system. You also should use a surge protector on you're a.c. line to prevent voltage surges or spikes from setting your receiver aglow.

Attaching The Actuator To The Dish

Your dish will have either a horizon to horizon mount or a mount which requires an actuator arm. For "horizon" mounts, the motorized housing will attach directly to a mating flange on the mount. The principles related to setting the motor's programmable limits will be the same for wither style mount.
Before you begin to install your actuator arm, prop the dish up a few degrees with a block of wood or something else which won't damage the antenna. Attach the arm to the dish and the mount as indicated in the manufacturer's assembly directions. The arm attaches on the west side of the dish on systems located in western Asia. IF you are somewhere in the middle of the continent, observe how they are mounted on existing systems in your area or ask your satellite retailer which is the correct method for you.

Dish Alignment Settings

You have now completed the basic construction of the dish and are eagerly anticipating your first pictures from space. To fine tune those pictures and get your dish to track, you, or someone you can communicate with, will need to watch the TV screen while adjustments are being made to the antenna. You may even want to bring the TV and receiver out to the dish. If you have purchased a dual-band receiver, be sure that it is set to C-band before proceeding.
At this point, it is best to connect the satellite receiver directly to the TV and not through a VCR, video switcher, splitter, or any other device. The appropriate receiver output connector will be labeled "To TV" or "RF OUT". On most receivers, the output signal can be switched between two VHF or UHF channels. Select the VHF or UHF channel which is not in use in your area. Tune the TV set to receiver the selected VHF or UHF channel.
AT this point it is a good idea to follow the step-by-step procedures provided in the owner's manual. In most cases, the receiver also will prompt you with instructions that are displayed on the TV screen or on the receiver's front panel.

You first may be instructed to “Set East and West Limits”. This is referring to the limits of travel for the actuator arm or horizon drive. Although the motor has a slip clutch to prevent damage when the arm is extended or retracted completely, it is best to set the receiver’s programmable limits at positions before the arm reached these points. Many motors come with built-in limit switches which will shut off the motor at designated points.

Setting the east and west programmable limits. The receiver’s programmable limits need to be set to stop the travel of the arm or horizon driver before the built-in limit switched are engaged or before the drive’s physical limits are reached. If the arm does reach its full length or is retracted completely the motor’s slip clutch will start making loud “clicks”. Stop immediately. If the arm become stuck in this position, take the motor off and insert the blade of heavy screwdriver in the slot where the motor engages the arm. Turn the screw driver just enough to loosen the arm, then put the motor back in place.

The idea here is to set the limits so they are just past the last satellite at either end of the satellite arc but before the mechanical limits of the drive. You can determine the elevation angles for the last satellite to the east and west.

Setting the polar axis elevation of the dish. Extend the drive until the dish is looking at the highest point in the sky. Set the inclinometer onto the polar axis of the mount to the correct elevation angle for your location.

Setting the declination. Declination is the offset angle between the polar axis of the mount and the rim of the dish which permits the antenna to precisely track the Clarke Orbit. The declination angle at any site is determined by the latitude at that location. The declination setting must be adjusted to the figure supplied by the manufacturer for your specific site. If you need to compute the declination you can find out the approximate value by using the chart.

With a modified polar mount antenna, correct tracking of the total Clarke Orbit is only possible when the declination has been properly set. Set the inclinometer on the back plate of the antenna. Using the declination adjustments on the mount, set the antenna for an elevation angle that is equal to the polar axis angle plus the number of degrees of declination for your area. The dish should be looking down slightly from the angle of the mount.

Tracking Procedures

Now is the time to begin tracking the satellites and programming their positions into memory. This is not difficult now that you have everything set. When moving the dish to the east or west, the dish’s look angle should now follow a curve similar to that of the Clarke Orbit.

You may have a satellite receiver that was designed to find and program the satellites on its own. However, even these “smart” receivers will require you to find and identify one upper and one lower satellite. There also are automatic dish peaking and polarity peaking features on some receivers. If you choose to use these auto features, first follow the steps presented below to get your dish to track the Clarke Orbit. Once you are confident that you are receiving your best signal on a lower and upper satellite and have programmed them into the receiver, you are ready to turn on the auto program feature.

The accuracy of these auto features primarily depends on which brand of receiver you have purchased. Some receivers occasionally miss a satellite or two and you often find that you can peak the position of the dish and polarity better manually. It is recommended, especially during the initial installation, that you turn these features off.

Many receivers have a scanning feature that is handy for locating satellites. These receivers scan repeatedly through all of the available satellite channels at a rapid pace, providing you with glimpses of the active transponders. Channels will flash by on your TV screen as you move the dish past a satellite. You can go back to where the flashed occurred, turn off the scan feature, and identify the satellite by comparing the programming you encounter to the satellite TV program grids. Some satellites only carry a few active transponders. Without the scan feature, you would need to select an active transponder and tune to the correct polarization before you could find the satellite.

Preview the sections in your receiver manual on dish set-up and programming. Also read through these next steps to get familiar with the overall steps to get familiar with the overall procedure you are about to perform. Finally, initiate each of the steps below.

Inclinometer readings for the satellite look angles should be taken on the back plate of the antenna or on a surface parallel to the plane of the rim of the dish.

1) Determine the elevation of the lowest satellite available from your location and move the dish until the inclinometer registers that elevation.
2) Engage the receiver’s scan feature or set the receiver to a channel which should have programming on it. A 24 hour service, even if it is scrambled, would be a good choice. Refer to a current satellite program guide to find a suitable selection.
3) Push the dish to the right or left so that it rotates on the pole until you see a flash of video on your TV screen. Turn off the scan and go through the channels until you find video.

If the video seems to zip off the screen as soon as you stop on the channel try changing the receiver's polarization format. That is, if you have your odd channels set for vertical polarization and your events for horizontal, change the format to odds-horizontal, evens-vertical. You may not even know the present polarization format changes the relationship of the feedhorn's pick-up probe by 90 degrees. If changing the format keeps the video on the screen, then it has to be the correct setting for that satellite on your system.

Select the best skew setting for the odd and even channels. The skew is the fine tuning of the feedhorn's polarization, required because the satellite's signal polarization is only truly "horizontal" or "vertical" when the satellite is positioned at the same longitude as the installation site. The skew and format buttons are found either on the front of the receiver or on the remote control. Many receivers with on-screen graphics require you to choose these functions on the menu.

Most receivers have a LED signal level indicator on the front panel or a digital level indicator presented by on-screen graphics. The level indicator provides a better reading of peak satellite performance in contrast to just viewing the picture on the TV screen.

4) For locating satellite in the lower section of the Clarke Orbit, push the dish right and left on the pole and move the drive east and west in slight increments until you are satisfied you have the strongest signal. Then tighten the mount's bolt onto the pole so that the dish won't rotate. Do not tighten them down firmly yet, however. Note the numerical reading provided on the receiver's front panel or on-screen display that corresponds to dish position at this location. This is a relative number that changes as the dish moves.
5) Move the dish east or west until you reach the zenith for your location. Select an active transponder for the satellite closest to the east or west of arc zenith or turn the scan control on. Now move the dish in the direction of the nearest satellite. If all the settings have been done right you should not have a problem finding it.
6) For locating satellites that are in the upper section of the Clarke Orbit, jog the actuator drive east and west and adjust the elevation bracket up and down slightly. You should not have to move the elevation setting very much because you already have pre-set it for your location. The rule of thumb here is : *Rotate the dish on the pole and use the actuator to receive lower satellites, but do not rotate the dish on the pole to receive upper satellites. Adjust the elevation of the dish and use the actuator to receive upper*

satellites, but do not adjust the elevation to receive lower satellites.

7) Fine tune your tracking by repeating these steps until the satellites in both the upper and lower sections of the Clarke Orbit appear at their maximum signal strength without requiring any further adjustments. If this cannot be done, you have probably made a miscalculation in the elevation or declination settings. Once you have the dish tracking properly, firmly snug the bolts that secure the mount onto the pipe. Placing a bolt all the way through the pipe may be desirable in high wind areas. Mark the pole and the mount for later reference.

The Final Connection

The final connection is from your satellite receiver to your TV set. We mentioned above that you can hook up a coaxial cable directly from the “To TV” (RF Out”) output of the receiver to the “Antenna” input of the TV set. Your local antenna wire, which formerly was connected directly to the TV set, should now be connect to the “Antenna” input on the back of the receiver. To watch local channels, turn the satellite receiver off and the local channels will automatically appear on their respective channels on the TV.

If your satellite receiver does not have this feature, you will need to purchase an A/B switch from your local satellite or electronics store. Both the satellite receiver and local antenna connect to the “A” and “B” input ports on this switch, while the single output port connects to the antenna input on the TV. This switch will have to be changed manually whenever you want to go from one to other. You also will need to use an external A/B switch if a second TV is connected to the satellite receiver and one person wants to watch local TV while the other is watching a satellite TV program.

There are other options when it comes to connecting the satellite system to your TV set or home theater system. There are video and stereo audio outputs on the back of your receiver. These can be connected directly to a TV monitor or to a VCR for recording programs. Whenever a VCR is part of the overall entertainment system, the output of the VCR must be connected to the TV set and the local antenna is usually also connected to the “Antenna” input of the VCR.

The satellite receiver’s stereo audio outputs can be connected directly to the stereo inputs of the TV set or to the auxiliary inputs of your stereo system’s audio amplifier or tuner.