INSTALLING REPEATER NETWORKS

Application Note **25**

for Vantage Pro2™ systems

INTRODUCTION

This document outlines the process to determine what repeaters may be needed and how they should be placed and configured to bring weather data from one location to another. With the superior wireless transmission scheme of the Vantage Pro2, it is possible to send data much greater distances. This, in turn, provides greater flexibility, but also greater complexity in the possibilities of various station layouts. This document will attempt to simplify this decision process.

REPEATER NEEDS

Determine whether you actually need a repeater. If you have a major obstruction(s) or already know that you need to employ multiple chains in your network, then you will need a solution to extend your data transmission range. The following table lists the conditions where standard equipment should be sufficient (ISS™ + console or Envoy™ receiver).

Distance to Transmit	Environmental Conditions
<300' (90 m)	Any (excepting Major Obstructions)
<400' (120 m)	Indoors or High RF interference Outdoors
<800' (240 m)	Minor Obstructions or Low RF interference Outdoors
<1000' (300 m)	Line of Sight (Outdoors)

If your distance requirements exceed those in the table above, then you will need a solution to extend the range of data transmission:

- If cost is a concern for your setup, then determine whether you have AC power and a land-based phone line near (within 1000' of the weather station) where you want to place your weather station. If they are both available, then purchasing WeatherLink™ software and external telephone modem is your most cost effective solution (see Application Note 27).
- If cost isn't an issue and cellular service is available where the weather station is located, then you may want to consider purchasing WeatherLink software along with a cellular telephone modem.
- If neither type of telephone service is viable, you will need to employ repeaters in your layout. However, the longest transmission distance from weather station to receiver cannot exceed 14.4 miles (23.3 km).

It is impossible to cover all the possible scenarios that might be encountered in real-world situations. This document will attempt to give the most common examples and provide the tools needed to help you to determine what you will need for your specific application. For specific information on how to mount and configure your repeater, consult the Wireless Repeater for Vantage Pro2 instruction manual. Bear in mind that due to unanticipated levels of RF interference, you may need more repeaters in your network than your careful planning may indicate. You may not come to this realization until you begin to test and install the elements of your network.

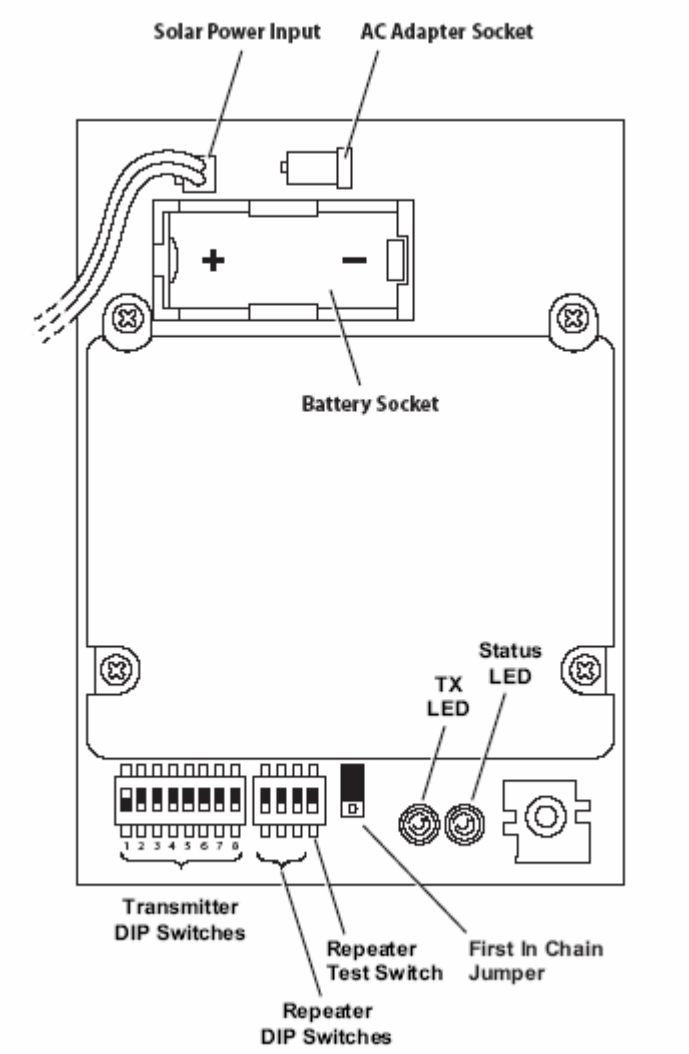
WIRELESS THEORY OF OPERATION

In any weather station setup, there are two types of wireless equipment: transmitters and receivers. A transmitter is an outside Station, like the ISS (Integrated Sensor Suite), a Leaf/Soil Station, or a Temperature/Humidity Station. A receiver is either a Console or an Envoy. A repeater falls into both categories: It both *receives* data and re*transmits* data. A display console or Envoy can also function as a repeater and retransmit data in addition to its basic function as a receiver. The basic function of a repeater is to extend the range of a transmitter by receiving data and re-transmitting it.

For example, if your transmitter is over 1000' (300 m) away from your receiver, and/or your receiver is indoors, you may need to place a repeater close enough to the transmitter (say, 1000' (300 m) away) so that it can reliably receive the transmitter, yet close enough to the receiver that it can reliably hear the repeater.

USING ONE REPEATER WITH ONE TRANSMITTER

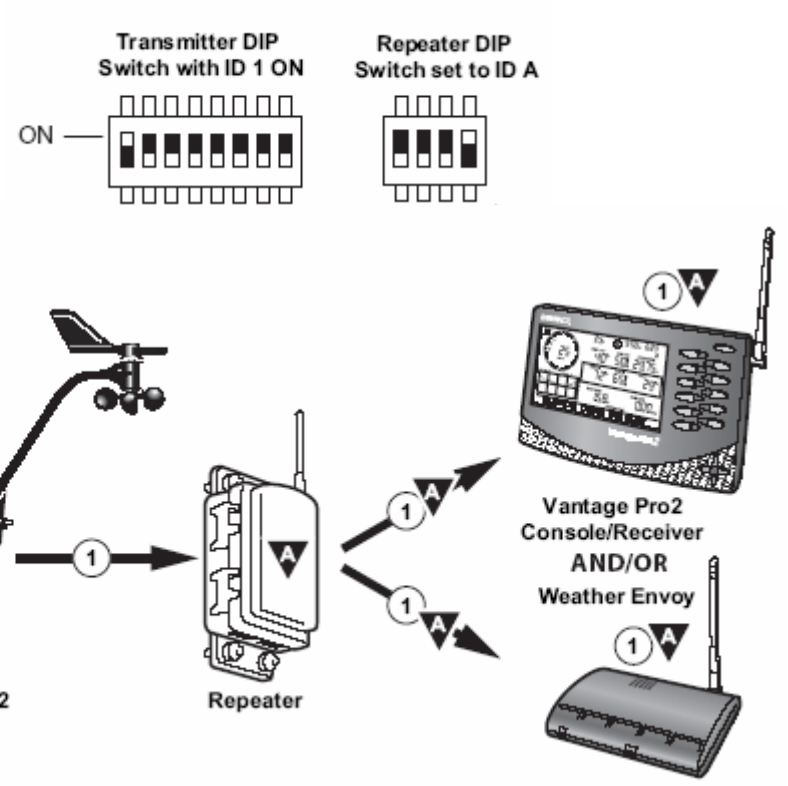
All repeaters have an ID that is indicated by a letter (A through H) and the ability to indicate which transmitters to receive and repeat.



All repeaters come from the factory configured for Repeater ID A. This is the setting for a simple, “one” repeater setup and applies to the most common repeater applications. Repeater A, the first repeater in a “chain” by design, will not listen to other repeaters. It will only listen to all transmitter ID’s selected by the DIP switches (ID #1 selected is the factory default), and re-transmit them.

REPEATER ID CODE	SWITCH 1	SWITCH 2	SWITCH 3
A (default)	off	off	off
B	off	off	ON
C	off	ON	off
D	off	ON	ON
E	ON	off	off
F	ON	off	ON
G	ON	ON	off
H	ON	ON	ON

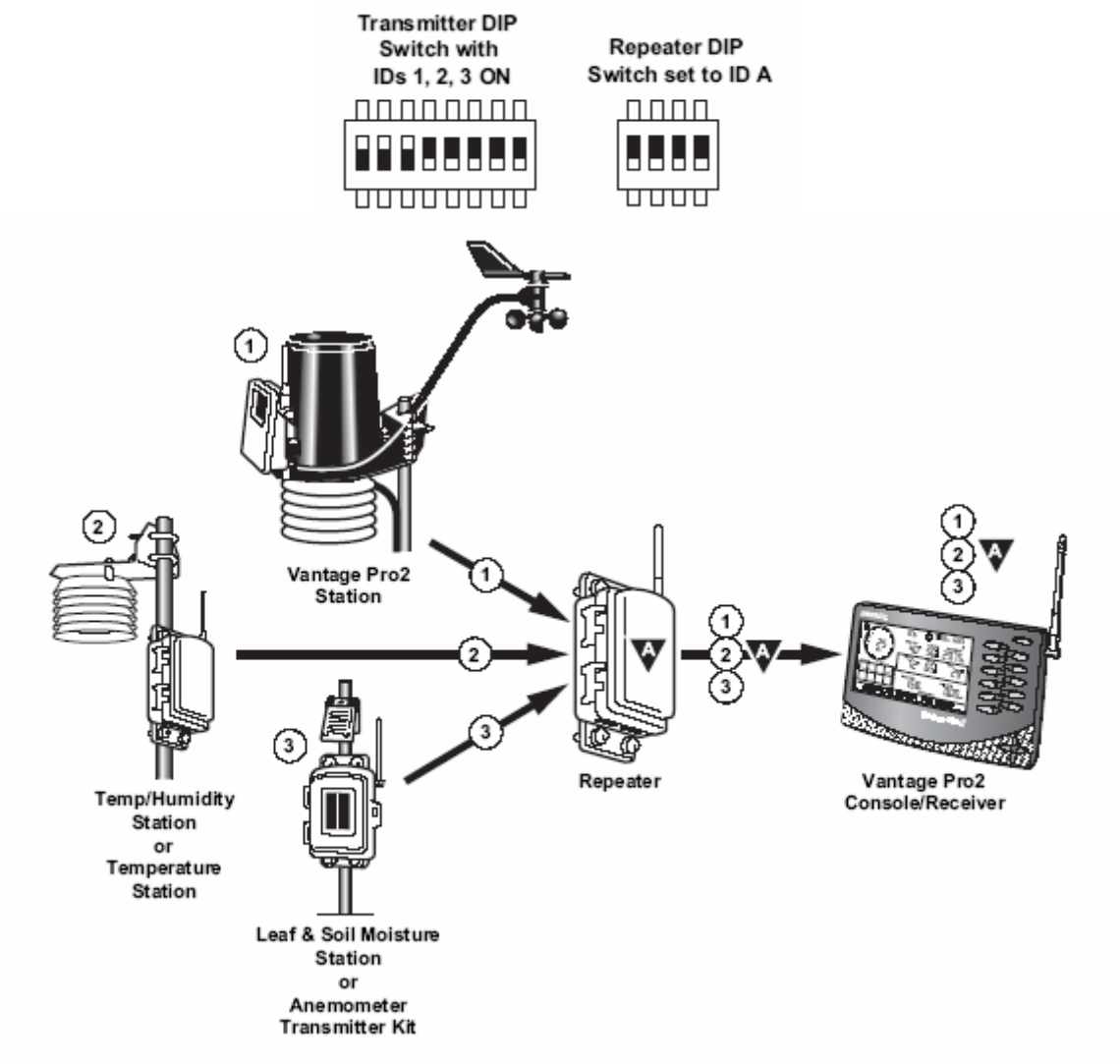
Repeater ID DIP Switch Positions



Information is added to the packets that a repeater transmits, (i.e., that this packet came from Repeater A), so that receivers can distinguish between repeated data packets and data packets from the original transmitter, as well as other Repeater ID's. Other additional information includes a transmitter list (of what this repeater is re-transmitting), as well as battery status information. The Vantage Pro2 Console/Receiver and Weather Envoy also need to be specifically configured to receive the correct repeater.

USING ONE REPEATER WITH MULTIPLE TRANSMITTERS

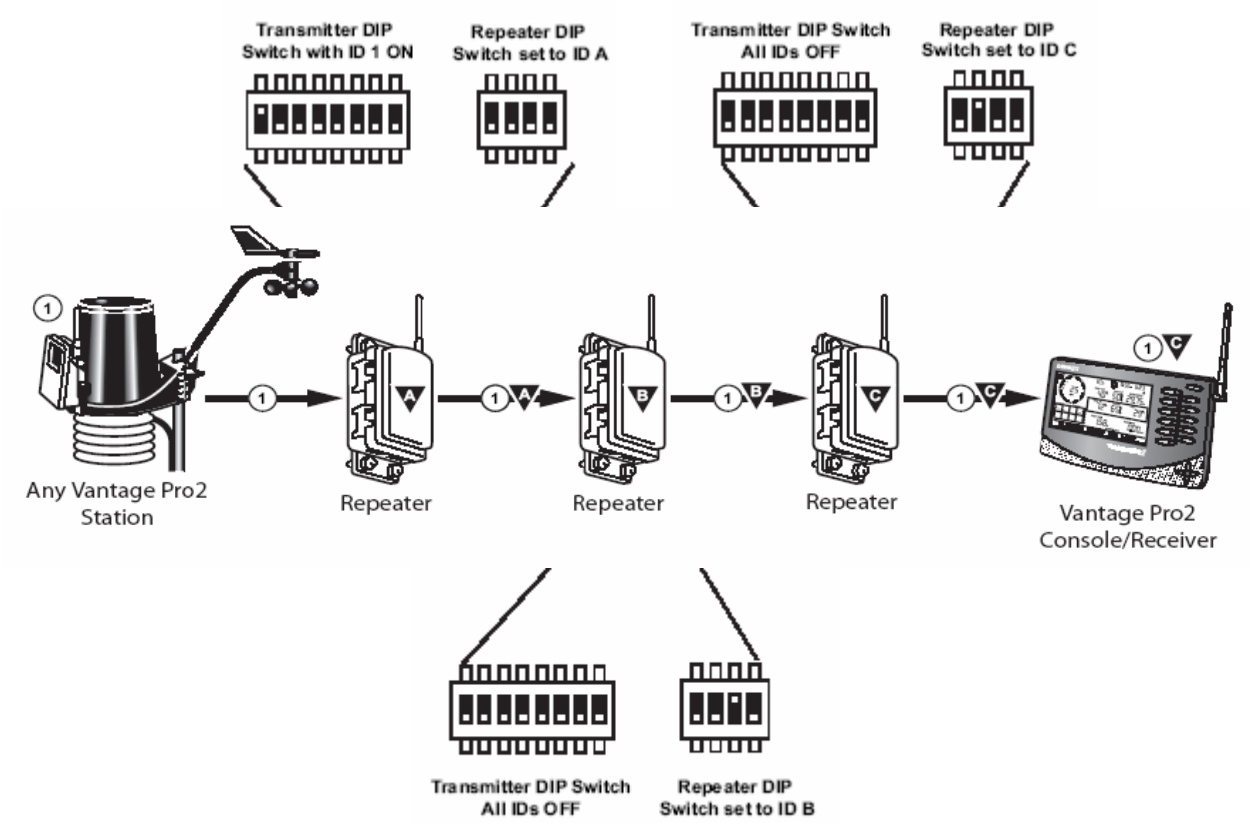
More than one transmitter can be repeated. Select additional transmitter ID's with the DIP switches and the repeater will receive all these ID's and re-transmit them.



USING MULTIPLE REPEATERS

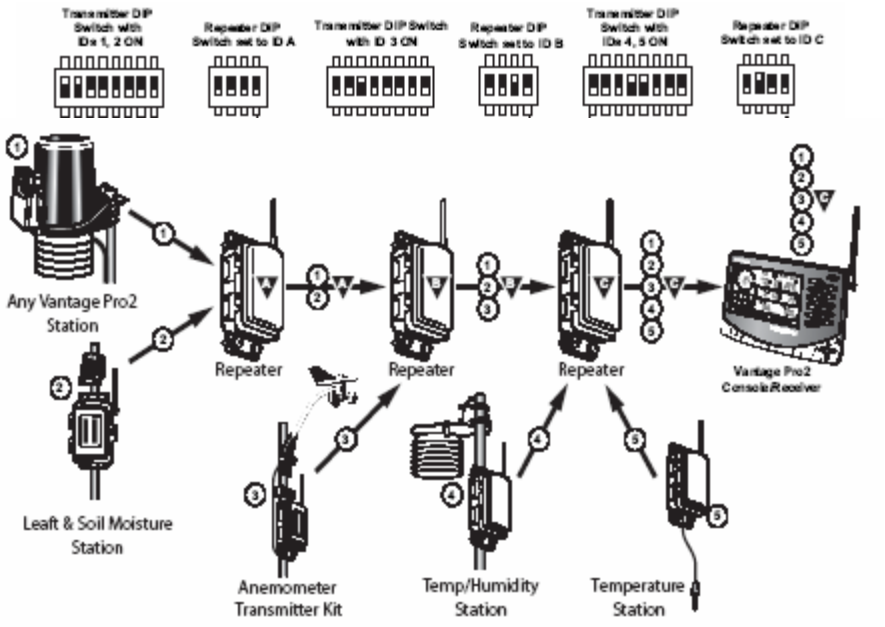
If you need even greater distance between the transmitter and the receiver, up to eight Repeaters can be strung together in a "chain".

The second repeater in a chain is normally Repeater B. Repeater B will always look for Repeater A. Once it acquires any Transmitter ID being re-transmitted by Repeater A, it will get the list of all Transmitter ID's being re-transmitted by Repeater A. It will then continue acquisition until it has successfully found all re-transmitted ID's on the list. You do not need to tell Repeater B which ID's to get from Repeater A, it will automatically get the list from Repeater A. In the factory default case (Transmitter ID 1 on Repeater A only), Repeater B is done as soon as it acquires ID 1 from Repeater A, as it is the only ID on the list.



Additionally, Repeater B will only acquire data packets being re-transmitted by Repeater A (transmitters selected by the transmitter ID DIP switches). Repeater B will ignore packets from other repeaters, as well as original transmitter packets (unless specifically selected). If you setup both Repeater A and B to retransmit the same transmitter ID, Repeater B will flag a configuration error using the repeater's diagnostic LED's (if in TEST mode). Consult the Repeater Troubleshooting Error Codes in the Wireless Repeater for Vantage Pro2 manual.

Repeaters C-H behave similarly, with each Repeater only acquiring the previous Repeater ID (Repeater C acquires Repeater B, etc.), plus any ID's selected by the Transmitter ID switches.



REPEATER TYPE AND ACCESSORY NEEDS

This section will help you determine what types and quantity of repeaters, if any, you will need to achieve your data transmission goals.

DETERMINING STATION/REPEATER LAYOUT

First, determine your weather station(s) layout.

Do you have?

- One weather station in your proposed layout? or
- Multiple weather stations located in one general area?

And,

- Are you transmitting data back to one central location? or
- Are multiple receivers located in one general area?

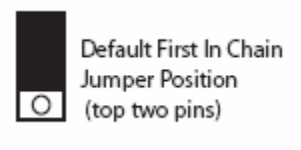
If the answer to either of the first questions is yes, and the answer to either of the second questions is yes, then you can apply a single chain configuration. Whether you need one or more repeaters is a question of distance and whether there are any obstructions in your proposed transmission path.

If the answer to both questions above in either section is no, you probably need to employ multiple chains to your repeater layout. In this case, you will need to determine your repeater needs for each branching chain of your system layout, and add the results together to determine the total number and type of repeaters you will need.

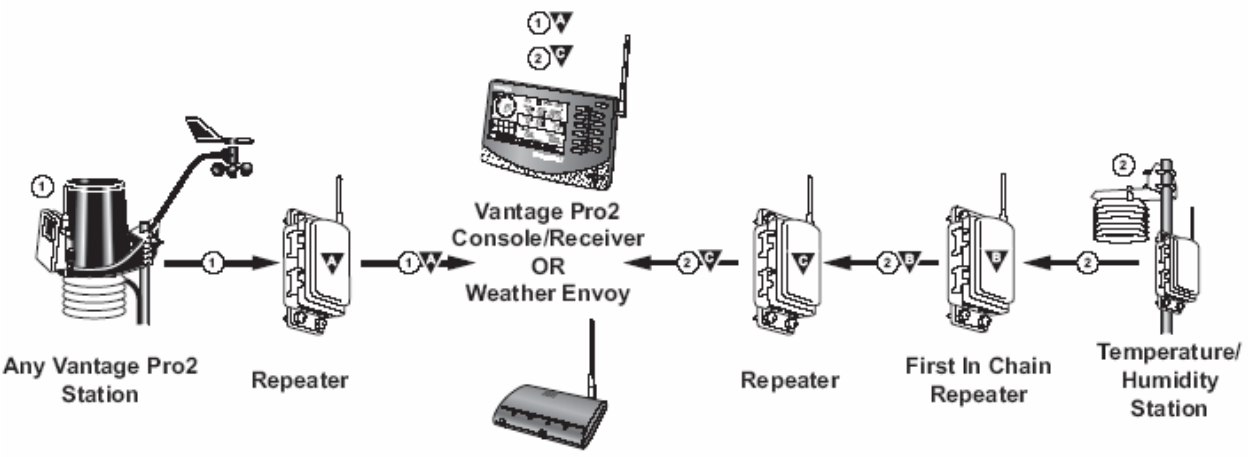
Note: You cannot exceed a total of eight repeaters in one chain regardless of repeater type.

There are other situations where weather stations are located in opposite directions from where the data is to be received. Less common, you may transmit data from one weather station to

multiple receiving locations. If you need multiple chains in your repeater network and want to use less than 8 repeaters, you can configure a repeater that is not A to behave like Repeater A –that is, it will not try to acquire a previous repeater ID in the chain. For example, if Repeater C has the First in Chain jumper set, then it will not try to acquire Repeater B, only the transmitter ID DIP switches that are set.



An example with two chains (two weather stations and one receiver) is shown below.



It is best to utilize no more than 8 repeaters in a network, however, if the chains are spaced apart enough, you can utilize up to 8 repeaters on any chain. This can also be aided by having major obstructions between repeaters where you don't want one to hear the other. You can only have up to 8 chains because you can only have 8 weather stations in a network. The maximum theoretical number of repeaters you can have is 64 (8 repeater IDs x 8 chains).

DETERMINING YOUR ENVIRONMENT

First, you must assess how far you want to transmit your data. As we all know, the shortest distance between two points is a straight line. If the shortest distance between your transmit and receive locations does not contain any solid obstructions such as hills, large buildings or large thickets of vegetation, you can use this distance to determine your needs. If not, then you will need to attempt to go over or around these obstructions. This scenario is covered in the section "Overcoming Major Obstructions". Note that any case involving obstructions will require the use of at least one repeater. A map or measuring device (tape measures, string, range finders, handheld GPS receiver, etc.) will help you determine distances. Use a topographic map to help you determine whether or not you have any significant obstructions or elevation changes. Free topographic maps can be found at the following site: http://www.topozone.com .

Overcoming Major Obstructions

Whether you go over or around an obstruction, you should choose whichever is the shortest distance. To determine the distance when going around, if possible, select a location to place a repeater where you can visually see repeaters on either side of the obstruction. If you cannot, you will need to place one or more repeaters around the obstruction until you achieve this criterion. When going over an obstruction, if possible, place a repeater at the top of the obstruction where the repeaters on either side can be seen. For long range repeaters with Yagi antennas, the angle between the ground and the straight line up to the repeater on the obstruction cannot exceed 25°, for standard repeaters, this angle is 30°.

DETERMINING DISTANCE

Next, determine what type of repeater(s) you need.

Standard Repeaters

Most antennas sacrifice performance in certain directions in order to gain performance in other directions. This makes the relative orientation of two antennas important. Most antennas do not perform equally well in all directions.

All Davis transmitters, receivers and Standard Repeaters come with a Dipole antenna, which is omni-directional. This means that (with the antenna pointing straight up), the antenna performs best and equally well in all directions around the side of the antenna (perpendicular to the antenna). It does not do as well above or below the antenna. For a vertically oriented dipole antenna, another antenna can be 30° above or below its horizontal plane before the performance starts to seriously degrade. If two dipole antennas need to communicate, but have more than this 30° angle between them (say due to an elevation change), the antennas can be rotated so that this perpendicular direction of best performance can be pointing at each other.

With sufficient height, optimal antenna orientation, and no obstacles or interference, a Davis Vantage Pro2 transmitter/receiver pair with dipole antennas can achieve a range of 1000 feet (300 m). Obstacles or interference will reduce this range.

The following table covers the shorter ranges where a standard repeater should be sufficient.

Standard Minimum Repeater Requirement Table

(Use Yagi antennas on all Long Range Repeaters)

Total Transmission Distance	Line of Sight with Little or No Interference (Outdoors)	Minor RF Interference or Minor Obstructions	Into a Building or All Outdoors *with* High RF Interference	Into a Building *with* Minor RF Interference
<300' (90 m)	None Needed	None Needed	None Needed	None Needed
300' to 400' (90 m to 120 m)	None Needed	None Needed	None Needed	1 Standard
400' to 600' (120 m to 180 m)	None Needed	None Needed	1 Standard	1 Standard
600' to 800' (180 m - 240 m)	None Needed	None Needed	1 Standard	2 Standard
800' to 900' (240 m to 270 m)	None Needed	1 Standard	2 Standard	2 Standard

Note:

- Any solid obstructions have to be overcome by going over or around them. In this case, you will need to include that in your transmission distance figures.
- If either your multiple weather stations or multiple receivers are spread far enough apart to require the use of multiple chains:
    - You will need to apply the distance figures in the above table for each chain, and then add the requirements for each chain together to get the total number of repeaters required.
    - If the total distance to be covered exceeds 3000' (920 m), it may be less expensive to use Long Range Repeaters. Use the appropriate table to determine the optimum layout.

If your distance needs are greater than those covered in the table above, you may need a Long Range repeater.

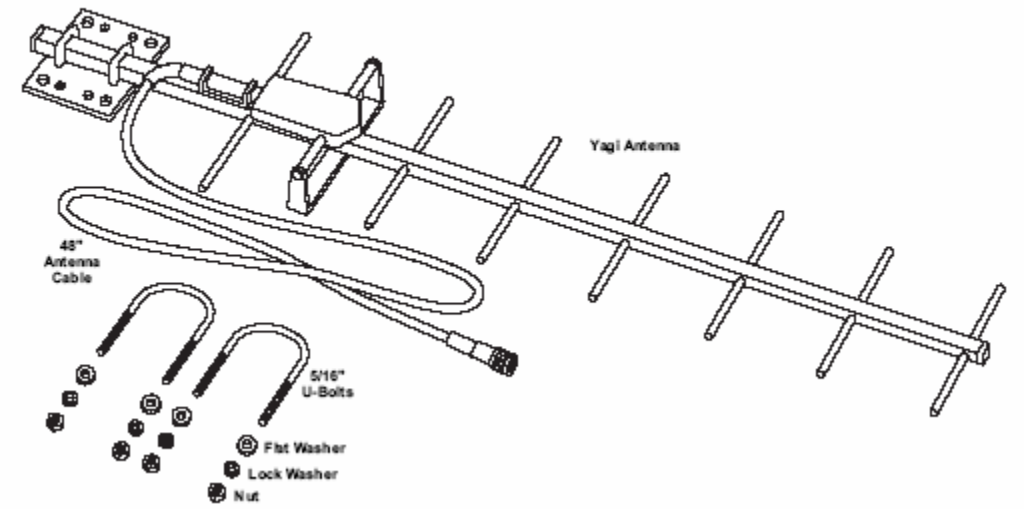
Long Range Repeaters

The Long Range Repeater is very similar to the Standard Repeater. The only difference is that instead of a single dipole antenna, there are two antenna connectors (one for transmit, one for receive). This allows the connection of higher performance (gain) antennas.

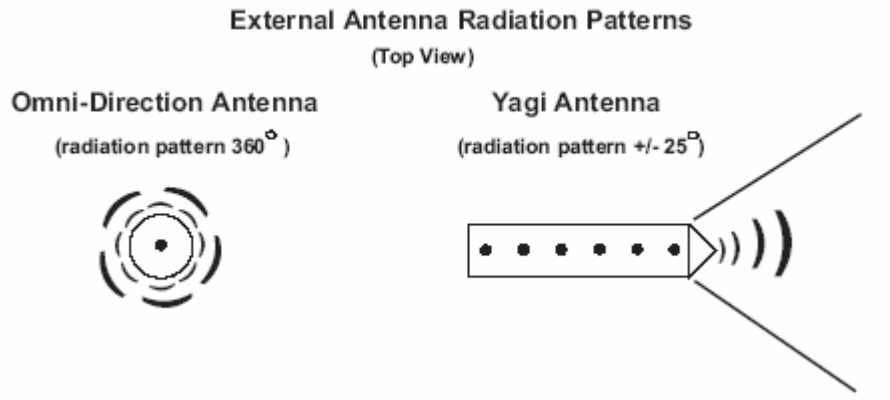
The 7660 Yagi antenna has much greater performance in one direction, at the sacrifice of all other directions. Its transmission distance is 3.16 times greater than a dipole antenna. When you pair a Yagi antenna with a dipole antenna, you can achieve a maximum transmission distance of 3160' (950 m), and 5000' (1500 m) with a high-gain Omni. When paired with another Yagi, the distance increases to a maximum 10,000' (3000 m). This antenna is best used when a repeater is receiving from one transmitter, transmitting to one receiver, or receiving or transmitting multiple transmitters or receivers that are all in a straight line.

Yagi (Directional) Antenna (#7660)

The Yagi antenna includes the directional antenna and mounting hardware:



When paired with another antenna, it is best to be in the 'beam' of the Yagi antenna (Yagi antenna pointed straight at the other antenna), but can be up to 25° above, below, left or right of the center of the beam as shown below before performance seriously degrades.



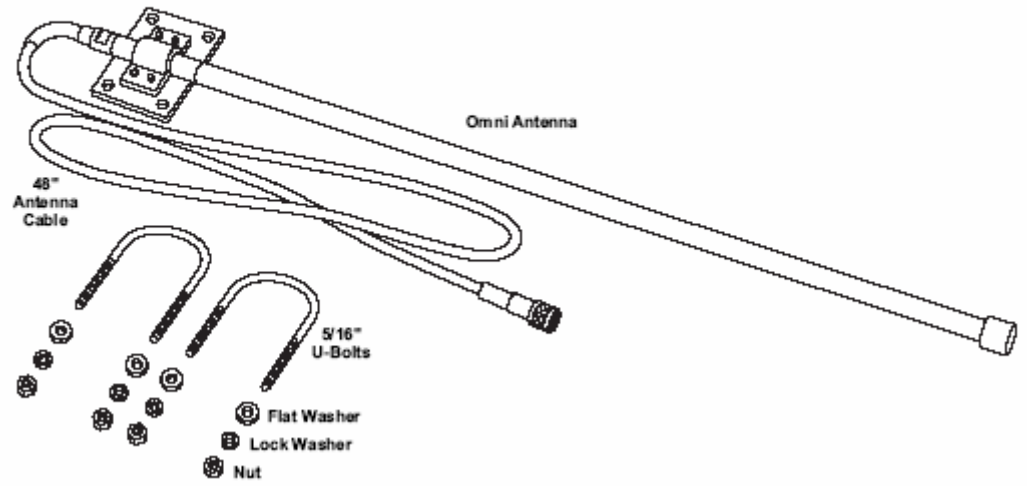
Determine whether you can use all Yagi antennas in your network. If any of the situations below apply, you may use table on page 16 to determine your minimum repeater requirements.

- If you have one weather station and one receiver.
- If you have more than one weather station or more than one receiver, and they all fall within 25° either side of your proposed transmission path centerline.
- If either your multiple weather stations or multiple receivers are spread far enough apart to require the use of multiple chains
    - And they all fall within 25° either side of the transmission path centerline.
    - If any of them do, you can use all Yagis in those particular chains. Add the repeater requirement results from each chain together to get the total number of repeaters required for those types of chains. Any that don't are covered in the next section below.

The 7656 high-gain Omni antenna is similar to the dipole since it performs best and equally well in all directions around the antenna. However, it is has higher performance compared to the dipole. Its transmission distance is 1.58 times better than the dipole. The main disadvantages of the high-gain Omni over the dipole is that it cannot be rotated to an angle and it performs even worse above and below the transmission plane than the dipole does. Another antenna can only be about 20° above or below this horizontal plane before the performance begins to seriously degrade. When you pair a high-gain Omni antenna with a dipole antenna, you can achieve a maximum transmission range of 1580' (475 m). When paired with another high-gain Omni, the distance increases to 2500' (750 m). This antenna is best used when a repeater is receiving multiple transmitters that are in very different directions relative to the antenna, or transmitting to multiple receivers that are in very different directions relative to the antenna.

Omni-direction Antenna (#7655)

The omni-direction antenna includes the omni-directional antenna and mounting hardware:



You may need to use high-gain Omni antennas at one end of your transmission chain(s):

- If your weather stations are spread far enough apart to fall outside 25° either side of the transmission path centerline or
- If your receivers are spread far enough apart to fall outside 25° either side of the transmission path centerline

You may need to employ high-gain Omni antennas in the middle of the chain:

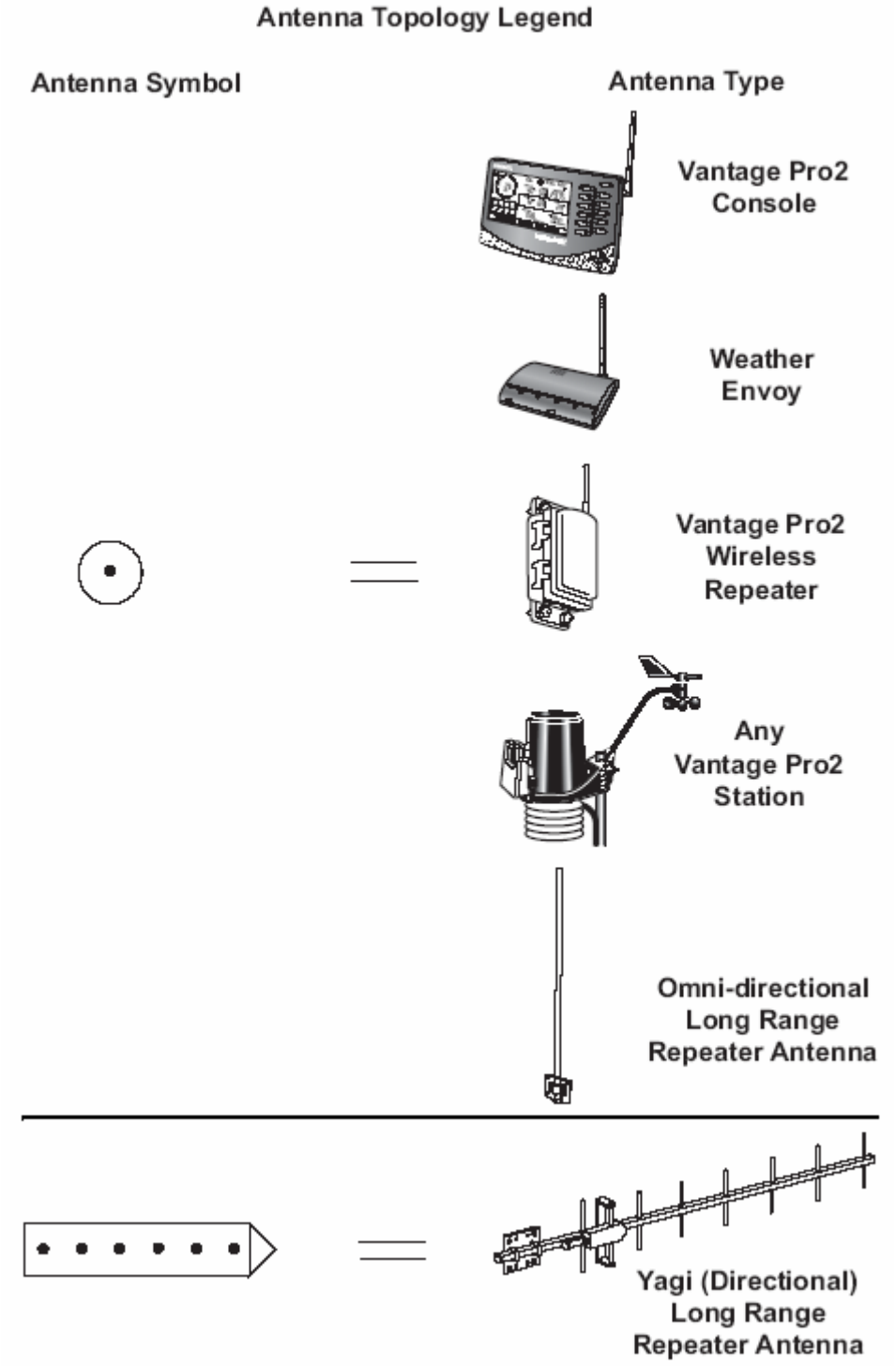
- A station branching off of a main chain may require the use of a high-gain Omni antenna if it branches off at greater angle than the transmission cone of a Yagi antenna AND the station is not near the Yagi antenna. Yagi antennas can receive transmissions behind or to their side when close to the antennas (<200' (60 m) line of sight)
- Two stations branching off a main chain will always require the use of a high-gain Omni at that point.

Since placing high-gain Omni antennas in the middle of chains complicates your network distance capabilities, it is best to use the distance table in the "Planning Where to Place Repeaters" section. You may still use one of the "Omni" Tables to determine the requirements for the branching chain since the high-gain Omni will reside at the end of the branching chain.

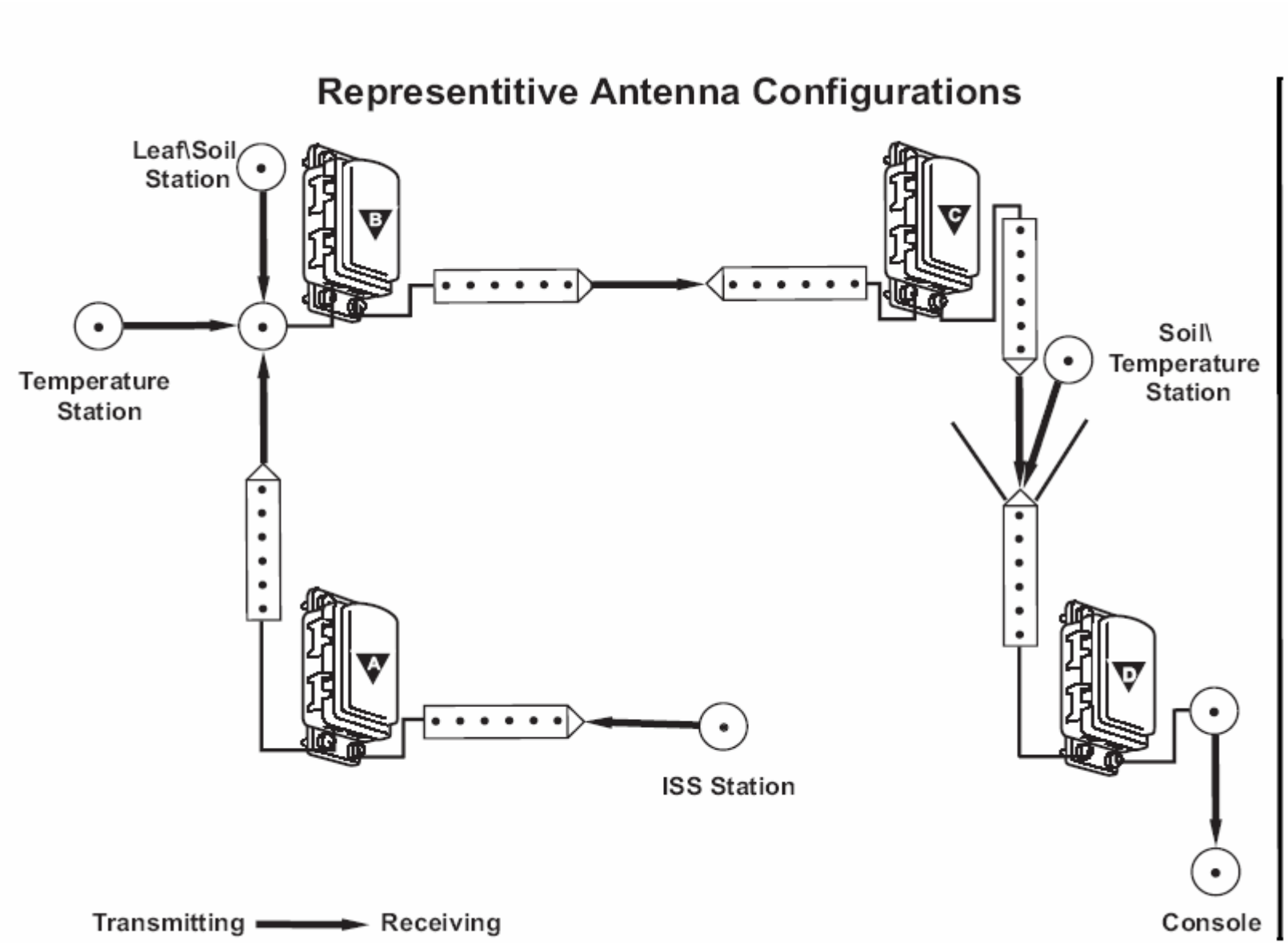
General Notes on the use of Long Range Repeaters:

- Remember that Standard Repeaters use dipole antennas which are omni-directional, so they will transmit and receive in all directions just like the high-gain Omni antennas.
- You cannot exceed a total of eight repeaters in a chain regardless of repeater type.
- If RF interference levels are higher than anticipated, you may need to use more repeaters than indicated.

The legend below describes the antenna types and how they are represented in the sample antenna configuration:



The first symbol represents any station/receiver/repeater with a normal dipole or long range omni antenna. The second symbol represents the long range Yagi antenna.
The diagram on the next page contains all the long range external antenna configurations available for a network. In this example, there are four repeaters, each with a unique station-to-repeater or repeater-to-repeater antenna relationship.


Representitive Antenna Configurations
Leaf\Soil
Station
Temperature
Station
B
C
Soil\
Temperature
Station
A
D
ISS Station
Console
Transmitting
Receiving

PLANNING WHERE TO PLACE REPEATERS

You should position your repeaters within a chain at equal distances apart unless you have obstructions to overcome (see “Overcoming Obstructions” section). Avoid placing repeaters at the edge of the maximum transmission range. This may lead to inconsistent reception due to varying RF environmental factors. It is better to add one more repeater to a chain if you are on the edge of the transmission range.

Consider the installation environment. Determine, if possible, whether or not your situation has any significant RF interference or any minor obstructions. Use the following table to determine the maximum distances you can place your repeaters apart from each other. Remember that a weather station, console/receiver, Weather Envoy, and standard repeater all have dipole antennas. You should use one of the Dipole antenna combinations to determine the maximum distance between these devices and a long range repeater.

Transmit Antenna to Receive Antenna	**Multiplier**	**Maximum Transmission Distance**			
		Line of Sight with Little or No Interference (Outdoors)	**Minor RF Interference or Minor Obstructions**	**Into a Building or All Outdoors *with* High RF Interference**	**Into a Building *with* Minor RF Interference**
Dipole to Dipole	1.00	1000’ (300 m)	500 - 800’ (150 - 250 m)	200 - 400’ (60 m - 120 m)	100 - 320’ (30 - 100 m)
Dipole to Omni	1.58	1580’ (475 m)	790 - 1260’ (240 - 380 m)	320 - 630’ (100 m - 380 m)	160 - 510’ (50 - 150 m)
Dipole to Yagi	3.16	3160’ (950 m)	1580 - 2530’ (475 - 760 m)	630 - 1260’ (190 m - 380 m)	320 - 1010’ (95 - 210 m)
Omni to Omni	2.50	2500’ (750 m)	1250 - 2000’ (375 - 600 m)	500 - 1000’ (150 - 300 m)	250 - 800’ (40 - 240 m)
Omni to Yagi	5.00	5000’ (1500 m)	2500 - 4000’ (750 - 1200 m)	1000 - 2000’ (300 - 600 m)	500 - 1600’ (75 - 480 m)
Yagi to Yagi	10.00	10,000’ (3000 m)	5000 - 8000’ (1500 - 2400 m)	2000 - 4000’ (600 - 1200 m)	1000 - 3200’ (150 - 960 m)

If you unaware of whether you have RF interference, use the Line of Sight or the Minor Obstructions column as appropriate to determine the maximum transmission distance between repeaters. If you have higher levels of RF interference than you are aware, you will need to install each repeater closer together.

If there are hazards (bodies of water, unstable ground, livestock range) along your transmission path where you cannot place repeaters, then it is best to place one on each side of the hazard. If the hazard is more than 10,000’ (3000 m) across, then try going around the hazard. In the case where the weather station is located at the edge of the hazard and the distance across the hazard is more than 1000’ (300 m), you will need a Long Range Repeater with a high-gain Omni antenna for receiving, and a Yagi antenna for transmitting adjacent to the weather station. This configuration will allow you to transmit up to 10,000’ (3000 m) across the hazard if you use a long range repeater with a Yagi antenna at the other side of the hazard. One example of this would be where a weather station is installed on a small island in the middle of the lake, which must then transmit to the lake shore and this distance exceeds 1000’ (300 m) line of sight.

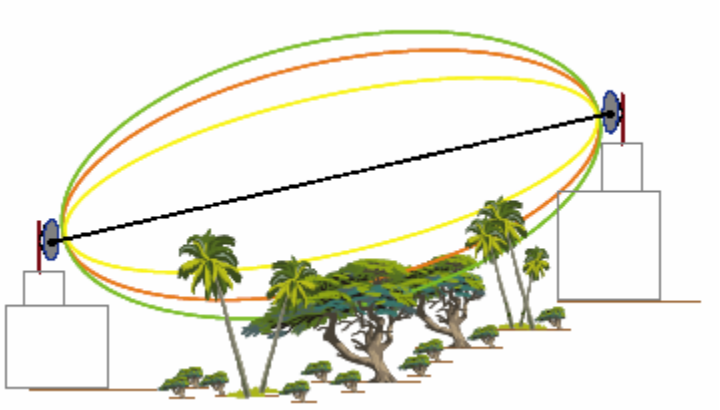
MOUNTING HEIGHT AND LINE OF SIGHT

Antennas transmit in both the horizontal *and* vertical direction. For this reason the antennas effectiveness may be altered by objects that are not directly in the straight line of sight transmission path or even the ground itself. For this reason, best results are obtained the higher you mount antennas above the ground. The transmission distance specifications attempt

to take the ground into account, and to a lesser extent, minor obstructions in the transmission path. Assuming there are no objects in the transmission cone, mounting the long-range repeater antennas up to the maximum effective height (see table below) above the ground should improve your reception. Mounting heights above this value have little additional benefit. However, Davis Instruments cannot guarantee better results than those specified in the distance tables.

Transmit Antenna to Receive Antenna	Maximum Effective Antenna Mounting Height
Dipole to Dipole	8' (2.4 m)
Dipole to Omni	9' (2.8 m)
Dipole to Yagi	12' (3.8 m)
Omni to Omni	11' (3.4 m)
Omni to Yagi	17' (5.1 m)
Yagi to Yagi	22' (6.6 m)

The transmission cone of each transmit/receive antenna pair merge to form a football shaped zone between them. Thus, objects near either antenna that are below them have little affect, whereas, objects on the ground halfway between the two antennas can have a significant impact on the transmission distance. In this case, the antennas should be mounted even higher: above the height of any objects within the transmission zone. The closer you mount the antennas, the less effect these objects will have.



REPEATER NETWORK FINALIZATION HINTS

TESTING AND INSTALLATION GUIDELINES

The following instructions will have you install each "link" of the network, one by one, verifying that each link in the network is working properly, first with the weather station, then with the first repeater in the chain, and then each repeater in the chain, working your way back to the receiver location. This will make it easier to check and verify that each repeater in each chain is working. For networks with multiple chains, test and install each chain one at a time.

It is highly recommended that you familiarize yourself with the diagnostic parameters (Received Signal Strength Indicator (RSSI), synchronization, background noise, reception %, and signal to noise ratio (S/N)), where they are found and how to set transmitter IDs. This information can be found in the console and repeater manuals.

First, power up and test just the weather station(s) and receiver(s) in your living room, garage or office before placing the weather station(s) in their proposed outdoor location(s). This will verify that the main components of your weather station network are functioning normally. If you have both a console and Envoy, use the console for testing because it is easier to carry around and has the ability to provide more data on reception diagnostics than the Envoy does. Consult the Vantage Pro2 console manual for details on how to enter and use the diagnostic screen. If you only have an Envoy, you will need to carry a laptop with you to read the data from the Envoy. Select Console Diagnostics on the Reports menu to access this information. If you are receiving 95% or more of the data packets after a few minutes of operation and your RSSI is 50 or greater while the weather station(s) and receiver(s) are adjacent, you have successfully determined that they are working and can safely proceed to the next step in installation. Consult the troubleshooting section of the appropriate manual if you fail to achieve these results. Failure to receive any of the weather stations may indicate a problem with the receiver, but you should go through the troubleshooting sections of both instruction manuals to be sure.

Next, take your weather station and receiver out to the weather station installation site and install the weather station. Power up both units and verify that the receiver is successfully receiving the weather station (using the same criteria as above). Force a resynch by going in and out of the setup screen, then go into and clear the diagnostic screen on the receiver. Check the background noise (measured only during signal acquisition). If the number is 10 or greater, then you may have high RF interference issues outdoors. If you fail to achieve the same success here in the outdoors that you obtained in your workspace environment or you fail to receive any signal at all, your RF environment may be so poor that wireless technology may not feasible in your area. Should you encounter such trouble, leave the receiver in the area for a few hours to gather enough diagnostic information to be sure.

If successful, near the weather station, power up the first repeater in the chain, configure it to listen to the weather station's ID number, and place it in Test mode. You will need to reconfigure your receiver to listen to repeater A (or whichever is first in the chain) and place it near that repeater. Remember, unless you set the "first-in-chain" jumper, the first repeater in the chain must be A. Clear the diagnostic screen on the receiver. When the receiver acquires the signal from the repeater, check both the reception % and RSSI. An RSSI of less than 50 or reception % of less than 95% while the weather station(s) and receiver(s) are adjacent indicates the receiver is having trouble listening to the repeater. If the receiver tested well before, then the problem may lie with the repeater. Go to the Current screen and select wind direction. The number that appears there will be that repeater's RSSI from the weather station while the repeater is in Test mode. If the reception % is below 95% and/or the RSSI is below 50, this indicates that the repeater is having trouble listening to the weather station. Should a problem be indicated, consult the wireless repeater manual troubleshooting section to determine the problem and course of action.

If you are able to receive the weather station through the first repeater in the chain as you just tested, relocate the repeater to its proposed installation location. Again, on the receiver, force a resynch and clear the diagnostic screen on the receiver. Check the background noise. (What is shown is the receiver value, but it will be the same for the repeater if you are using a standard repeater because they both have dipole antennas.) As before, a background noise of 10 or more indicates high RF interference. When you acquire the repeater signal, take the RSSI reading. Subtract the background noise value from it to get your signal to noise ratio value. If the number is 10 or less and the reception % is 75% or greater after waiting a few minutes, then you may confidently install the first repeater in the chain at this location.

However, if your background noise value is 10 or higher, force a resynch on the console and move the repeater gradually closer to the weather station. When the background noise level on the console diagnostics drops below 10, clear the diagnostic screen and leave the receiver at this location for several minutes. Afterwards, read your RSSI, calculate your signal to noise ratio and check your reception % again. If the numbers are acceptable here (S/N>=10, %>=75%), then you will need to install the repeater here (closer to the weather station) rather than where originally planned due to higher levels of RF interference than anticipated. You may need to repeat this process several times to determine the correct installation location of this repeater because RF interference can vary widely at any given location and over short distances. If the background noise level is less than 30 and your reception % does not improve before you reach the weather station, make sure you followed the guidelines for your layout outlined earlier in this document. If you have, then you may have a problem with your repeater. Consult the wireless repeater manual troubleshooting section to determine the problem and course of action.

If you have only one repeater in the chain you are testing, then verify your receiver's reception diagnostics at the location where the receiver is to be located. If they are acceptable, then you are done testing for that chain and you should turn OFF TEST mode on the repeater. If the numbers are not acceptable, you may need to add a repeater to your chain.

If you have more repeaters, replicate the instructions above for the second repeater excepting that you will set the next repeater to listen to the previous repeater.

TROUBLESHOOTING & MAINTENANCE HINTS

If you leave either a weather station or a repeater in Test mode, it will drain the battery rapidly. So, when you are finished testing your network, be sure and turn off Test mode. Also, if you leave Test mode on one or more repeaters, the RSSI number you see will be for the last repeater in that chain that is in Test Mode.

If you believe your transmission success is less than optimal, check for any Low Battery messages on any of the weather stations or repeaters. You may simply need to change the batteries in one or more parts of your network. If no battery message is present, check your reception diagnostics. If you are receiving less than 75% of the data packets after a few minutes and your RSSI is 30 or less, then you may have a problem with one or more repeaters, the weather station(s), or receiver. Repeat the steps in the "Testing Hints" section to determine where in the network the problem lies. If each part of the network appears to be functioning normally, but you still have poor reception, you may simply need more repeaters than originally anticipated. This may be the result of increased RF interference or an increase in the number and size of obstructions (construction and/or foliage growth) since the original installation.

If you ever receive a Low Battery message for any of the repeaters, you should change the battery as soon as possible. The receiver can only process 4 Low Battery messages at a time, so there may be more low batteries in your repeater network than it appears. If you find that you have to change batteries often, make sure no repeaters are in Test mode. For solar powered repeaters, be sure they are mounted in a location that receives direct sunlight most of the day (avoid shaded locations) and face the solar panel south in the Northern Hemisphere (north in the Southern Hemisphere). If these suggestions don't remedy the situation, make sure that the repeater with the low battery is able to receive all the stations and repeaters it is intended to receive. This will be confirmed by seeing two flashing green lights while in Test mode. Any other colors displayed indicate a problem with either reception or the repeater itself.

Consult the wireless repeater manual troubleshooting section to determine the problem and course of action.

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