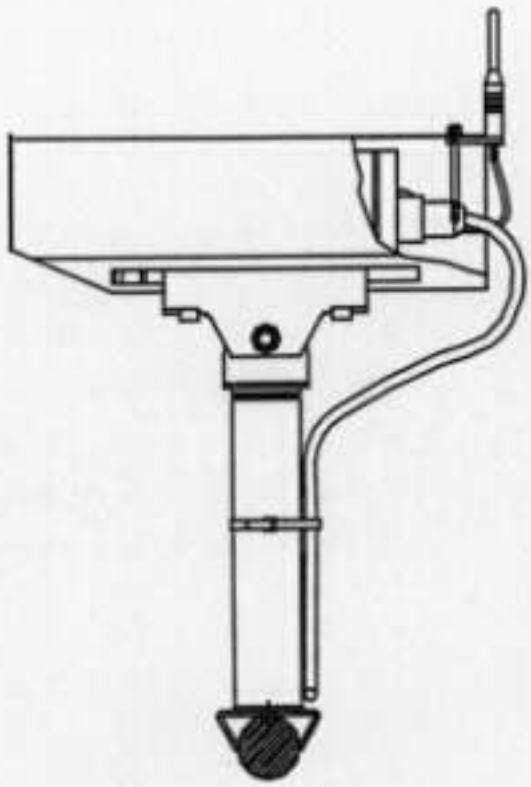
Preliminary Release 12/29/99

ITERIS

VANTAGE WIRELESS CAMERA SETUP AND INSTALLATION GUIDE

Companion Guide To The Vantage Product Installation And User Guide



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CONTENTS

WIRELESS APPLICATIONS

Wireless Video Image Detection System (VIDS)

By Bob Ung, Principal Systems Engineer and Vantage Applications Manager, Iteris, Inc., Anaheim, California

Any major city that relies on vehicle detection for its signal control system will eventually encounter the occasion where traditional inductive loops are damaged due to roadway construction or pavement failure. Road widening or road re-surfacing projects have been known for damaging inductive loops to the point where consistent and reliable vehicle detection are compromised. Maintaining optimum traffic flow during such construction activities can also be difficult due to temporary striping and lane closures.

Adverse weather conditions also impede repair of inductive loops and at times may delay repair activities for several months. During such time, the intersection that relies upon the failed inductive loop may go into max-recall for the duration.

Iteris, Inc. (formerly known as Odetics ITS, Inc.) has expanded their line of Vantage™ video image detection systems (VIDS) to include wireless video transmission. The use of wireless video transmission facilitates rapid deployment for permanent and temporary applications while maintaining superb vehicle detection where inductive loops or other vehicle detection methods cannot be deployed or repaired.

Wireless VIDS Application

Wireless video communications is not a new technology, however, its application in ITS, specifically in vehicle detection, provides enormous benefits. VIDS in general provides flexibility in the placement of vehicle detection zones. Temporary lane closures and lane markings can be accommodated by simply moving the detection zones of the video image processor.

Other benefits of VIDS can be realized at locations where there are high volumes of heavy vehicles. At some intersections, the constant abuse of the roadway surface from heavy vehicles requires inductive loops to be replaced every year. For these types of locations, VIDS is one of the best alternative detection methods.

Wireless video transmission, between the VIDS CCTV camera and video image processor, provides additional flexibility where quick and low cost deployment is required. At many locations where VIDS detection replaces inductive loops, running high quality coaxial cable may be difficult or impossible due to existing conduits filled to capacity, blocked with debris, or even frozen. Wireless video technology provides cable free live video from the VIDS CCTV camera to the controller cabinet, where the video image processor is housed.

2.4 GHz FM Video Transmission

Iteris' Wireless Vantage System utilizes the license-free 2.4 GHz band to transmit live video from the VIDS CCTV camera to the controller cabinet. A wireless transmitter has been integrated into the Vantage CCTV camera and has no external components other than a 3-inch "rubber ducky" antenna. The video transmitter is FCC compliant and does not require the end user to have an operators license from the FCC.

The wireless transmission system uses frequency modulation (FM) techniques to transmit the video. This modulation scheme, unlike spread spectrum transmission where data is digitized prior to transmission, uses analog methods to modulate the video signal. Digital transmission typically requires higher bandwidths than FM-based systems. A FM-based system was selected to accommodate up to four simultaneous video channels at one location, effectively supporting a typical four-approach intersection.

There are several reasons why the 2.4 GHz band was selected. The 902-928 MHz unlicensed band cannot support four simultaneous live video channels since each live video channel requires approximately 12 MHz of bandwidth. The 5.8 GHz unlicensed band encounters signal reflections common to higher frequency devices at locations where several obstructions and radio wave reflectors exists. Since wireless video transmission devices would be mounted at lower elevations,

signal poles, mast arms, signal heads and even vehicles may cause havoc with multipaths and reflections causing image ghosting, image shifting and possibly even image cancellation.

Benefits of Using FM-Based Video Transmission

The question arises. How can multiple intersections use wireless VIDS if only four channels are available? The nature of FM communications allows the deployment of several intersections using the same operating frequencies. Frequency modulation receivers detect and use the strongest signal they receive. Wireless Vantage video transmitters are low power devices. Signal strengths of adjacent intersection video transmitters are significantly lower than local transmitters and do not cause interference, provided that adjacent intersections are at least 250 feet away.

Other benefits of FM-based video transmission:

- Proven video transmission technology
- Ease of deployment
- Lower maintenance costs (does not require expensive digital test equipment)
- Frequency re-use

CCTV Camera Power

The portability of the Wireless Vantage VIDS hinges upon how power is provided to the CCTV camera. Since the recommended mounting location of the Vantage CCTV camera is on the safety light arm above the signal head, the luminaire circuit supplies the CCTV camera power. The only requirement is that the luminaire head be controlled by its own photocell. In this manner, power for the CCTV can be tapped prior to the photocell by hardwiring in the power cable or by the use of a photocell power adapter that is placed in between the photocell and its receptacle (see Figure 1). The photocell can still provide nighttime switching capabilities while providing continuous 24-hour power to the CCTV camera.

Receiver Antenna Type And Location

The wireless video receiver is located in the controller cabinet. Its baseband video output provides full motion video to the Vantage VIDS. Getting clean, optimum radio waves to the video receiver takes careful planning prior to system installation. As with any wireless transmission, radio wave reflections, multipaths and obstructions can degrade signal quality.

For optimum radio wave signal reception, the receiver antenna should be placed as high as possible to eliminate reflections from ground level objects such as pedestrian signal heads and moving objects (e.g. high profile vehicles). The receiver

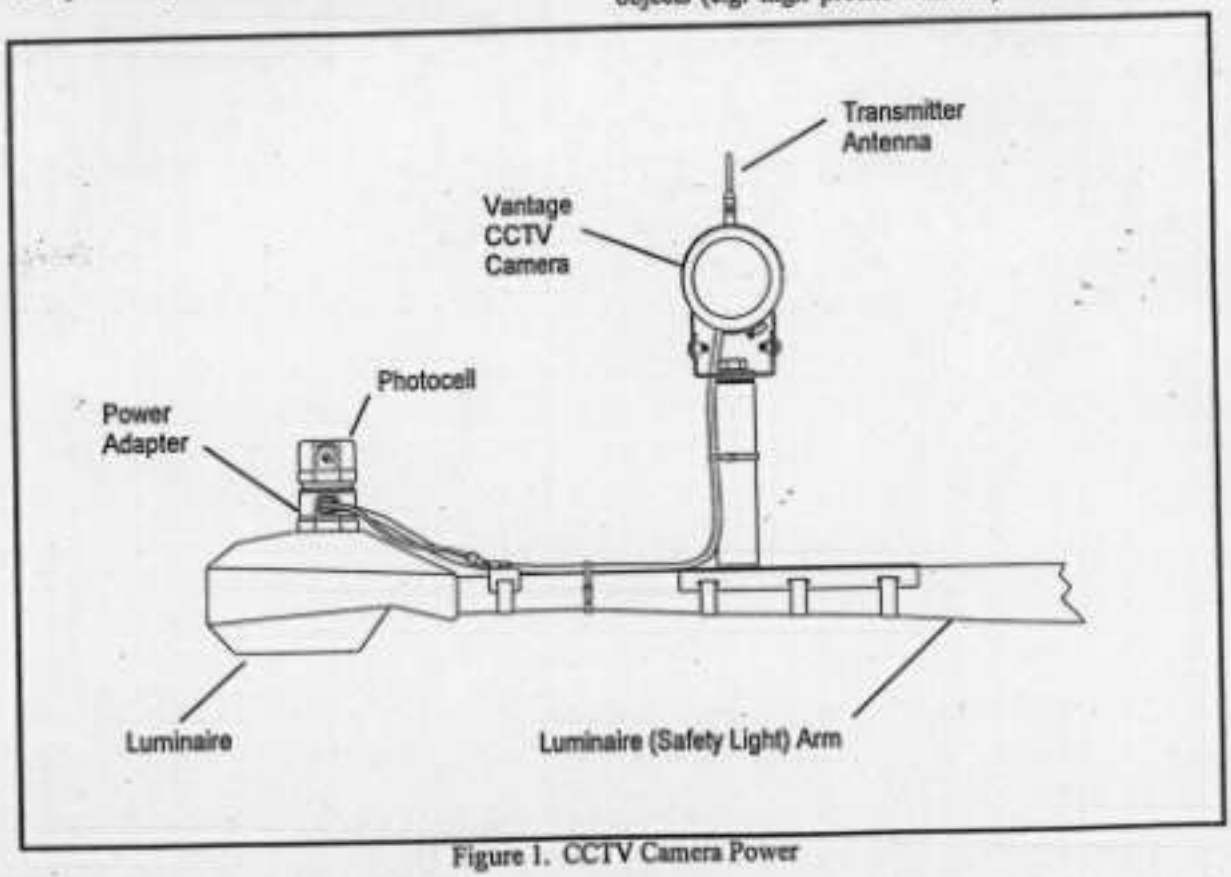


Figure 1. CCTV Camera Power

antenna height also dictates the amount of signal degradation induced from pedestrians. A minimum height of 20 feet is recommended for most applications. Some sites may require additional receiver antenna height if direct line-of-sight between the transmitting antennas and receiver antenna cannot be achieved.

A linear polarized directional patch antenna for receivers provides the best results in most applications. This type of antenna typically has a 60 to 90 degree angle of reception and is designed for vertical or horizontal polarization. Linear polarized antennae reject reflected radio waves since polarization of reflected signals are typically shifted in some manner. In addition, patch type directional antennae provide rejection of reflected radio waves by rejecting signals coming from behind the patch antenna.

Other Applications

Wireless VIDS for construction management activities during road widening, intersection improvements, or temporary lane closures are obvious applications. Other applications that could significantly benefit from the use of wireless VIDS are locations where road surfaces are continually being damaged by heavy vehicles or severe weather. At these locations, permanent installations of the wireless system significantly reduce recurring maintenance costs and headaches.

Mid-block vehicle detection can also benefit from the use of wireless VIDS by eliminating the need to install conduit and cabling from the mid-block detection location to the intersection controller cabinet. A higher-gain Yagi receiver antenna can be used to extend the reception distance to more than a mile.

The use of wireless technology in VIDS applications expands the flexibility for deployment. Coaxial cable and other hard wiring are no longer limiting factors. Iteris, Inc. has taken the lead in the VIDS industry and has integrated their proven Vantage VIDS with wireless video transmission to provide a more flexible VIDS product that can accommodate almost any intersection and mid-block configuration.

ITEMS REQUIRED FOR SYSTEM INSTALLATION

Necessary Tools And Equipment

1) Bucket truck
2) Monitor
3) Lens Adjustment Module (LAM)
4) Volt/Ohmmeter (VOM)
5) Coaxial stripper
6) Banding tool
7) Hammer
8) Screwdriver
9) Adjustable wrench
10) 9/16" wrench
11) Needle nose pliers
12) Wire cutters
13) Wire strippers
14) Two-way communication equipment
15) High heat soldering iron and solder
16) Meter probe adapters to male banana plug

Necessary Supplies

1) ½" or ¾" banding material or lag bolts
2) Camera bracket(s)
3) Connectors *(Type N Male Coaxial Connectors)*
   * See Reference section in the back of this manual.
4) Coaxial cable *(Type LMR 400)*
   *See Reference section in the back of this manual.
5) Photocell power adapter(s)
6) Surge suppressor *See Reference section in the back of this manual.
7) Signal splitter (Required if it is a multiple camera installation)
   * See Reference section in the back of this manual.
   Grounding wire
8) 3' BNC to BNC coaxial jumper cables
9) PVC Cement

INSTALLING THE CAMERA AND RECEIVER UNIT

Summary

- Install the photocell power adapter
- Mount the camera
- Run the coaxial cable for the receiving antenna
- Mount the receiving antenna
- Setup the Vantage equipment in the traffic control cabinet
- Adjust the receiving antenna for maximum signal strength
- Get the correct camera field of view

Mounting The Camera Transmitter Unit

Power must be supplied to the camera transmitter unit. This can be 120 or 220 VAC. You can use the photocell power adapter if you mount the camera close to the luminaire, or else you will need to wire into another electrical AC source. See the Diagram 1a, 1b, 1c on pages 3, 4, and 5. Follow the camera mounting instructions in the Vantage product Installation and User Guide. Because the system is wireless you will not need to run coaxial cable to the cameras.
Make sure the Ground wire (Green) is securely grounded to the luminare arm to provide a good safety ground.
See the section in this user guide for instructions on setting up the receiver unit and other wireless ancillary equipment.

Installing The Coaxial And Power Cables

Coaxial cable (Type LMR 400) must be pulled, depending on the installation option, from the receiving antenna to the traffic control cabinet. Some jumpers will need to be made or purchased for the required connections in the cabinet. Do NOT use (LMR 400) to connect the receiver unit to the Vantage unit. Belden 8281F coaxial cable should be used for the connection from the receiver unit to the Vantage processor unit and for any other video connections.

See Reference Section at the end of this manual for coax specifications.
The power cable should be a SJOW type three conductor 16 gauge cable.

For specifics on video and power cable see Appendix A in the back of your Vantage product Installation and User Guide.

Antenna Mounting Configuration Options

Generally speaking, the higher the receiver antenna mounting the less interference and the better the video reception.

Pole Top Antenna Mounting

The antenna is mounted utilizing the pole nearest to the traffic control cabinet. The poles cap is drilled for the actual antenna mounting and the coax is run from the cabinet to the antenna at the top of the pole. This coaxial cable run should not exceed 100 feet. Longer runs will most likely result in excessive signal loss and inadequate signal strength. See Diagram 2a on page 6.

Side Pole Antenna Mounting

The antenna is mounted using the antenna bracket. The bracket can be mounted to the side of a pole using ½" or ¾" banding material. If it is a wooden pole, lag bolts can be used to secure the antenna mounting bracket to the pole instead of banding material. See Diagram 3a on page 7.

Cabinet Top Antenna Mounting

The antenna can be mounted on top of the controller cabinet. The pole top and side pole mountings are recommended over the cabinet top mounting option due to performance limitations of the cabinet top mount. See Diagram 4a on page 8.

Mounting The Camera Transmitter Unit

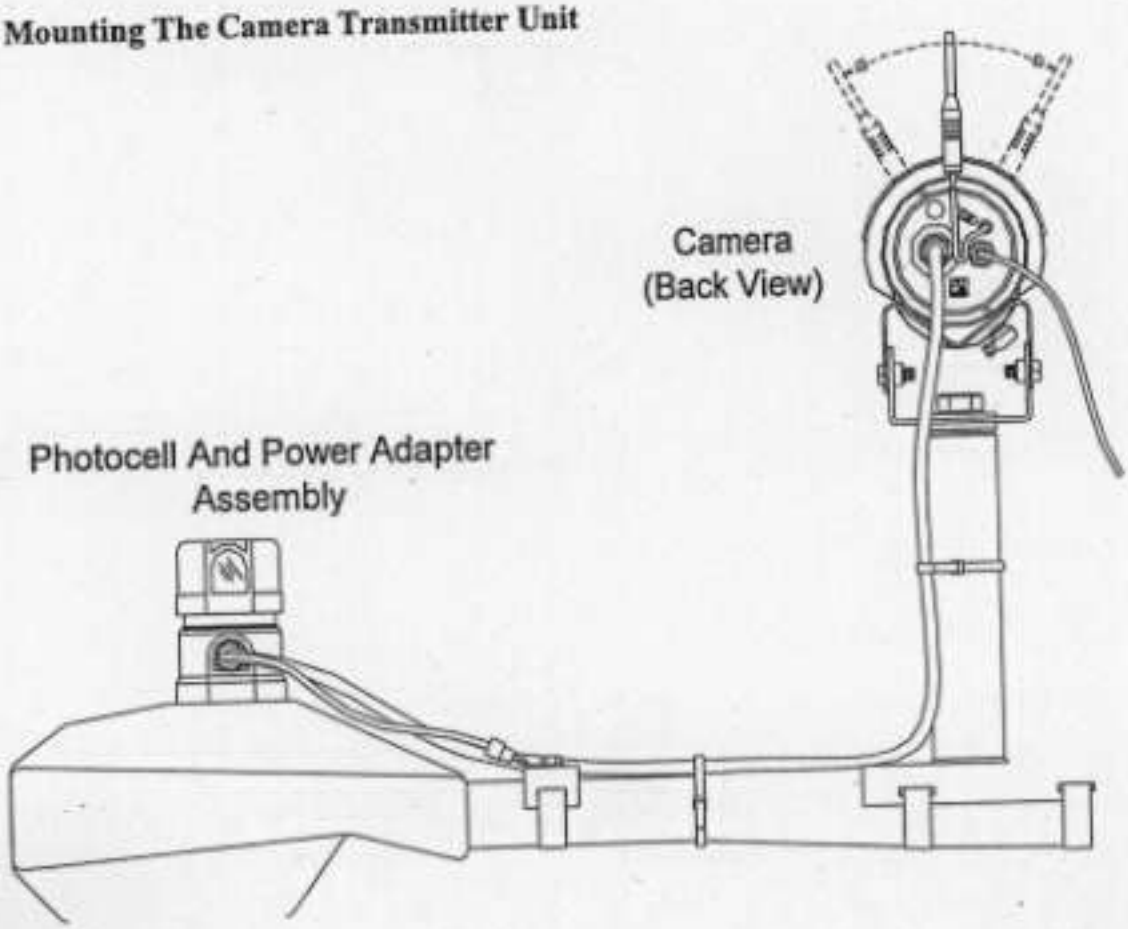
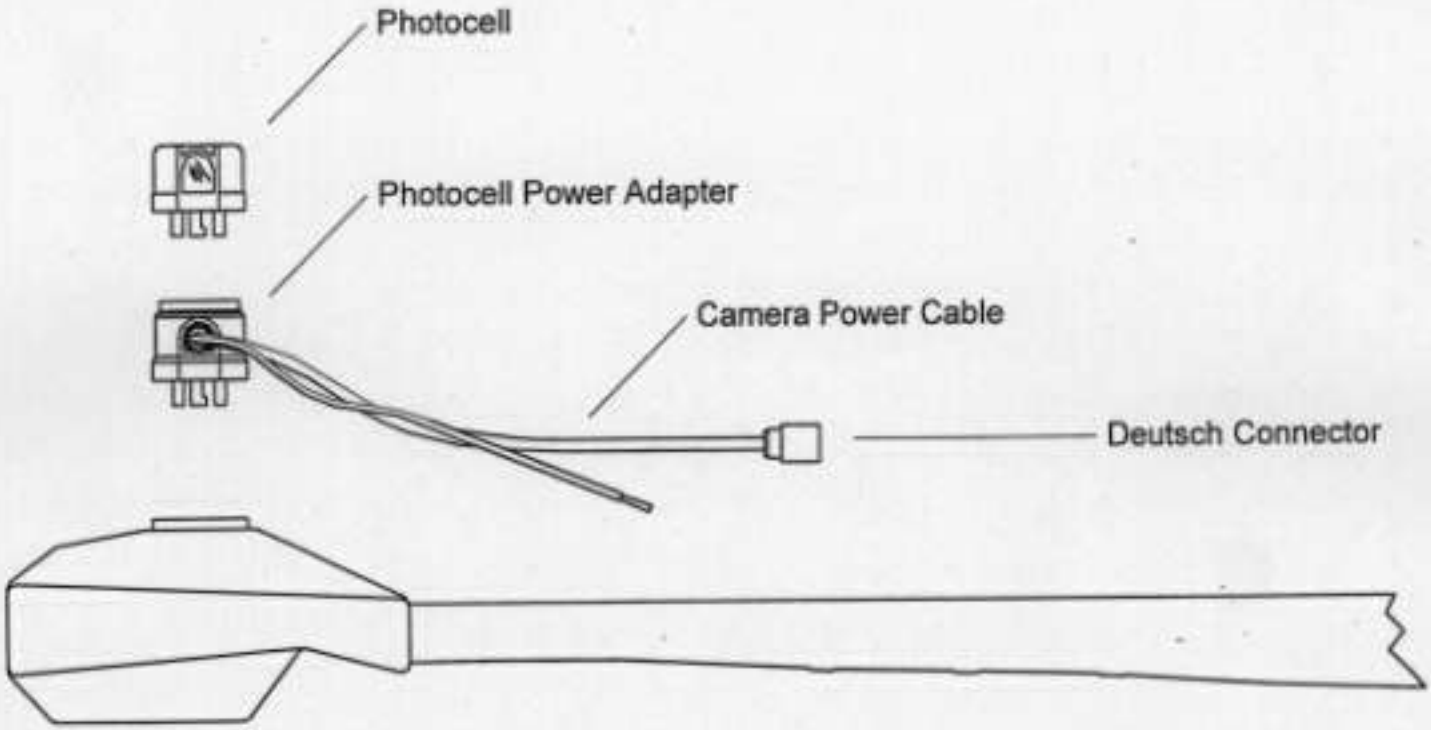


Diagram 1a.

Diagram shows the use of the Photocell Power Adapter
The BNC connector on the back of the camera would only be used during setup with the Lens Adjustment Module (LAM)
The antenna should remain in the vertical position for most applications



Luminaire Arm

Diagram 1b.

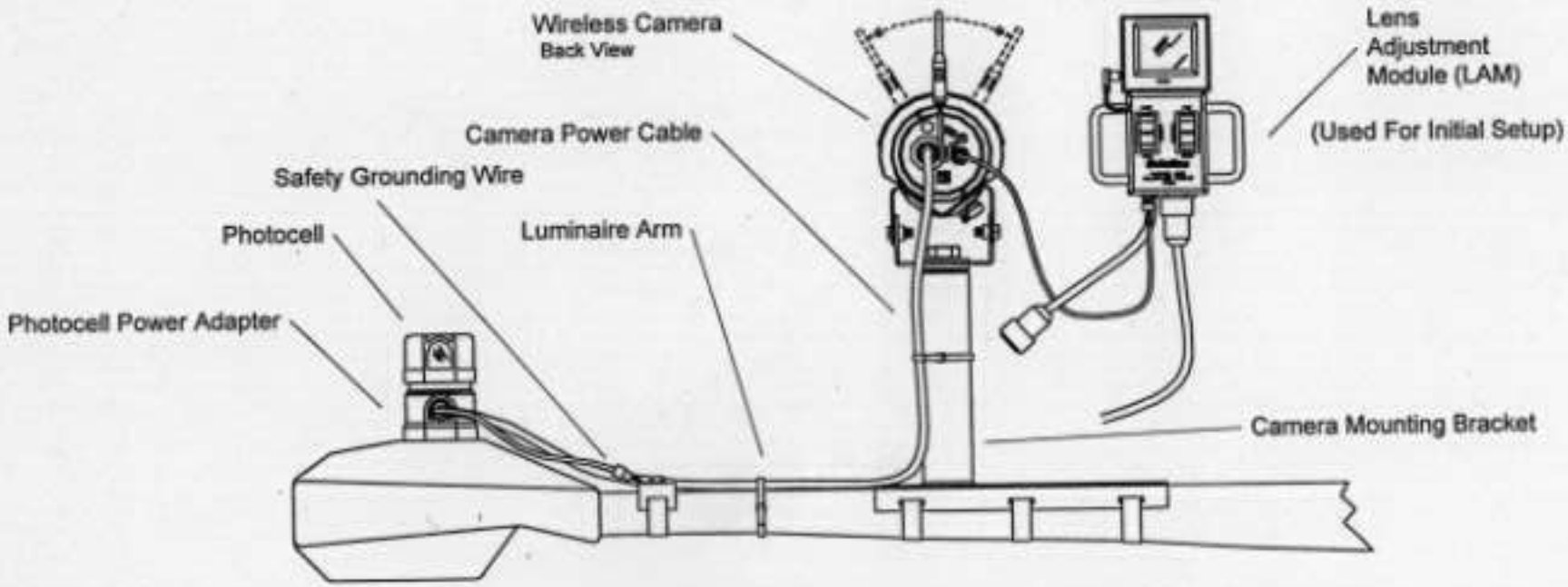

Wireless Camera
Back View
Lens
Adjustment
Module (LAM)
(Used For Initial Setup)
Camera Power Cable
Safety Grounding Wire
Photocell
Luminaire Arm
Photocell Power Adapter
Camera Mounting Bracket

Diagram 1c.

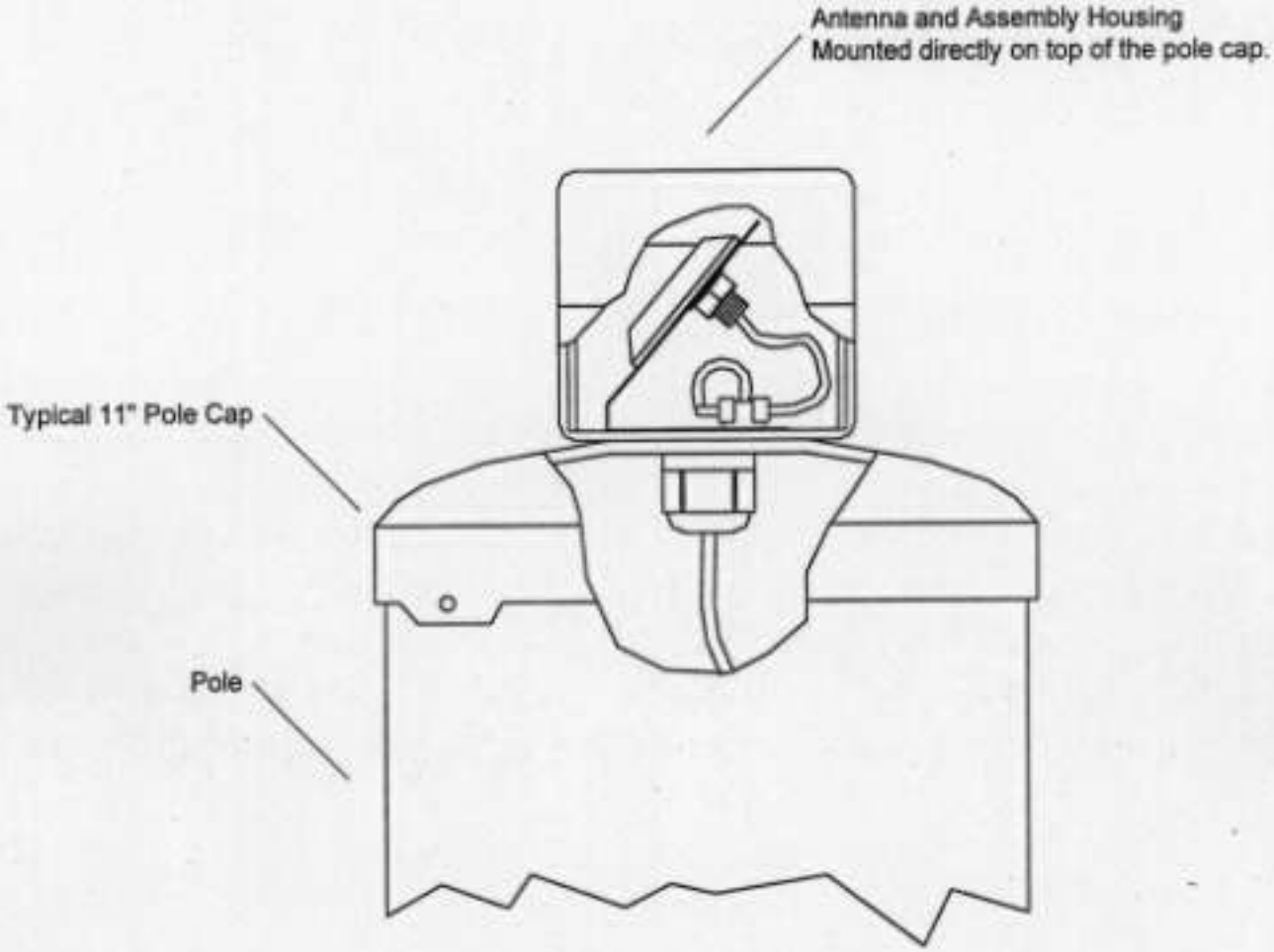

Antenna and Assembly Housing
Mounted directly on top of the pole cap.
Typical 11" Pole Cap
Pole

Diagram 2a.

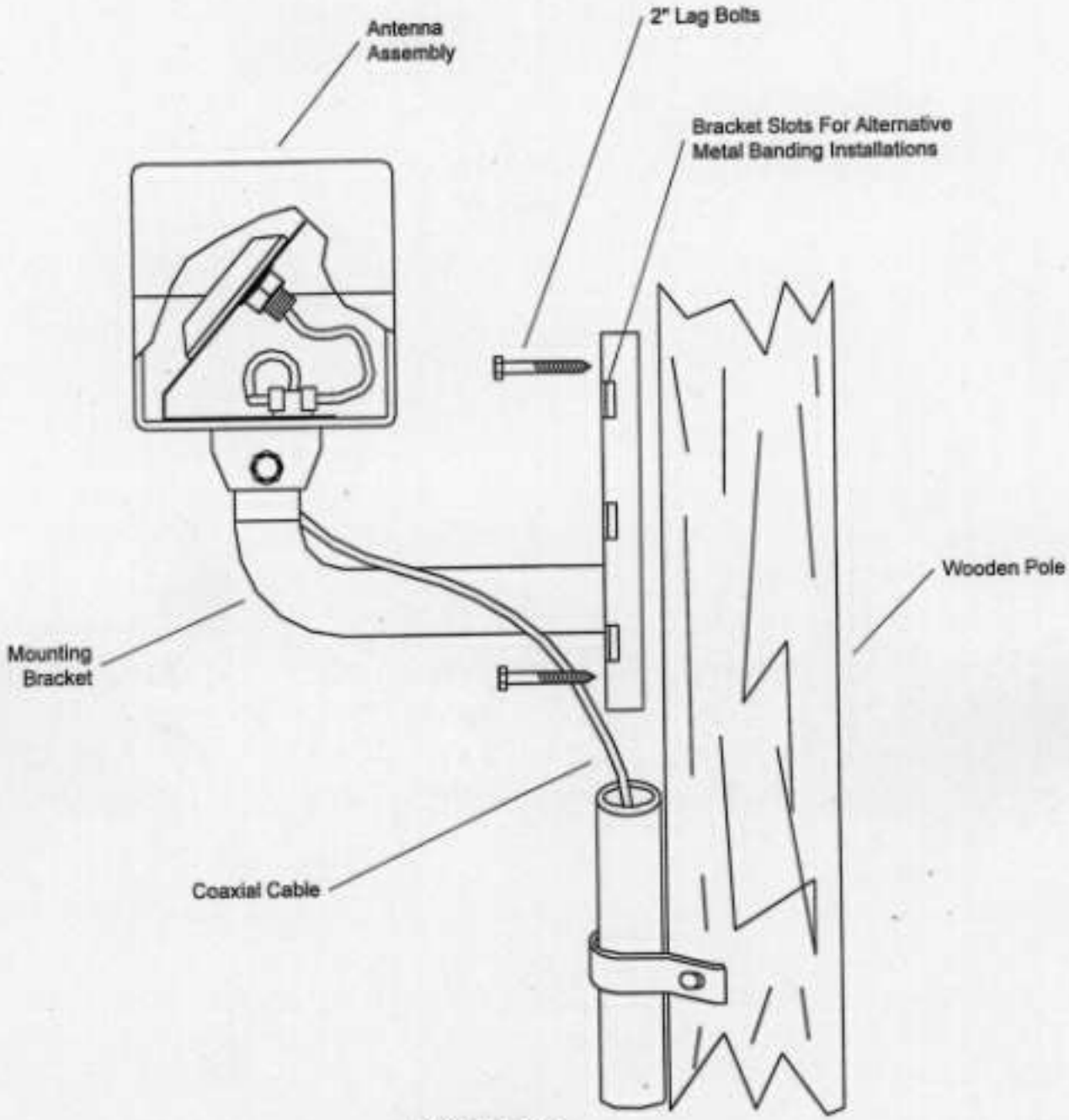


Diagram 3a

Wooden Pole Type Antenna Mounting Configuration Option

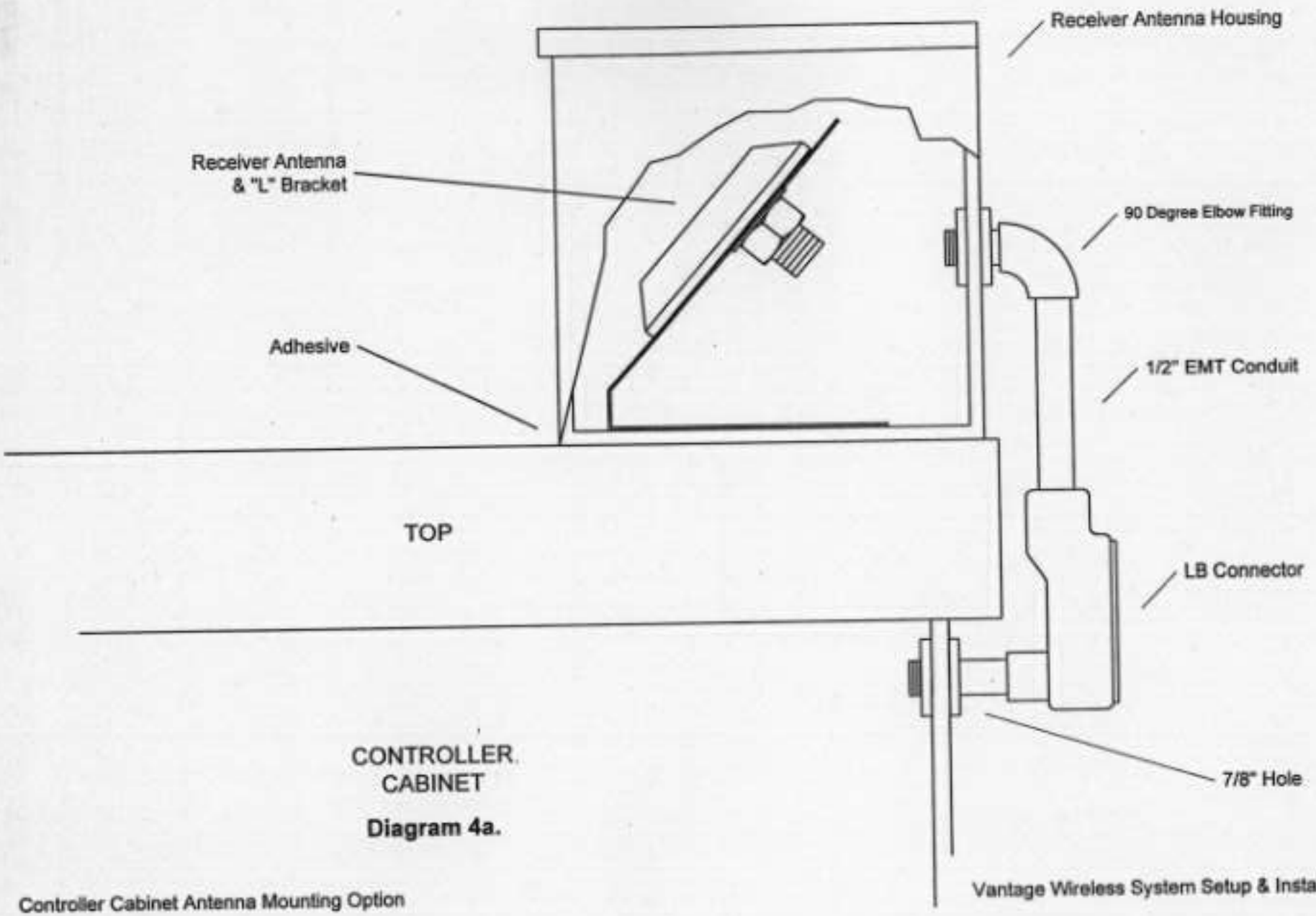


Diagram 4a.

Controller Cabinet Antenna Mounting Option

Setting Up The Receiver Frequency

Carefully remove the circular plastic plug on the top of the receiver unit that covers up the recessed compartment that allows access to the DIP switches. See the diagram to see how to set the DIP switches to select each of the four available frequencies. The Receiver Unit must be set to the same frequency as the associated Camera Transmitter Unit. See Diagram 5a on page 10.

Setting Up The Camera Transmitter Frequency

If there is not a plastic plug cover on the camera back plate it is a fixed frequency unit, disregard this section and proceed to the next section.
Carefully remove the oval plastic plug on the back of the camera transmitter housing to expose the four jumper terminals. Place the plastic shunt on the set of terminal jumper pins that corresponds to the desired transmitter frequency. See Diagram 6a and 6b on pages 11 and 12.

Cabinet Vantage Wireless Equipment Setup

Route the antenna coaxial cable into the cabinet. See Diagram 7a on page 13. Connect the coaxial cable to the Surge Protection device. See Diagram 7b on page 14. Make sure the Surge Protection device is properly grounded to the cabinet grounding buss. From the Surge Protection device a coaxial jumper cable should go to the Splitter source input if multiple receiver units are being used. See Diagram 7c on page 16. From the Splitter output a coaxial jumper should go to the appropriate receiver input. The heavy duty velcro tabs provided can be used to mount the equipment firmly to the cabinet wall or shelves. See the Reference section at the end of the manual for Surge Protection and Splitter specifications.

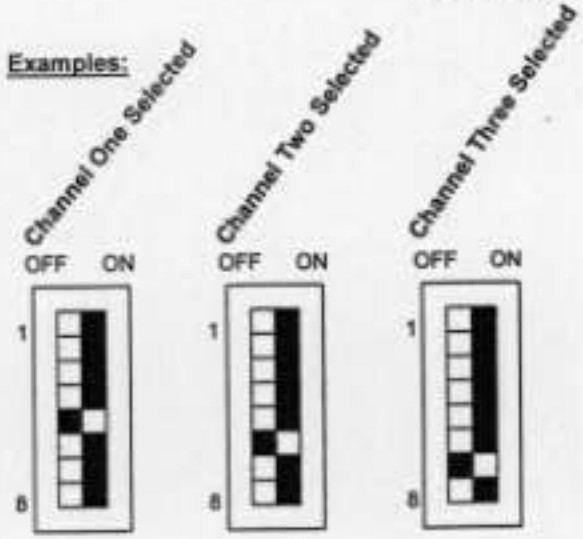
Tuning The Receiving Antenna For Maximum Receiver Signal Strength

After the receiving antenna has been correctly mounted, it must be adjusted to provide maximum signal strength to each of the receiver units. This is done by rotating the receiver antenna housing while monitoring each receivers relative signal strength. The receiver signal strength is measured by using a standard multi-meter. Select the DC measurement scale and insert the meter probes into the color coded test point jacks (Using banana type jack adapters) on the receiver unit to measure the DC signal strength. It should fall somewhere between 1 to 4 volts DC. For optimal performance the signal strength should exceed 1.3 VDC. You will want to adjust (rotate) the receiving antenna until you obtain the maximum average signal strength for all the receiver units. Remember, if you have multiple receivers you want to obtain the highest average signal strength for each of them. Realize while obtaining a higher reading for one receiver you may be degrading the signal strength of another. You need to adjust the receiving antenna to find a happy medium. When you are successful you should have a stable video picture for each camera view. When you find this desirable position tighten the antenna to permanently keep it in place. Mark the outer PVC housing to designate the direction the antenna is pointing. Use PVC cement to seal and install the top antenna cap. Make sure the coaxial cable has a drip loop and tie-wrap it for added strain relief. See Diagram 8a and 8b on page 16 and 17.

The field of view and focusing adjustment is the same for the wireless camera as it is with the normal Vantage video camera. You will be using the Lens Adjustment Module (LAM) to obtain the desired field of view and focus the camera. For specific information on LAM operation and camera field of view adjustment please refer to your Vantage product User and Installation Guide.

DIP SWITCH POSITION CHART / FREQUENCY SELECTION					
1		OFF	Not Used - Always		
2		OFF	Keep These Switches (1-4)		
3		OFF	In The "OFF" Position		
4		OFF	"		
5	*CHN 1*	OFF		ON	2400 MHZ
6	*CHN 2*	OFF		ON	2427 MHZ
7	*CHN 3*	OFF		ON	2454 MHZ
8	*CHN 4*	OFF		ON	2481 MHZ

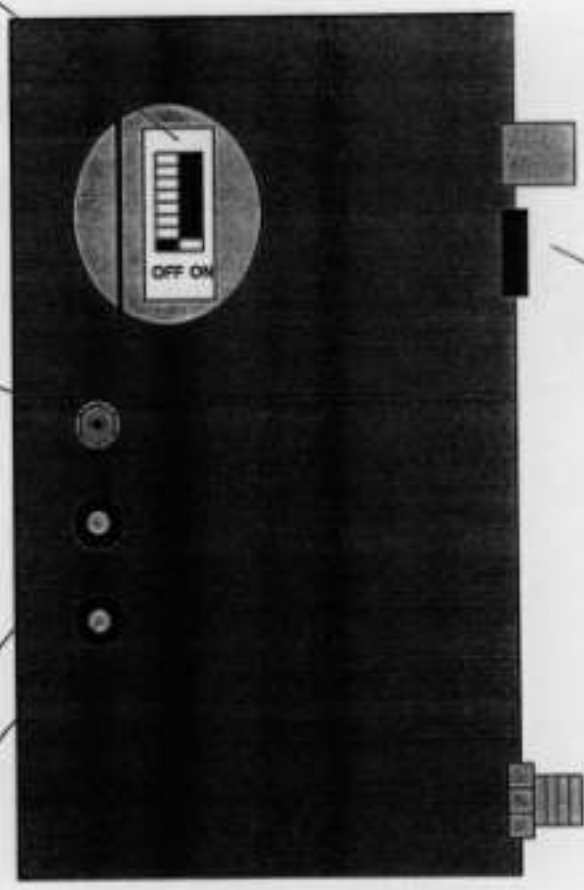
Examples:



*WARNING Do NOT turn "ON" more than one frequency at a time

Frequency Selector DIP Switches
Shows Channel Four Selected

Plastic DIP Switch Selector Cover

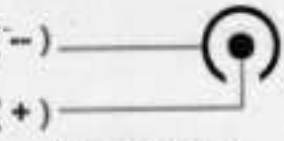


Video Output To Vantage Unit

(RCA Type connector 75 Ohm)
Requires RCA to BNC Adapter Included

Power Connection (Wall Transformer)
Power Requirements
12-15 VDC
500 mA

Grounding Lug
Wire Size #14 or Larger



Power Adapter Polarization Diagram

Measuring Points For RF Signal Strength
(Plug Your Meter In Here)
0-4 VDC 4 = Strongest Signal

Negative Terminal Post
(Banana Plug Type)

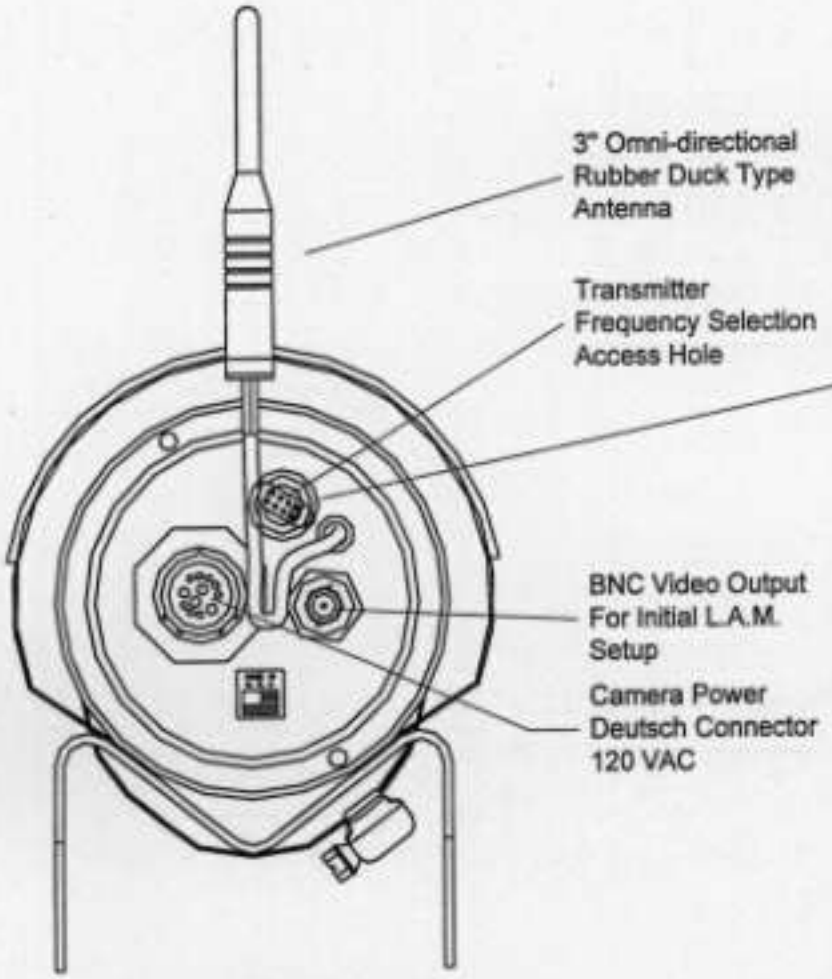
Positive Terminal Post
(Banana Plug Type)

Video Input From Antenna or RF Splitter
SMA connector
50 Ohm
RG 223 Coaxial cable

SINGLE CHANNEL RECEIVER UNIT

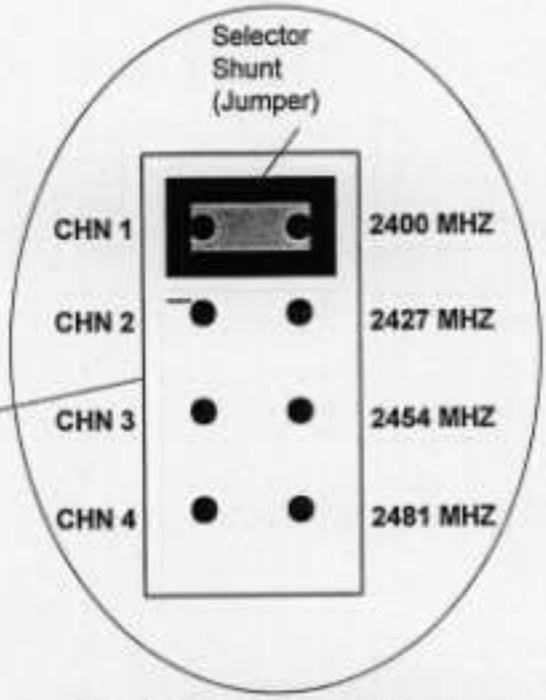
Diagram 5a.

*NOTICE: *Frequency Selection Is Not Available On Fixed Frequency Cameras*
There will be no access hole on the camera back plate.



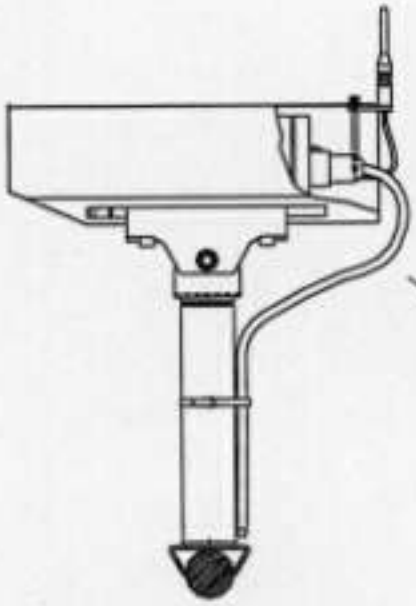
WIRELESS CAMERA
Back View

Diagram 6a.

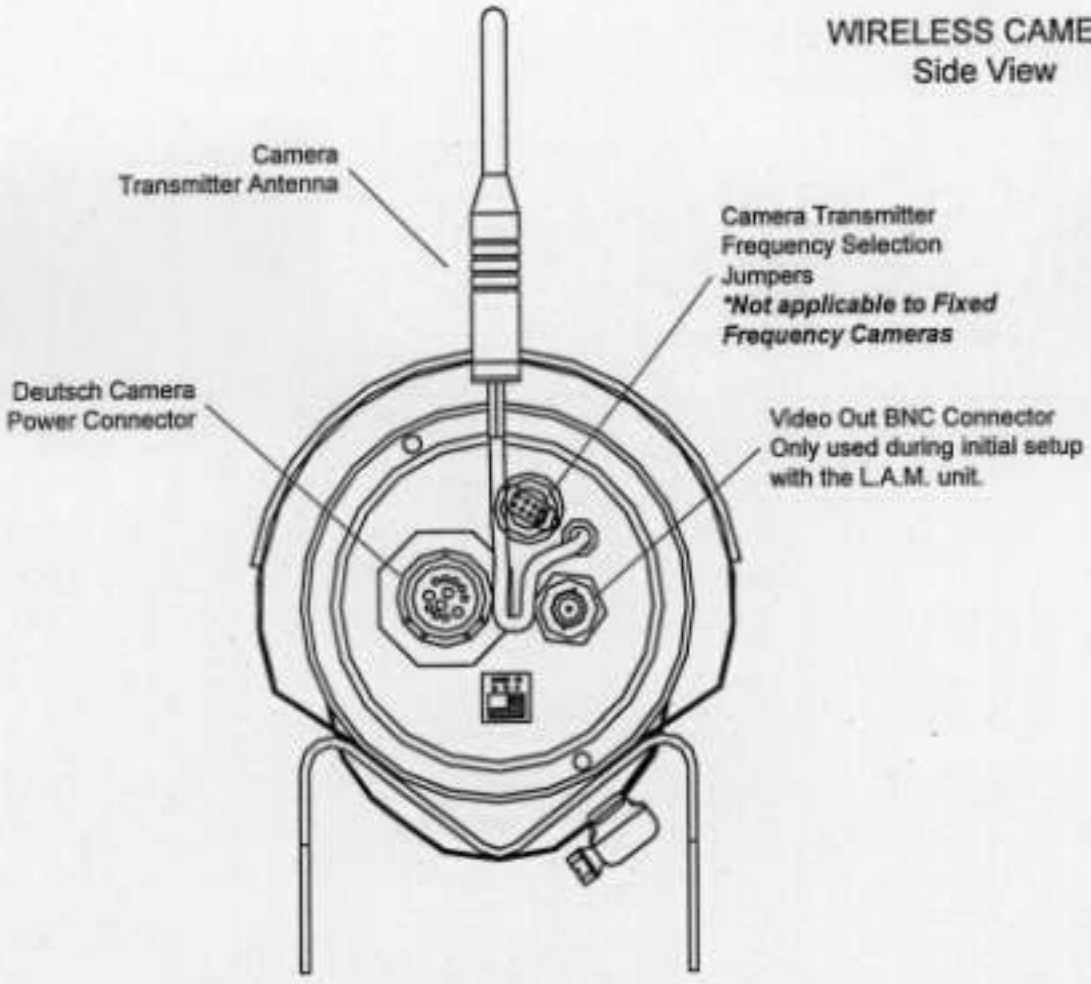


The diagram above shows channel one (2400 MHZ) selected

The channel and frequency selected on the transmitter should correspond to the same channel and frequency on the receiver unit.



WIRELESS CAMERA
Side View



WIRELESS CAMERA
Back View

Diagram 6b.

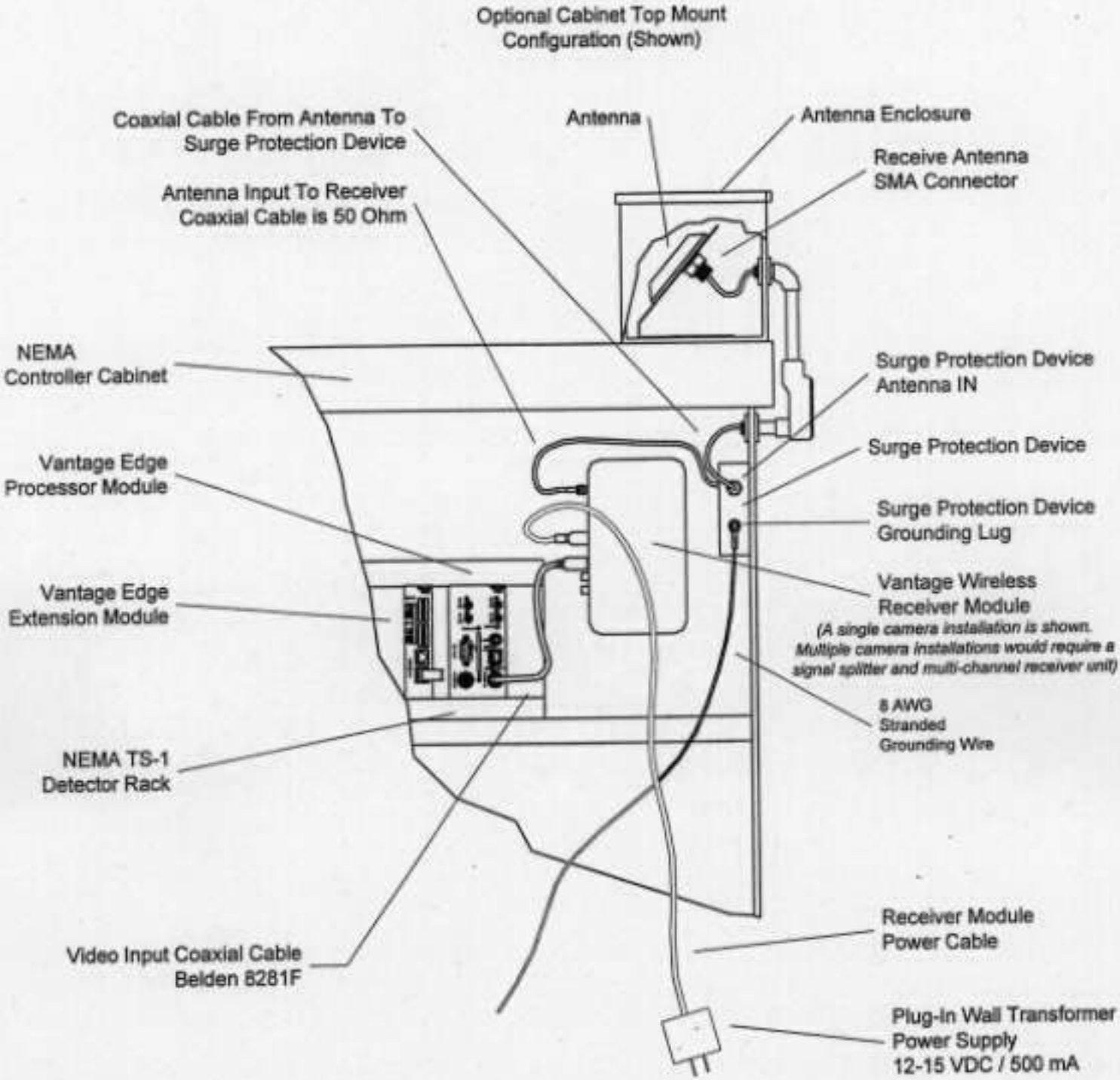
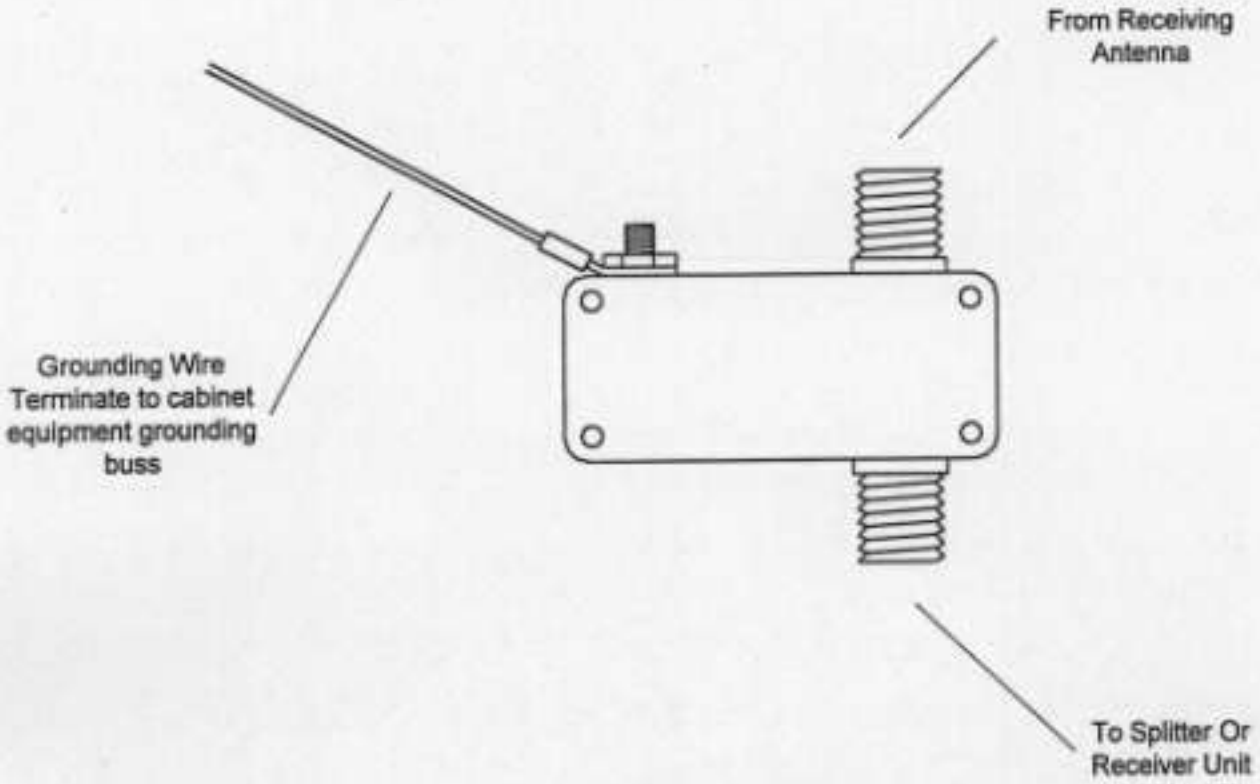

Optional Cabinet Top Mount
Configuration (Shown)
Coaxial Cable From Antenna To
Surge Protection Device
Antenna Input To Receiver
Coaxial Cable is 50 Ohm
Antenna
Antenna Enclosure
Receive Antenna
SMA Connector
NEMA
Controller Cabinet
Vantage Edge
Processor Module
Vantage Edge
Extension Module
NEMA TS-1
Detector Rack
Video Input Coaxial Cable
Belden 8281F
Surge Protection Device
Antenna IN
Surge Protection Device
Surge Protection Device
Grounding Lug
Vantage Wireless
Receiver Module
(A single camera installation is shown.
Multiple camera installations would require a
signal splitter and multi-channel receiver unit)
8 AWG
Stranded
Grounding Wire
Receiver Module
Power Cable
Plug-In Wall Transformer
Power Supply
12-15 VDC / 500 mA

Diagram 7a.



IS-MT50LN

Diagram 7b.

See Specification Sheet For More Information

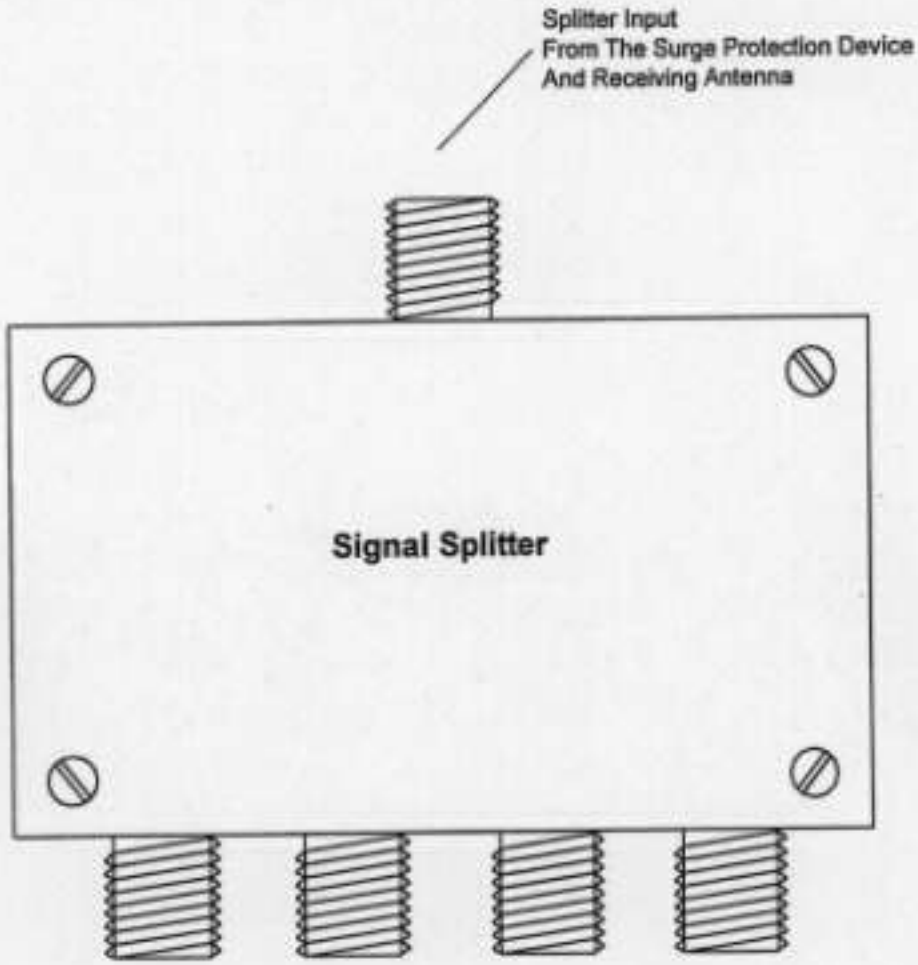

Splitter Input
From The Surge Protection Device
And Receiving Antenna
Signal Splitter
Splitter Outputs (1-4)
Going To The Multi-Channel
Receiver Unit

Diagram 7c.

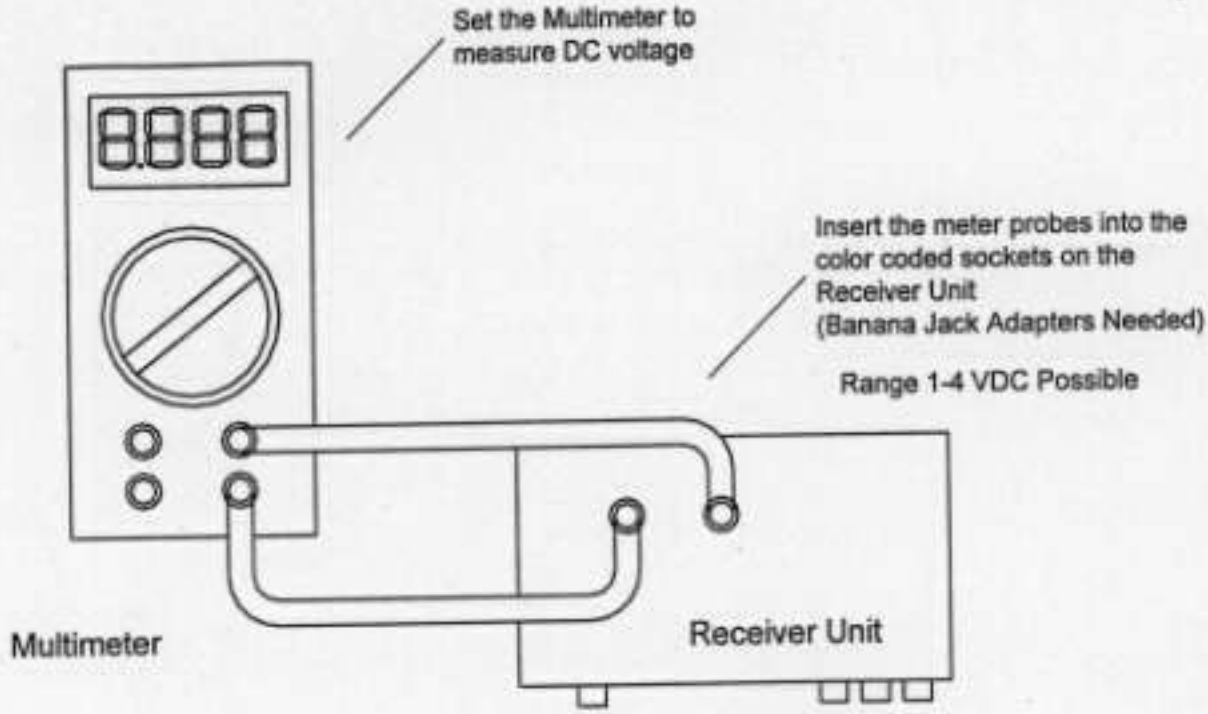
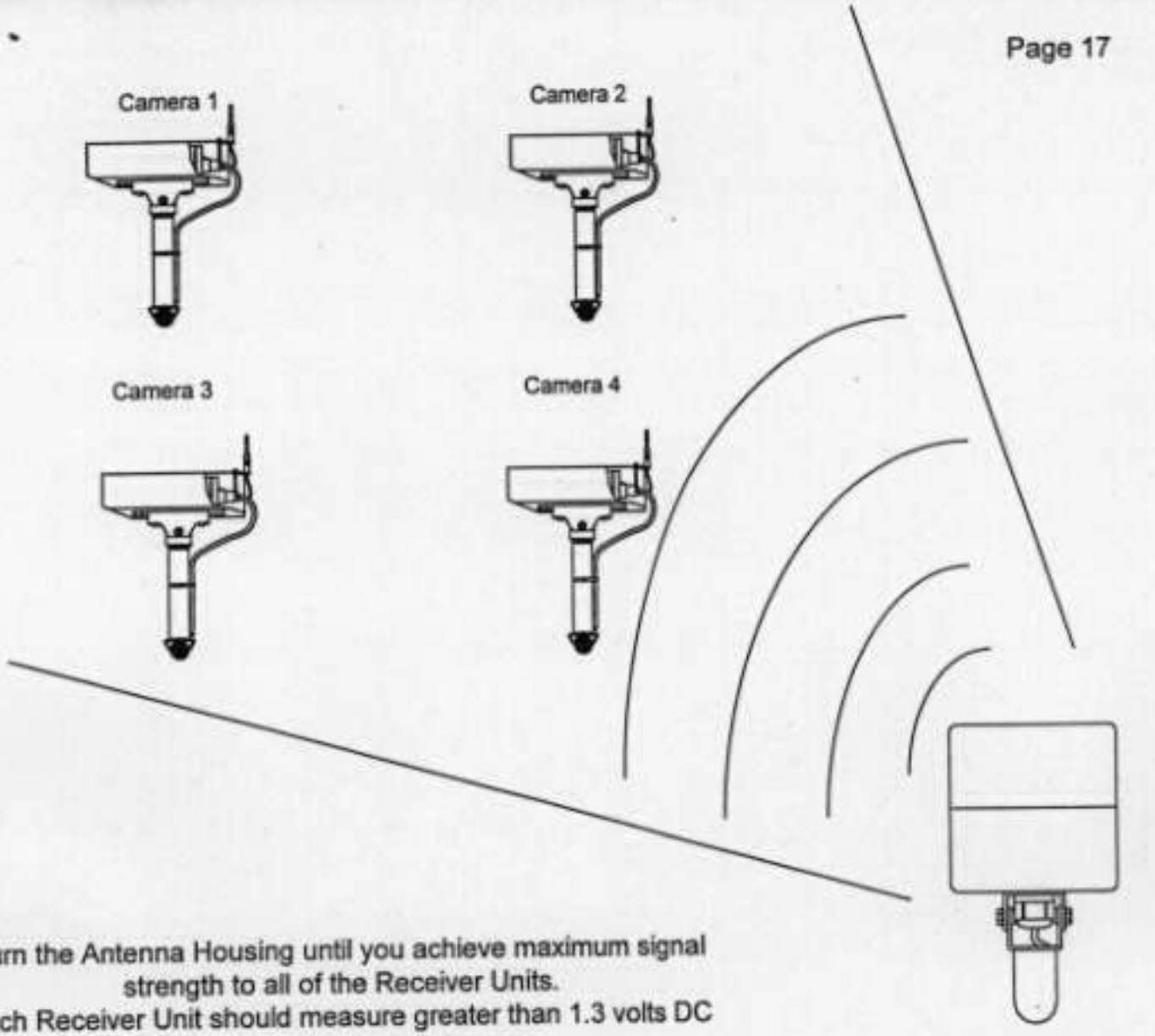


Diagram 8a.

On multiple Receiver Units, this measurement needs to be done for each receiver. Readings will change during Receiving Antenna adjustment.
A minimum signal strength of 1.3 VDC or greater should be obtained for all Receiver Units.



Turn the Antenna Housing until you achieve maximum signal strength to all of the Receiver Units.
Each Receiver Unit should measure greater than 1.3 volts DC for acceptable system performance.

Receiving Antenna

One Receiving Antenna when used with the signal Splitter can provide adequate signal for up to four Wireless Cameras.

Correct Antenna adjustment is imperative for optimal system performance.

Tuning The Receiving Antenna For Maximum Receiver Signal Strength

Diagram 8b.

For Vantage Processor setup and Zone setup instructions refer to the Vantage product Installation and User Guide.

If you have further questions about the Vantage Wireless System installation, please contact the Vantage Product Support Team at (714) 780-7201 or (714) 780-7255.

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