



**MakoTL**

**Hardware Reference Manual and  
Installation Guide**

*Version 1.3*

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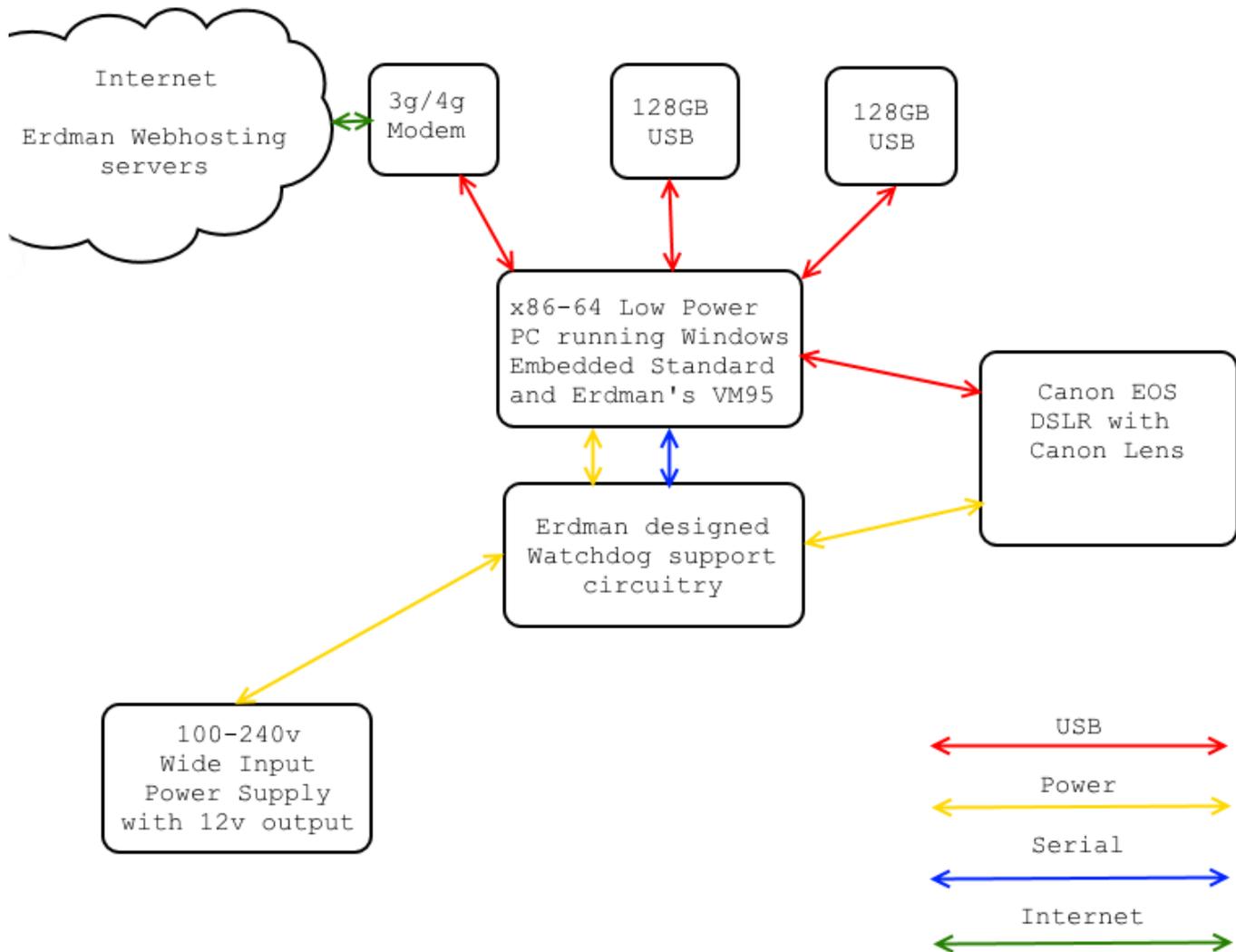
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# Hardware Overview

## System Summary

The MakoTL System is an internet connected appliance which uses a Windows Embedded computer and embedded support circuitry to create a reliable image capturing system that can run unattended for months to years, while continuously taking images, archiving them and uploading them to the Internet. The main components of a complete system consist of the computer, watchdog circuitry, a digital camera with an environmental housing, support circuitry, power supplies and cabling.

## System Block Diagram



## **Power Requirements**

The MakoTL System has a wide range voltage input. It is designed to accept 10v to 30v DC. Switching power supplies throughout the system ensure low power consumption of about 10 watts under full load (without heating elements). A wide range AC input power supply is included in the system. It accepts 100-240v AC and outputs 12v DC at 3A. Solar power stations are offered as an upgrade to facilitate placement where AC power is not available.

## **Long Term Reliability and Maintenance Strategy**

There are a number of subsystems and features incorporated into the MakoTL to ensure reliable operation and remote maintenance. The MakoTL system incorporates an embedded microcontroller, henceforth called the Watchdog. The Watchdog performs various functions including power management, watchdog and A/D conversion. It's most important function though is ensuring that the system software continues to function. In the case of a software or operating system crash, the watchdog will automatically power cycle the system.

Remote access is included with the purchase of the system. Programming and maintenance can be performed remotely without having to visit the site.

The operating system shipped on the MakoTL system is a customized Windows Embedded 8 build that features a ROM operating mode. This mode ensures that no changes can be made to the system partition during normal operation. Images are stored on separate USB storage in a mirrored configuration.

Error reporting and system status can be sent via email.

The system hardware should routinely be checked for cleanliness every 3-6 months depending on the location. Bird droppings, dust, frequent rain, icy conditions, and salty environments will hasten this requirement. Extension mops can be purchased at your local hardware store to give you the ability to wipe down the external housings of any debris. Check screw cage clamp (green pluggable terminal) wiring at least once a year to ensure a tight connection. Check mounting bracket at least once a year for loose screws, attach points, or safety straps. Adjust as needed. If operating with UPS battery backup, be sure to follow the manufacturer's recommended battery replacement schedule.

## **Hardware Components**

**Embedded x86-64 Computer:** This component is what's called an embedded pc. It utilizes a low power x86-64 dual core 64 bit microprocessor, which runs at 1.33GHz. It is a very low power computer requiring approximately 6w. Systems will come with 4GB of RAM and two 128GB USB flash drives. The computer has 4 USB ports (2 occupied by flash storage and a third occupied by the EOS camera, a VGA port and an Ethernet (RJ45 jack).

**Watchdog:** This is an 8-bit microcontroller. It has 8K programmable flash and executes our custom firmware that performs a number of low level functions including power management, rebooting, A/D conversions, watchdog, voltage/temperature monitoring, and wake up alarm for the embedded pc.

**Main Board:** Our in-house designed and manufactured PCB. It's approximately 4" x 3" and sits as the base board in the card stack.

**Functional Switches and LED's:** There is 1 functional switch on the Main Board. The "on/off" switch is used to tell the Watchdog that the unit is to be powered on. This is a soft switch and carries no current. There are also 3 LED's located on the edge of the circuit card. Watchdog status, PC power, and HDD activity.

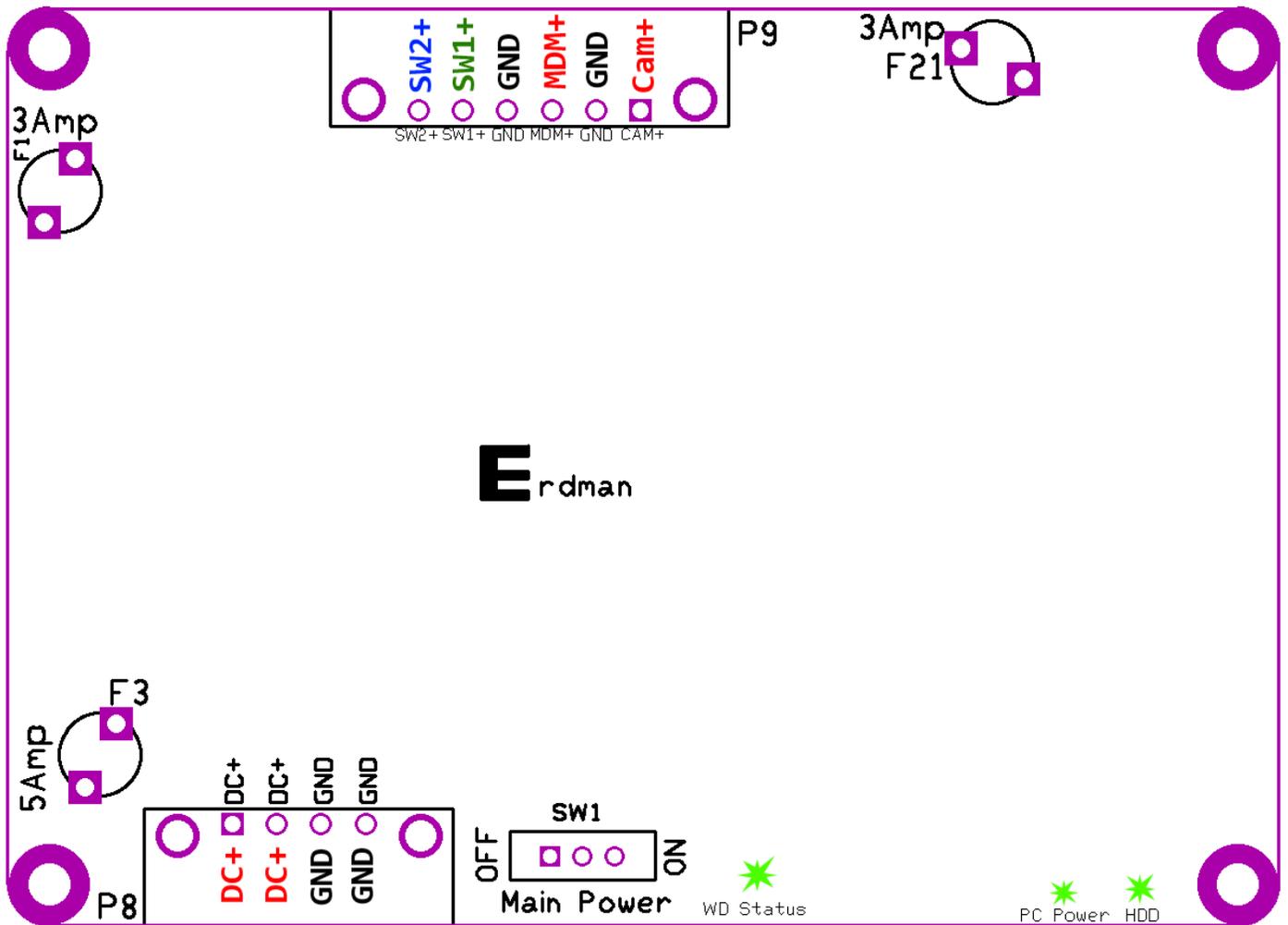
**Ports and Connectors:** All the user accessible ports to connect to the embedded pc are located on the edge of the board. This includes USB, monitor (VGA HDDB-15), and network (RJ/45). All external connections to the main board are through pluggable terminal strips. All the connections are labeled for convenience.

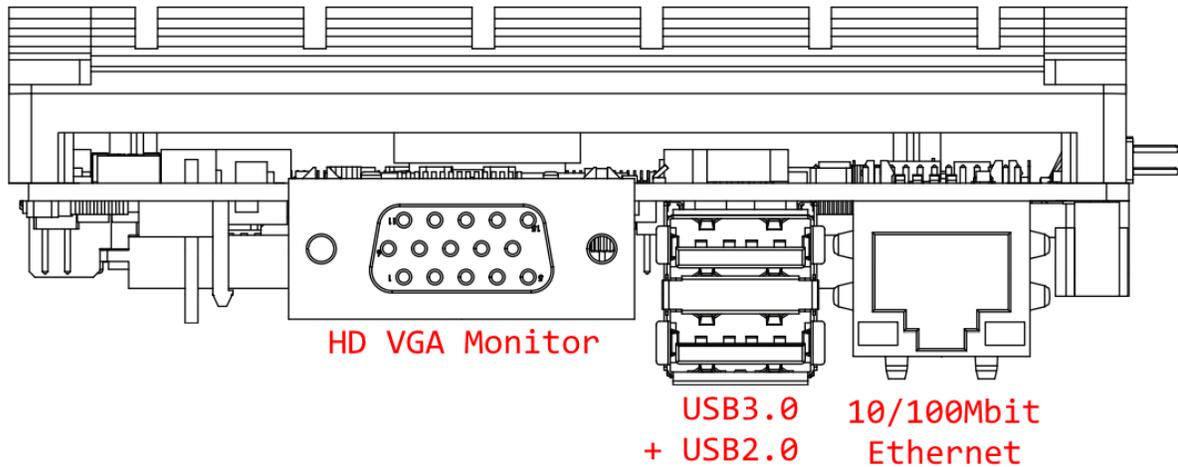
**Heaters:** The system can be outfitted with heaters to prevent fogging/icing of the camera housing glass. The heaters come thermostatically controlled so as to turn on at 80° F and turn off at 110° F. This keeps the camera housing temperature at or above 80° F during most of the operation. This temperature range is well above the highest average dew point in the contiguous US, and safe for the equipment.

**Enclosures:** All our enclosures are outdoor rated. The camera enclosure is made from polycarbonate and certified to IP68 protection. The enclosure is UL listed.

**Internal Connections**

There are a number of internal connections that the user will encounter while setting up the MakoTL system. The user should familiarize themselves with the connections prior to system deployment. This will help keep stress and confusion in the field to a minimum. Below is a reference image for the “main board” component of the system. This shows where the switches fuses and LED’s are located. It also shows the wire terminal locations.





Embedded PC connections: The embedded PC has all the connections of a normal PC. These connections will allow you to connect a monitor, keyboard, mouse, and ethernet cable to the system for diagnostics and configuration. All the user connections are along the edge of the circuit board as shown above for easy access.

### Switches

Power Switch: There is only one power switch on the EVS mainboard. This switch is a soft switch (no current passes through the switch.) Left position is “off”, right position is “on”.

### Fuses and Circuit Protection

There are three fuses on the EVS mainboard: one main fuse, one camera fuse, and one embedded PC fuse. These fuses are subminiature radial fuses and can be replaced in the event that they are tripped. Fuses will trip in the event of over-voltage or over-current conditions. These conditions are as follows:

Fuse	Overcurrent max	Overvoltage max
Main fuse - F3	5A	34VDC
Embedded PC fuse - F2	3A	7.0VDC
Camera fuse - F1	3A	14.7VDC

Fig 1.8 Transient voltage protection ratings

Contact EVS to receive replacement fuses.

# Installation

## Suggested tools

- #2 Phillips Screwdriver
- Large flat blade screw driver
- Small flat blade screw driver
- 7/16" open face/box wrench
- 1/2" open face/box wrench
- 3/4" open face/box wrench
- Adjustable crescent wrench
- Battery operated screwdriver with 5/16" nut driver
- Level
- Pliers
- Ty-wraps
- Wire cutters
- Wire strippers

## Unpacking the hardware

Unpack all the boxes and lay the equipment out so that you can get an idea of the setup. If you find anything missing or have a question about a specific item please give us a call. Things can sometimes get damaged in shipping. It is better to get a damaged part replaced now before you get to the jobsite.

## Safety

Please take appropriate safety measures while working on the system. Take precautions such as wearing work safety glasses, work helmets, harnesses etc. to avoid any injuries. Follow all posted safety notices and guidelines for the location you are installing the camera. Many construction sites have specific requirements. If you are unsure of the guidelines of the job site you are on, ask for the superintendent or foreman. Usually they will be able to provide you with the appropriate safety equipment and instruction.

## Jobsite preparation

Scope out the location for the camera so that the angle of view can cover the entire subject matter. If you are unsure of the lens angle of your particular model you can find out by contacting us. Typical angles are 65°, 97° or 108°. If broadband internet and power are available on-site, consideration should be taken to locate the camera within reach of these resources. AC power and local broadband internet connection can save a considerable amount of money and time to perform an installation. If these are not available or out of reach the location must be scouted for cellular signal strength and clear southern exposure for a solar panel. Make sure you have permission to install the camera at the chosen location. If on a construction site, notify the superintendent of all intentions in regards to location and planned date of installation.

## Prepare the location of the camera installation:

Pole installation: If mounting on a new pole, be sure to install a pole with a minimum diameter of 6" or a minimum 6" X 6" post. Make sure the pole is installed to local building codes and permits. Please allow for enough ballast to ensure the pole/post is stable. Make certain the pole is as vertically level as possible and stable as possible. If mounting to an existing pole, be wary of other equipment attached to the pole that may interfere with the camera equipment. Inspect the pole for rotting or other deterioration. Small diameter vertical poles with a minimum diameter of 2" will also work.

Camera mount parts required: Adjustable pole mount (EM2000).

Vertical wall installation: A suitable wall should be found that can hold up to 20lb of equipment. Use anchors for the mount that are suitable to the construction material(ex. sleeve anchors or heavy duty tapcons can be used for a concrete wall).

Camera mount parts required: Mounting Arm and Adjustable Head.

Top of wall or parapet installation: Use anchors for the mount that are suitable to the construction material(ex. sleeve anchors or heavy duty tapcons can be used for a concrete wall). Extra care should be taken when anchoring through flashing. Be sure you know what is underneath. Also make sure silicone is used in all the penetrations in order to maintain the roof's waterproofing.

Camera mount parts required: Adjustable Head(AH1000), Pedestal bracket (PM2010).

## **Installing the camera mount**

Attach the camera mount following the instructions provided in the Pelco Mount quick installation guides. Here are some tips:

1. It is useful to have a battery operated screwdriver/drill and a 5/16" nut driver to strap the hose clamps around the pole.
2. Be sure to point the arm towards the desired view. This allows for tilt adjustment of tapering poles.
3. The point of attachment of the arm and the pole adaptor can be leveled 5 degrees. To get the most level view, level the top of the arm as best as possible.
4. When using a pedestal, please use the included rubber washer between the adjustable head and mounting arm to prevent the mount from shifting in the future.

## **Mounting the camera housing**

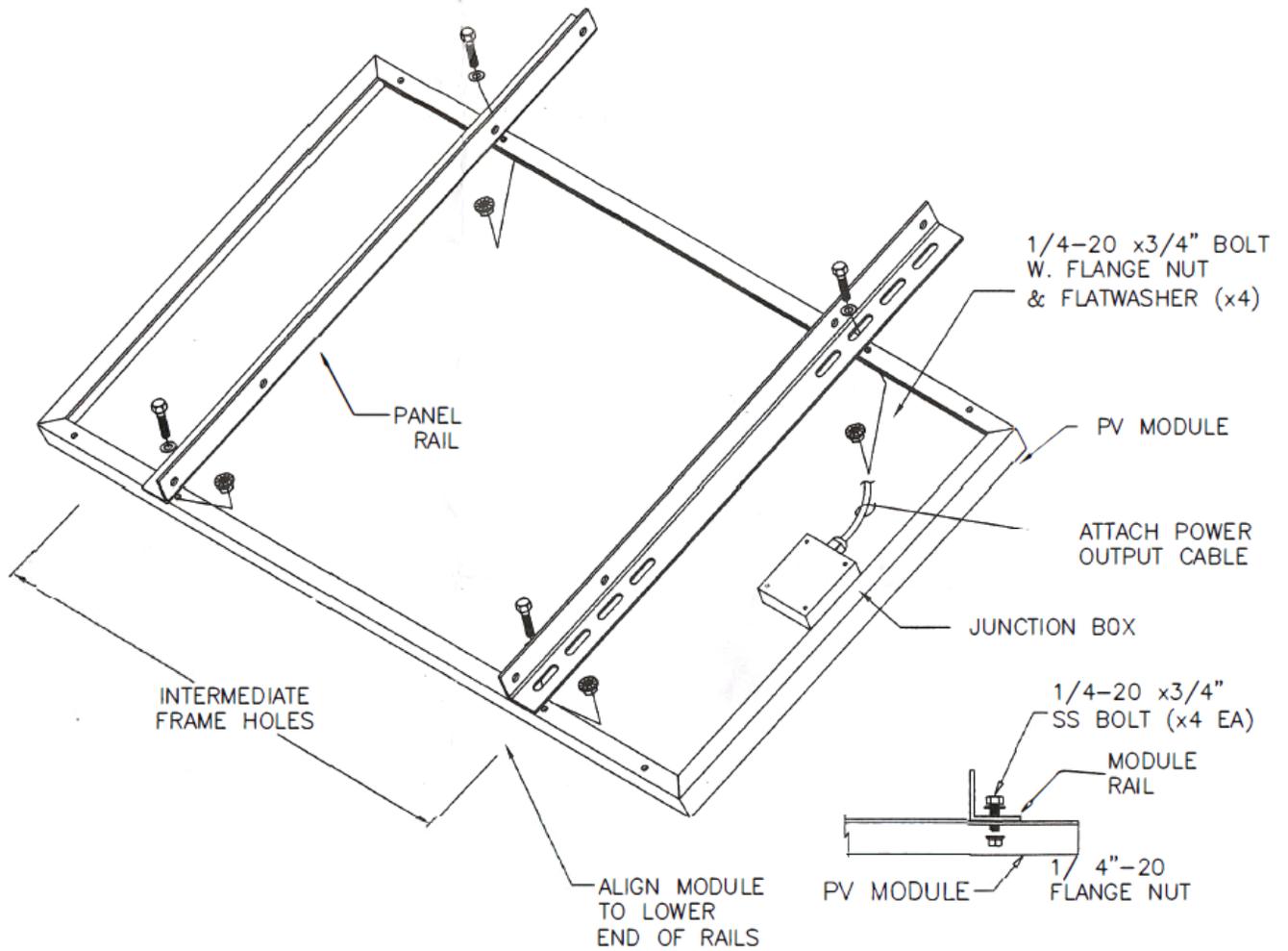
Mount the camera onto the adjustable head using the included steel bolts supplied. The ¼-20 bolts necessary have been screwed into the bottom of the camera enclosure or are attached to the mount so that they don't get lost. Strain relief the wires coming from the camera housing using cable ties. Providing enough wire for a service loop, approx. 1-2ft, is good practice.

## **Powering the Camera System**

Option #1: Attach the camera system to an AC power source. The system will come with an 7-8ft 3 prong(US style) outlet cord. This is able to be plugged into 100v-240v AC power. Ensure that the outlet box is in a weatherproof location or that it's a GFCI protected outlet. If installing in a long term or permanent location, consider wiring directly to a 10A. This requires the removal or alteration of the power cord supplied. Ensure that the outlet is properly grounded.

Option #2 Solar Kit assembly and installation

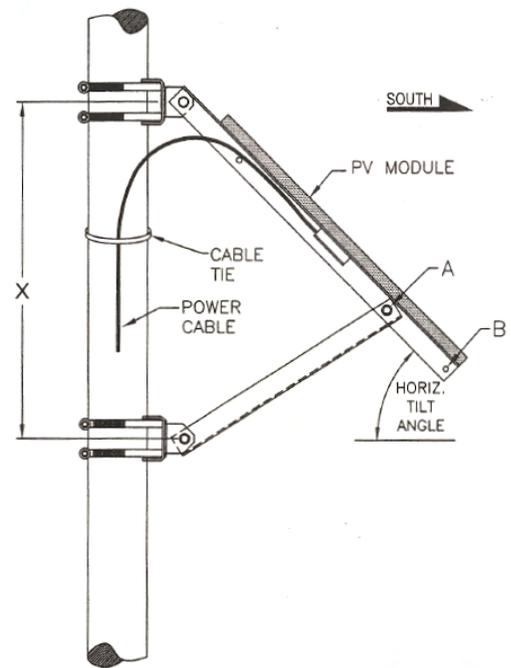
1. Lay solar panel face down and attach to panel rails with 1/4-20" bolts and washers using 7/16" wrench



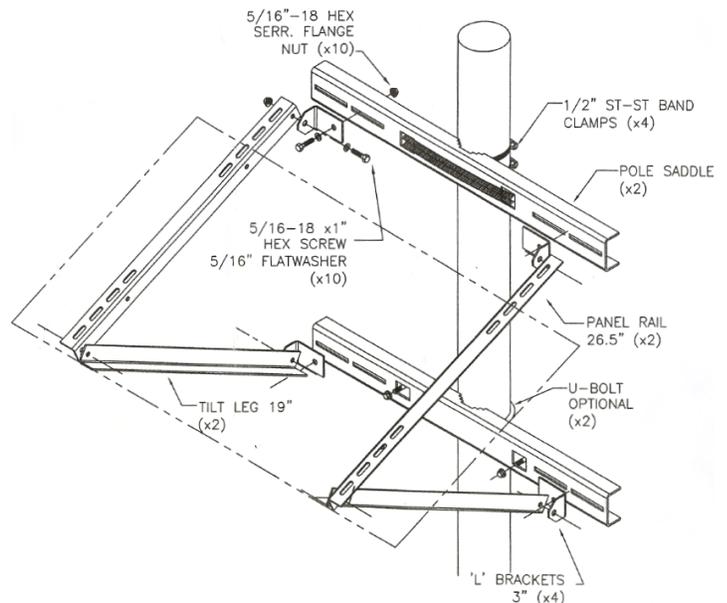
2. Mount the upper and lower saddle bracket in one of the following ways:
  - a. U-Bolt - You must specify the pole diameter to Erdman in order to have this shipped with your order.
  - b. 12" x 1/2" stainless steel pipe clamps
  - c. The saddle brackets should be spaced apart according to the following chart:

Horiz. Tilt	Mtg. Hole	X Dist. (inch)
60°	B	34.5
55	B	31
50	B	26.5
45	B	18
40	A	22
35	A	18.5
30	A	14.5
25	A </td <td>8.75</td>	8.75

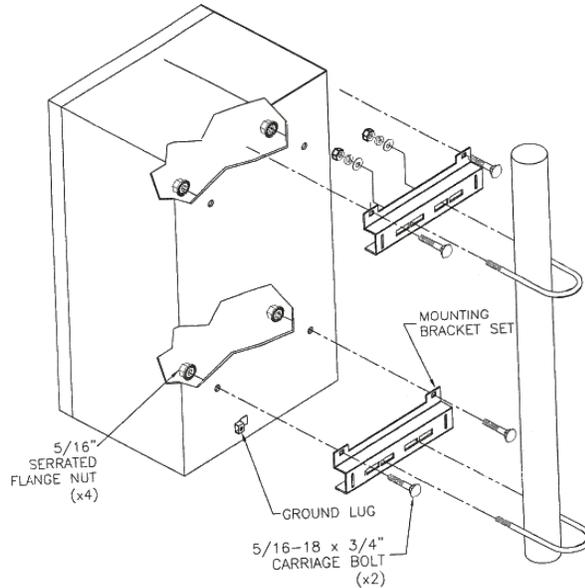
This will help you achieve the desired angle for your installation latitude. Try to match the installation angle to the latitude. You also must face the panel due south if you are in the northern hemisphere.



3. Mount L-Bracket to the saddles using 5/16" stainless steel bolts and nuts provided
  - a. The distance between the L-Brackets is determined by the panel rails as assembled in step 1
  - b. Leave the bolts loose so they can be adjusted to attach the solar panel assembly
4. Mount Tilt Legs to L-Brackets using 5/16" stainless steel bolts and nuts provided
  - a. Leave the bolts loose so they can be adjusted to attach the solar panel assembly
5. Attach the fully assembled solar module to the L-Brackets so the panel is the farthest away from the pole. Tighten the L-Brackets in place.
6. Attach the tilt legs to the now hinging solar module. The Tilt Legs can either be attached to the "A" hole or the "B" hole depending on your desired tilt angle(see table above).
7. Tighten all bolts and nuts and apply the included thread locking compound to ensure the safety of the installation.
8. Strain relief the wires to the pole or mounting arm using ty-wraps.



9. Mount the battery box. The battery box comes with a pole/wall mounting kit. Installation of the box needs to be as close as possible to the solar panel. The top of the battery box should be at least 6 feet off the ground.
  - a. The battery box will mount to a pole using stainless steel straps or U-Bolts (shown)
  - b. If using U-Bolts, the pole diameter must be specified to Erdman before shipping.
  - c. If using stainless steel straps, double or triple up on the top mounting bracket. It is also recommended to utilize an additional braided steel rope for safety if only stainless steel straps are used. Also, please tuck the ends of the stainless straps under the mount or bend them to prevent eye injury.



10. Once the battery box is secure to the pole, place the battery inside the box so that the terminals are closest to the door of the box. This will make it easier to attach the battery terminal lugs.
11. Ensure that the load wire (wire that leads to the camera housing) and solar panel are not yet connected.
12. Attach the battery terminal lugs to the battery being careful to match the red wire to the positive terminal and the black wire to the negative terminal. All batteries are marked with “+” and “-” to denote the positive and negative terminals. Once the battery is connected, you should have lights on the charge controller.
13. After you are sure the battery is attached and the charge controller is powered, connect the solar panel by attaching the MC-4 connectors. These are pre-wired into the charge controller and hanging off the back of the box. Simply un-coil the wire and neatly ty-wrap it up the pole to the solar panel. Attach the wires by mating the “male” and “female” connectors.



14. Next, check the charge controller for functionality. It should indicate the overall status and battery condition with LED status indicators. Here is a table with the different statuses:

Color	Indication	Operating State
None	Off (with heartbeat <sup>1</sup> )	Night
Green	On Solid ( with heartbeat <sup>2</sup> )	Charging
Red	Flashing	Error
Red	On Solid ( with heartbeat <sup>2</sup> )	Critical Error

<sup>1</sup> heartbeat indication flickers the Status LED on briefly every 5 seconds

<sup>2</sup> heartbeat indication flickers the Status LED off briefly every 5 seconds

SOC LED	Indication	Battery Status	Load Status
Green	Fast Flashing (2 Flash / sec)	Equalize Charge	Load On
Green	Med. Flashing (1 Flash / sec)	Absorption Charge	Load On
Green	Slow Flashing (1 Flash / 2 sec)	Float Charge	Load On
Green	On solid	Nearly Full	Load On
Yellow	On solid	Half Full	Load On
Red	Flashing (1 Flash / sec)	Battery Low	LVD Warning (Load On)
Red	On solid	Battery Empty	LVD (Load Off)

a. Status LED: The status LED indicates the overall state of the charge controller. If the LED is solid GREEN during the day it is operating normally. If there is a problem internally or externally that is not allowing the charge controller to work normally, the LED status will show RED. See the table to the left.

b. Battery LED: The battery LED indicates the “State of Charge”. The battery will normally show as solid GREEN or YELLOW in the morning when recovering the charge and different levels of flashing GREEN in the afternoon once the battery is topped off. If there is a problem and the battery voltage is too low, the LED will show flashing or solid RED. If the LED is solid RED, this indicates that the battery has fallen below the acceptable level to run the load. The power to the camera will be disconnected until it can recover enough charge for safely powering the system.

15. Last, wire the load cable into the charge controller.

- a. Uncoil the wire that is attached to the camera enclosure and neatly run the wire to the battery box. Feed the wire through the empty cable gland at the back of the box leaving enough cable for a service loop.
- b. Strip the wire ends and wire them into the WHITE euro terminal block. The red wire will pair with the red wire and black wire will pair with the black wire coming from the charge controller. Red is the positive terminal and black is the negative terminal. Ensure the power output is on by checking for blinking LED's inside the camera enclosure.

## Finalizing the Installation

The next step is programming the camera views and activating the webhosting. If you have webhosting services with Erdman, contact your account representative or call our main phone number 888-495-6057 for activation of your service. Please allow 20-30 min for programming and activation. If you have a smartphone available, your Erdman account representative will direct you to the proper URL to view the webpage for your camera.