The NASA Fireball Network All-Sky Cameras

R.M. Suggs/NASA/MSFC/EV44

The construction of small, inexpensive all-sky cameras designed specifically for the NASA Fireball Network is described. The use of off-the-shelf electronics, optics, and plumbing materials results in a robust and easy to duplicate design. Engineering challenges such as weather-proofing and thermal control and their mitigation are described. Field-of-view and gain adjustments to assure uniformity across the network will also be detailed.

The NASA Fireball Network All-Sky Cameras

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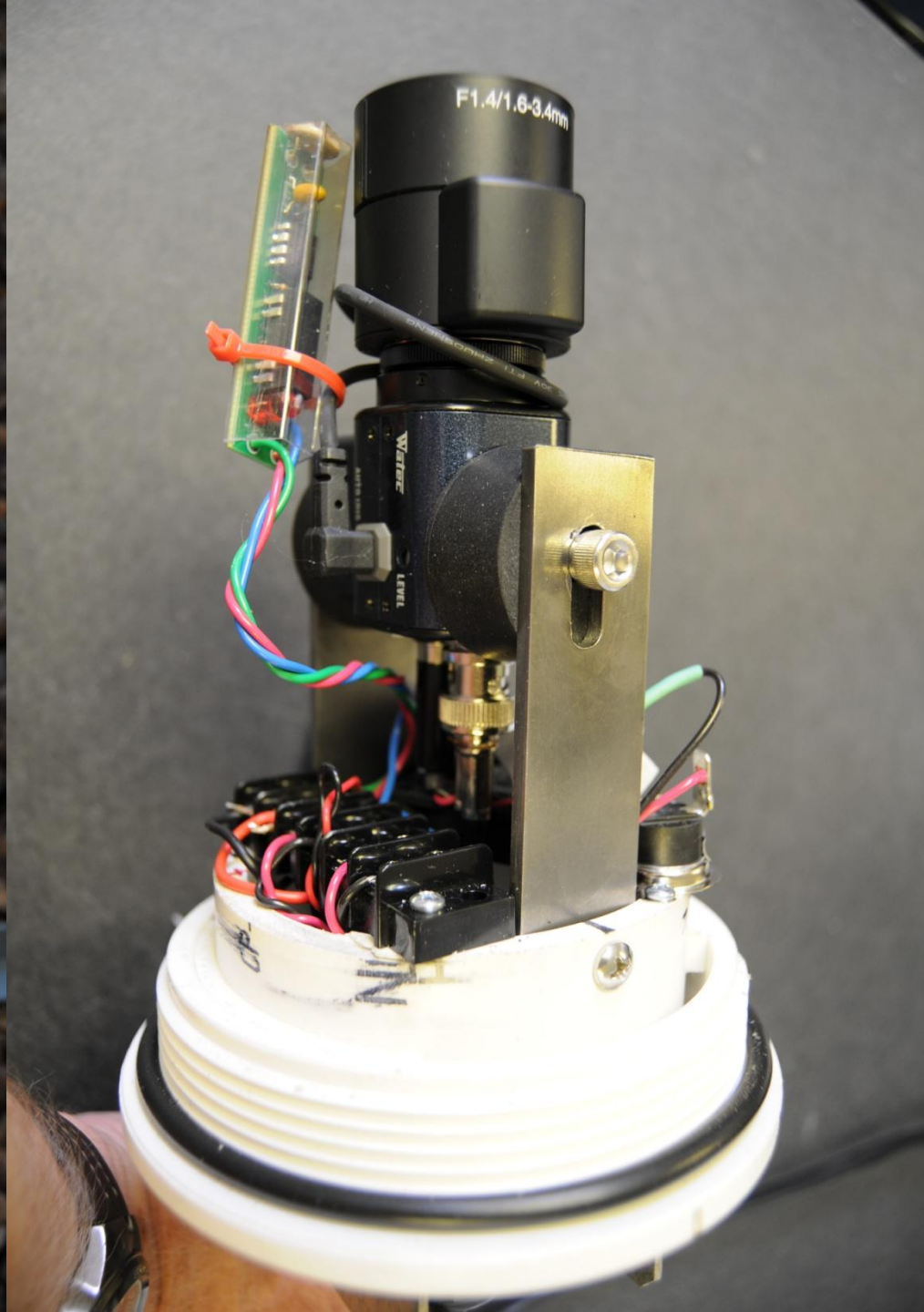
Requirements

- Low-cost
- Weather-proof including dew resistance
- Same field of view and sensitivity as existing University of Western Ontario cameras in our network

Subsystems

- Housing – PVC plumbing and transparent dome based on UWO design
- Camera - Sony HAD EX-based CCD video
- Power – 12v “brick” and twilight sensor
- Thermal control – fan, heaters, thermostat
- Mount – mast or flat roof
- Cabling – integrated power and video
- Other system components
  - PC running Linux and ASGARD
  - GPS receiver (USB connection)
  - Uninterruptable Power Supply


Bill & Candace were here
Happy Tracking Partner
Tullahoma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Housing

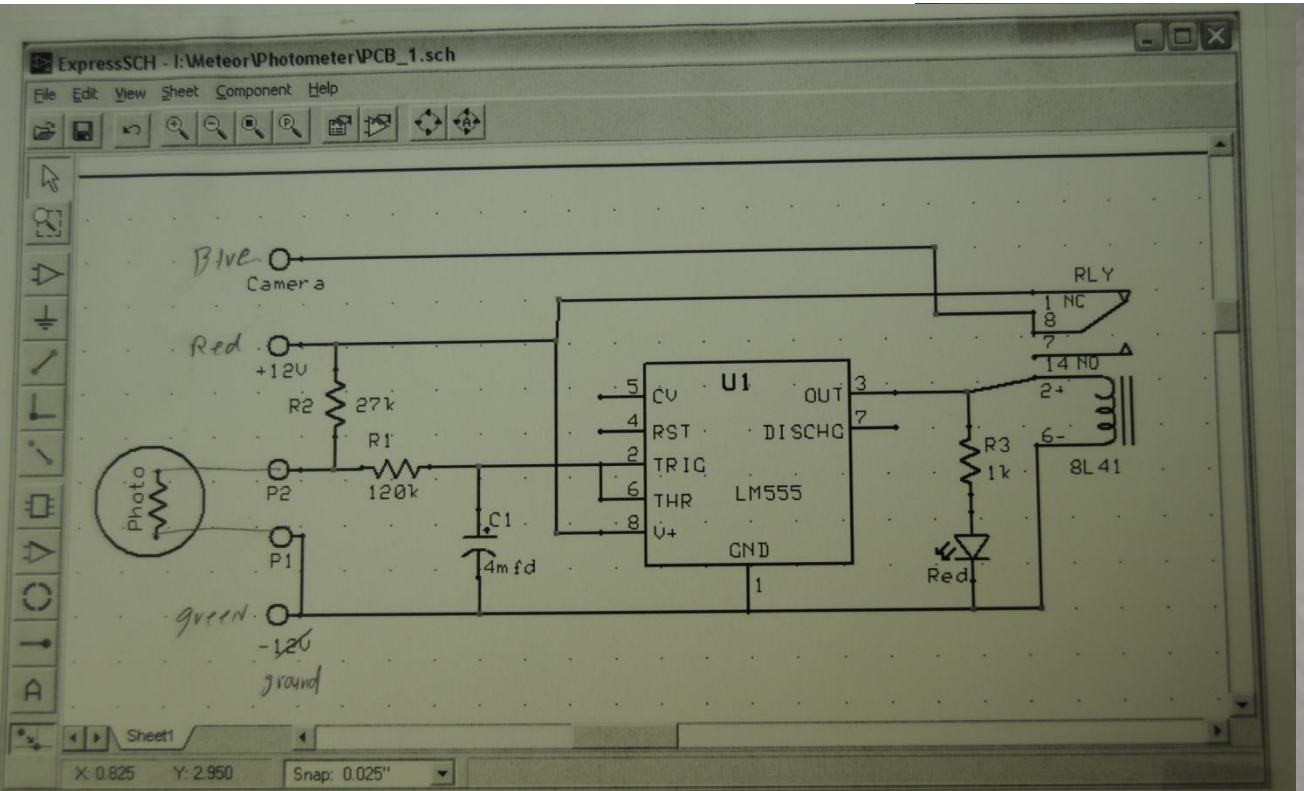
- 4 Inch diameter PVC pipe
  - Two 4” Canadian (flanged) cleanout plugs – machined for top and bottom
  - 4” NPT to 4” PVC hub inner
  - 4” NPT to 4” PVC hub outer
  - 3” PVC x 1.5” inner hub, cemented to bottom
  - Three 3” PVC shims to center above in bottom
- Acrylic dome
- Dome to pipe adhesive – Henkel PL Polyurethane window and door sealant
  - Selected after extensive testing of several urethane, silicone, and polyurethane adhesives
- Any joints must be caulked
- O rings must be covered with aluminum tape to protect from UV
- Install dessicant packs just in case

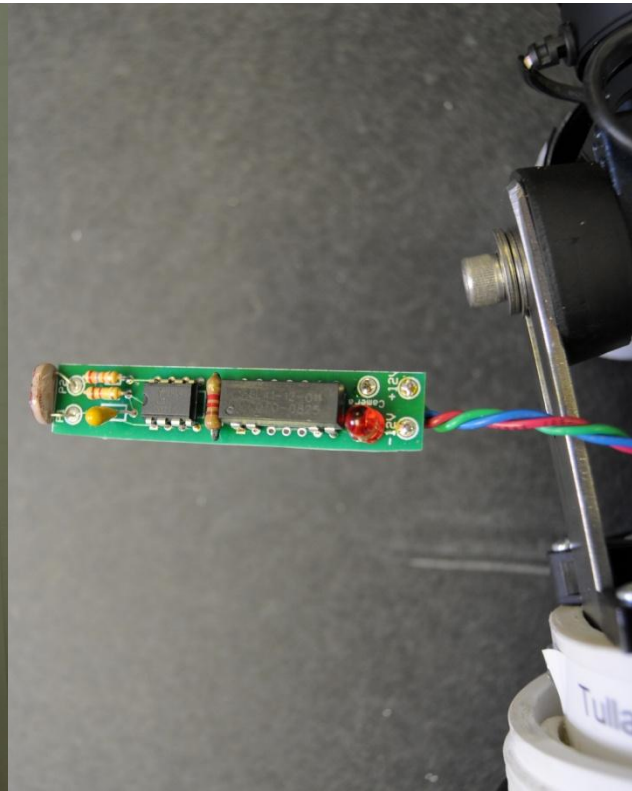
Camera

- Watec 902H2 Ultimate – based on Sony HAD EXview CCD
- Rainbow L163VDC4P 1.6 – 3.4 mm f1.4 zoom fisheye lens
- Adjustments
  - Shutter speed 1/30 second (1/60 second fields)
  - Gamma = 0.45
  - Manual gain control set to match sensitivity of existing UWO camera
  - Autoiris setting full CW to disable autoiris function
  - Camera focal length adjusted to give field-of-view identical to UWO camera

Power System

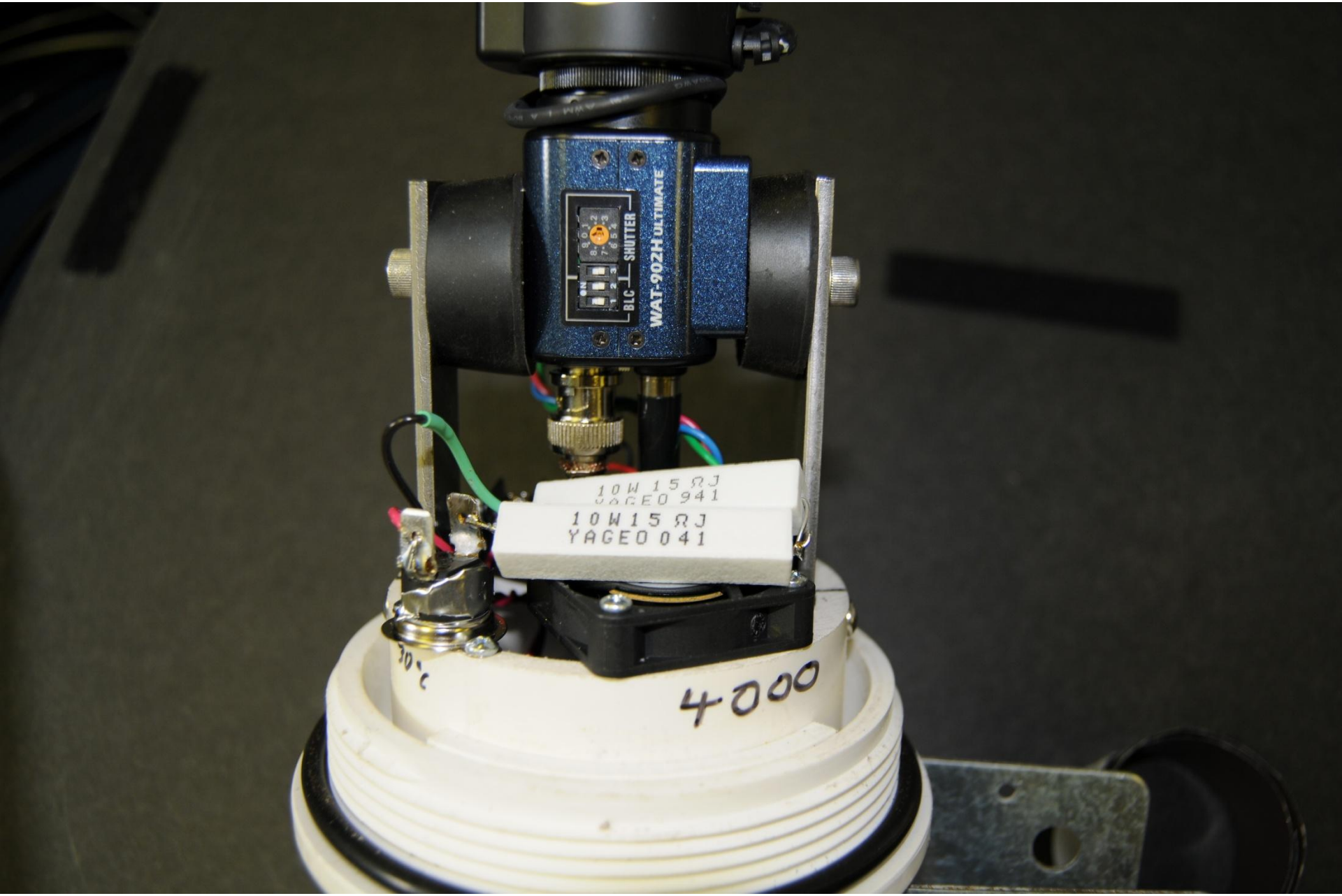
- 12v 2 Amp off-the-shelf power brick
- Twilight sensor based on CdS photocell and 555 timer chip. Powers camera during darkness.





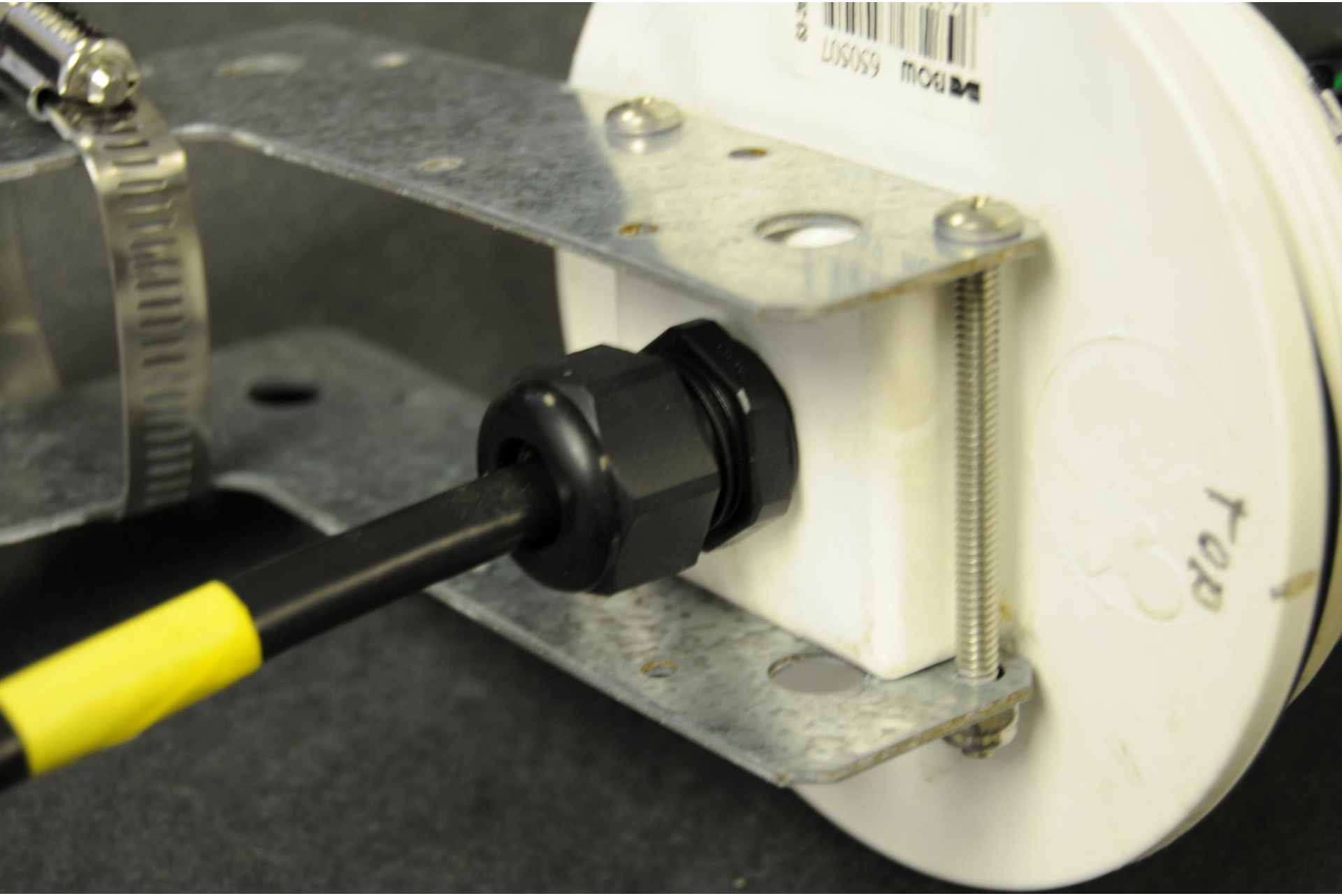
Thermal Control

- 12 v micro-fan forces air toward dome over two 15 ohm 10 watt resistors in series giving 4.8 watts of heating
- Normally closed thermostat opens to remove current to resistors at 85 degree F (30 C). This is above the maximum nighttime dewpoints in the southeastern U.S.
- Timer switch turns off all power to the camera between 6am and 6pm local time
- Active cooling would probably extend the lifetime of the cameras but this is very difficult
- Daytime temperatures inside dome can exceed 110 F (43 C)
  - Watec operating temperature limit is 104 F (40 C)
  - Watec non-operating temperature limit is 158 F (70 C)


WAT-902H ULTIMATE
SHUTTER
BLC
10W 15 ΩJ
YAGEO 941
10W15 ΩJ
YAGEO 041
4000

Cabling

- Integrated video coax and power
- No connectors are exposed to the weather
  - Weather-proof compression feedthrough is at the bottom of the housing
- Cable length tests
  - 125 ft cable has 1.7 volt drop under full load
  - 50 ft cable has 0.8 volt drop under full load
  - Video quality looks the same in each case



Mount

- L bracket attaches case to standard antenna mast
- Roof mount has proved to be very flexible for any flat surface installation


ENERGYGUIDE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Summary

- The design is robust and inexpensive
- Primary issues:
  - Thermal – daytime heating is severe and no active cooling is easily achievable
  - Weather-proofing – caulking of joints is essential. Dome adhesive is critical
  - Camera lifetime – hot pixels develop with time which complicates data analysis (especially “plates”) and limits useful lifetime of cameras

Acknowledgements

- This camera design is the result of Wesley Swift's efforts. It simply wouldn't exist without his creativity and hard work.
- Wes had many useful conversations and help from Zbigniew Krzeminski from the University of Western Ontario.