



MnSGC

Minnesota Space Grant Consortium | E-Vent

“Development of an Adaptable Vent for Latex Weather Ballooning”

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Attachment Point

SECURED TO THE BALLOON NECK

Resistor Cutters

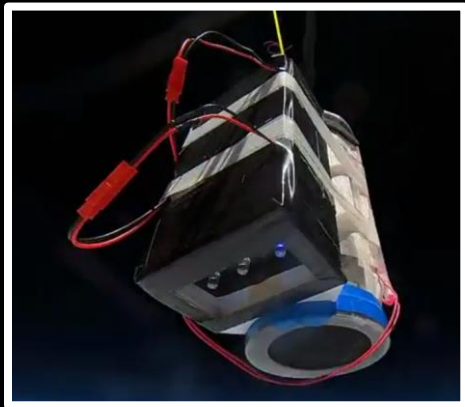
BURN TO RELEASE THE BALLOON

Servo Notch

AVIONICS ATTACHMENT

Vent Flapper

RELEASES LIFTING GAS

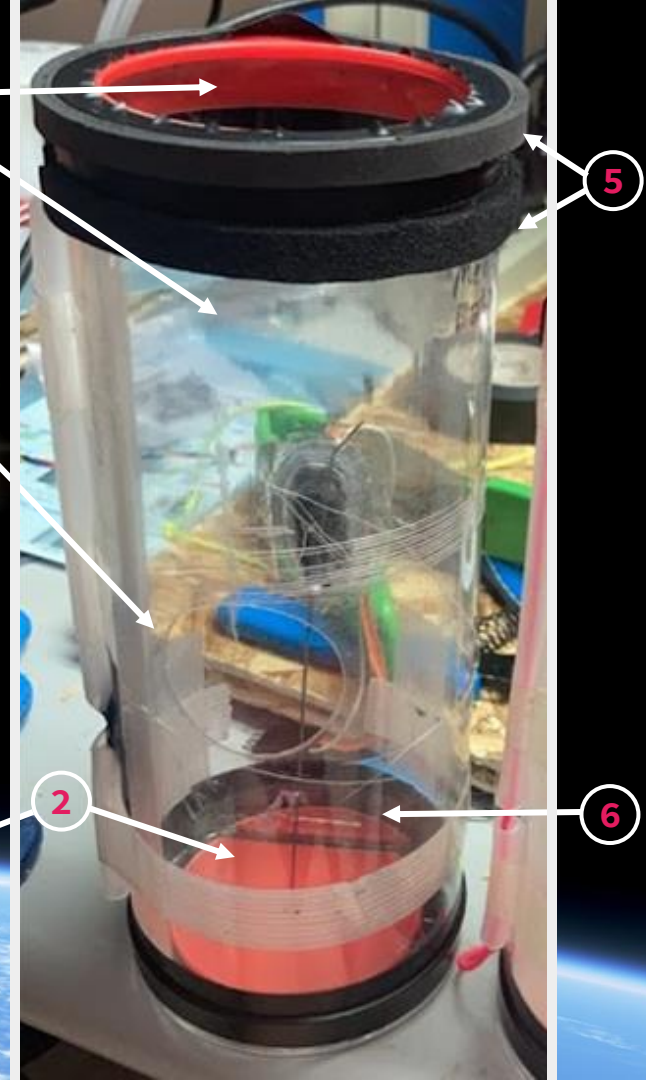
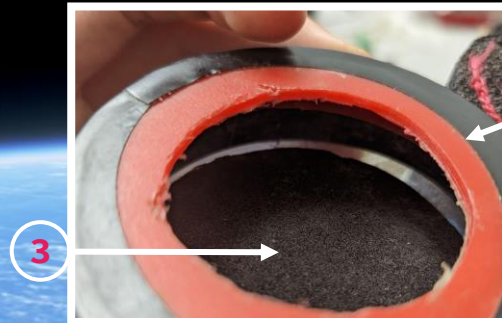




Mechanism

STRUCTURE

- 1 Thin tubing with rings cut out of caps for reinforcement
- 2 Inward-opening flap pressed against the bottom ring
- 3 EPDM foam seal attached to the opening flap
- 4 Access port and filling hatch
- 5 Foam rings sealing the balloon neck and rigging
- 6 "Service-able" design

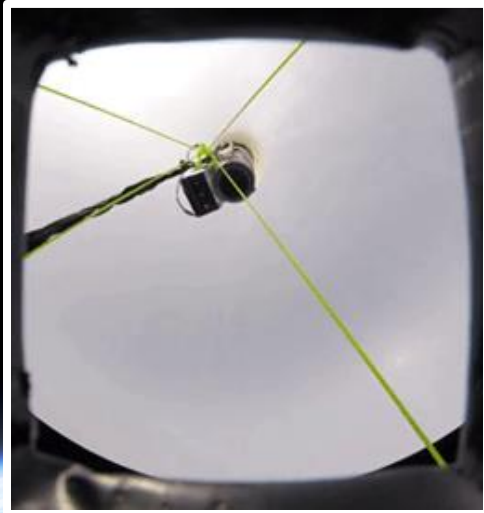


VENTING ACTION

VENT DOOR OPENS INWARD

SERVO AND ROD
ATTACHMENT
ADJUSTABLE
LENGTH

FOAM SEAL



THE ATTACHED SERVO CONTROLS THE "FLAPPER", THEREBY RELEASING LIFTING GAS UPON COMMAND

VENT RIGGING

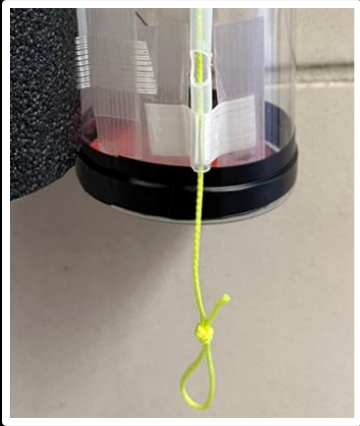
TOP RIGGING STARTS AT THE "LASSO" AND RUNS THROUGH A POLYETHYLENE TUBE

NOTCH FOR RESISTOR BURNER

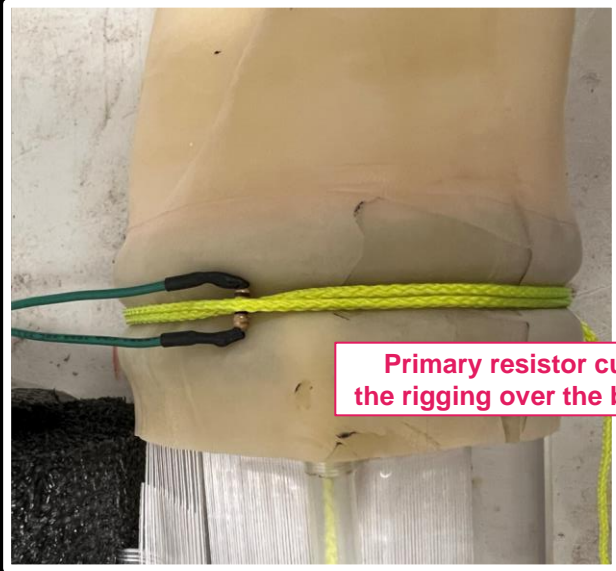
THE LINE ENDS IN A LOOP AT THE BOTTOM

PAYLOAD STACKS CAN BE CLIPPED TO IT

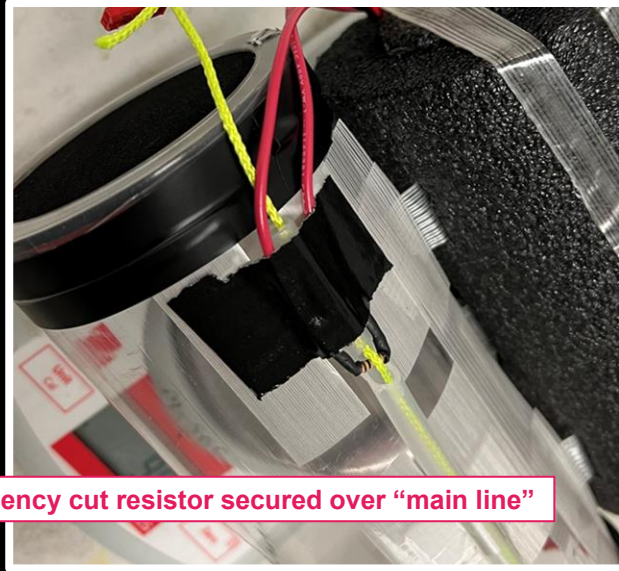
THE RIGGING SECURES THE BALLOON NECK TO THE VENT IN A CIRCULAR NOTCH



CUT DOWN/DESCENT



Primary resistor cutter tied with the rigging over the balloon neck

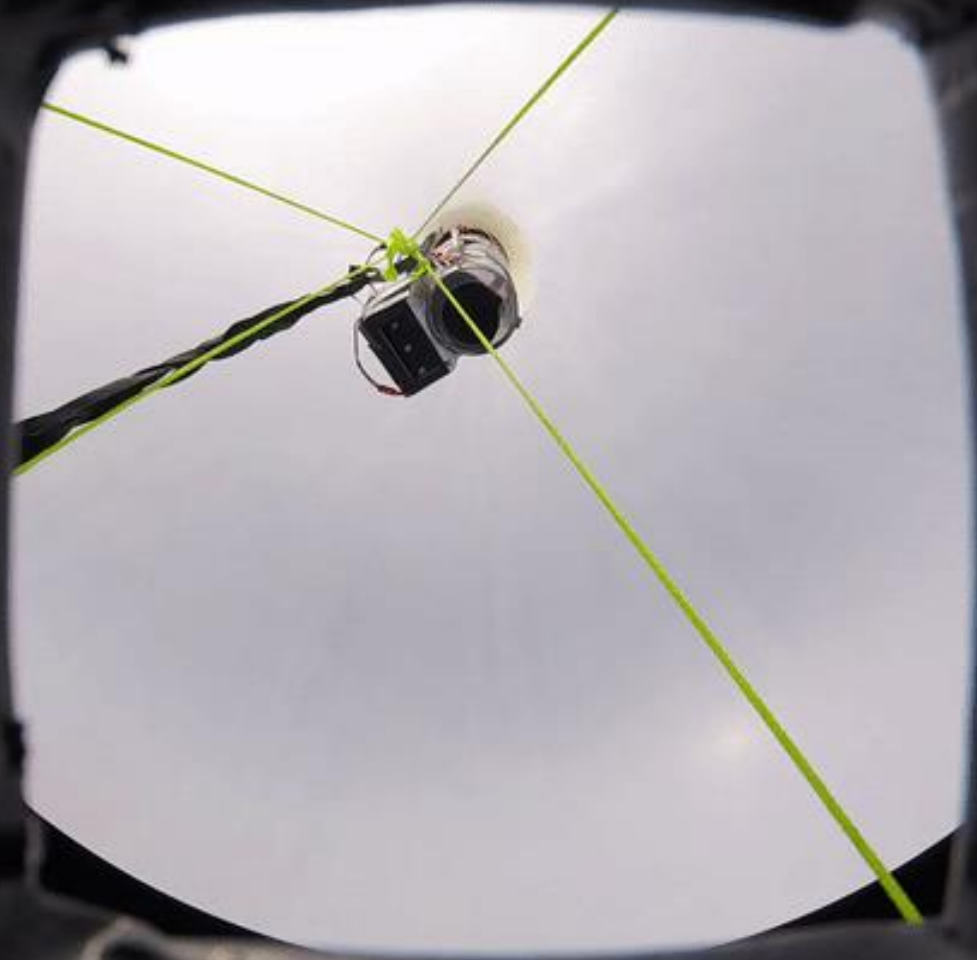


Emergency cut resistor secured over "main line"

The primary resistor performs a controlled, pinpoint burn on the "waist line" rigging securing the balloon neck.

The rigging is cut loose, the balloon neck itself slips off of the vent, and the payload begins its free-fall.

Should this burn fail, the emergency cut resistor activates, and the vent assembly is lost.



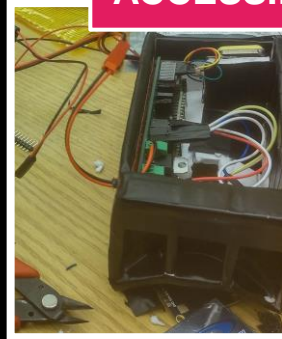
The image shows the interior of a metal avionics equipment case. The case is open, revealing a complex arrangement of electronic components. In the foreground, there are several yellow-wrapped capacitors or inductors. Behind them, a printed circuit board (PCB) is visible, populated with numerous integrated circuits, resistors, and other electronic components. A dense network of wires in various colors (red, yellow, black) is routed throughout the case, connecting the components. The overall lighting is somewhat dim, highlighting the intricate wiring and components within the metal enclosure.

Avionics

FUNCTIONALITY

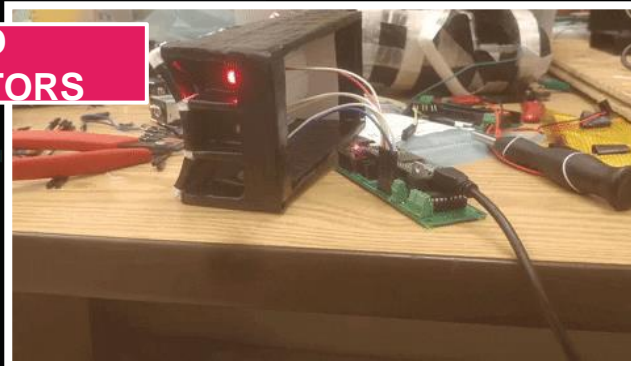
```
1 // *****Main Termination Function + Helper Functions*****
2
3 // *****
4
5 // Function to release the vent from the ball valve
6 // Overall strategy: burn each resistor individually and not at the same time; burn
7 void terminate()
8 {
9   if(emulationCheck == true){ // used only for emulation
10    Serial5.println("<TERM>");
11   }
12   currTimeS = millis() / 1000; // Resetting currTimeS just in case it's off by a cert
13
14   if (!terminationBegun) {
15     terminationStartTimeS = currTimeS;
16     terminationBegun = true;
17     Serial.println("Termination has begun");
18   }
19
20   if (terminationStartTimeS + 20 < currTimeS)
21   {
22     if (!Res1Burned)
23     {
24       if (!Res1on)
25       {
26         burnResistor();
27         burnTime1StartS = currTimeS;
28       }
29     }
30     burnResistor();
31     Serial.println("Burning waistline resistor");
32     if (currTimeS - burnTime1StartS > 7.9)
33     {
34       stopBurn();
35       Serial.println("Waistline resistor burning stopped");
36       Res1Burned = true;
37     }
38   }
39   else if (!Res1Burned2)
40   {
41     if (!Res1on)
42     {
43       burnTime1StartS = currTimeS;
44     }
45   }
46 }
```

ACCESSIBLE CASING

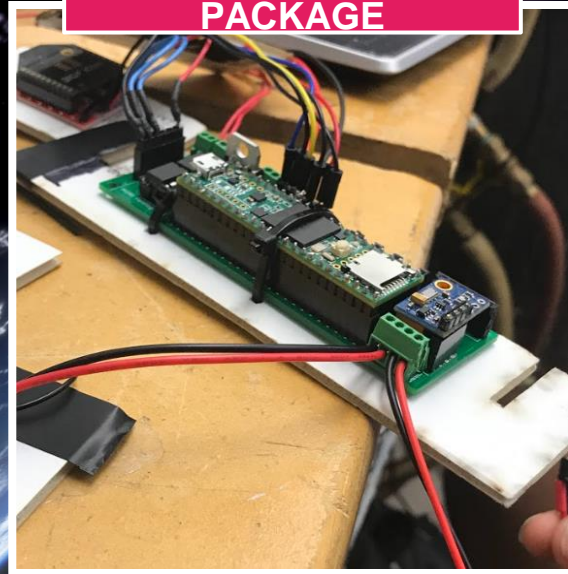


AUTONOMOUS CONTROL

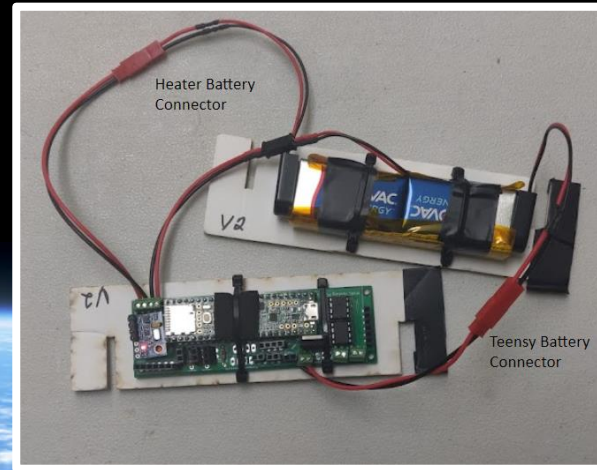
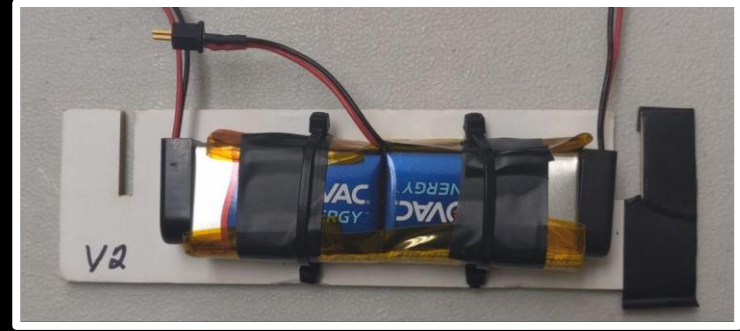
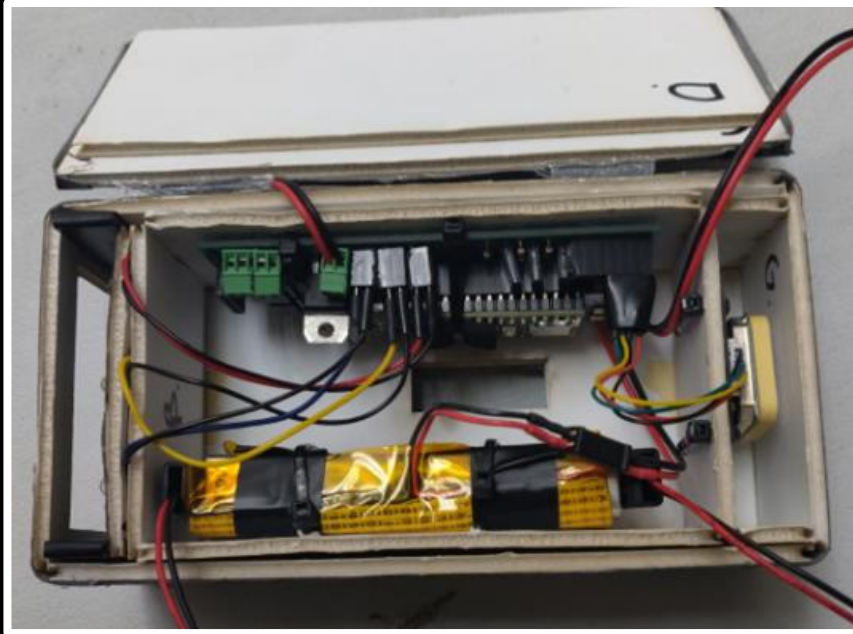
LED INDICATORS



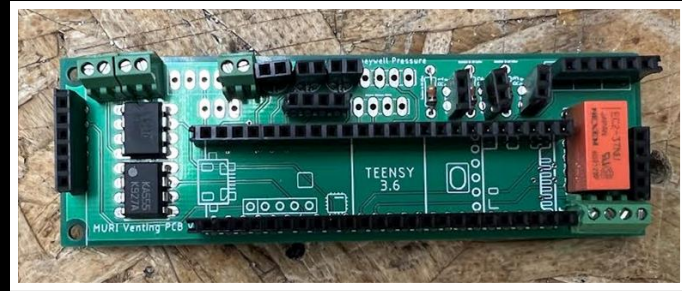
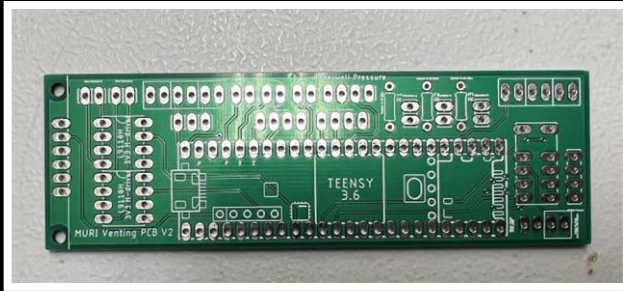
HARDWARE PACKAGE



MODULAR DESIGN



ONBOARD SENSOR SUITE



80 Female Headers | **8** Terminals | **2** H-Drivers | **1** H-Driver Socket

2 Resistor Cutters | **1** Thermistor | **1** Heater Relay | **1** Pressure

Sensor

2 9V Battery Connectors | **1** 5V Regulator | **1** UBlox GPS | **1** Teensy 3.5

-40°C

MINIMUM OPERATING TEMPERATURE



85°C

MAXIMUM OPERATING TEMPERATURE

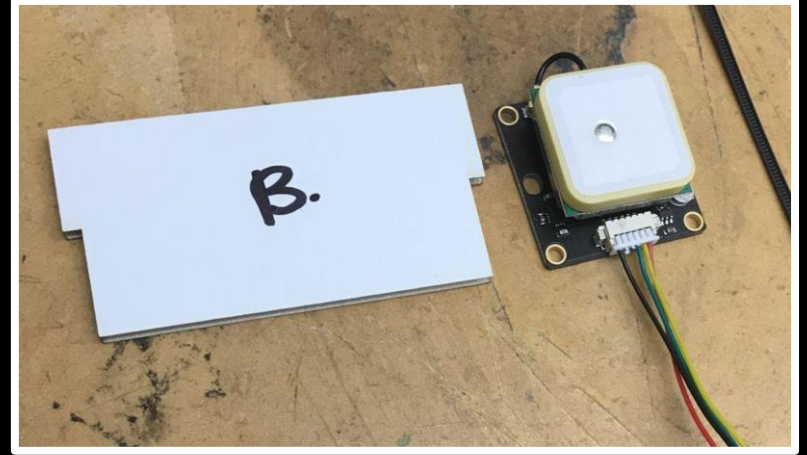
3.5V

EXPECTED VOLTAGE

PRIMARYLY USED FOR VENTING DECISIONS

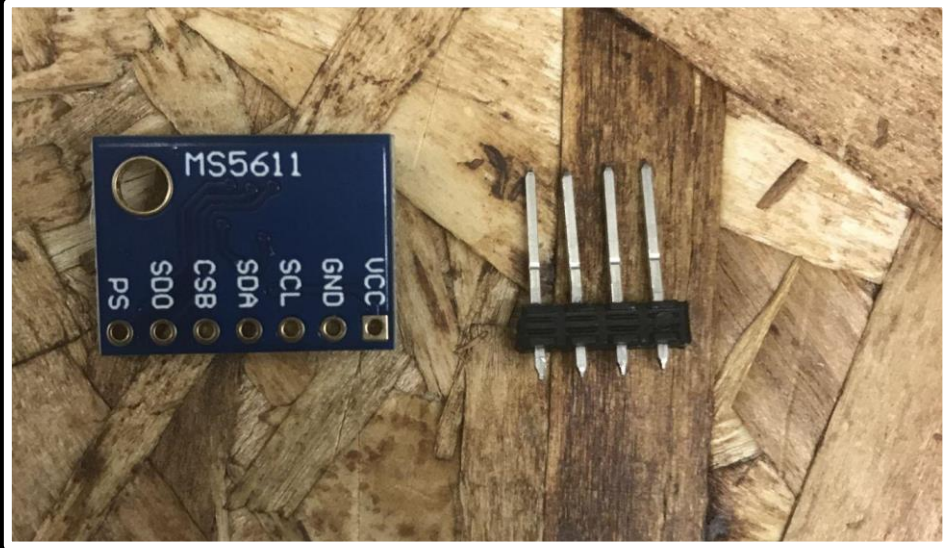
Enables location and altitude specific data

UBlox NEO M8N/M9N



GPS/ALTIMETER

HiLetgo MS5611



PRESSURE SENSOR

-40°C

MINIMUM OPERATING TEMPERATURE

85°C

MAXIMUM OPERATING TEMPERATURE



3.5V

EXPECTED VOLTAGE

Backup for GPS Venting Decisions

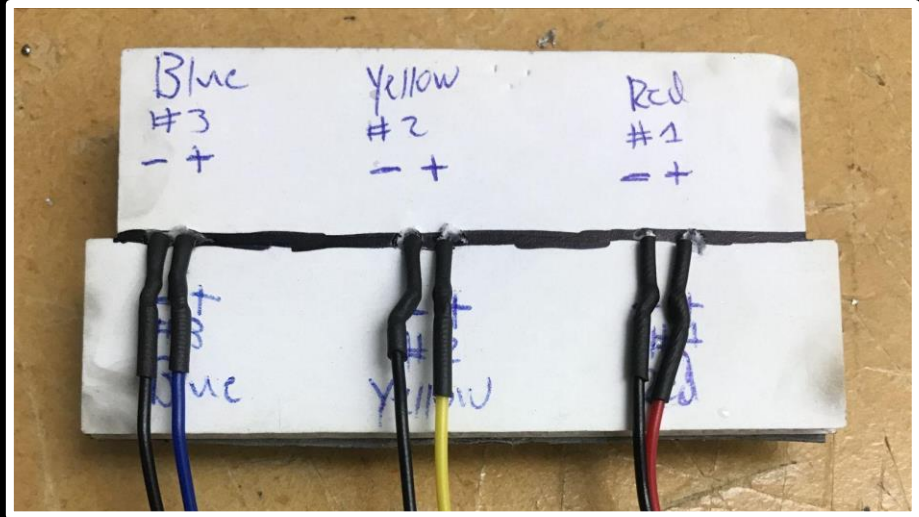
Calculates altitude from pressure data

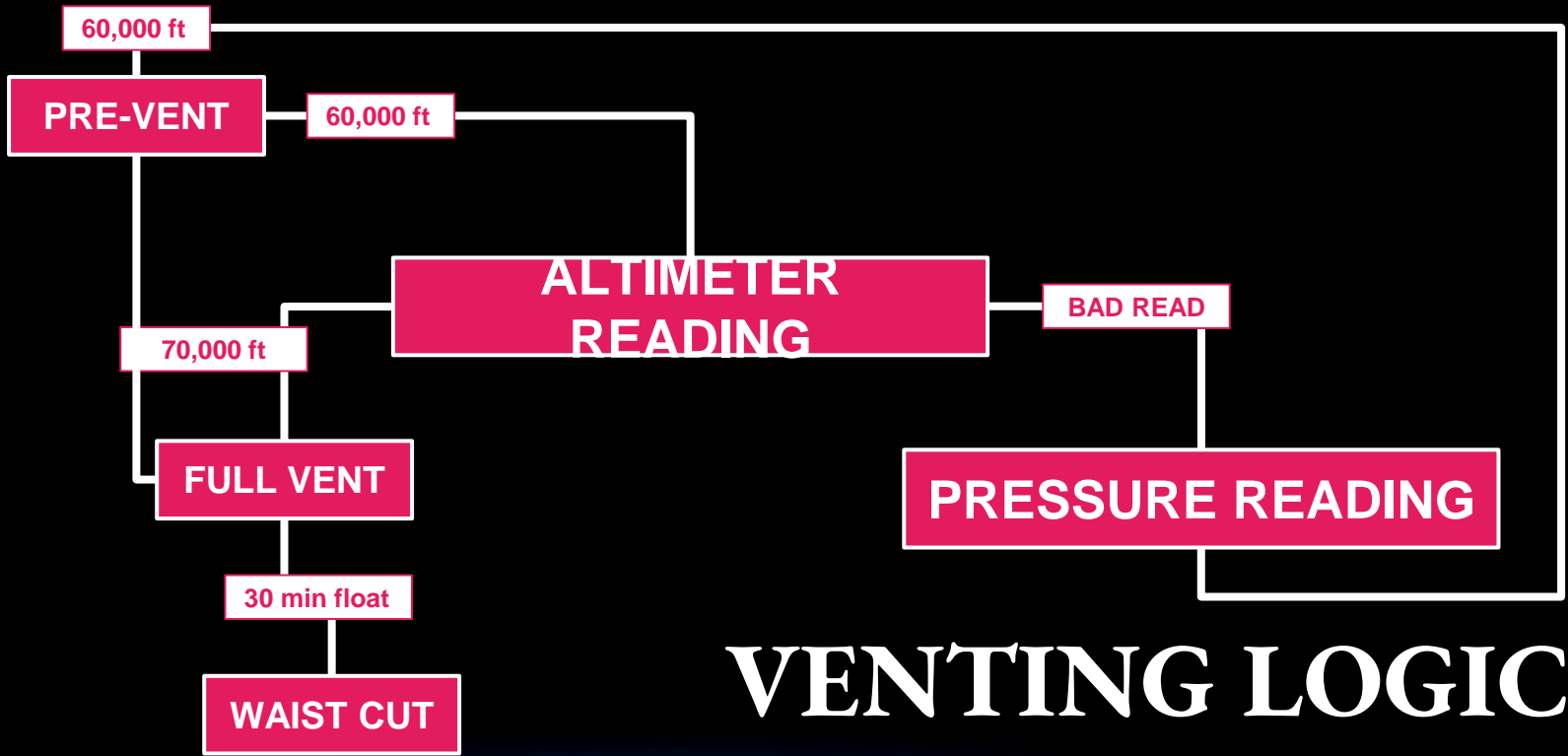
INDICATOR LEDS

THERMISTOR



BATTERY HEATING





VENTING LOGIC



A high-altitude balloon or probe is shown in space, with the Earth's surface and atmosphere visible in the background. The balloon is orange and white, and the probe is blue and white. The text "FINAL REMARKS" is overlaid in white, serif font across the center of the image.

FINAL REMARKS