CDK17 Remote Control System

construction and maintenance log

Imager Instruments

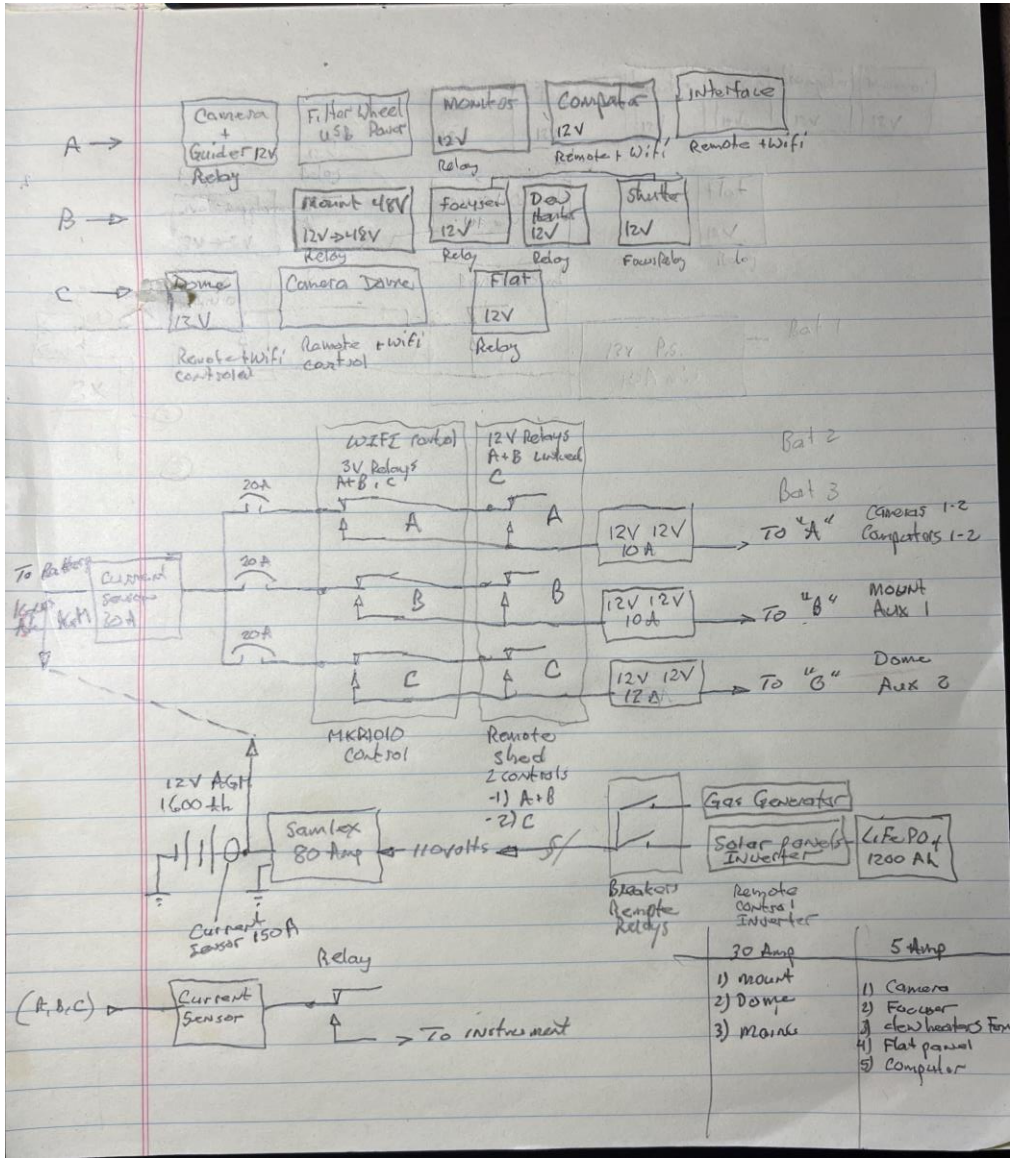
10' Dome ImagerSet	Front				Mega 2650			AGM 200Ah			(2) 8-Relay Boards	Sensor	Sensor						
Instruments	Panel Power	WIFI	Network	USB	AtoD Sensor	RS232	5 Volts	12 Volts	Current	48 Volts	Power Relay	Current	Voltage	Source Bank					
Camera 1, usb3, cooler	x			x usb3	x-current				3.77-2.2		x	x-5A		1					
Guider usb2				x					usb2 from camera					1					
Filter Wheel usb2				x				x	<1					1					
Focuser1	x				x-current	x		x	<1		x	x-5A		2					
Dew heaters and scope fans	x				x-current						x	x-5A		2					
Flat Panel retractable	x			x	x-current			x	??3.0??		x	x-5A		3					
Shutter CDK17 baffle	x			x				x	<1		x	attached to Focuser		2					
Mount Taurus 400	x			x usb3	x-current				3.0-1.0	x	x	x-30A		2					
Computer 1		x	x	x	x-current				2.7-1.0		x From Shed and MKR	x-5A		1					
monitor	x			x				x			x	x-5A		3					
MKR_Wifi_1010		x		x			x				Always on			3					
Dome	x			usb2-RS232	x-current	x			1.0-6.0		x From Shed and MKR	x-30A on 12v side		3					
DomeMonitoringcamera			x?	x?				x	USB		on with dome			3		might be usb powered from computer			
5 Volt Power supply								x MicroAdjustable			always on for MKR			2					
Fan for cooling								x			x			3					
Temp Humidity Sensor					2x MKR														
Battery Mains												x-30A	voltage +-30V						
From Charger												x150amp							

Cables

- OTA Cable 10’long
  - Camera Cable
    - USB3 Instrument to A to computer
    - Power
  - Focuser
    - RS232 cable to USB then connect to OTA Hub
    - Power 12 volts
  - Shutter
    - USB-2 mini to A then connect to OTA Hub
    - Power
  - Heater Delta T
    - USB-2 Instrument to A then connect to OTA Hub
    - Power
  - USB3 hub
    - USB3 Instrument to A to computer
    - Power from the camera cooler

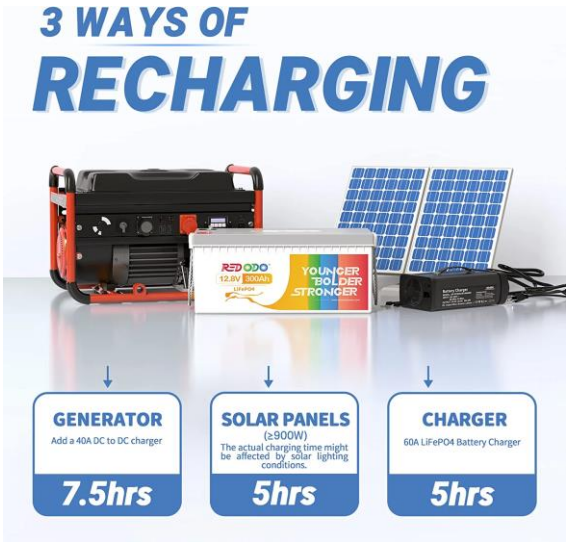
- Mount 10’ long
  - USB-2 mini to A attach to computer
  - Power 48volts
- Flat Panel 10’ long
  - USB-2 mini to A attach to computer
  - Power
- Dome 15’ long
  - RS232 RJ 6-conductor to DB-9 computer
  - Power
- Monitor
  - HDMI
  - On the Rack…USB Hub USB-3 to A to Computer USB3
  - Power for Monitor and USB Hub
  - Mouse-Keyboard from USB Hub

Block-Schematic



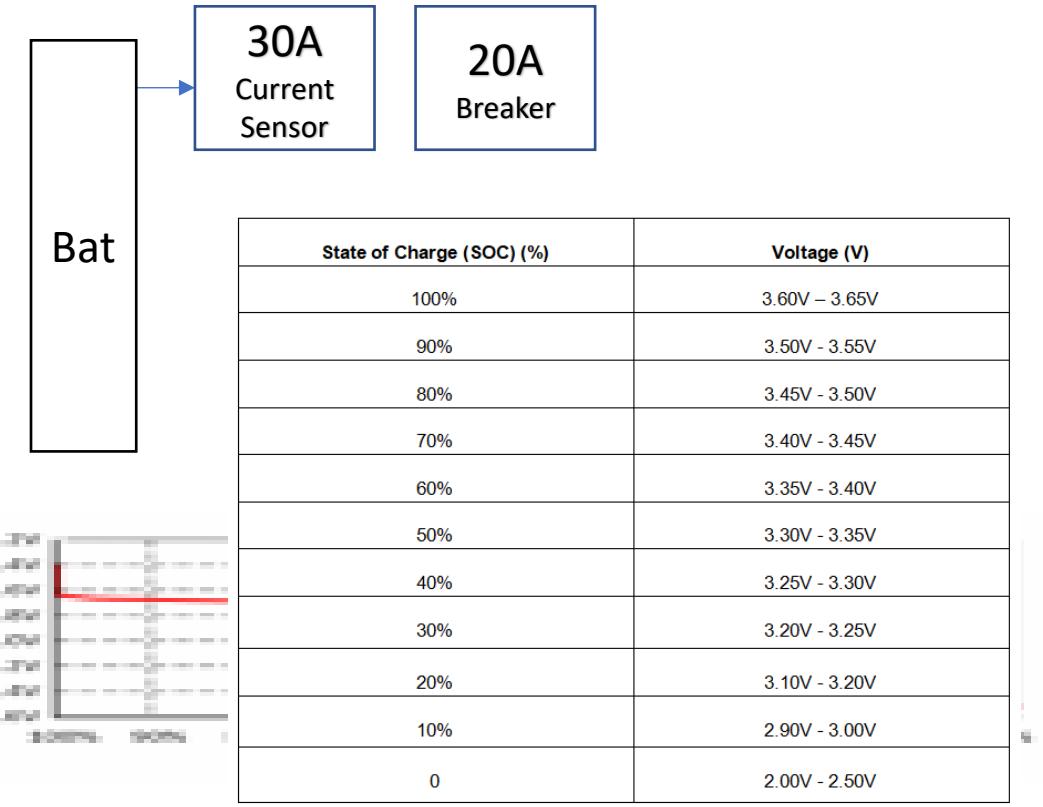
(4) 300Ah LiFePO4 Batteries

- Redodo 12V 300Ah LiFePO4 Lithium Battery, Built-in 200A BMS, Max. 2560W Power Output, 4000-15000 Deep Cycles & 10-Year Lifetime, UL&FCC Certificated...



Voltage	Capacity
14.4V	100%
13.6V	100%
13.4V	99%
13.3V	90%
13.2V	70%
13.1V	40%
13.0V	30%
12.9V	20%
12.8V	17%
12.5V	14%
12.0V	9%
10.0V	0%

LiFePO4 Discharge Profile

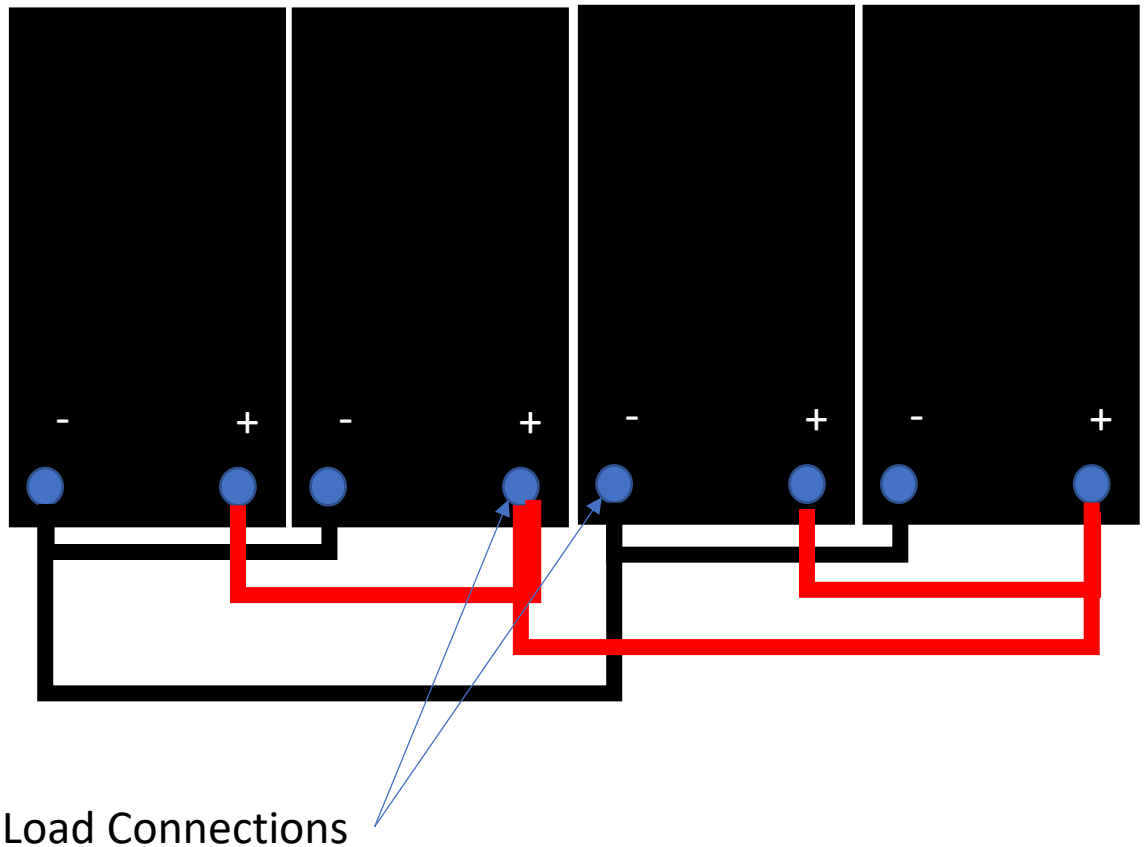


State of Charge (SOC) (%)	Voltage (V)
100%	3.60V – 3.65V
90%	3.50V - 3.55V
80%	3.45V - 3.50V
70%	3.40V - 3.45V
60%	3.35V - 3.40V
50%	3.30V - 3.35V
40%	3.25V - 3.30V
30%	3.20V - 3.25V
20%	3.10V - 3.20V
10%	2.90V - 3.00V
0	2.00V - 2.50V

SOC	V 48V setup	Cell	My Limits Self imposed	My Limits Self imposed 12V Setup	My Limits Self imposed 24V Setup	My Limits Self imposed 48V Setup
100.00%	58.40	3.65	3.294	13.2	26.4	52.7
99.50%	55.20	3.45				
99.00%	54.00	3.38				
90.00%	53.60	3.35	3.277	13.1	26.2	52.4
80.00%	53.20	3.33	3.260	13.0	26.1	52.2
70.00%	52.80	3.30	3.242	13.0	25.9	51.9
60.00%	52.40	3.28	3.225	12.9	25.8	51.6
50.00%	52.20	3.26	3.208	12.8	25.7	51.3
40.00%	52.00	3.25	3.191	12.8	25.5	51.1
30.00%	51.60	3.23	3.173	12.7	25.4	50.8
20.00%	51.20	3.20	3.156	12.6	25.2	50.5
14.00%	50.40	3.15				
9.50%	48.00	3.00	3.156	12.6	25.2	50.5
5.00%	44.80	2.80				
0.50%	40.60	2.54				
0.00%	40.00	2.50	2.950	11.8	23.6	47.2

10’ Dome 4-Battery “Parallel Balanced” Wiring

300 Amp hour LiFePO4 batteries



Deep Cycle AGM Battery 12 Volt 200Ah
SKU: RNG-BATT-AGM12-200-US

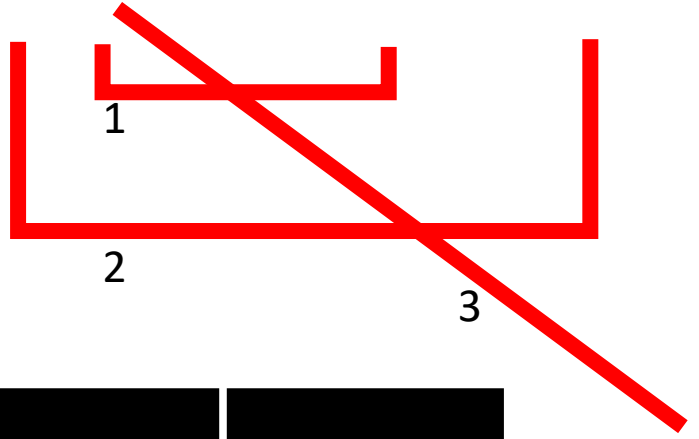
12 Volt 200Ah Deep Cycle AGM Battery
Electrical Specifications
Battery Type: AGM
Rated Capacity: 200Ah (20 Hour Rate to 10.5V)
Nominal Voltage: 12V
Cycle Use Voltage: 14.4V~14.8V
Internal Resistance: Approx. 3.5mΩ
Self-discharge Rate (77°F/25°C): ＜3% / month
Connection Method: In Series, and In Parallel (up to 4)
Automatically Self-heating Function: No
Mechanical Specifications
Dimensions: 20.6 x 9.4 x 8.8 in / 522 x 240 x 224 mm
Weight: 127.9 lbs / 58 kg
Container Material: ABS
opc:

Charging Parameters
Float Charge Voltage: 13.6V~13.8V
Maximum Charging Current: 60A
Discharging Parameters
Maximum Discharging Current: 2000A (5 seconds)
opc:
Temperature Parameters
Standard Operation Temperature: 77°F±9°F（25°C±5°C）
Storage Temperature: -4~140°F/ -20°C~60°C
Charge Temperature: 32~122°F/ 0~50°C
Discharge Temperature: -4~140°F/ -20~60°C
Communication Port
Built-in Biuetooth: No
opc:
Accessories
M8 Bolts: x2
opc:
Warranty
Material and workmanship warranty: 2-year
opc:

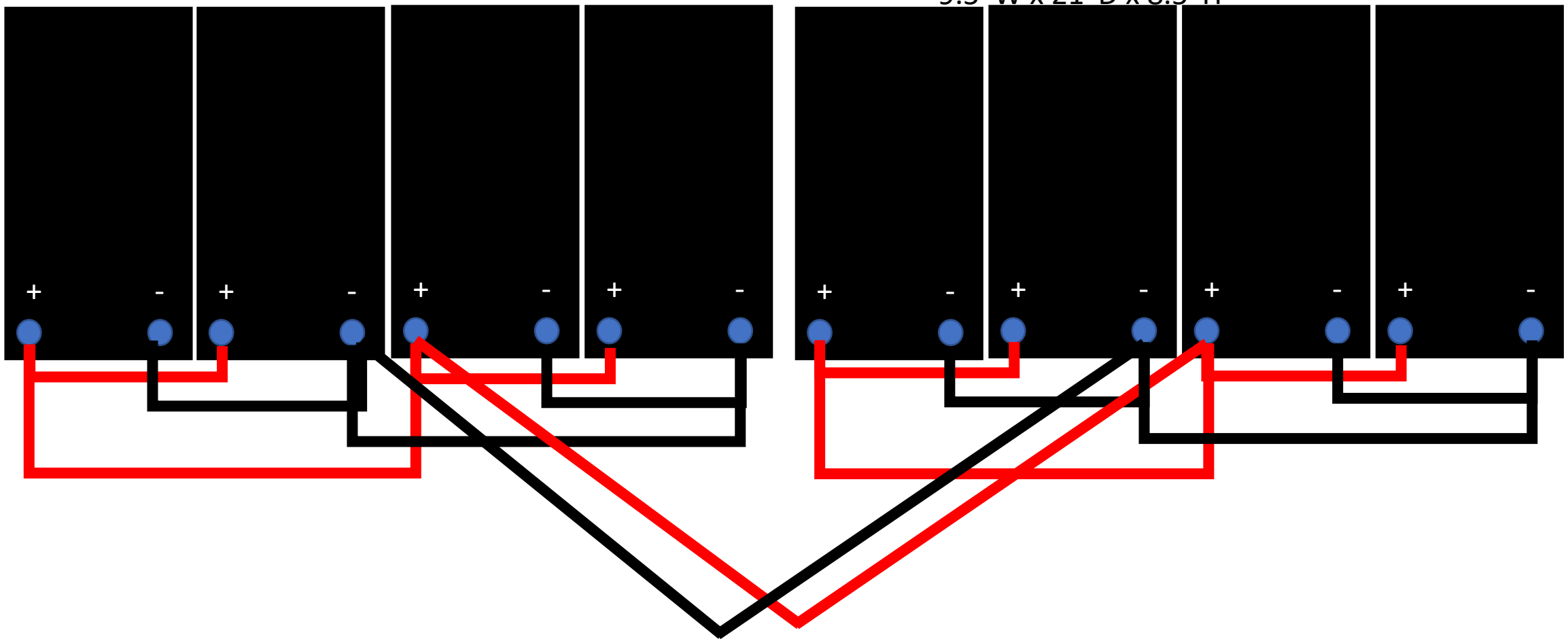
(8) 200Ah AGM Batteries

8-Battery Parallel Balanced Wiring

200 Amp hour AGM deep cycle batteries



9.5”W x 21”D x 8.5”H



3,2,1,3 3,2,1,3 3,1,2,3 3,1,2,3 3,2,1,3 3,2,1,3 3,1,2,3 3,1,2,3

Samlex 80-Amp Charger

110Volt inputs, switchable
Solar-battery bank
3500Watt Generator

6.1 INSTALLATION DIMENSIONS

Installation dimensions are given below. Dimensions are same for SEC-1280UL and SEC-2440UL.

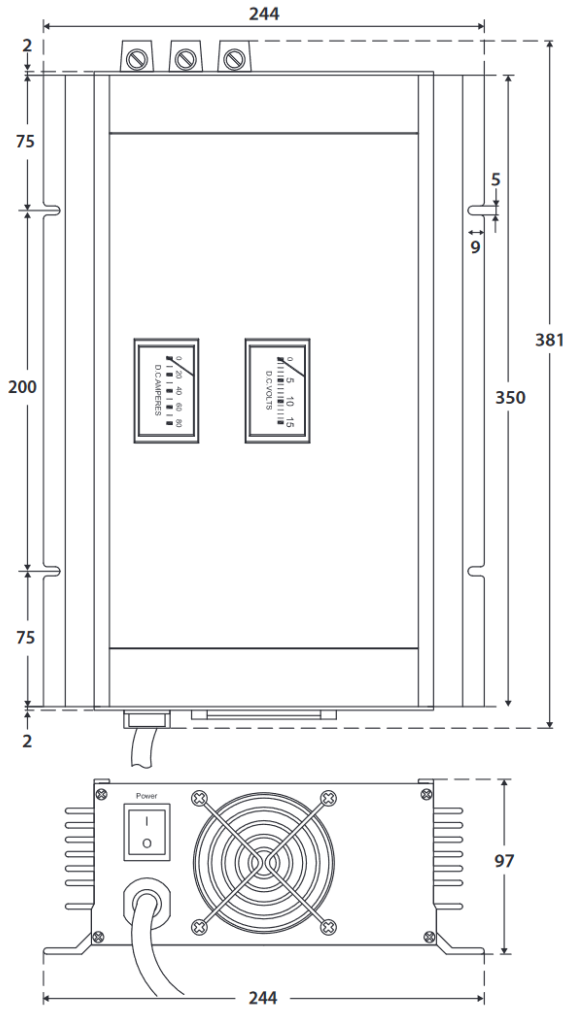


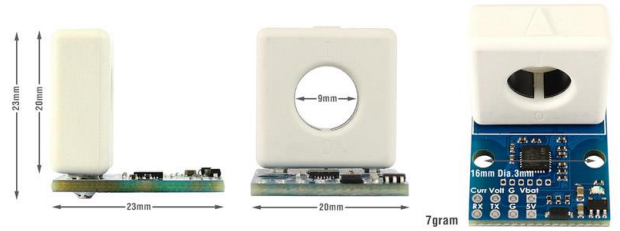
Fig. 6.1 Dimensional Drawing of SEC-1280UL & SEC-2440UL

Current Sensor 150Amp

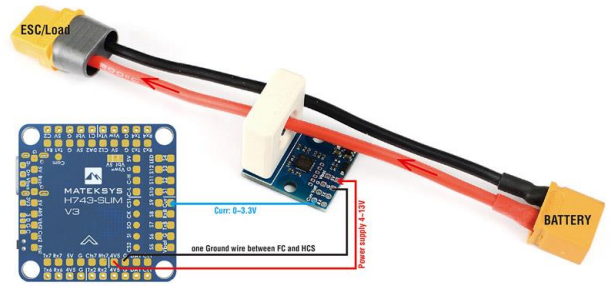
Between the Charger and Batteries

MATEKSYS

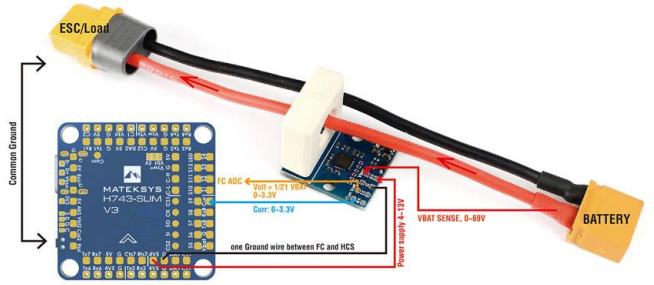
HALL CURRENT SENSOR 150A

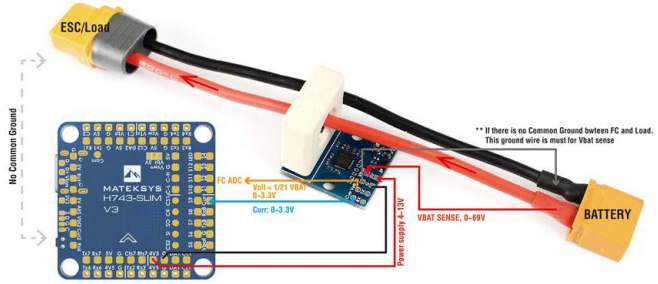


CURRENT SENSE



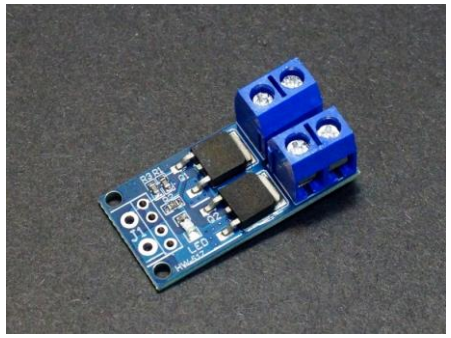
CURRENT + VBAT SENSE





Remote Controllable Gas Generator

~~SW-M221~~



ALPHA & OMEGA SEMICONDUCTOR

AOD4184A

40V N-Channel MOSFET

General Description

The AOD4184A combines advanced trench MOSFET technology with a low resistance package to provide extremely low $R_{DS(ON)}$. This device is well suited for high current load applications.

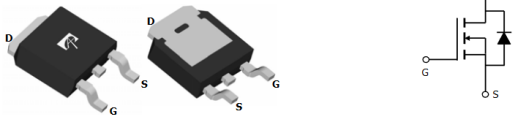
Product Summary

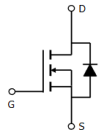
V_{DS}	40V
I_D (at V_{GS}=10V)	50A
$R_{DS(ON)}$ (at V_{GS}=10V)	< 7mΩ
$R_{DS(ON)}$ (at V_{GS} = 4.5V)	< 9.5mΩ

100% UIS Tested
100% Rg Tested

Green Product

TO252
DPAK



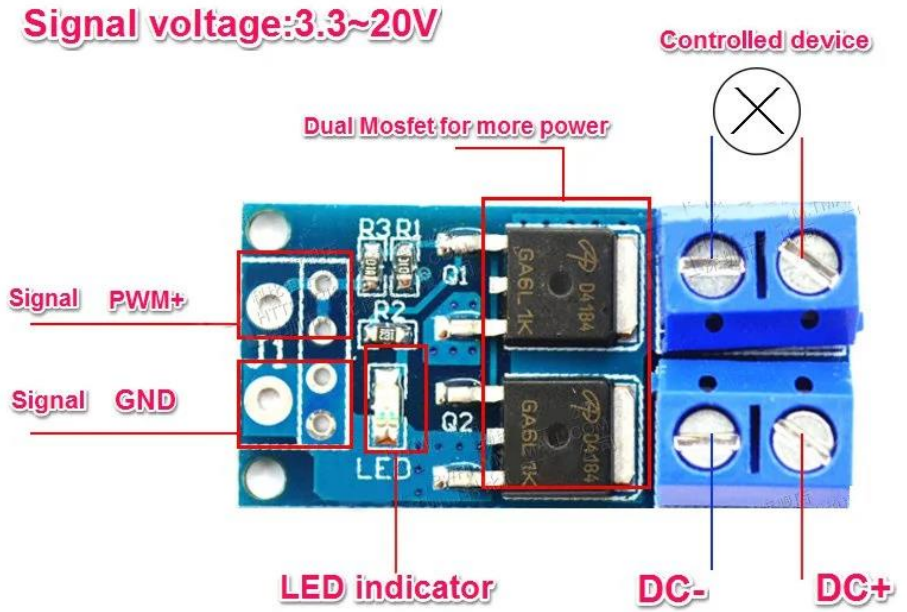


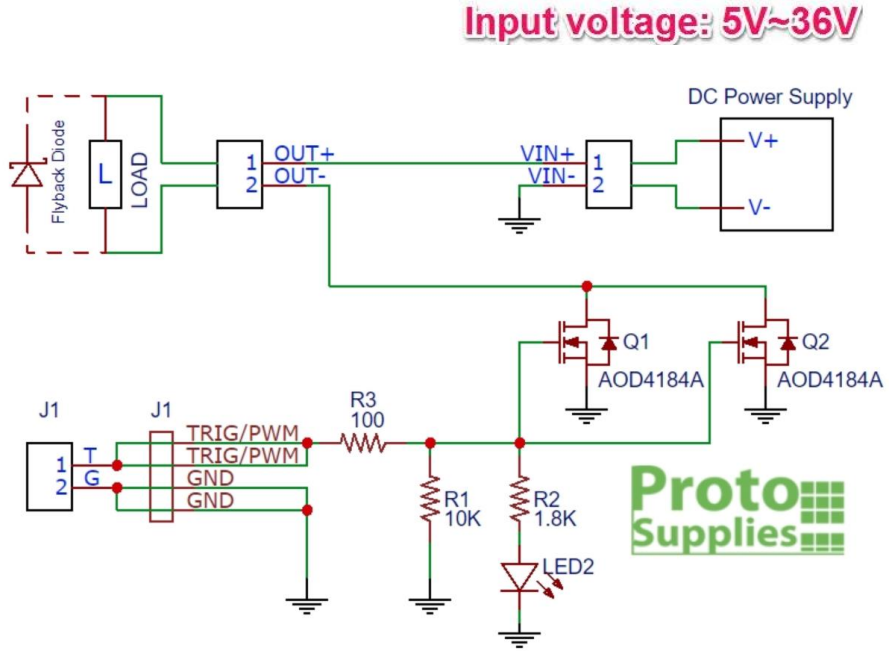
Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	Maximum	Units
Drain-Source Voltage		V_{DS}	40	V
Gate-Source Voltage		V_{GS}	±20	V
Continuous Drain Current [G]	T_C=25°C	I_D	50	A
	T_C=100°C		40	
Pulsed Drain Current [C]		I_{DM}	120	
Continuous Drain Current	T_A=25°C	I_{DSM}	13	A
	T_A=70°C		10	
Avalanche Current [C]		I_{AS}, I_{AR}	35	A
Avalanche energy L=0.1mH [C]		E_{AS}, E_{AR}	61	mJ
Power Dissipation [B]	T_C=25°C	P_D	50	W
	T_C=100°C		25	
Power Dissipation [A]	T_A=25°C	P_{DSM}	2.3	W
	T_A=70°C		1.5	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 175	°C

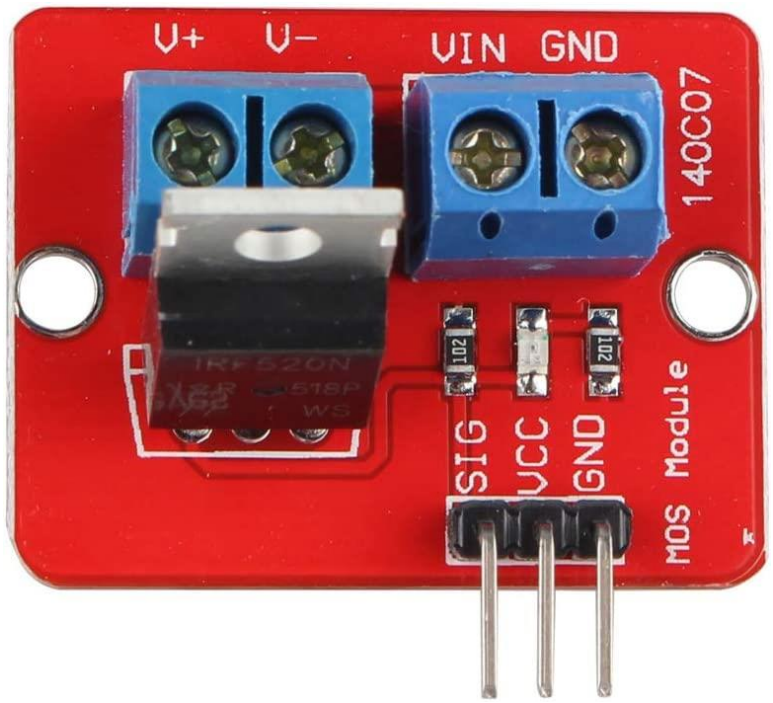
Thermal Characteristics

Parameter		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient [A]	t ≤ 10s	$R_{\theta JA}$	18	22	°C/W
Maximum Junction-to-Ambient [A D]	Steady-State		44	55	°C/W
Maximum Junction-to-Case	Steady-State	$R_{\theta JC}$	2.4	3	°C/W





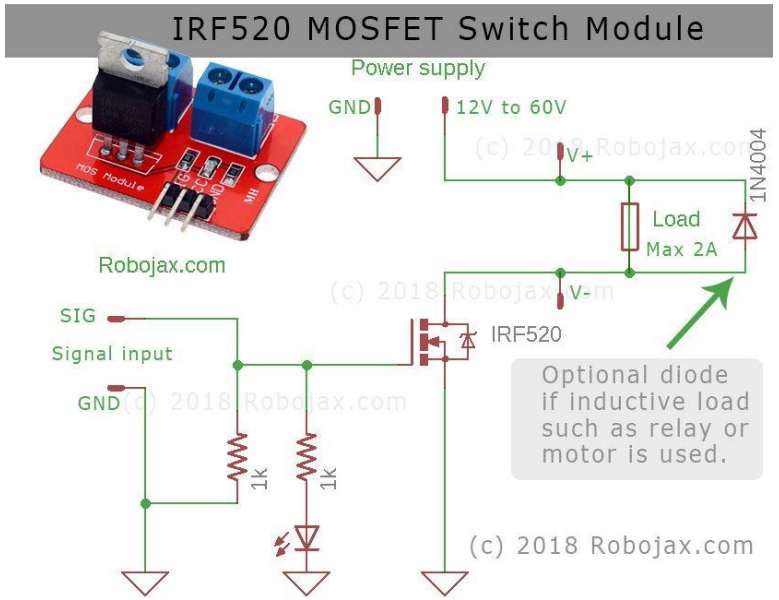
~~IRF520 MOSFET Module~~



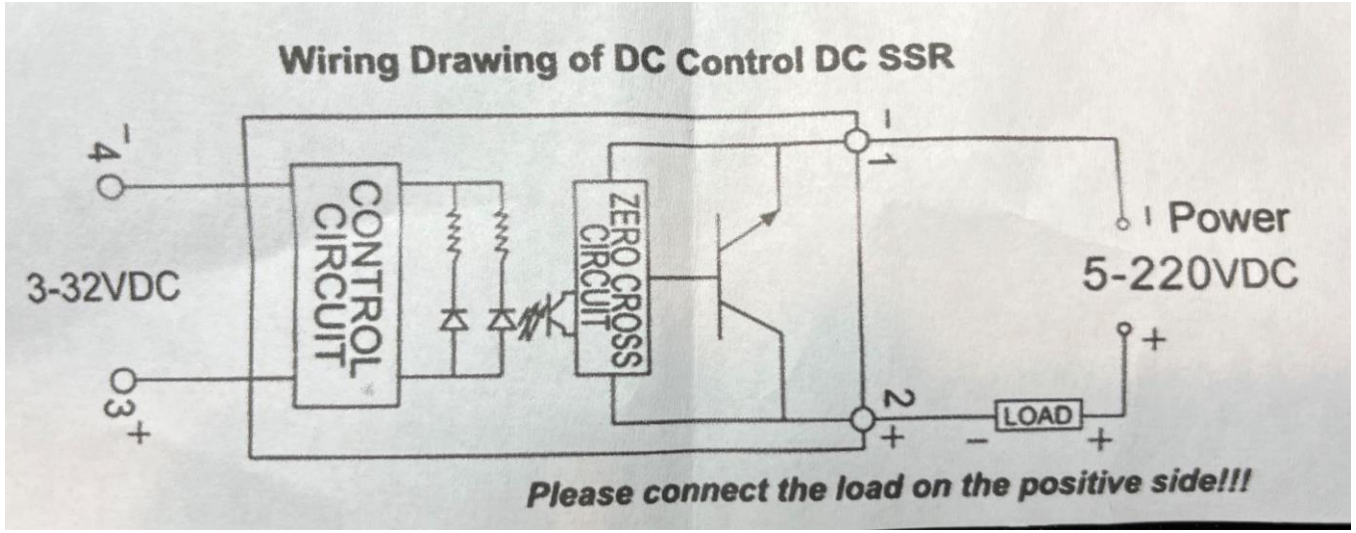
Description：
This little module is a breakout board for the IRF520 MOSFET transistor. The module is designed to switch heavy DC loads from a single digital pin of your microcontroller. Its main purpose is to provide a low cost way to drive a DC motor for robotics applications, but the module can be used to control most high current DC loads. Screw terminals are provided to interface to your load and external power source. An LED indicator provides a visual indication of when your load is being switched.

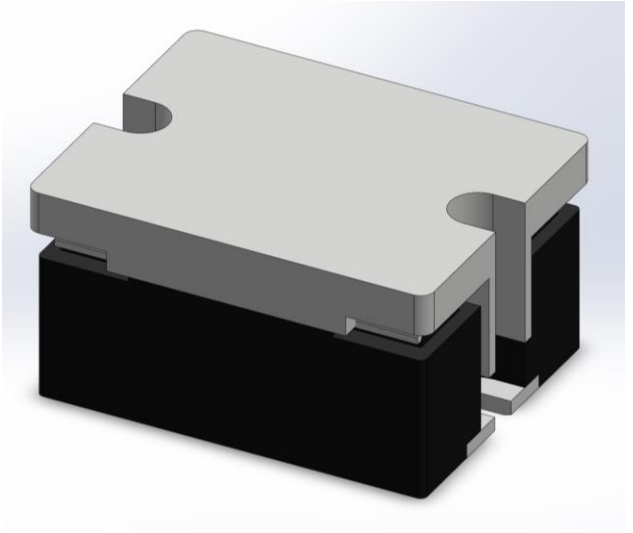
Specification:
Size: 33*24mm
Voltage: 3.3V, 5V
Ports: Digital Level
Output load voltage: 0-24V
Output load current: <5A (1A above need to add heat sink)
Platform: Arduino, MCU, ARM, raspberry pie
Using original IRF520 Power MOS, you can adjust the output PWM Drive up to 24V allows the load, such as LED lights, DC motors, miniature pumps, solenoid valves PWM dimming LED can be used to achieve stepless dimming, variable speed motor

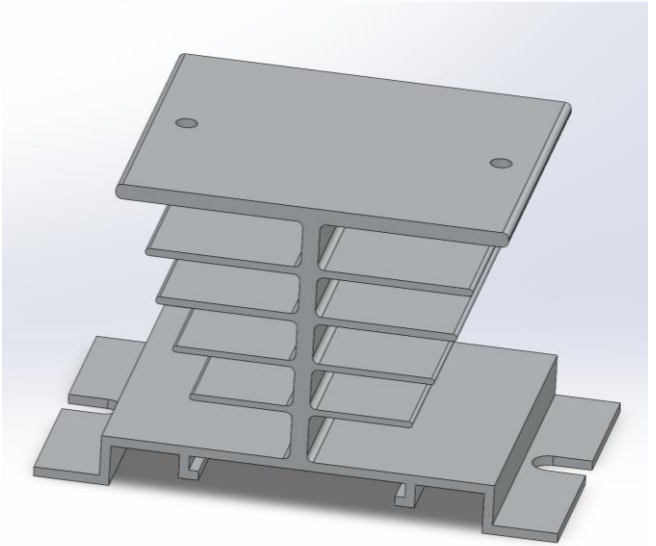
Package Included:
5* IRF520 MOSFET Driver Module



~~DC Solid State Relay (SSR) 20Amp~~

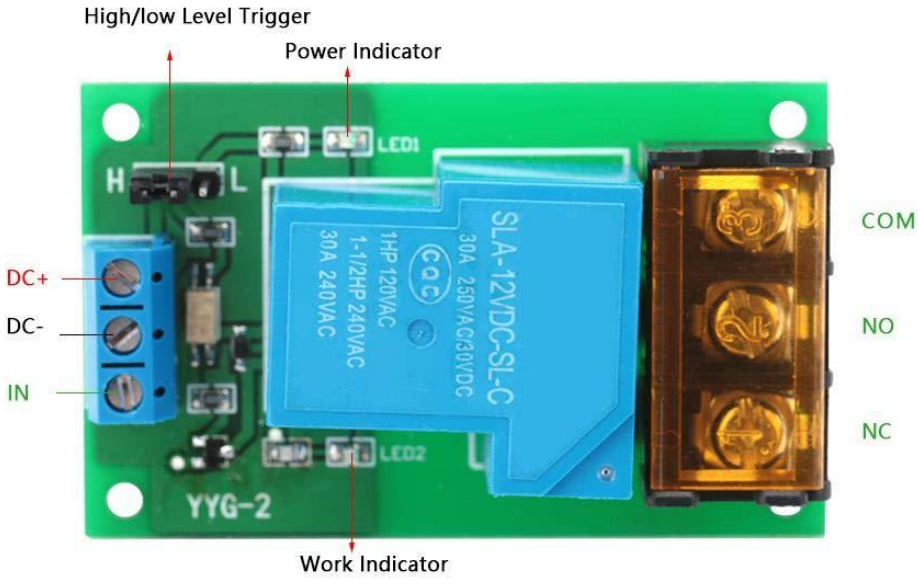




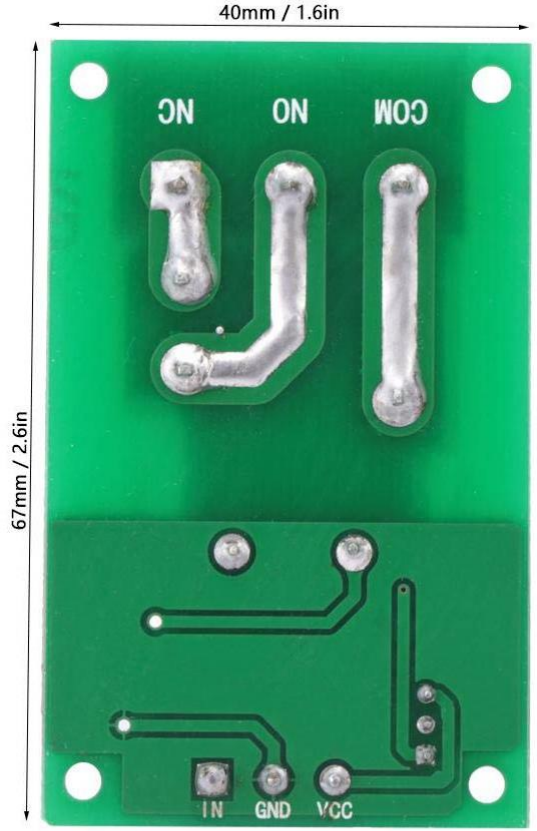


SSR didn’t work as it requires switching the ground and thus isolating the ground. I had back flow through the power supplies that had things on without switching the SSR. Additional diodes might have fixed the problem but the added complexity isn’t worth it.

Relay Module One Way 30A Optocoupler Isolation Relay



1.3125” x 2.3125” hole pattern

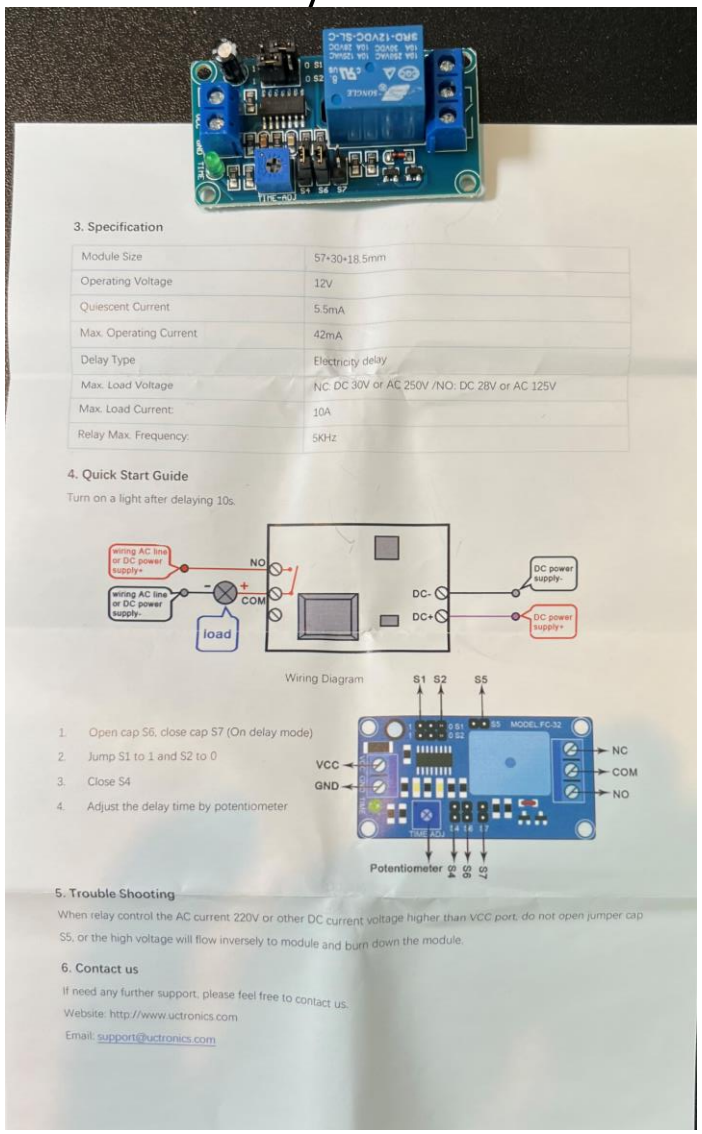


Current Rating	30 Amps
Brand	YWBL-WH
Coil Voltage	12 Volts
Contact Current Rating	30 Amps
Maximum Switching Current	30 Amps

1. DC+: the positive pole of the external DC power supply
2. DC-: the negative pole of the external DC power supply
3. IN: Signal input terminal
4. NO: the relay often opens the interface, the relay suspends before pulling in, and then shortens the connection with the COM.
5. COM: common interface of relay
6. NC: the relay is normally closed, the relay is short to the COM before it is pulled in.

Time Delay Relay…

Momentary Contact for Computer ON-Button



3. Specification

Module Size	57*30*18.5mm
Operating Voltage	12V
Quiescent Current	5.5mA
Max. Operating Current	42mA
Delay Type	Electricity delay
Max. Load Voltage	NC: DC 30V or AC 250V /NO: DC 28V or AC 125V
Max. Load Current:	10A
Relay Max. Frequency:	5KHz

4. Quick Start Guide

Turn on a light after delaying 10s.

Wiring Diagram

1. Open cap S6, close cap S7 (On delay mode)
2. Jump S1 to 1 and S2 to 0
3. Close S4
4. Adjust the delay time by potentiometer

5. Trouble Shooting

When relay control the AC current 220V or other DC current voltage higher than VCC port, do not open jumper cap S5, or the high voltage will flow inversely to module and burn down the module.

6. Contact us

If need any further support, please feel free to contact us.

Website: http://www.uctronics.com

Email: support@uctronics.com

UCTRONICS DC 12V Time Delay Relay Module

Model: U6031

1. Introduction

The DC 12V time delay relay module is designed for different control systems. It can set on delay or off delay modes with the adjustable time range from 0.1s to 1h. The delay mode and delay time can be set by shorting or opening the jumper pins and rotating the potentiometer. It can be widely used for smart home, automobile control, Arduino robotics, and other electronic projects.

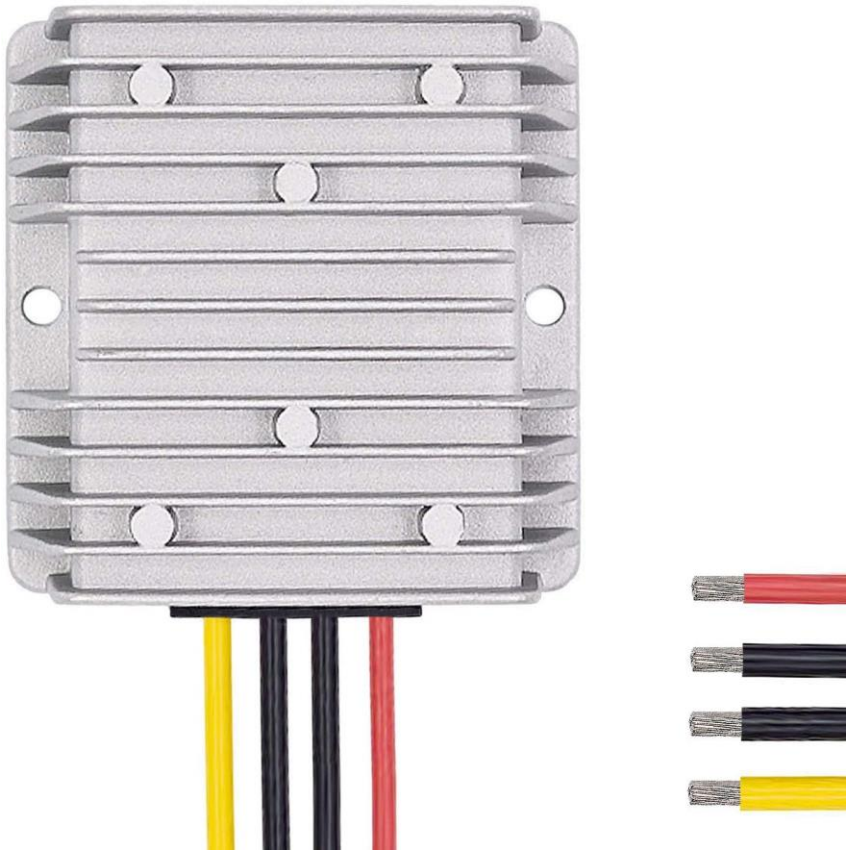
2. Functions

S6	S7	Function	Description	Timing Chart
Open	Close	On Delay	The time delay starts when applying the power supply and the output switches to the operate condition after the setting time has elapsed.	
Close	Open	Off Delay	The output immediately switches to the operate condition and the time delay starts when applying the power supply, and the output switches to the release condition after the setting time has elapsed.	

Adjustable Range of Time T with potentiometer

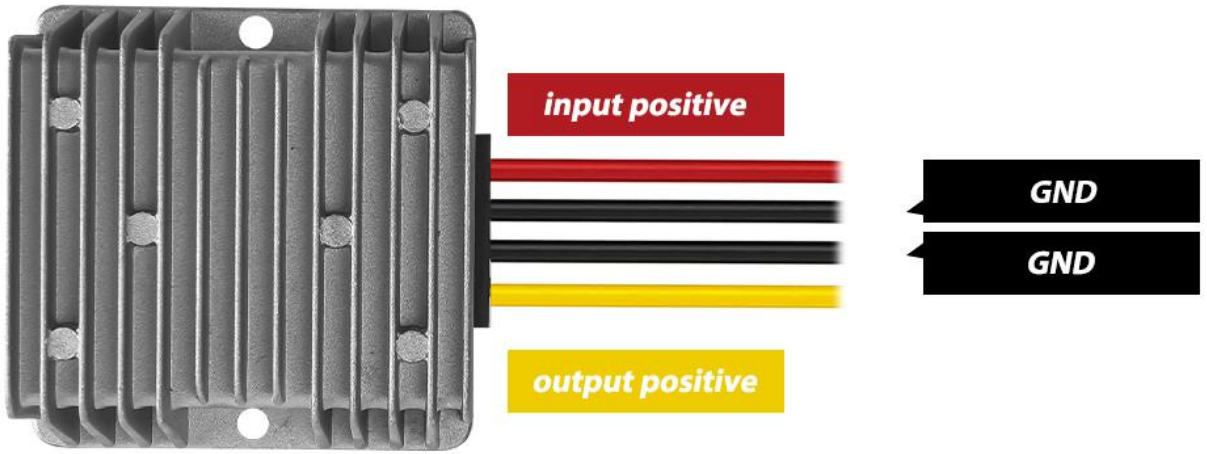
Mode	S1	S2	Diagram	S4	T
1	0	1		open	0.13-1.3s
2	1	0		open	0.5-5.2s
3	0	1		close	1.5-14.5s
4	0	0		open	4.4-42s
5	1	0		close	6-58s
6	1	1		open	38-340s
7	0	0		close	48-463s
8	1	1		close	389-3700s

12Volt DC-DC Converter

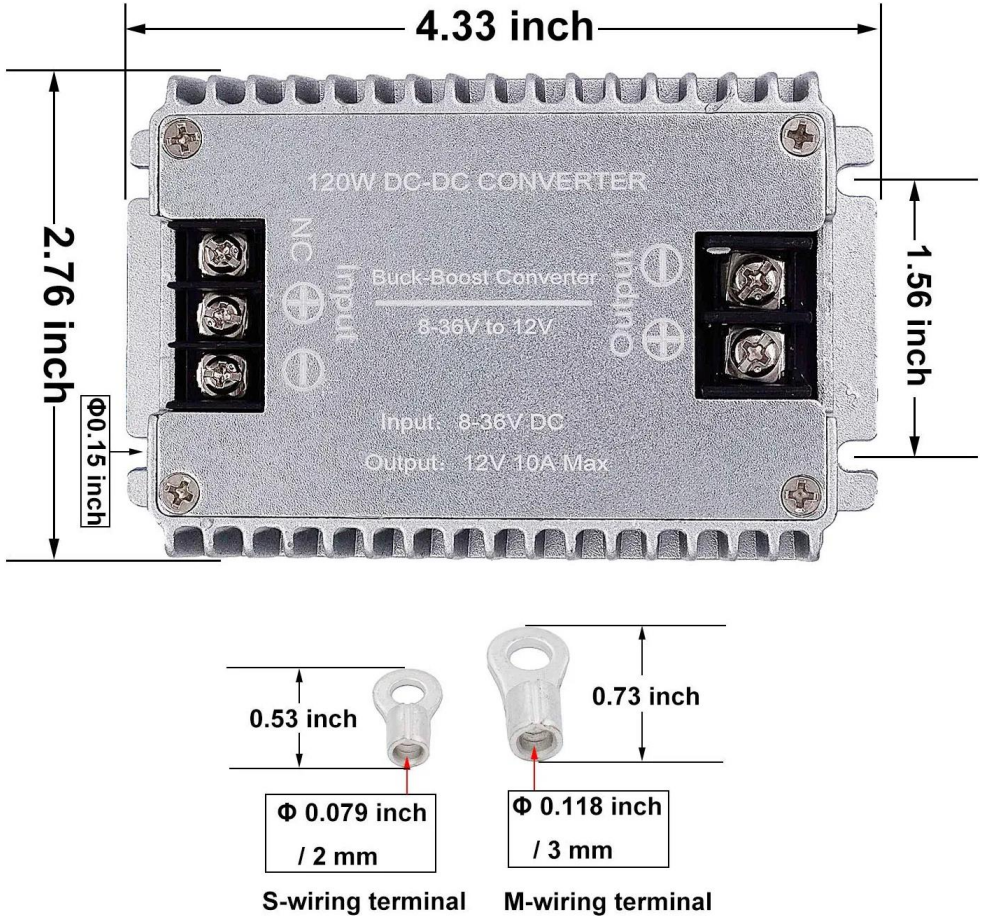


DC 12V 4A Voltage Stabilizer Surge Protector Power Supply Regulator for Auto Truck Vehicle Boat Solar System etc. (DC10-36V Input, DC12V Output)

Wiring Diagram



12V 12A Buck Converter for the Dome



Power Supply Distribution

10' Dome ImagerSet	Front Panel Power	WIFI	Network	USB	Mega 2650 AtoD Sensor	RS232	5 Volts	AGM 200Ah 12 Volts	Current	48 Volts	(2-3) 8-Relay Boards Power Relay	Sensor Current	Sensor Voltage	Source Bank				
Instruments																		
Camera 1, usb3, cooler	x			x usb3	x-current				3.77-2.2		x	x-5A		1				
Guider usb2				x					usb2 from camera					1				
Filter Wheel usb2				x				x	<1					1				
Focuser1	x				x-current	x		x	<1		x	x-5A		2				
Dew heaters and scope fans 5-Amps	x				x-current				5-amps		x	x-5A		2				
Flat Panel retractable	x			x	x-current			x	2.8Amps		x	x-5A		3				
Actuator Linear									1Amp									
Shutter CDK17 baffle	x			x				x	<1		x	attached to Focuser		2				
Mount Taurus 400	x			x usb3	x-current				3.0-1.0	x	x	x-30A		2				
Computer 1		x	x	x	x-current				2.7-1.0		x From Shed and MKR	x-5A		1				
monitor	x			x				x			x	x-5A		3				
MKR_Wifi_1010		x		x			x				Always on			3				
Dome	x			usb2-RS232	x-current	x			1.0-6.0		x From Shed and MKR	x-30A on 12v side		3				
DomeMonitoringcamera			x?	x?				x	USB		on with dome			3		might be usb powered from computer		
5 Volt Power supply								x MicroAdjustable			always on for MKR			2				
Fan for cooling								x			x			3				
Temp Humidity Sensor					2x MKR													
Battery Mains												x-30A	voltage +-30V					
From Charger												x150amp						

(2) 8-Relay Boards

Relay Board 1

- Imaging Power Supply 30A
  - Relay Board 1 power
  - Relay Board 2 power
  - Interface power
  - Computer 1 power

  - Mount Relay 30A
  - Monitor 5Amp Current sensor
  - Focus
  - Dome Camera
  - LAN
  - USB 3 hub
- Imager Mains
  - Camera Power Supply 5Amp Current sensor
  - Fan

Relay Board 2

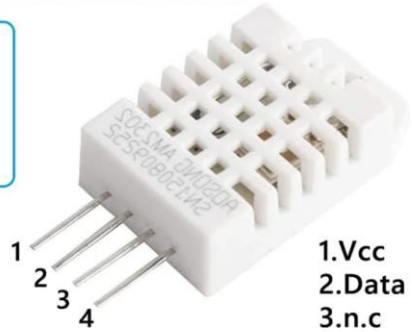
- Dome Power Supply
  - Dome Relay 30A
  - Flat 5Amp Current sensor
  - Shutter
  - Heater 5Amp Current sensor
  - Computer 2 5Amp Current sensor
  - Camera 2 5Amp Current sensor

DHT22 Temperature Humidity Sensor Arduino

DHT22 Temperature-Humidity Sensor

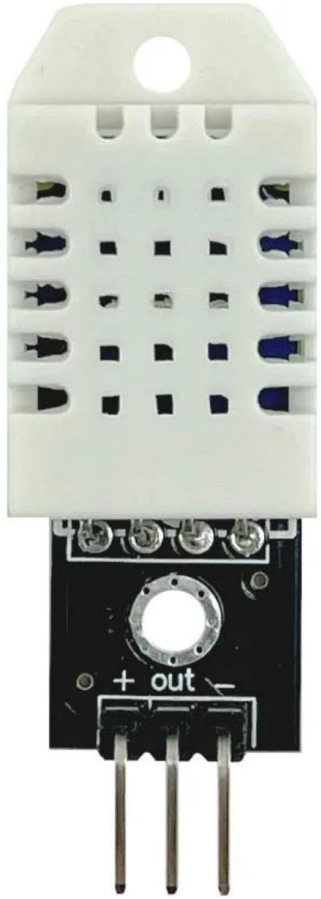
- 3.3 to 6V power and I/O
- 1.5mA max current use during conversion
- 0-100% humidity reading with 2-5% accuracy
- -40 to 80°C temperature readings ±0.5°C accuracy
- Up to 0.5 Hz sampling rate(once every 2 seconds)
- 4 pins,0.1" spacing

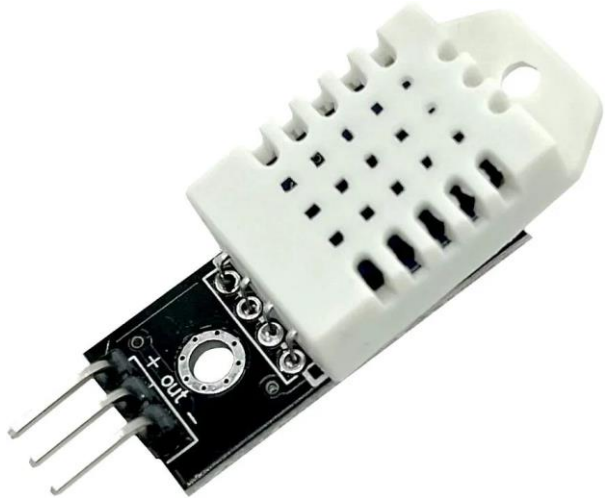
1)VCC
2)DATA(digital I/O)
3)Not Connected (N.C)
4)GND



1.Vcc
2.Data
3.n.c
4.GND

Note:Connect a 4.7K or 10K resistir between VCC and the DATA pin





DTH22 Library Header

DHT22.h - Notepad

File Edit Format View Help

```
/*!
 * @file DHT22.h
 * @brief Arduino library for interface with DHT22 sensor
 * @n without use of pointers.
 * @author dvarrel
 * @version  1.0.0
 * @date  2022-11-09
 * @url https://github.com/dvarrel/DHT22.git
 */
#ifndef _DHT22_H
#define _DHT22_H
#include "Arduino.h"

class DHT22{
  private:
    uint8_t _pinData;
    uint32_t _timer;
    uint64_t _rawData;
    uint16_t _h16bits;
    uint16_t _t16bits;
    uint8_t _crc8bits;
    uint8_t _timing80L;
    uint8_t _timing80H;
    uint8_t _timing50;
    uint8_t _timingBit0;
    uint8_t _timingBit1;
    bool _firstStart=true;

    const uint8_t T=30;
    enum error{
      OK,
      ERR_TIMING_80,
      ERR_TIMING_50,
      ERR_TIMING_BITS,
      ERR_CRC
    };

  public:
    DHT22(uint8_t pinData){
      _pinData = pinData;
    };
    /** @return 40bits of data sensor : h16 + t16 + crc8**/
    uint64_t getRawData();

    /** @return 40bits in a String ("0" left include)**/
    String getRawStrData();

    /** @return humidity %rH **/
    float getHumidity();

    /** @return temperature in °C **/
    float getTemperature();

    /** @return String with timings, 40bits, and calculate values**/
    String debug();

  private:
    /** @brief measure timings of sensor*/
    void measureTimings();

    /**
    *@brief read the 40bits sensor data
    *@return 0 if no error, num of error instead
    */
    uint16_t readSensor();

    /** @brief compute checksum of h & t data
     * @return true if checksum==crc**/
    bool computeCRC();

};

#endif
```

humidity and temperature, 1-wire only

Author

dvarrel

Website

https://github.com/dvarrel/DHT22

Category

Sensors

License

CC0 1.0

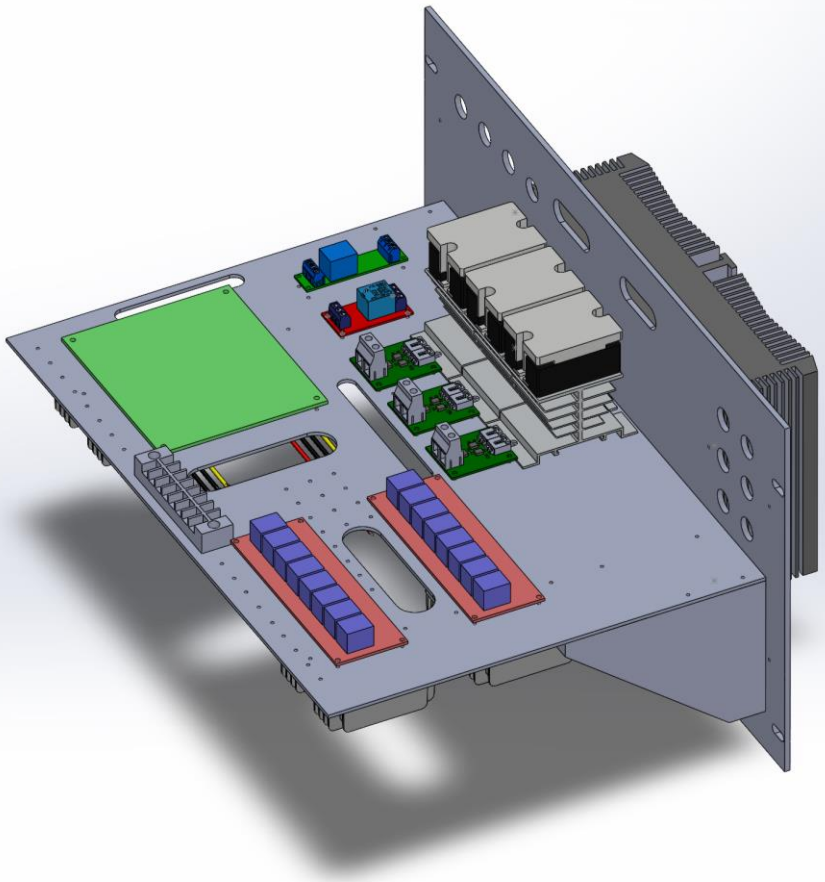
Library Type

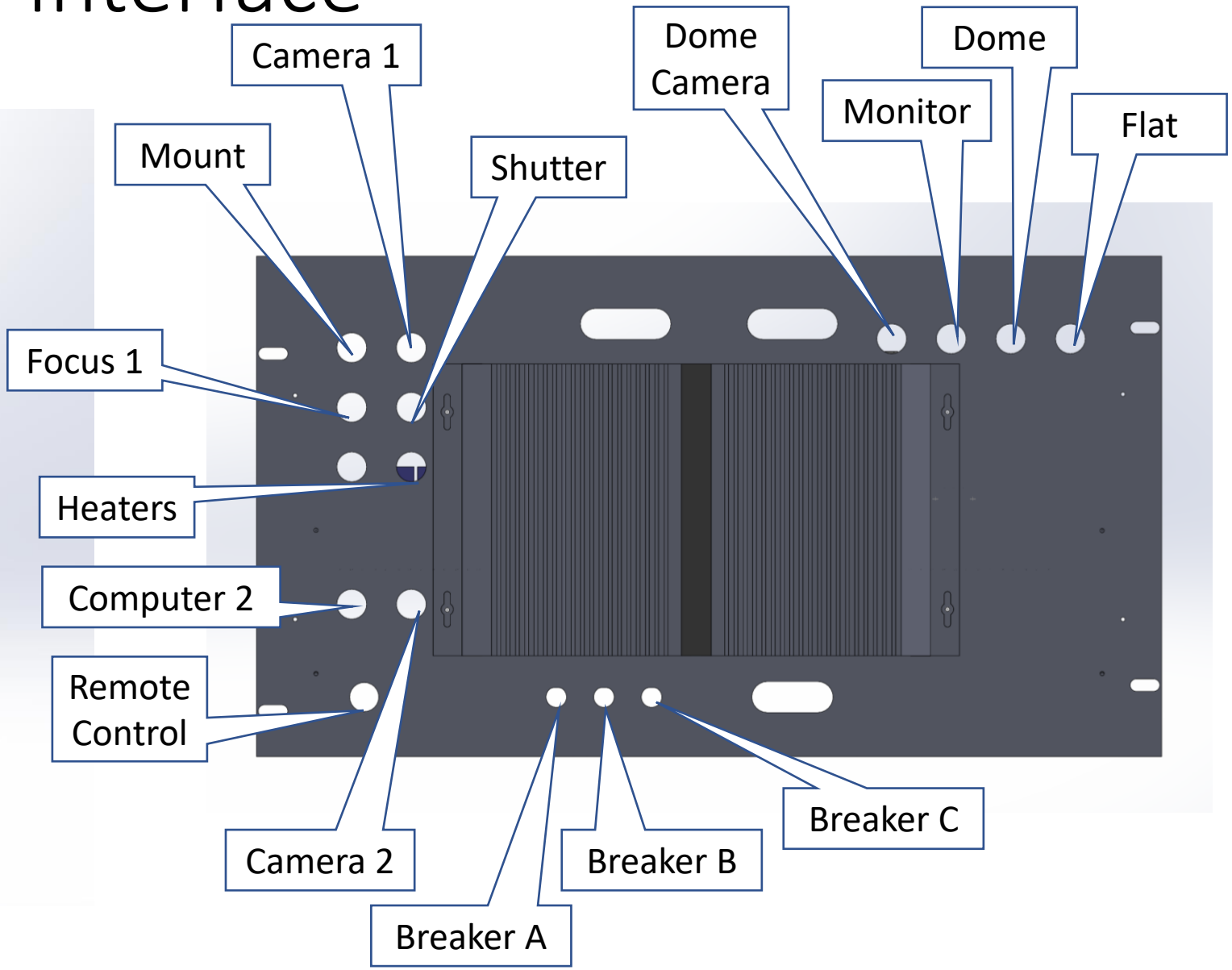
Contributed

Architectures

Any

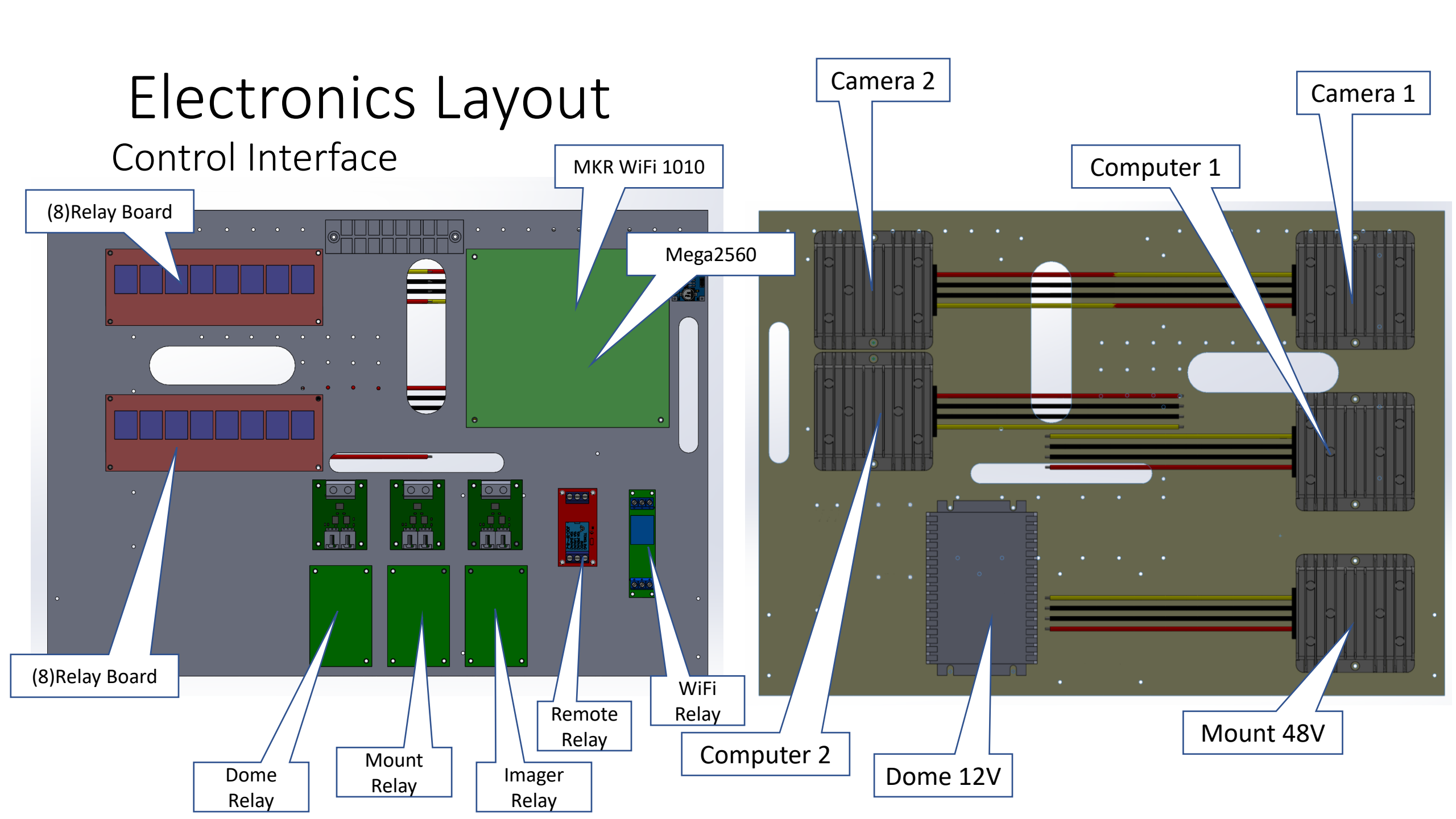
Mechanics Control Interface



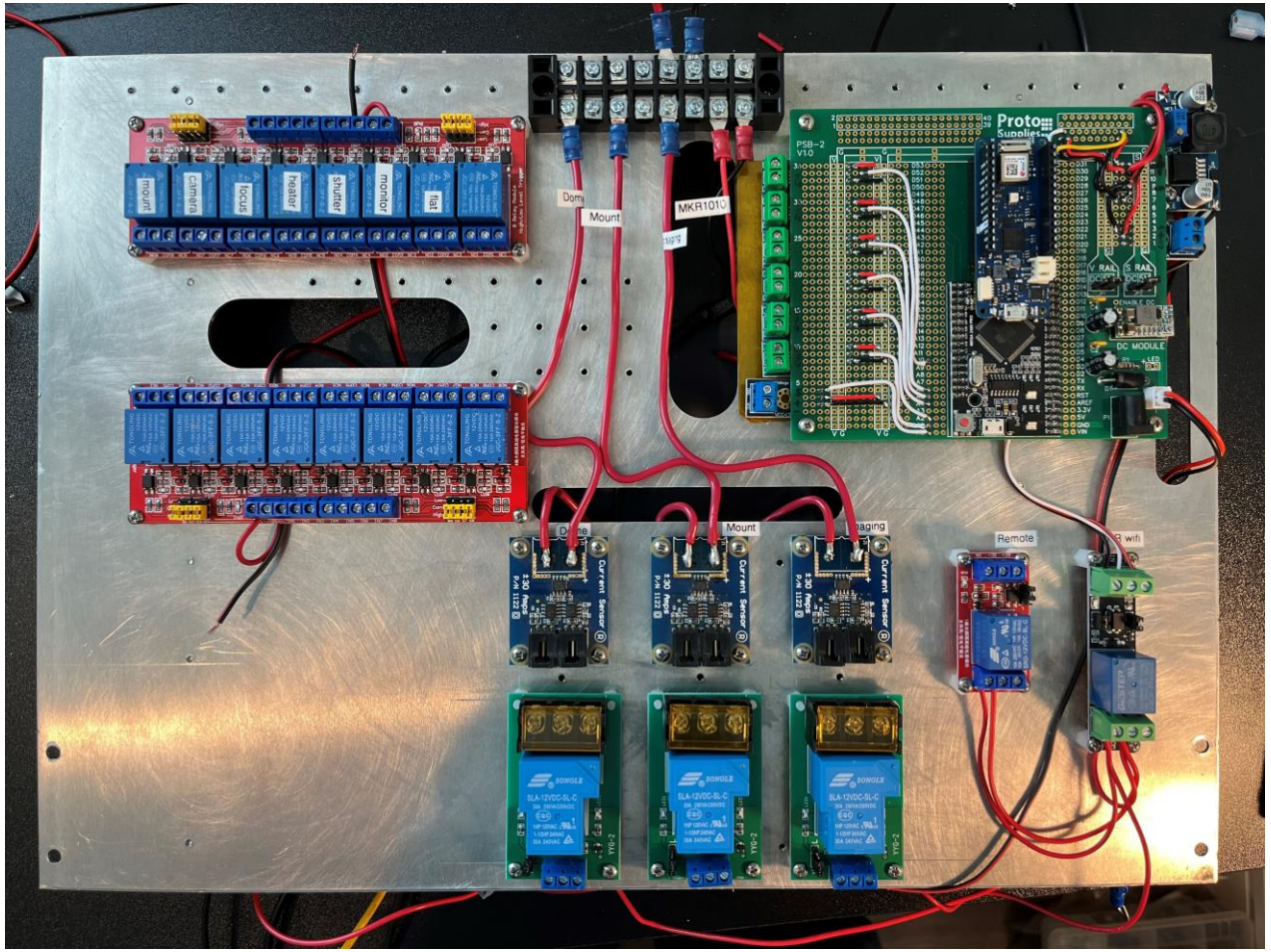


Electronics Layout

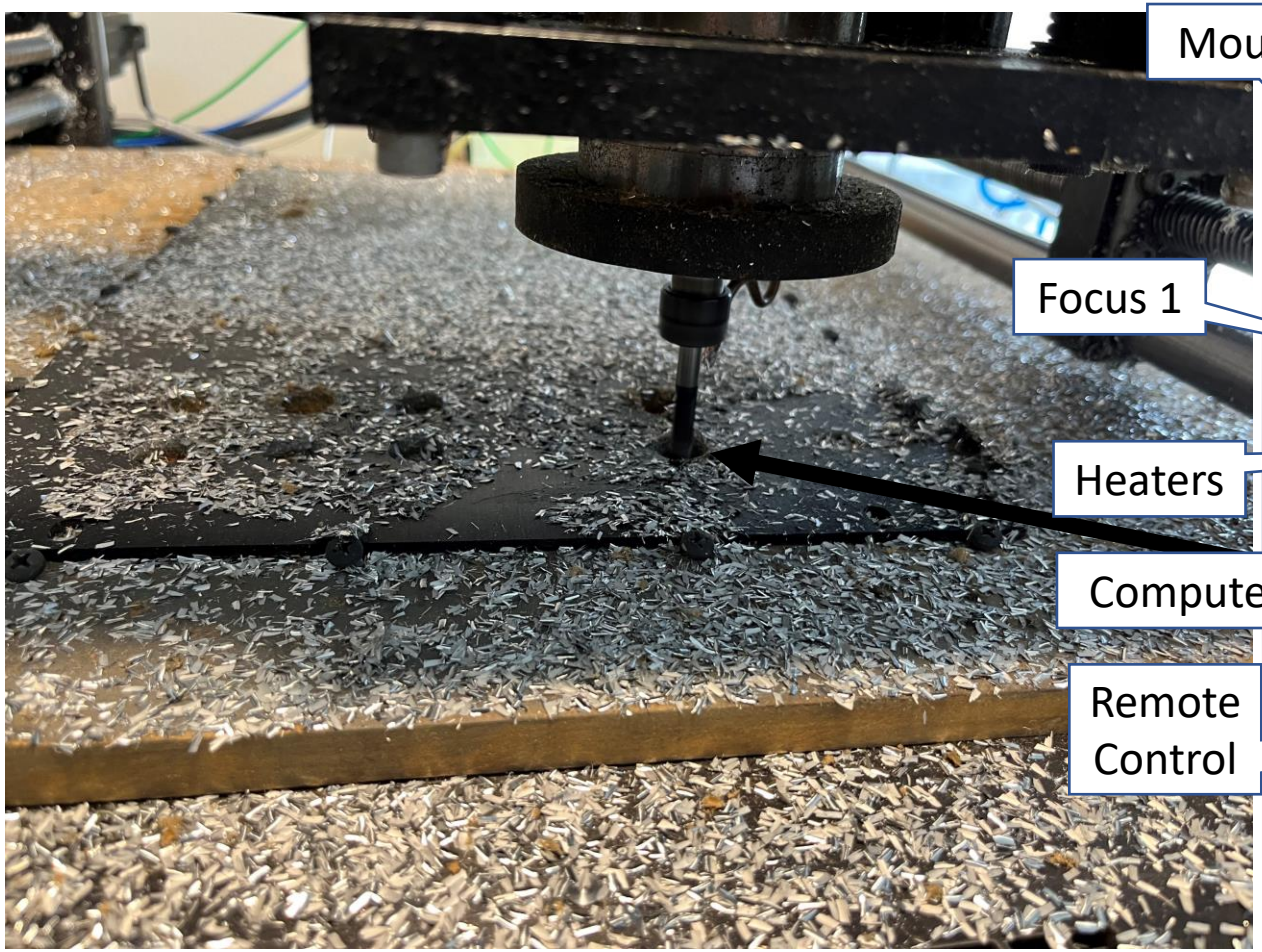
Control Interface

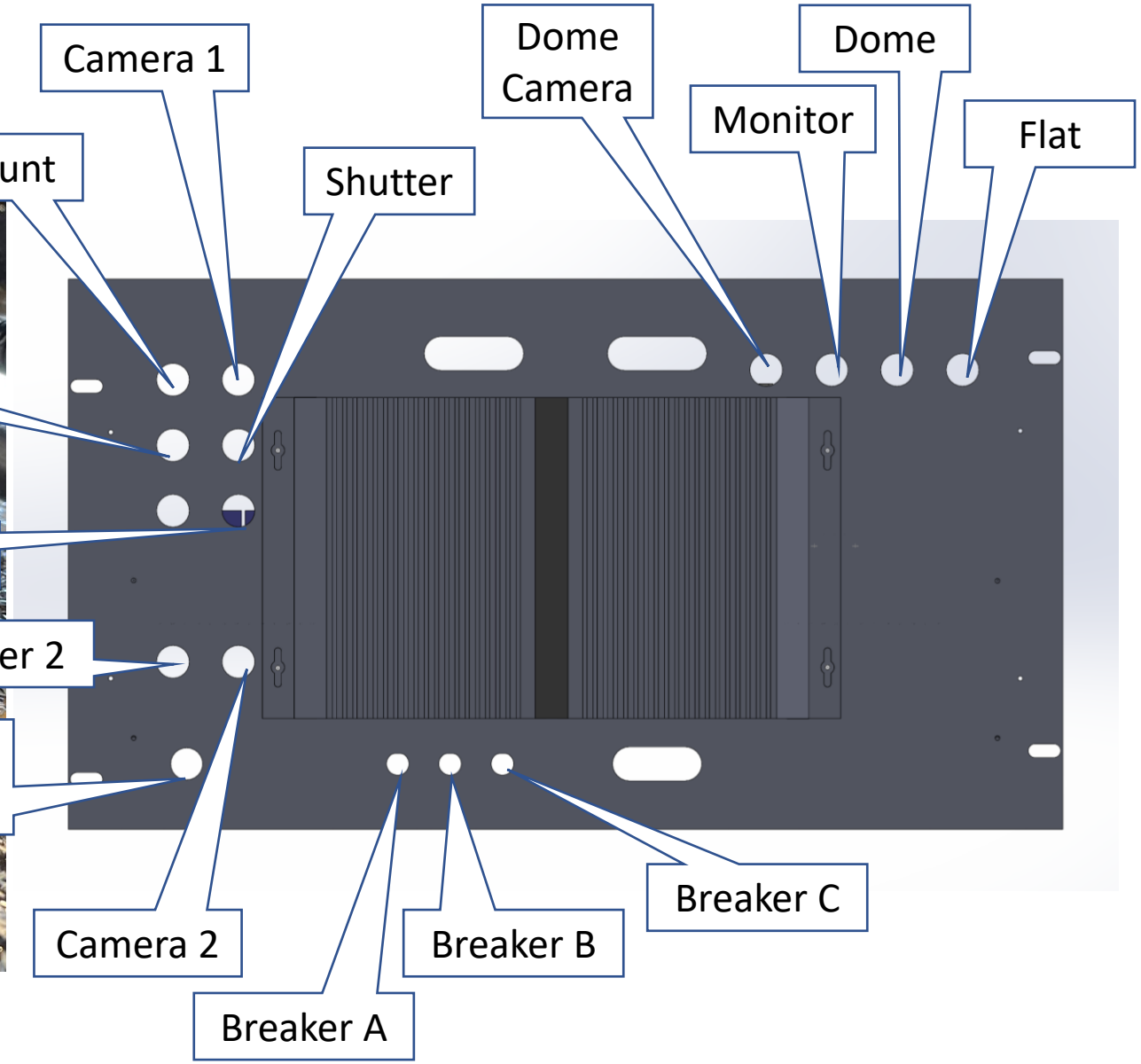


Electronics Plane Cutting in the CNC Router



Cutting the Front Panel

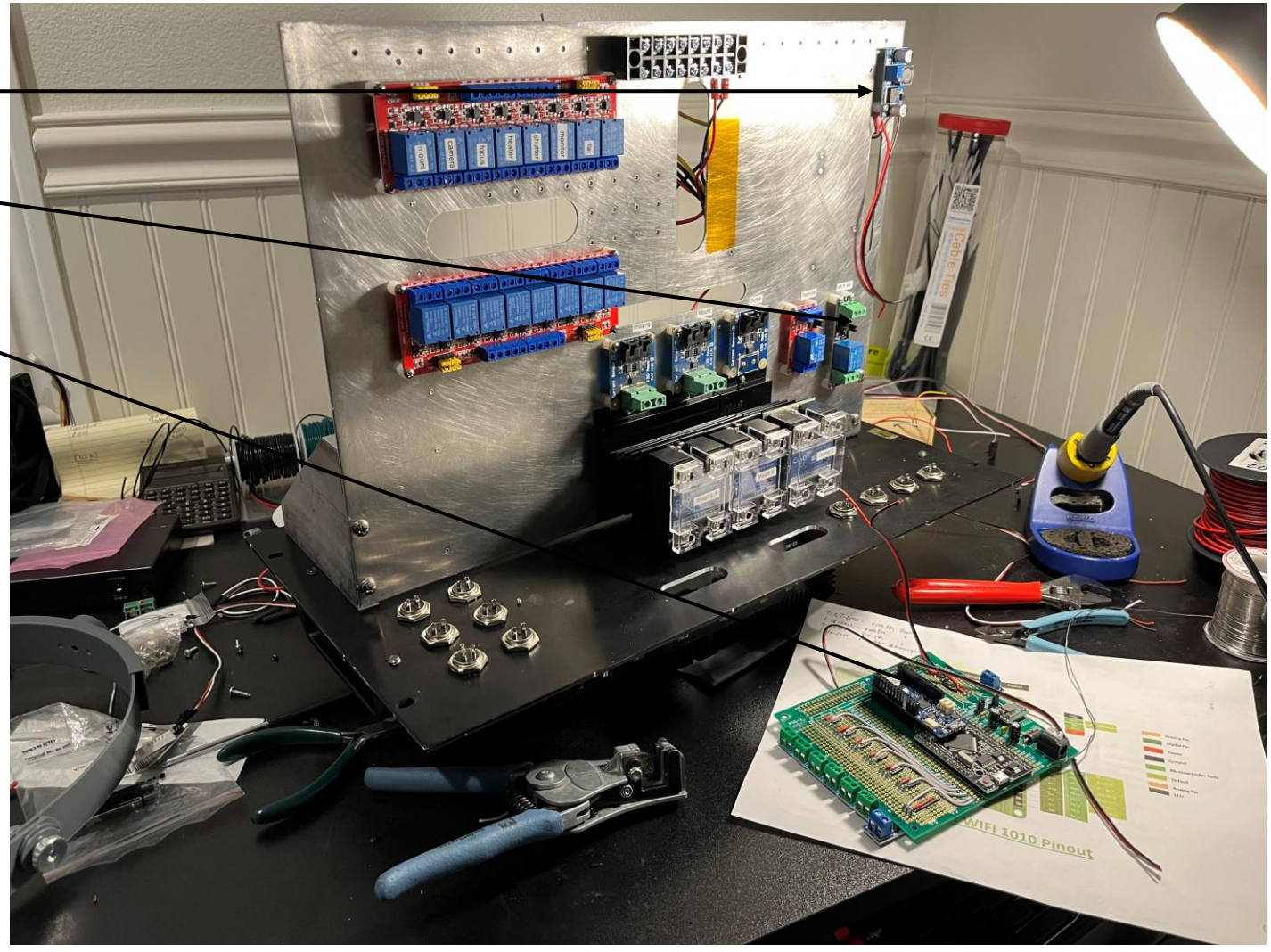




Let the Wiring Begin

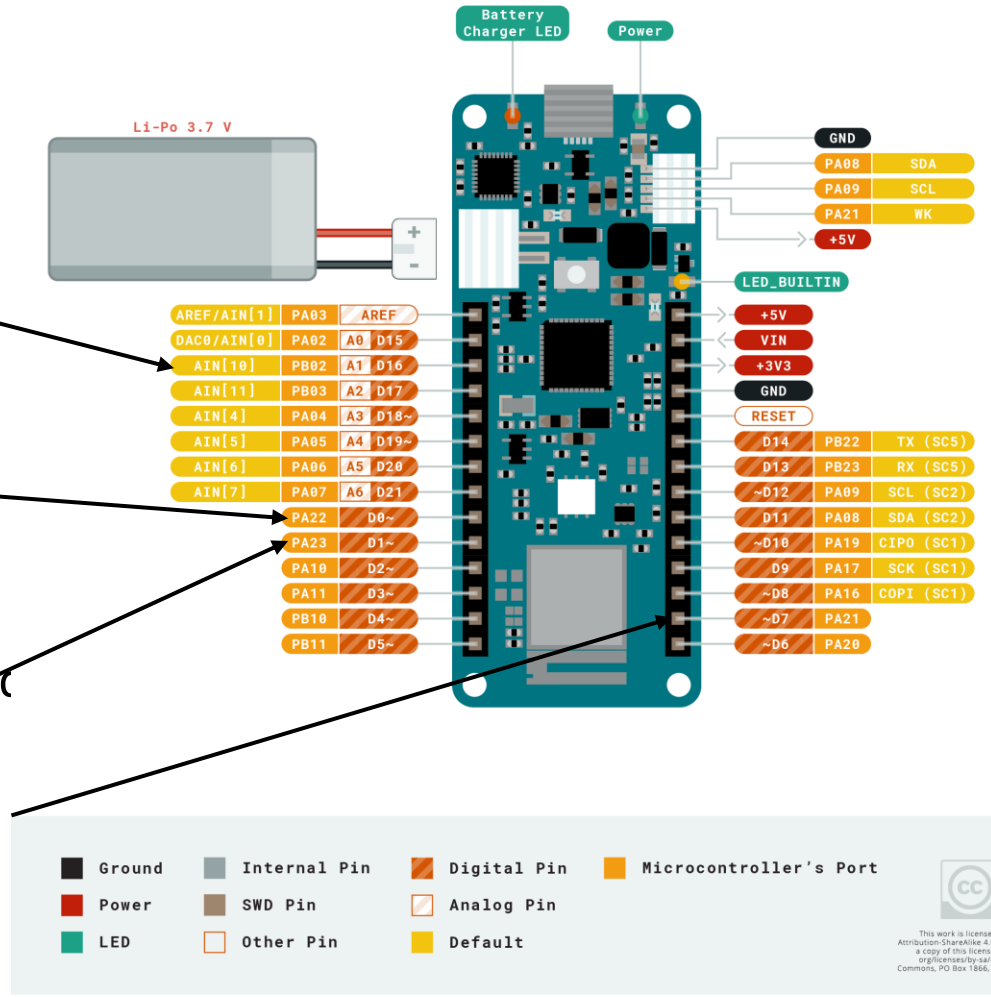
Wiring the “Always On” WIFI Remote Relay

- Buck 3.3V power supply
- 3.3Volt relay
- MKR 1010 WIFI



MKR1010 WIFI-LAN Remote Control

- Runs continually from 12Volt LiFePO4 battery bank
- Analog A1– Battery Voltage reading
  - analogRead(A1);
- Digital 0– DHT22 Dome Temperature and Humidity
  - DHTStable.h
  - DHTStable;
  - #define
  - float t=dht.getTemperature();
  - float H = dht.getHumidity();
- Digital 1– DHT22 Dome Control Room Temperature and Humidity.
- Digital 7– configured Hi-Low Operation for control of a 3.3 volt relay for system remote control
  - pinMode(7,OUTPUT);
  - digitalWrite(7,HIGH); , digitalWrite(7,LOW);



WIFI Disconnect Issue Resolved

- Any glitch in WIFI from router will disconnect the MKR1010 WIFI making control impossible
- Code added to the Arduino loop to resolve the issue 20230724.

```
 if (!wifiBegun) {
    WiFi.begin(ssid, pass);
    delay(1000); // acceptable freeze for this
 if (WiFi.status() == WL_CONNECTED) {
      wifiBegun = true;
  server.begin();                         // start the web server on port 80

    } else {
      WiFi.end();
    }
  } else if (wifiBegun && WiFi.status() != WL_CONNECTED) {
    WiFi.end();
    wifiBegun = false;
  }
```

Digital Read-Write Temp-Humidity Sensor

MKR1010 WIFI

Digital Read Pin:

- D0: DHT22 Dome Temp-Humid Sensor
- D1: DHT22 Control Room Temp-Humid Sensor

- A1 Voltage ADC

Digital Write Pin:

- D7: 3.3 volt relay for WIFI remote control

Computer Failed Replaced with

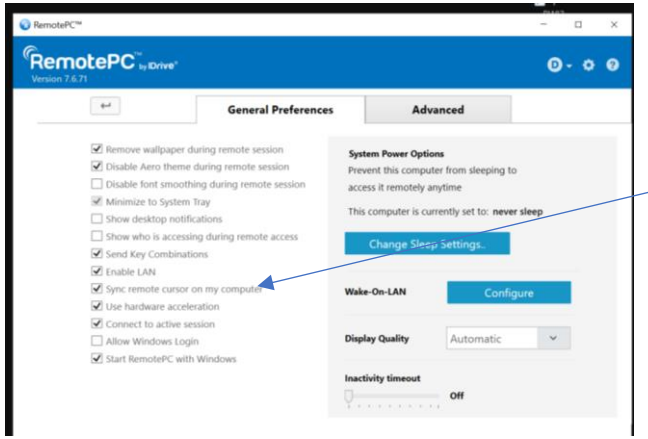
KINGDEL Fanless Industrial Computer, Mini PC, Intel i7 8th Gen. CPU with Window 11 Pro, 16GB RAM 512GB NVMe SSD, 4xUSB 3.0, HD Port, VGA, 2xCOM RS232, Metal Case

Replaced the drive with the one from the failed computer

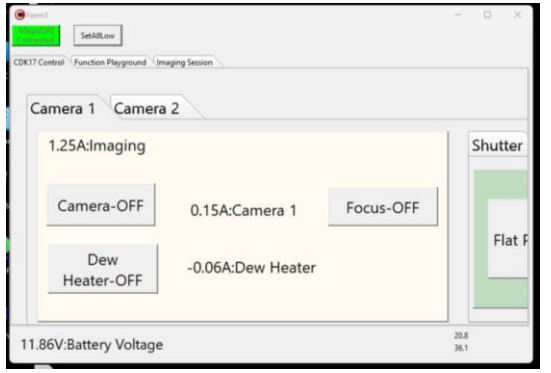
Replaced the memory with the one from the failed one NO ISSUES BRINGING IT UP!

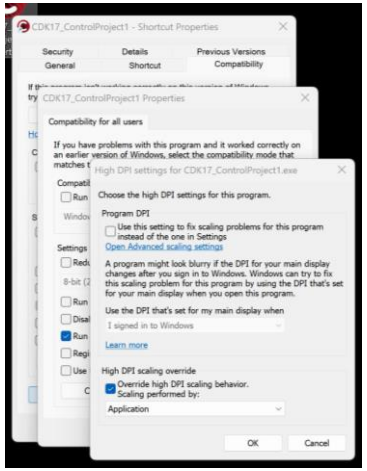
Software Issues:

1) RemotePC wouldn't work without a mouse
2) Application zoom issue



Check this box on the controlling computer





Relay Digital Control

Mega 2560

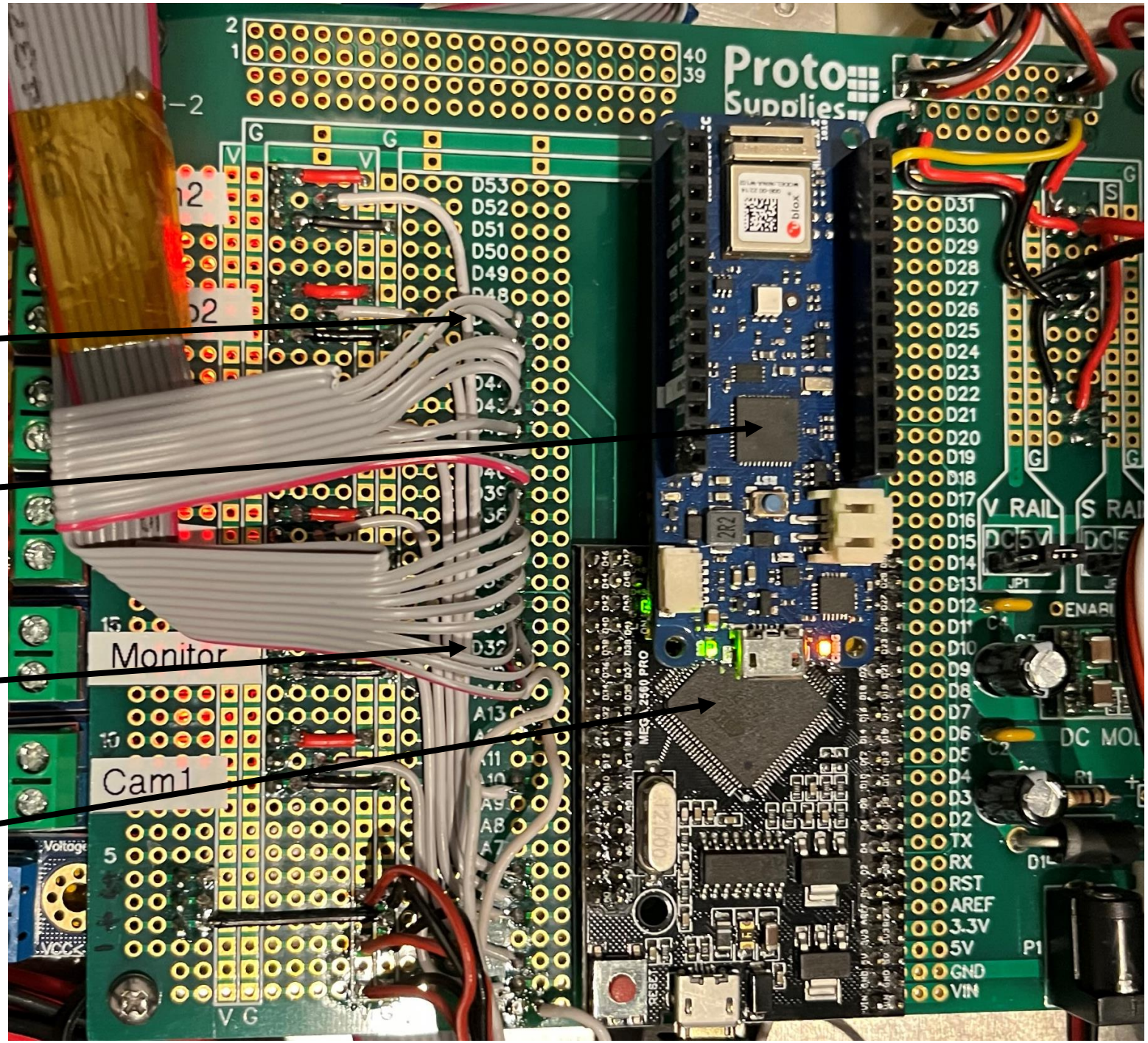
Ends at D47

Arduino MKR1010 WIFI

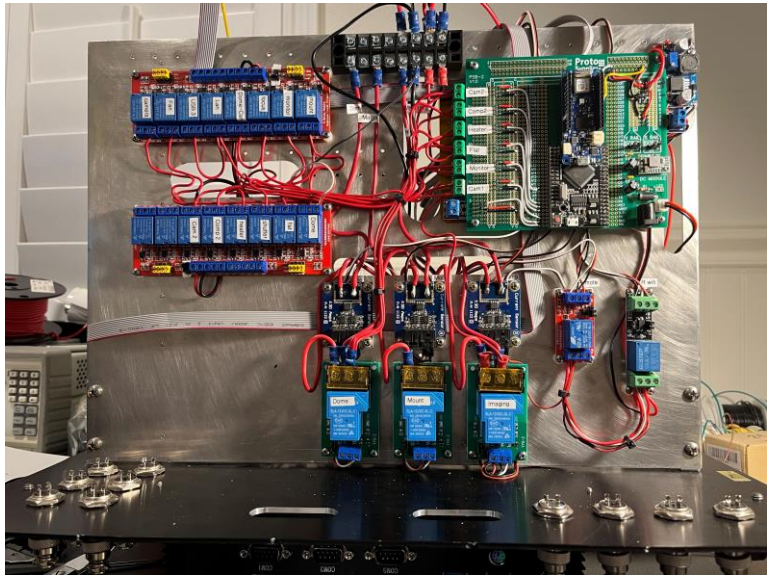
Starts at D32

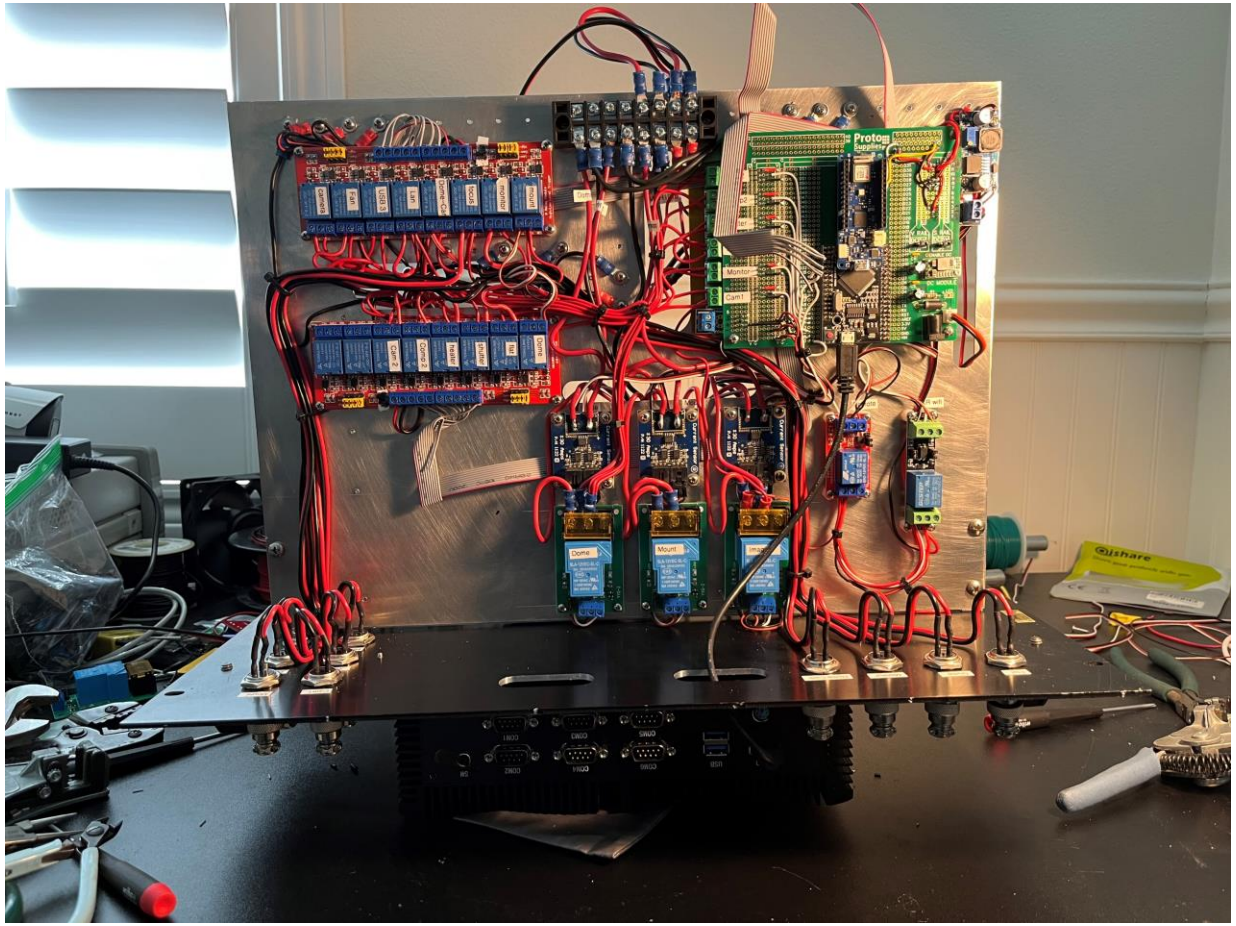
Arduino Mega2560

Test of the ADC inputs indicates no cross talk and all functioning normaly



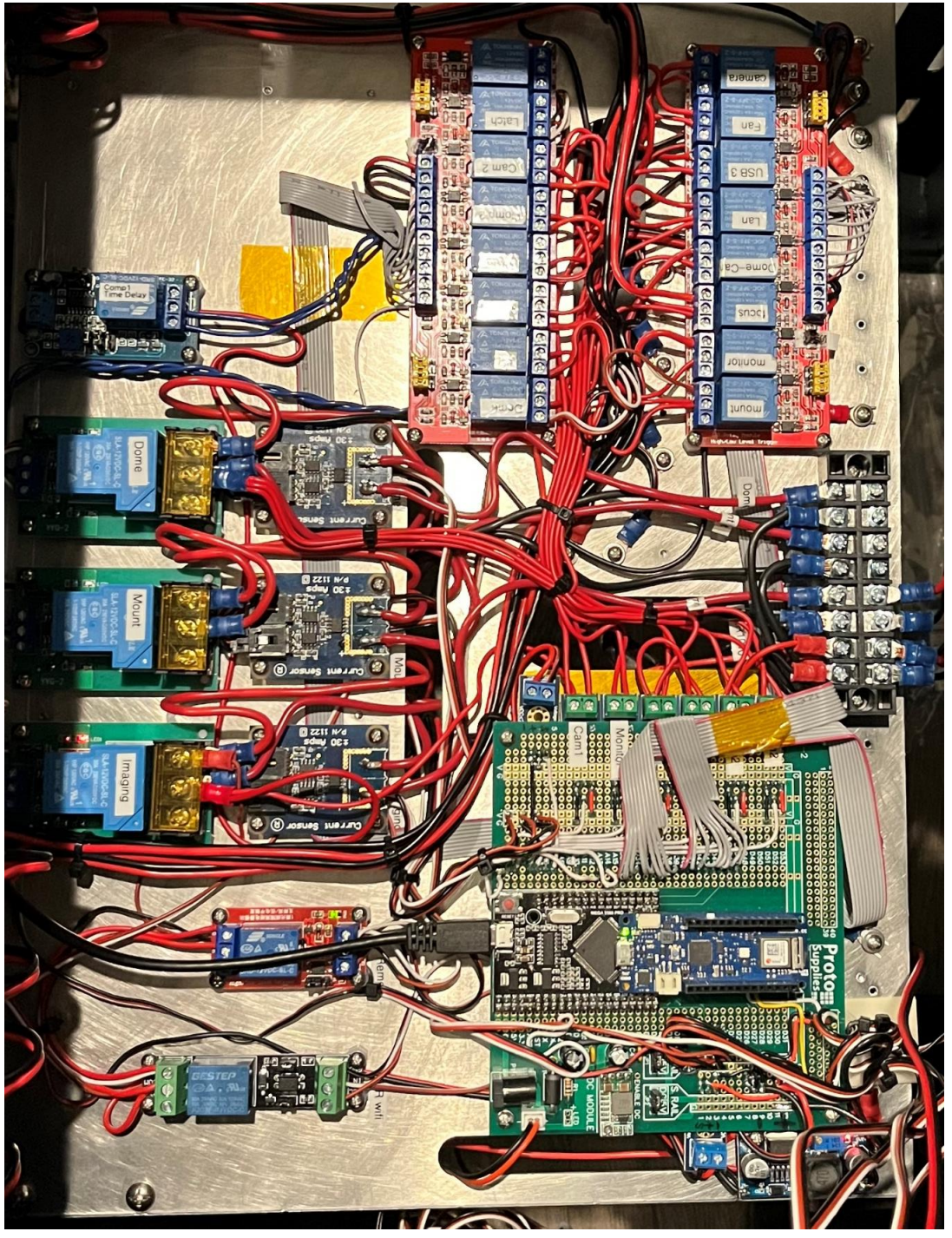
Wiring Nearly Complete





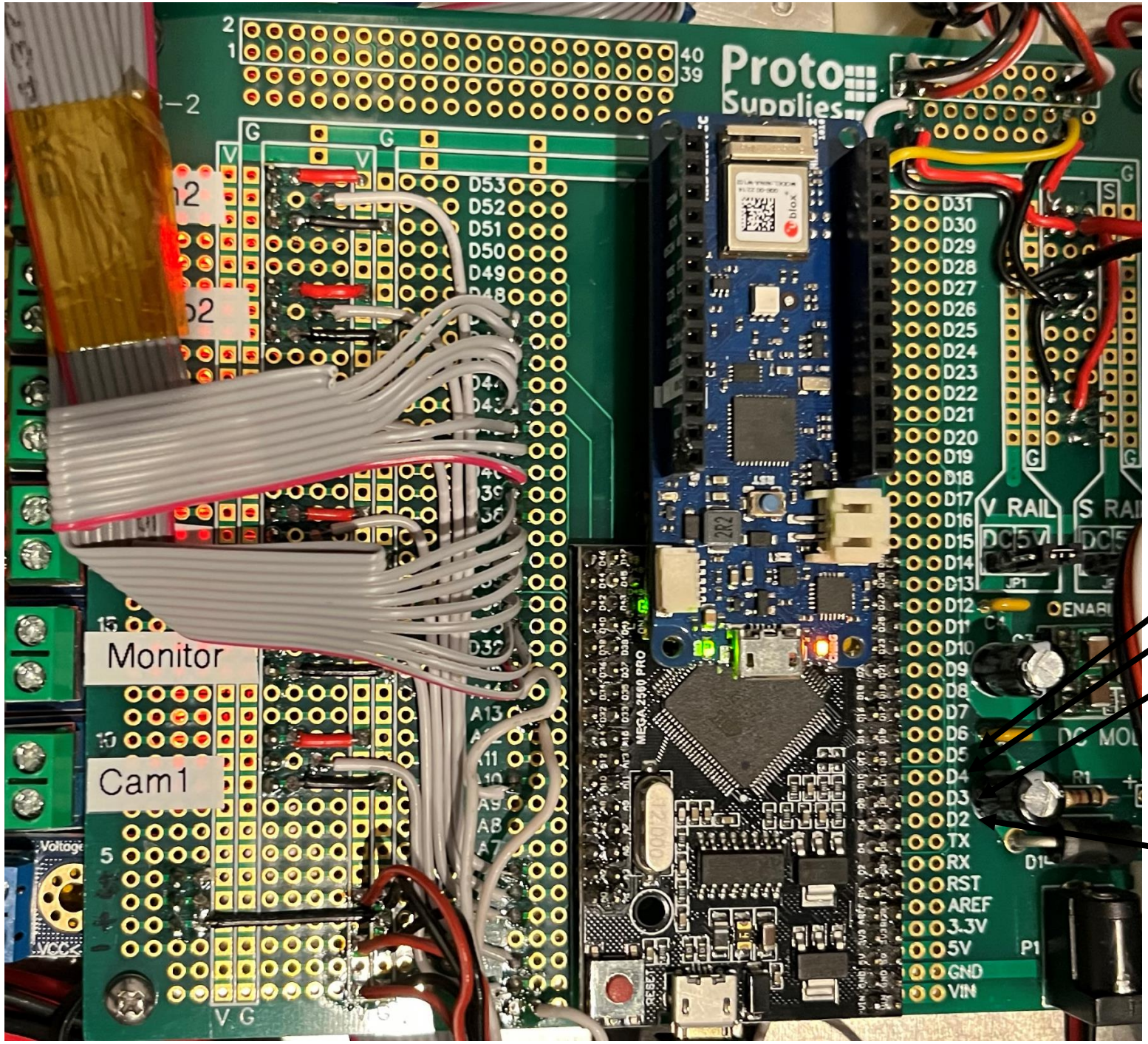
Relay Addressing

D32 Mount	index 0	Relay 1
D33 Monitor	index 1	Relay 2
D34 Focus	index 2	Relay 3
D35 DomeCam	index 3	Relay 4
D36 Lan	index 4	Relay 5
D37 USB3	index 5	Relay 6
D38 Fan	index 6	Relay 7
D39 Camera	index 7	Relay 8
D47 Dome	index 15	Relay 16
D46 Flat	index 14	Relay 15
D45 Shutter	index 13	Relay 14
D44 Heater	index 12	Relay 13
D43 Comp2	index 11	Relay 12
D42 Camera2	index 10	Relay 11
D41 Latch	index 9	Relay 10
D40 No Function	Index 8	Relay 9



Digital Input

Mega 2560



D5: DHT22 Control Room

D4: DHT22 Dome

D3: DHT22 Computer

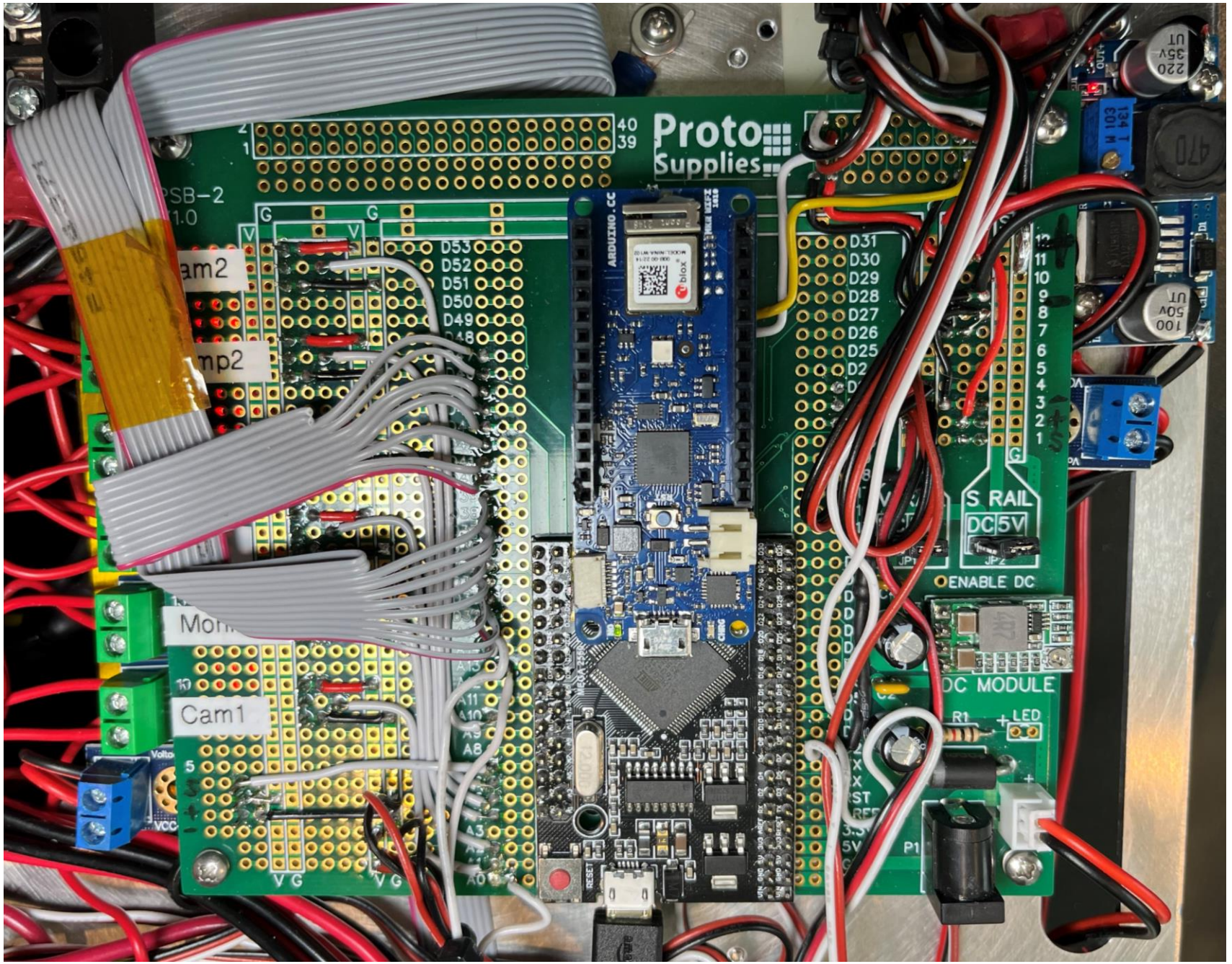
D2: “Local Use Mode”
Turns ON:
Latch: Relay 10
Monitor: Relay 2

ADC Current and Voltage Sensors

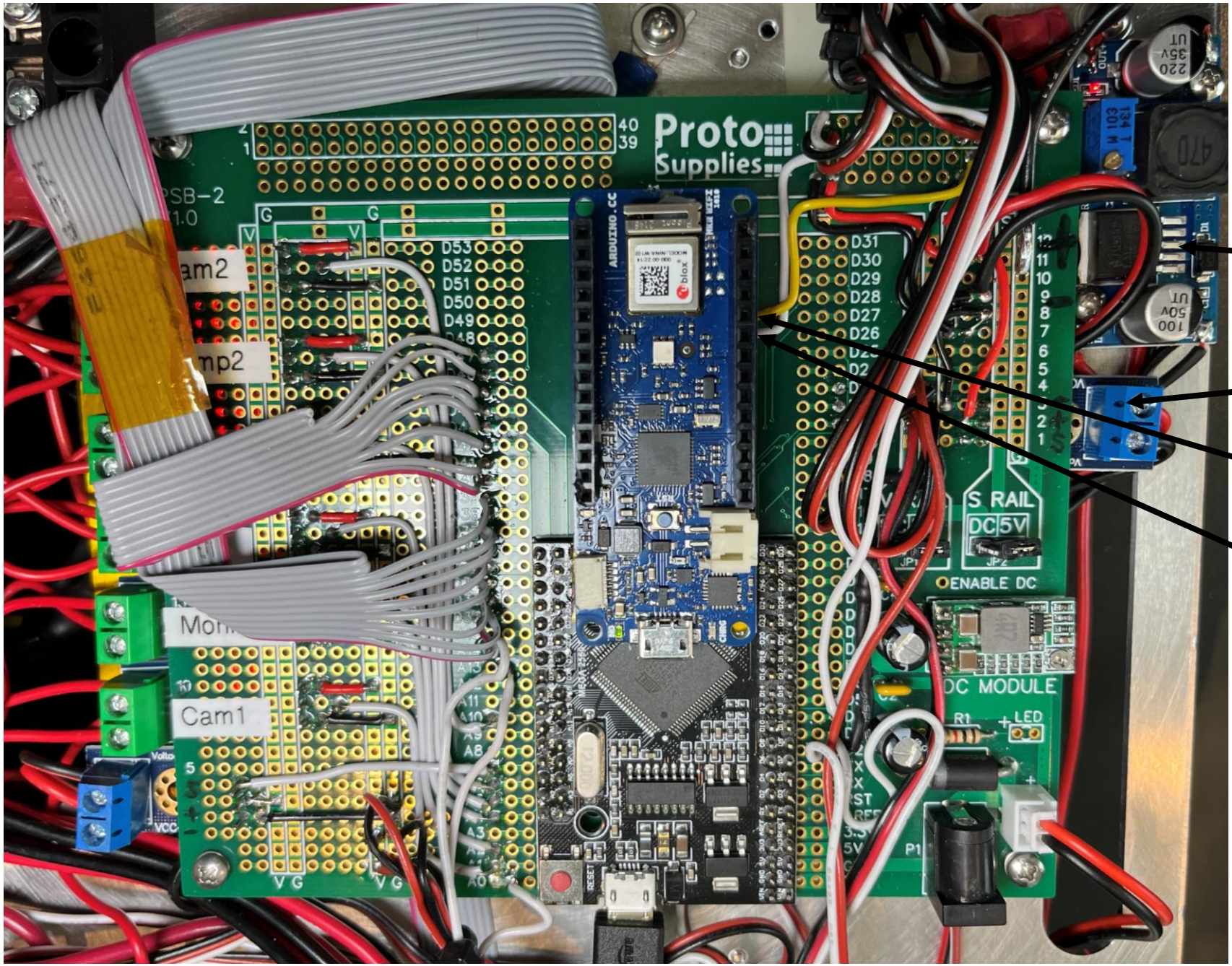
Mega 2560

Pins:

- 0-A0: Imaging 30Amp Sensor
- 1-A1: Camera1 10 Amp Sensor
- 2-A2: Monitor 5 Amp Sensor
- A3: NC
- 3-A4: Flat 5 Amp Sensor
- 4-A5: Dew Heater 5 Amp Sensor
- 5-A6: Computer 2 5 Amp Sensor
- 9-A7: Battery Volts Sensor
- A8: NC
- A9: NC
- 6-A10: Camera 2 5 Amp Sensor
- A11: NC
- A12: NC
- 7-A13: Mount 30Amp Sensor
- 8- A14: Dome 30Amp Sensor
- A15: NC



MKR 1010 WIFI Bat Volts, Temp-Humidity



3.3Volt Power Supply
“Always-ON”

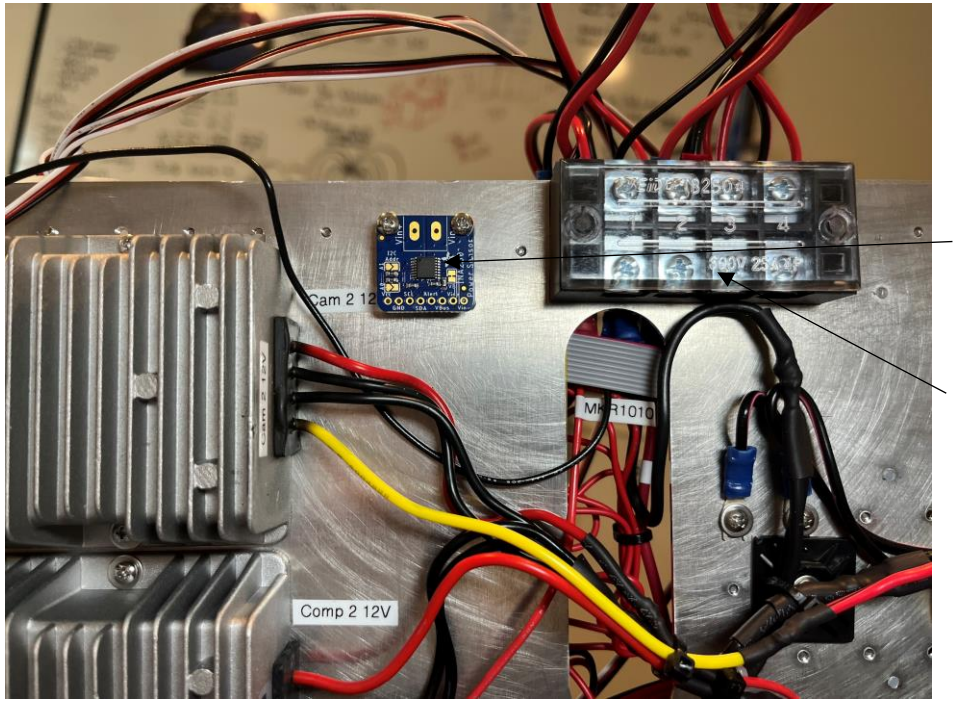
A1: Voltage Sensor
Battery

D1: Control Room
Temp-Humidity sensor

D0: Dome
Temp-Humidity sensor

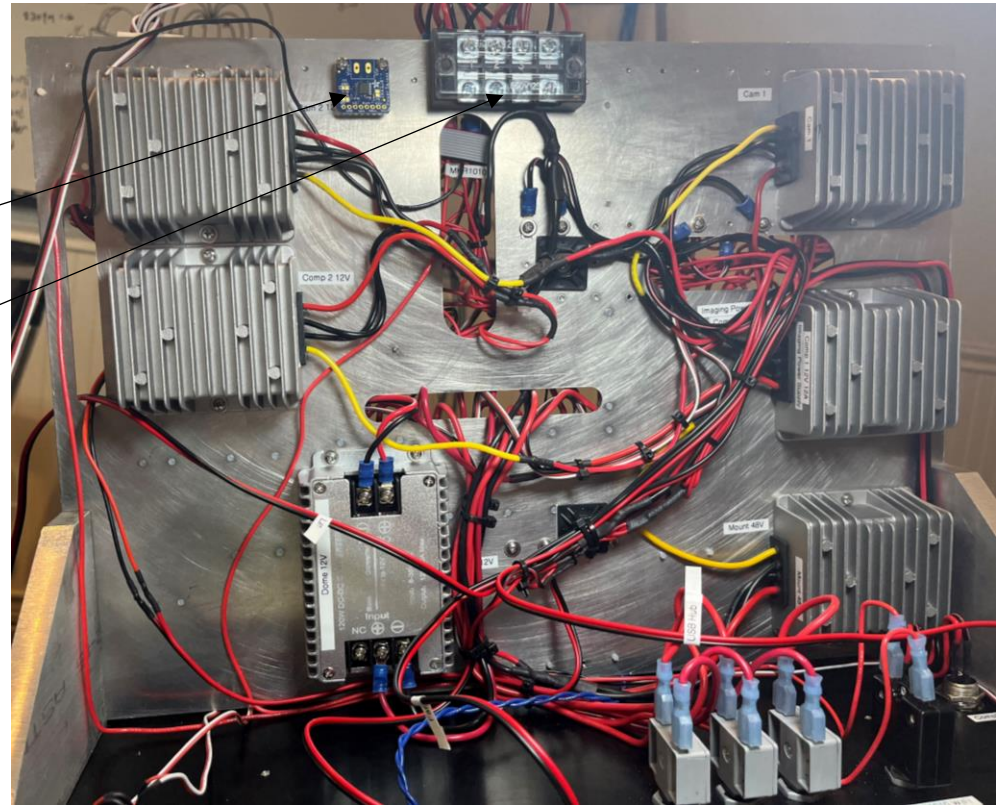
Battery Health Power Monitoring was not Accurate Enough
A result from March burn-in testing

- Use of simple ADC based components for voltage and current monitoring was not accurate enough for monitoring battery health. So an INA260 i2c power monitoring module was added. 3-11-2023 at the system input. 16bit values of milli-Watts power, milli-Amps current and milli-Volts voltage are reported by the module.



INA260 i2c Module

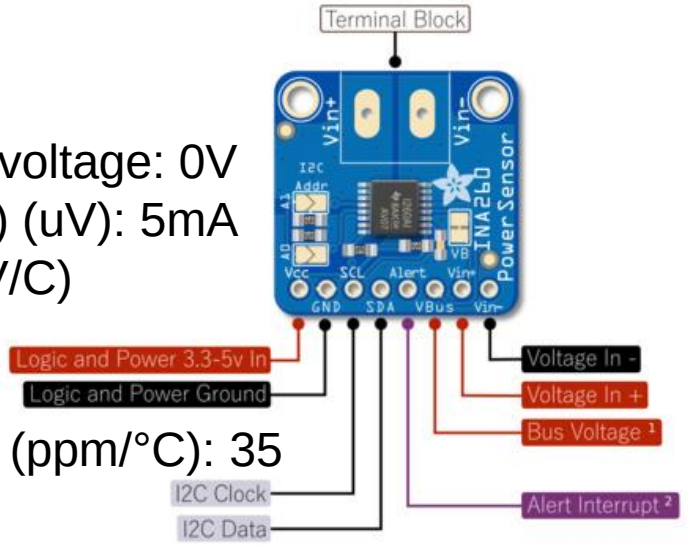
Terminal Block for
Power input added



1NA260 I2C Power Monitor

- Bi-directional
- Integrated Shunt
- Low-side Capable
- Precision Integrated Shunt Resistor:Current Sense Resistance: 2 mΩ
- Tolerance Equivalent to 0.1%
- 15-A Continuous From –40°C to +85°C
- 10 ppm/°C Temperature Coefficient (0°C to +125°C)
- Senses Bus Voltages From 0 V to 36 V
- High-Side or Low-Side Sensing
- Reports Current, Voltage, and Power
- High Accuracy:0.15% System Gain Error (Maximum)
- 5-mA Offset (Maximum)
- Configurable Averaging Options
- 16 Programmable Addresses

1NA260 Pinout



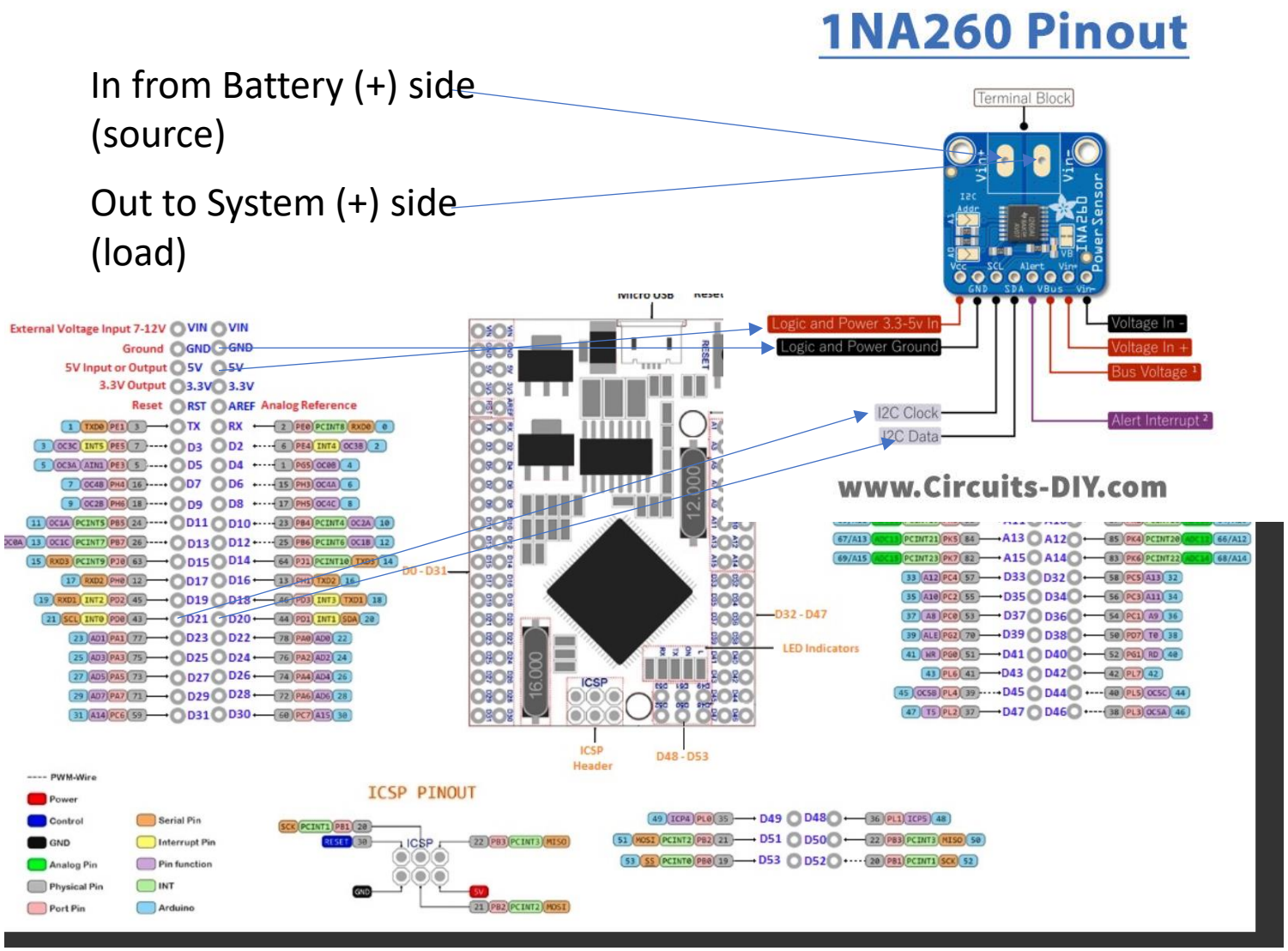
www.Circuits-DIY.com

- Minimum Common mode voltage: 0V
- Maximum Input offset (+/-) (uV): 5mA
- Input offset drift (+/-): 1(uV/C)
- Gain:1Gain
- Error: 0.15%
- Gain error drift (+/-) (Max) (ppm/°C): 35
- Minimum CMRR:126db
- Bandwidth: 3.5KHz
- Maximum Supply voltage: 5.5V
- Minimum Supply voltage:)2.7V
- Maximum Iq: 0.42mA
- Digital interface: I2C, SMS bus
- Resolution: 16bits
- Rating: Catalog
- Operating temperature range (C): -40 to 125

1NA260 I2C Power Monitor Hook-up and test sketch

In from Battery (+) side (source)

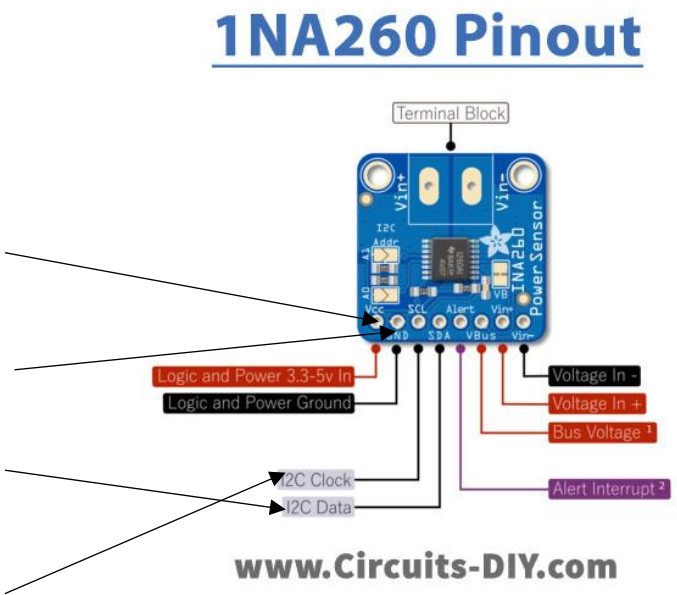
Out to System (+) side (load)




```
#include <Adafruit_INA260.h>

Adafruit_INA260 ina260 = Adafruit_INA260();

void setup() {
  Serial.begin(115200);
  // Wait until serial port is opened
  while (!Serial) { delay(10); }

  Serial.println("Adafruit INA260 Test");

  if (!ina260.begin()) {
    Serial.println("Couldn't find INA260 chip");
    while (1);
  }
  Serial.println("Found INA260 chip");
}

void loop() {
  Serial.print("Current: ");
  Serial.print(ina260.readCurrent());
  Serial.println(" mA");

  Serial.print("Bus Voltage: ");
  Serial.print(ina260.readBusVoltage());
  Serial.println(" mV");

  Serial.print("Power: ");
  Serial.print(ina260.readPower());
  Serial.println(" mW");

  Serial.println();
  delay(1000);
}
```

INA260 Power Monitor Wiring

- Red +5 Volts Vcc Mega2560 +5Volts
- Black Ground Mega2560 Ground
- Yellow Data Line Mega2560 pin 20
- Blue Clock Mega2560 pin 21



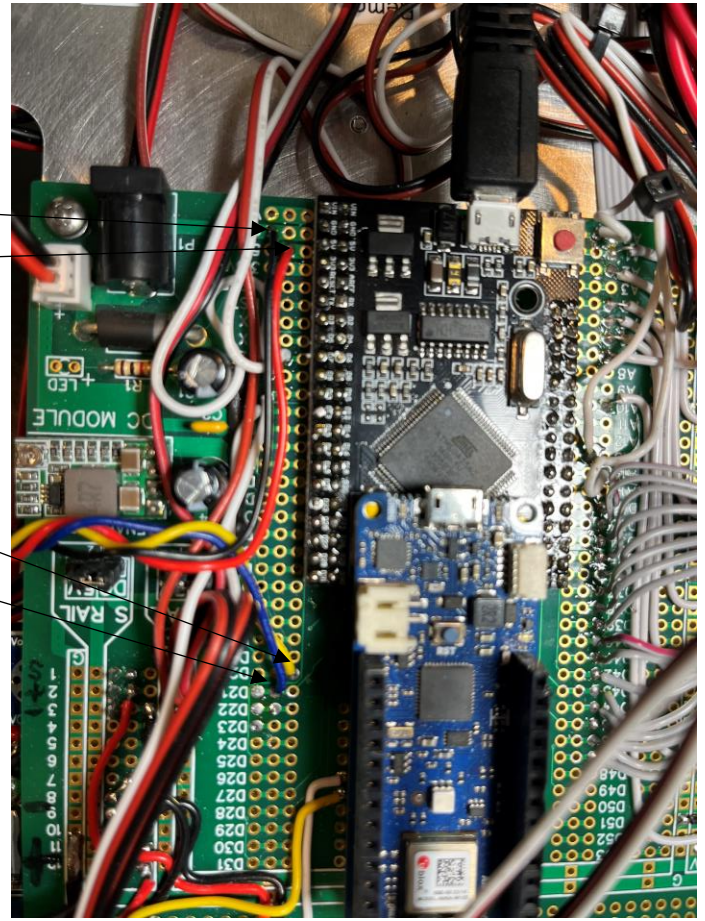
Mega 2560 I2C INA260 Wiring

Ground Connection

+5Volt Connection

INA260 i2c Data Yellow D20

INA260 i2c Clock Blue D21



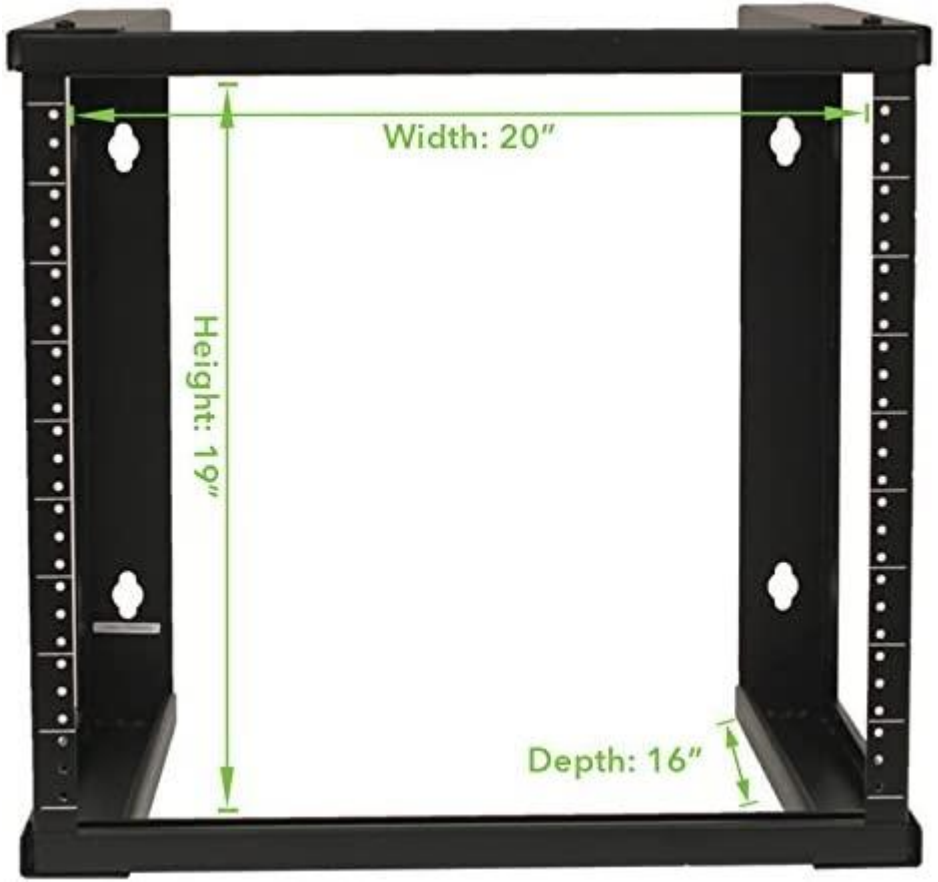
48 Volt power—Taurus 400 Fork Mount

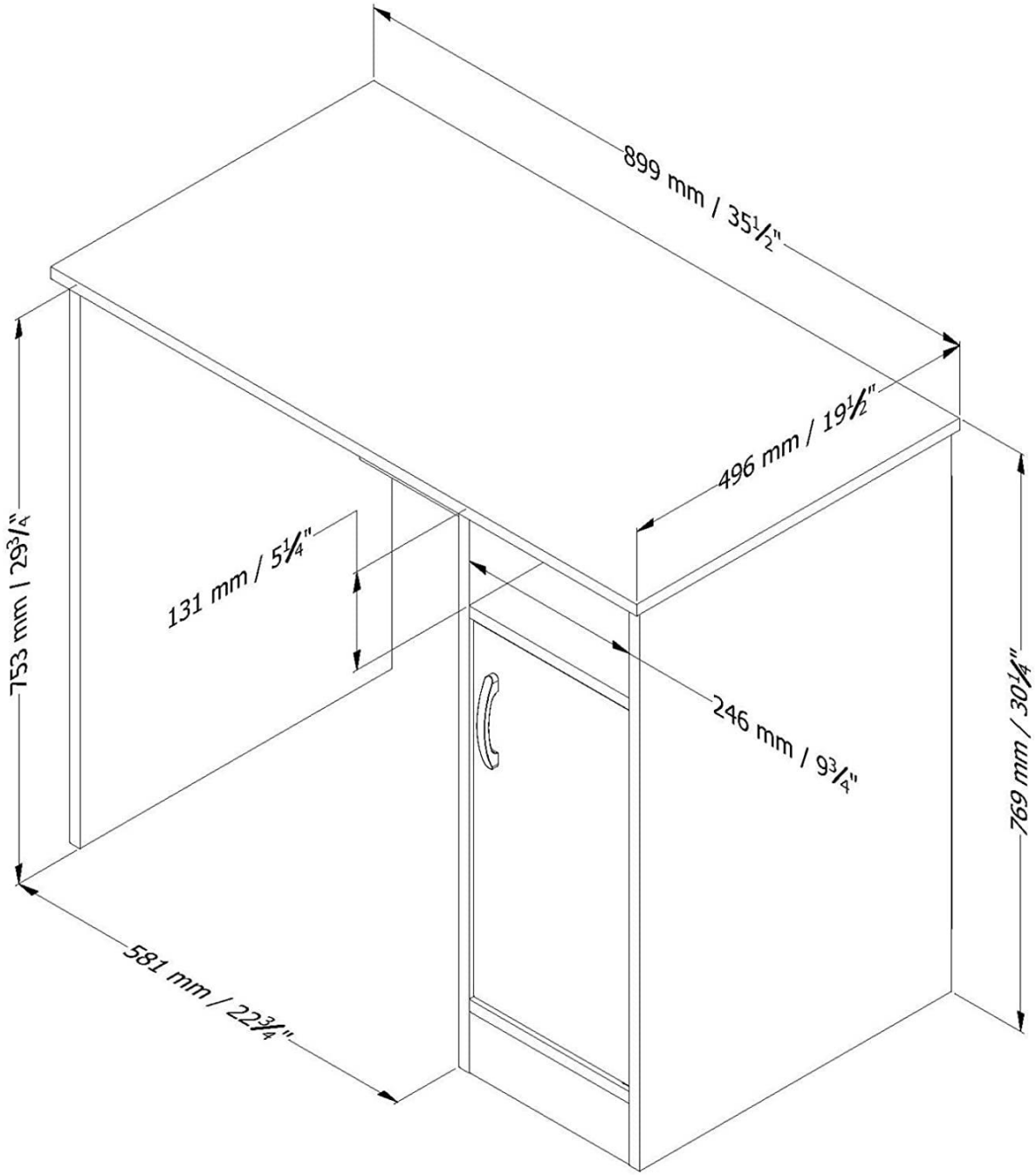
5.5mmod-2.5mm id Connector

Operational Measurements

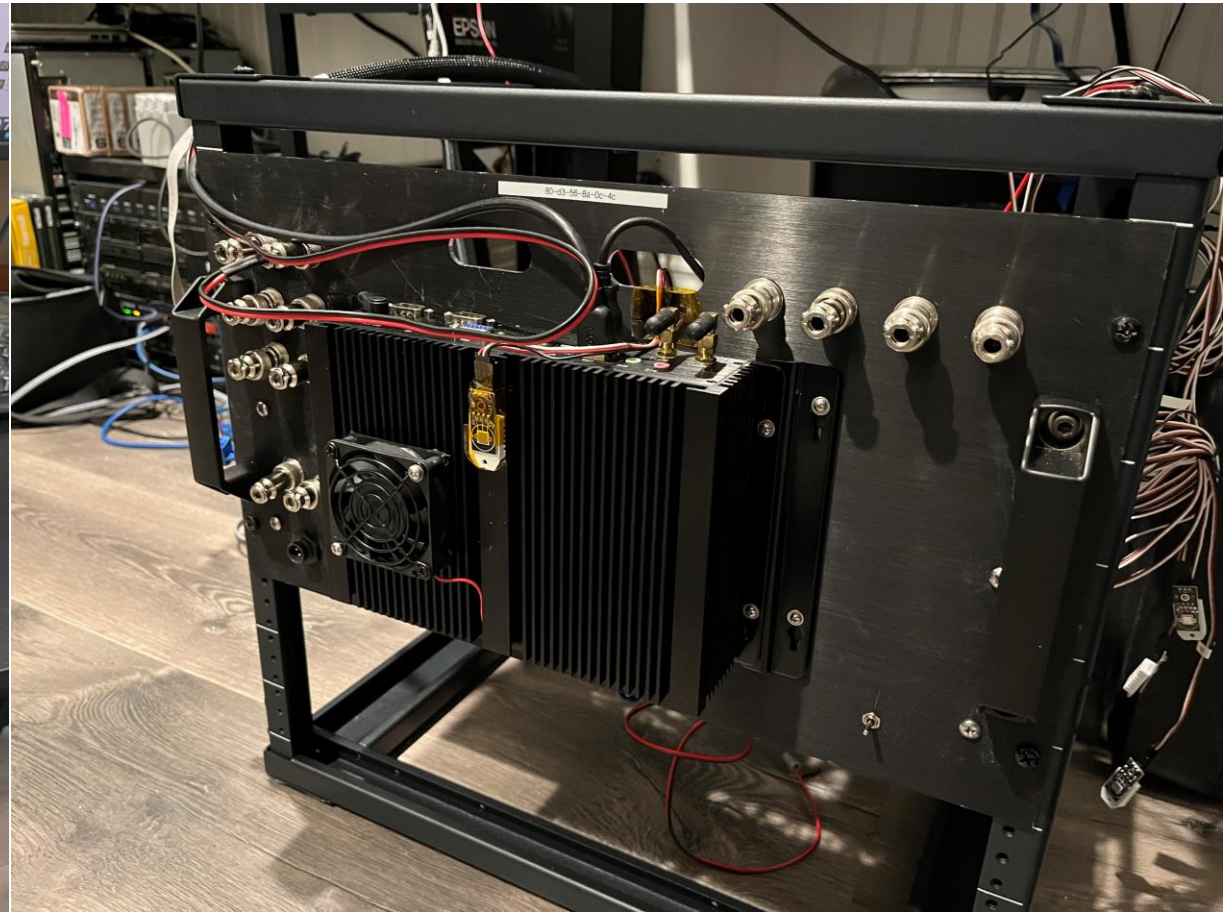
- 13.8 Volts input simulating the LiFePO4 batteries
  - 0.038Amps….MKR1010 WIFI running alone
  - Computer remote start 2.4Amps peak.. 0.63Amps running

9U-Rack and Small Desk

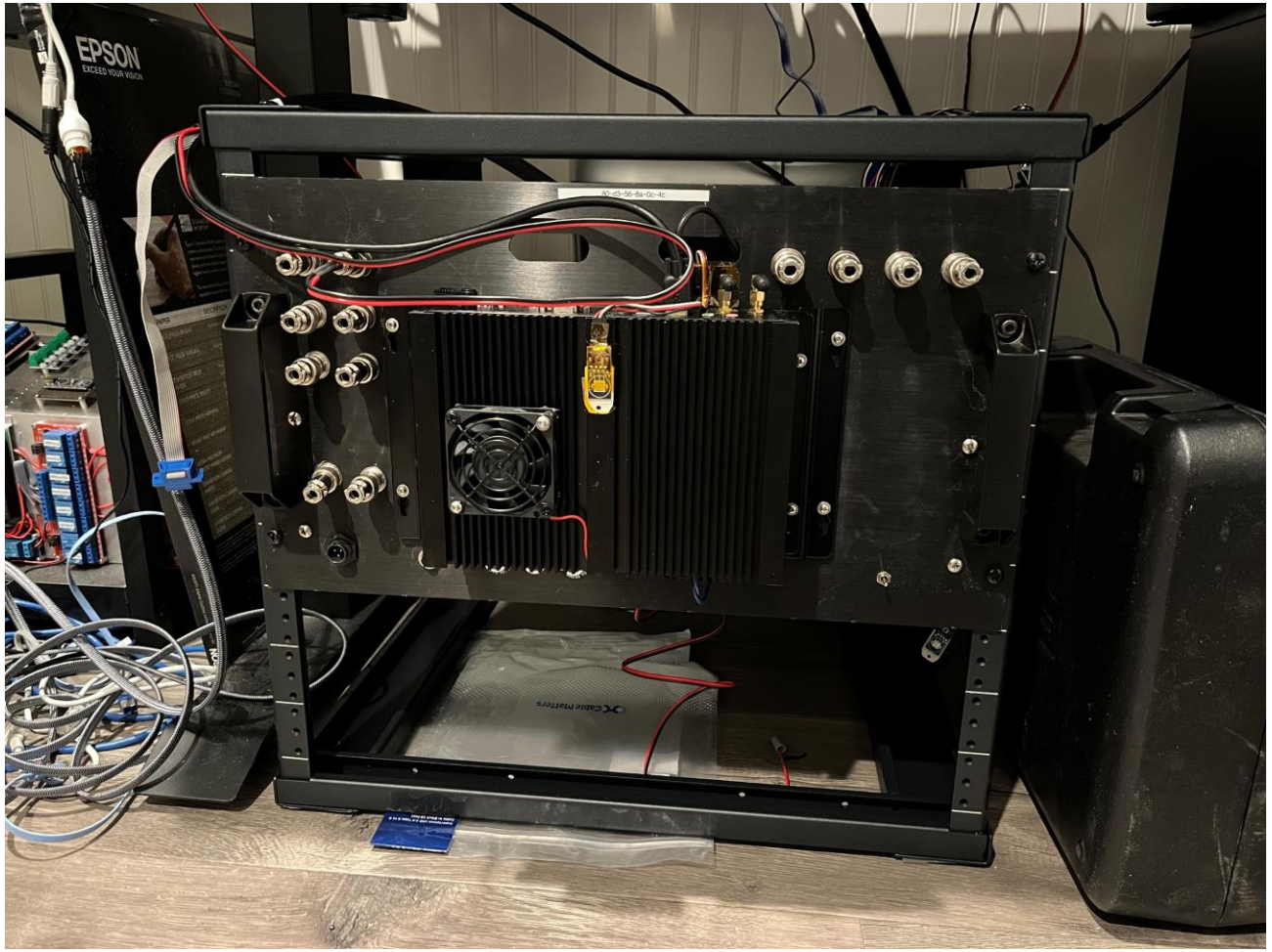


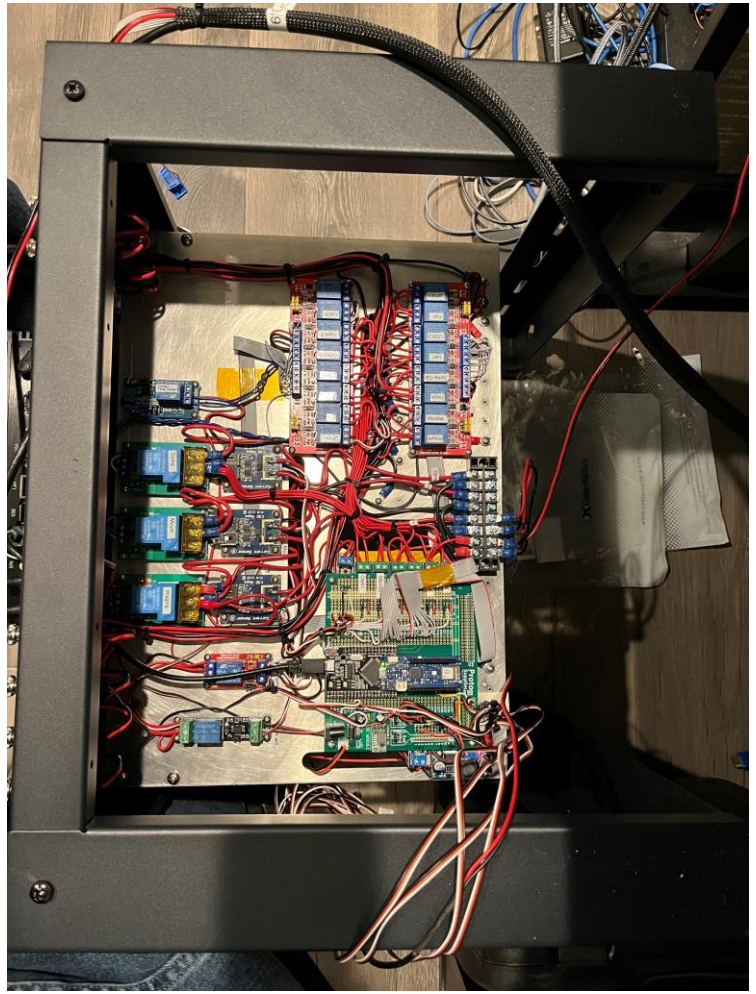


Computer Automatic Cooling

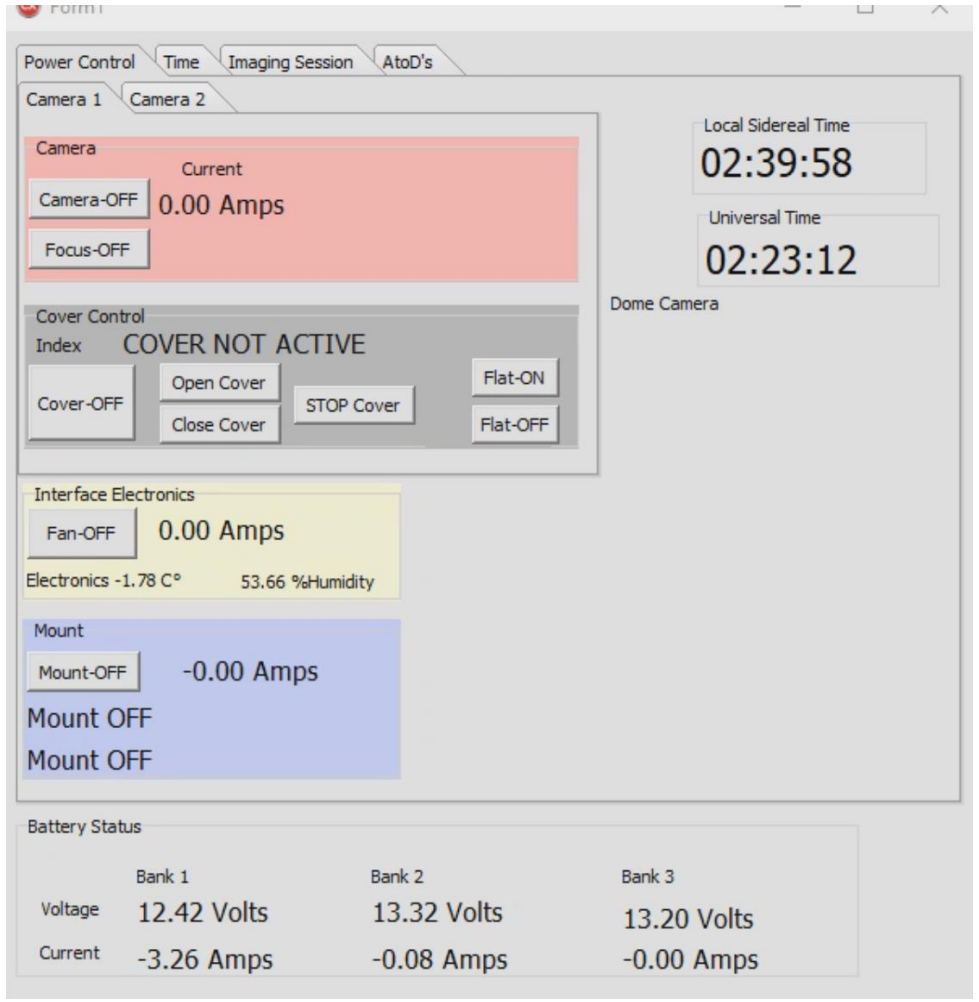


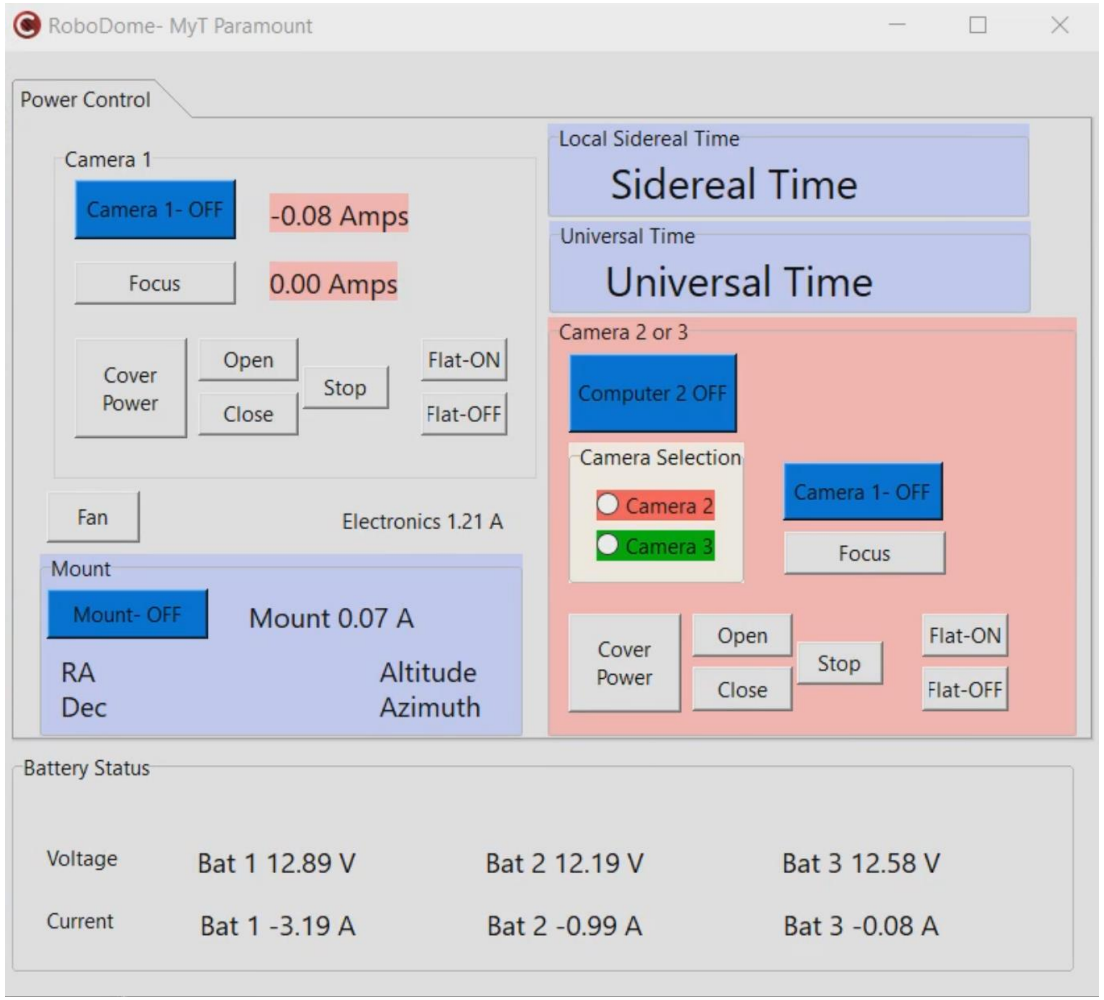
System in the Rack



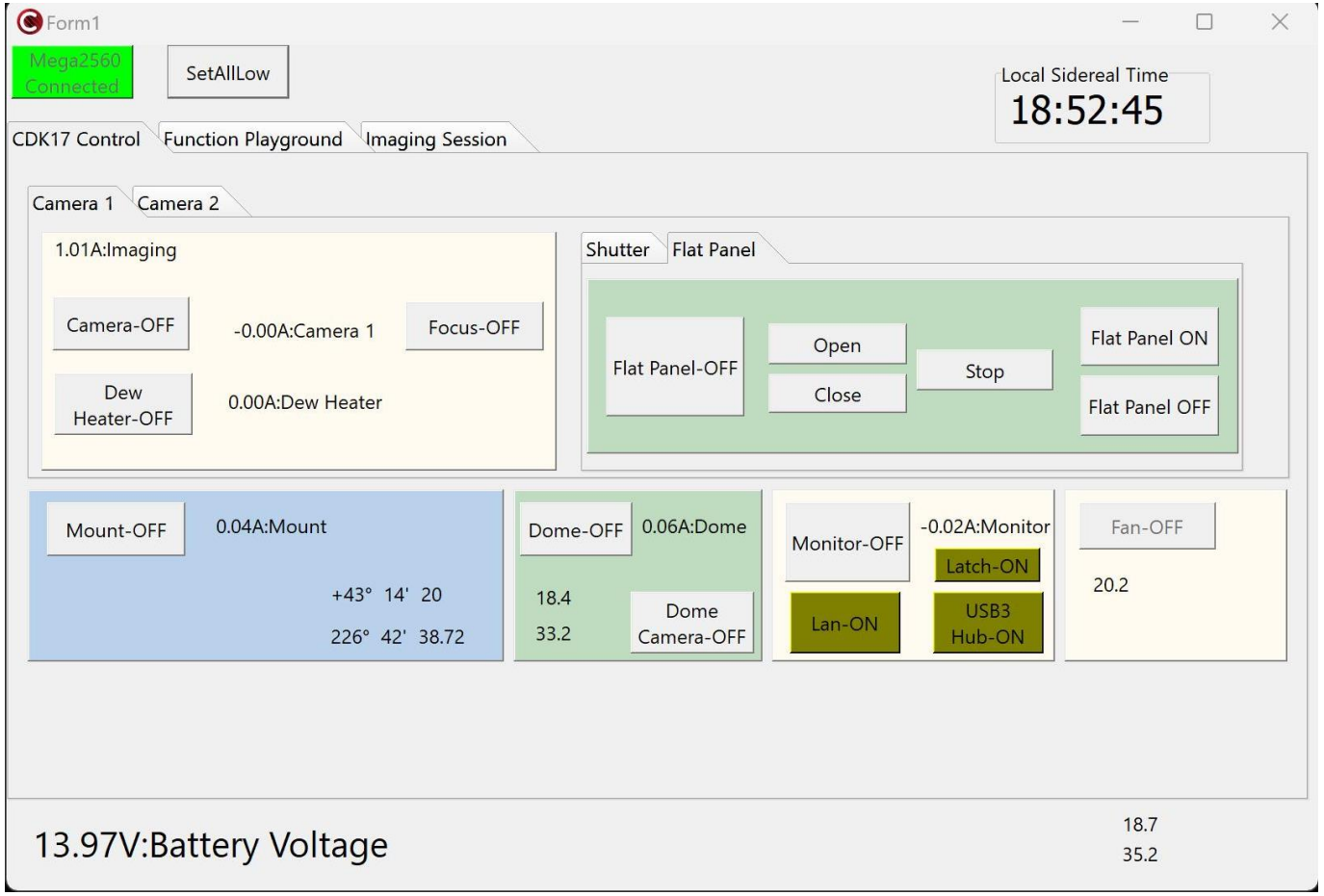


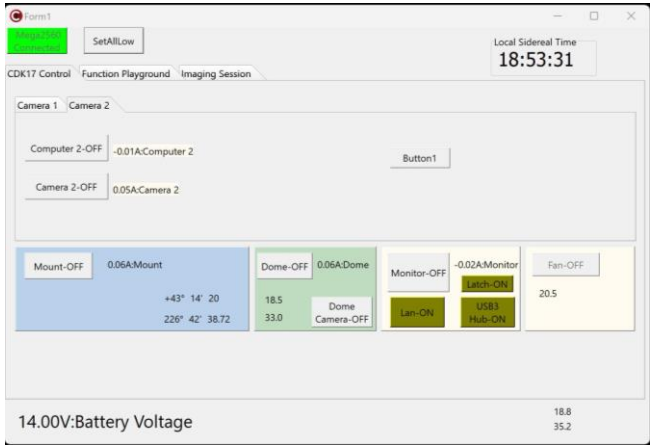
6’Dome and Robodome Control Interfaces

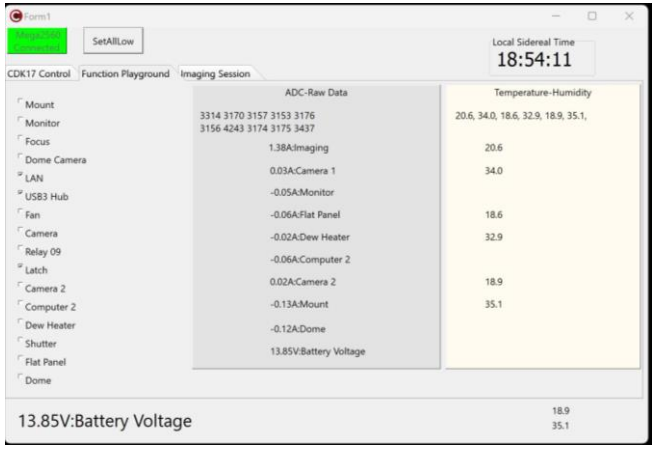


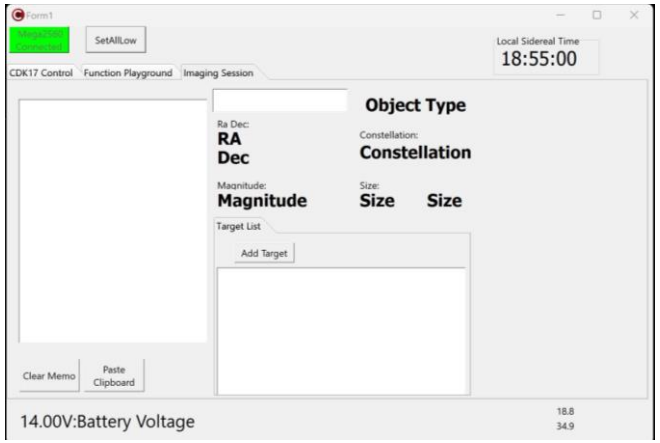


10’ Dome Control Interface Initial Implementation

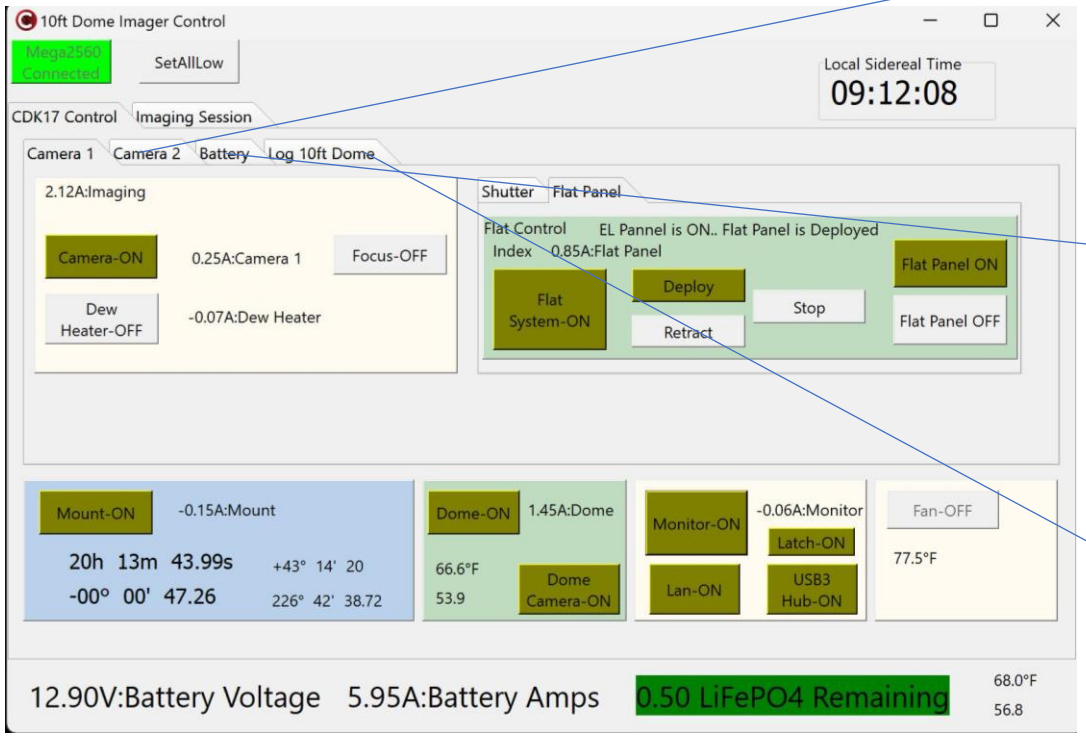


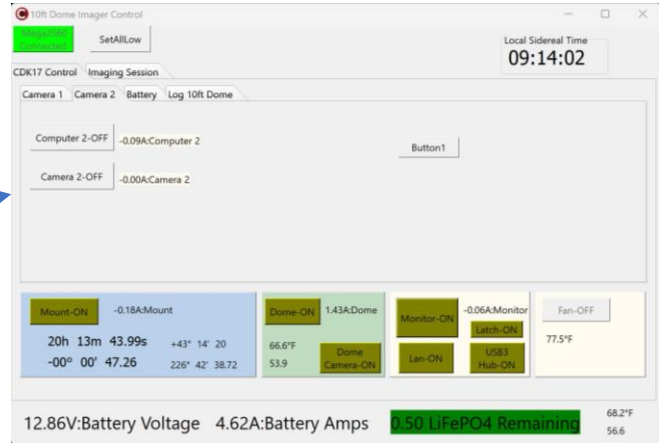


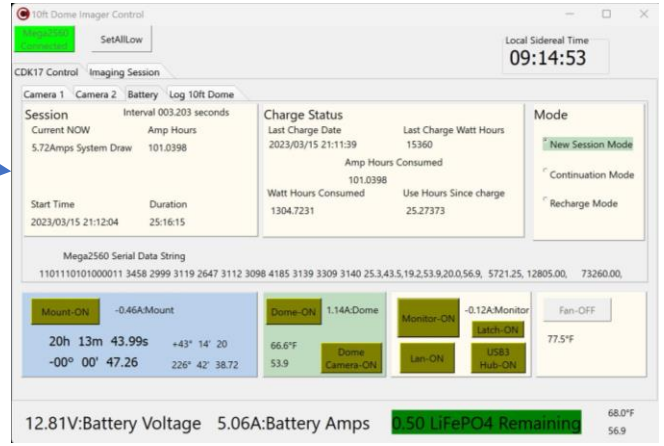


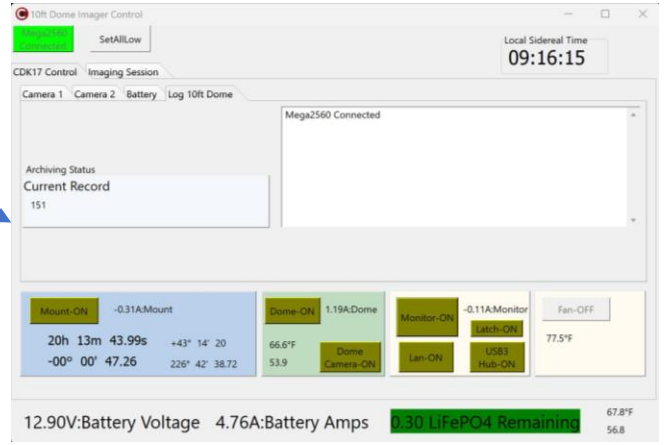


10’ Dome Control Interface Final Implementation

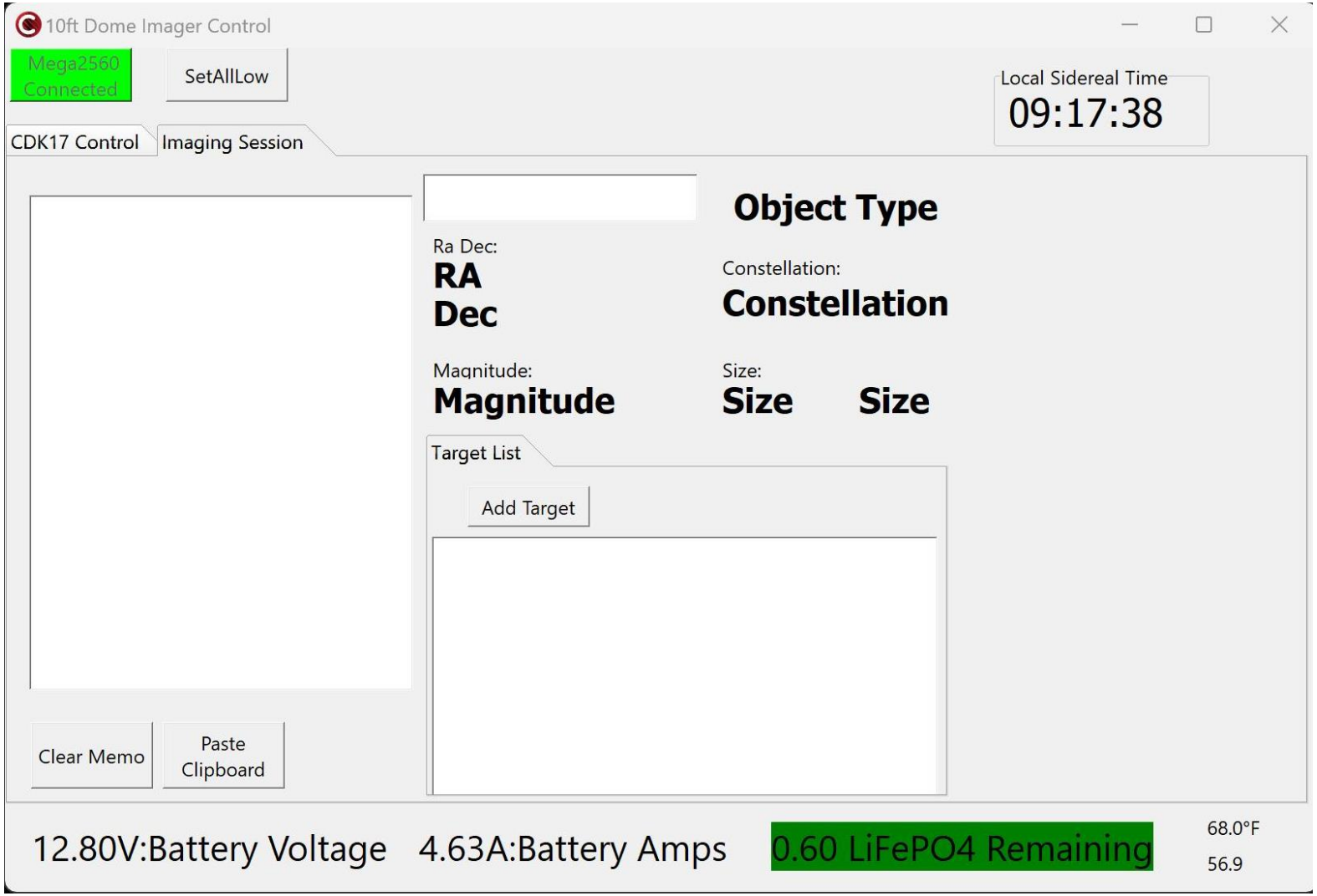




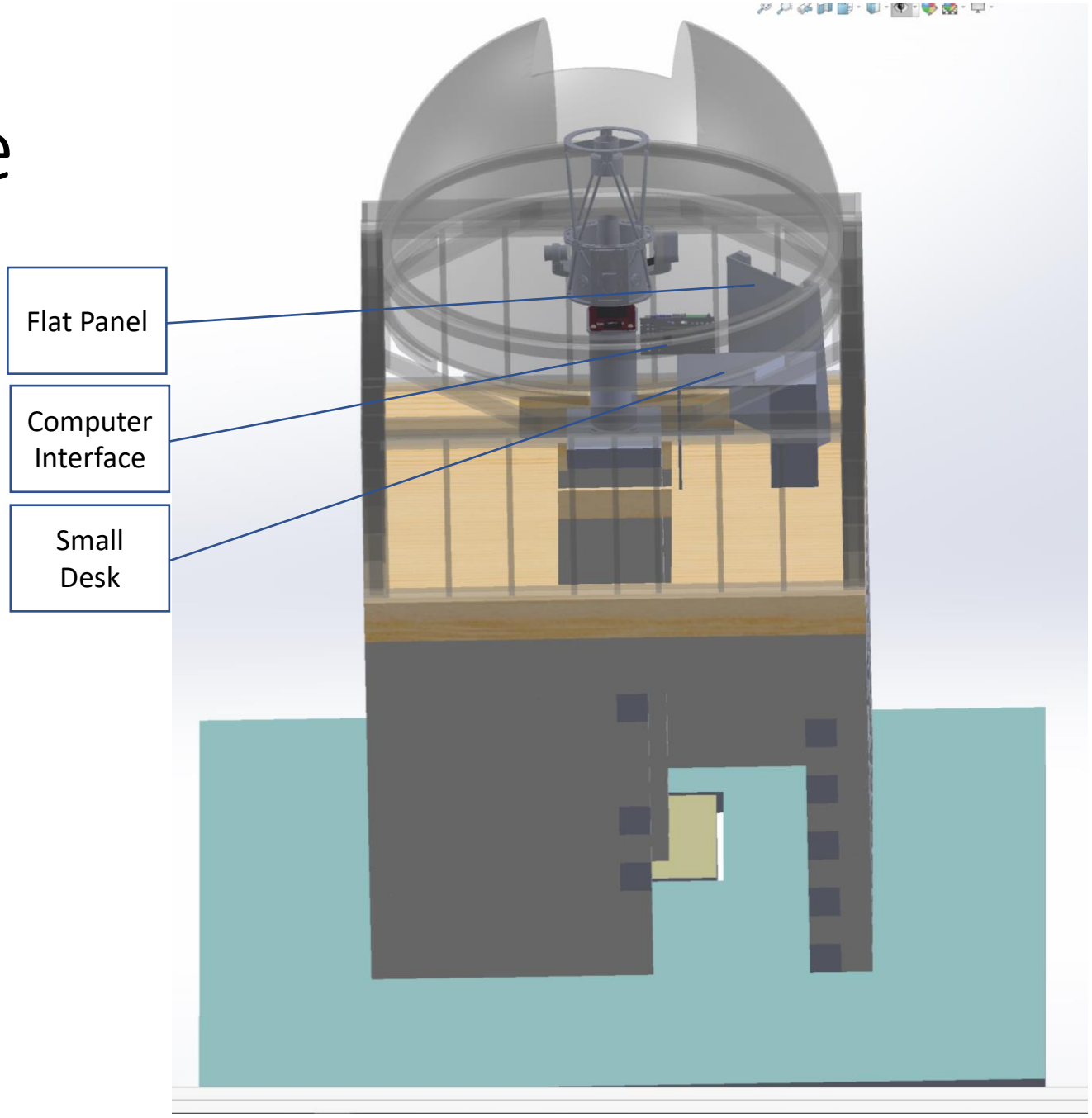




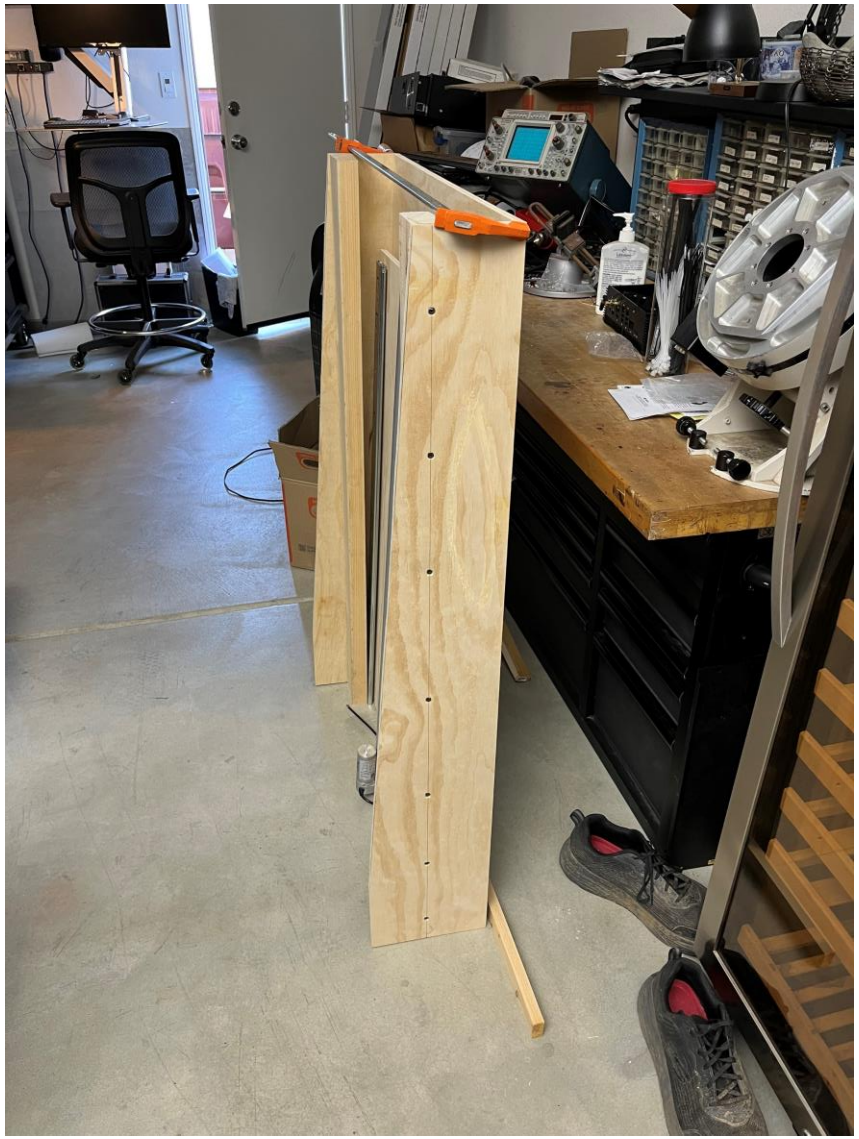
10’ Dome Control Interface Final Implementation

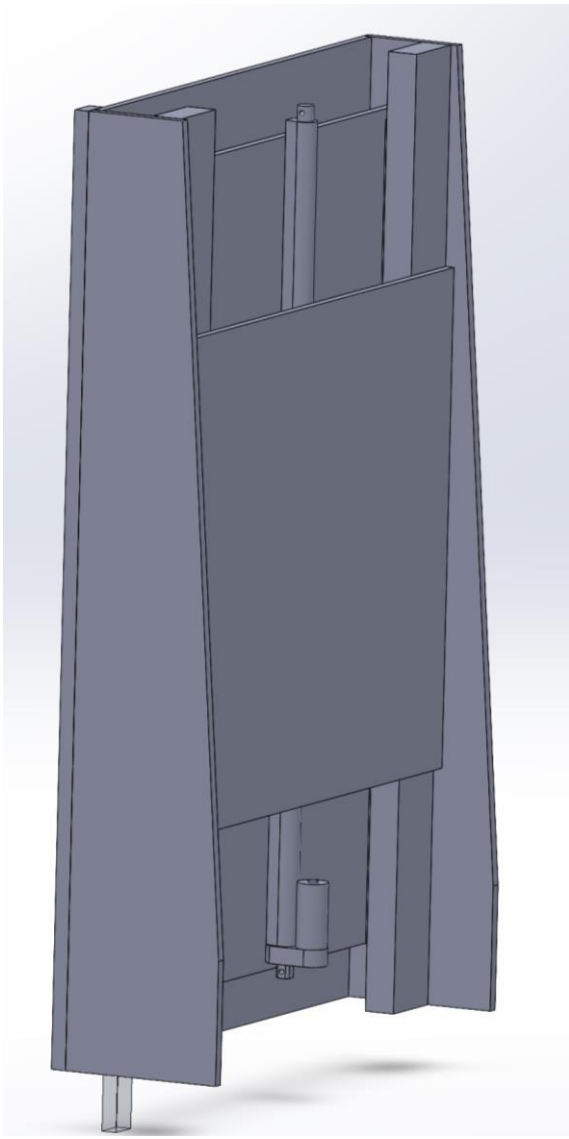


Positions in the Dome



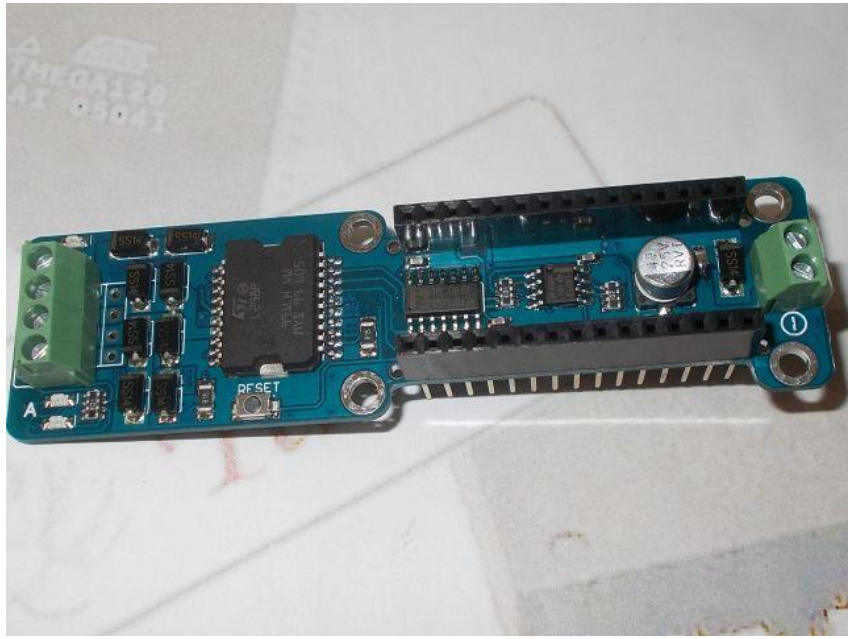
24”X36” EL-Flat Panel Construction CDK17 2-7-2023



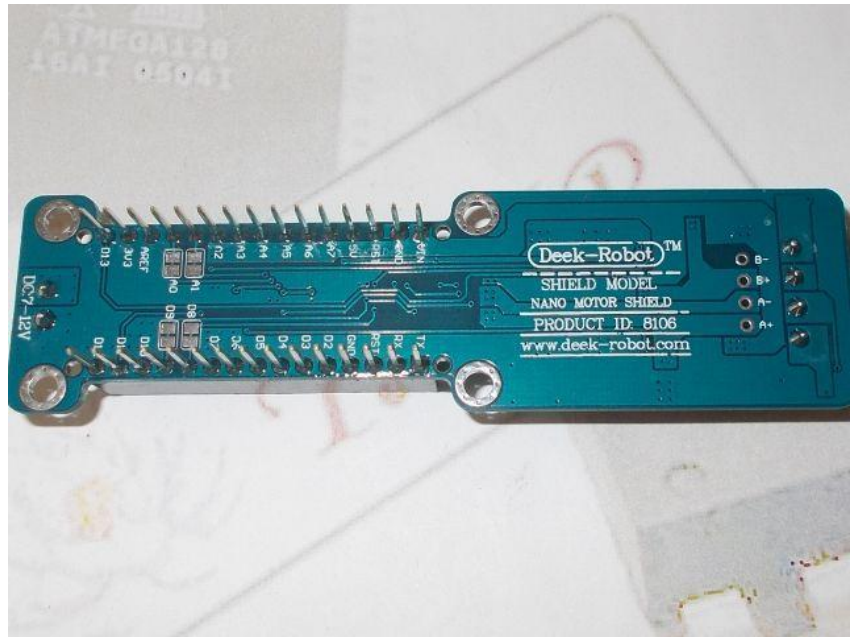


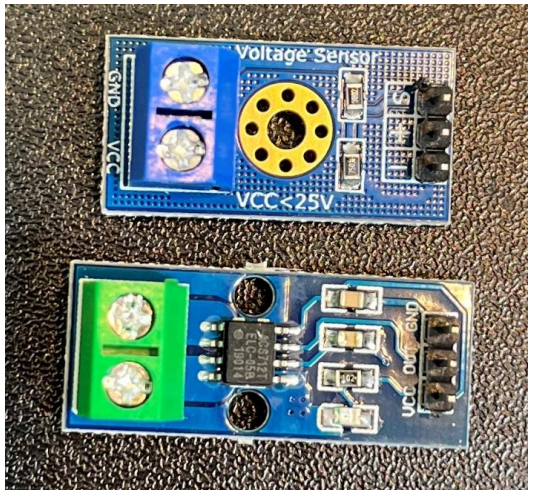
CDK17 Flat Panel Electronics

- Flat Frame Panel for CDK17 Linear Actuator
- Uses a DC 32" stroke linear actuator and Deek-Robot L298 with Arduino Nano,
- 2-relays, Voltage module and current module for Flat Panel
- This will run with RS232 through USB 2



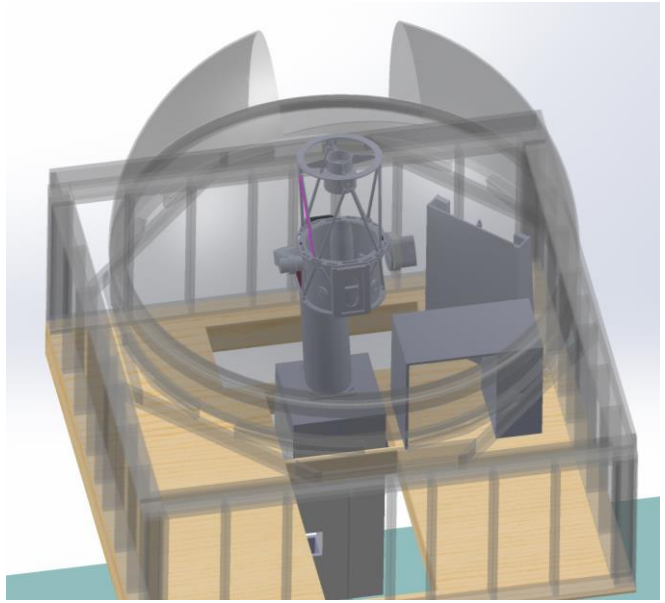
- Pulse Width Modulation Pins-int PWMA = 3;int PWMB = 11;
- Motor Direction Pins-int DirA = 12;int DirB = 13;int motorInterfaceType = 1;
- Relay Pinsint Relay1Pin = 9;int Relay2Pin = 10;
- Limit Switch Pins-int OpenLimitPin = 7;int CloseLimitPin = 8;
- Analog Pins-int CurrentA = 0;int CurrentB = 1;int FlatCurrent = 2;int VoltsFlat = 3;

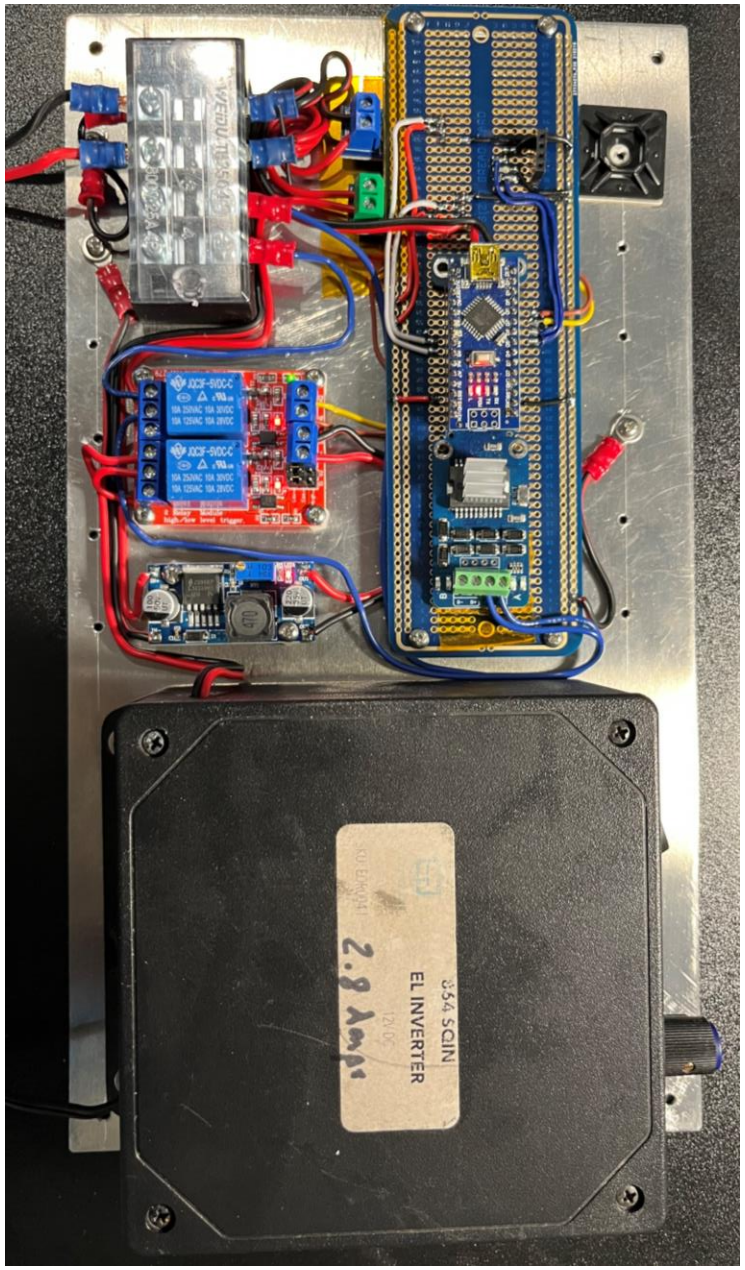




Function	pins per Ch. A	pins per Ch. B
Direction	D12	D13
PWM	D3	D11
~~Brake~~	~~D9~~	~~D8~~
Current Sensing	A0	A1

CDK17 Flat Panel Electronics Board



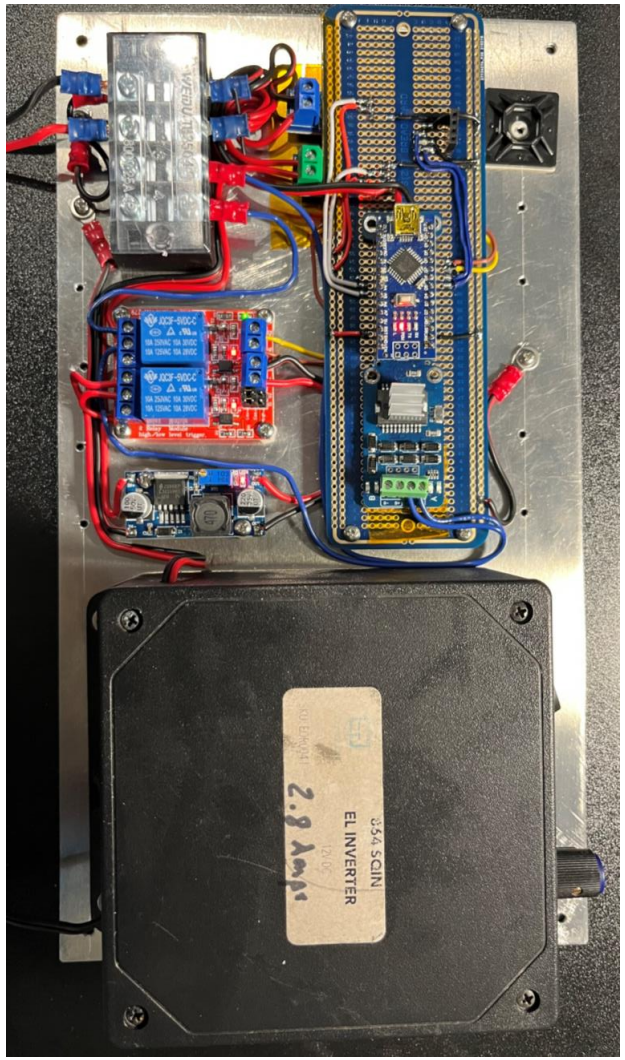


Slow Actuator used for safety

Deploy Time 3 min 14 sec

Retract Time 3 min 05 sec

10’ Dome CDK17 Flat Panel 24”x36” panel System is~80” Tall



Flat system Commands

```
strcpy(FlatCommand[2].Command,":GO#");

strcpy(FlatCommand[2].Description,"Opens the Cover");


strcpy(FlatCommand[5].Command,":GC#");

strcpy(FlatCommand[5].Description,"Closes the Cover");


strcpy(FlatCommand[7].Command,":GS#");

strcpy(FlatCommand[7].Description,"Stops the Cover Movement");



strcpy(FlatCommand[8].Command,":ON#");

strcpy(FlatCommand[8].Description,"Turns the EL panel ON if Cover is Tripped");


strcpy(FlatCommand[9].Command,":OF#");

strcpy(FlatCommand[9].Description,"Turns the EL panel OFF");


strcpy(FlatCommand[10].Command,":ST#");

strcpy(FlatCommand[10].Description,"Status Request");
```

```
trcpy(FlatData[0].Description, " ");
strcpy(FlatData[0].UserMessage, " ");

strcpy(FlatData[1].Description, " Open Command with the Close Limit Switch Tripped");
strcpy(FlatData[1].UserMessage, " Flat Panel Being Deployed");

strcpy(FlatData[2].Description, " Open Command with the NO Limit Switch");
strcpy(FlatData[2].UserMessage, " Deploying the Flat Panel");

strcpy(FlatData[3].Description, " Open Limit Switch has been Tripped");
strcpy(FlatData[3].UserMessage, " Success the  Flat Panel is Deployed!");

strcpy(FlatData[4].Description, " Close Command with the Open Limit Switch Tripped");
strcpy(FlatData[4].UserMessage, " Beginning to Retract the  Flat Panel");

strcpy(FlatData[5].Description, " Close Command with the NO Limit Switch Tripped");
strcpy(FlatData[5].UserMessage, " Retracting the  Flat Panel");

strcpy(FlatData[6].Description, " Close Limit Switch Tripped");
strcpy(FlatData[6].UserMessage, " Success the  Flat Panel Retraction Complete!");

strcpy(FlatData[7].Description, " Stop the  Flat Panel Motion");
strcpy(FlatData[7].UserMessage, "  Flat Panel Motion has been Stoped");

strcpy(FlatData[8].Description, " EL Pannel is ON.. Flat Panel Deployed");
strcpy(FlatData[8].UserMessage, " EL Pannel is ON.. Flat Panel is Deployed");

strcpy(FlatData[9].Description, " EL Pannel is OFF");
strcpy(FlatData[9].UserMessage, " EL Pannel is OFF");

strcpy(FlatData[10].Description, "  Flat Panel Stoped!!  Flat Panel NOT CLOSED...EL Pannel is OFF");
strcpy(FlatData[10].UserMessage, "  Flat Panel Stoped!!  Flat Panel NOT CLOSED...EL Pannel is OFF");


strcpy(FlatData[12].Description, " The Stepper Board is On-Line");
strcpy(FlatData[12].UserMessage, " Flat System is ON_LINE");
```

Flat System Return Values

- case 1: //Flat Panel Being Deployed
- case 2: //Deploying the Flat Panel
- case 3: //Success the Flat Panel is Deployed!
- case 4: //Beginning to Retract the Flat Panel
- case 5: //Retracting the Flat Panel
- case 6: //Success the Flat Panel Retraction Complete!
- case 7: //Flat Panel Motion has been Stoped
- case 8: //EL Pannel is ON.. Flat Panel is Deployed
- case 9: //EL Pannel is OFF
- case 10: //Flat Panel Stoped!! Flat Panel NOT CLOSED...EL Pannel is OFF

Shutter for CDK17

November 2021

Shutter covering the central baffle

Primary cover in place

Stepper Motor with 100:1 gearbox direct drive

Shutter fully open

Baffle shutter used for dark frames
and to protect field lens elements
During non-use times

Shutter Commands “ShutterWithLimits.cpp”

```
Shutter_Limits :: Shutter_Limits()
strcpy(StepperCommand[2].Command,":GO#");
strcpy(StepperCommand[2].Description,"Opens the Cover");
strcpy(StepperCommand[5].Command,":GC#");
strcpy(StepperCommand[5].Description,"Closes the Cover");
strcpy(StepperCommand[7].Command,":GS#");
strcpy(StepperCommand[7].Description,"Stops the Cover Movement");
strcpy(StepperCommand[8].Command,":ON#");
strcpy(StepperCommand[8].Description,"Turns the EL panel ON if Cover is Tripped");
strcpy(StepperCommand[9].Command,":OF#");
strcpy(StepperCommand[9].Description,"Turns the EL panel OFF");
strcpy(StepperData[0].Description, " ");
strcpy(StepperData[0].UserMessage, " ");
strcpy(StepperData[1].Description, " Open Command with the Close Limit Switch Tripped");
strcpy(StepperData[1].UserMessage, " Beginning to Open the Cover");
strcpy(StepperData[2].Description, " Open Command with the NO Limit Switch");
strcpy(StepperData[2].UserMessage, " Opening the Cover");
strcpy(StepperData[3].Description, " Open Limit Switch has been Tripped");
strcpy(StepperData[3].UserMessage, " Success the Cover is Opened!");
strcpy(StepperData[4].Description, " Close Command with the Open Limit Switch Tripped");
strcpy(StepperData[4].UserMessage, " Beginning to Close the Cover");
strcpy(StepperData[5].Description, " Close Command with the NO Limit Switch Tripped");
strcpy(StepperData[5].UserMessage, " Closing the Cover");
strcpy(StepperData[6].Description, " Close Limit Switch Tripped");
strcpy(StepperData[6].UserMessage, " Success the Cover is Closed!");
strcpy(StepperData[7].Description, " Stop the Cover Motion");
strcpy(StepperData[7].UserMessage, " Cover Motion has been Stoped");
strcpy(StepperData[8].Description, " EL Pannel is ON..Cover is Closed");
strcpy(StepperData[8].UserMessage, " EL Pannel is ON..Cover is Closed");
strcpy(StepperData[9].Description, " EL Pannel is OFF");
strcpy(StepperData[9].UserMessage, " EL Pannel is OFF");
strcpy(StepperData[10].Description, " Cover Stoped!! Cover NOT CLOSED...EL Pannel is OFF");
strcpy(StepperData[10].UserMessage, " Cover Stoped!! Cover NOT CLOSED...EL Pannel is OFF")
strcpy(StepperData[12].Description, " The Stepper Board is On-Line");
strcpy(StepperData[12].UserMessage, " Cover is ON_LINE");
```

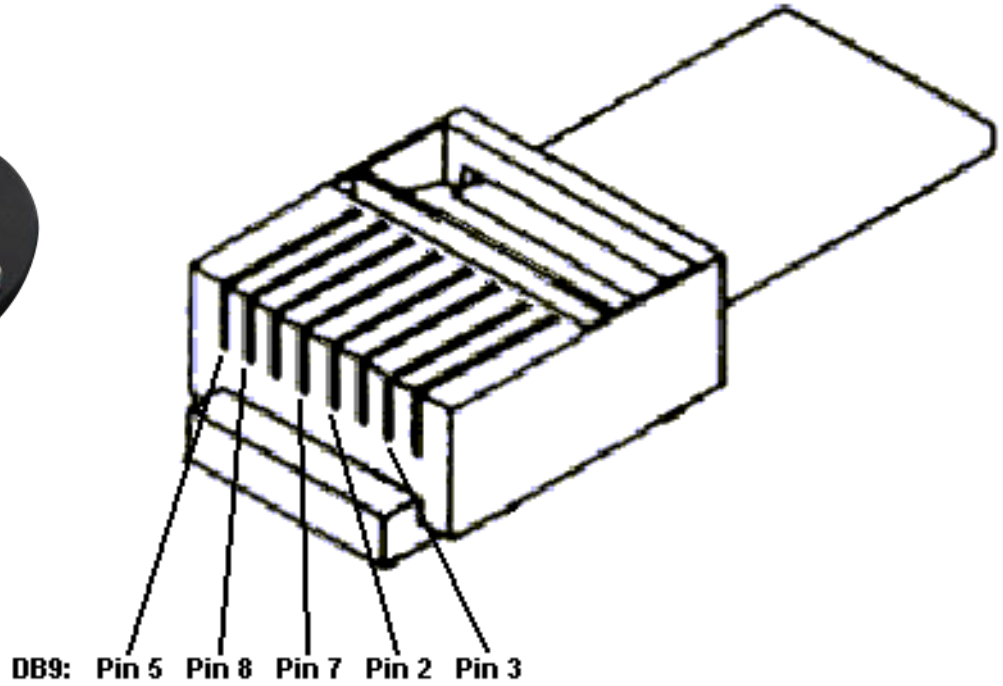
Shutter Return Values

- Return value conditions
- condition 1: open command with CLOSE limit trip... Beginning to Open the Panel
- condition 2: open command no limit trip... Opening the Panel
- condition 3: open command with OPEN limit trip... Success the Panel is Opened!
- condition 4: Close command with Open limit trip... Beginning to Close the Panel
- condition 5: close command with no limit trip... Closing the Panel
- condition 6: close command with CLOSE limit trip... Success the Panel is Closed!
- condition 7: Stop the Panel Motion ... Panel Motion has been Stoped
- condition 8: EL Pannel is ON..Panel is Opened
- condition 9: EL Pannel is OFF... EL Pannel is OFF
- condition 10: Panel Stoped!! Panel NOT CLOSED...EL Pannel is OFF ... Panel Stoped!! Panel NOT CLOSED...EL Pannel is OFF
- condition 11: // none
- condition 12: The Board is On-Line... Panel is ON_LINE

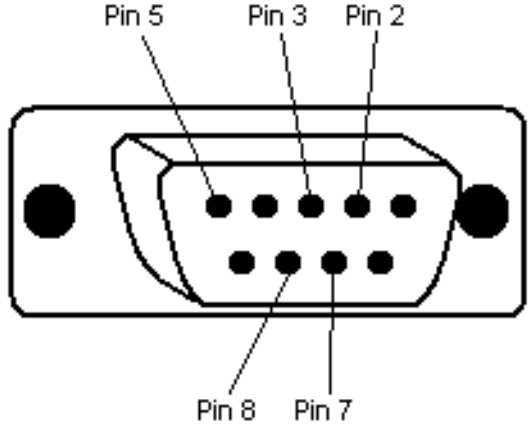
EFA

- Baud 19200
- Power connector 5.5 x 2.1mm

PC Port Cable – RJ45 and DB9



- 2 Receive Data
- 3 Transmit Data
- 5 Signal Ground
- 7 Request To Send
- 8 Clear To Send



Burn In Testing March 2023 CDK17 Control System

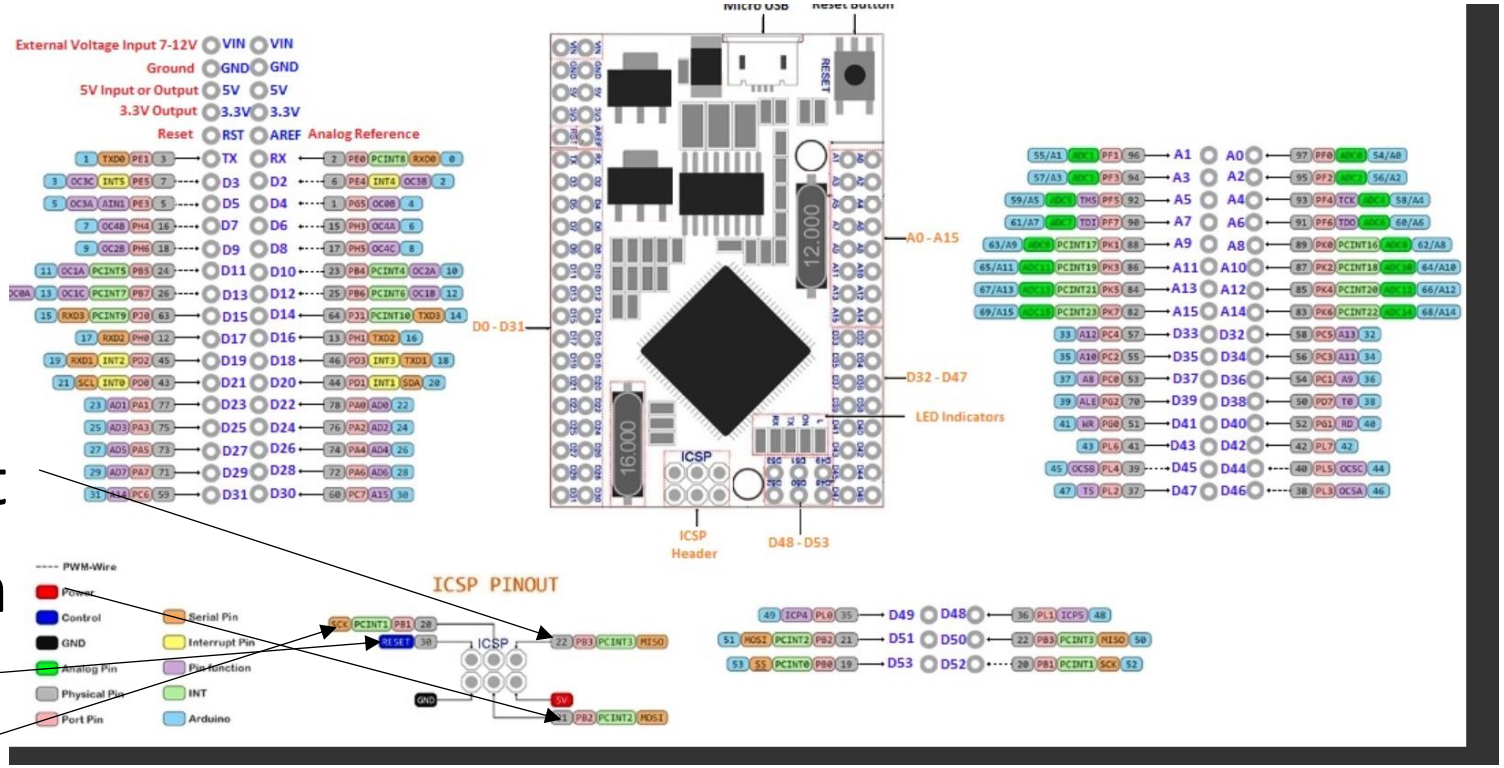
- 121.42 hours 7.2 KwHr Battery consumed
- Test started 3-9-2023
- Voltage 12.6 At end of cycle 3-14-2023

- Recharge 40 amps 16 hours 14.6-13.8 volts ~ 9 KWHr
- Full charge 13.7 volts using MKR1010 probe data

Issue with Mega2560 boot loader Mar 2 2023

- Occurred after disconnection from batteries while hot
- Mega stopped functioning

- MISO Master In Slave Out
- MOSI Master Out Slave In
- SS RESET
- SCK Serial Clock



Rewriting boot loader failed to fix. The Mega2560 failed and was replaced. It is working again

Issue with Mega2560 Overheating March 20, 2023

- Occurred after connection and disconnection to batteries, or static discharges.
- Mega gets very hot but hasn’t stopped functioning.
- Mega / MKR1010 board rewired with socket for easy replacement
- A power cut switch will be added

Re-Wired Controller Board rev.2 MKR 1010 Wifi Pinouts March 21,2023

WiFi Relay D7

D1: DHT22 Control RoomTemp-Humid Sensor

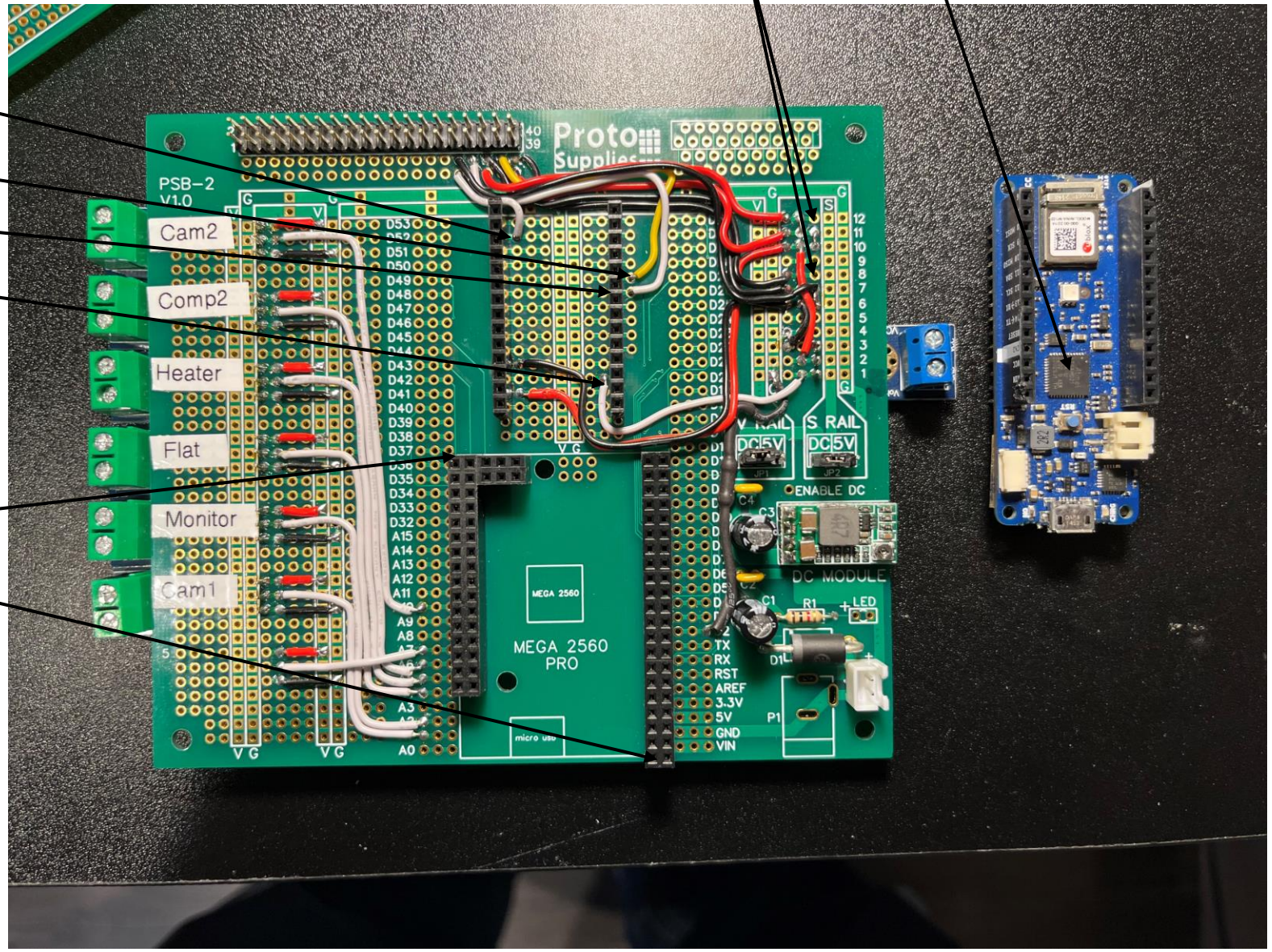
D0: DHT22 Dome Temp-Humid Sensor

Voltage Sensor A1

Mega Socket

Always-ON Power IN

MKR1010 WIFI

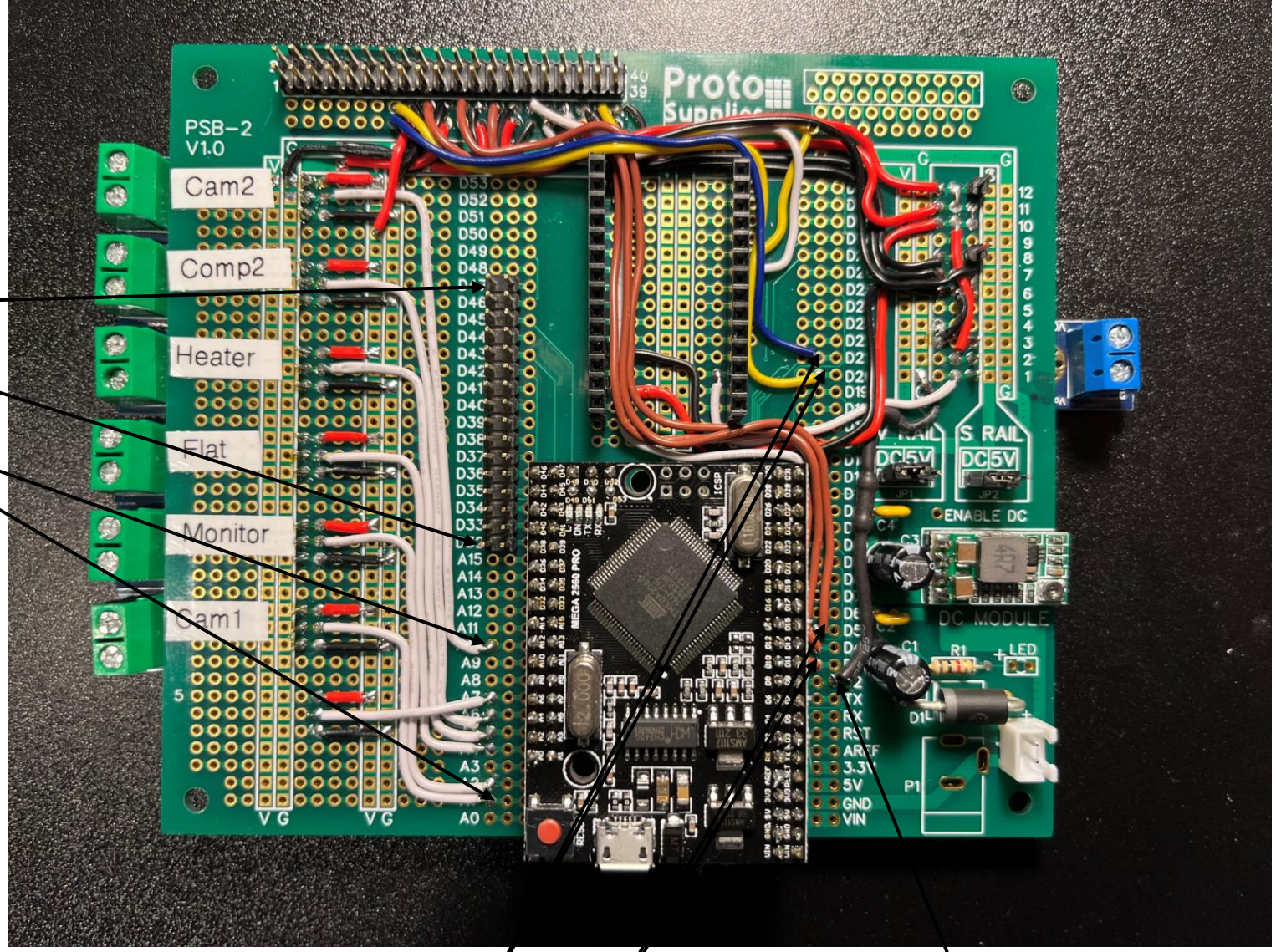


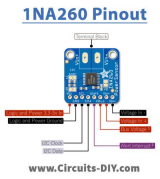
Mega2560Pro Re-Wiring rev.2

March 21,2023

Relays D32 to D47

ADC Current Monitoring
5Amp sensors





Precision Power Monitor i2c
INA260 Clock D20 and Data D21

Local On-Off D2

Temp-Humid Sensors D3, D4, D5 One-Wire
DHT22 Computer, Dome, Control Room

40-Pin Header Mapping

40-Pin Header

1 NC
2 30 amp Imager Sensor A0
3 +5Volts red
4 Ground black

5 NC
6 30 amp Mount Sensor A13
7 +5Volts red
8 Ground black

9 NC
10 30 amp Dome Sensor A14

40-Pin Header

11 +5Volts red
12 Ground black

13 Data D21 INA260 Power Sensor blue
14 Clock D20 INA260 Power Sensor yellow
15 +5Volts red
16 Ground black

17 NC
18 D5 DHT22 Control Room brown
19 +5Volts red
20 Ground black

40-Pin Header

21 NC
22 D4 DHT22 Dome brown
23 +5Volts red
24 Ground black

25 NC
26 D3 DHT22 Computer brown
27 +5Volts red
28 Ground black

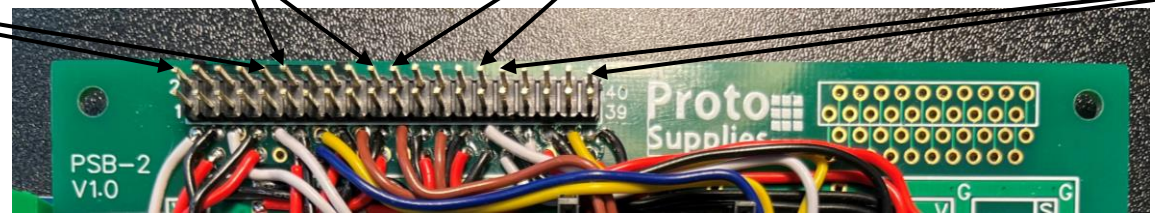
29 Local ON-OFF white
30 Local ON-OFF black

40-Pin Header

31 WIFI Relay white
32 Ground black

33 NC***MAKR1010WiFi
34 DTH22 Dome white
35 +5Volts red
36 Ground black

37 NC ***MAKR1010WiFi
38 DHT22 Control Room yellow
39 +5Volts red
40 Ground black

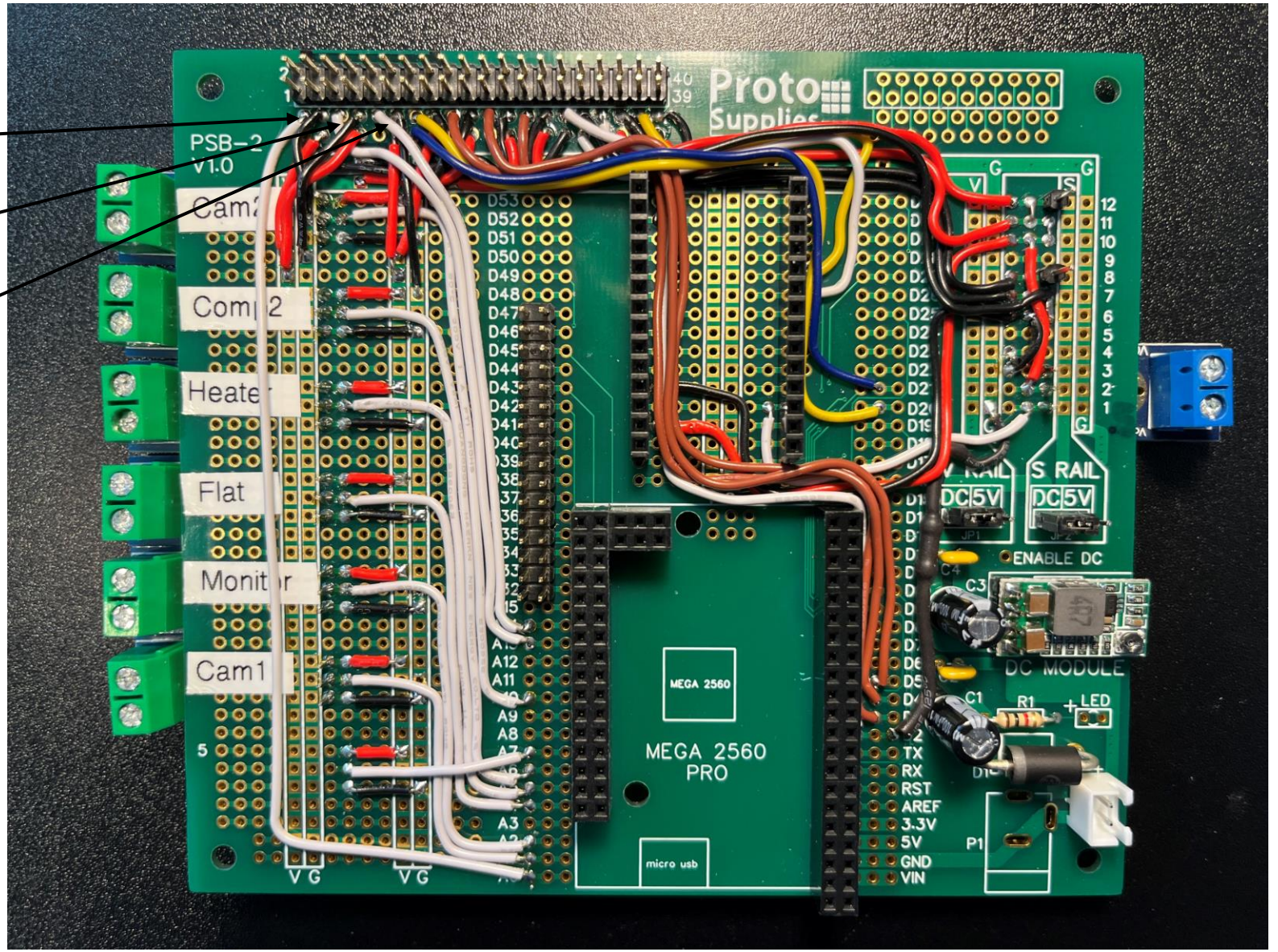


Mega 30Amp Sensor Wiring March 22,2023

Imager Pin 2 A01

Mount Pin 6 A13

Dome Pin 10 A14



Mega ADC Pin and Relay Pin Mapping

Pins:

0-A0: Imaging 30Amp Sensor
1-A1: Camera1 10 Amp Sensor
2-A2: Monitor 5 Amp Sensor
A3: NC
3-A4: Flat 5 Amp Sensor
4-A5: Dew Heater 5 Amp Sensor
5-A6: Computer 2 5 Amp Sensor
~~9-A7: Battery Volts Sensor~~
A8: NC
A9: NC
6-A10: Camera 2 5 Amp Sensor
A11: NC
A12: NC
7-A13: Mount 30Amp Sensor
8- A14: Dome 30Amp Sensor
A15: NC

D32 Mount	index 0	Relay 1
D33 Monitor	index 1	Relay 2
D34 Focus	index 2	Relay 3
D35 DomeCam	index 3	Relay 4
D36 Lan	index 4	Relay 5
D37 USB3	index 5	Relay 6
D38 Fan	index 6	Relay 7
D39 Camera	index 7	Relay 8
D40 No Function	Index 8	Relay 9
D41 Latch	index 9	Relay 10
D42 Camera2	index 10	Relay 11
D43 Comp2	index 11	Relay 12
D44 Heater	index 12	Relay 13
D45 Shutter	index 13	Relay 14
D46 Flat	index 14	Relay 15
D47 Dome	index 15	Relay 16

Components Lost During Burn-In March 2023

- Computer… ESD
- Router… ESD
- Mega… ESD
- Mega… Battery surge
- 12Volt 12Amp power supply… battery polarity
- INA260 Battery… Polarity
- 30Amp Relay… Polarity

Cables

- OTA 10’
  - Camera power
  - Camera USB-3
  - Focus Power
  - Hub usb-3 Power
  - OTA Hub USB-3
  - Ground
- Flat Panel 10’
  - Ground
  - USB-2
  - Power
- Dome 15’
  - Ground
  - RS232- RJ45
  - Power
- Mount 10’
  - Ground
  - Power 48V
  - USB-2
- Dome Camera 30’
  - CAT-5e
  - Power
- Monitor 10’
  - Power
  - HDMI
  - USB for keyboard
  - USB for mouse

Auxiliary Instruments

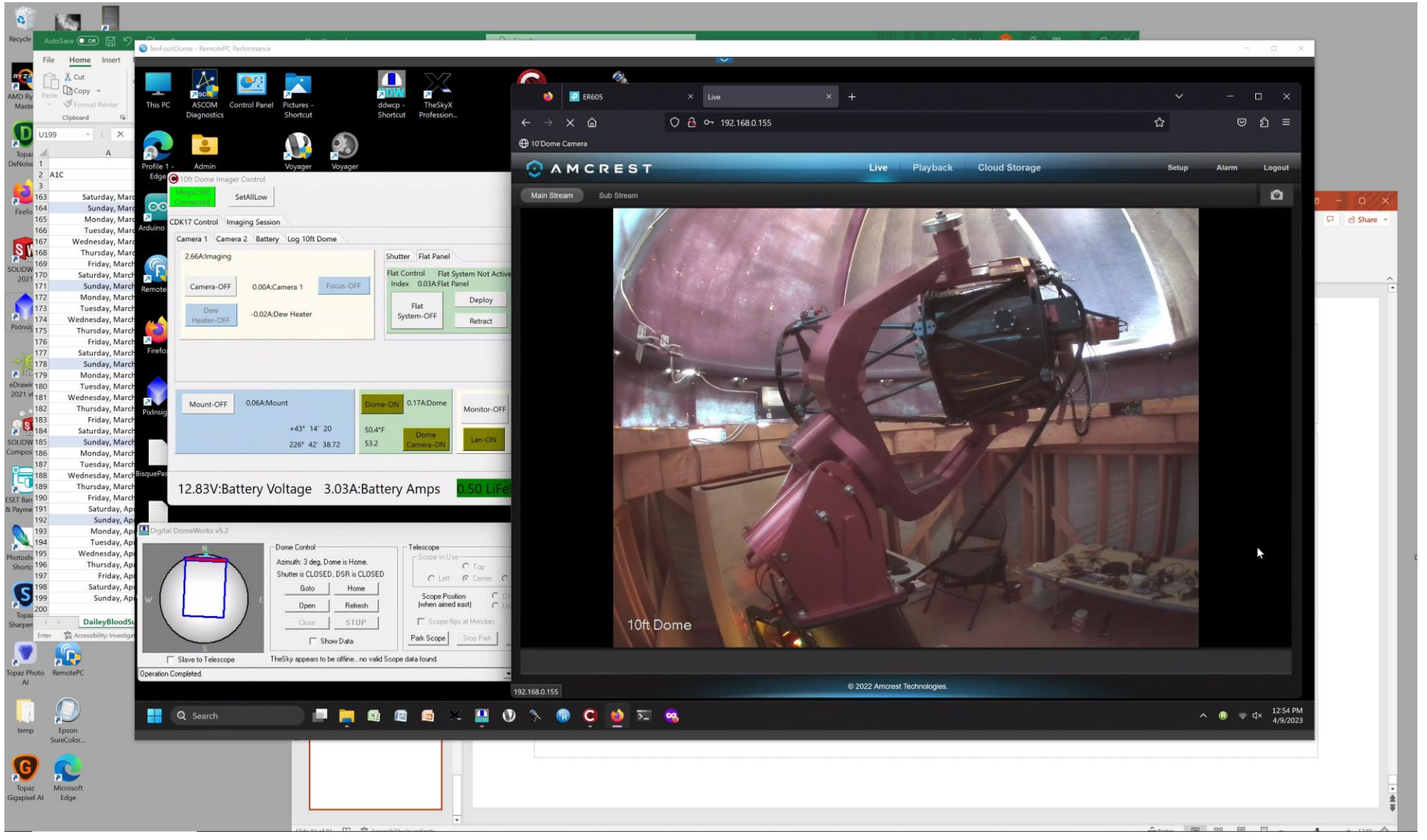
- Seismic
- Infrasound
- Lightning
- Cloud sensor
- Seeing monitor
- SQM
- Sunrise Sunset Cameras
- All-Sky Camera
- Solar scope
- Moon Planets scope
- Starlink

Install April 7-8, 2023

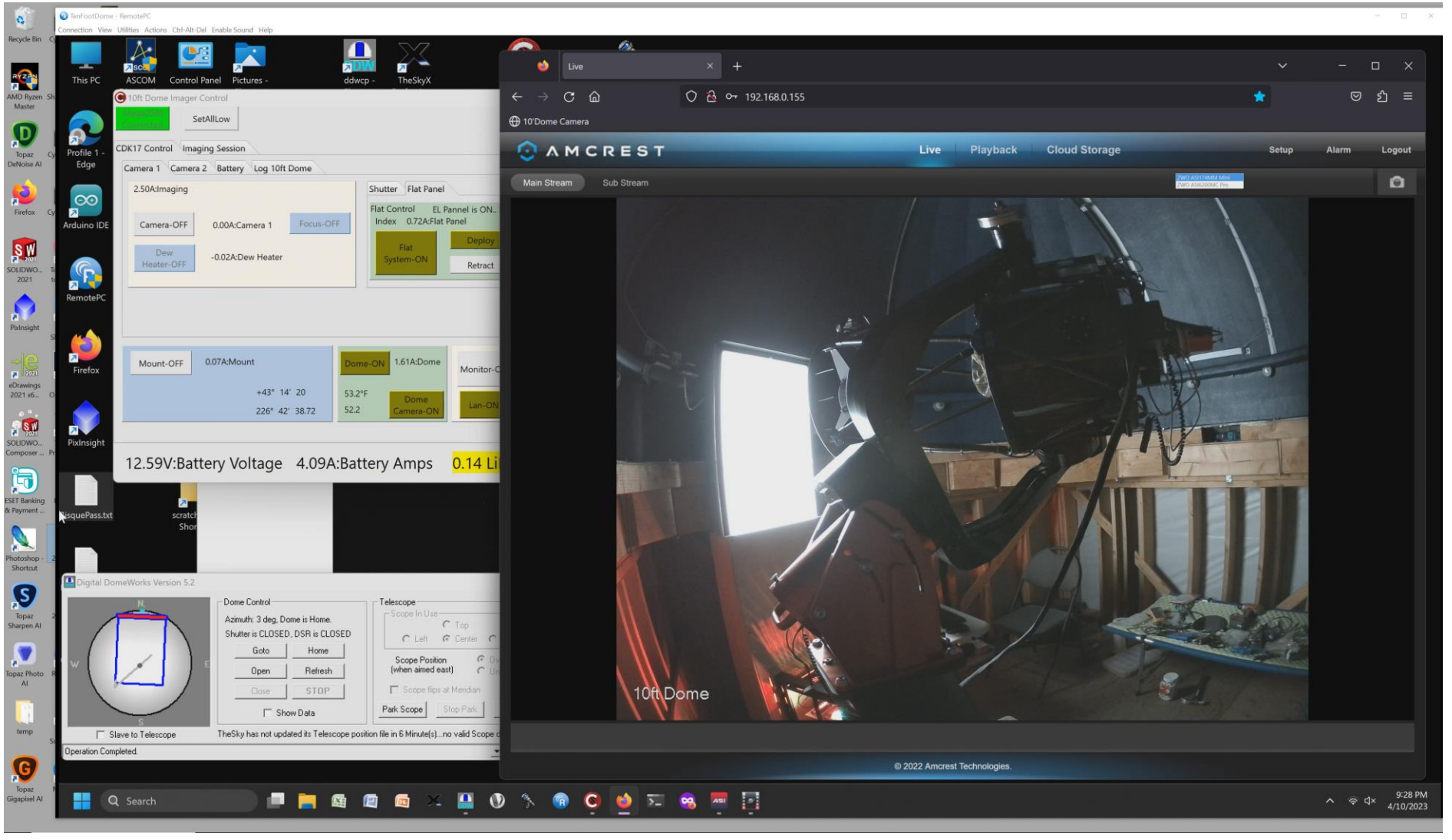
- Rack and Flat Panel lifted to dome level
- One battery lifted to dome level for fit, it was too big. So it was then lowered again and placed below the ladder on the south east wall.
- Battery balanced parallel wiring 4-batteries.
- Dome power cable #18 was to small so replaced with #12 works well.
- Dome serial didn’t work with computer native com port 1or2 so a RS232 to USB converter was added, and worked fine.
- Power cable from batteries #14 will be augmented with an additional #10 power cable
- Dome camera with local network didn’t work in spite of working at home. IP address changed fro, 192.168.0.154 at home to 192.168.0.155 in Dome…
- Focuser COM 9 port is recognized by system but focuser will not connect to the computer through the on-OTA-USB3 hub. So a separate USB2 cable will be run back to the computer. RS232 to USB converter will be changed if necessary.
- Finder camera connected through the OTA USB hub works.
- Primary mirror has a couple of WD40 spots that need cleaning.

10’ Dome Camera Image

- Clean the primary mirror
- Make adjustments for star quality
- Get the focuser working… EFA is cat5 and RS232 so conversion from CAT5 ro RS232 to USB will be used
- Set mount limits north camera, horizons, etc.
- Clean All-Sky Camera dome…
- Covers for the electronics rack.



Flat Panel Working

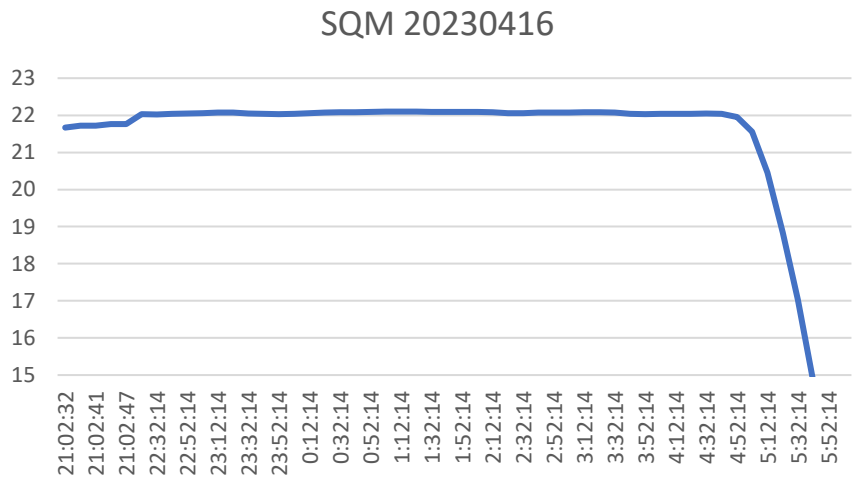


April 14-15

- April 14
  - Focuser working
  - Camera (2)- 85mm ASI094 working
  - Seeing monitor working
  - CDK17 Needs precision balancing
- April 15
  - Mike Hatcher up
  - First All night CDK17 Automated Script… worked well
  - Need new T-Point model

April 16-17, 2023

- Drove home, 9-mile and desert Super Bloom from the wet winter was incredible!!!
- Removed 0.035” from focus spacer of Melior QHY camera
- Repainted, assembled camera spacer system
- Review of images from last night, out of focus! But script worked flawlessly!!
- CDK17 April 16-17 night
  - Remote operation from Home-in-Beaumont
    - Refocus at 9.3C = 4919, 7.1C = 5031, 1.1C = 5080
    - 20 steps / c deg
  - Flawless operation
  - Turbulent

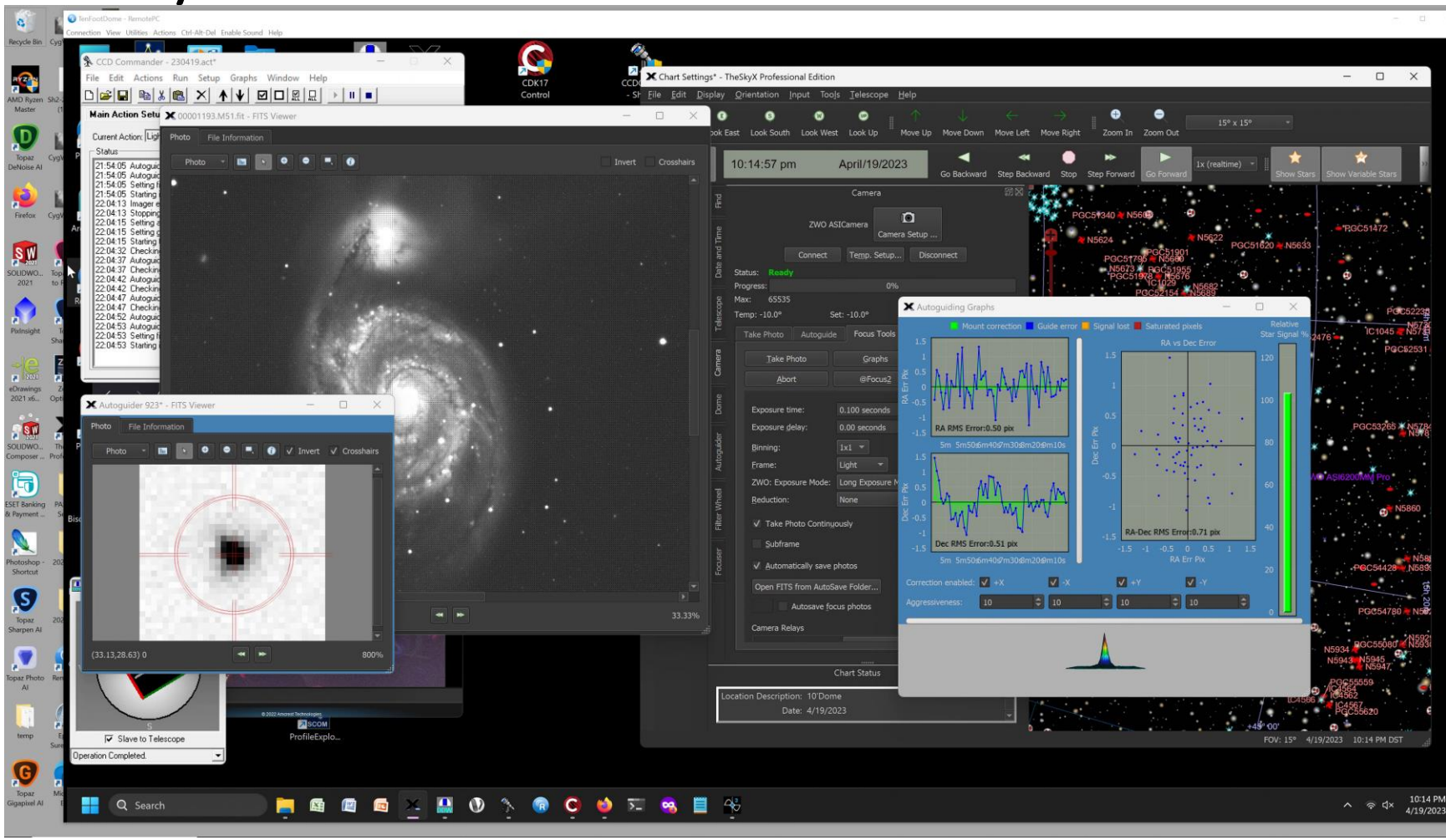


April 17-18, 2023

- Set Voyager control software up it works but there are balance issues with mount, and Voyager software dome control has issues that need resolution.
- Imaged using CCD-Commander without issues.
- Turbulence toward north is worse that meridian and south, again.

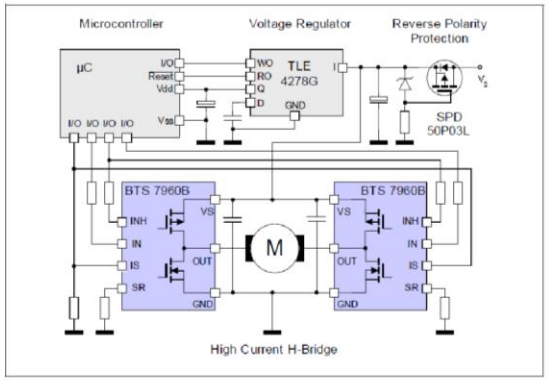
Imaging Underway 20230419

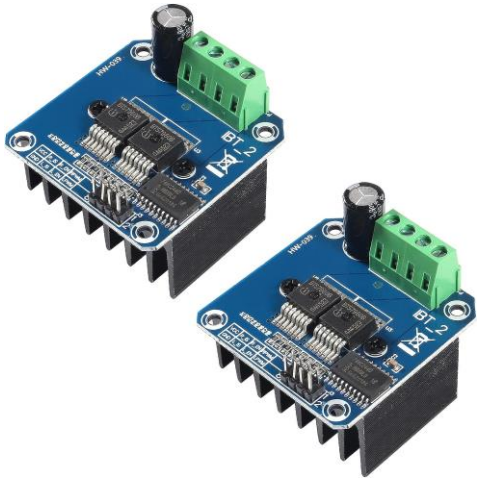
- Seeing appears to be 0.5 arc sec. based on FWHM guide star.
- Better than the 2 arc sec Nyquest of the OSC.



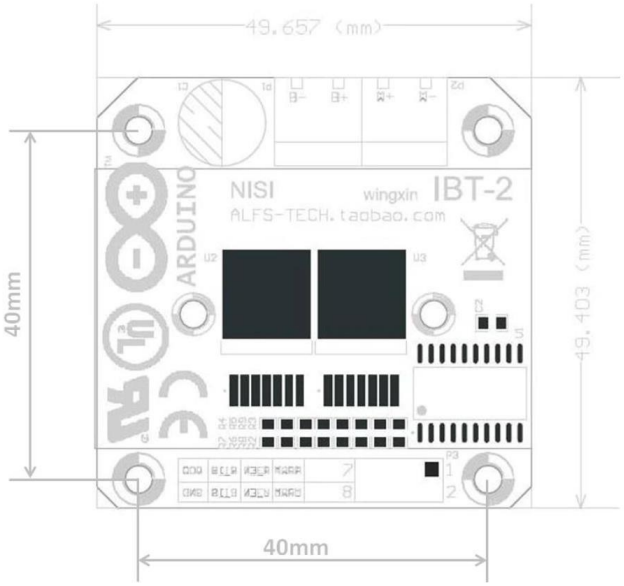
Window Fans Control

BTS7960 43A High Power Motor Driver

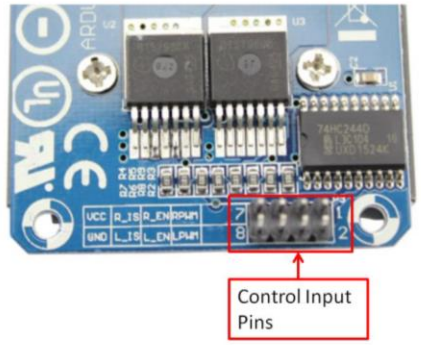




BTS7960 43A High Power Motor Driver

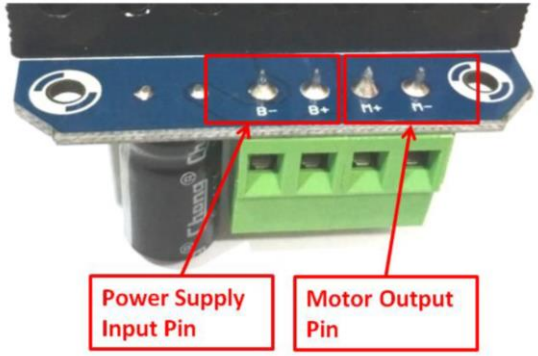


Control Input Pin Function:

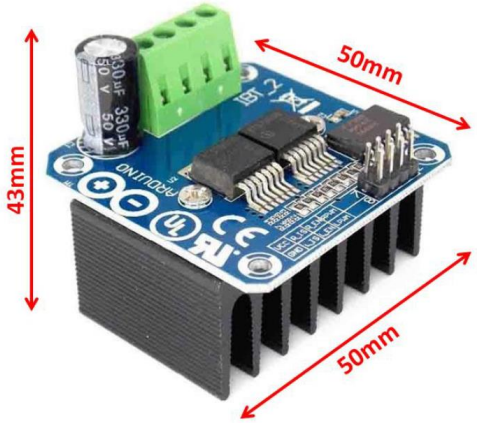


Pin No	Function	Description
1	RPWM	Forward Level or PWM signal, Active High
2	LPWM	Reverse Level or PWM signal, Active High
3	R_EN	Forward Drive Enable Input, Active High/ Low Disable
4	L_EN	Reverse Drive Enable Input, Active High/Low Disable
5	R_IS	Forward Drive, Side current alarm output
6	L_IS	Reverse Drive, Side current alarm output
7	Vcc	+5V Power Supply microcontroller
8	Gnd	Ground Power Supply microcontroller

Motor Power Supply & Output Pin Assignment:



Pin No	Function	Description
1	B+	Positive Motor Power Supply. 6 ~ 27VDC
2	B-	Negative Motor Power Supply. Ground
3	M+	Motor Output +
4	M-	Motor Output -



Control Failure 11-4 2023

- WIFI MKR1010 communicated over WEB
  - Was able to turn on and off by remote control
  - C++ Software initiated but no ADC readings or relay control
  - Driver appeared to work but wouldn’t communicate with Mega 2560
- This has happened before but the “Remote Fix” didn’t work this time
  - Could fix by reinitializing the WCH CH340 driver, by a disable and enable
    - The WCH-CD340 is the USB on COM port 4 to Serial chip on the Mega2560 on COM port 4
    - From Device Manager disable then enable the device on com 4…
- Drive up the Site

Control Failure 11-4 2023, Drove up to the Site

Nov 10, 2023

- Pushed the Mega reset button… NO Impact
- Installed the MKR1010 remote reset sketch… No Impact
- Reinstalled multiple versions of the CH240 driver… NO Impact
- Removed the Remote control RACK from the dome and drove it home
  - Nov 12, 2023 drove home

MKR1010 WIFI Sketch upgrade

Additional Relay Board Added to Translate MKR 3volt to MEGA 5volt

- Added /R function to the Sketch
  - Digital pin6 held “LOW”
  - (ip address)/R command
    - digitalWrite(6, High);
    - Delay(2000);
    - digitalWrite(6,LOW);
  - The MKR is a 3 volt system, the MEGA is a 5 volt system
    - Opto-isolated 3V relay side: to switch PIN 6 of the MKR.
    - Relay side: “RST” pin of the Mega at 5 volts “HIGH” switched to ground “LOW” for 2 seconds to reset the Mega…

Rack Repair 11 2023 Reinstall 12-3-2023

- Replaced Mega 2560 and programmed additional spares
- Added Mega reset Relay WIFI controlled by MKR1010 over the web IP/R== reset mega
- Purchased new 4K 12” monitor for manual scope control, its low power 12Volt
- Added 2U drawer
- Added side and rear covers
- #4 AWG cable and terminal block for battery connection added
- 1 week burn-in

Lighting 10’Dome

6-Zones, 11-relays

- West Wall, Lower level (1) Light near door
- East Wall, Lower level (2) Light near window and over batteries
- Stairs (1) lower level south west ceiling, (2) connected together south stairwell
- Courtesy lights dome level (1) East wall, (1) North wall
- Downward desk dome level courtesy light (1) west wall
- Downward dome level skirt lights (1) southeast, (1) northeast,

(1) Northwest

Solar Panels for the 10’ Dome

April 2025

Solar Array for the 10’ Dome

- Railroad ties, 8’ long, installed April 22, 2025
- Concrete 36” deep

April 29, 2025 solar Panel Setup

- Setup for the Solar Panels

Electrical Panel Components Crude Layout

Components: Solar Charger 10’ Dome

OutBack Flex 60 Charge Controller

Midnite Solar-MNDC-GFP63

MidNite Solar MNEPV63 Circuit Breaker 150VDC 63A 1-Pole

Din Rail Mount Combiner PV Breaker - 20 Amp, 150 VDC, | MNEPV20

Additional Components

Electrical Boxes: Solar Charger 10’ Dome

MidNite Solar
MNBIGBABY Big Baby
Box Enclosure

Box 1:

PV Input to controller connect breaker

Output from controller to batteries connect Breaker

Ground Fault (GFI)

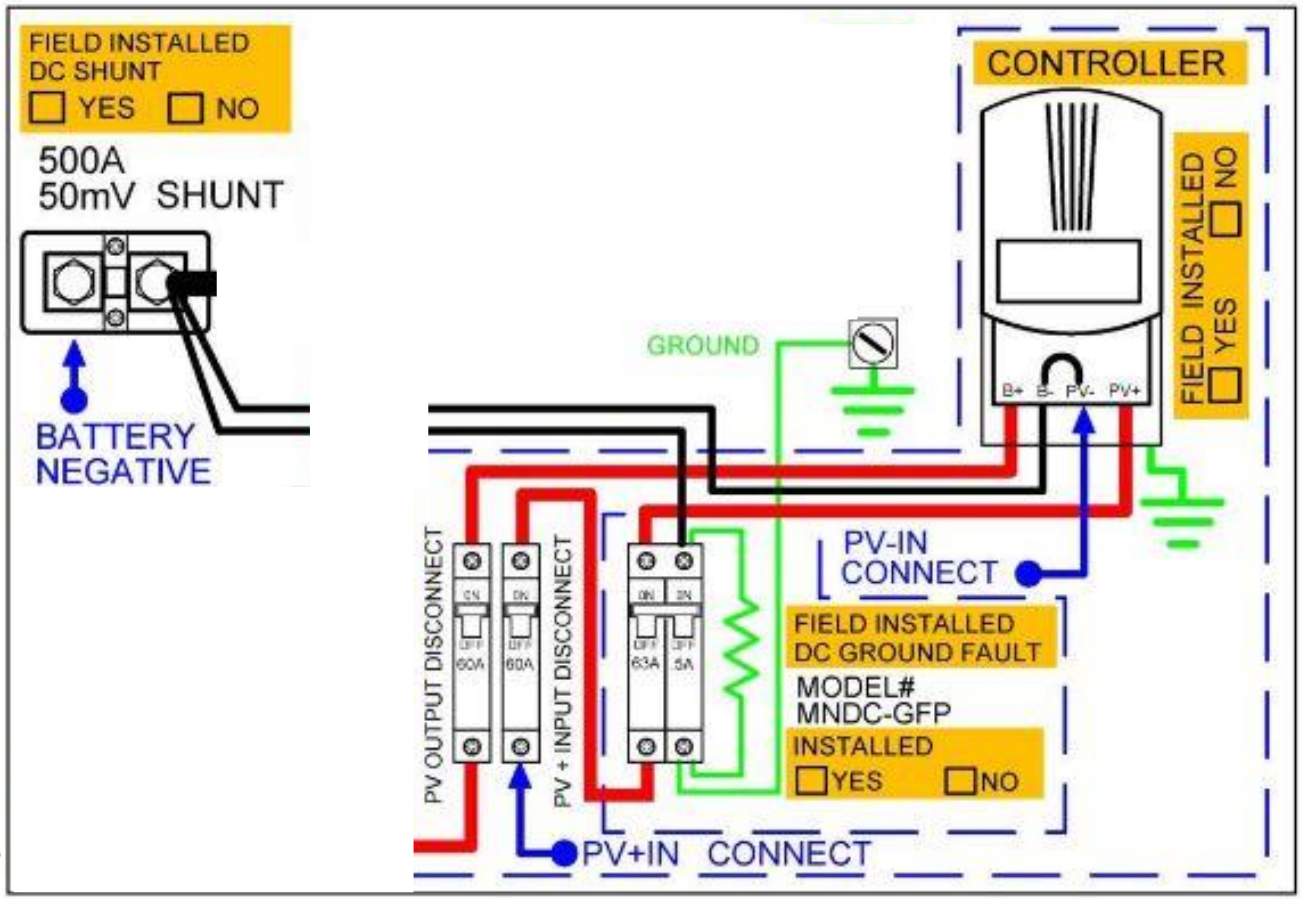
Box 2:

20 Amp for Lamps

20 Amp for imaging system

20 Amp for Aux systems

20 Amp Spare



Wiring diagram supplied on the door of MNDC

Panel Wiring Solar Charger 10’ Dome

Electrical Boxes: Solar Charger 10’ Dome

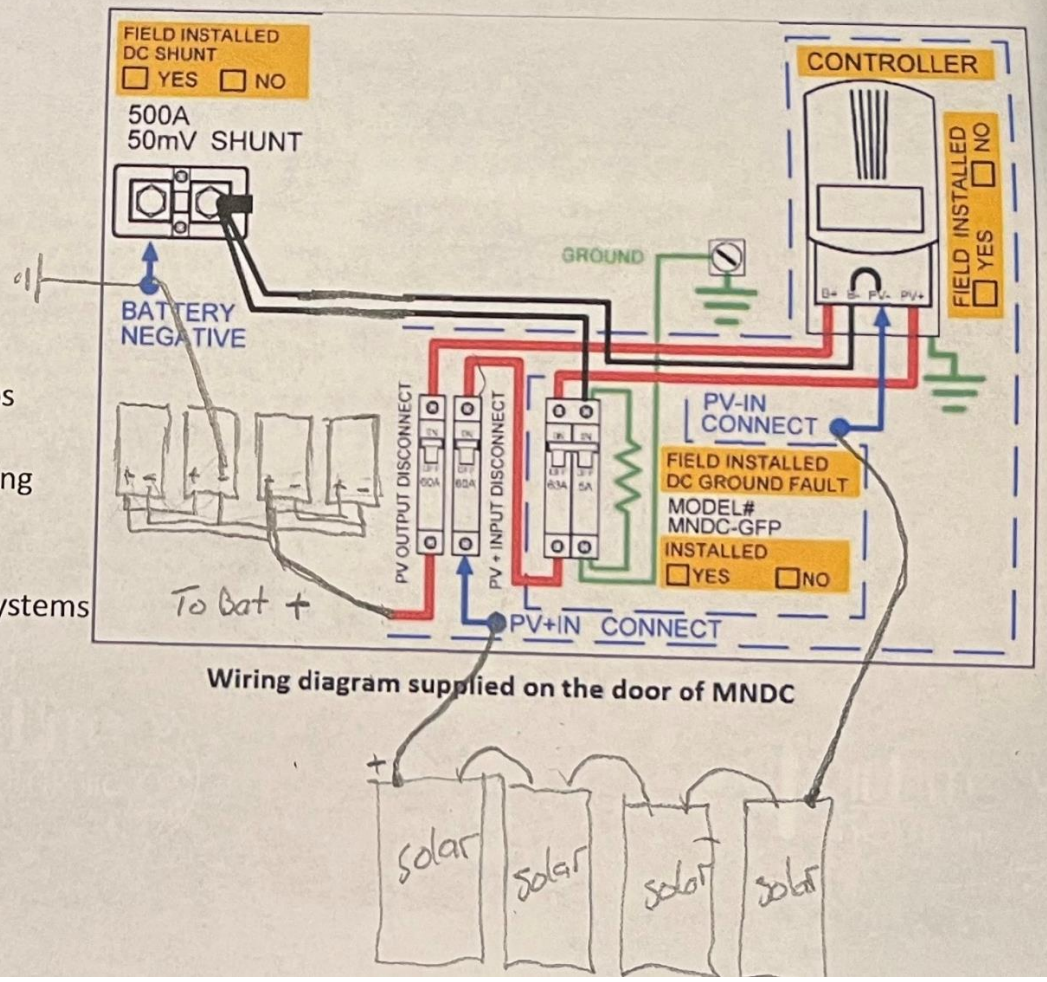
MidNite Solar
MNBIGBABY Big Baby
Box Enclosure

Box 1:

- PV Input to controller connect breaker
- Output from controller to batteries connect Breaker
- Ground Fault (GFI)

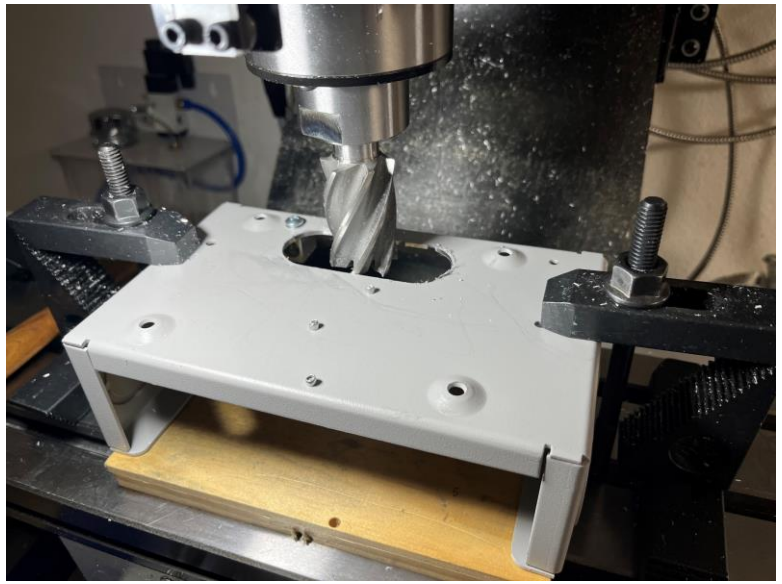
Box 2:

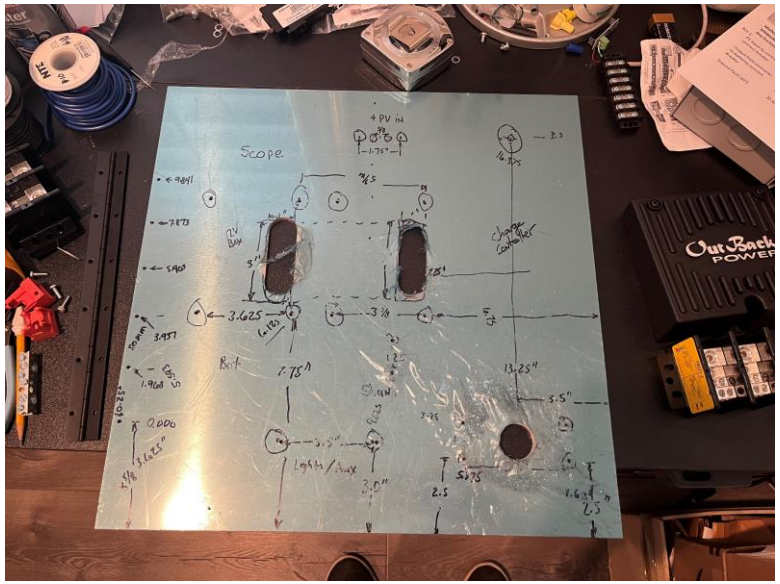
- 20 Amp for Lamps
- 20 Amp for imaging system
- 20 Amp for Aux systems
- 20 Amp Spare

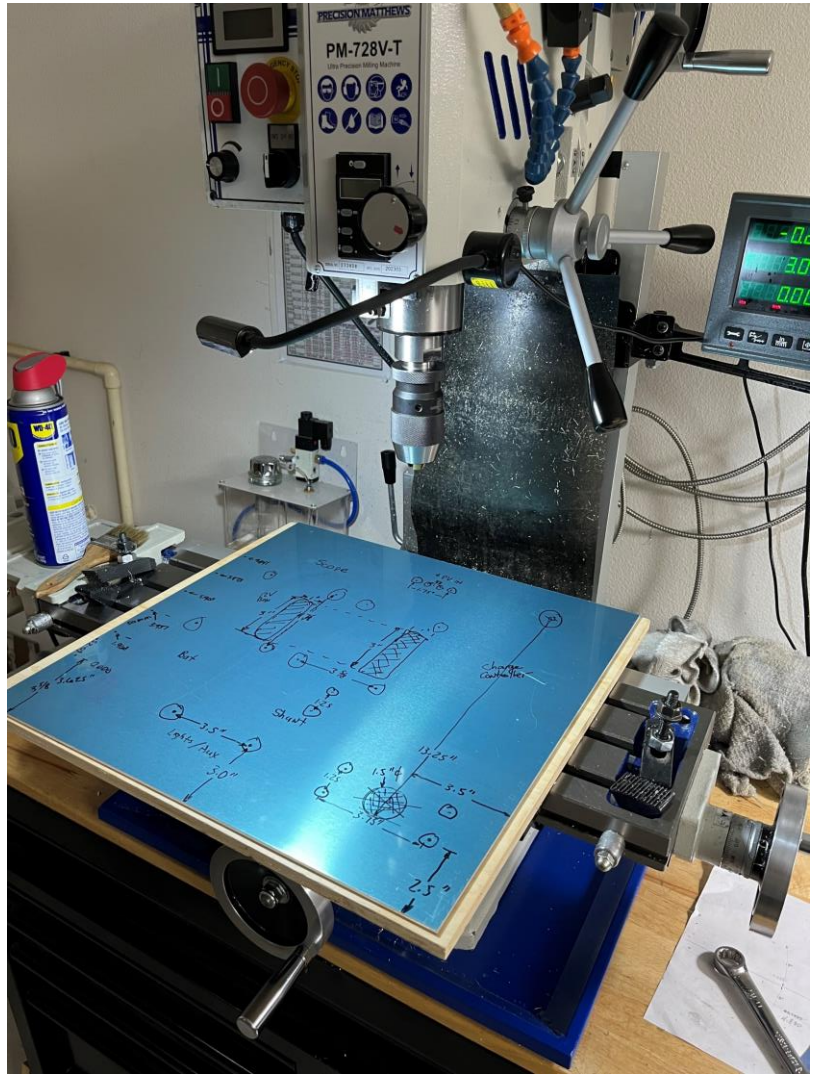


Wiring diagram supplied on the door of MNDC

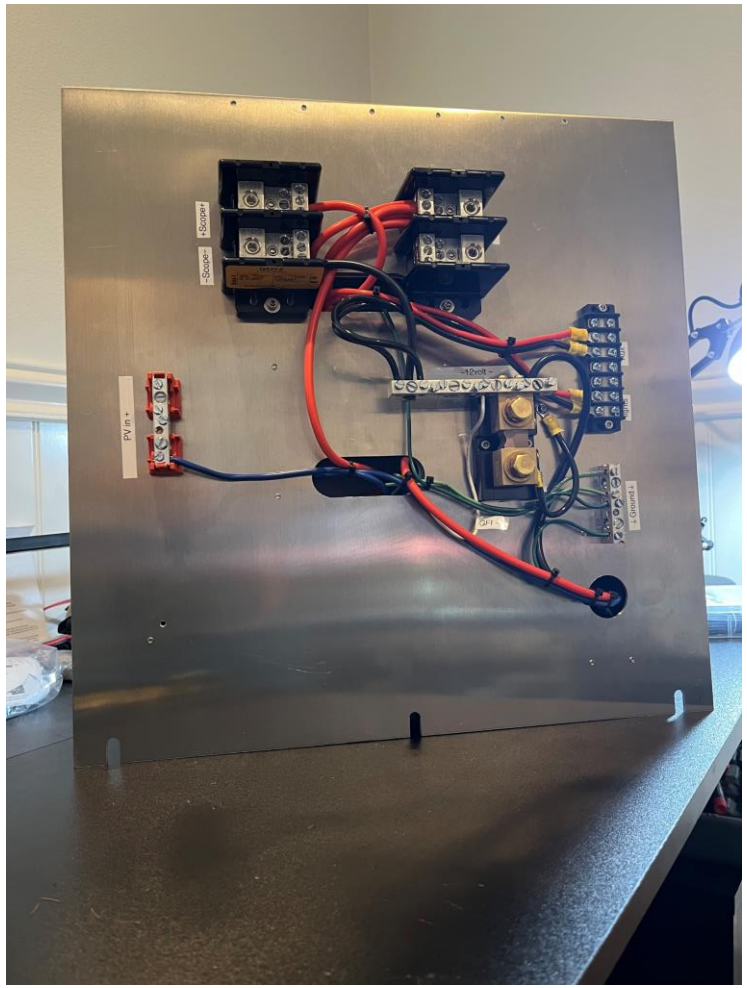
Some Machining Work May 12, 2025

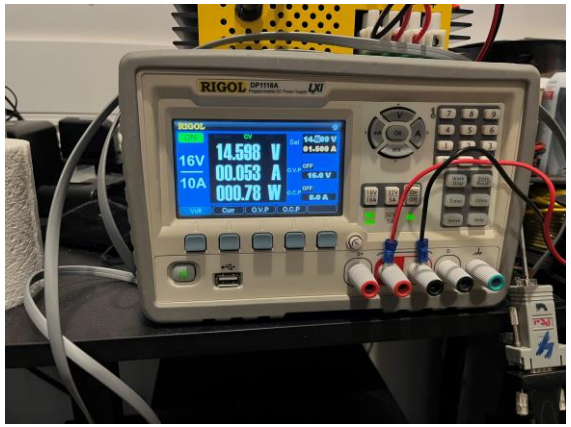




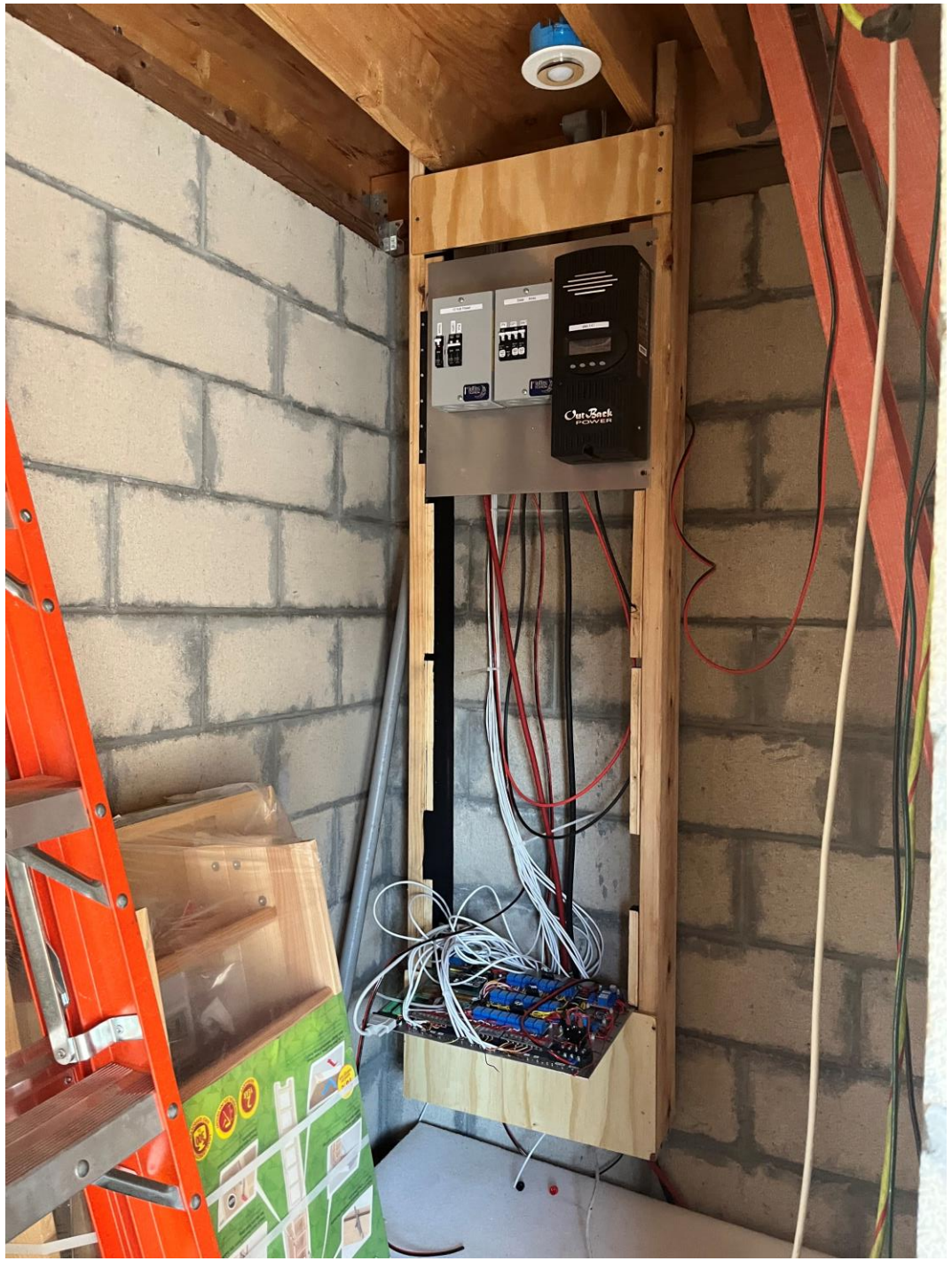


Wiring and Burn In May 13, 2025





The “Rack” Ready to Go



Martin Fills in the Footings with Dirt May 12, 2025

Installing the Solar Panels

Solar Panels Installed

Up and Running