# PC Controlled Power Supply

Made by: Rowan Lester, Lawrence Huber, Meshari Alqahs

The PC controlled power supply's purpose is to regulate power on two channels based on the input of both physical buttons on it and scpi commands given to it from a computer attached to it.
The system has 7 requirements to it that it must meet,

1. **Customer Requirement:** The power supply must have multiple channels
   **Engineering Requirement:** The system will supply at least two independent channels of voltage at least including the range of 2-14V.

   Video link:
   https://drive.google.com/file/d/1uOWHGfIyGVhz88gasMyklhoKjyNoJTzQ/view?usp=sharing

2. **Customer Requirement:** The power supply needs to be powerful
   **Engineering Requirement:** The system will supply up to 1.5A on each of its channels.

   Video link:
   https://drive.google.com/file/d/13TxO9xFGUIXU9IcP6W4597IKJlBcxGGw/view?usp=sharing

3. **Customer Requirement:** The system must be safe.
   **Engineering Requirement:** The system will only use US standard plugins for connecting to external devices, will not allow any object with a diameter greater than 1mm to enter the enclosure, and will be disabled if more than 1A is drawn from the wall power or 1.5A from the output at anytime.

4. **Customer Requirement:** The system must be accurate
   **Engineering Requirement:** The voltages and currents displayed by the system (to user and reported via serial) must be within 5% or .1V of real values whichever is larger.

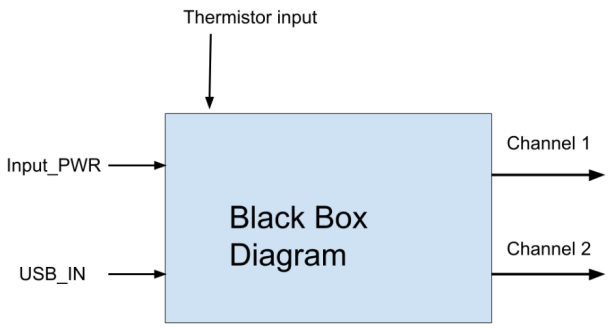
   Video link:
   https://drive.google.com/file/d/1itvrsjTNGudmqB3E8nFXFgUpeDppaXRn/view?usp=sharing

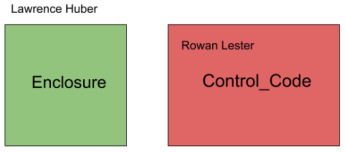
5. **Customer Requirement:** The power supply needs to be programmable
   **Engineering Requirement:** The system will be configurable for all channels over a serial interface using SCPI protocol that can adjust voltages and current limits.

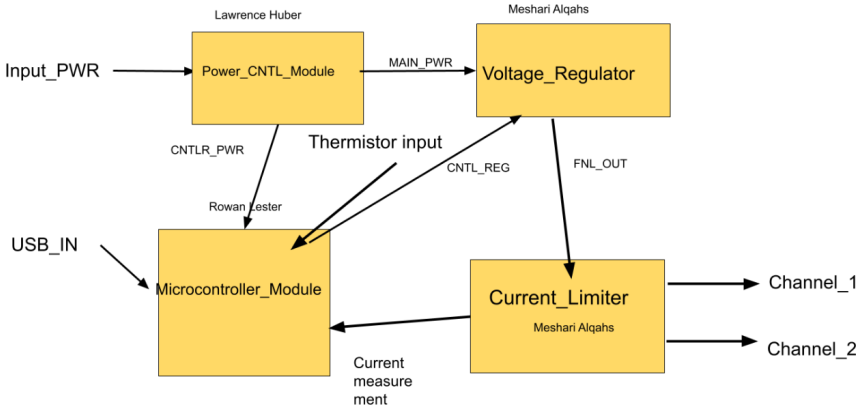
6. **Customer Requirement:** The power supply will have status LEDs on it.
   **Engineering Requirement:** The system will be able to display the status of itself on the LED's, it will have LEDs turn on for if the channels are enabled, if they are current limited, Or if the system is overheating.

7. **Customer Requirement:** The power supply will be able to tell if its overheating

**Engineering Requirement:** The system will be able to sense its own temperature in order to be able to report if it is overheating as an expansion of the safety requirement. When the temperature reaches a specified amount then it will force the channels to be off.




Block diagram of assigned jobs

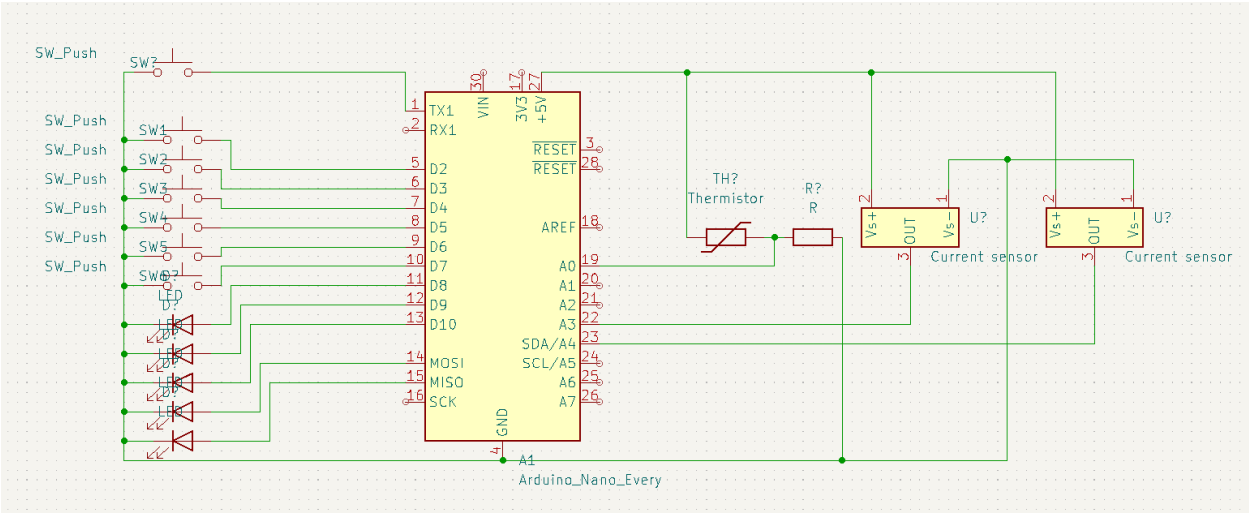
**Interface Definitions**

| Interfaces | Properties | Parameters |
|---|---|---|
| Input_PWR | AC Power, Analog Signal | 120 VAC, 1 A-max |
| USB_IN | Digital Input, User Input | Input from comp. |
| Thermistor_input | Sensor, analog signal | Temperature sensor, resistance changes as temperature changes |
| Power_CNTL_Module | DC output, AC Input, Circuit | Outputs 20 V with a maximum of 1.5 A |
| Microcontroller_Module | Circuit, Coding involved | Arduino Nano |
| Voltage_Regulator | DC output, Circuit | Regulates 20V into variable outputs |
| Current_Limiter | Circuit, DC input, DC output | Controls the current output from Voltage_Regulator Module |
| CNTRL_PWR | Connection, DC Input | 20V into Microcontroller_Module |
| MAIN_PWR | Connection, DC Input | 6-20V at maximum 0.5 A |
| CNTL_REG | Connection, Digital Signal | PWM from Nano, 0-5V 1024 steps |
| FNL_OUT | Connection, DC output | Final Output from power supply to channels |
| Channel_1 | Output, DC Power | 6-20V , 1.5 A-max output |
| Channel_2 | Output, DC Power | 6-20V , 1.5 A-max output |
| Enclosure | Mechanical, Other | Enclosed box with power supply inside |
| Control_Code | Code, User Input | Code base installed in the microcontroller |

The arduino contains both the code block and the arduino hardware block.
This code will drive the arduino and will perform the following:

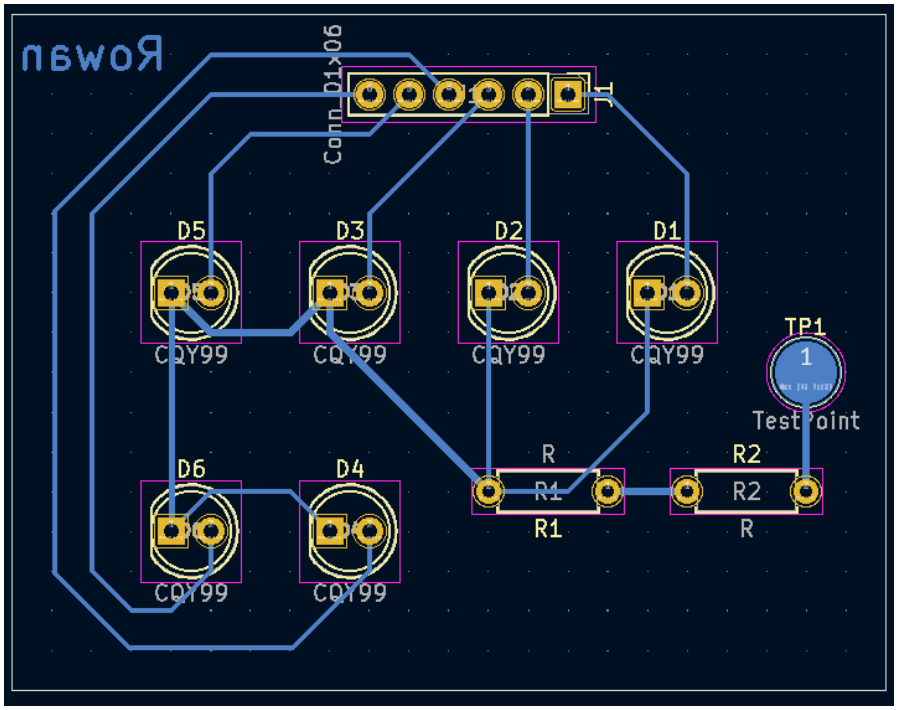
- The arduino will temporarily disable the channels when it detects that it is overheating (the thermistor has reached the temperature specified in the config)
- The arduino will indicate with an LED when the machine is overheating and say it in the consol
- The arduino will disable an individual channel when the current limit is reached and turn on an LED to indicate it.
- The arduino will be able to use scpi commands like ch1 and ch2 to read the settings on ch1 and ch2
- The arduino will be able to also accept commands via physical buttons on the enclosure (when added)
- The arduino will have 4 analog pins that are for controlling the voltage regulator and will utilize pulse width modulation up to 5v *

The arduino block itself is a microcontroller with hardware attached to it for user and pc input, its main purpose is to be the brain of the system and make everything talk to each other.
The hardware of the arduino contains buttons, LEDs, A custom PCB, a thermistor, and a few current sensors.
* Despite the interface definitions saying that CNTL_REG is a PWM signal from 0-5V digital potentiometers were used so they actually are acting as a digital output to control them.



Arduino Wire Diagram. Made using kicad schematic maker

The arduino has a Custom made PCB attached to it that hold the LEDs used to indicate status



Custom Arduino PCB made and plotted using Kicad

Arduino code:
https://drive.google.com/drive/folders/1TMKOWWOPAx1jRHoFnYcey3PT5NtXAFza?usp=sharing

Video of it working:
https://drive.google.com/file/d/11HEUMF8g0Mm85wF4R_hIZ-ATIrM8T9FS/view?usp=sharing

Enclosure Block

# Functionality

1. With FreeCad 0.19, I designed the encasing for the power supply parts, mounting them in a safe environment.
    a. Designed in ventilation holes to help dissipate heat
    b. Cut out openings for
        i. Power cord
        ii. Meters
        iii. Banana plugs
        iv. Manual radial switches

## Design:

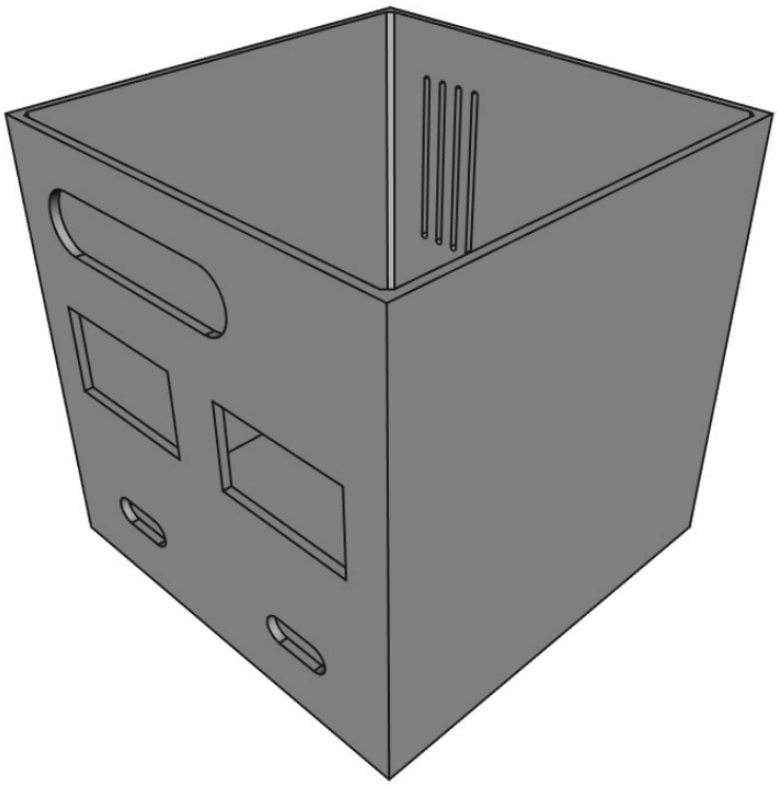


**Figure1: Front Perspective of the main housing**

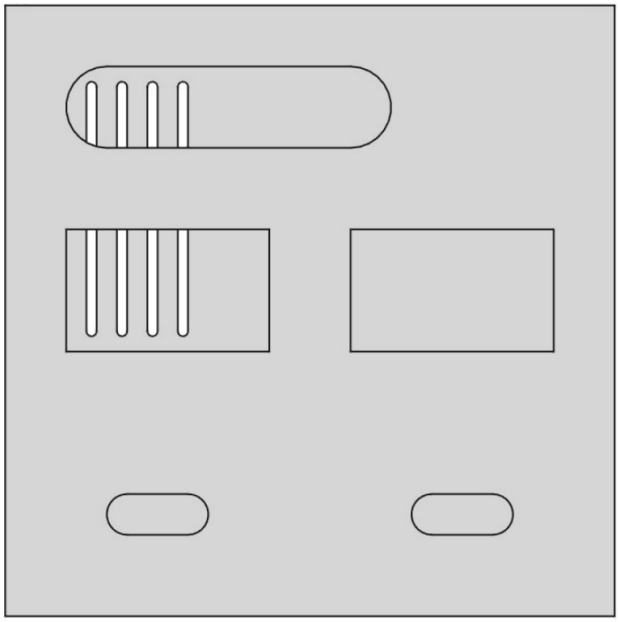


**Figure2: Front Orthographic perspective with openings for functions**

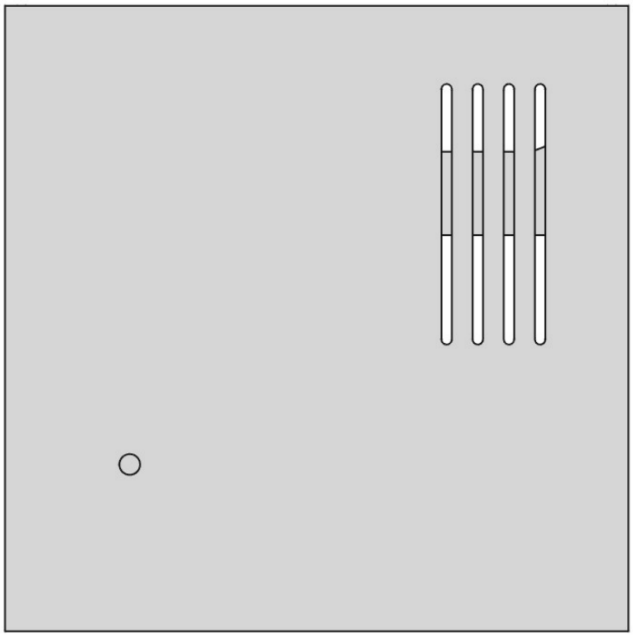


**Figure3: Rear Orthographic View with power cable opening and ventilation slits**

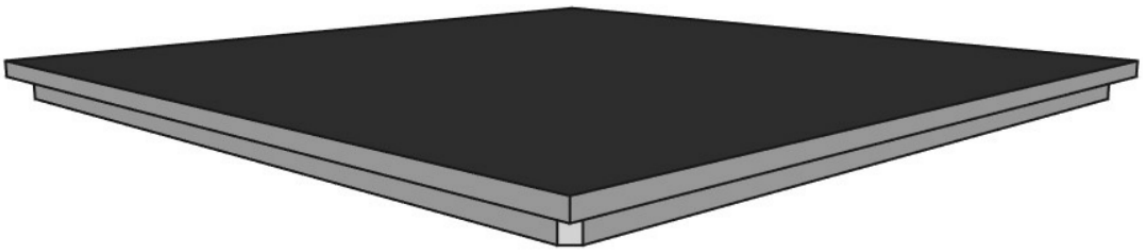


**Figure4: Top cover that will slid into the main housing**

AC-DC power module

**Functions**

1. Constant 20V at 1A is outputted at CNTLR_PWR
2. 20V is outputted at MAIN_PWR.
3. Fuses break when reaching above 24W of power.
4. D5 indicates whether power is flowing across fuse

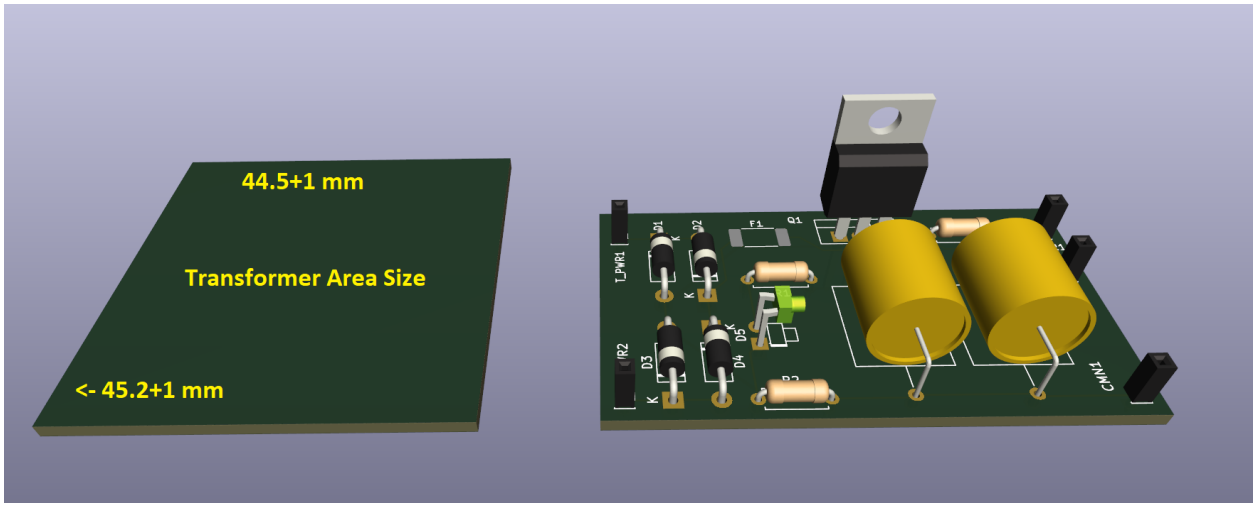



**Figure 3: 3D-View**

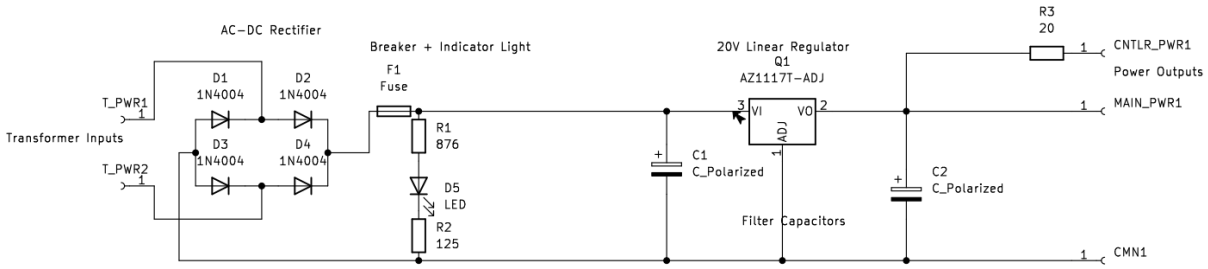



**Figure 1: Schematic Diagram**

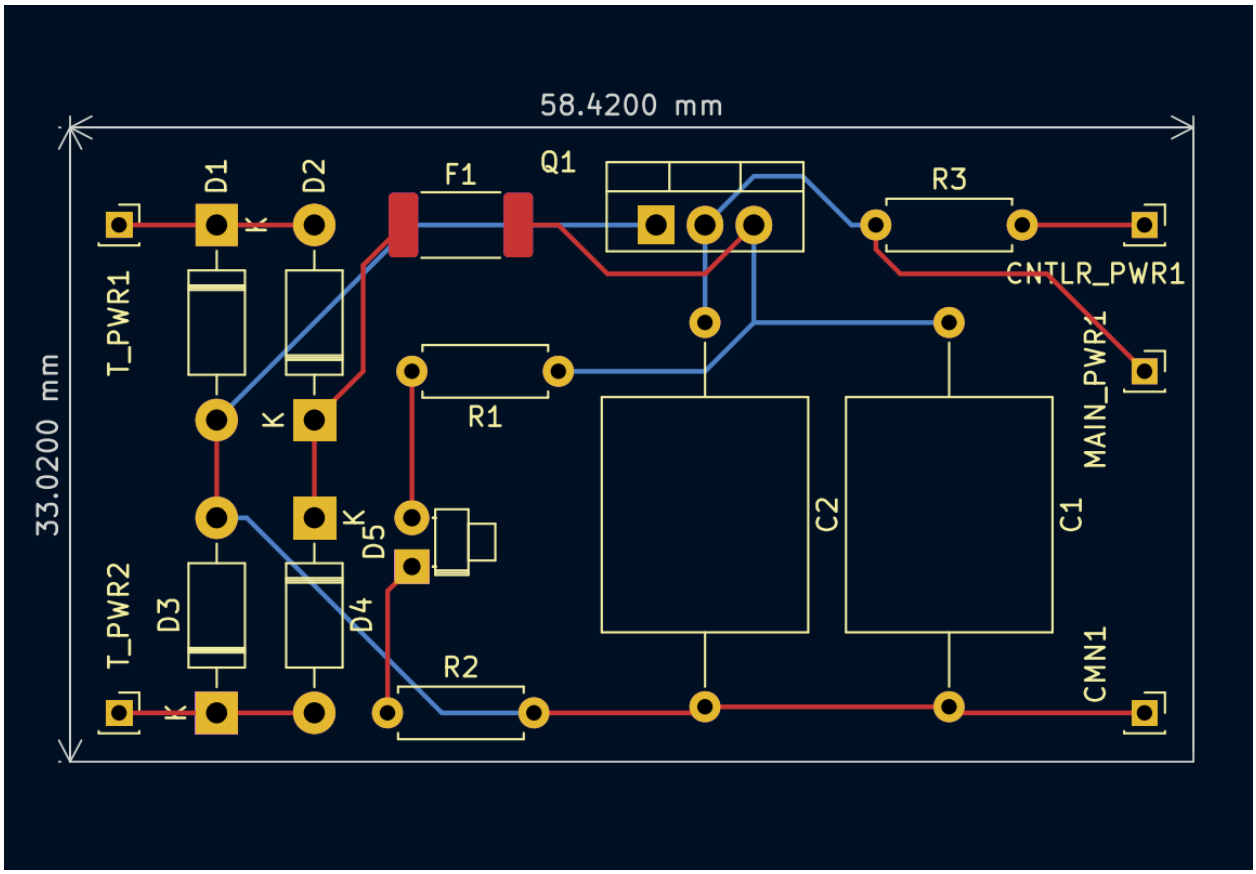



**Figure 2: PCB Design**

**Interface Table**

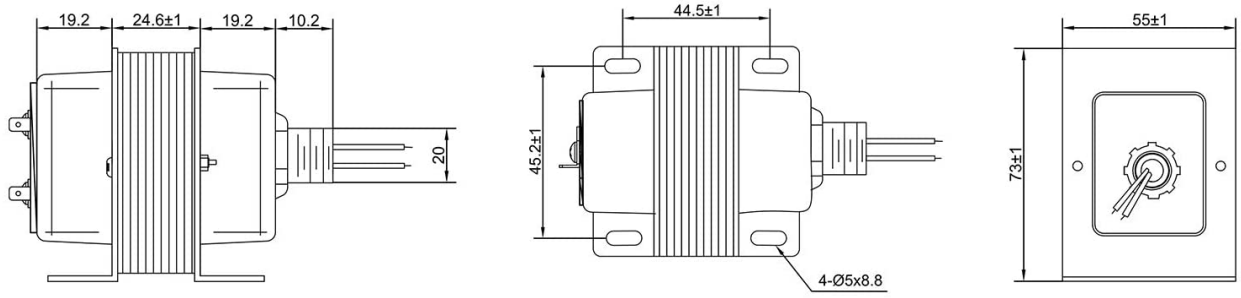
| Interfaces | Properties | Parameters |
|---|---|---|
| Vs | Source, Power | 120VAC |
| T1 | Transformer, Mechanical | 120VAC->24VAC, 40VA |
| D1-D4 | Rectifier Diodes, Semiconductor | If 1A, Vr 400V, Vf 1.1V, Max A 27A |
| D5 | LED, Green Light | 2.5V, 20mA |
| F1 | Fuse, Slow Blow | 1A, 125VAC |
| R1 | Resistor, Metal Film | 876 ohm, 100mW |
| R2 | Resistor, Metal Film | 125 ohm, 250mW |
| R3 | Wire rounded, Silicon coated | 20 ohm, 20W |
| C1-C2 | Al-Electrolytic Caps, Axial | 100uF, 25V |
| Q1 | Voltage Reg. To-220-3 Package | Output 20V, 1A |
| CNTLR_PWR | Power | 20V, 1A |
| MAIN_PWR | Power | 20V, Variable amps |
| CMN (Common) | Power | Negative Channel |

## Testing for Functions

1. With proper voltmeter and ammeter measure outputs at CNTLR_PWR and MAIN_PWR with differing loads.
    a. At least a 40 ohm, 10W resistor will test a low load, where possible cutoff from Q1 should activate. Meters should show a similar value to 20V at 0.5A.
    b. 20 ohm, 20W resistor will test a medium load. Measuring the power with both meters should show a value of around 20V at 1A.
    c. 10 ohm, 40W resistor will test the high load where the fuse would break. Where the LED at D5 should shut off due to no power coming across F1 Fuse.

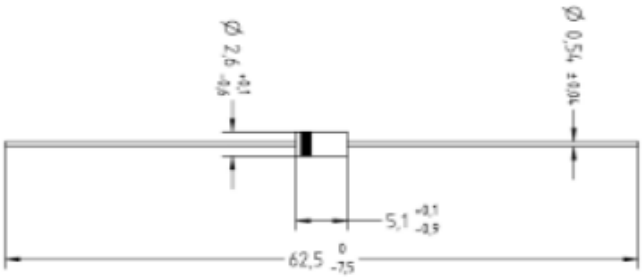
**Parts Mechanical Draigns**

**T1:**



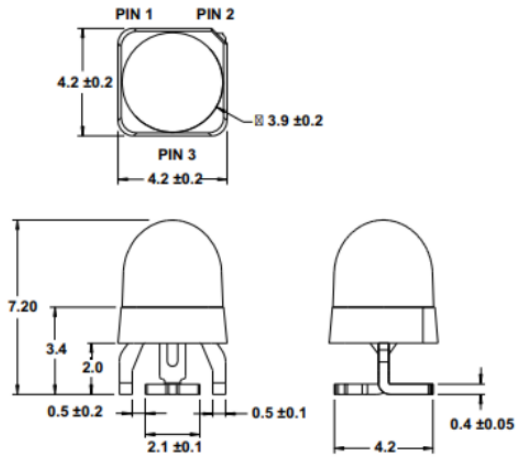

Note: Dimensions - mm

**D1-D4:**




**Dimensions - Maße [mm]**

**D5:**




| Lead Configuration | |
|---|---|
| Pin 1 | Anode |
| Pin 2 | Cathode |
| Pin 3 | Anode |

**NOTE:**

1. All dimensions are in millimeters (mm).
2. Tolerance is ±0.50 mm unless otherwise specified.

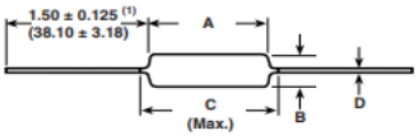
**F1:**

| | |
|---|---|
| Height: | 3.81 mm |
| Length: | 9.73 mm |

Note: found on Mouser.com, the Brand; Littlefuse's datasheet was not loading so updating to schematic with full picture will be done at a later time.

## R1 & R2:

**DIMENSIONS** in inches (millimeters)



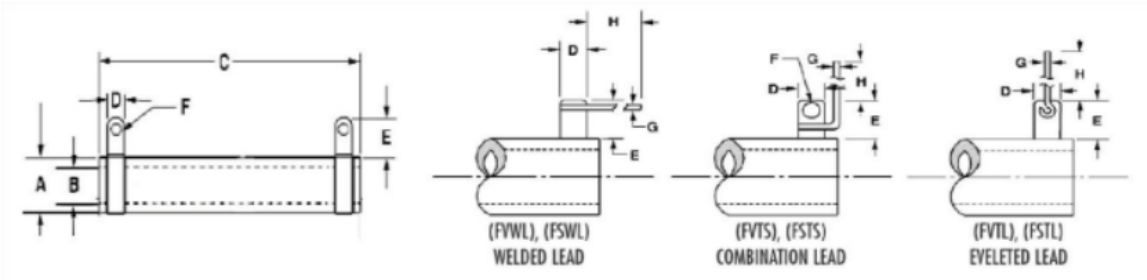

| VISHAY DALE MODEL | A | B | C (MAX.) | D |
|---|---|---|---|---|
| CMF50 | 0.150 ± 0.020 (3.81 ± 0.51) | 0.065 ± 0.015 (1.65 ± 0.38) | 0.244 (6.20) | 0.016 ± 0.002 (0.41 ± 0.05) |
| CMF55 | 0.240 ± 0.020 (6.10 ± 0.51) | 0.090 ± 0.008 (2.29 ± 0.20) | 0.290 (7.37) | 0.025 ± 0.002 (0.64 ± 0.05) |
| CMF60 | 0.344 ± 0.031 (8.74 ± 0.79) | 0.145 ± 0.015 (3.68 ± 0.38) | 0.425 (10.80) | 0.025 ± 0.002 (0.64 ± 0.05) |
| CMF65 | 0.562 ± 0.031 (14.27 ± 0.79) | 0.180 ± 0.015 (4.57 ± 0.38) | 0.687 (17.45) | 0.025 ± 0.002 (0.64 ± 0.05) |
| CMF70 | 0.562 ± 0.031 (14.27 ± 0.79) | 0.180 ± 0.015 (4.57 ± 0.38) | 0.687 (17.45) | 0.032 ± 0.002 (0.81 ± 0.05) |
| CMF07 | 0.240 ± 0.020 (6.10 ± 0.51) | 0.090 ± 0.008 (2.29 ± 0.20) | 0.290 (7.37) | 0.025 ± 0.002 (0.64 ± 0.05) |
| CMF20 | 0.375± 0.040 (9.53 ± 1.02) | 0.145 ± 0.015 (3.68 ± 0.38) | 0.425 (10.80) | 0.032 ± 0.002 (0.81 ± 0.05) |

**Note**

(1) Lead length for product in bulk pack. For product supplied in tape and reel, the actual lead length would be based on the body size, tape spacing and lead trim.

## R3:

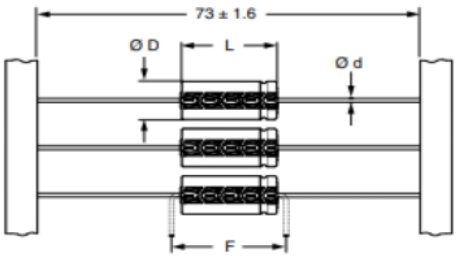
**DIMENSIONS** in inches [millimeters]




| MODEL | DIMENSIONS in inches [millimeters] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | CORE DIMENSIONS | | | TERMINAL | | | | LEADS | | BRACKET TYPE |
| | A | B | C | D | E | F | DESIGNATION | G | H | |
| FSTL05 | 0.313 [7.94] | 0.188 [4.76] | 1.000 [25.40] | 0.188 [4.78] | 0.438 [11.11] | - | R2 | 0.032 [0.813] | 2.00 [50.80] | 209 |
| FSTS05 | 0.313 [7.94] | 0.188 [4.76] | 1.000 [25.40] | 0.188 [4.78] | 0.438 [11.11] | 0.104 [2.64] | R2 | 0.032 [0.813] | 2.00 [50.80] | 209 |
| FSWL05 | 0.313 [7.94] | 0.188 [4.76] | 1.000 [25.40] | 0.125 [3.175] | 0.250 [6.35] | - | A2 | 0.032 [0.813] | 2.00 [50.80] | 209 |
| FSTL10 | 0.313 [7.94] | 0.188 [4.76] | 1.750 [44.45] | 0.188 [4.78] | 0.438 [11.11] | - | R1 | 0.040 [1.02] | 2.00 [50.80] | 209 |
| FSTS10 | 0.313 [7.94] | 0.188 [4.76] | 1.750 [44.45] | 0.188 [4.78] | 0.438 [11.11] | 0.104 [2.64] | R1 | 0.040 [1.02] | 2.00 [50.80] | 209 |
| FSWL10 | 0.313 [7.94] | 0.188 [4.76] | 1.750 [44.45] | 0.125 [3.175] | 0.250 [6.35] | - | A1 | 0.040 [1.02] | 2.00 [50.80] | 209 |
| FSTL20 | 0.438 [11.11] | 0.260 [6.604] | 2.000 [50.8] | 0.188 [4.78] | 0.406 [10.32] | - | R1 | 0.040 [1.02] | 2.00 [50.80] | 203 |
| FSTS20 | 0.438 [11.11] | 0.260 [6.604] | 2.000 [50.8] | 0.188 [4.78] | 0.406 [10.32] | 0.063 [1.59] | R1 | 0.040 [1.02] | 2.00 [50.80] | 203 |
| FSWL20 | 0.438 [11.11] | 0.260 [6.604] | 2.000 [50.8] | 0.125 [3.175] | 0.250 [6.35] | - | A1 | 0.040 [1.02] | 2.00 [50.80] | 203 |

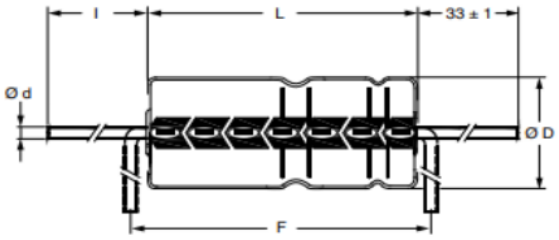
## C1 & C2:

**DIMENSIONS** in millimeters **AND AVAILABLE FORMS**




**Form BR:** Taped on reel
Case Ø D x L = 6.5 mm x 18 mm to 15 mm x 30 mm
**Form BA:** Taped in box (ammopack)
Case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm

Fig. 2 - **Forms BA** and **BR**




**Form AA:** Axial in box
Case Ø D x L = 10 mm x 30 mm to 21 mm x 38 mm

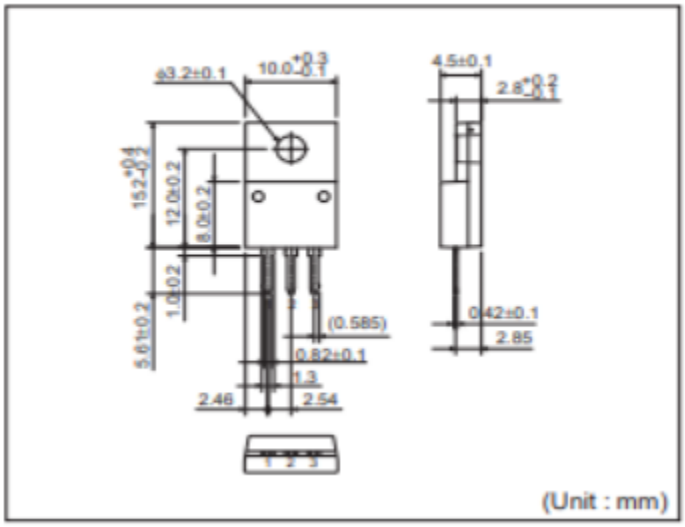
Fig. 3 - **Form AA**

**Table 1**

| **AXIAL; DIMENSIONS** in millimeters, **MASS, AND PACKAGING QUANTITIES** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **NOMINAL CASE SIZE Ø D x L** | **CASE CODE** | **AXIAL FORM AA, BA, AND BR** | | | | | **MASS (g)** | **PACKAGING QUANTITIES** | | |
| | | **Ø d** | **l** | **Ø $D_{max.}$** | **$L_{max.}$** | **$F_{min.}$** | | **FORM AA** | **FORM BA** | **FORM BR** |
| 6.5 x 18 | 4 | 0.8 | - | 6.9 | 18.5 | 25 | ≈ 1.3 | - | 1000 | 1000 |
| 8 x 18 | 5 | 0.8 | - | 8.5 | 18.5 | 25 | ≈ 1.7 | - | 500 | 500 |
| 10 x 18 | 6 | 0.8 | - | 10.5 | 18.5 | 25 | ≈ 2.5 | - | 500 | 500 |
| 10 x 25 | 7 | 0.8 | - | 10.5 | 25.5 | 30 | ≈ 3.3 | - | 500 | 500 |
| 10 x 30 | 00 | 0.8 | 55 ± 1 | 10.5 | 30.5 | 35 | ≈ 4.8 | 340 | - | 500 |
| 12.5 x 30 | 01 | 0.8 | 55 ± 1 | 13.0 | 30.5 | 35 | ≈ 7.4 | 260 | - | 400 |
| 15 x 30 | 02 | 0.8 | 55 ± 1 | 15.5 | 30.5 | 35 | ≈ 11.7 | 200 | - | 250 |
| 18 x 30 | 03 | 0.8 | 55 ± 1 | 18.5 | 30.5 | 35 | ≈ 12.9 | 120 | - | - |
| 18 x 38 | 04 | 0.8 | 34 ± 1 | 18.5 | 39.5 | 44 | ≈ 19.0 | 125 | - | - |
| 21 x 38 | 05 | 0.8 | 34 ± 1 | 21.5 | 39.5 | 44 | ≈ 24.0 | 100 | - | - |

## Q1:

**TO220CP-3**



**Voltage Regulator Module:**

- Takes an input voltage from a range of 4 volts up to 40 volts.
- The output can be adjusted from 1.2 volts up to 37 volts.
- The output current is 1.5 amps max.

The block can be controlled via a regular potentiometer or a digital potentiometer which allows the user to control it via PC.

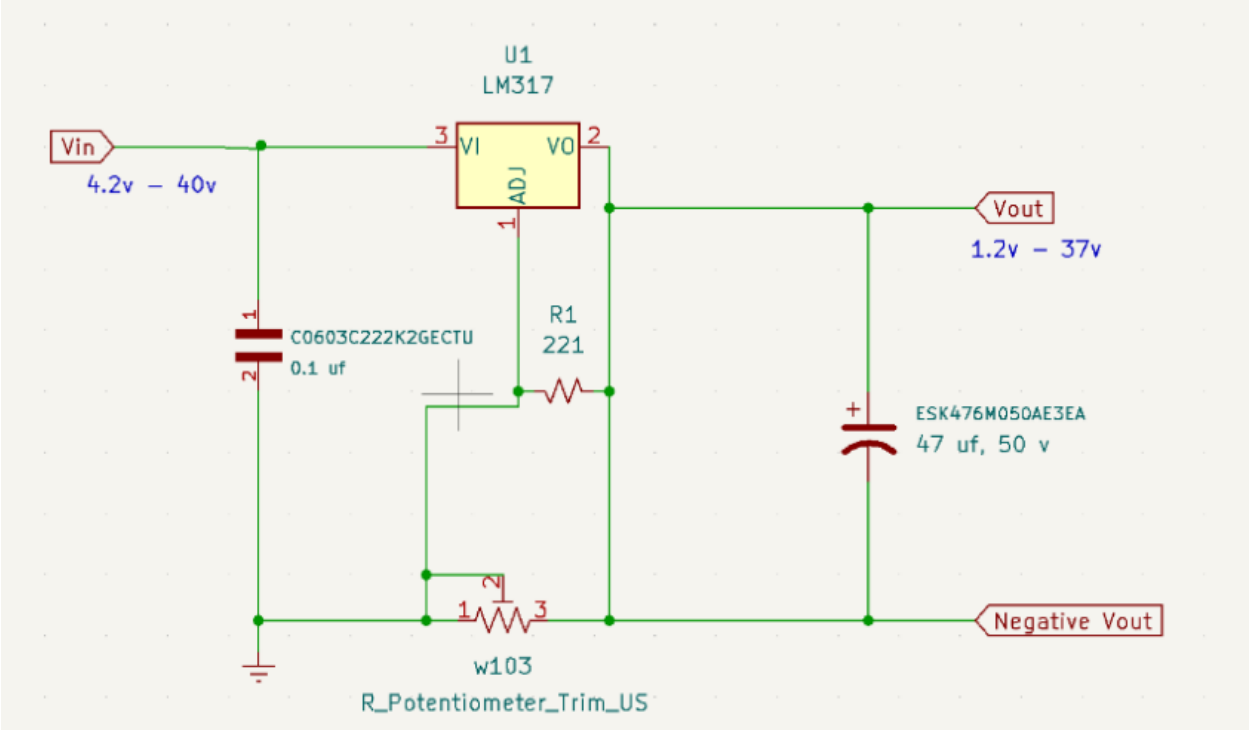



**Figure 1: Block Schematic**

**Block interface:**

| Interfaces | Properties | Parameters |
|---|---|---|
| Voltage_Regulator | DC output, Circuit | Regulates 20V into variable outputs |
| Vin | Voltage input | 4.2v – 40v |
| Vout | Voltage output | 1.2v – 37v |
| LM317 | Voltage Divider | |
| R1 | Resistor 1 | 221 ohms |
| W103 | Potentiometer | 10 ohms to 2 megohms |

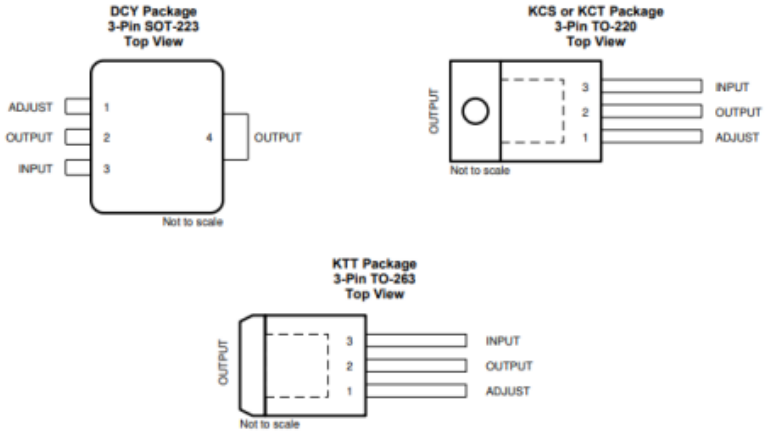
| | | |
|---|---|---|
| C1 | C0603C222K2GECTU | 0.1 uf |
| C2 | ESK476M050AE3EA | 47 uf, 50v |
| GND | Ground | |
| Negative Vout | | |

**Block Dimensions:**

**35.6 (mm) x16.8 (mm)**

Mechanical Drawing:

# LM317



**Current limiter Block:**

The block's function is to limit the current so it stays within the range that was specified in the project requirements. Also, the block holds the final channels which are channel 1 and channel 2.

**Block Schematic:**

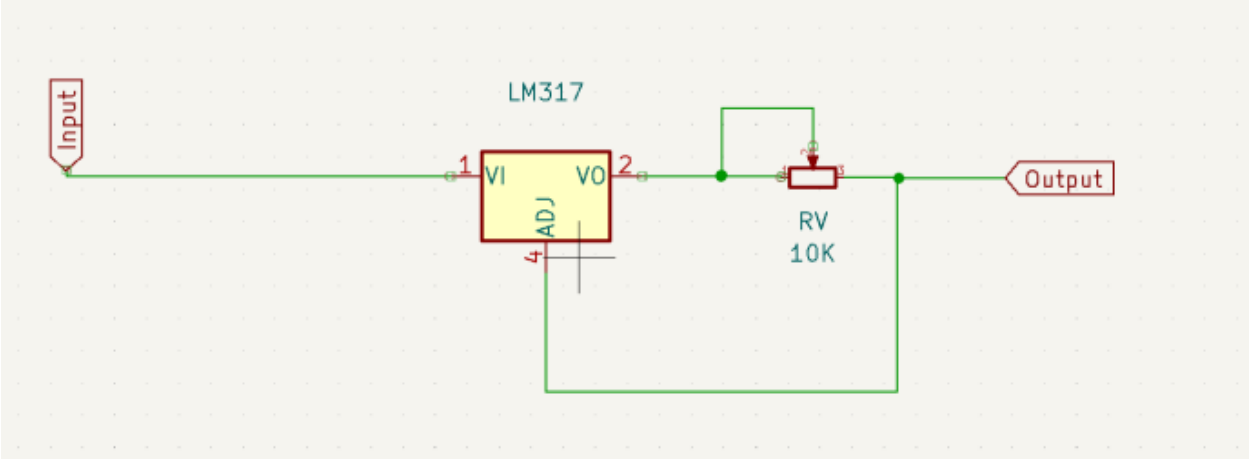
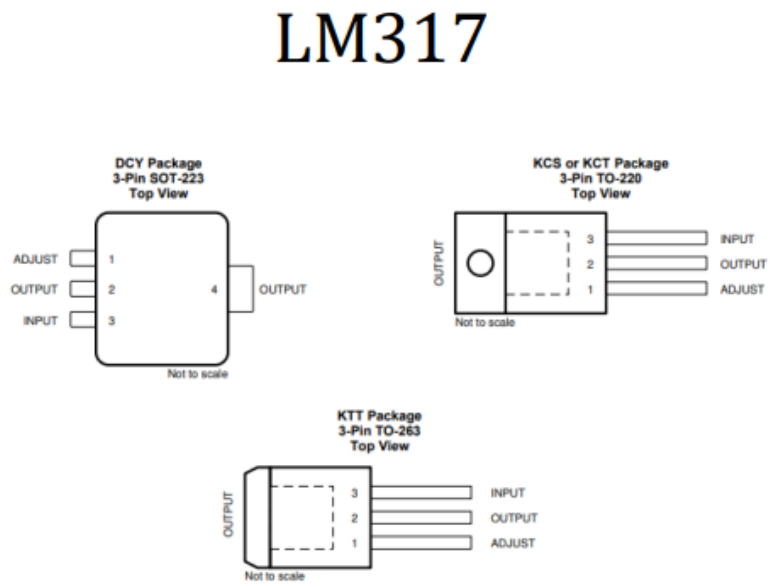



**Figure 1: Block Schematic**

Mechanical Drawing:



Parts List:

| item | cost | shipping | quantity | calculated cost | calculated total | link |
|---|---|---|---|---|---|---|
| Voltage regulator | 1.275 | 7 | 4 | 12.1 | 226.59 | https://www.ti.com/store/ti/en/p/product/?p=TPS54231DR&keyMatch=TPS54231DR&tisearch=search-everything&usecase=OPN |
| banana jack | 8.99 | | 1 | 8.99 | | https://www.amazon.com/EIGHTNOO-Binding-Speaker-Amplifier-Terminal/dp/B07CK1VL3B/ref=sr_1_15?crid=1I78P36DO8FIZ&keywords=banana+plug+female&qid=1650483047&sprefix=banana+plug+female%2Caps%2C131&sr=8-15 |
| arduino nano | 18 | 0 | 1 | 18 | | https://www.amazon.com/Arduino-Nano-Every-Single-Board/dp/B07VX7MX27/ref=sr_1_3?crid=21H9CNUQRMB79&keywords=arduino+nano+every&qid=1652288850&sprefix=arduino+nano+every%2Caps%2C136&sr=8-3 |
| display | 9.59 | | 1 | 9.59 | | https://www.amazon.com/HiLetgo-Voltmeter-Ammeter-Digital-Meter/dp/B072BY4XZ7/ref=sr_1_1_sspa?crid=2SUV9M2JFR3MZ&keywords=voltage+and+amp+display&qid=1650483876&sprefix=voltage+and+amp+display%2Caps%2C127&sr=8-1-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEzRDQ5WTRNTENCODROJmVuY3J5cHRlZEIkPUExMDA5MDk5T1BUQUhQWlQ1U1ZRJmVuY3J5cHRlZEFkSWQ9QTA0MjI3NTYyMFhNSDg0VTdKTUpaJndpZGdldE5hbWU9c3BfYXRmJmFjdGlvbj1jbGlja1JlZGlyZWN0JmRvTm90TG9nQ2xpY2s9dHJ1ZQ== |
| thermo resistor | 0.926 | | 5 | 4.63 | | https://www.digikey.com/en/products/detail/littelfuse-inc/103JG1K/1769856 |
| 10k resistor | 0.0436 | 4.99 | 50 | 7.17 | | |
| 5v ac step down | 11.99 | | 2 | 23.98 | | https://www.amazon.com/gp/product/B07FNFJTHH/ref=ewc_pr_img_1?smid=ATCVC199CHVK0&psc=1 |
| outlet power cord | 6.99 | | 1 | 6.99 | | https://www.amazon.com/CorpCo-Power-Cord-Sony-PlayStation/dp/B010L06UK2/ref=sr_1_10?crid=3SD1N9VDUJOYT&keywords=power+cord&qid=1650488536&sprefix=power+cord%2Caps%2C144&sr=8-10 |
| 120VAC-24VAC transformer | 24.99 | 4.99 | 1 | 29.98 | | https://www.amazon.com/Thermostat-Doorbell-Transformer-Compatible-Honeywell/dp/B07L9X9V57/ref=sr_1_3?crid=1RNMUUJYQYE90&keywords=power+transformer+20v&qid=1650858186&sprefix=power+transformer+20v%2Caps%2C129&sr=8-3 |

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|---|---|---|---|---|---|---|
| AC power cord (three pronged) | 8.09 | 4.99 | 1 | 13.08 | | https://www.amazon.com/StarTech-com-Computer-Replacement-Printer-Monitor/dp/B0002GRUIM/ref=sxin_14_ac_d_rm?ac_md=2-2-Y29tcHV0ZXIgcG93ZXIgY29yZA%3D%3D-ac_d_rm_rm_rm&cri d=3TCUCGCLELRMB&cv_ct_cx=power+cord&keywords=power+cord&pd_rd_i=B0002GRUIM&pd_rd_r=36491eab-e2a2-4a0b-8e4a-27d028a35f71&pd_rd_w=bCePt&pd_rd_wg=36Dyj&pf_rd_p=16c2e2c7-394a-43c0-a64c-993eb5e237ce&pf_rd_r=SWN8FQ7EFE937BNSQ89W&psc=1&qid=1650858627&sprefix=power+cor%2Caps%2C148&sr=1-3-7d9bfb42-6e38-4445-b604-42cab39e191b |
| Filter Capacitors | 3.78 | 4.99 | 2 | 12.55 | | https://www.mouser.com/ProductDetail/Vishay-BC-Components/MAL211936101E3?qs=AhZUXTPDWi7MDv58P7XejQ%3D%3D |
| 20V Regulator | 0.84 | 4.99 | 1 | 5.83 | | https://www.mouser.com/ProductDetail/ROHM-Semiconductor/BA17820CP-E2?qs=IsRgwgmxh69i6dj9wnMrLg%3D%3D |
| 1A fuse | 3.08 | 4.99 | 1 | 8.07 | | https://www.mouser.com/ProductDetail/Littelfuse/0154001.DRT?qs=gu7KAQ731UQPKHSDuMkClg%3D%3D |
| rectifier diodes | 0.49 | 4.99 | 4 | 6.95 | | https://www.mouser.com/ProductDetail/Diotec-Semiconductor/1N4004?qs=OlC7AqGiEDk3eaZusDVIWQ%3D%3D |
| green indicator diodes | 1.16 | 4.99 | 1 | 6.15 | | https://www.mouser.com/ProductDetail/Broadcom-Avago/AEMD-CM1L-34002?qs=TuK3vfAjtkVL%252BTbsF6JDLw%3D%3D |
| 20 ohm resistor(for nano at 20V, 1A) | 7.78 | 4.99 | 1 | 12.77 | | https://www.mouser.com/ProductDetail/Vishay-Huntington/FSTL20R1E20R00JENI?qs=sGAEpiMZZMtlubZbdhIBIDDTn0wYDoXKC0YK8rNRgL8%3D |
| 125 ohm resistor | 0.57 | 4.99 | 1 | 5.56 | | https://www.mouser.com/ProductDetail/Vishay-Dale/RN60D1250FB14?qs=sGAEpiMZZMtlubZbdhIBIMRkrCcqHXyaRc6dlcTtrb8%3D |
| 876 ohm R | 0.9 | 4.99 | 1 | 5.89 | | https://www.mouser.com/ProductDetail/Vishay-Dale/RN55E8760BRE6?qs=sGAEpiMZZMtlubZbdhIBID%252BpopiEiQduF58kbd7HJRY%3D |
| 10k Ohm Multi-Turn Trimmer Potentiometer | 1.5 | | 2 | 3 | | https://resi.store/products/819/ |
| voltage and current meter | 11.99 | | 1 | 11.99 | | https://www.amazon.com/dp/B08BZKPSFY?psc=1&ref=ppx_yo2ov_dt_b_product_details |
| cable | 8.99 | | 1 | 8.99 | | https://www.amazon.com/dp/B07GD2PGY4?ref=ppx_yo2ov_dt_b_product_details&th=1 |
| protoboar | 1.16 | 3. | 1 | 4.33 | | https://pt.aliexpress.com/item/1005004190188068.html?spm=a2g |

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|---|---|---|---|---|---|---|
| ds | | 17 | | | | 0o.productlist.0.0.24362a3bhroiN6&algo_pvid=333efee8-bb31-4a3f-9f58-b2460decf52b&aem_p4p_detail=20220511101134408985222951368001751397 3&algo_exp_id=333efee8-bb31-4a3f-9f58-b2460decf52b-9&pdp_ext_f=%7B%22sku_id%22%3A%2212000028329560498%22%7D&pdp_npi=2%40dis%21USD%21%211.16%21%21%213.17%21%21%400bb0623c16522890942595972eb87d%211200028329560498%21sea |

**Time Report:**

| Name | Time spent on project |
|---|---|
| **Meshari Alqahs** | **130 hrs/14.4 hrs weekly** |
| **Rowan Lester** | **~122 hrs ~13.6 hrs weekly** |
| | |