Phil-Mont Mobile Radio Club

March 2023 Radio Labs

Adjustable Regulated Power Supply Kit

What we're going to do…

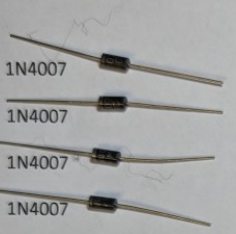
- Build a 1.25 to 25VDC Adjustable Regulated Power Supply
- Learn to identify electronic components
- Learn the Block Diagram of a Linear Power Supply
- Learn to recognize symbols on a Schematic Diagram
- Learn the function of each component in the Power Supply
- Learn basic assembly skills
- Learn basic soldering skills

Have FUN!!!

Electronic Components

Step #1 - DIODES

D1	1N4007
D2	1N4007
D3	1N4007
D4	1N4007

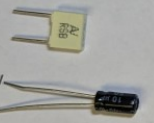


Step #2 - RESISTORS

R1	10k ohm 1/4W 5%	Brown / Black / Orange / Gold
R2	120 ohm 1/4W 5%	Brown / Red / Brown / Gold
R3	1k ohm 1/4W 5%	Brown / Black / Red / Gold

Step #3 - SMALL CAPACITORS

C4	0.15uF
C5	10uF / 50V



Step #4 – TERMINAL BLOCKS

18VAC INPUT	IN -/+ / IN -/+
VDC OUTPUT	PWR / GND

Step #5 – VARIABLE RESISTOR

VR1	4.7k ohm

Step #6 – LED (LIGHT-EMITTING DIODE) INDICATOR

L1	"Red Drop"

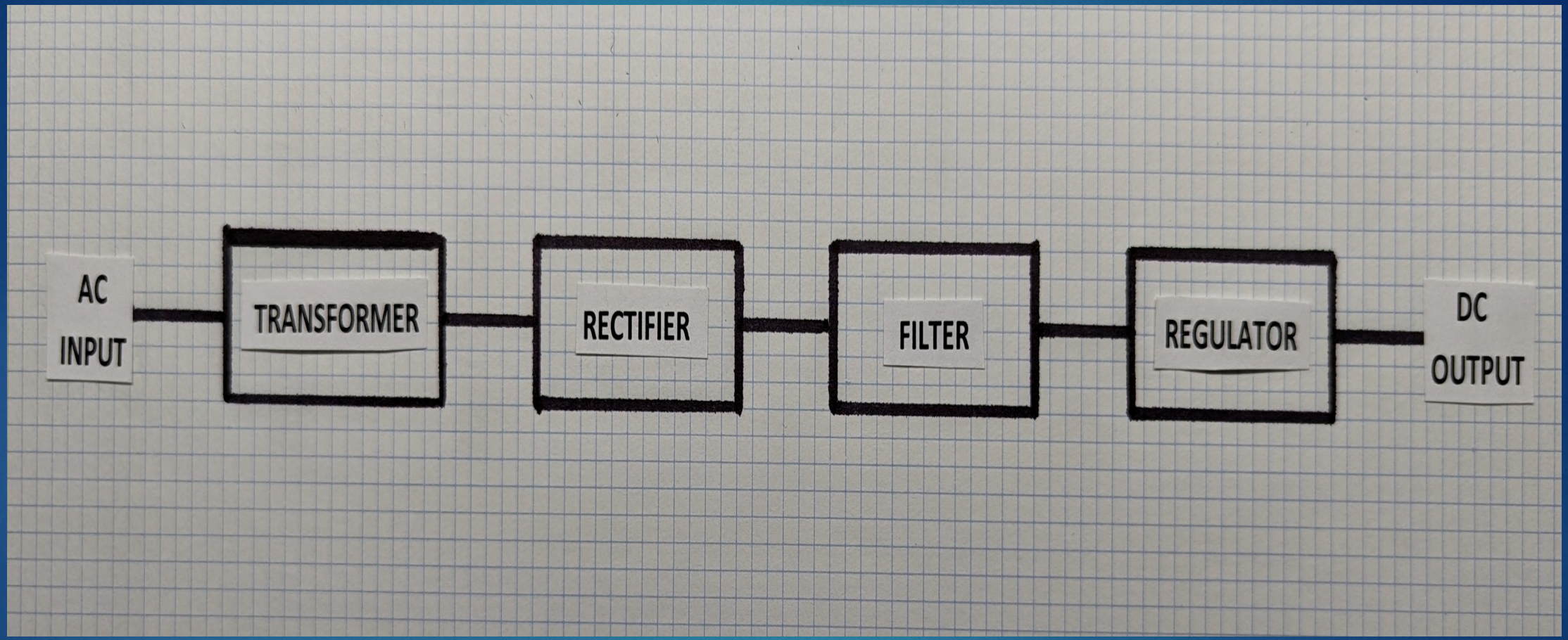
Step #7 – LARGE CAPACITOR

C1	3300uF / 35V

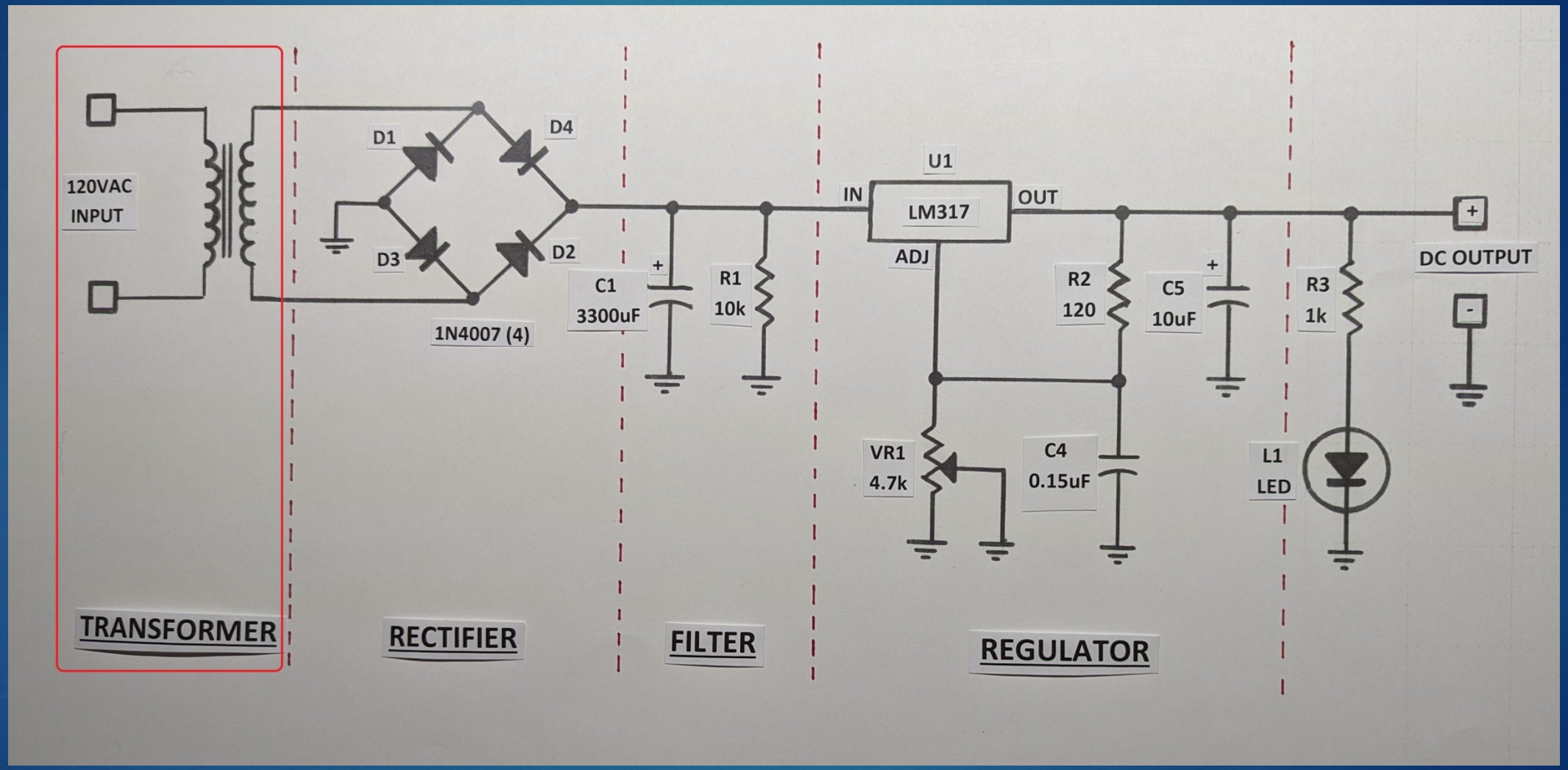
Step #8 - REGULATOR

U1	LM317

Linear Power Supply Block Diagram



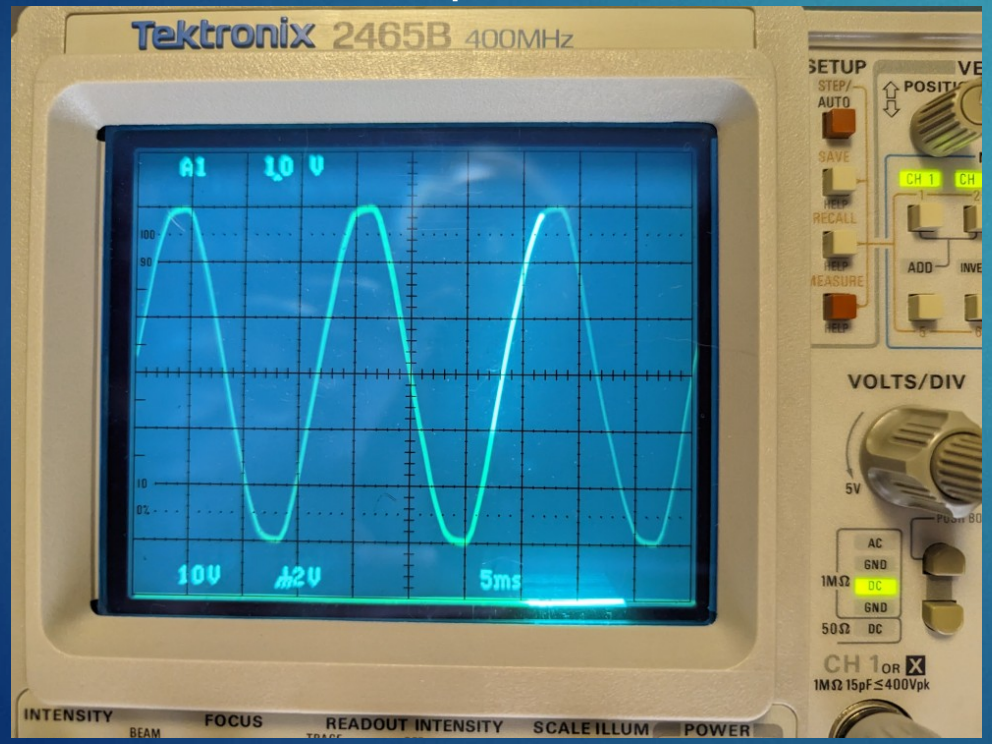
Transformer



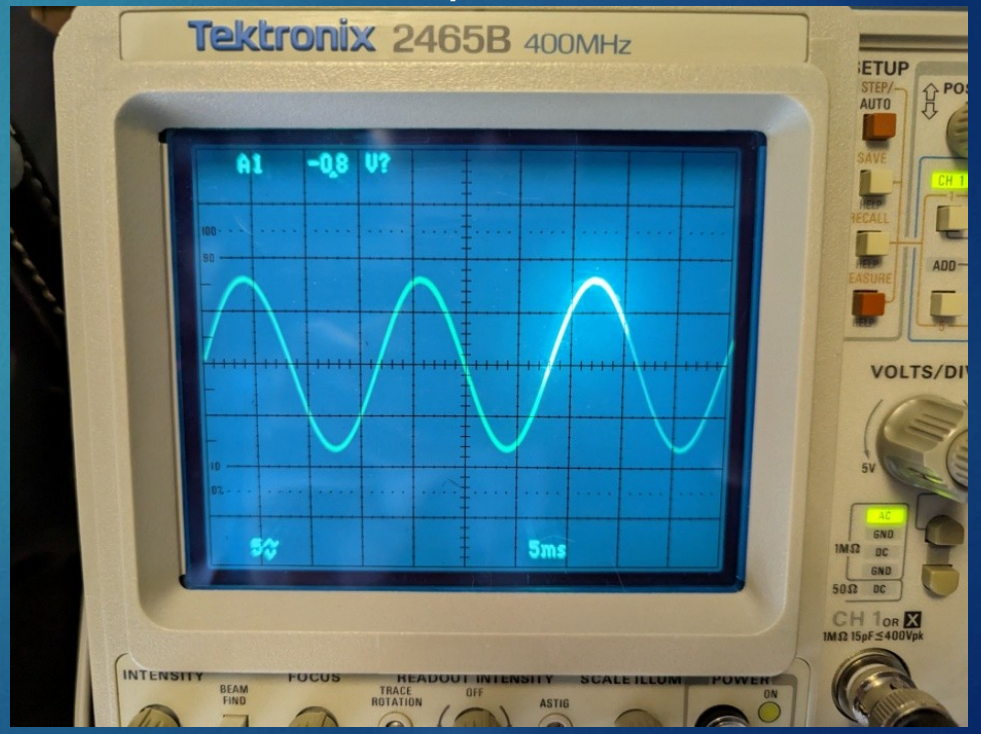
Transformer

- Transfer electrical energy from one circuit (Primary) to another (Secondary)
- Amount of energy transferred is proportional to the turns ratio (Primary to Secondary)

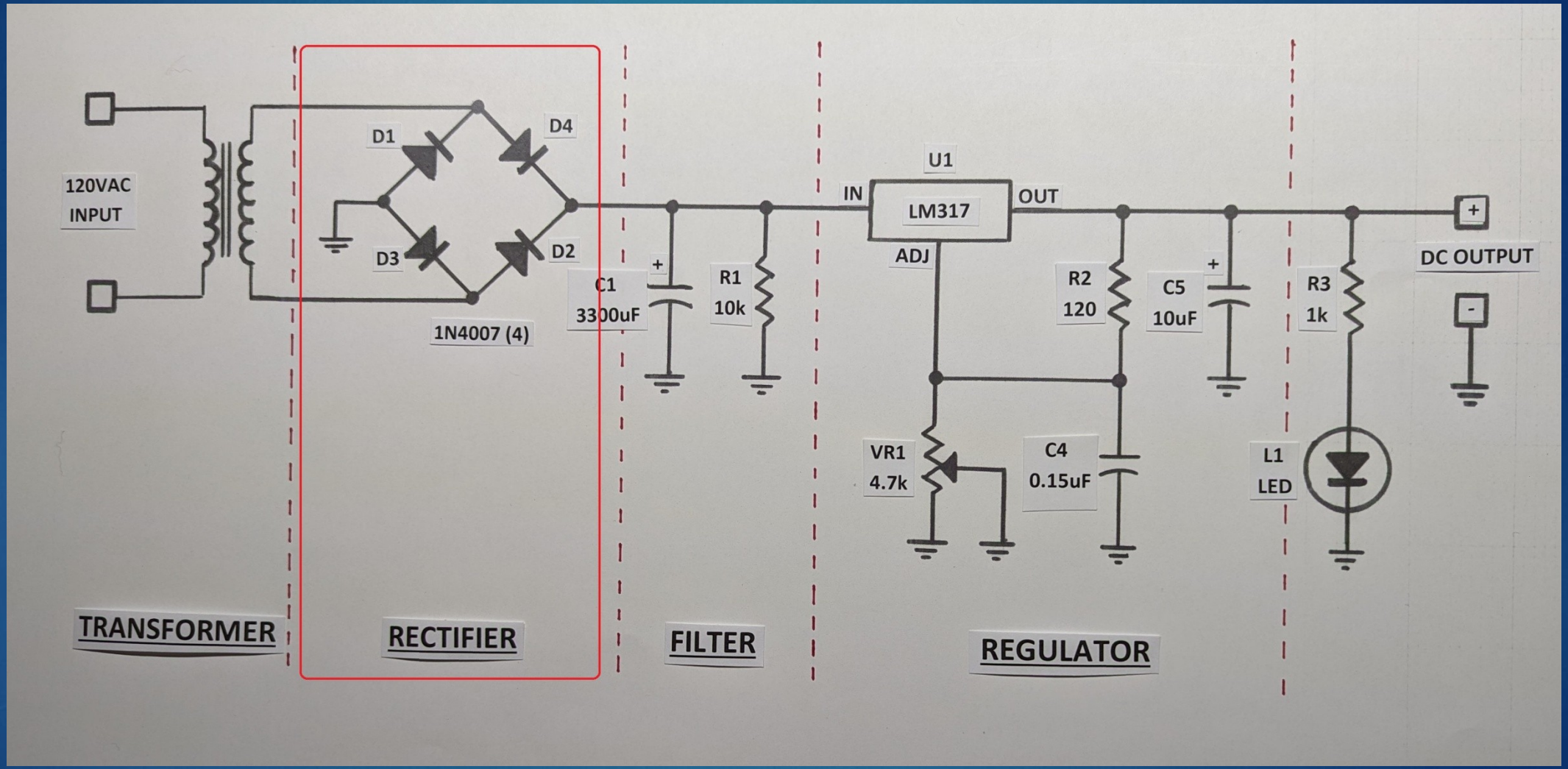
120 VAC Input Waveform



18VAC Output Waveform



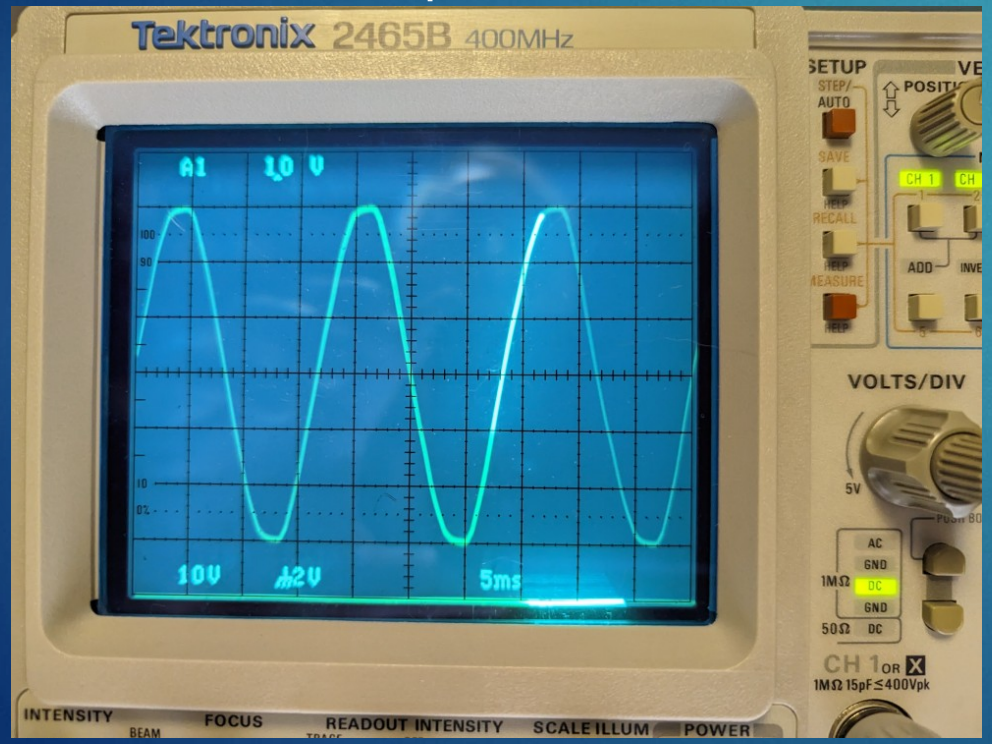
Rectifier


120VAC
INPUT
D1
D4
D3
D2
1N4007 (4)
C1
3300uF
R1
10k
U1
IN
LM317
OUT
ADJ
R2
120
C5
10uF
R3
1k
DC OUTPUT
VR1
4.7k
C4
0.15uF
L1
LED
TRANSFORMER
RECTIFIER
FILTER
REGULATOR

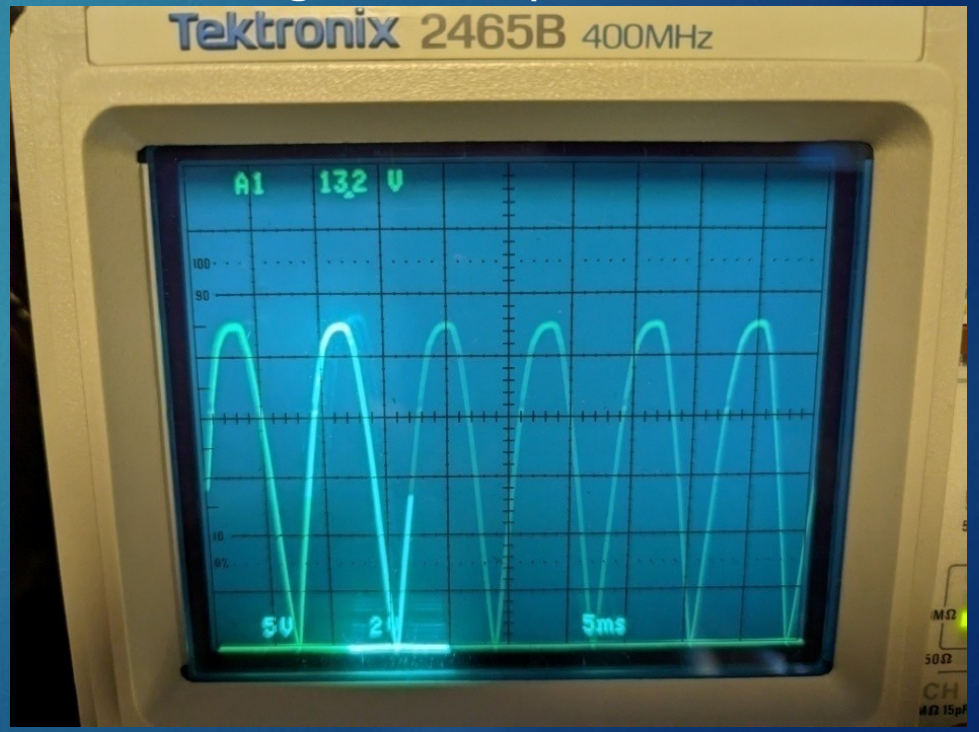
Rectifier

- A “Rectifier” is one use for a diode
- A diode allows current to flow in ONE direction
  - From Anode (Positive) to Cathode (Negative)
- Converts AC voltage to pulsating DC voltage

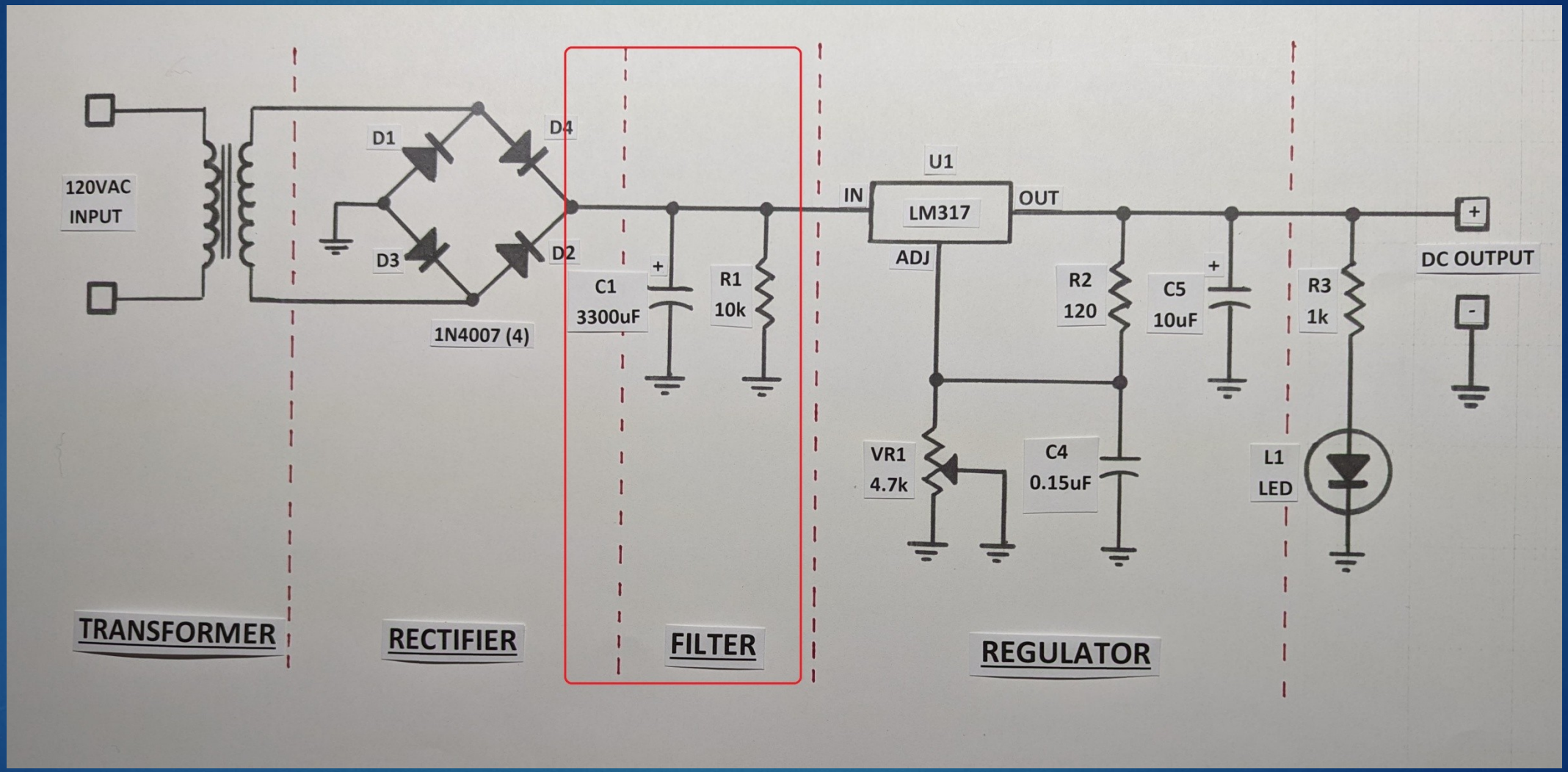
18VAC Input Waveform



Pulsating DC Output Waveform



Filter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L1
LED
TRANSFORMER
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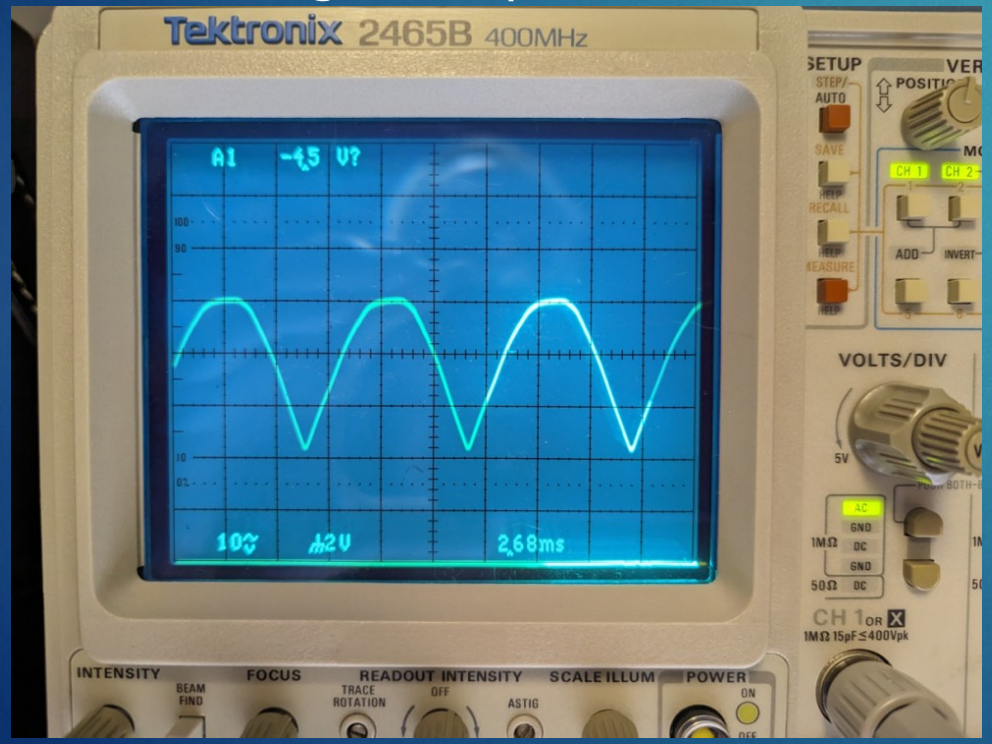
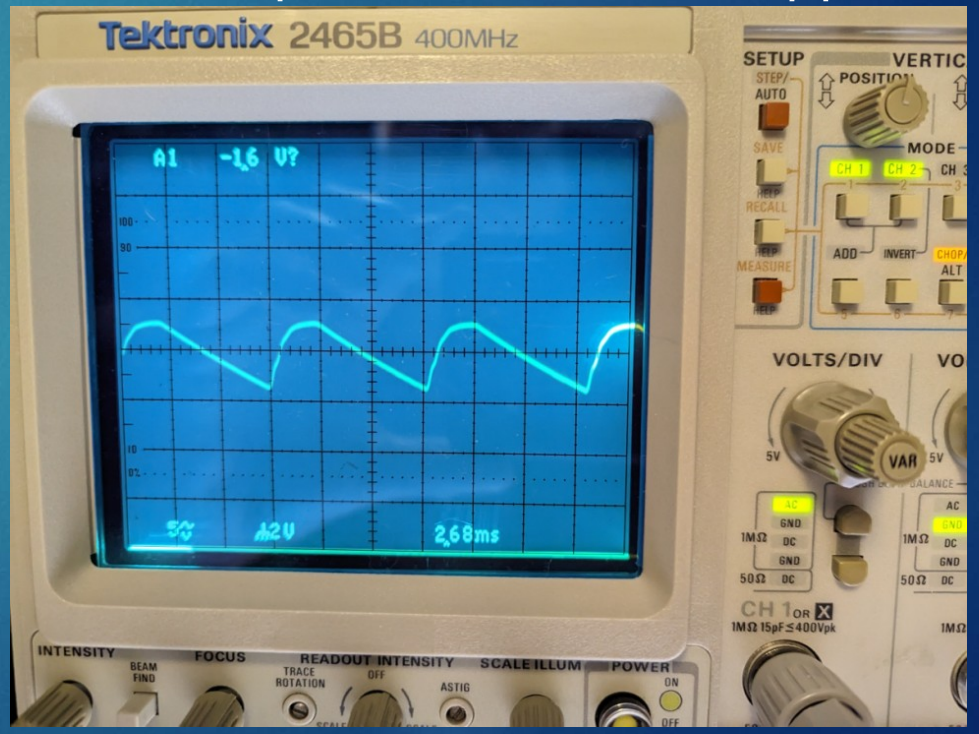
Filter

- A “Filter” is one use for a capacitor
- Stores electrical energy between parallel plates
- Electrolytic Capacitors are polarity-sensitive
- “Smoothes” the applied pulsating DC voltage
- Capacitance here is 2uF

Pulsating DC Input Waveform



DC Output Waveform w/Ripple

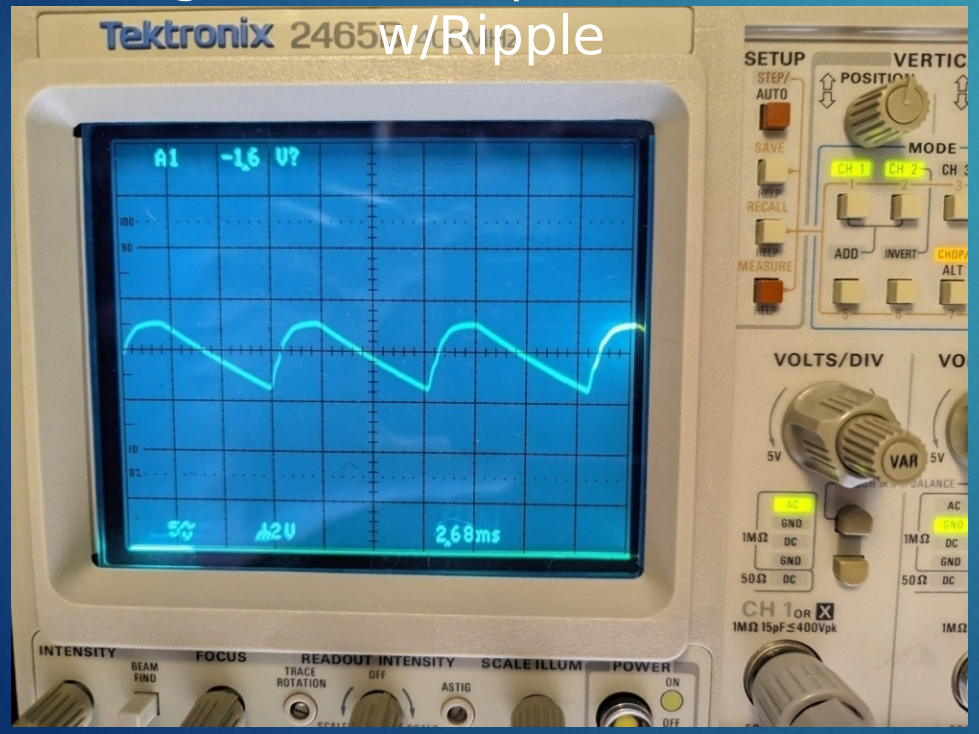


Selecting A Better Filter…

Better Filter

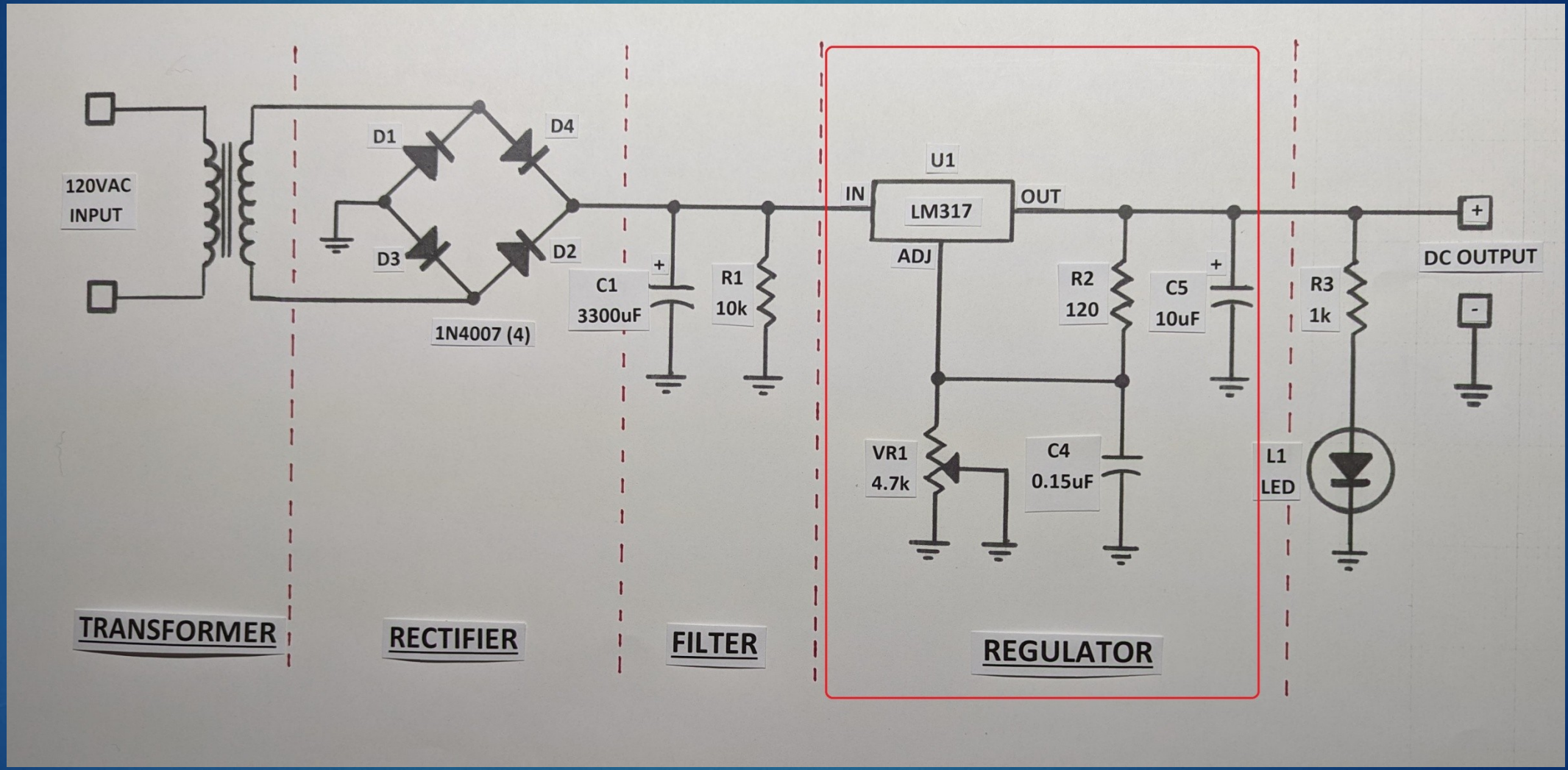
- A higher-value capacitor removes more ripple from the applied pulsating DC voltage
- Capacitance here is 220 uF

Original DC Output Waveform w/Ripple



DC Output Waveform w/o Ripple

Regulator


120VAC
INPUT
D1
D4
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1N4007 (4)
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LED
TRANSFORMER
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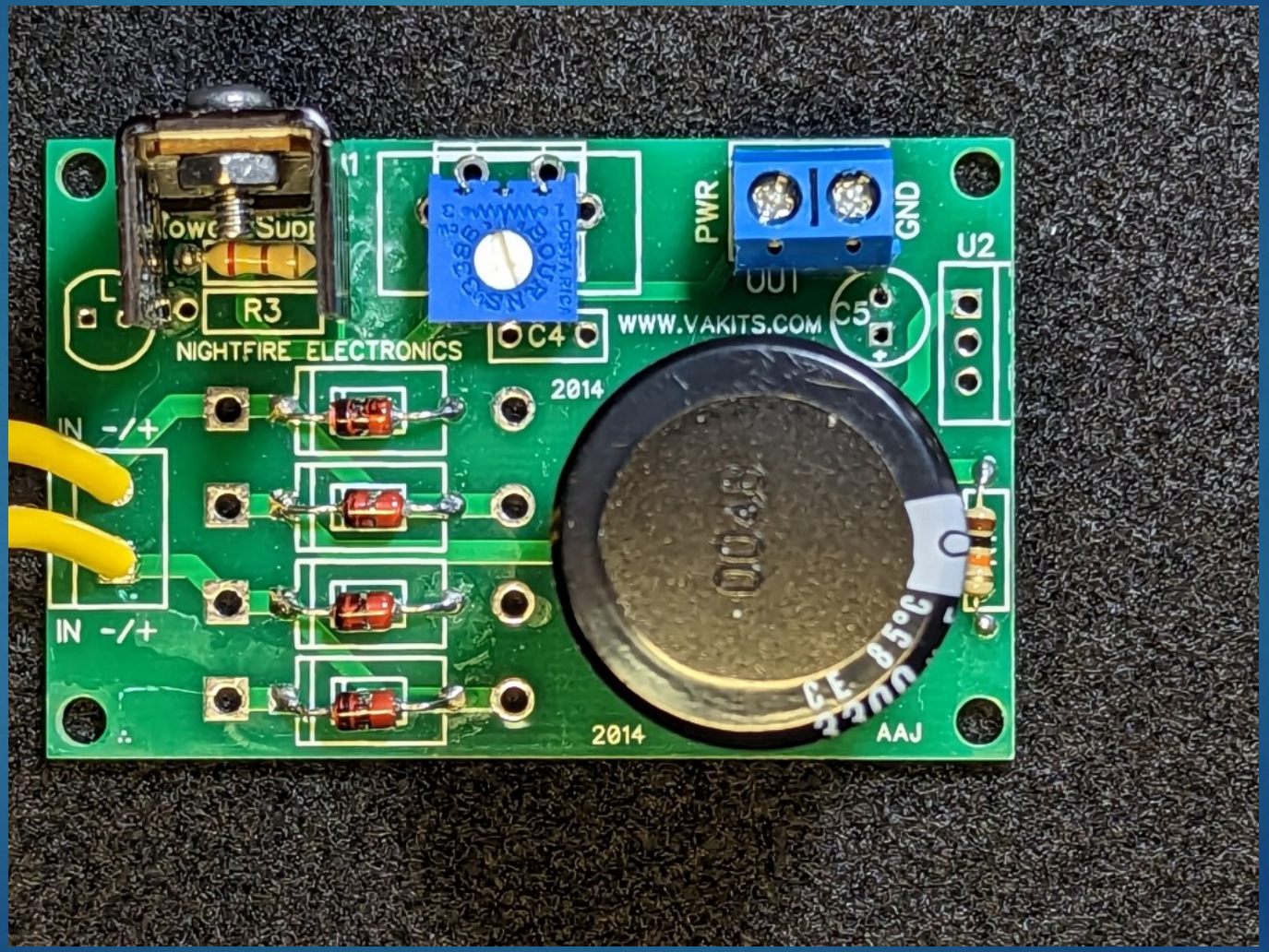
FILTER
REGULATOR

Regulator

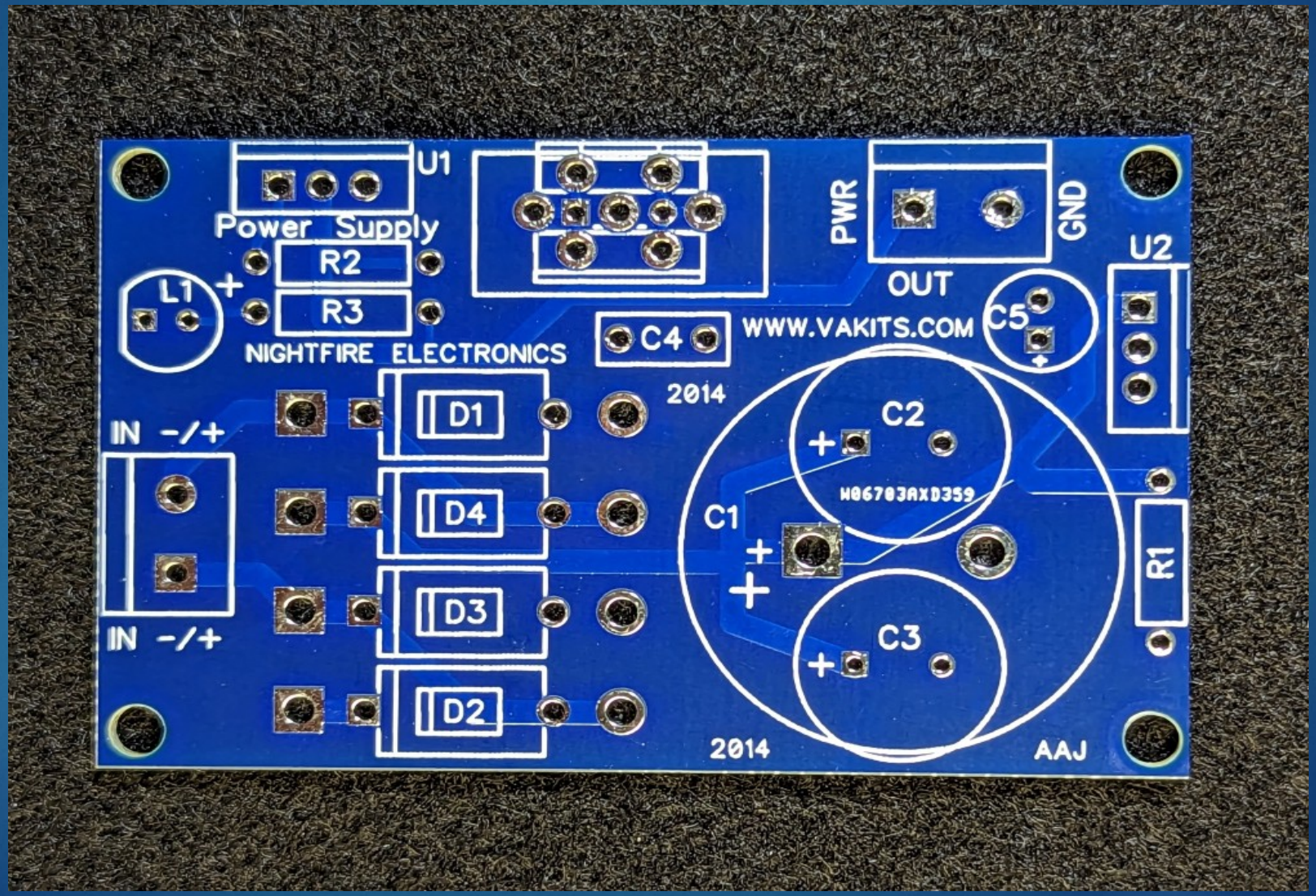
- Generates a constant output voltage from an unstable (varying) input voltage
- Three-Terminal Adjustable Regulator Integrated Circuit (IC) type LM317
- CAUTION!!! The IC get HOTTER as the current being drawn increases
- Different Regulator ICs for Positive and Negative Output Voltages
  - Fixed Positive Regulators: 7805 / 7812 / 7815 / 7824 / others
  - Fixed Negative Regulators: 7905 / 7912 / 7915 / others
  - Adjustable Negative Regulators: 337

CAUTION: Terminals are NOT the same for different devices!

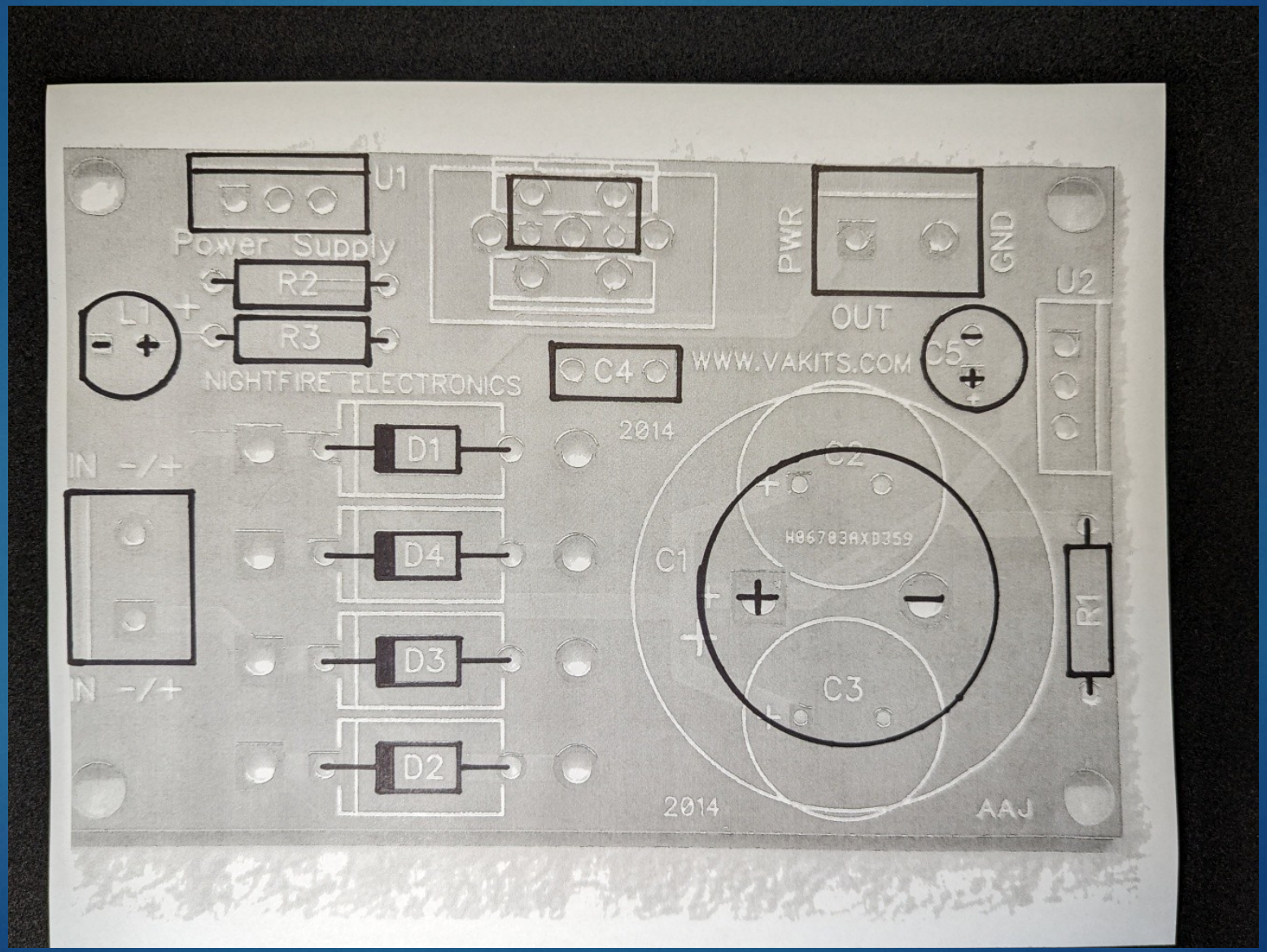
Assembled Power Supply



Printed Circuit Board

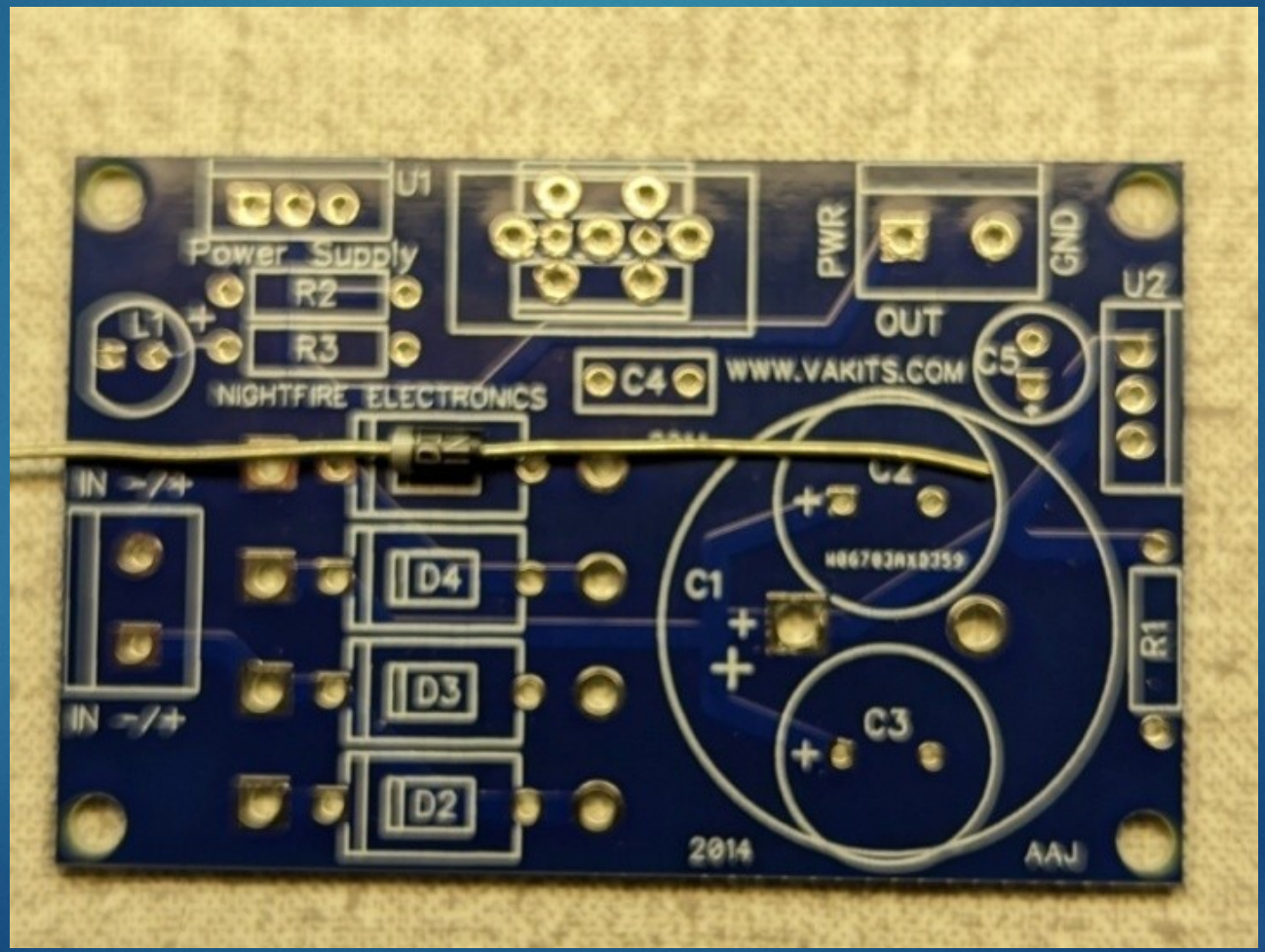


Assembly Drawing



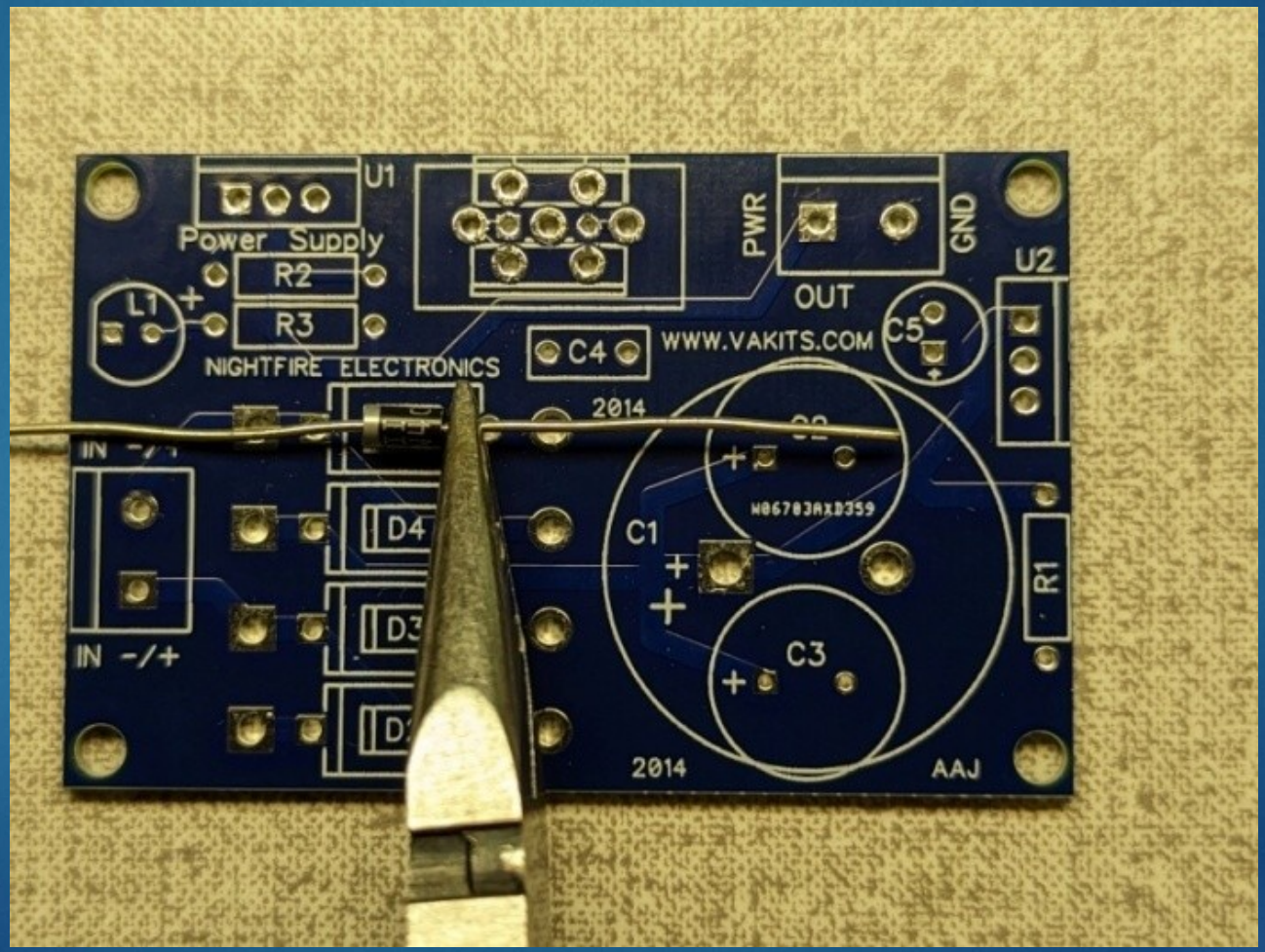
Component Installation – Step 1

- Step 1 – Place component over installation location



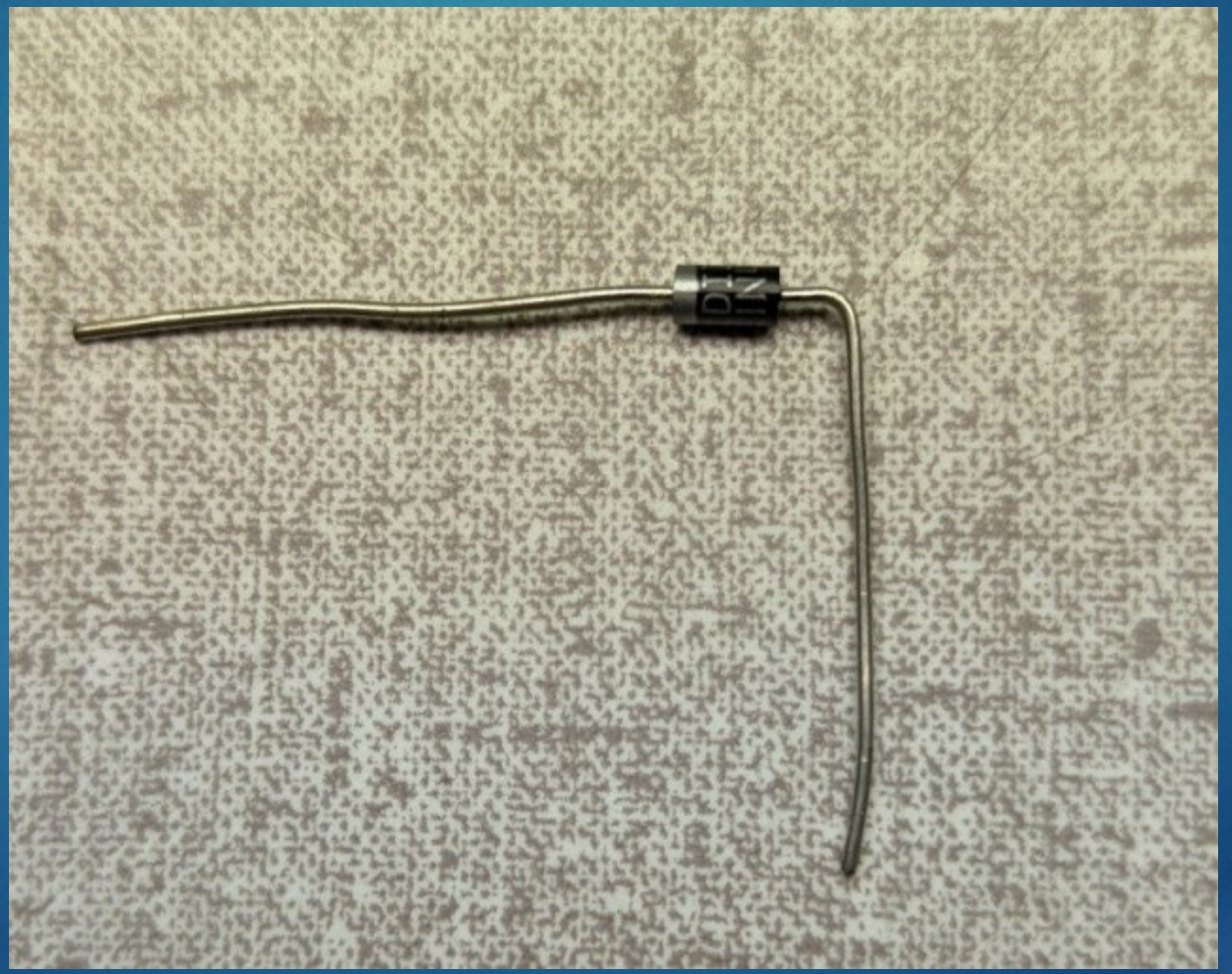
Component Installation – Step 2

- Step 2 – Grab component lead with pliers against body



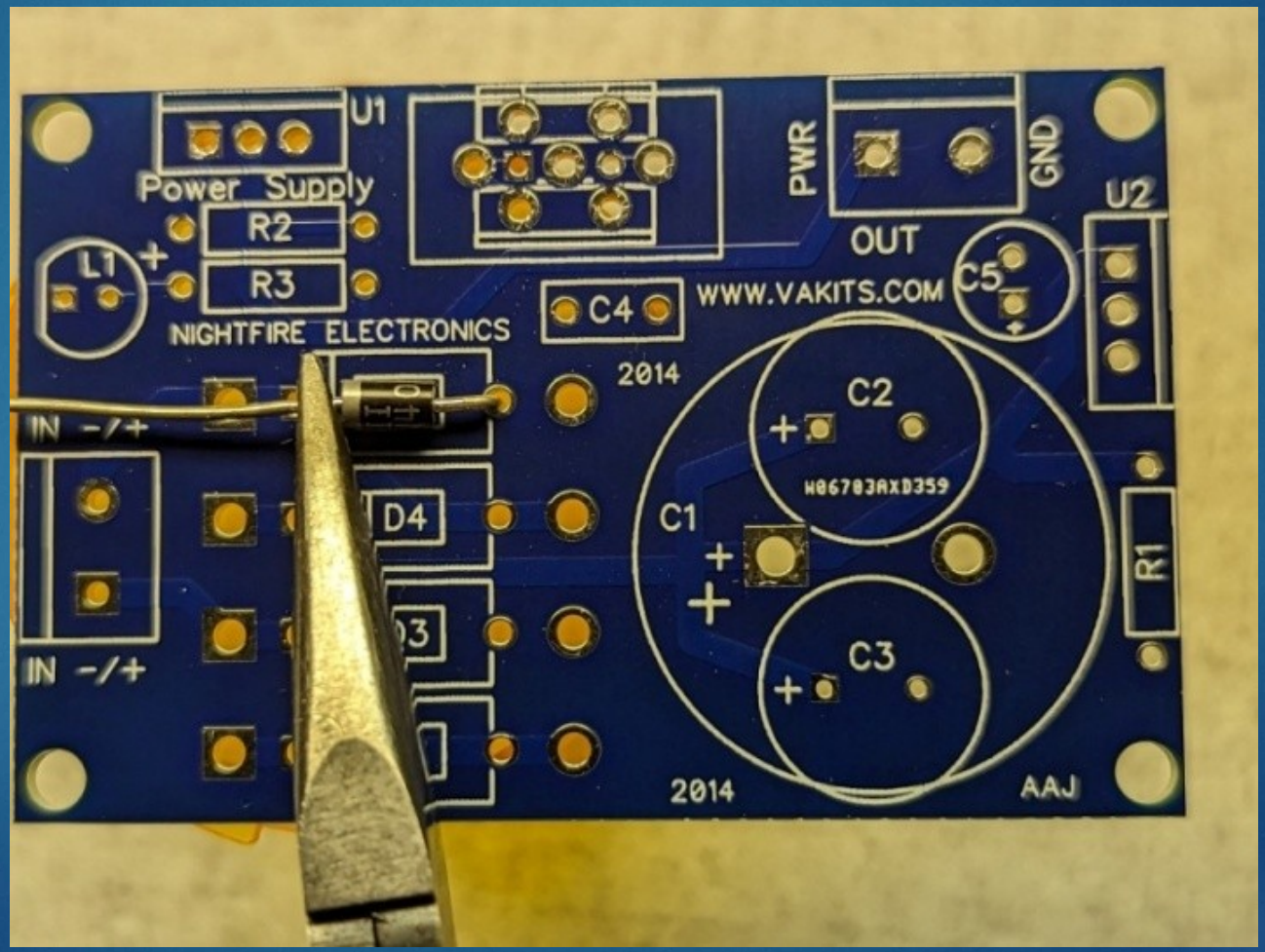
Component Installation – Step 3

- Step 3- Lift component and bend lead as shown



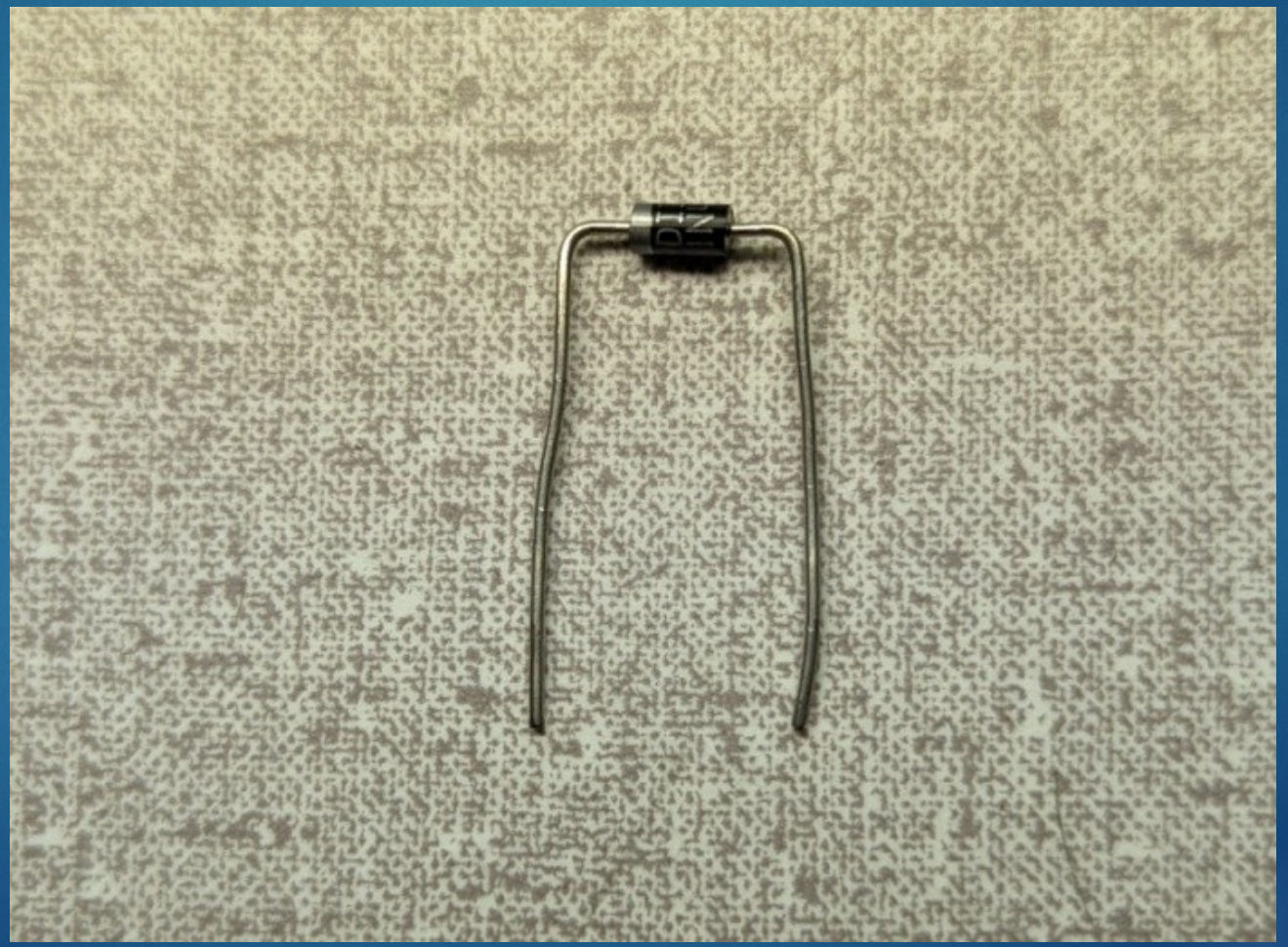
Component Installation – Step 4

- Step 4 – Insert bent lead and grab the other lead as shown



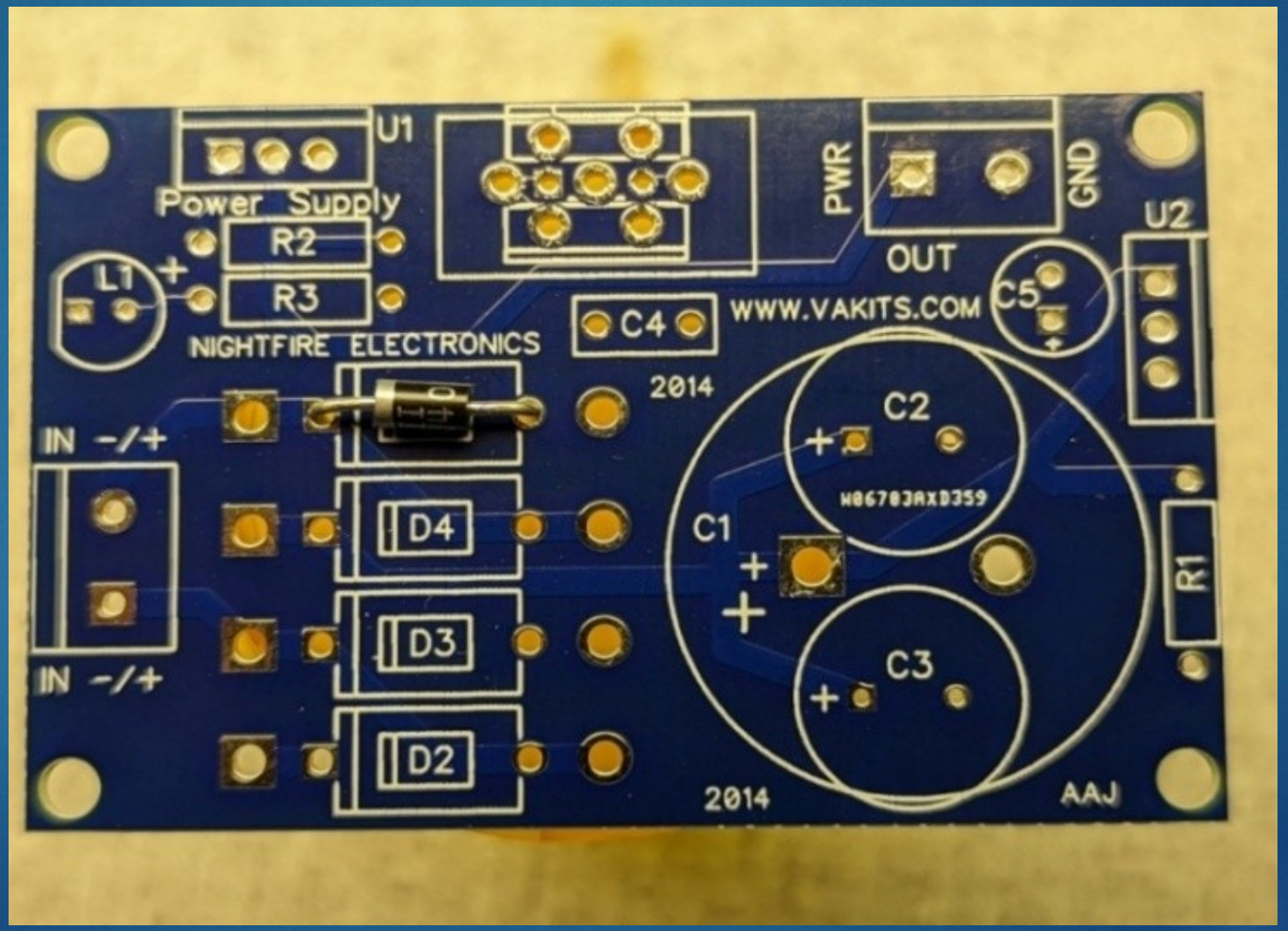
Component Installation – Step 5

- Step 5 – Bend second lead as shown



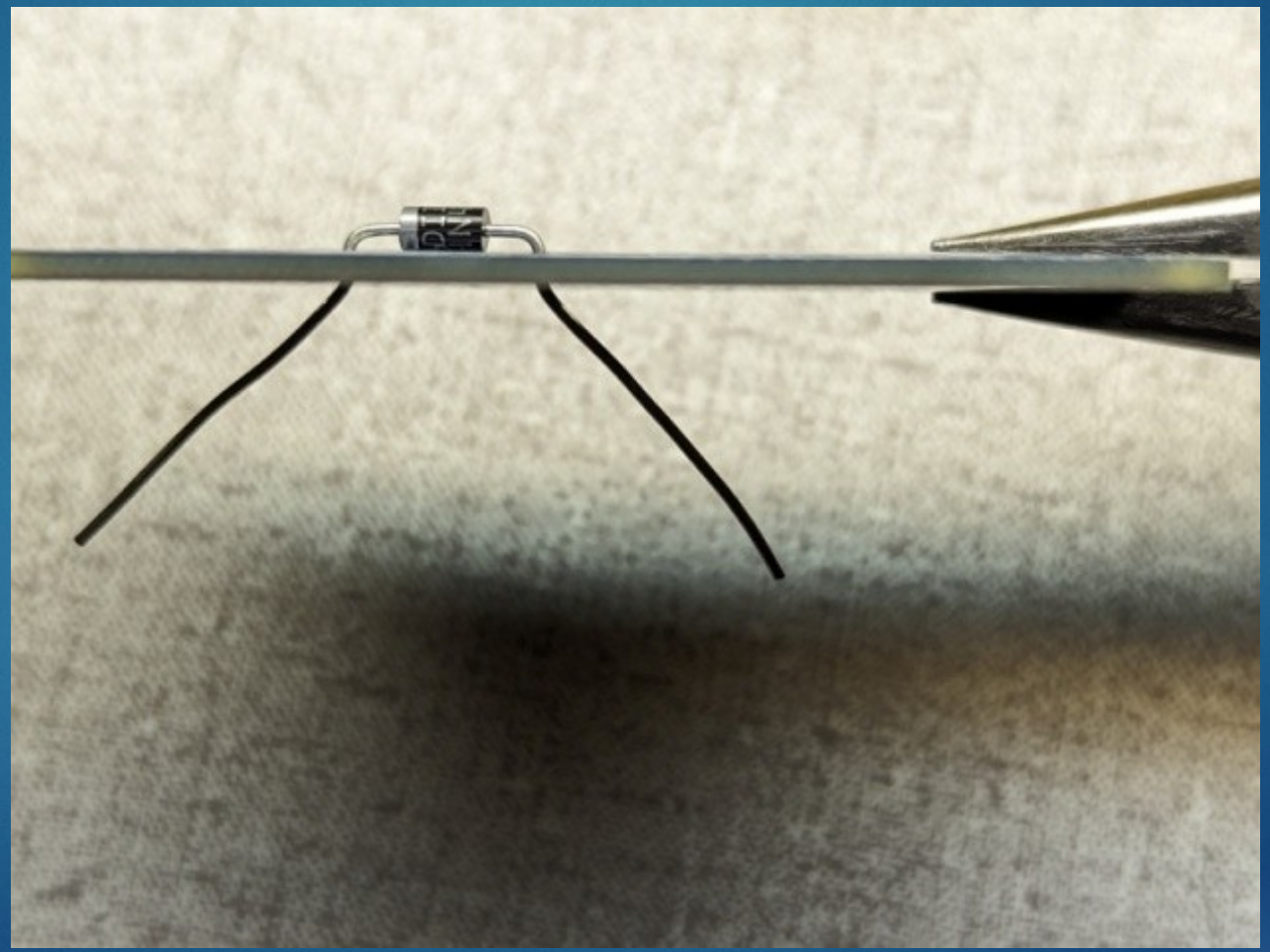
Component Installation – Step 6

- Step 6 – Insert component into position



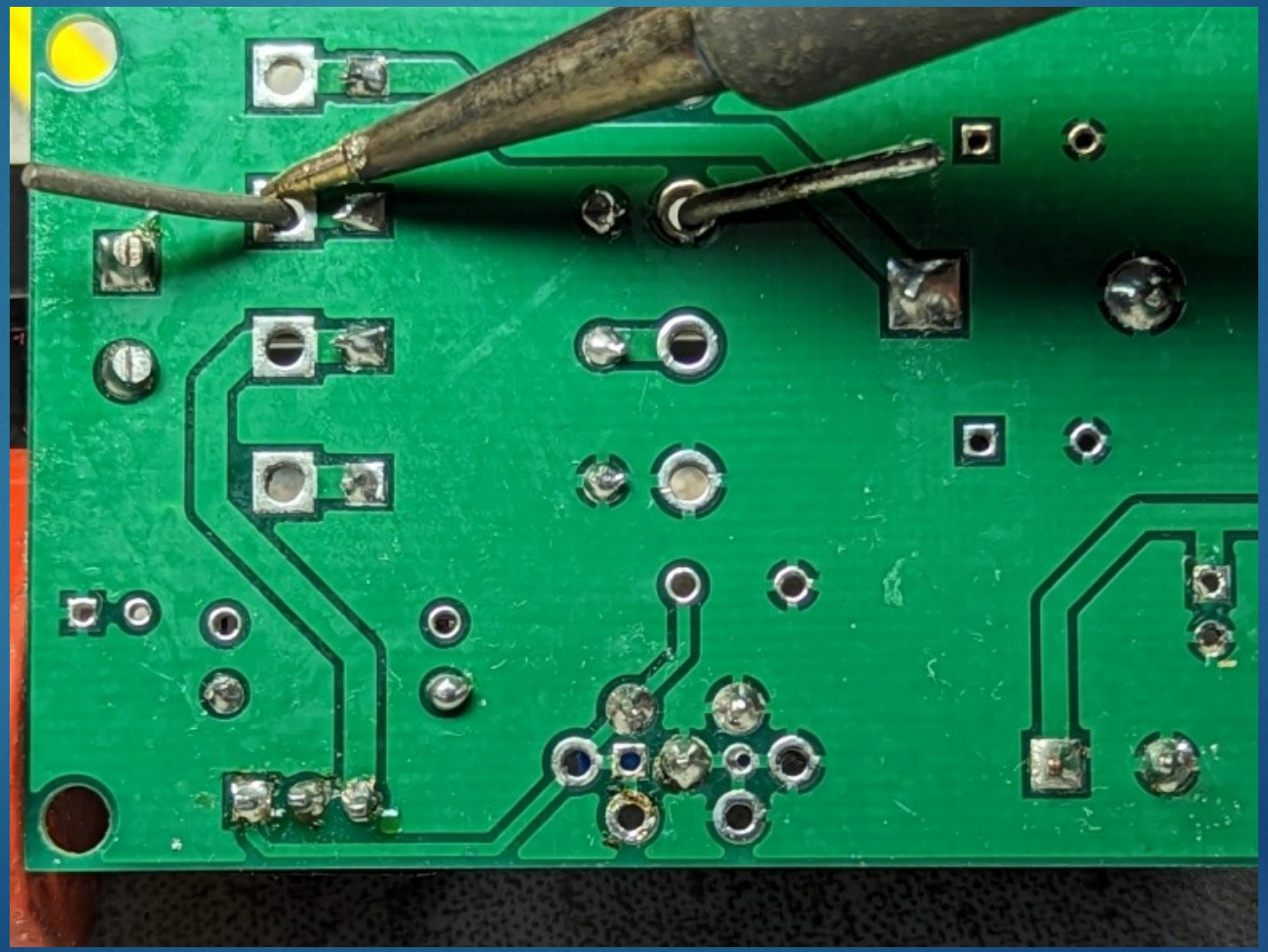
Component Installation – Step 7

- Step 7 – Bend leads as shown to hold component in place



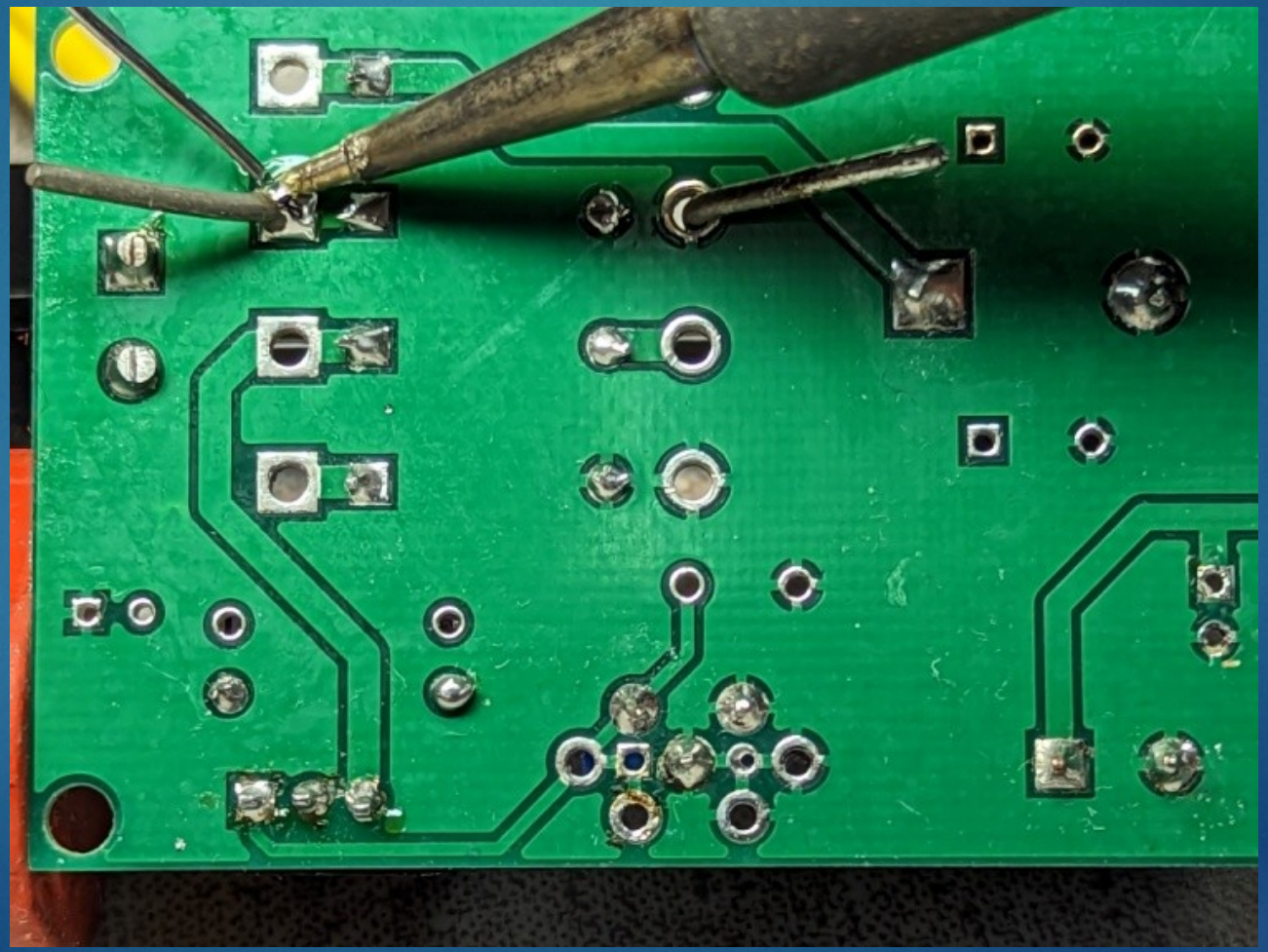
Soldering – Step 1

- Step 1 – Place Iron against BOTH board AND component lead to heat



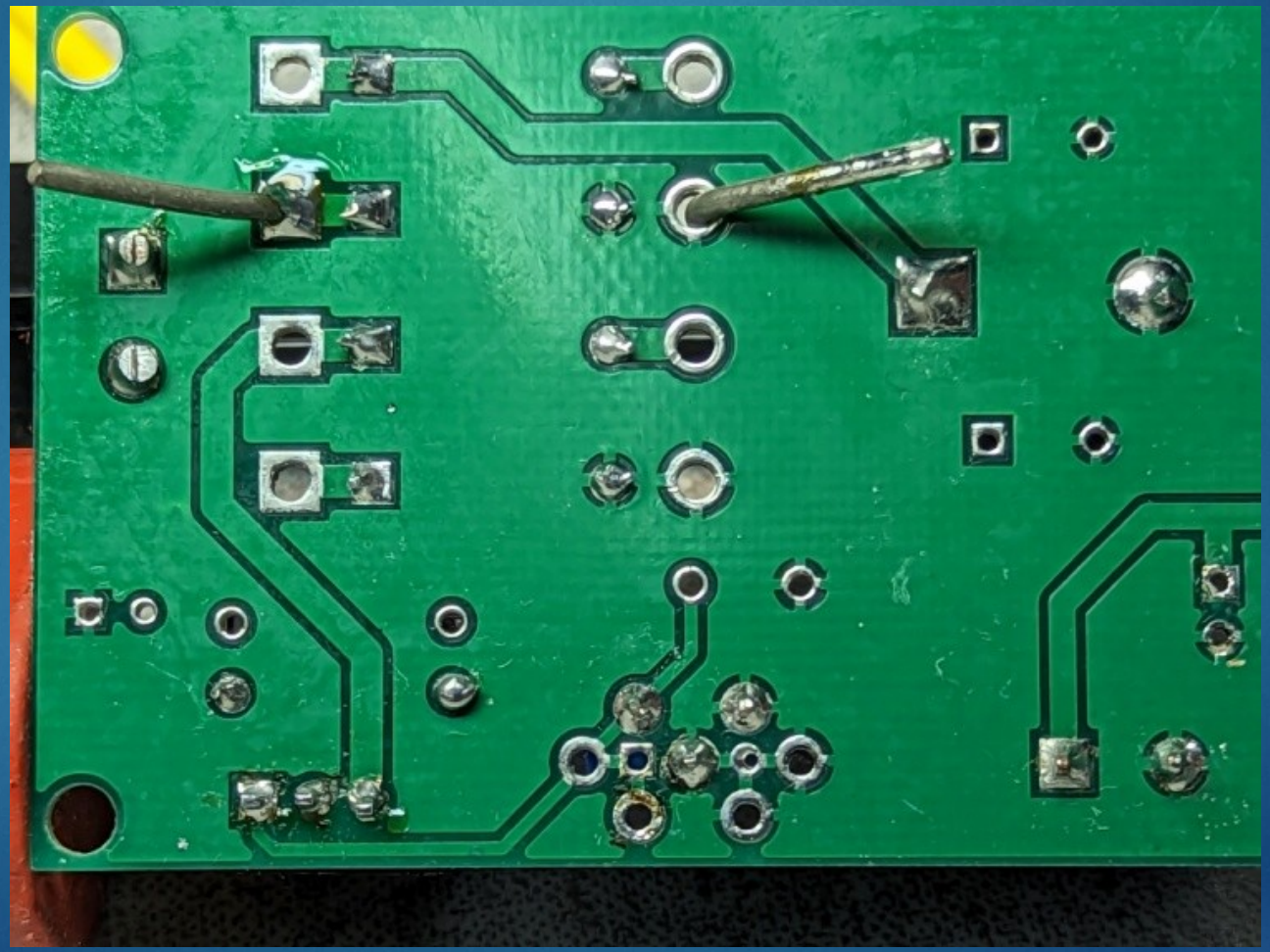
Soldering – Step 2

- Step 2 – After 10-15 seconds GENTLY push solder against Iron Tip, component lead, and board until solder starts melting



Soldering – Step 3

- Step 3 – When a small mound of solder forms, remove solder and then the Iron, KEEPING THE JOINT STILL for a few seconds for solder to set



Assembly (1 of 3)

- DIODES - Observe Polarity! Band identifies Cathode (Negative) Lead
  - D1 1N4007
  - D2 1N4007
  - D3 1N4007
  - D4 1N4007

- RESISTORS
  - R1 10k 1/4W 5% Brown - Black - Orange - Gold
  - R2 120 1/4W 5% Brown - Red - Brown - Gold
  - R3 1k 1/4W 5% Brown - Black - Red - Gold

Assembly (2 of 3)

- SMALL CAPACITORS
  - C4 0.15uF
  - C5 10uF / 50V Observe Polarity! Negative Lead is marked
- TERMINAL BLOCKS
  - 18VAC Input IN -/+ / IN -/+
  - VDC Output PWR / GND
- VARIABLE RESISTOR
  - VR1 4.7k ohms

Assembly (3 of 3)

- LED (LIGHT-EMITTYING DIODE) INDICATOR
  - L1 “Red Drop” Observe Polarity! Positive Lead is longer
- LARGE CAPACITOR
  - C1 3300uF / 35V Observe Polarity! Negative Lead is marked
- VOLTAGE REGULATOR
  - U1 LM317 FLAT SIDE faces OUTWARD on PCB

Pre-Test Inspection / Prep

- Visual Inspection
  - Diode Banded-End pointing toward Input Terminal Block
  - Large Capacitor NEGATIVE pointing toward 10k resistor
  - Small capacitor NEGATIVE pointing toward Output Terminal Block
  - Ensure all component leads have been trimmed on bottom
  - Ensure all joints have been soldered
- Check for Solder Bridges (Shorts)
- Set VR1 to Mid-Rotation

Smoke Test!

- Connect Power Transformer to AC Input Terminal Block
- Set DMM to read DC VOLTS
- Connect DMM to Output Terminal Block
- GO! Plug the Transformer into a Wall Outlet
- LED should illuminate - if it doesn’t, UNPLUG IMMEDIATELY!!!
- DMM should read approximately 12 VDC
- IT WORKS!!!

Functional Test

- Using a small screwdriver, turn the Variable Resistor fully counterclockwise
- DMM should read approximately 1.25 VDC
- Using a small screwdriver, turn the Variable Resistor fully clockwise
- DMM should read approximately 25 VDC
- Using a small screwdriver, adjust the Variable Resistor until the DMM reads 12.6 VDC
- CONGRATULATIONS! COMPLETE SUCCESS!!!

In Case of Difficulty

- Go back to Pre-Test Inspection / Prep
- Voltage Checks
  - Voltage across Input Terminal Block should be approximately 20.8 VAC
  - Voltage across R1 should be approximately 27.5 VDC