Fibonacci (THT)

Information

and

Assembly Guide

Sleepy Pony Labs

sleepyponylabs.com

Document Revision **1** for Board Revision **1**

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Introduction

Welcome and thank you for purchasing the Fibonacci THT soldering kit from Sleepy Pony Labs! The Fibonacci THT is a soldering practice board that use old-school logic chips to calculate numbers in the Fibonacci sequence from 0 to up to 46,368 and display them on a set of 7-segment display.

This kit is designed for beginners practicing through-hole soldering. There are multiple types of devices available to solder on the board and most of them have duplicates for you to solder multiple times. After you have finished soldering, it could be put into a common 4x6 inches photo frame for show.

Specifications

- **PCB board:** Green FR4 board of size 4*6 inches
- **Parts count:** 59 pieces
- **Power supply:** 5v DC adapter, 5.5x2.1 mm, center positive (not included)

- **Soldering Difficulty:** 3/10
- **Soldering Type:** THT only, smallest pitch 2.54 mm

- **Firmware parts:** PIC16F1578 x1 (with ICSP header)

Unpacking List / Bill of Materials (BOM)

References	Description	Quantity
C1 – C15	100nF Ceramic Capacitor	15
C16, C19	100uF Electrolytic Capacitor	2
C17	10nF Ceramic Capacitor	1
C18	10uF Electrolytic Capacitor	1
R1, R2, R4	10 kΩ Resistor	3
R3, R5 – R8	4.7 kΩ Resistor	5
RN1	330 Ω Resistor (7x)	1*
RN2	1 kΩ Resistor (5x)	1*
D1	Red LED	1
U1	74HC32 Logic IC	1
U2	74HC74 Logic IC	1
U3 – U6	74HC273 Logic IC	4
U7 – U10	74HC283 Logic IC	4
U11 – U12	74HC165 Logic IC	2
U13	PIC16F1578 Microcontroller	1
U14	NE555 Timer IC	1
U15	CD4017 Logic IC	1
U16 – U20	7-Segment Display (single digit, common anode)	5
SW1	THT Slide Switch	1
Q1 – Q6	2N2907 PNP Transistor	6
Q7	2N2222A NPN Transistor	1
J1	THT DC Jack (5.5x2.5mm barrel)	1
	Total	59

Note: RN1 is 7 separate 1/4W resistors, and RN2 is 5 separate 1/4W resistors.

Note: High-Resolution image of the PCB is on page 15.

Note: ICSP header not included.

Note: We strongly recommended that you use the interactive BOM during unpacking and assembling. It will make your life much easier. It is available here: https://www.sleepyponylabs.com/ibom/html/ibom_fibonacci_tht_rev_1.html

Assembly Guide

The general guide in soldering anything is to solder components with the lowest profile (least in height) first before soldering other taller components.

This guide sums up my experience in soldering the board during the testing. Follow the steps here to reduce possible problems.

1. Resistor (Horizontal)

Fold the resistor's legs even with its body, then insert it through the hole. Hold it with tape then solder them. There is no polarity.

Note: This is also how you install RN1 and RN2.

2. IC

First, find the pin 1 mark. It will be a dimple or indent on one side of the chip. Align it with the notch marking on the board. Insert the chip into the holes. Be careful not to break any pin. Hold it in and solder two diagonal pins (for example, pin 14 and 28, or pin 1 and 15), then solder the rest of the pins.

You might also want to add IC sockets (not included) so you could easily remove the chips later.

3. LED

Insert it through the hole and be careful of the polarity. Align the flat side with the board as shown. Hold it with tape then solder them.

4. Ceramic Capacitor

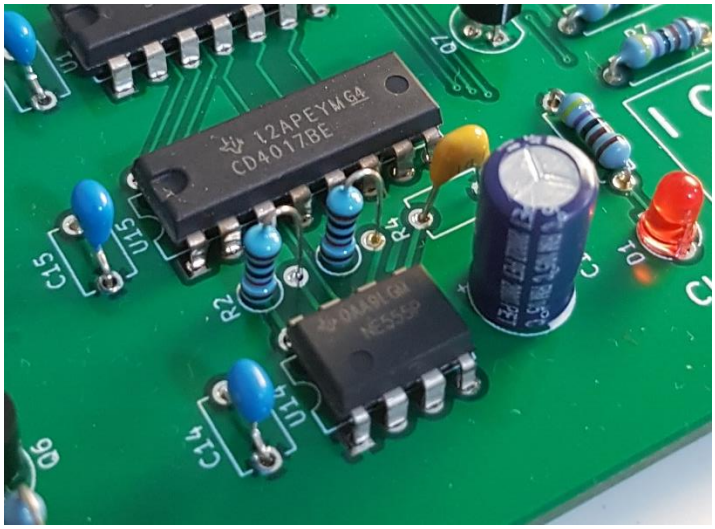
Insert it through the hole. Hold it with tape then solder them. There is no polarity.

Note: The capacitors that come with the kit might have 2.54mm pitch. In this case you will have to pry the legs to make them fit the 5.08mm pitch footprint on the board. However, don't force them or the legs might break off.

5. Resistor (Vertical)

Bend one leg of the resistor 90 degrees, then bend it 90 degrees again. You should now get a vertical resistor with 2.54mm pitch.

Insert it through the hole. Hold it with tape then solder them. There is no polarity.

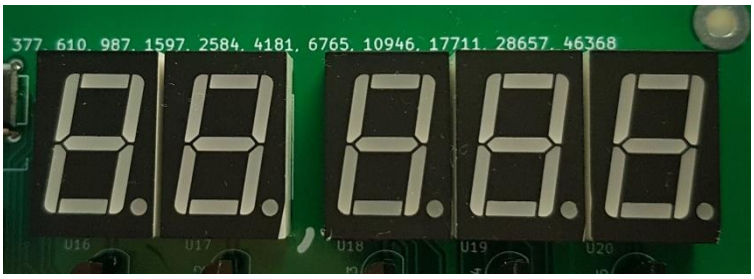


How to install ceramic capacitors (2.54/5.08mm pitch) and resistors with vertical footprint

6. 7-Segment Display

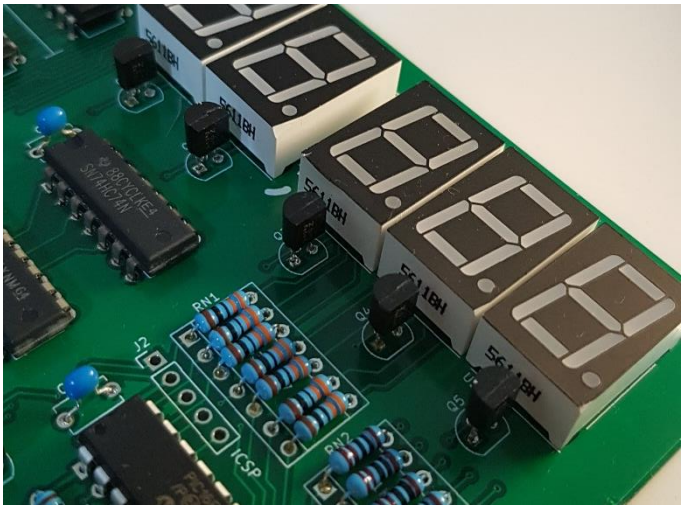
Place the display on the footprint. Make sure the decimal point is at the bottom of the display. Hold it with tape and solder it.

Note: If your display comes with a protective sticker and you plan to clean the board with flux cleaner or alcohol later, leave the sticker intact for now and only remove it after you are done. **Cleaning solutions will dissolve the black display coating.**



7. Transistor (TO-92)

First, face the flat side of the transistor towards you. Then, bend the middle leg of the transistor backward until you can fit it in the footprint. Push it in a little bit until it will go no further (noted that it will not go in all the way). Now it will most likely hold itself on the board and you can then solder it.



8. THT Slide Switch

Insert the switch through the hole and then hold it with tape. Solder the retaining pins on each side of the switch first then solder the rest of the pins.

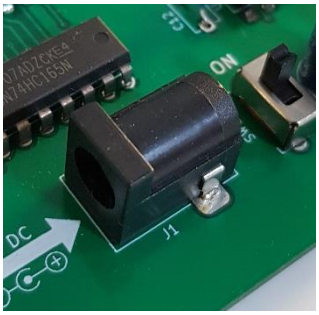
9. Electrolytic Capacitors

Insert it through the hole and be careful of the polarity. Hold it with tape then solder them.

Note: The white stripe on electrolytic capacitors denotes the negative pin.

10. Barrel Jack

Insert it through the hole. Hold it with tape then solder it.

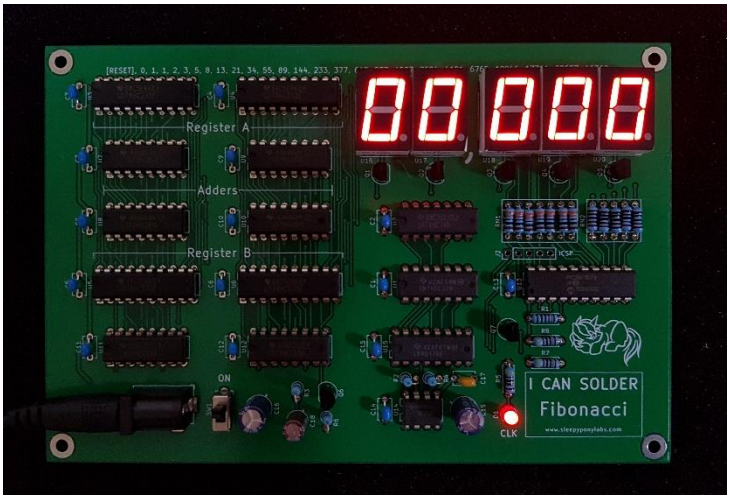


How to Use

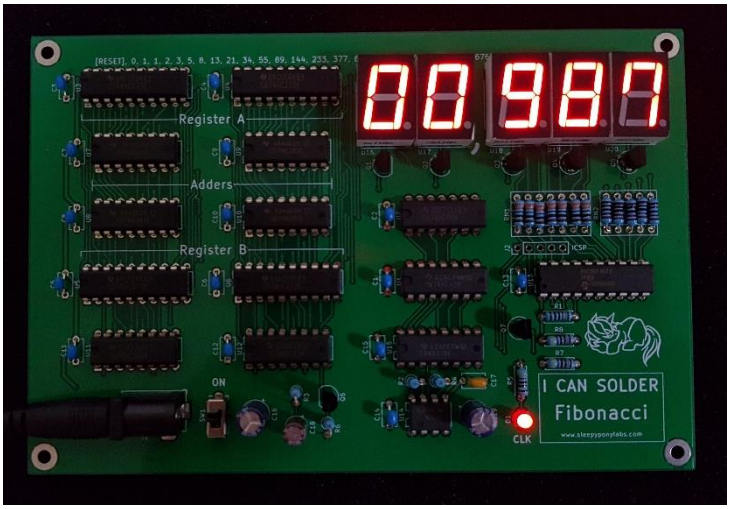
After all the parts were soldered, connect the 5V power source and turn the switch to ON position. All of the 7-segment displays should light up 00000.

Every time the CLK LED flashes, the display should update to the next number in the Fibonacci sequence (as written on the top of the board).

When the display reaches 46368, the highest number that could fit in a 16-bit register, the circuit will reset back to 00000 and start counting from the beginning again. The circuit will loop indefinitely until it is turned off.



Correct Power-On Behavior



Correct Running Behavior

Troubleshooting

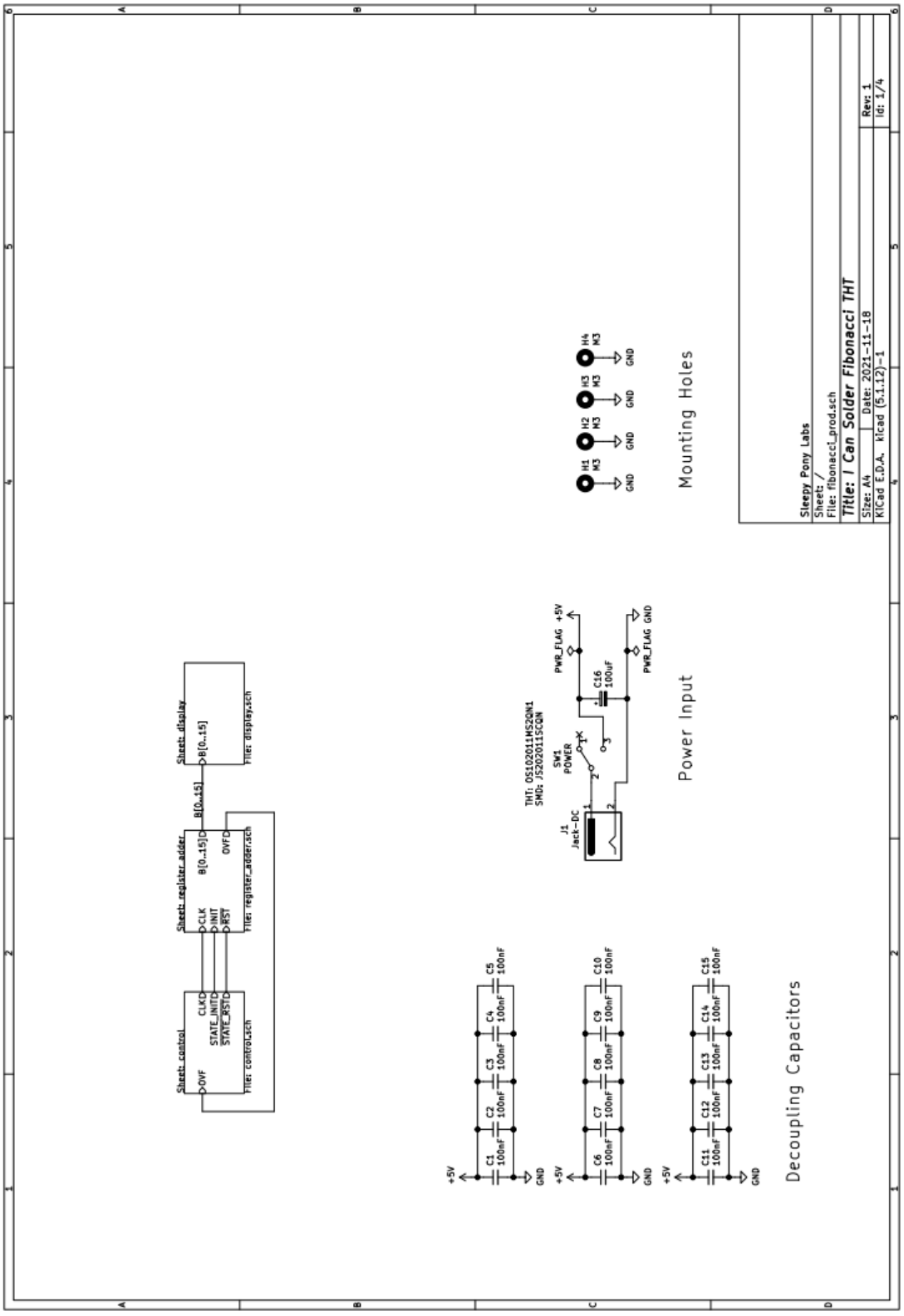
In case your circuit does not work, the list below contains some possible causes of the issue from most likely to least likely:

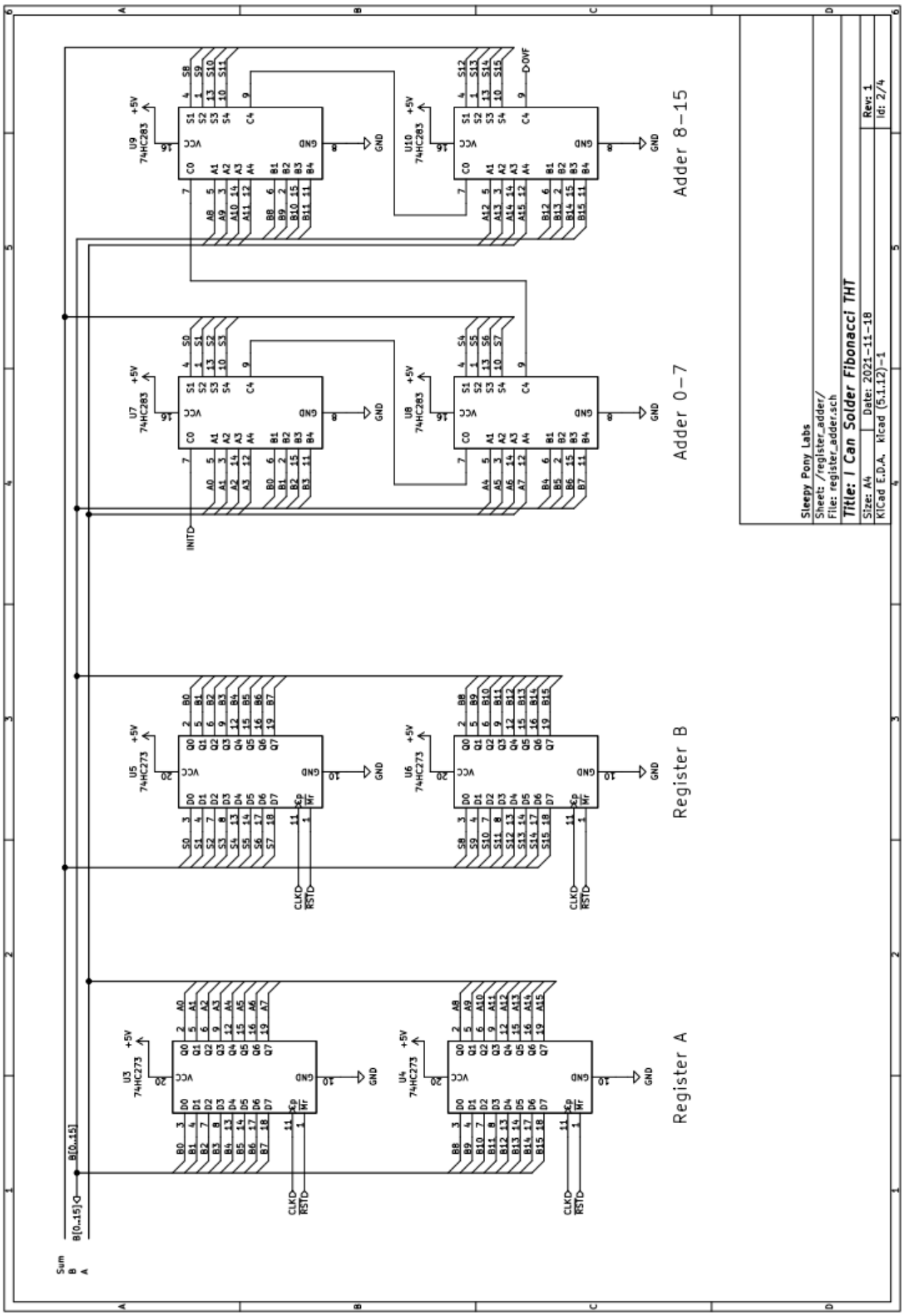
- Bad solder joints (Cold joints, Short between joints, Unconnected joints)
- Incorrectly installed components (Wrong location or orientation)
- Bad power supply (Battery dry, Wrong type, Wrong polarity)
- Components damaged by soldering heat.
- Components damaged by static electricity or broken from the factory.
- PCB damaged by soldering heat or impact (Broken pads or traces).

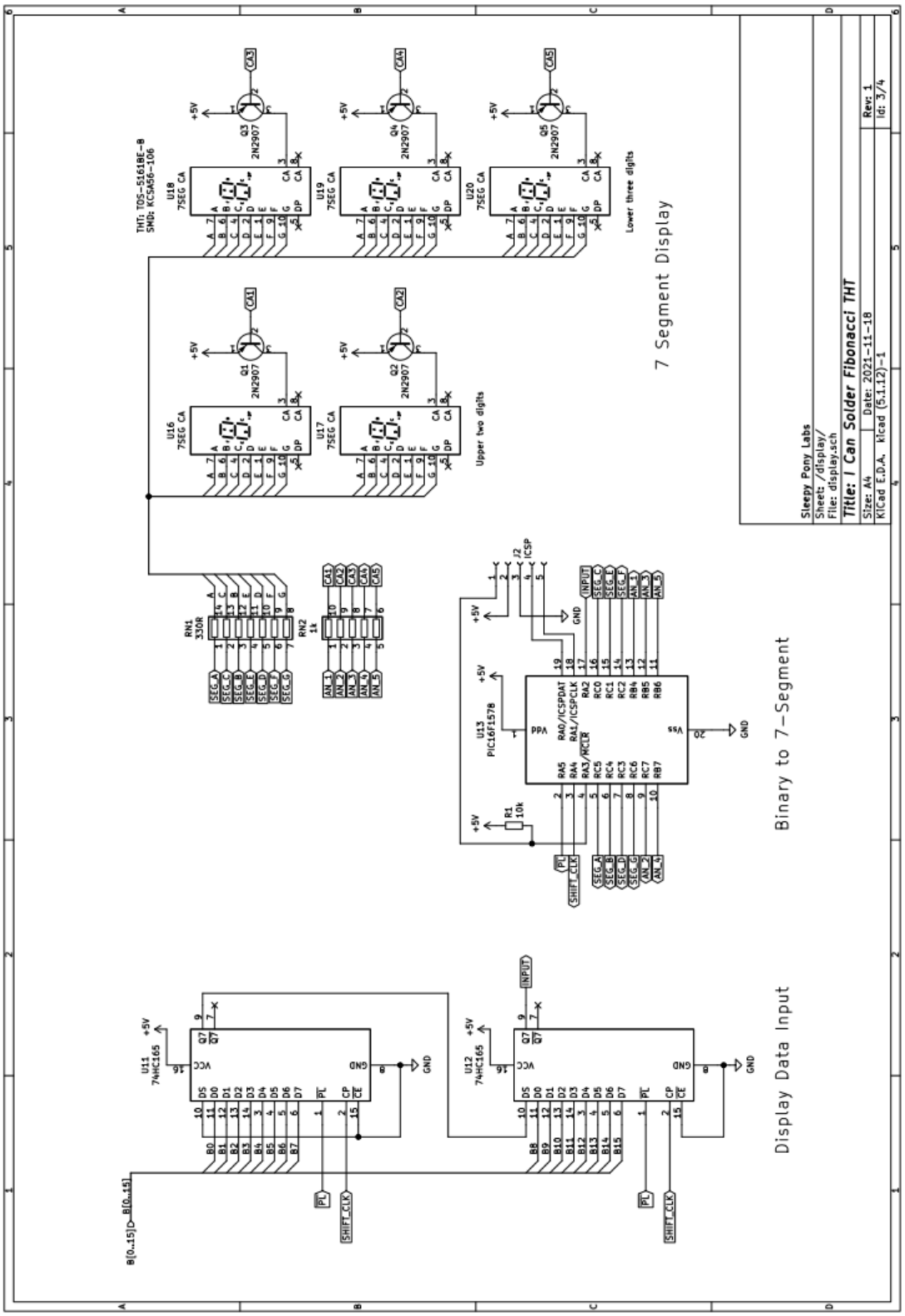
And these are possible causes specific to this kit:

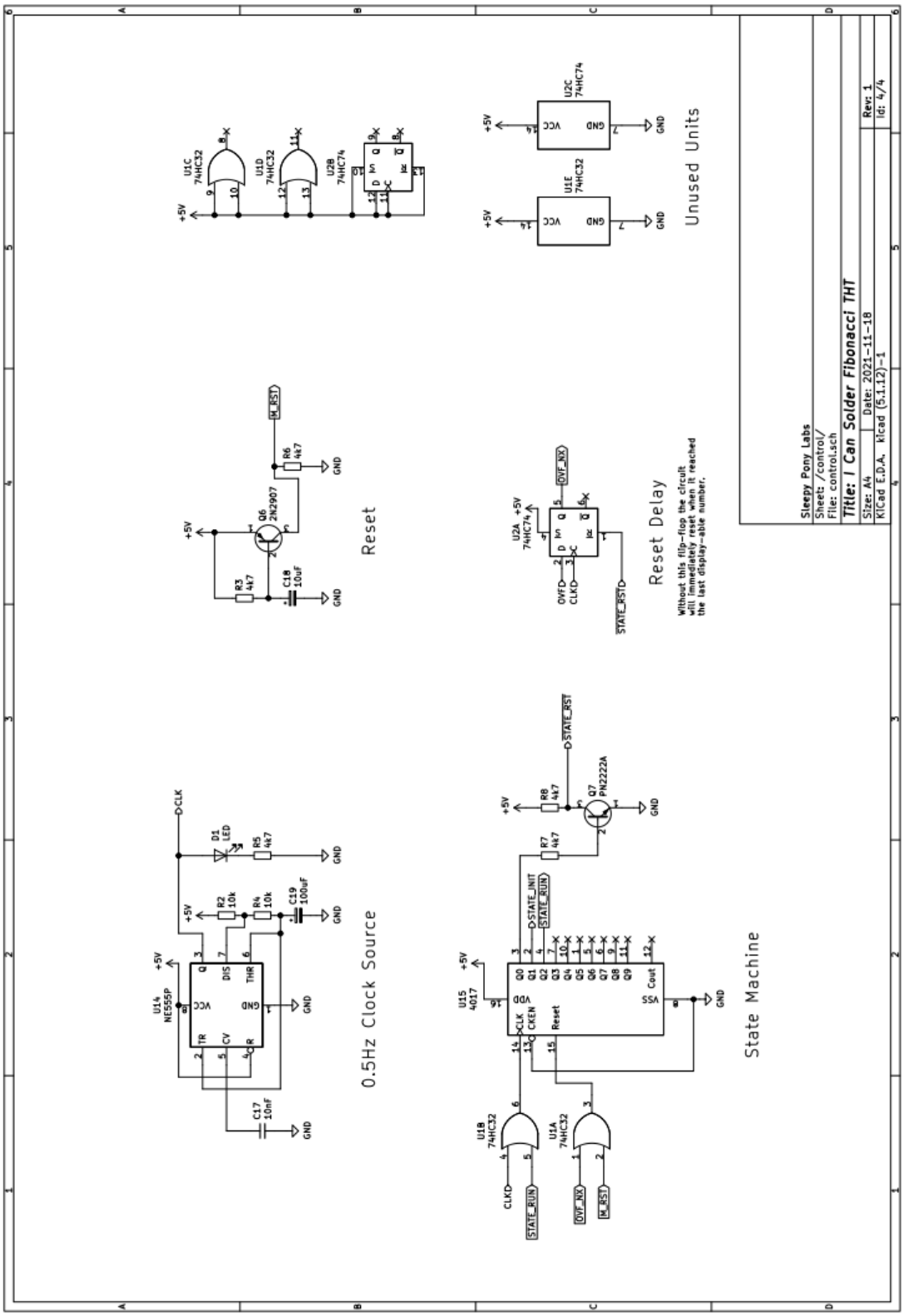
- None found so far. If you have something concerning, please contact me on my website or on Tindie. Thanks!

Schematics


Sheet: control
OVF
CLK
STATE_INIT
STATE_RST
File: control.sch
Sheet: register_adder
CLK
INIT
RST
B[0..15]
OVF
File: register_adder.sch
Sheet: display
B[0..15]
File: display.sch
Decoupling Capacitors
Power Input
Mounting Holes
Sleepy Pony Labs
Sheet: /
File: fibonacci_prod.sch
Title: I Can Solder Fibonacci THT
Size: A4
Date: 2021-11-18
KiCad E.D.A. kicad (5.1.12)-1
Rev: 1
Id: 1/4


Adder 8–15
Adder 0–7
Register B
Register A
Sleepy Pony Labs
Sheet: /register_adder/
File: register_adder.sch
Title: I Can Solder Fibonacci THT
Size: A4
Date: 2021-11-18
Rev: 1
KiCad E.D.A. kicad (5.1.12)-1
Id: 2/4


7 Segment Display
Upper two digits
Lower three digits
Binary to 7-Segment
Display Data Input
Sleepy Pony Labs
Sheet: /display/
File: display.sch
Title: I Can Solder Fibonacci THT
Size: A4
Date: 2021-11-18
Rev: 1
KiCad E.D.A. kicad (5.1.12)-1
Id: 3/4


Unused Units
Reset
Reset Delay
Without this flip-flop the circuit will immediately reset when it reached the last display-able number.
0.5Hz Clock Source
State Machine
Sleepy Pony Labs
Sheet: /control/
File: control.sch
Title: I Can Solder Fibonacci THT
Size: A4
Date: 2021-11-18
Rev: 1
KiCad E.D.A. kicad (5.1.12)-1
Id: 4/4

PCB Layout

Front