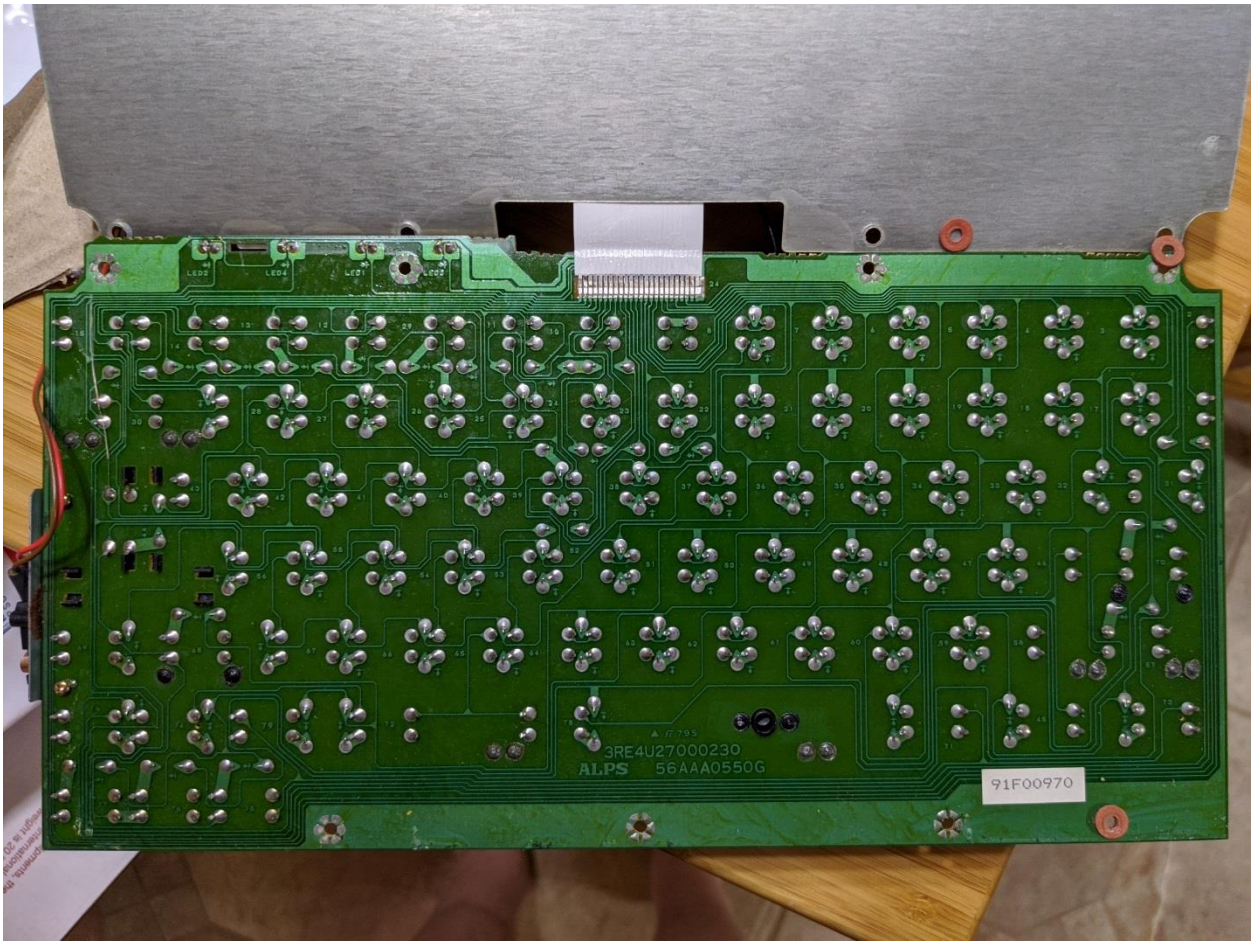
Zenith Supersport USB Keyboard Controller Project. I partnered with Aaron (the owner of the keyboard) on this project. Aaron did all disassembly of the Supersport chassis, assembly of the Teensy connector board, and testing of the code on the keyboard. I did the layout of the Teensy connector board and wrote the code.

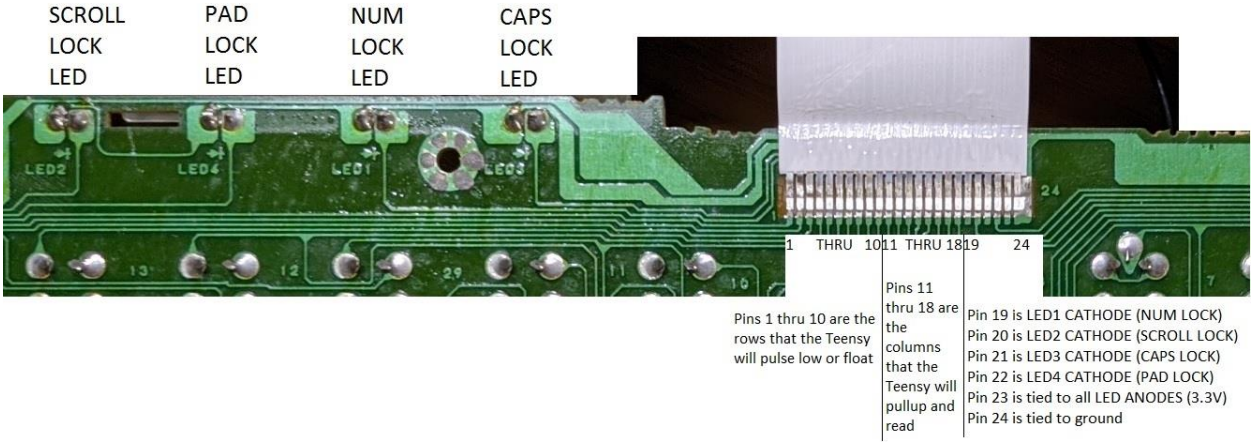
The keyboard is shown removed from the case.

Note the Pad Lock selection in addition to the Num Lock selection. There are 4 keyboard LEDs: CAPS, NUM, PAD, and SCROLL LOCK. Pad Lock is discussed here but I am not sure I coded it the way it was intended. I chose to make Num Lock turn on the numbers in the multifunction keys to act as a number pad. If Num lock is selected, Pad Lock cannot be selected. When Pad Lock is selected, the multifunction keys act as arrow/movement keys.

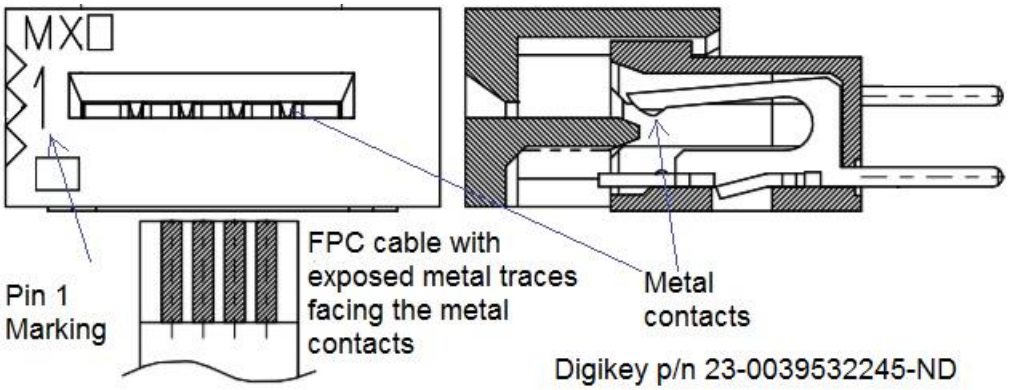
The keyboard backside is a circuit board with a diode at each key switch.



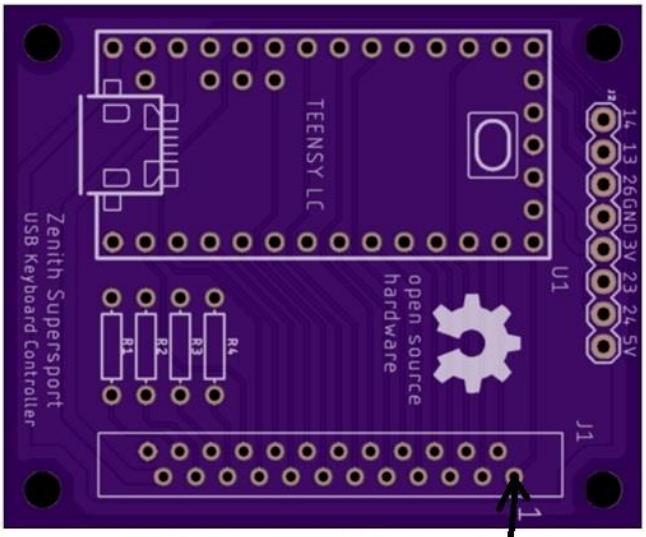
Zenith Supersport SX Keyboard Connections as viewed from the backside



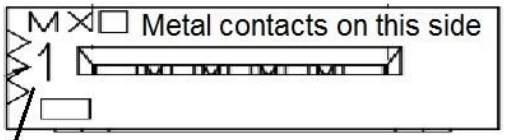
The FPC connector has a pin 1 marking on it but it will not coincide with the pin 1 position on the connector board or keyboard. The connector must be oriented so that the exposed metal traces on the FPC cable coincide with the metal contacts inside the connector (see below).



Digikey p/n 23-0039532245-ND



Match the metal contacts on this side of the connector with the bare metal traces on the FPC cable



Disregard the pin 1 marking on the connector.

Pin 1 on the circuit board gets connected to Pin 1 on the keyboard

All keyboard switches have diodes in series with the switch to block backflow current that can cause “ghosting” when multiple keys are pressed at the same time. The diode cathodes must be hooked to the Teensy outputs (rows). These outputs are pulsed low or floated by the software. The diode anodes must be connected to the Teensy inputs (columns) with internal pullups enabled.

FPC pin Description:

FPC24 = Ground

FPC23 = ALL Keyboard LED ANODES (3.3V)

FPC22 = LED4 CATHODE (PAD LOCK)

FPC21 = LED3 CATHODE (CAPS LOCK)

FPC20 = LED2 CATHODE (SCROLL LOCK)

FPC19 = LED1 CATHODE (NUM LOCK)

FPC11 TO 18 = INPUTS TO TEENSY WITH BUILT IN PULLUPS

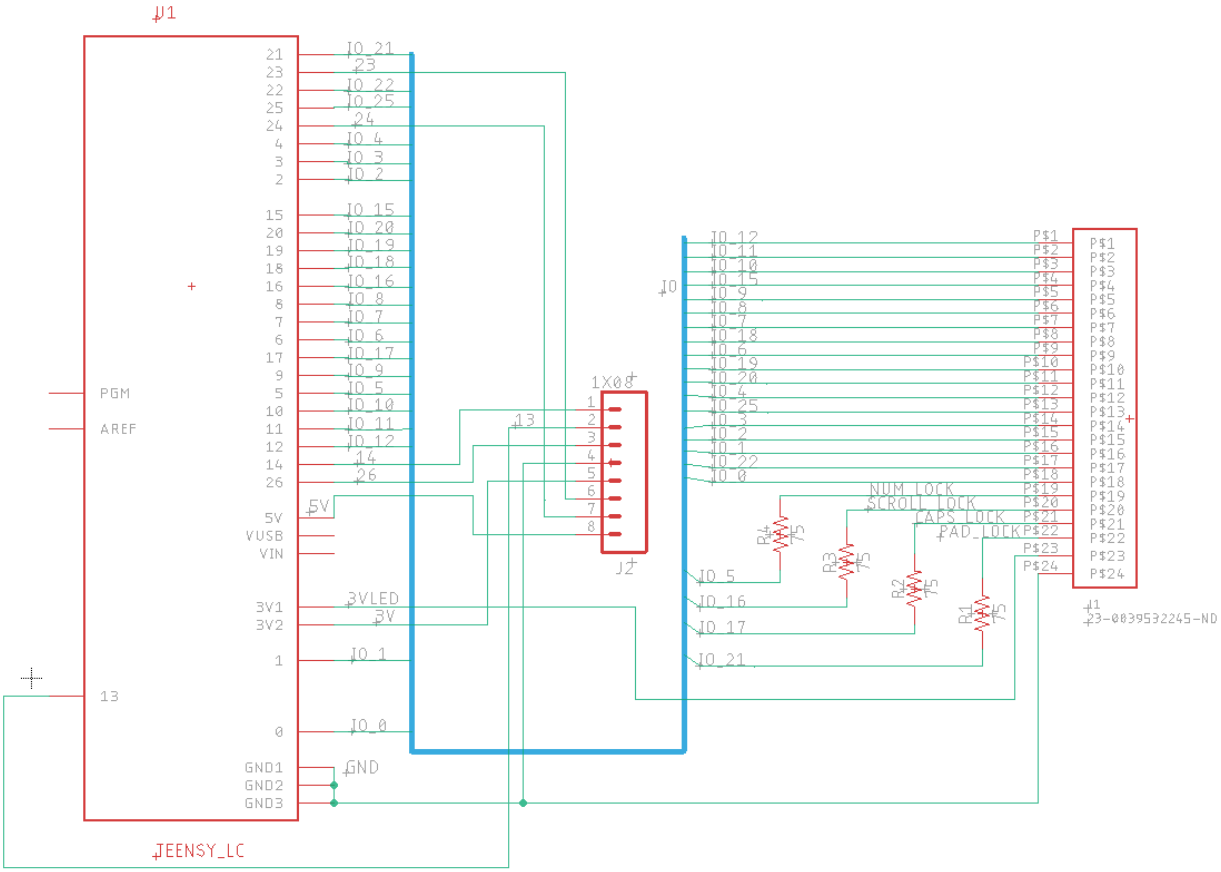
FPC1 TO 10 = OUTPUTS FROM TEENSY PULSED LOW OR FLOATING

LEDs are turned on by sending the Teensy LC output low. The Teensy LC has 4 I/O’s (5, 16, 17, 21) that can source or sink 20ma and the rest of the I/O’s can only source or sink 5ma. The LEDs are controlled with the 4 high current I/O’s. The LED anode voltage is 3.3 volts from the Teensy internal regulator that can source up to 100ma. If all 4 LEDs are turned on (not likely), the 80ma load is still within the 100ma limit. The current limit resistor for each LED is 75Ω:

(3.3V – 1.8V)/.02A = 75Ω

Power is .02 x .02 x 75 = 30mW A standard 1/8 watt or 1/10 watt 75 Ω resistor will work fine.

Eagle Schematic



The unused I/O's, plus power and ground are brought to solder pads at J2 for future use. I/O 13 can drive up to 5ma. It currently drives the LED on the Teensy with 3ma.

The translation from FPC pin numbers to Teensy LC I/O numbers is given below.

FPC Pin #	Teensy I/O #
1	12
2	11
3	10
4	15
5	9
6	8
7	7
8	18
9	6
10	19
11	20
12	4
13	25
14	3
15	2
16	1
17	22
18	0
19	Num Lock 5
20	Scroll Lock 16
21	Caps Lock 17
22	Pad Lock 21
23	3.3 Volts
24	Ground

The Teensy code “Matrix_Decoder_LC_Zenith” produced the following FPC connector pin list.

cntrl-l	18	5
cntrl-r	14	2
shift-l	18	4
shift-r	14	1
alt-l	17	1
alt-r	14	3
fn	18	1
a	17	5
b	15	4
c	17	2
d	16	5
e	15	6
f	15	5
g	14	5
h	13	5
i	11	5
j	12	5
k	12	4
l	12	3
m	13	4
n	14	4
o	11	4
p	11	3
q	17	6
r	14	6
s	17	4
t	13	6
u	11	6
v	16	4

w	16	6
x	17	3
y	12	6
z	18	3
`	18	7
1	17	7
2	16	7
3	15	7
4	14	7
5	13	7
6	12	7
7	11	7
8	10	7
9	10	6
0	10	5
-	10	4
=	10	3
bckspace	9	2
esc	18	8
f1	17	8
f2	16	8
f3	15	8
f4	14	8
f5	13	8
f6	12	8
f7	11	8
f8	10	8
f9	9	8
f10	9	7
insert	9	4

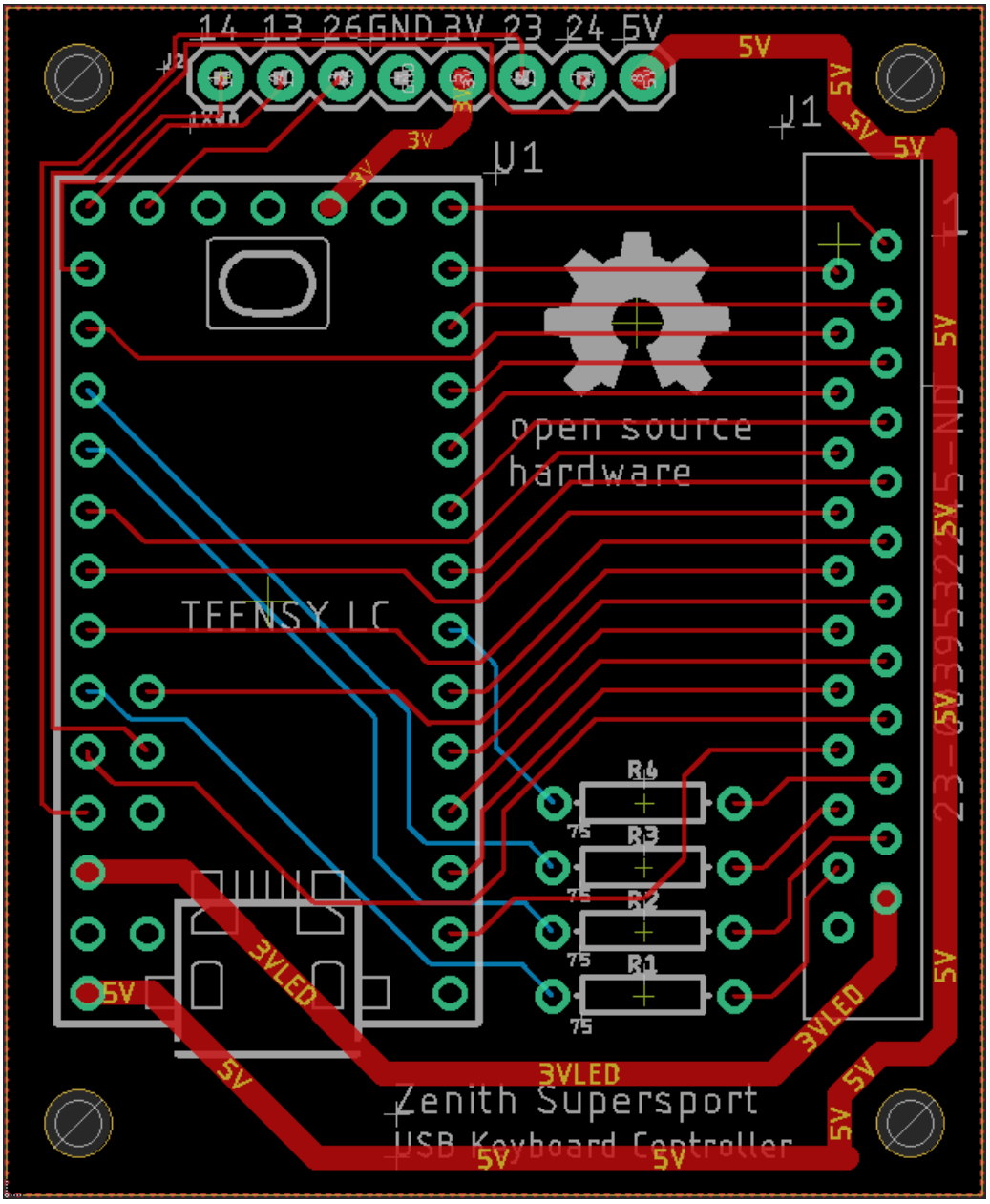
delete	9	3
arrow-r	15	1
arrow-l	15	2
arrow-u	15	3
arrow-d	16	1
/	13	1
period	13	2
comma	13	3
;	12	2
'	12	1
enter	10	1
[	11	2
]	11	1
\	9	1
caps-lck	18	2
tab	18	6
space	16	3
prt-sc	10	2
num-lk	9	6
pause	9	5

Zenith Supersport SX Keyboard Matrix was created from the pin connection list (shown below).

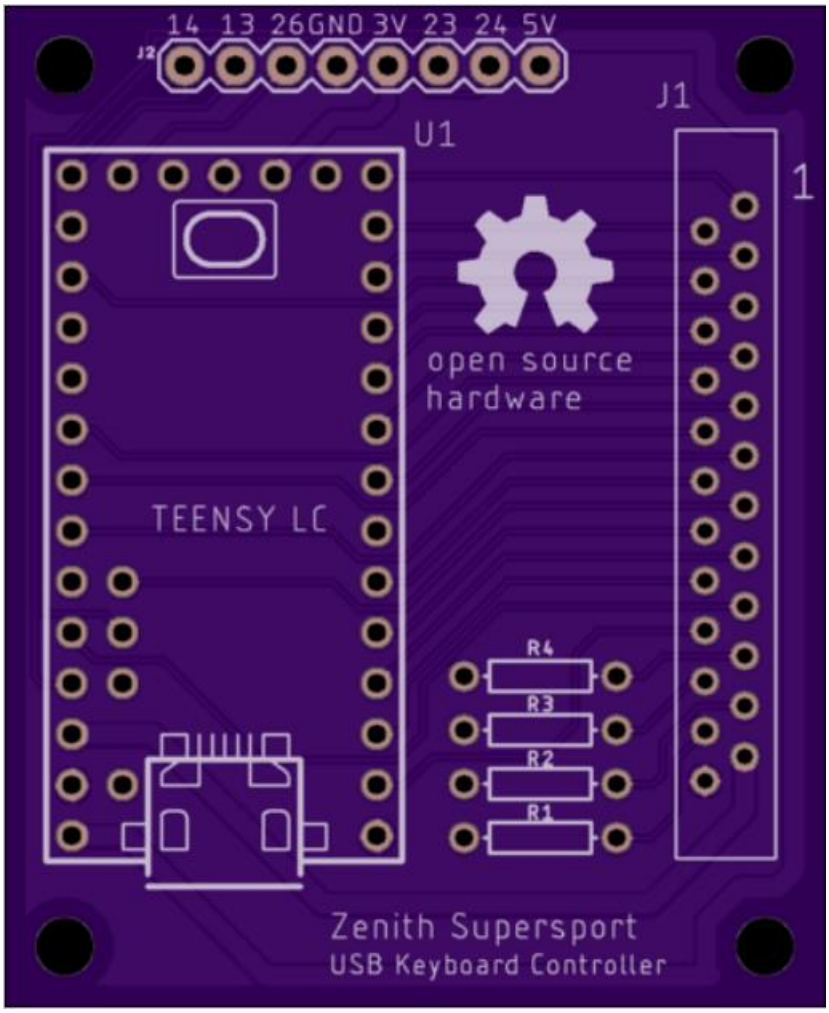
	FPC 1 I/O 12	FPC 2 I/O 11	FPC 3 I/O 10	FPC 4 I/O 15	FPC 5 I/O 9	FPC 6 I/O 8	FPC 7 I/O 7	FPC 8 I/O 18
FPC 9 I/O 6	\	Bckspace	Delete	Insert	Pause	NumLck	F10	F9
FPC 10 I/O 19	Enter	Prntscrn	=	-	0	9	8	F8
FPC 11 I/O 20	]	[	P	o	i	U	7	F7
FPC 12 I/O 4	Quote	;	L	K	J	Y	6	F6
FPC 13 I/O 25	/	Period	Comma	M	H	T	5	F5
FPC 14 I/O 3	**Shift-R**	**Cntrl-R**	**Alt-R**	N	G	R	4	F4
FPC 15 I/O 2	Right	Left	Up	B	F	E	3	F3
FPC 16 I/O 1	Down		Space	V	D	W	2	F2
FPC 17 I/O 22	**Alt-L**	C	X	S	A	Q	1	F1
FPC 18 I/O 0	**Fn**	CapsLck	Z	**Shift-L**	**Cntrl-L**	Tab	`	Esc

This matrix was put into the Teensyduino code “Zenish_Supersport_RevC.ino” and is fully functional.

Eagle Board Layout



OSH Park's purple board is shown below with the "area fill" ground plane. JLCPCB will produce a similar green board.



Parts List:

U1 - Teensy LC with pins from PJRC $14.65

R1, R2, R3, R4 – 75Ω, 1/8Watt. Digikey Part Number RNF18FTD75R0CT-ND $0.10 x 4

J1 - 24 pin 1.25mm pitch vertical FPC connector. Digikey Part Number 23-0039532245-ND $2.24

PCB – Two (of many) possible sources to fabricate the printed circuit board are OSH Park and JLCPCB.

OSH Park - Load the Eagle file "Zenith.brd" on their website, use all the default settings. Cost is $15.90 for 3 boards and delivery is under 2 weeks. The board quality is better than JLCPCB and the surface finish is ENIG.

JLCPCB – Load the zip file "Zenith_2020-06-06.zip" on their website. When you get to the shipping menu, select "more" to show the Economy option. This will bring the price for 5 boards down to $8.37 but it will take a month for delivery. Surface finish is HASL which is not as good as ENIG but still works fine.