



Table of Contents

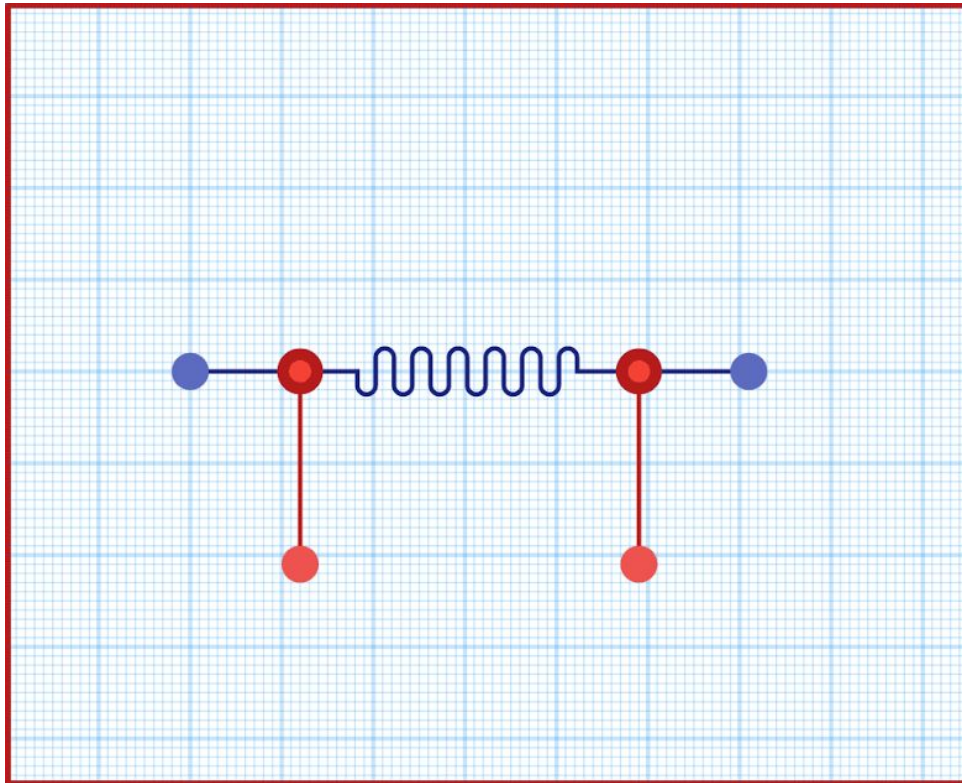
Table of Contents	1
Overview	2
Chip Design	3
Milling Guidelines	4
Milling Guidelines	4
Notes	4
Milling Instructions	5
Flow Layer	5
Control Layer	5
Testing Protocol	6
Flow Layer Setup	6
Control Layer Setup	7
Testing the Chip	7
Setup	7
Running the chip	7
Cleaning the Chip	8

Overview

PCR

Designed by Sarah Nemsick

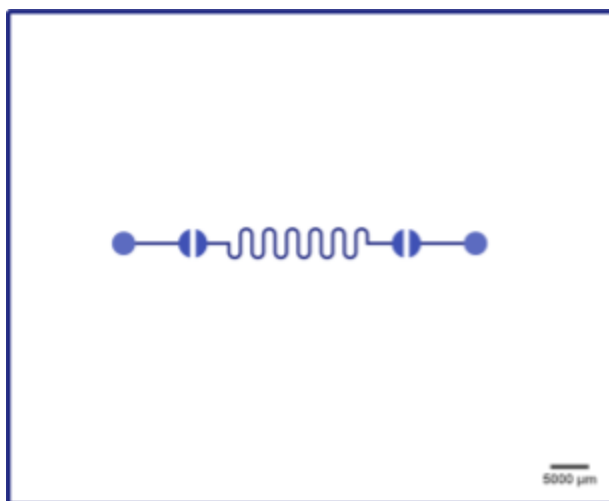
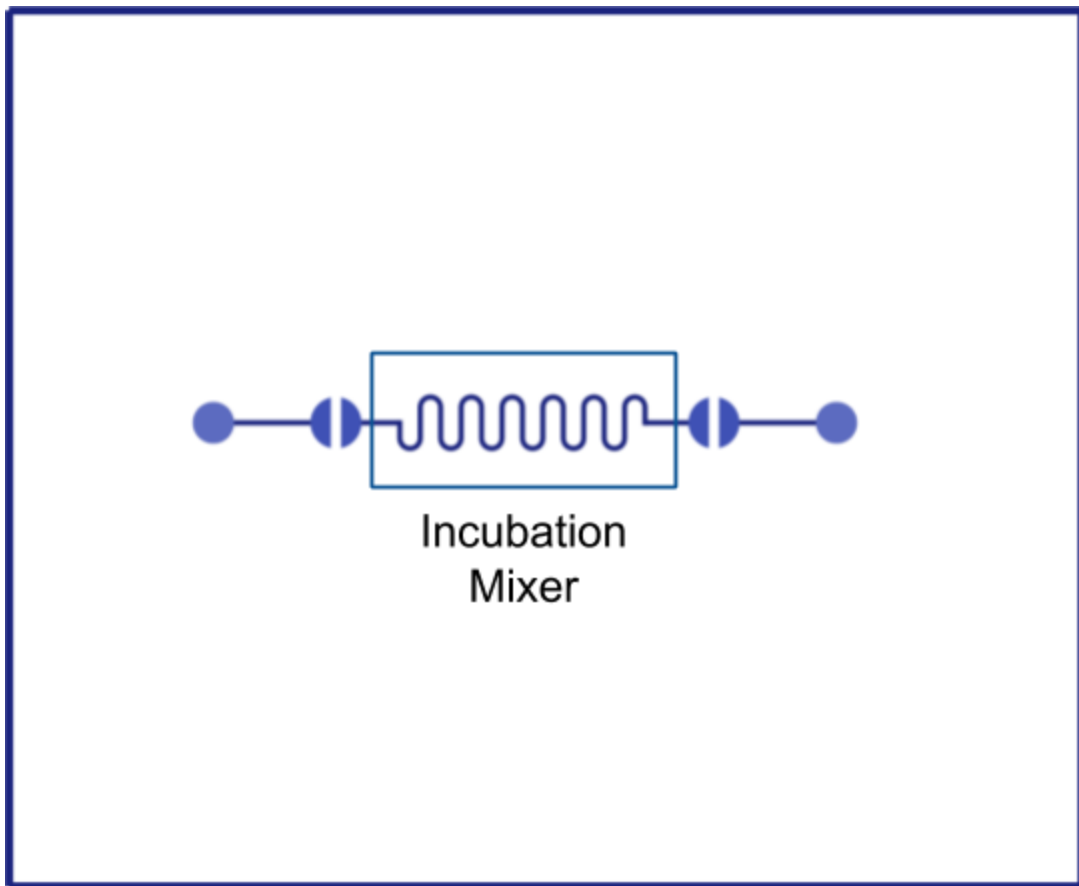
Date Completed: 10/17/2017



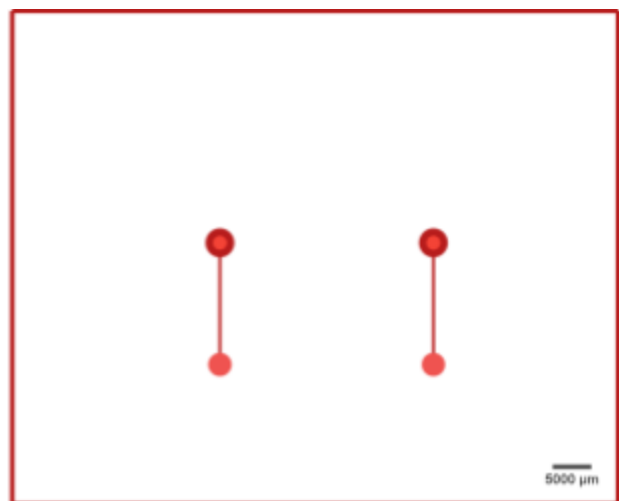
PCR, or polymerase chain reaction, is a commonly used protocol in synthetic biology in order to replicate target DNA fragments. Through the use of specific primers, polymerases, and temperature cycling, exponential replicas of the target DNA fragment can be made. These fragments can then be ligated into plasmids and transformed into bacteria.

This microfluidic chip is designed to perform PCR. A solution containing the required substrates for PCR is flowed into the chip and through a mixer, on top of chip a heating element will be placed. The valves at both ends of the mixer are closed, isolating the mixture, and then the heating element performs temperature cycling. The liquid is then pushed out into an output receptacle for future use in the lab.

Chip Design

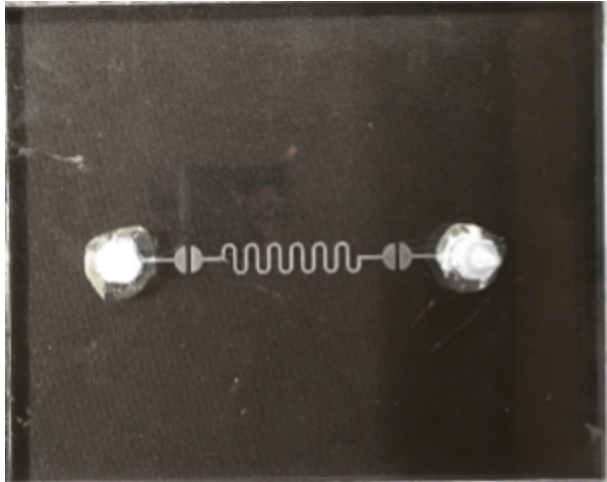


Flow Layer

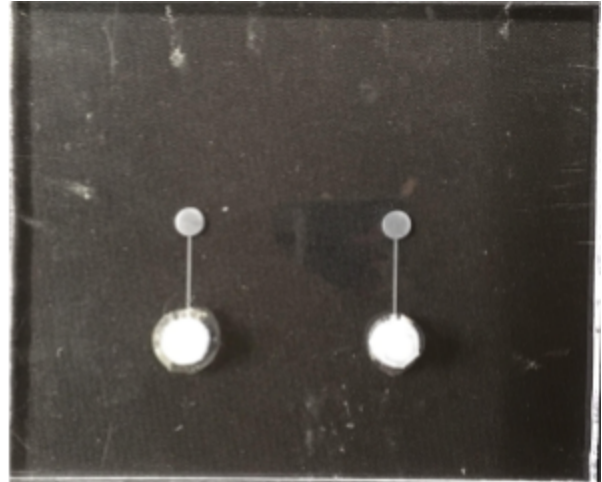


Control Layer

Milling Guidelines



Flow Layer



Control Layer

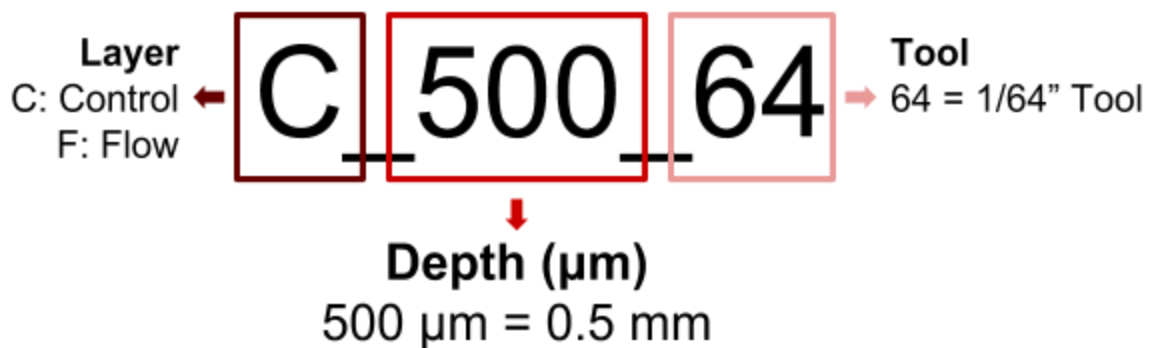
Milling Guidelines

For a comprehensive guide to milling click [here](#). For a list of tool parameters click [here](#).

Notes

1. This chip should be milled on medium or thick polycarbonate ($2.75\text{mm} < Z_{\text{Polycarbonate}}$).
2. This chip requires thick PDMS ($1.0\text{mm} < Z_{\text{PDMS}} < 1.5\text{mm}$)

All the required SVGs for milling this chip are provided in the ZIP file. The layer, depth, and tool required for each SVG is listed in the file name. Below is a key describing how to read an SVG file name:



Milling Instructions

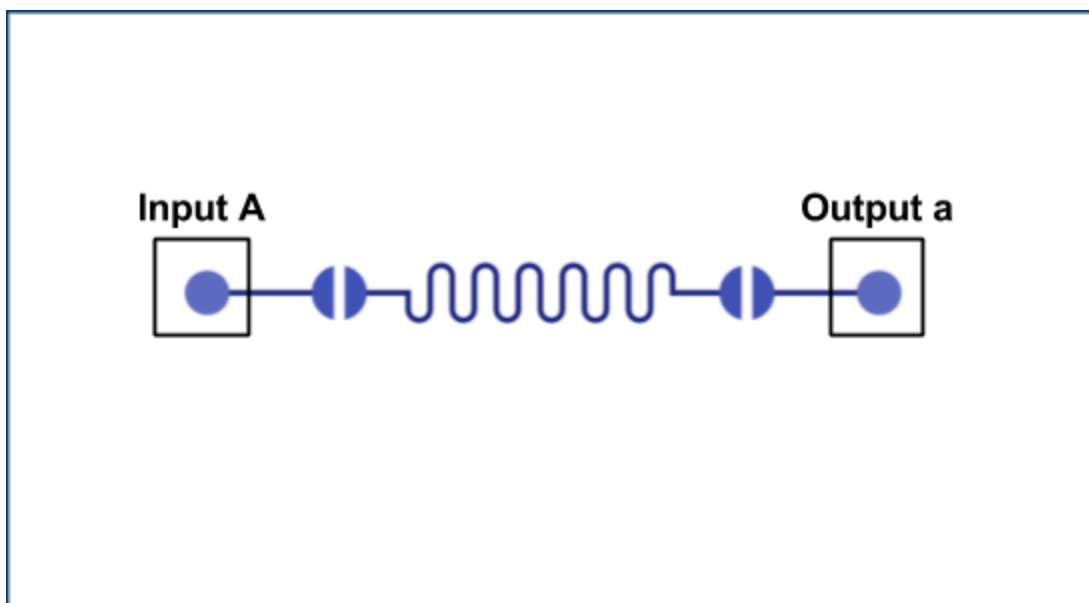
Mill the layers in the order they are listed with the correct depths and using the correct tools.

Flow Layer	
Order	Layer Name
1.	F_500_64
2.	F_PORTS_8
3.	Border

Control Layer	
Order	Layer Name
1.	C_1000_16
2.	C_100_64
3.	C_PORTS_8
4.	Border

Testing Protocol

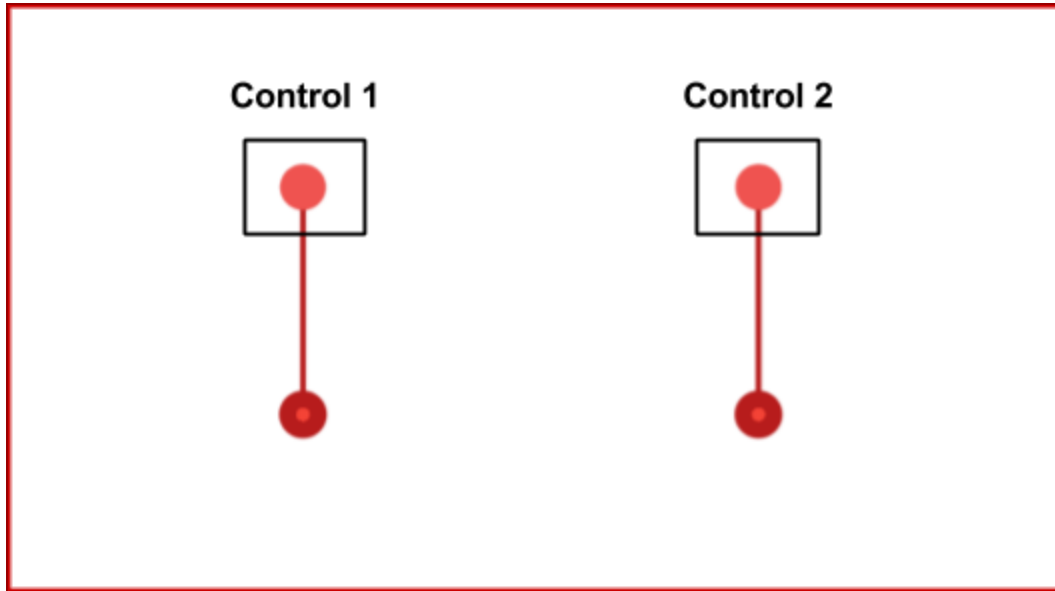
Flow Layer Setup



Inputs		
Name	Liquid	Flow Rate
A	PCR Solution	2.5 mL/hour

Outputs	
Name	Liquid
a	Final Output

Control Layer Setup



Testing the Chip

Setup

1. Prepare 4 syringes
 - a. 1 filled with colored water
 - b. 1 filled with mineral oil
 - c. 2 empty control syringes
2. Attach your syringe containing colored water to Input A
3. Attach your output tubing to Output a; this tube should connect to an eppendorf or other small collection receptacle
4. Attach two separate control syringes to Control 1 and Control 2

Running the chip

5. Open Control 1, then Control 2; you should feel significant resistance while you open these control valves
6. Begin flowing your colored water at a rate of 1.5 mL/hour
7. Once the liquid has crossed the first valve, gone through the mixer, and begun crossing your second valve, turn off your liquid flow
8. Close Control 1, then Control 2, in that specific order
9. Leave your colored water to sit for at least 2 minutes
10. Begin open Control 1, then Control 2
11. Attach a syringe with oil to Input A

12. Begin flowing your oil at a rate of 1.5 mL/hour
13. Collect all output liquid into your collection receptacle

Cleaning the Chip

14. Disconnect your output tubing carefully, then disconnect all other syringes
15. Clean the chip following the oil & water protocol listed [here](#)
16. Store your chip as detailed in the cleaning protocol