

Experiment Report

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Outline

- Experiment Setup
- Simulation Parameters
- Solution on binding
- Unsolved Problem
- Experiment



Experiment Setup

- ✓ Thermal Sensors probe (1~100°C)
- ✓ Flow sensors (G ½")
- ✓ Valve
- ✓ Tubing
- ✓ Connector (3/4" to 8 mm)
- ✓ Pump (45W, bought)
- ❑ Pressure Chamber(with gauge)
- ❑ Power Source

```
ROM = 28 89 46 EE 8 0 0 6E
Chip = DS18B20
Data = 1 AB 1 4B 46 7F FF 5 10 92 CRC=92
Temperature = 26.69 Celsius, 80.04 Fahrenheit
No more addresses.

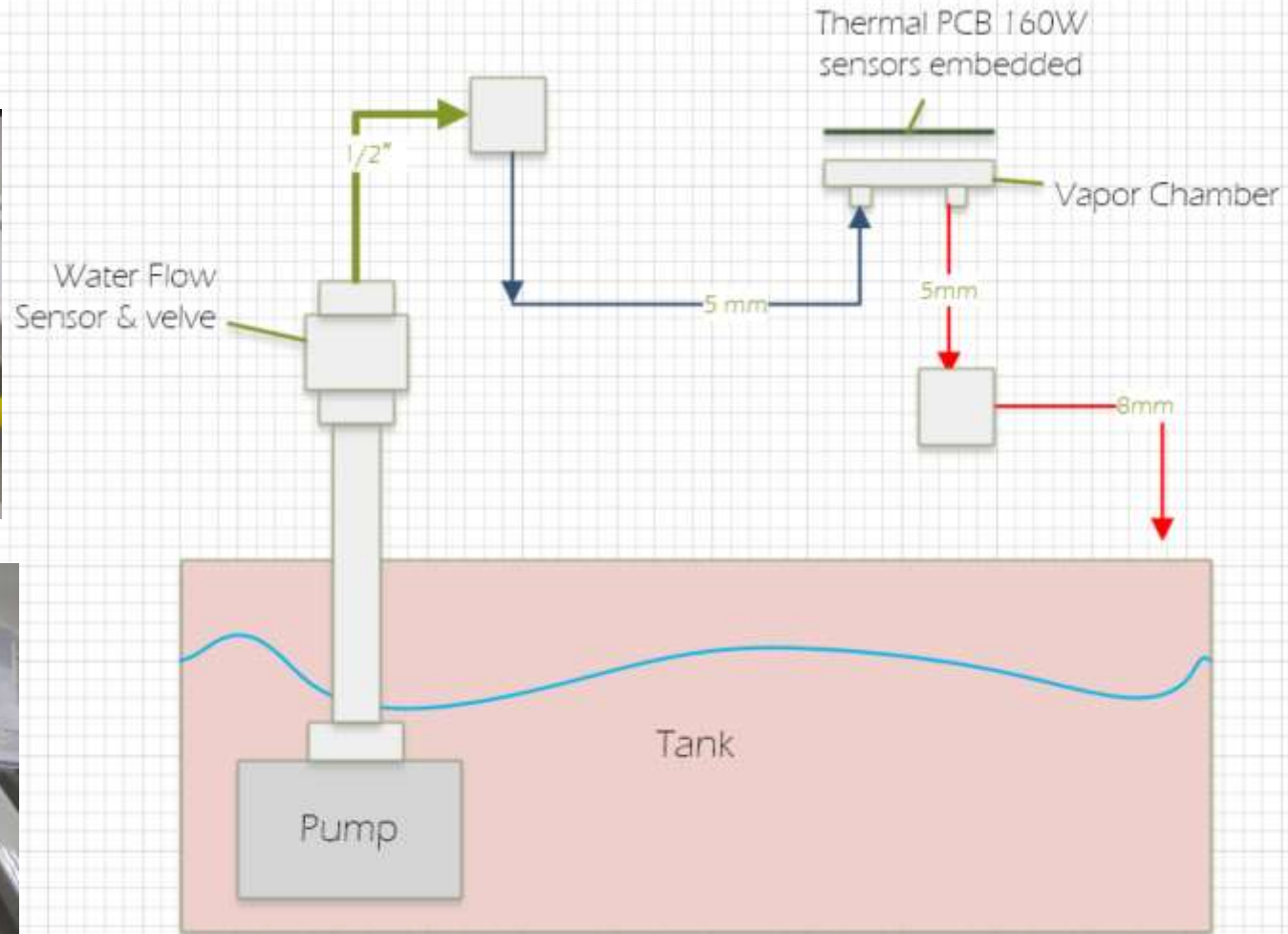
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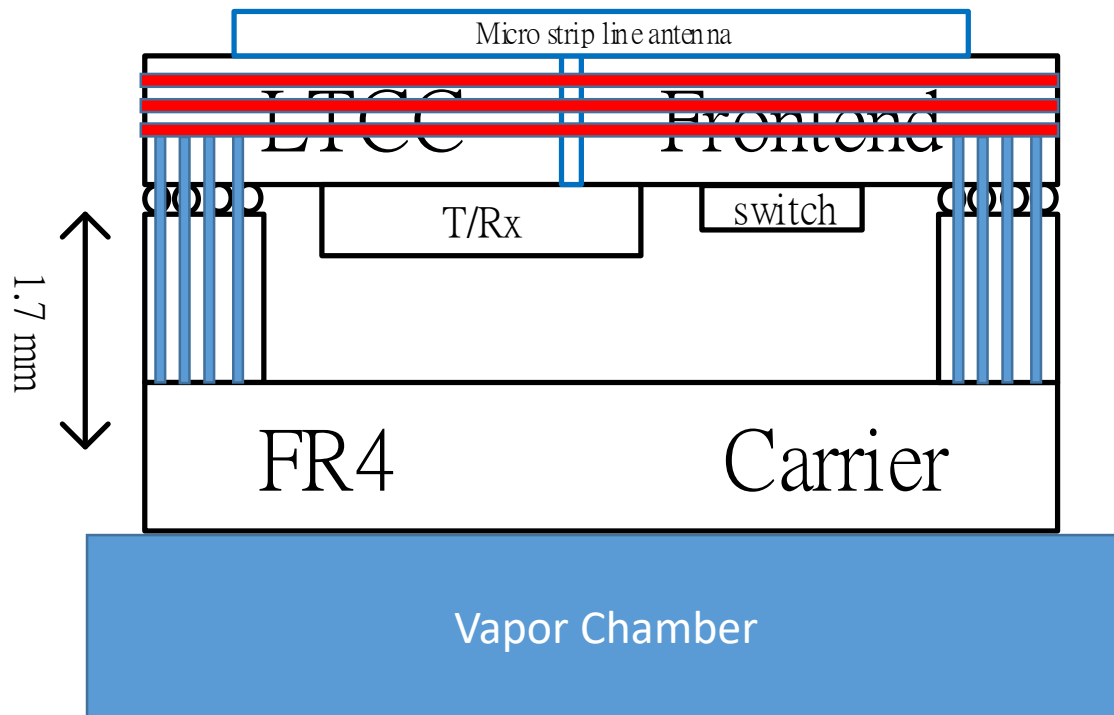
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```

Experiment Flow chart

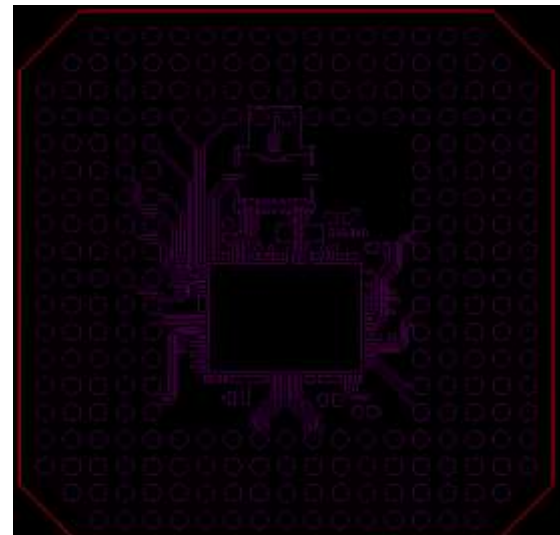
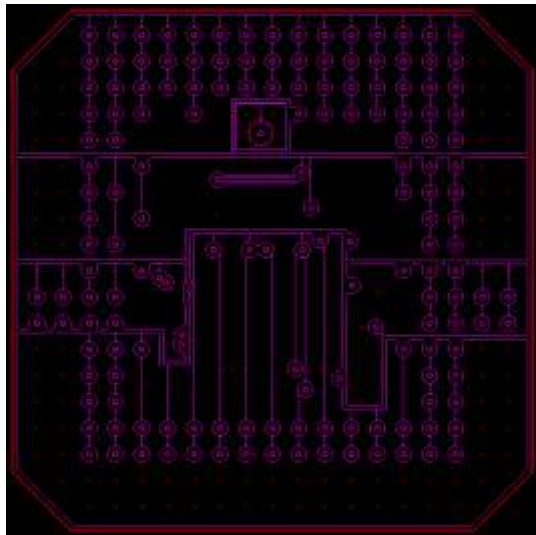
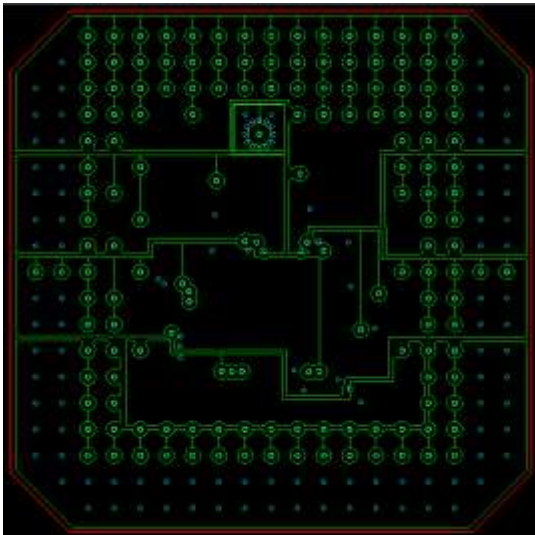
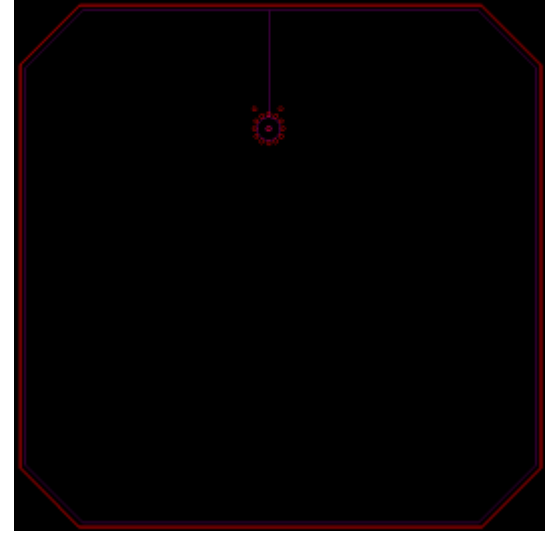
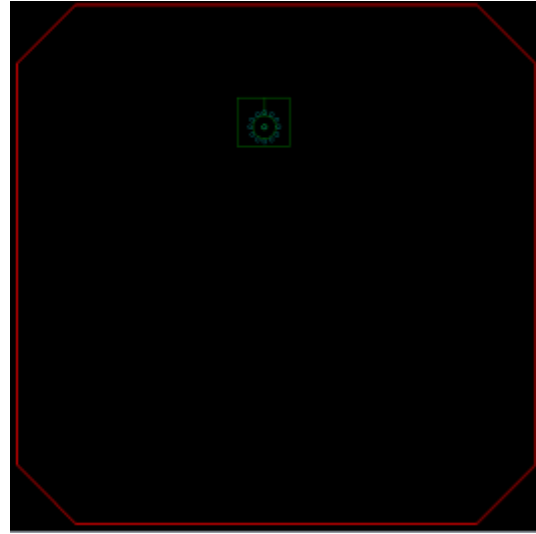
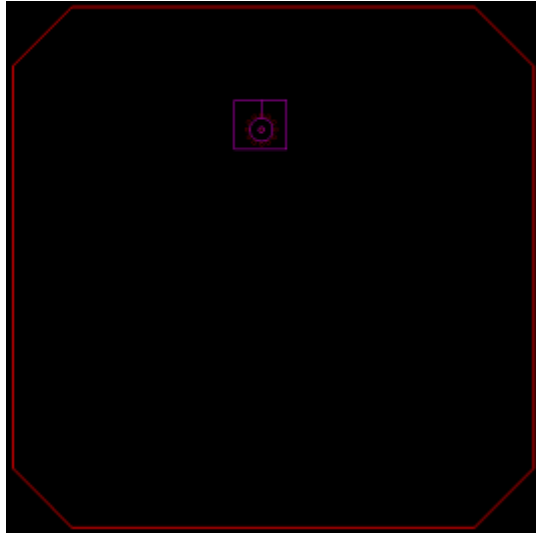
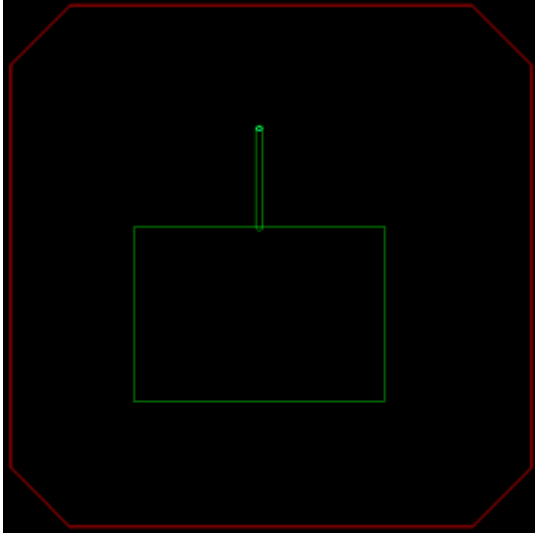


Unsolved Problem



- Problem 1:
 - Heat accumulation
heat might accumulated on top metal layers according to the figure
- Problem 2:
 - FR4 drilling
The accurate depth of the pit for T/Rx is 1.16 mm, CNC is more suitable in this cooling case for PCB drilling will cover a thin layer on top of surface, which is not optimal for cooling.

LTCC module



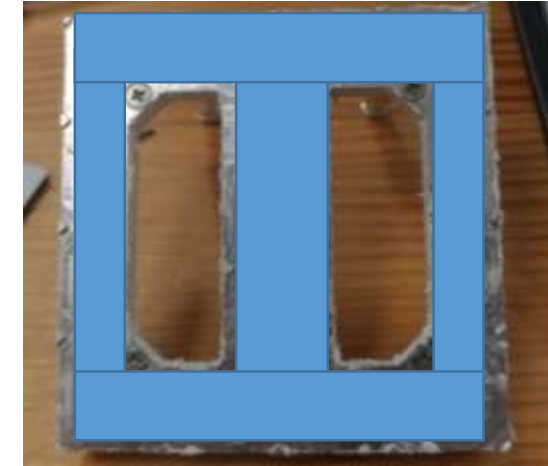
Bonding PCB to Aluminum Structure



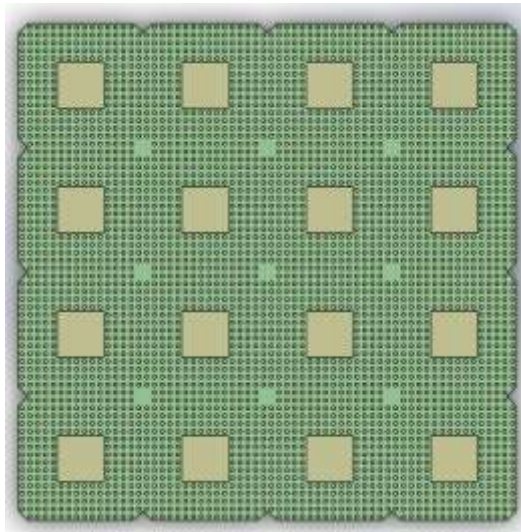
Assembly cell structure



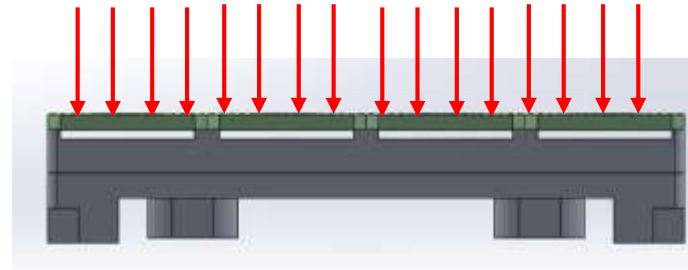
Clean Anodize Vapor Chamber Surface



Pre-apply Thermal Tape



Aligning the PCB on VC

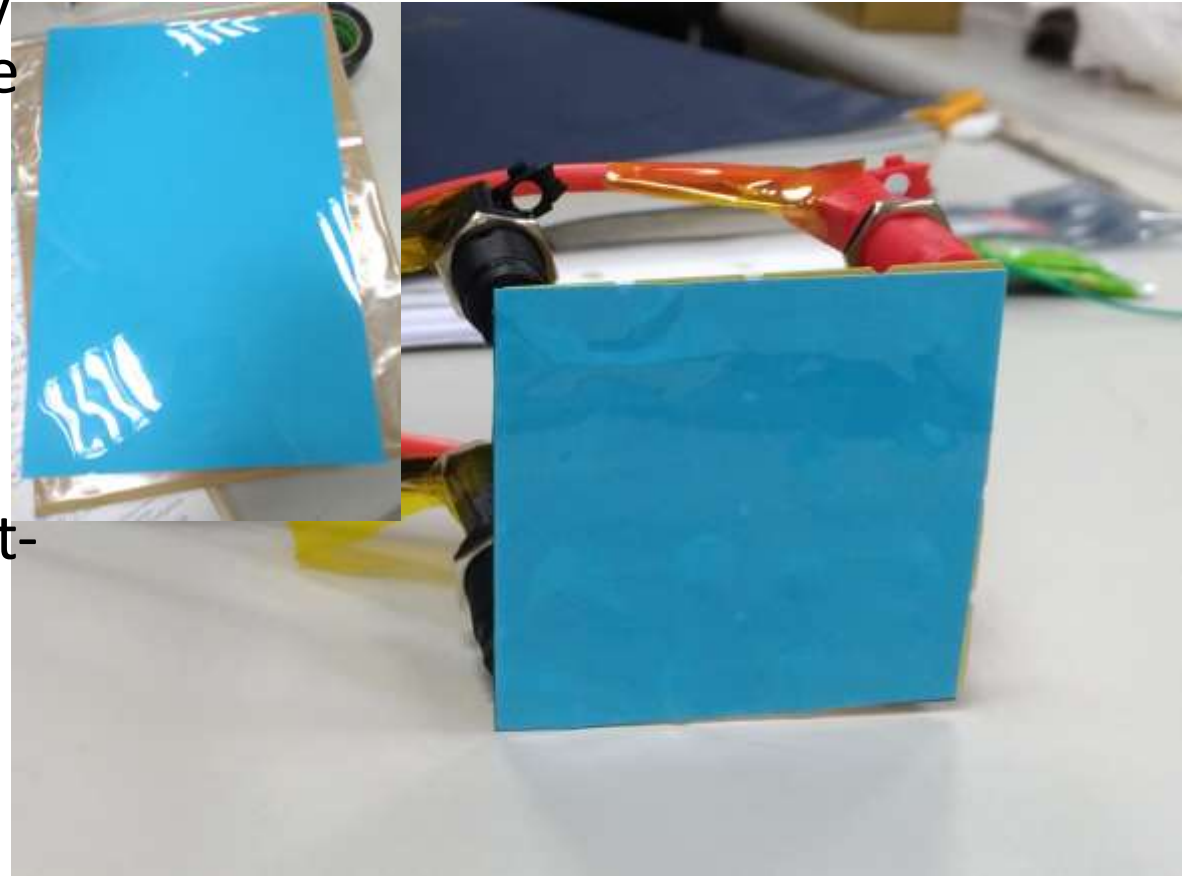


Pressure on both side

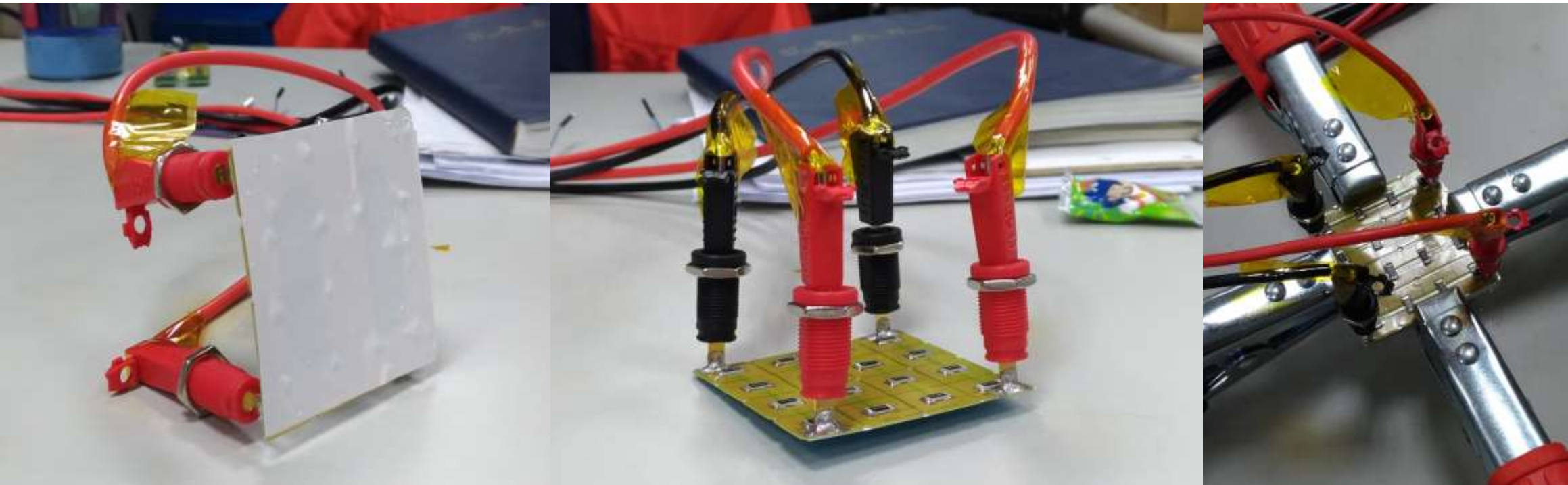
Tape Layer Thickness
Less than 150-200um

Thermal Tape

- 3M 8805 High Adhesion Thermally Conductive Adhesive Transfer Tape
 - Thickness: 5 mil (0.13 mm)
 - Conductivity 0.6 W/m-K
 - Adhesion: 5.8 @RT N/cm
- ✓ Problem: Aluminum Surface is wet-out, which cause the tape less adhesive on vapor chamber side
- Solution: coarse the surface with scratches (or silicone)

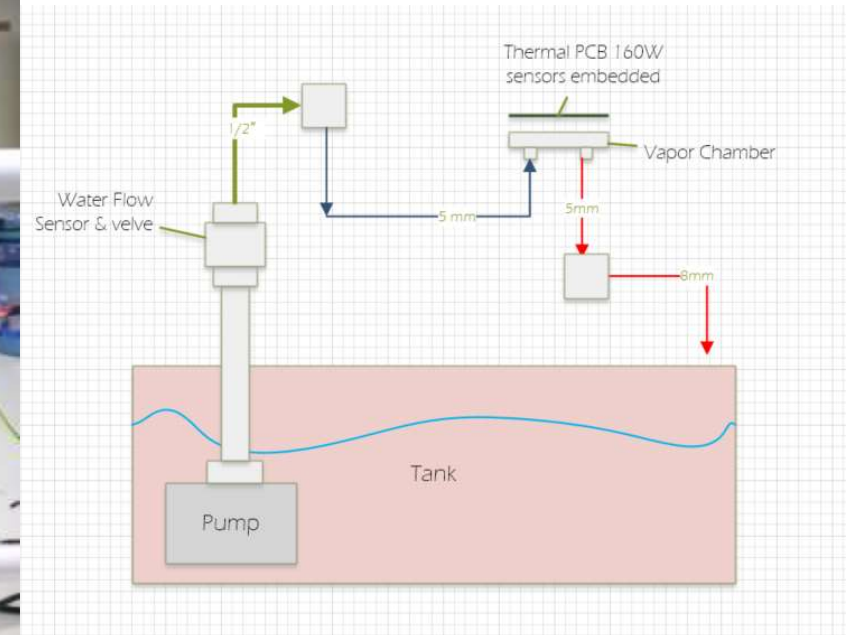


Tape Configuration



Experiment Setup

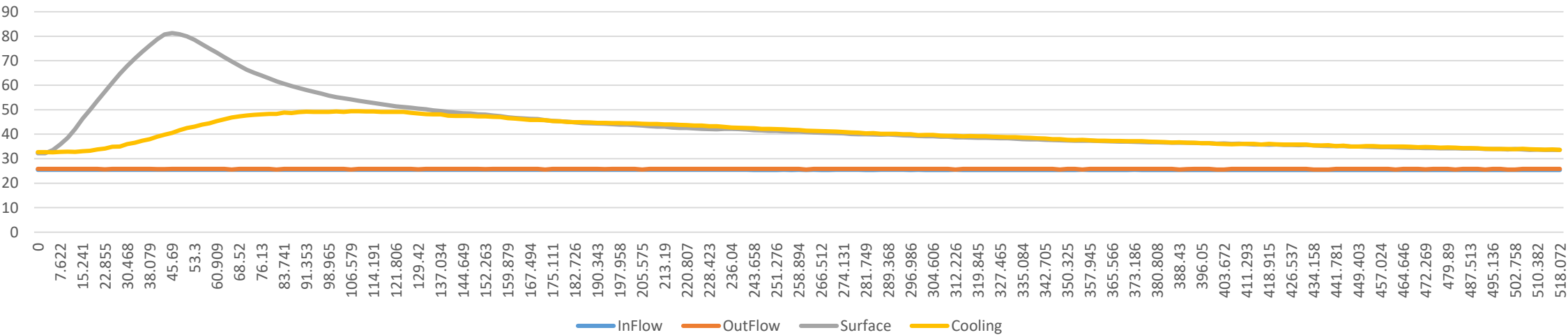
- Tube: 8 mm 12 mm tube (in ISO)
- All the sensors are in 12 mm tube; while the in/out of vapor chamber is 8 mm
- Surface and vapor chamber temperature sensor **does not** attach to the surface directly, only for the reference purpose.



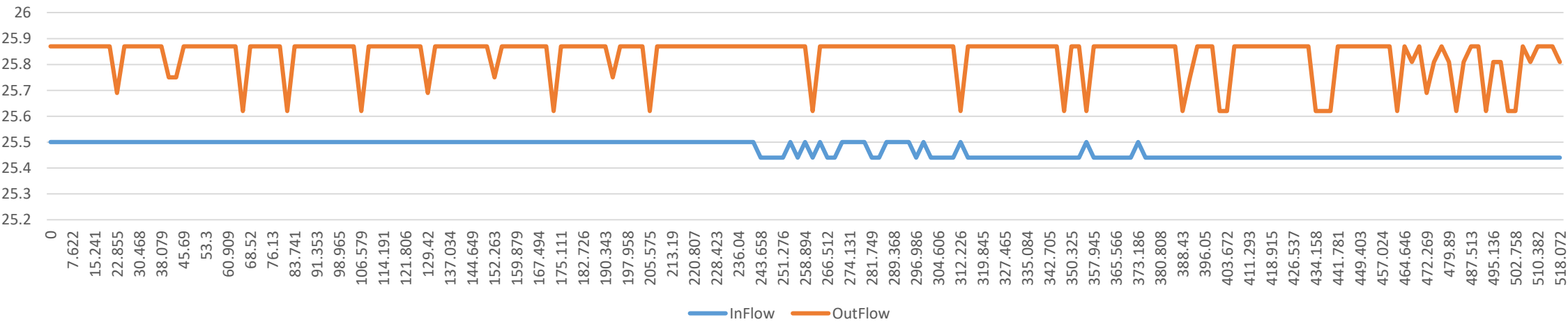
No Flow Temperature chart



No Flow Experiment



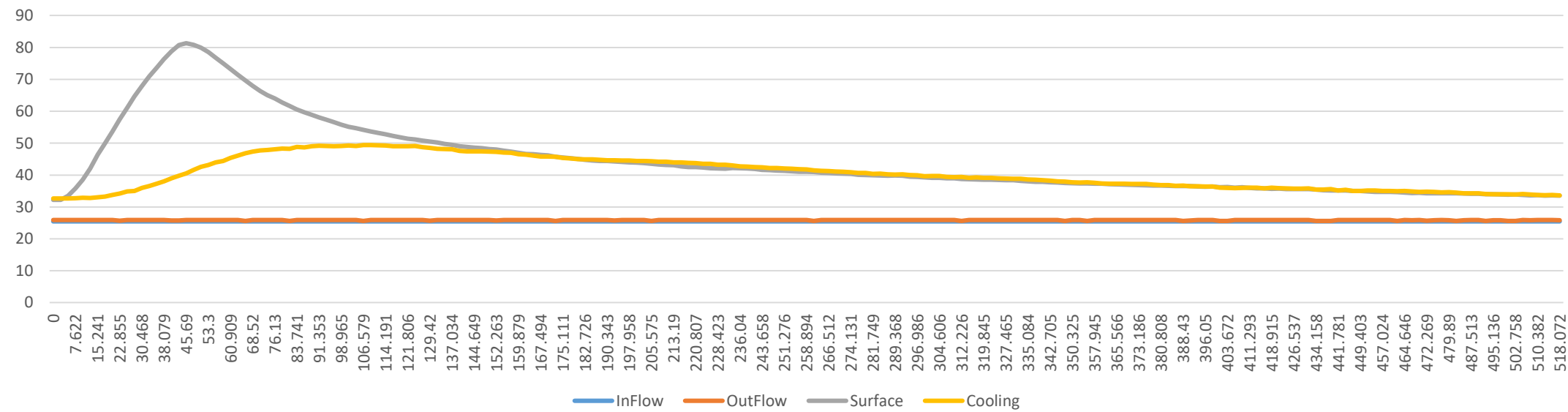
No Flow Experiment



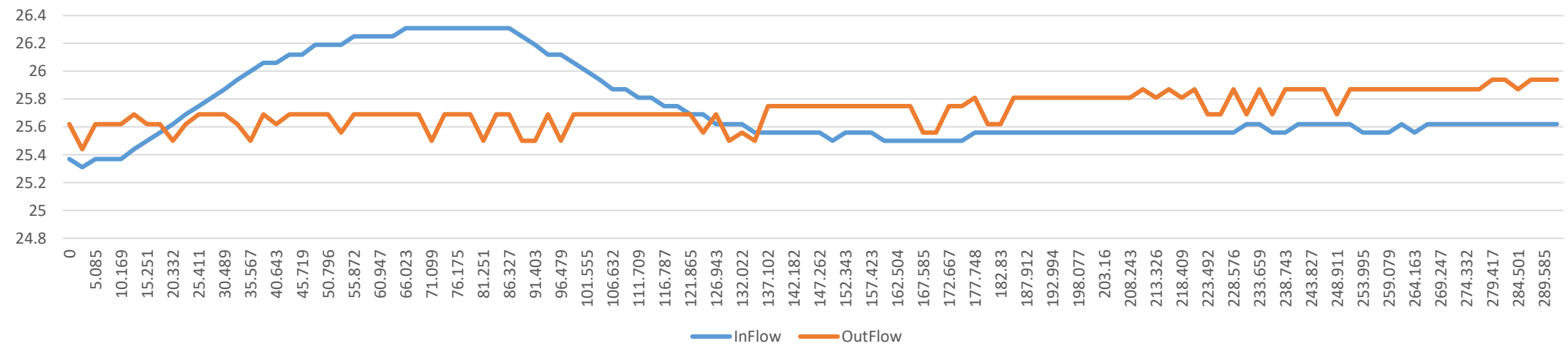
Flow Temperature chart



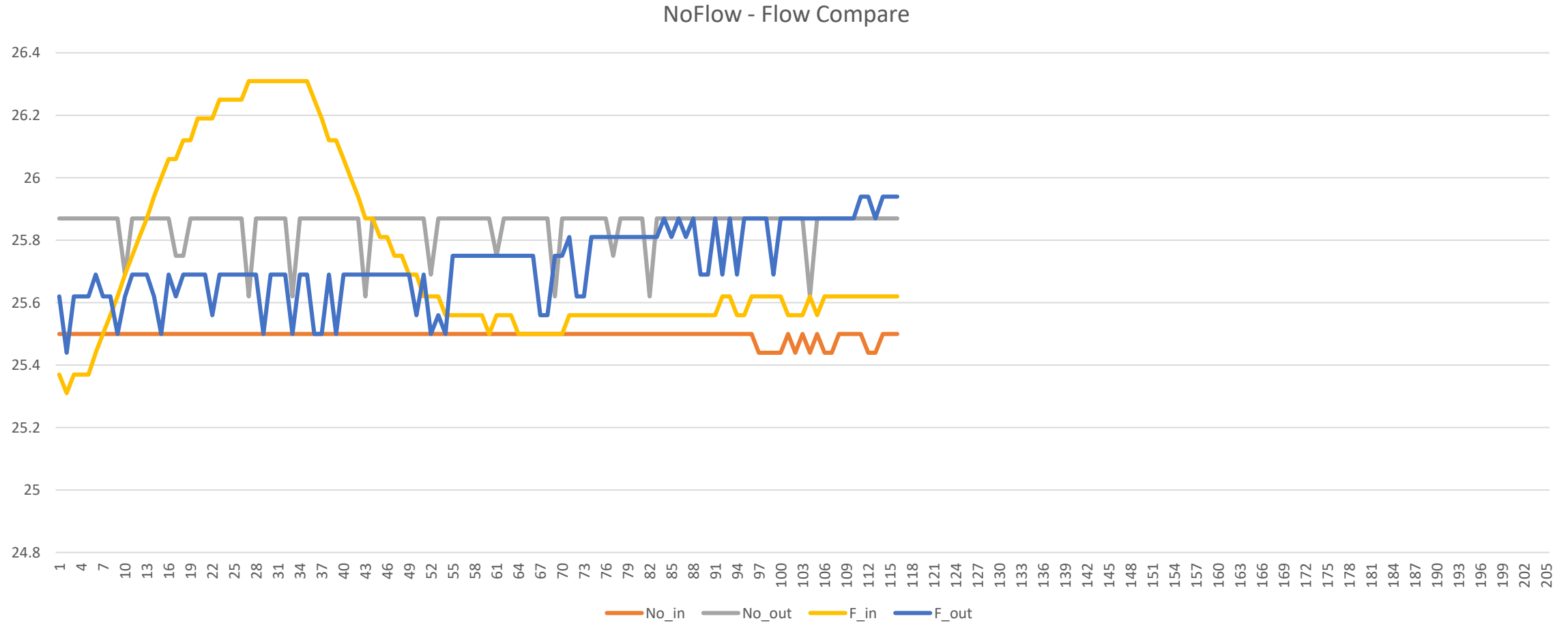
Flow Experiment



Flow Experiment



No Flow / Flow compare



Data Format and Parser

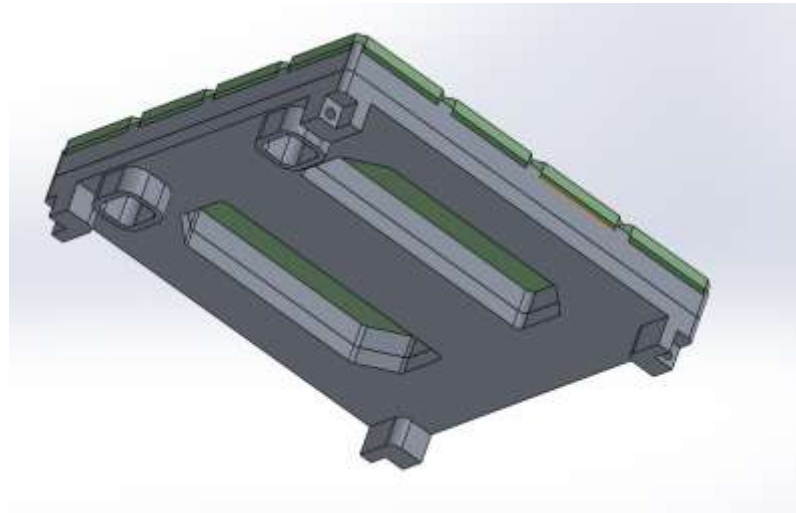
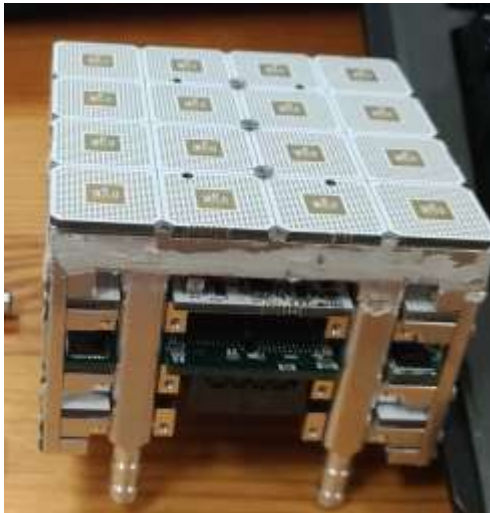
Experiment_parser.py

```
1 import sys
2 import csv
3
4
5 class DataParser:
6
7     # constructor
8     def __init__(self, filename):
9         self.filename = filename
10        self.line_cnt = 0
11        self.data = []
12        self.content = []
13        self.original_time = 8880
14        self.openfile()
15
16    def openfile(self):
17        with open(self.filename) as f:
18            reader = f.readlines()
19            self.content = [x.strip() for x in reader]
20            self.line_cnt = len(self.content)
21            self.original_time = int(self.content[1][self.content[1].find("...") + 3:])
22            print("Successfully open the file" + str(self.filename) + " with " + str(self.line_cnt) + " data.")
23            self.read()
24
25    def read(self):
26        print("Start reading...")
27        for i in range(self.line_cnt):
28            if((i % 2) == 0):
29                inflow = self.content[i].find("InFlow") + len("InFlow is:")
30                outflow = self.content[i].find("OutFlow") + len("OutFlow is:")
31                f1 = self.content[i].find("F1") + len("F1 is:")
32                f2 = self.content[i].find("F2") + len("F2 is:")
33            else:
```

```
1 Temperature InFlow is:25.69 = OutFlow is:25.94 = F1 is:27.50 = F2 is:26.19
2 Requesting temperatures...13464
3 Temperature InFlow is:25.69 = OutFlow is:25.94 = F1 is:27.56 = F2 is:26.31
4 Requesting temperatures...16007
5 Temperature InFlow is:25.69 = OutFlow is:25.94 = F1 is:27.62 = F2 is:26.44
6 Requesting temperatures...18549
7 Temperature InFlow is:25.69 = OutFlow is:25.94 = F1 is:28.56 = F2 is:26.25
8 Requesting temperatures...21092
9 Temperature InFlow is:25.69 = OutFlow is:25.94 = F1 is:30.44 = F2 is:26.12
10 Requesting temperatures...23633
11 Temperature InFlow is:25.75 = OutFlow is:25.94 = F1 is:33.06 = F2 is:26.19
12 Requesting temperatures...26175
13 Temperature InFlow is:25.81 = OutFlow is:25.94 = F1 is:36.38 = F2 is:26.44
14 Requesting temperatures...28716
15 Temperature InFlow is:25.87 = OutFlow is:26.00 = F1 is:39.81 = F2 is:26.12
16 Requesting temperatures...31256
17 Temperature InFlow is:25.87 = OutFlow is:25.94 = F1 is:42.88 = F2 is:26.25
18 Requesting temperatures...33796
19 Temperature InFlow is:25.94 = OutFlow is:25.94 = F1 is:47.44 = F2 is:26.44
20 Requesting temperatures...36336
21 Temperature InFlow is:26.00 = OutFlow is:26.00 = F1 is:51.56 = F2 is:26.44
22 Requesting temperatures...38875
23 Temperature InFlow is:26.06 = OutFlow is:26.00 = F1 is:55.31 = F2 is:26.56
24 Requesting temperatures...41414
25 Temperature InFlow is:26.12 = OutFlow is:26.00 = F1 is:58.88 = F2 is:26.25
26 Requesting temperatures...43953
27 Temperature InFlow is:26.12 = OutFlow is:26.00 = F1 is:62.50 = F2 is:26.50
28 Requesting temperatures...46491
```

Future works

- Test out what's the best adhesive for aluminum surface (Ra 6.3)
- Design the next version based on current experiment result



Thank you