Fran Quero

Tsinghua University
CRI, University de Paris

If you could detect any gene by 1$

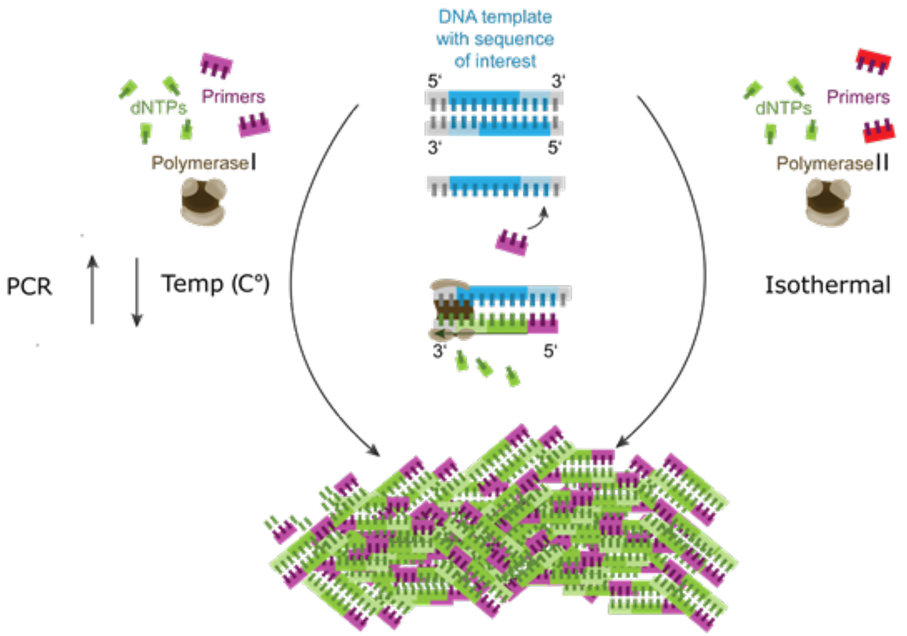
what would you do?

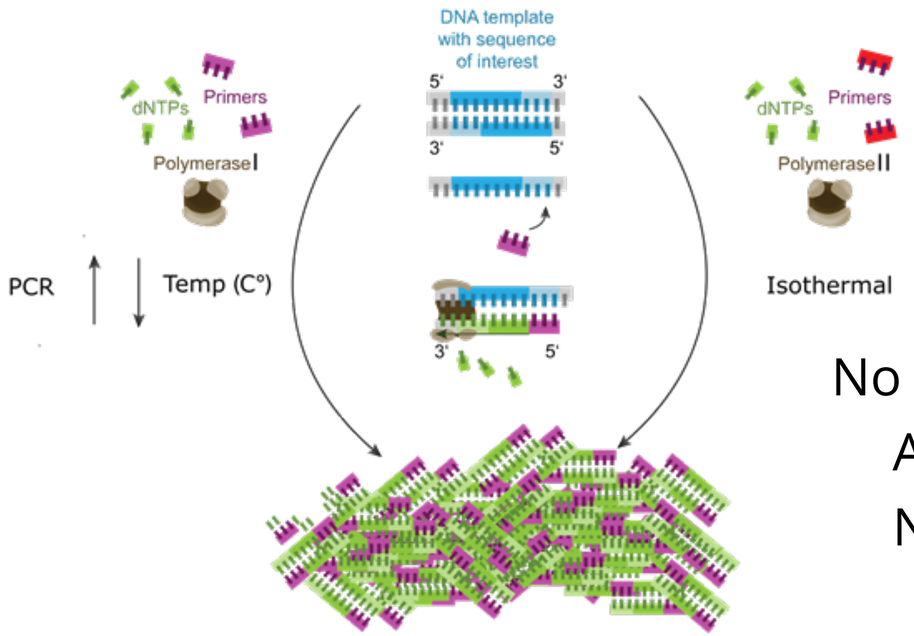
Funghi

Cov19

Water

GMO


DNA template
with sequence
of interest
5'
3'
3'
5'
dNTPs
Primers
Polymerase I
PCR
Temp (C°)
3'
5'
dNTPs
Primers
Polymerase II
Isothermal

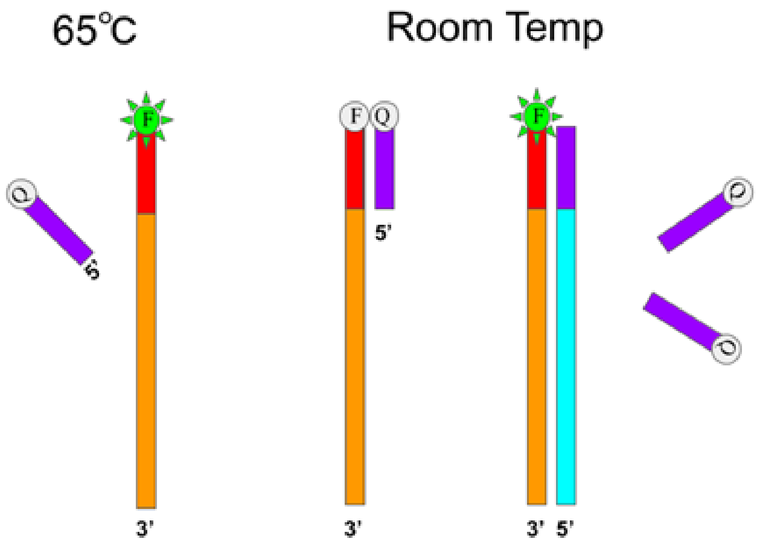


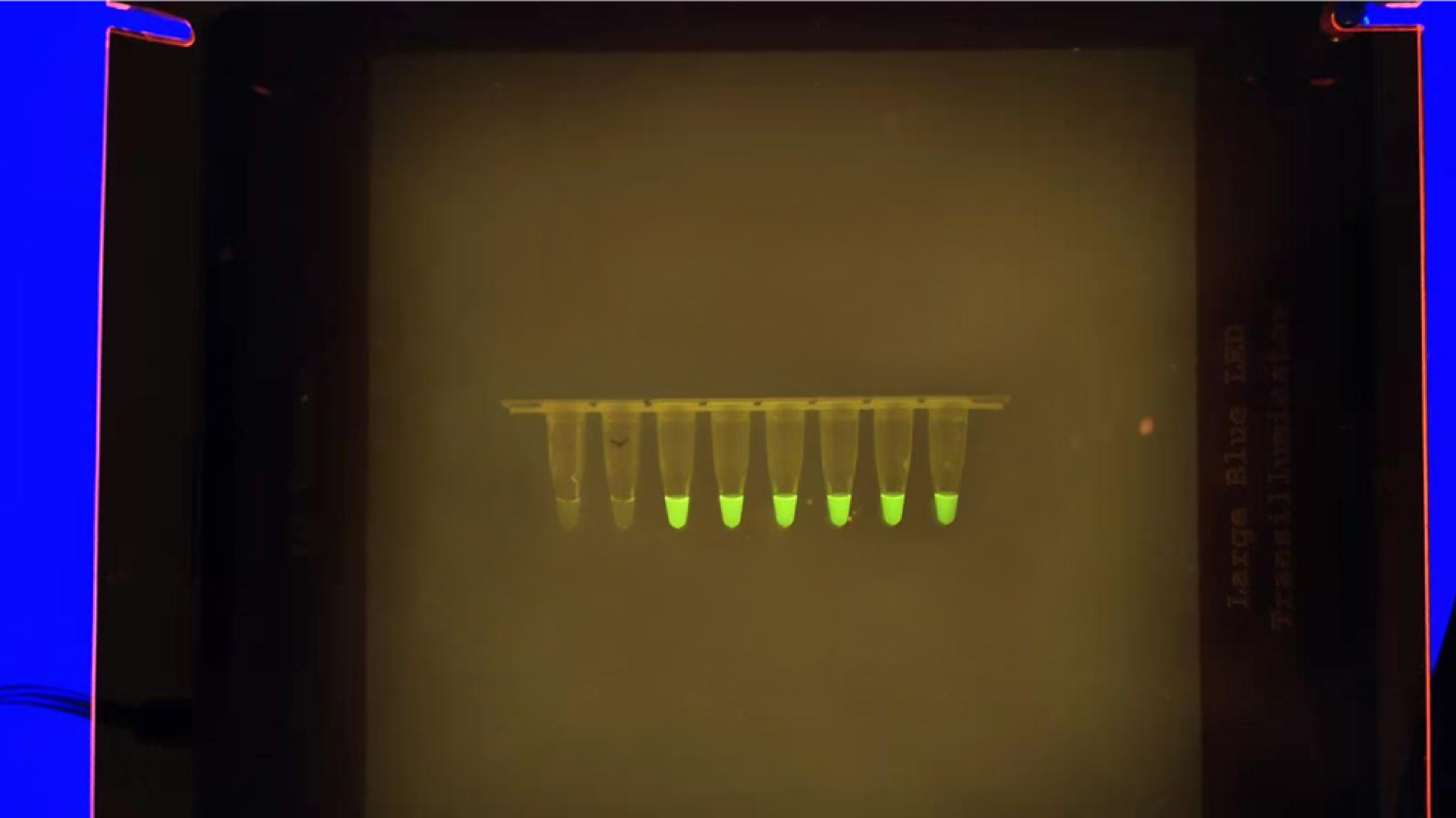
No thermocycler required!

Affordable

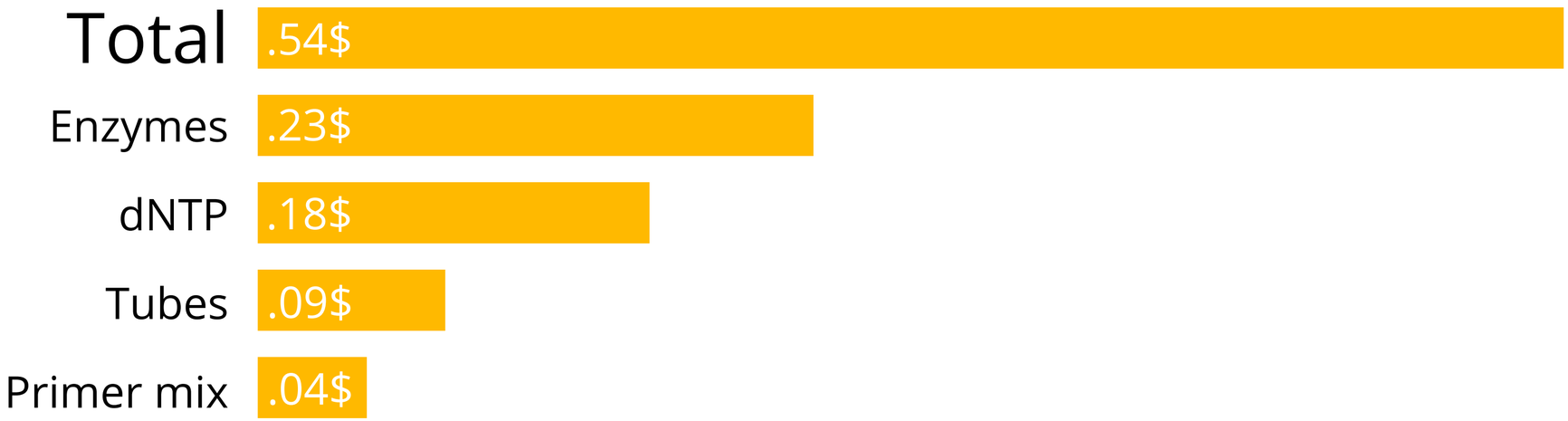
No lab required

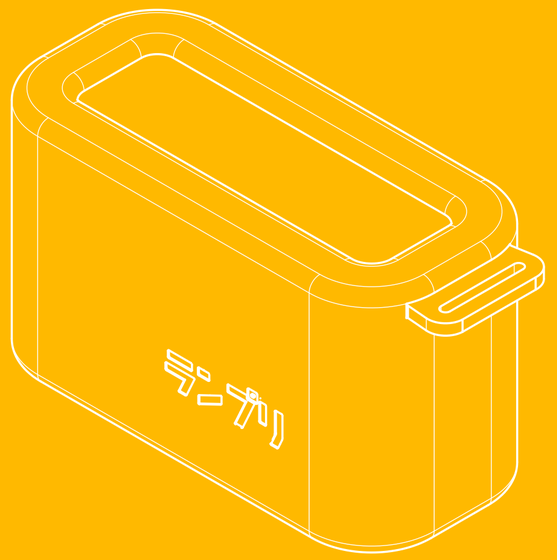
Image from New England Biolabs

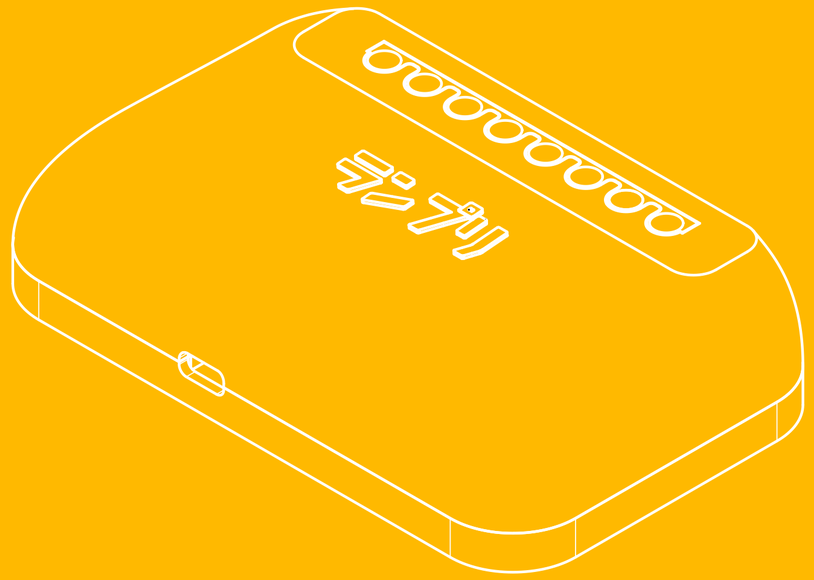

65°C
Room Temp
F
Q
5'
3'
3'
3'
5'

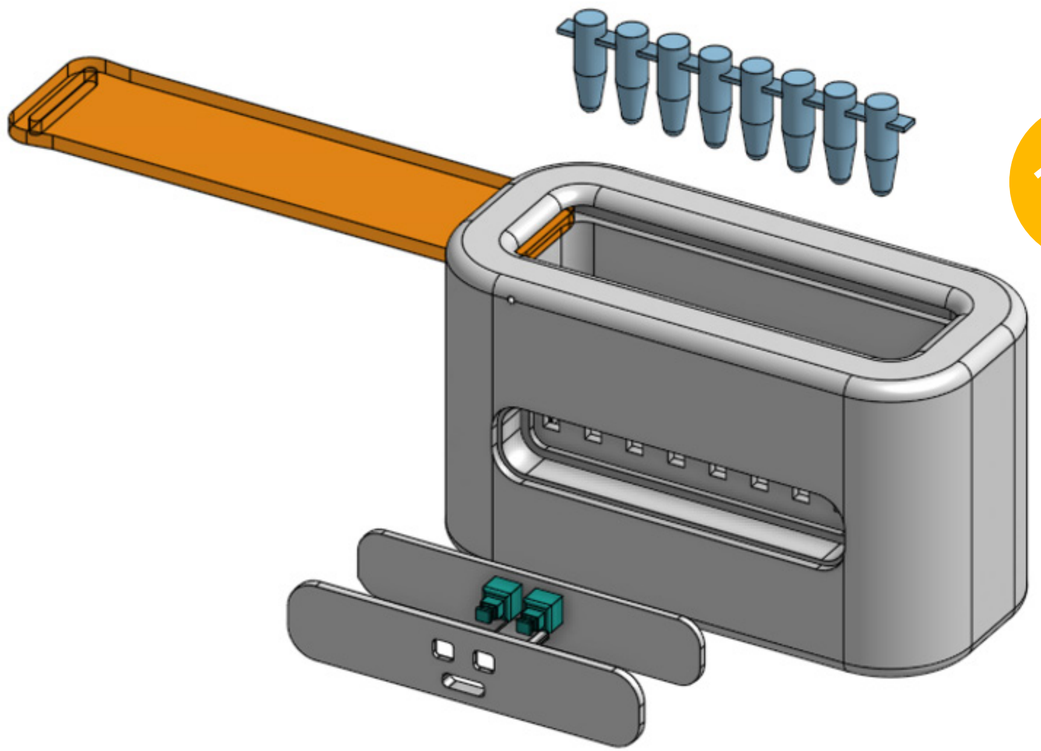

Large Blue Tan
Transilluminator

If you could detect any gene by ~~1~~$...




ランチ


ランチ



5€

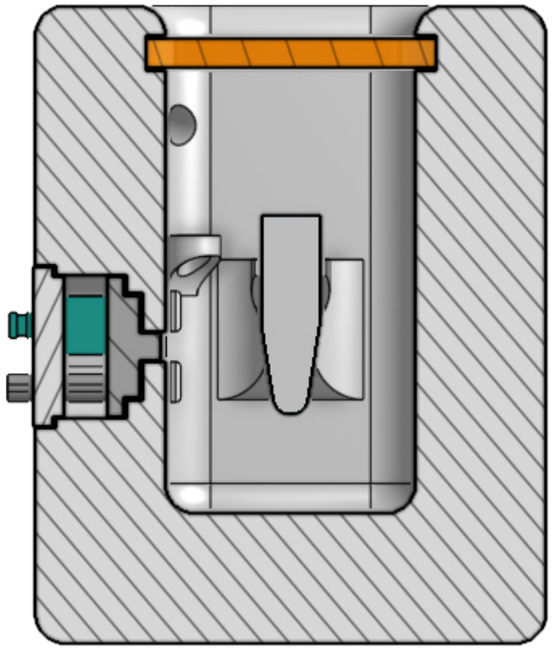
18W

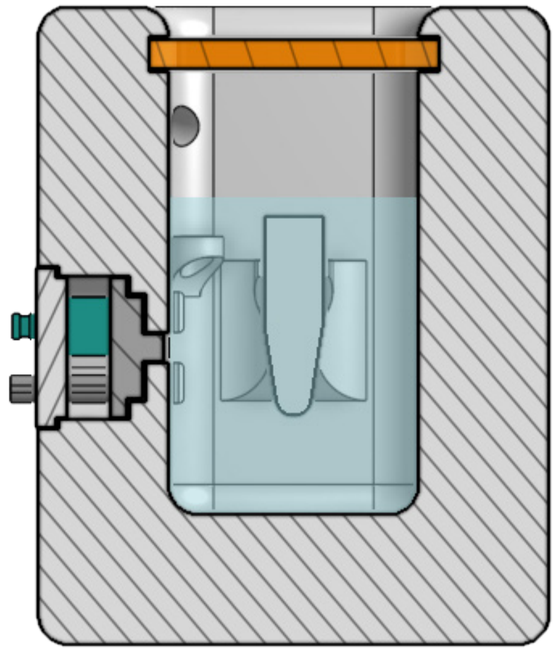
Waterbath & Transilluminator

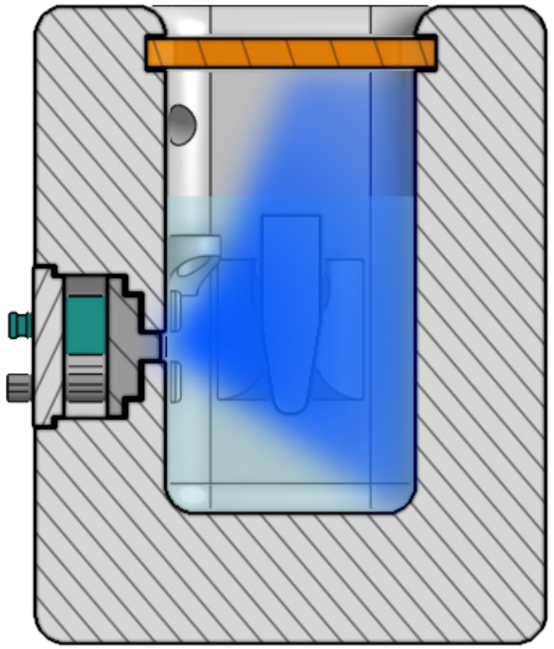
Liquid cooling offers higher thermal conductivity than air cooling.

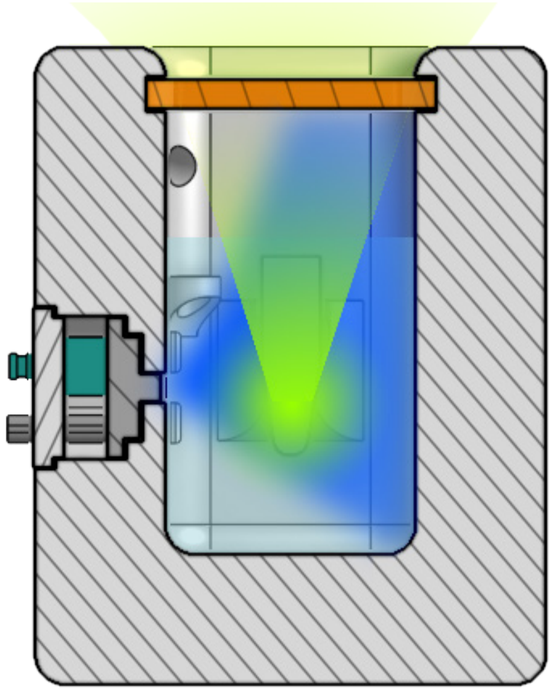
Water has unusually high specific heat capacity among commonly available liquids at room temperature and atmospheric pressure allowing efficient heat transfer over distance with low rates of mass transfer.

Kemmer, Frank N. (1979). The NALCO Water Handbook. McGraw-Hill.

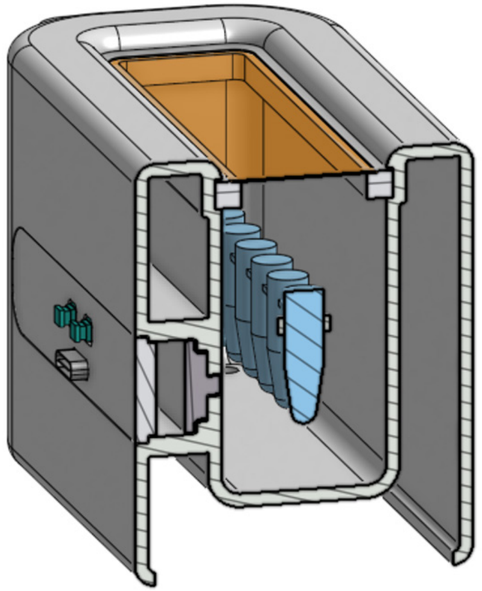


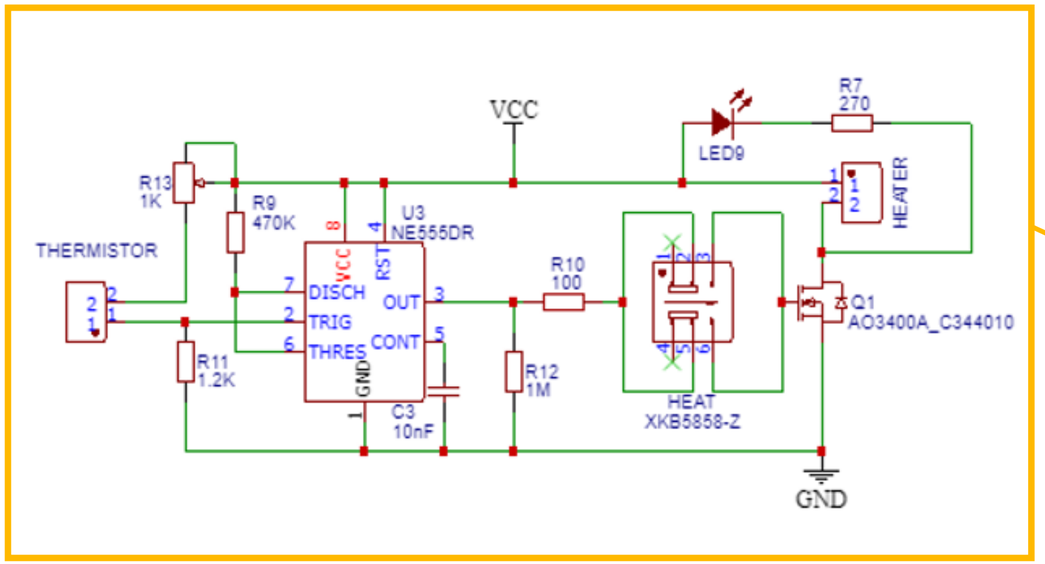


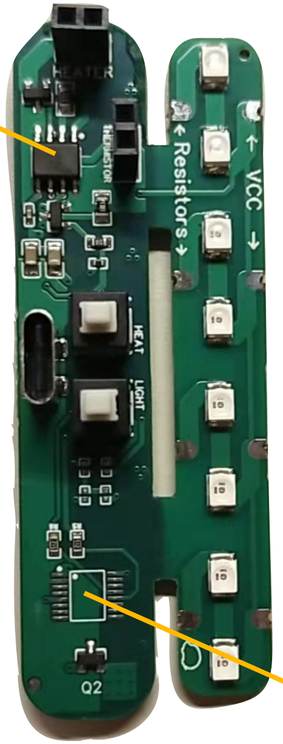


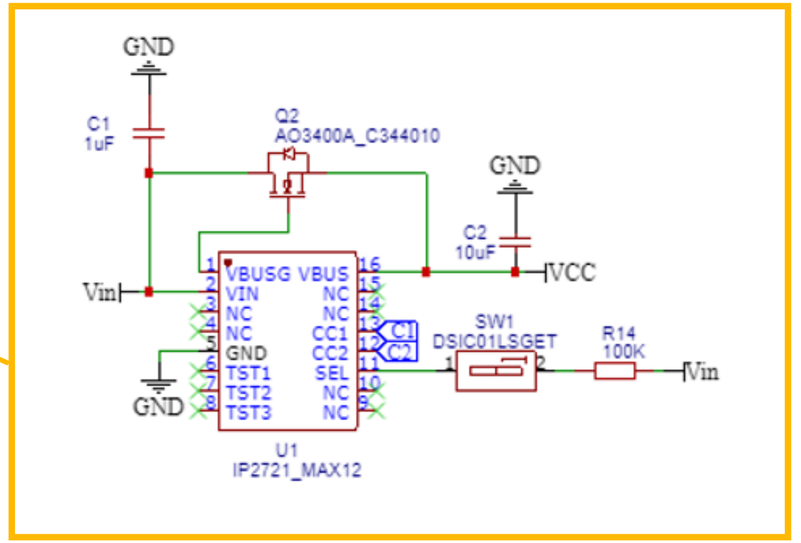


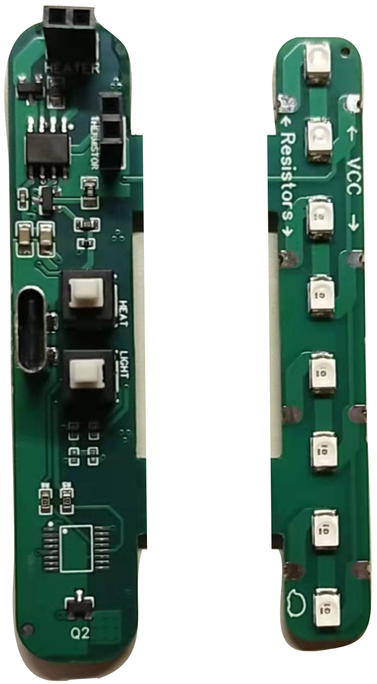

Ready to Print
formlabs




VCC
R7
270
LED9
R13
1K
R9
470K
U3
NE555DR
HEATER
THERMISTOR
VCC
RST
DISCH
OUT
TRIG
CONT
THRES
GND
R10
100
Q1
AO3400A_C344010
R11
1.2K
R12
1M
C3
10nF
HEAT
XKB5858-Z
GND


HEATER
RESISTOR
Resistors
VCC
HEAT
LIGHT
Q2


GND
C1
1uF
Q2
AO3400A_C344010
GND
C2
10uF
VCC
Vin
VBUSG
VIN
NC
NC
GND
TST1
TST2
TST3
VBUS
NC
NC
CC1
CC2
SEL
NC
NC
SW1
DSIC01LSGET
R14
100K
Vin
GND
U1
IP2721_MAX12

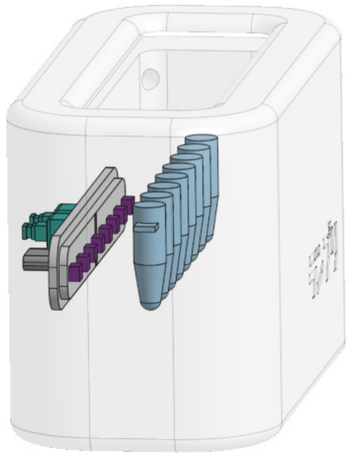

HEATER
INDUCTOR
HEAT
LIGHT
Q2

← VCC →
← Resistors →

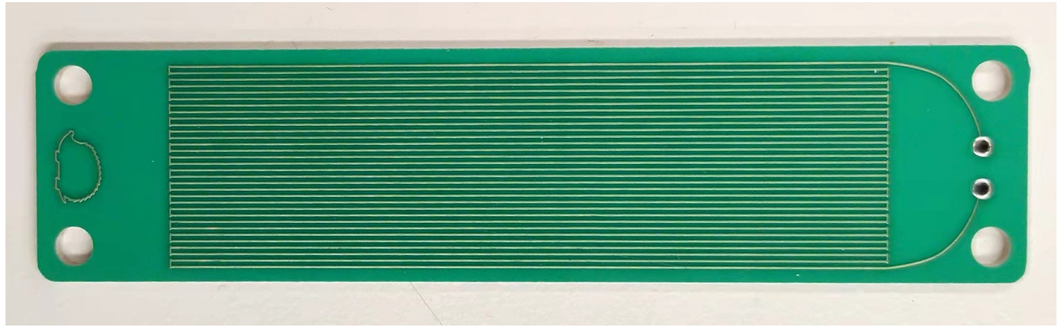

VCC
Resistors


VCC
Resistors


VCC
VCC
Resistors
Resistors

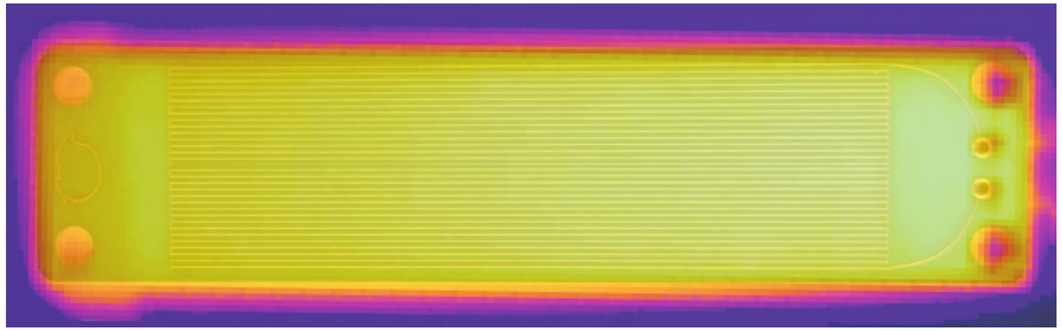


JLCPCB

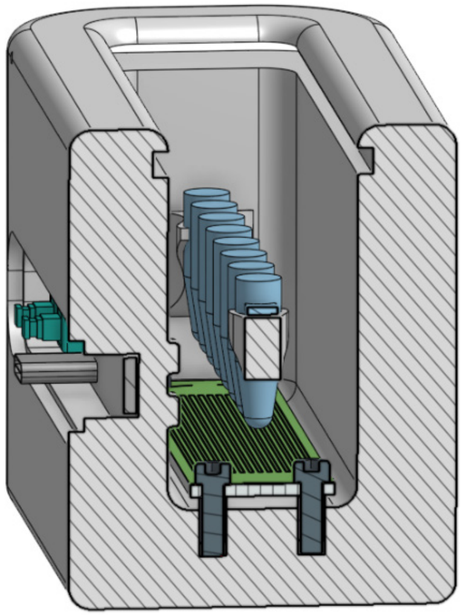


$$R = \rho \cdot \frac{L}{T \cdot W} \cdot [1 + \alpha(temp - 25)]$$

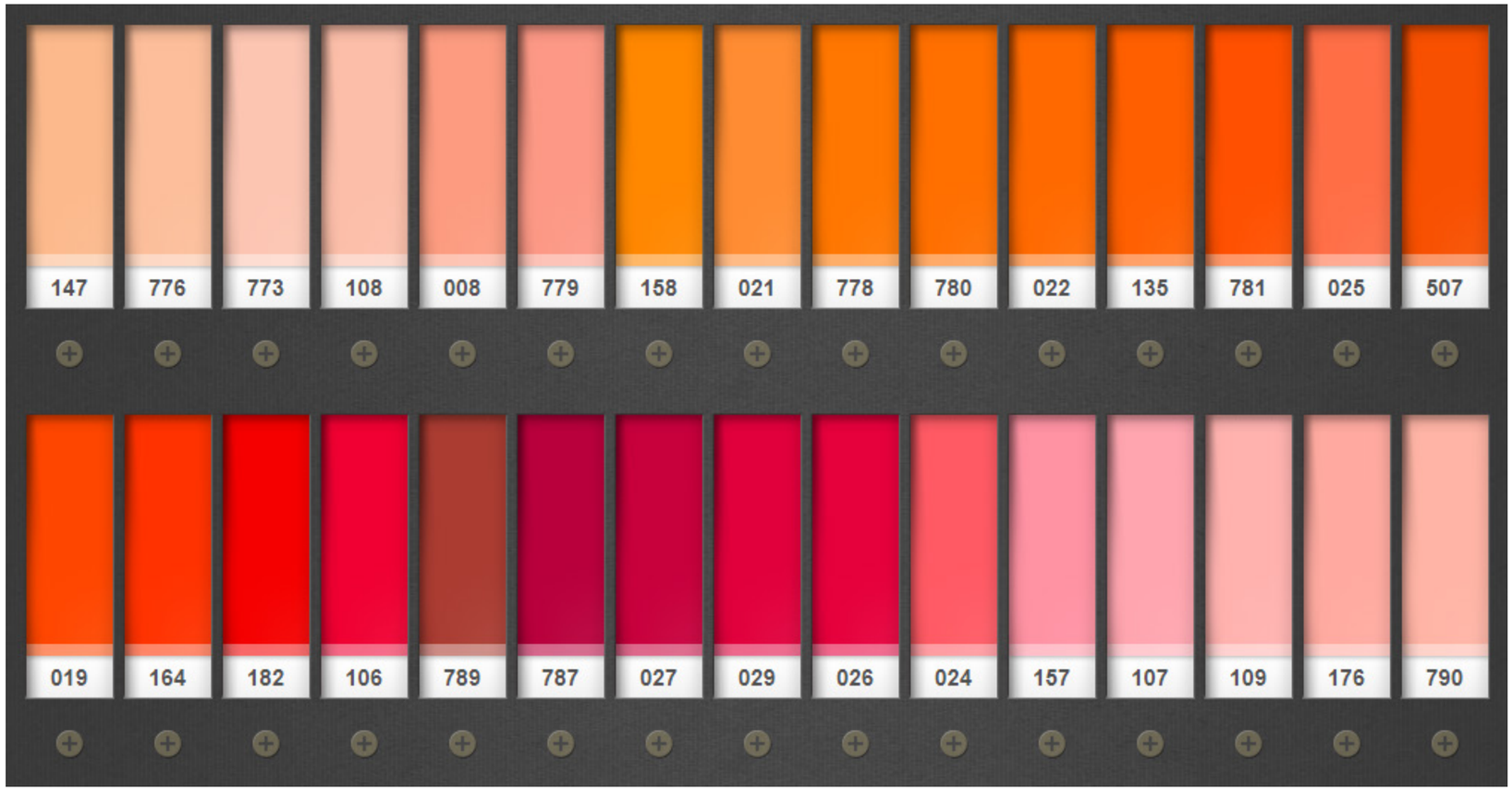
JLCPCB



$$R = \rho \cdot \frac{L}{T \cdot W} \cdot [1 + \alpha(temp - 25)]$$



Leefilters.com



Leefilters.com

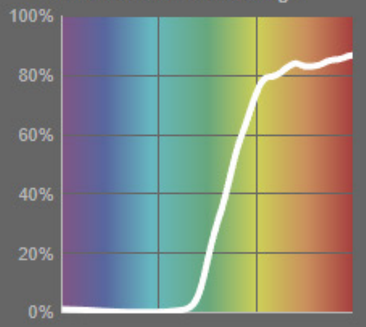
158 Deep Orange

A great fire effect.

Save to list

Download Data Sheet

Light transmitted (Y%)
for each colour wavelength

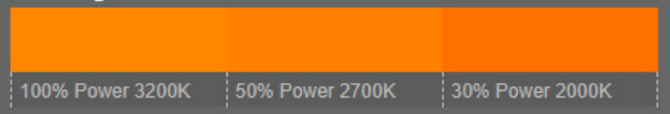


Source C

Transmission Y	29.9%
x	0.588
y	0.403
Absorption	0.52

Colour Temperature 6774K

Dimming Preview



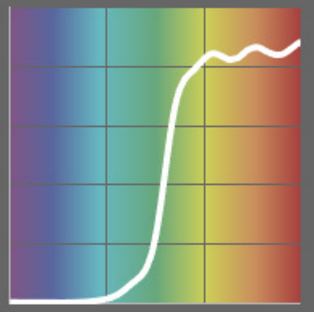
105 Orange

Good for light entertainment and functions. Creates a good fire effect when used with 106 or 104.

Save to list

Download Data Sheet

Light transmitted (Y%)
for each colour wavelength

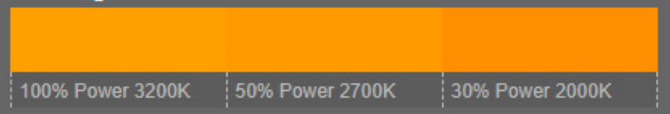


Source C

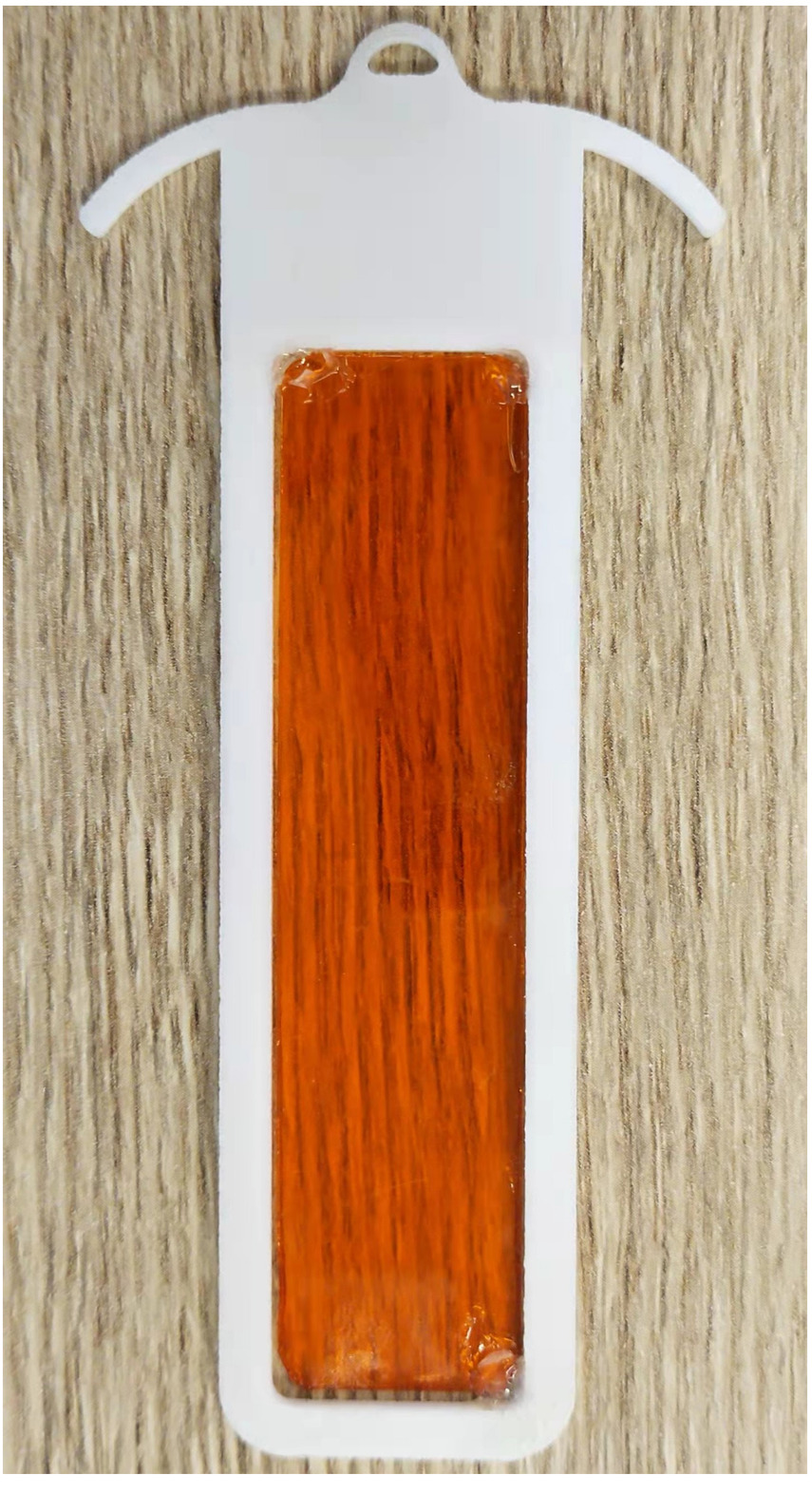
Transmission Y	41.3%
x	0.563
y	0.428
Absorption	0.38

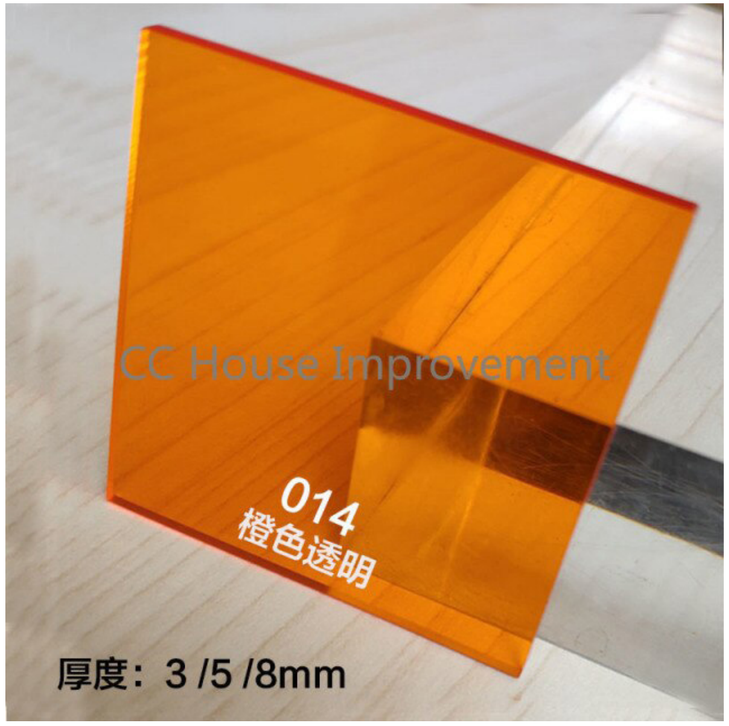
Colour Temperature 6774K

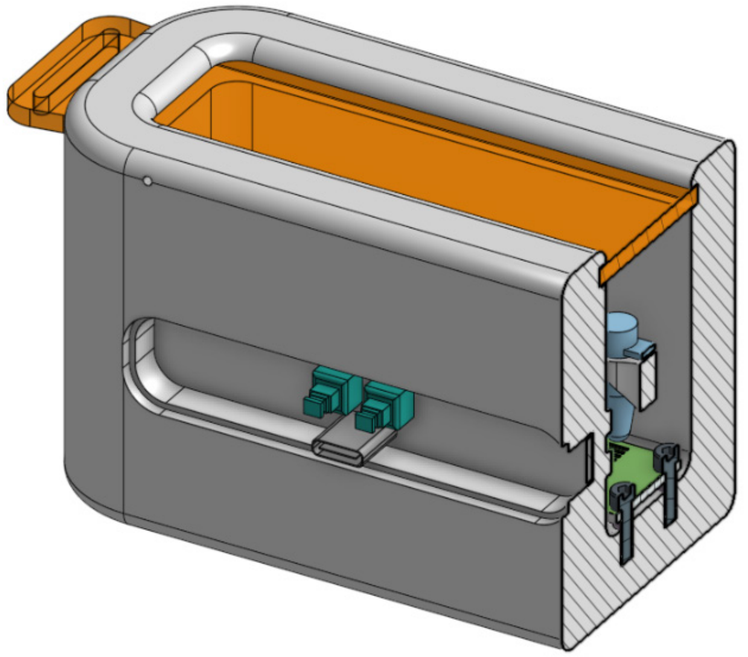
Dimming Preview

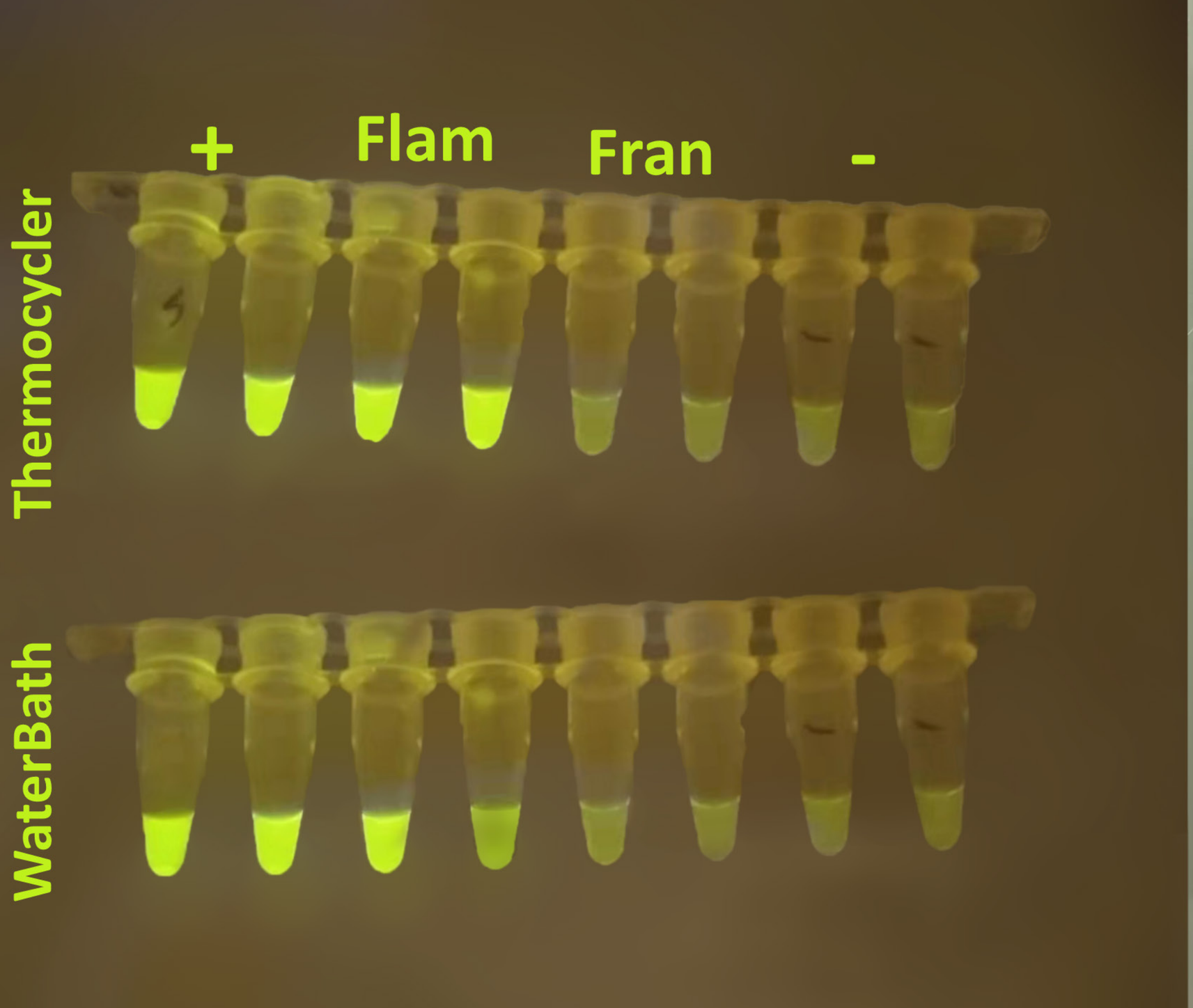


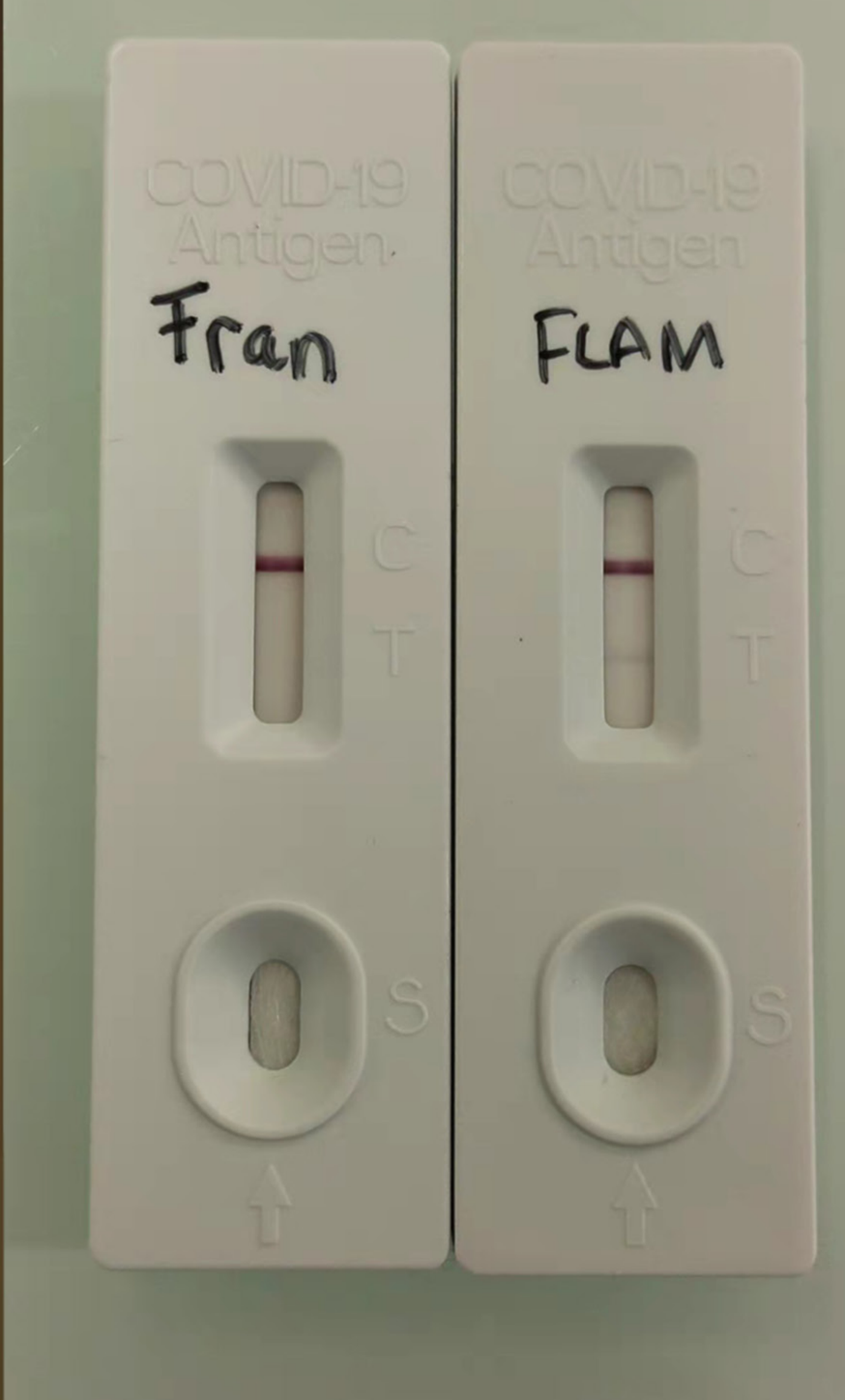
Leefilters.com




CC House Improvement
014
橙色透明
厚度：3 /5 /8mm

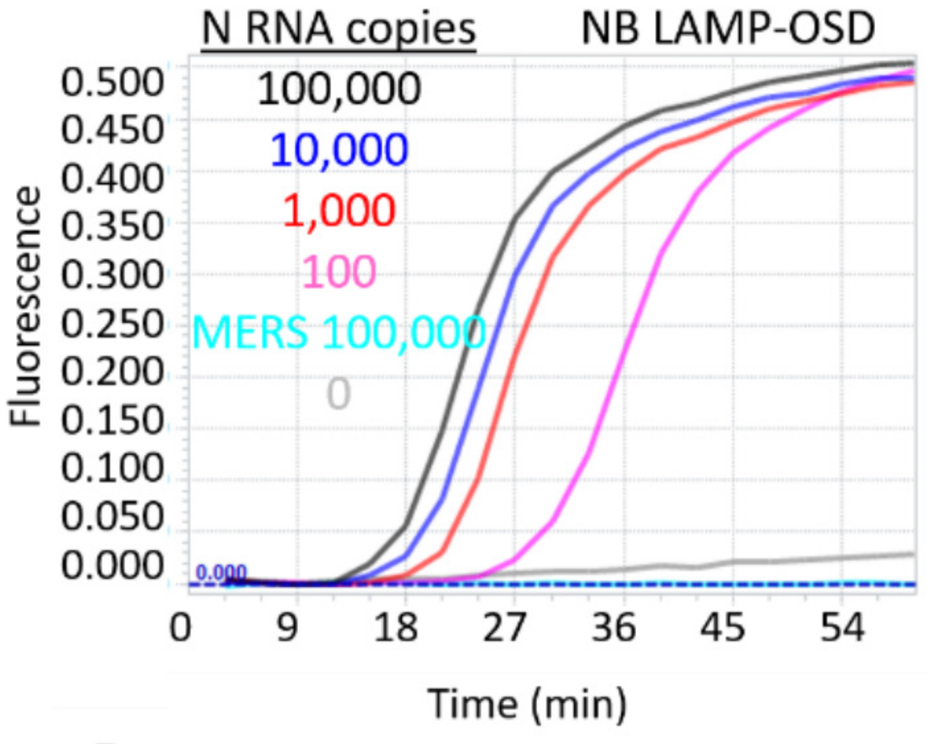



+
Flam
Fran
-
Thermocycler
WaterBath

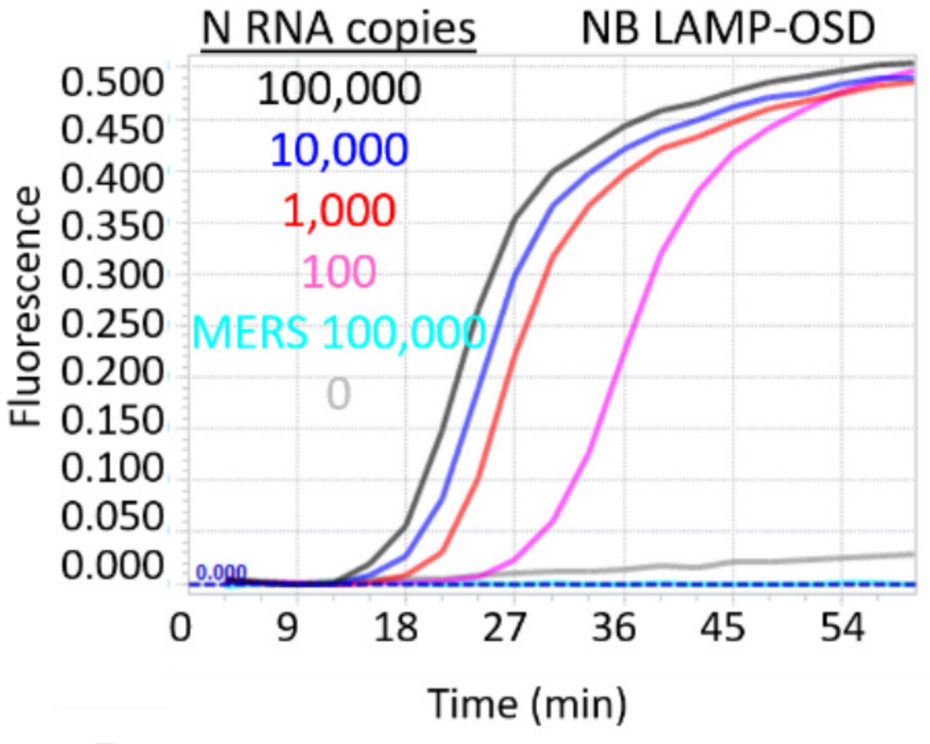

COVID-19 Antigen
Fran
C
T
S
COVID-19 Antigen
FLAM
C
T
S

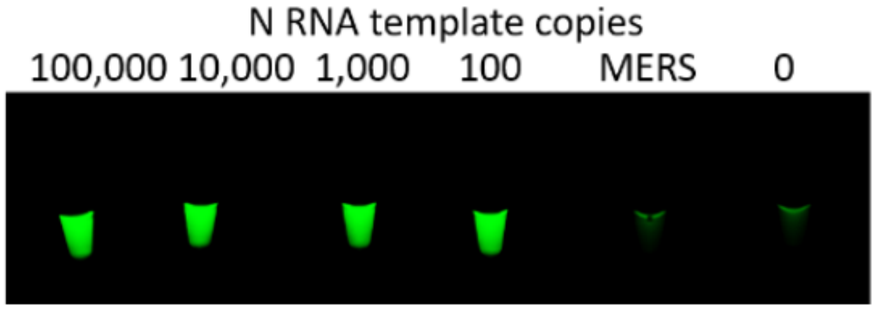
50€

Open qLAMP



"High-Surety Isothermal Amplification and Detection of SARS-CoV-2, Including with Crude Enzymes | BioRxiv." Accessed March 4, 2021. https://www.biorxiv.org/content/10.1101/2020.04.13.039941v1.full.


N RNA copies
NB LAMP-OSD
100,000
10,000
1,000
100
MERS 100,000
0
Fluorescence
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.000
0
9
18
27
36
45
54
Time (min)


N RNA template copies
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10,000
1,000
100
MERS
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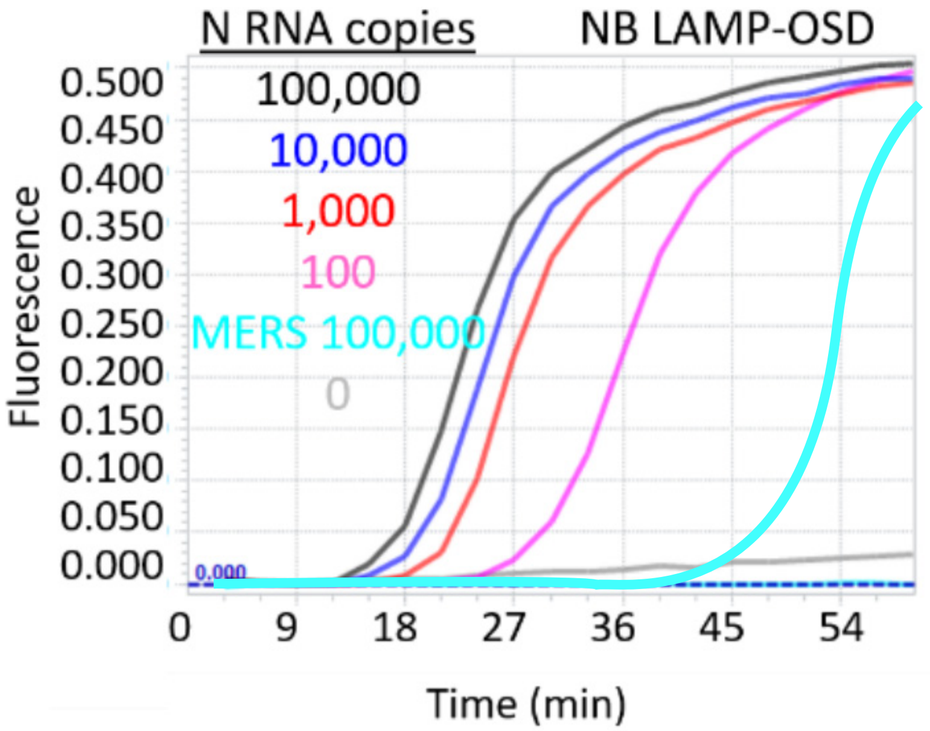
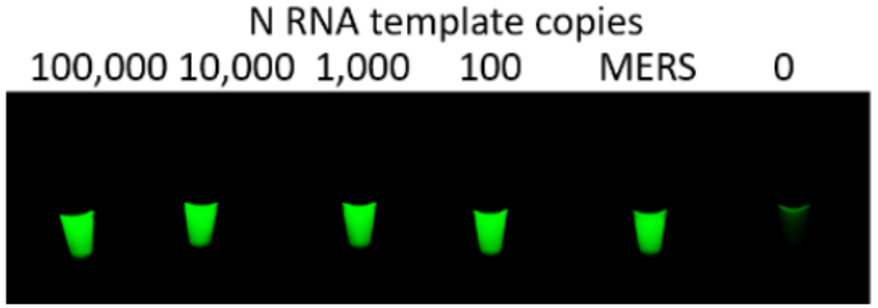
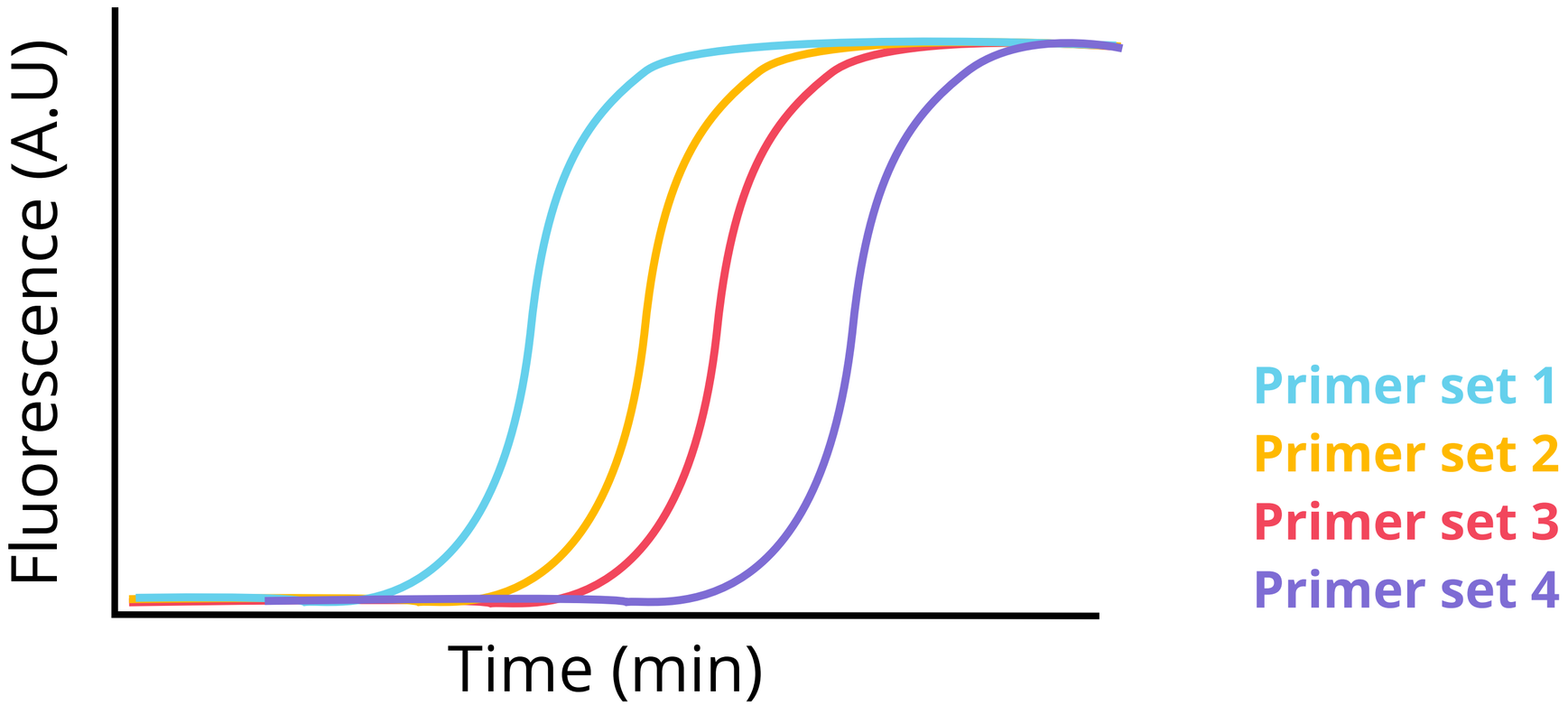
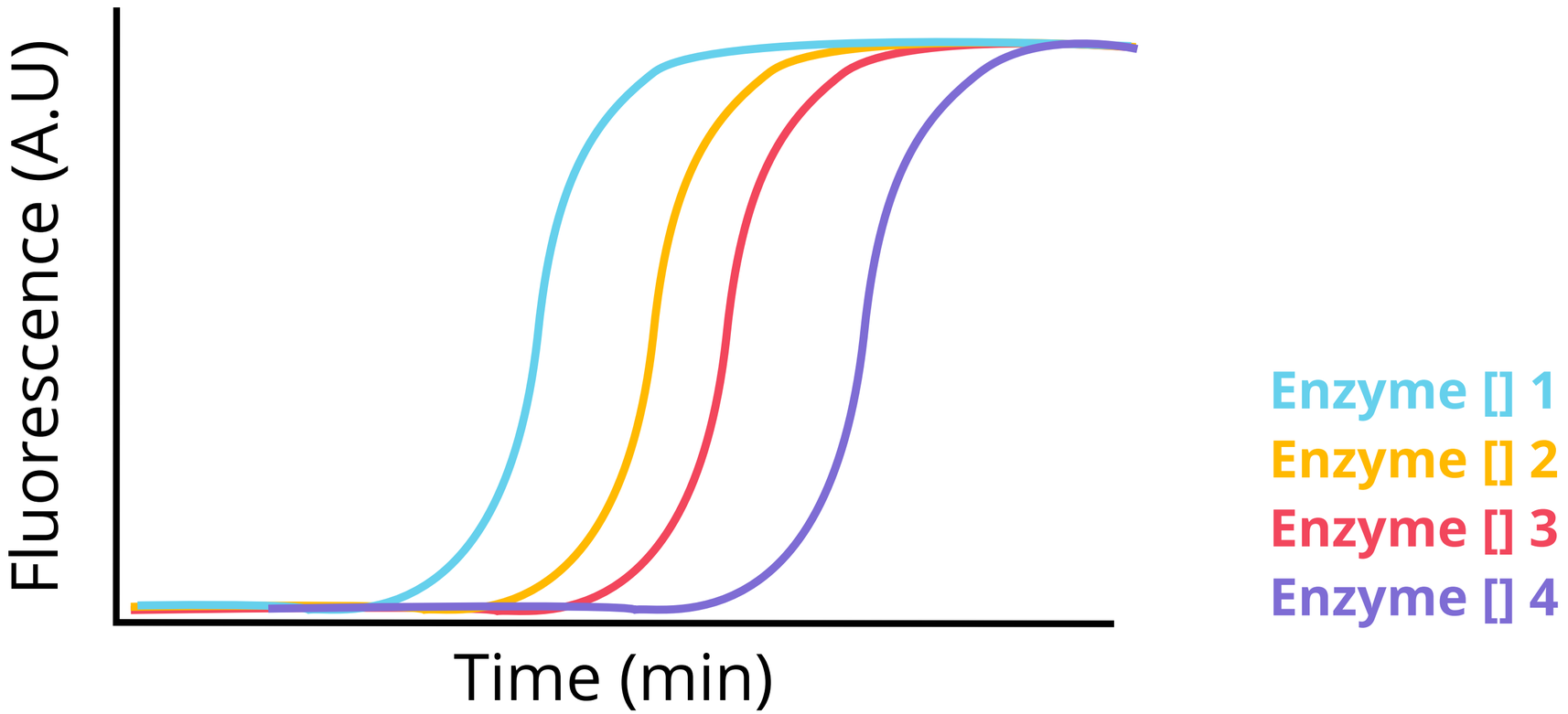
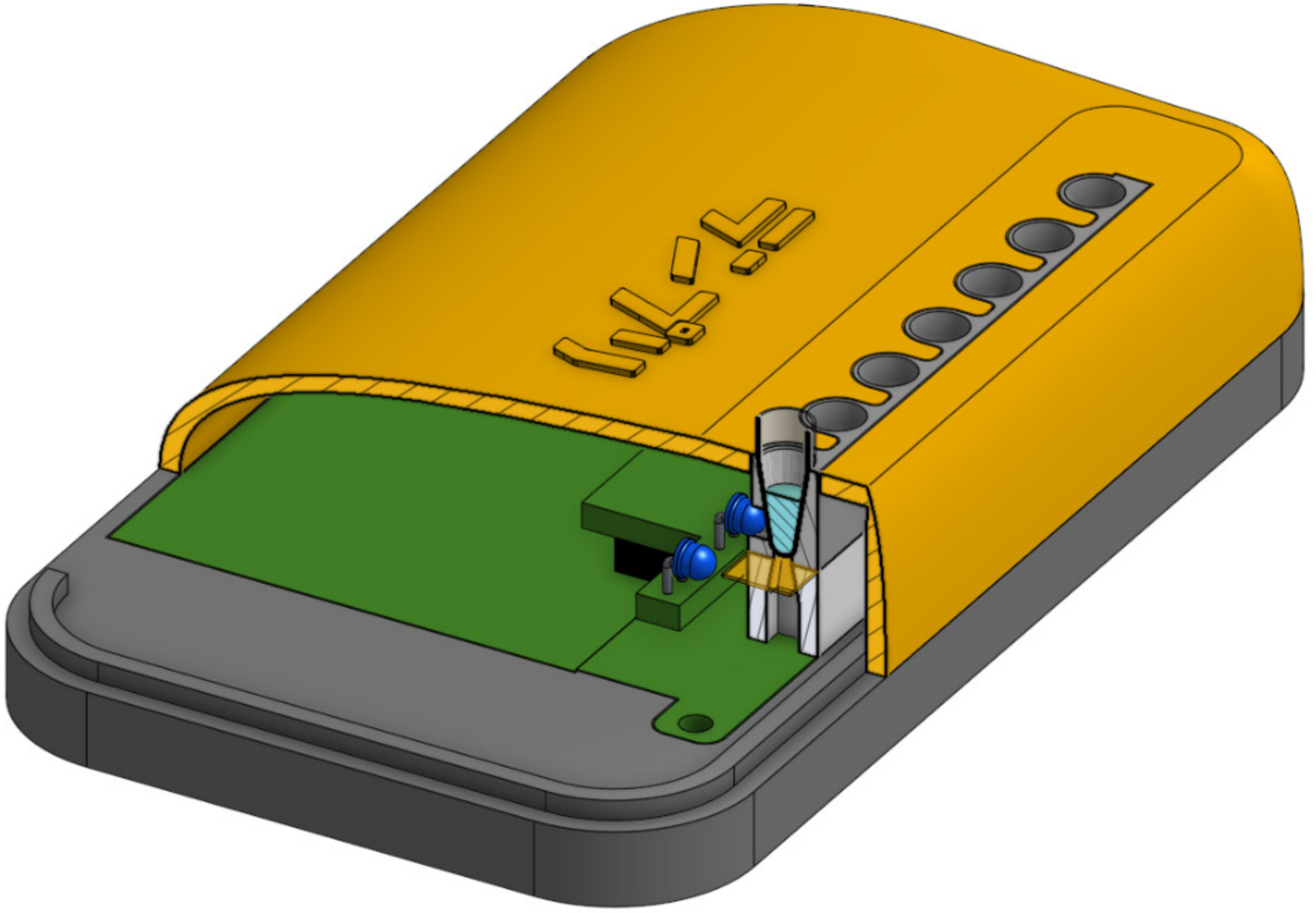
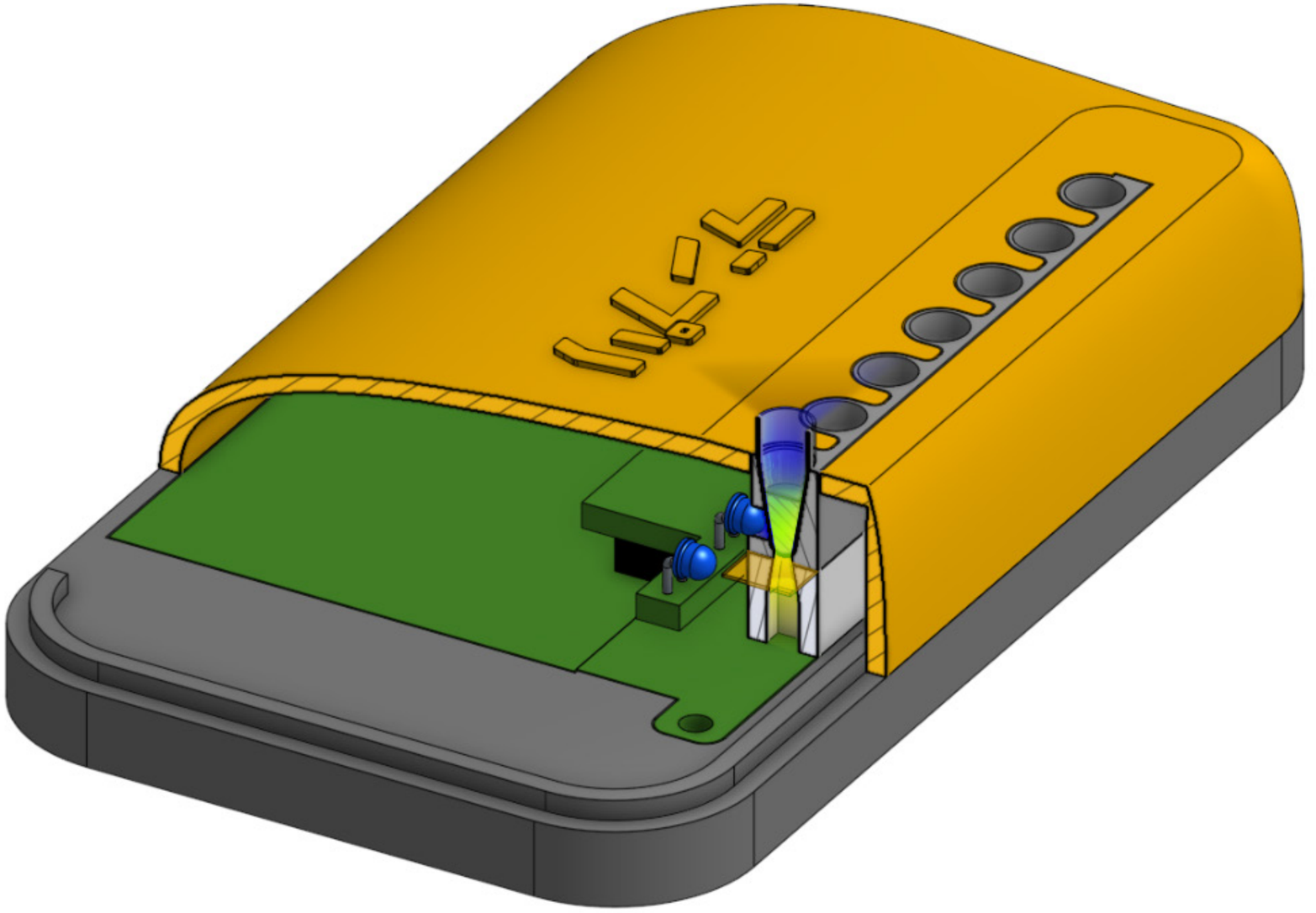

N RNA copies
NB LAMP-OSD
100,000
10,000
1,000
100
MERS 100,000
0
Fluorescence
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.000
0
9
18
27
36
45
54
Time (min)

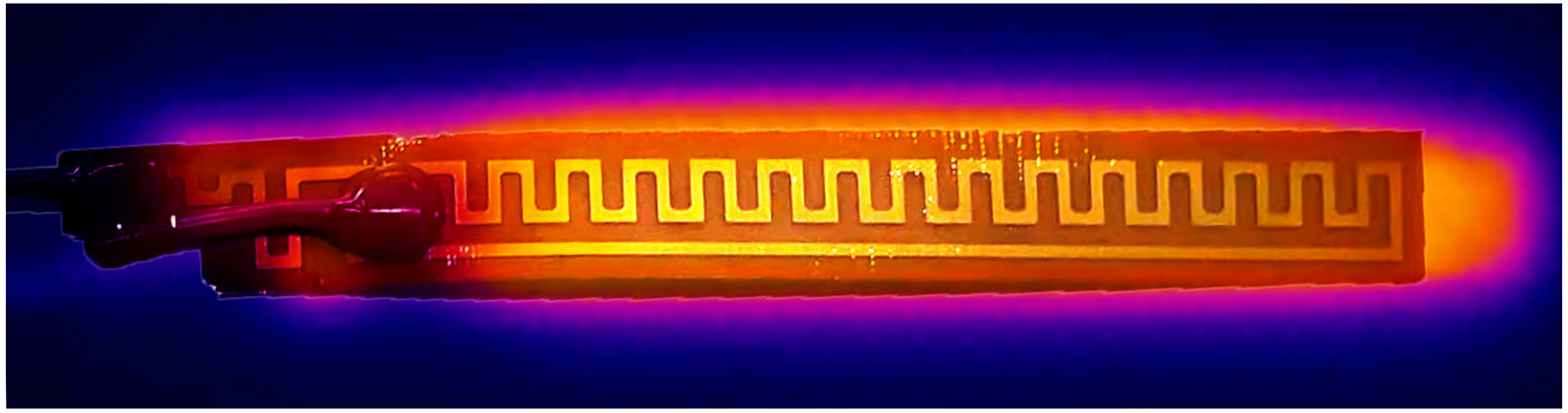

N RNA template copies
100,000
10,000
1,000
100
MERS
0


Fluorescence (A.U)
Time (min)
Primer set 1
Primer set 2
Primer set 3
Primer set 4


Fluorescence (A.U)
Time (min)
Enzyme [] 1
Enzyme [] 2
Enzyme [] 3
Enzyme [] 4

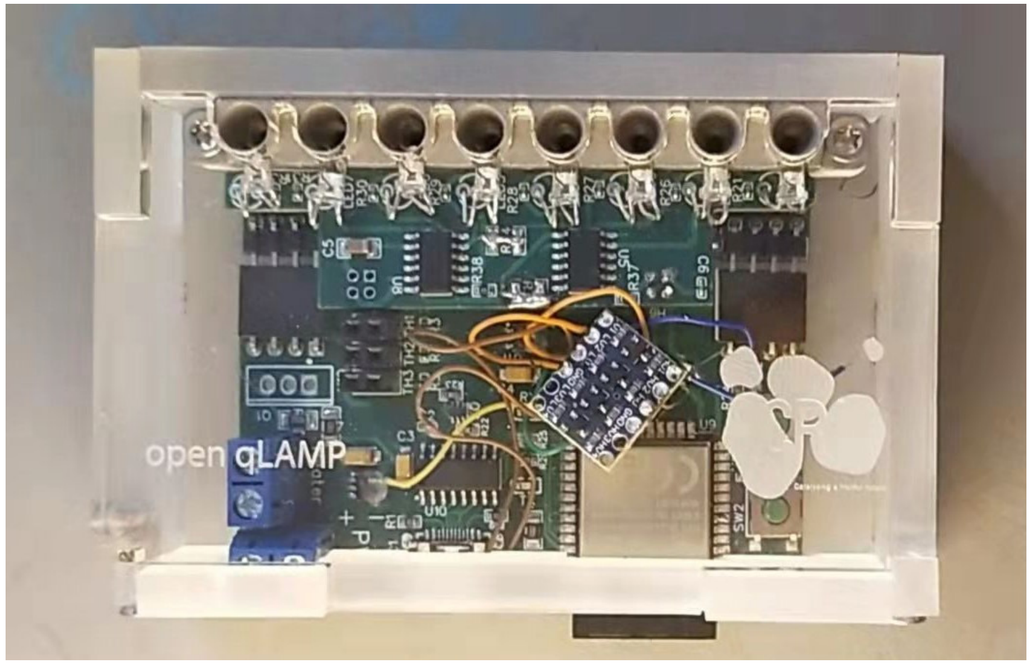




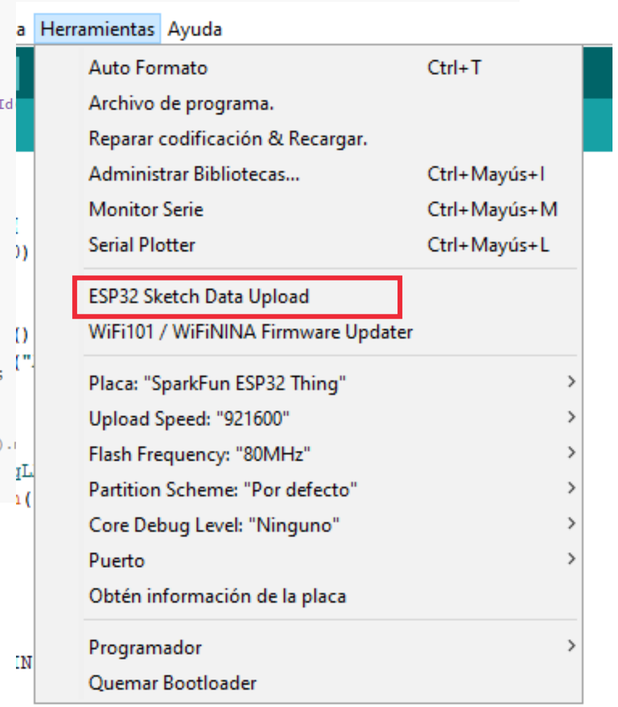


TaoBao (~5€)

All3D (~12€)


open qLAMP

```html
<!DOCTYPE html>
<html>

<head>
    <meta charset="UTF-8" />
    <meta name="viewport" content="width=device-width, initial-scale=1">
    <title>open qLAMP server &#9729;</title>
    <script src="https://cdn.jsdelivr.net/npm/chart.js"></script>
    <link rel="stylesheet" href="style.css">
</head>

<body>
    <div style="width: 80%; margin:auto;">
        <canvas id="chart" width="2" height="1"></canvas>
    </div>

    <div style="width: 80%; margin:auto;margin-top:50px;margin-left:20%">
        <input type="Number" pattern="^[0-9]{1,2}$/" placeholder="°C" style="max-width: 40px;margin-right: 20px" id="degrees">
        <button class="button-1" role="button" id="temp">Run</button><br/>
    </div>

    <script>
        var time_running = 0
        var runTemp = document.getElementById('temp');
        runTemp.onclick = function() {

            var hitted_button = new XMLHttpRequest();
            var url = "/ClickHeater?degrees=" + document.getElementById
            hitted_button.open("GET", url, true);
            hitted_button.send();

            setInterval(function ( ) {
                var xhttp = new XMLHttpRequest();
                xhttp.onreadystatechange = function() {
```



Main libraries:

- WebServer
- SPIFFS
- mDNS

General

- [ ] Connect level shifters at VCC.
- [ ] PCB bigger, the ESP32 should not go out from it.
- [ ] Include a USB-C PD sink chip, so everything go connected and powered through USB-C.

Temperature module

- [x] ESP32 reading of the 3 thermistors.
- [x] ESP32 control of the temperature through a PID.
- [ ] Final calibration with the final case.

Wifi server

- [x] mDNS working at qLAMP.local
- [x] Webpage in the data folder uploaded with ESP32 Filesystem Uploader.
- [x] Webpage served by ESP32 working with HTML/CSS/JS that perform GET requests to the ESP32 to control it.
- [x] Control of temperature implemented. Visualization with Chart.js
- [ ] Fluorescence reading.

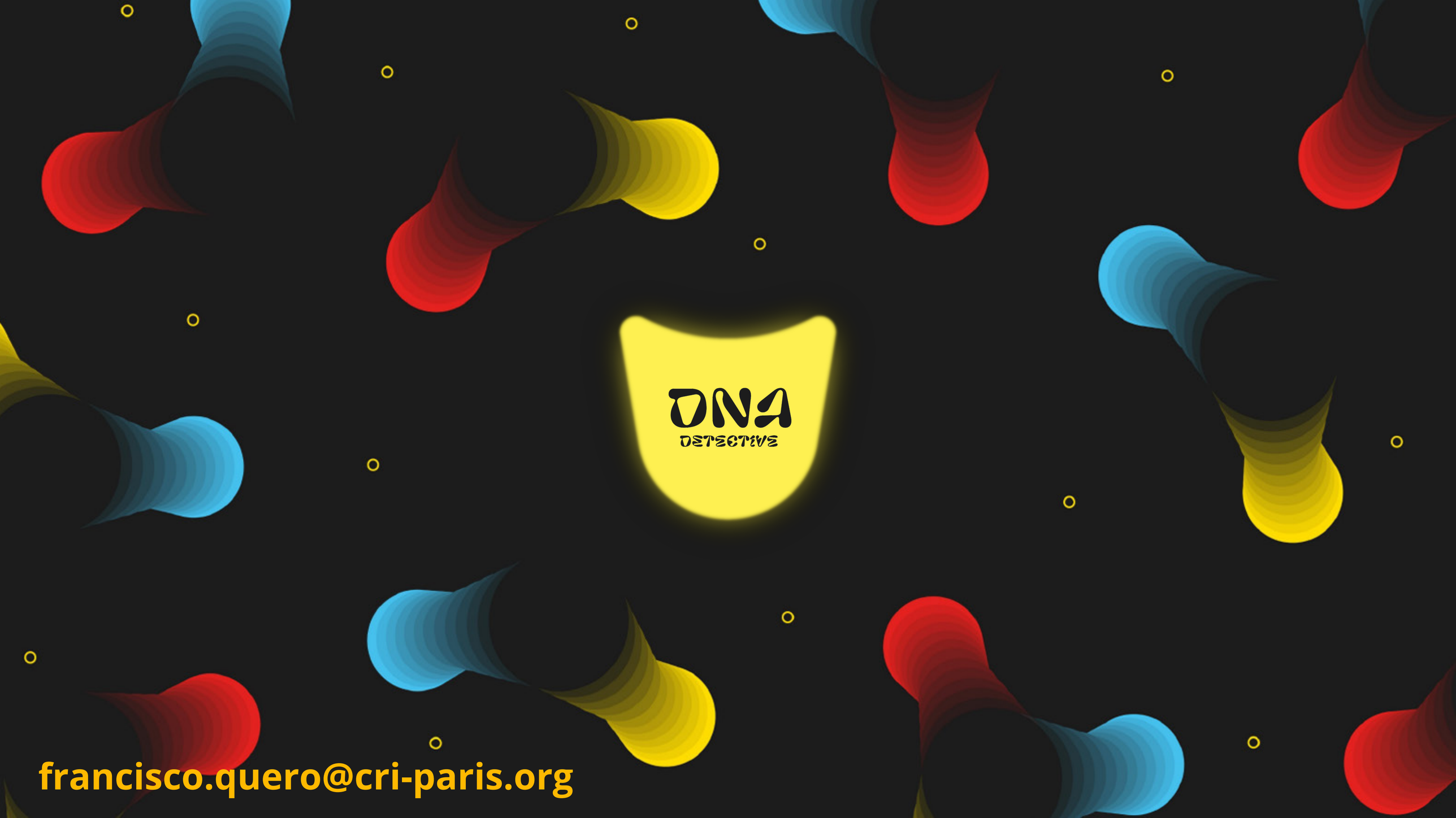
Light source module

- [x] ESP32 communicating successfully with the WS2814
- [ ] Find a library that substitutes the FastLED one and allows control of the white channel (The fourth LED).

Analog reading module

- [ ] ESP32 communicates with the ADC through I2C.
- [ ] Find the correct closed-loop resistors for detecting lamp fluoresce.
- [ ] The module can follow an entire amplification.

OBL GitLab



francisco.quero@cri-paris.org