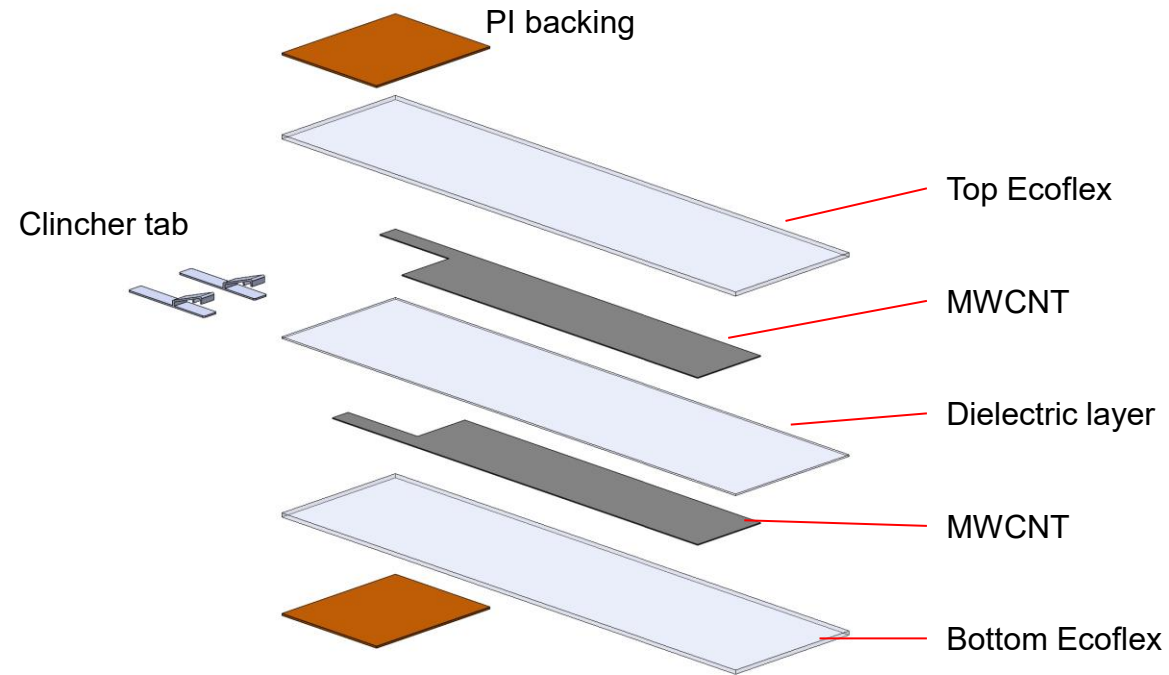


Stretchable capacitive strain sensor

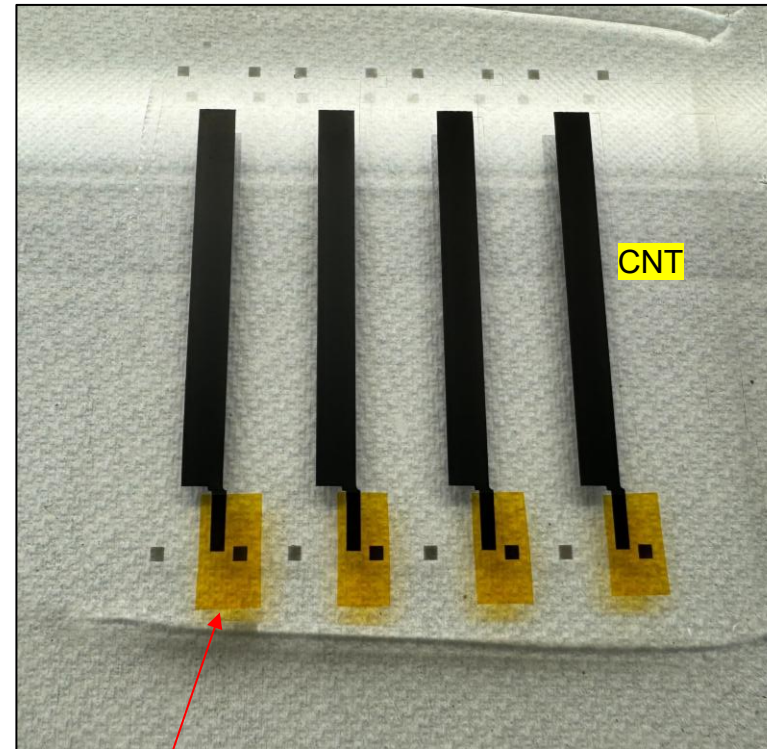
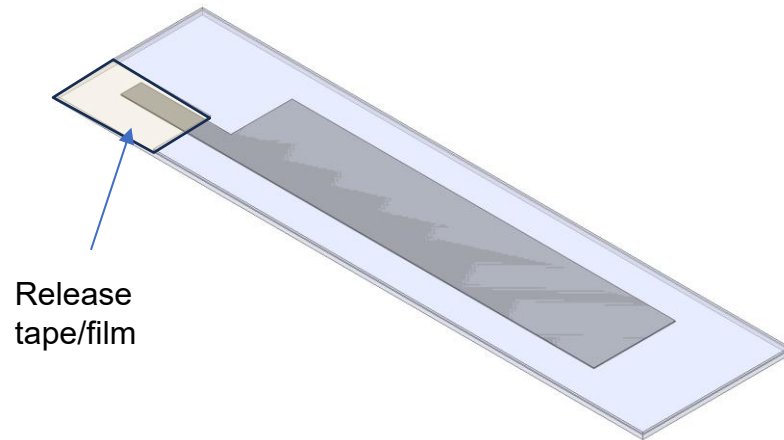


Custom strain sensor: spray-coated multiwall carbon nanotubes (MWCNTs) on Ecoflex

Method 4: using single PI connector at the center of the sensor



Step 1: blade coat Ecoflex on a glass substrate. Next, spray coat the first CNT layer. Then, cover the contact pad with a film or tape. After that, blade coat the middle Ecoflex layer.

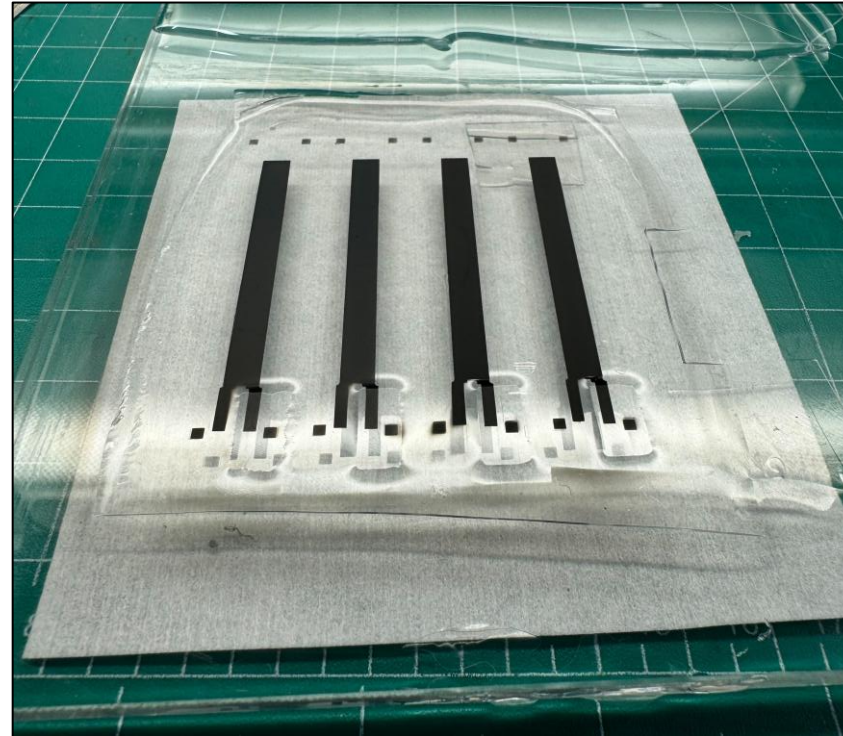
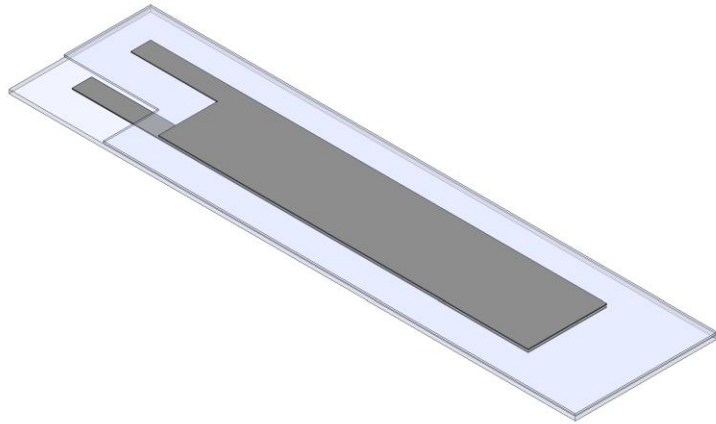


Release
tape/film

Method 4: using single PI connector at the center of the sensor



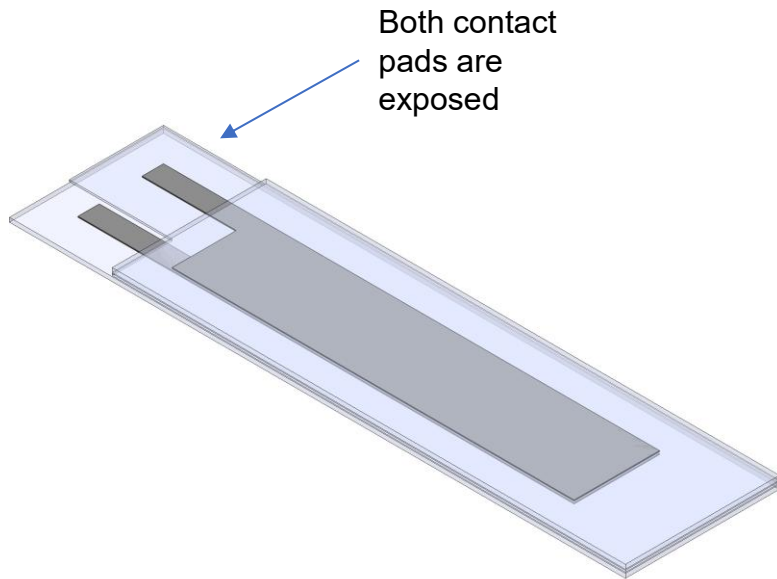
Step 2: remove the tape to expose the contact pad. Then, spray coat the second CNT Layer



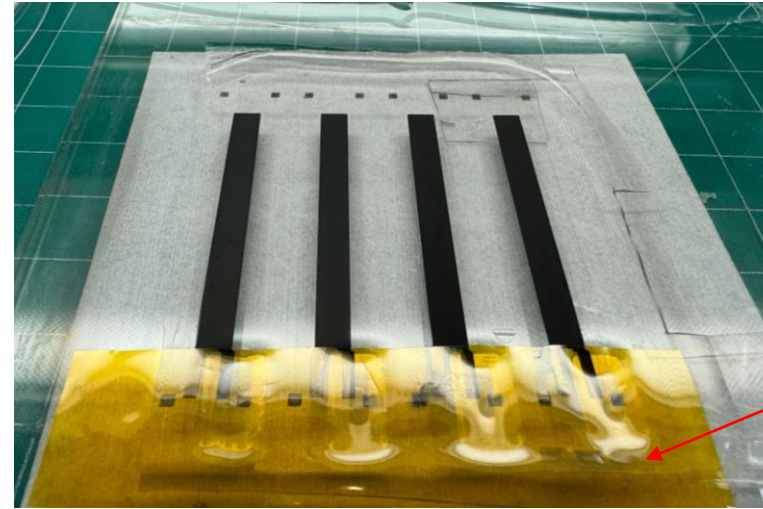
Method 4: using single PI connector at the center of the sensor



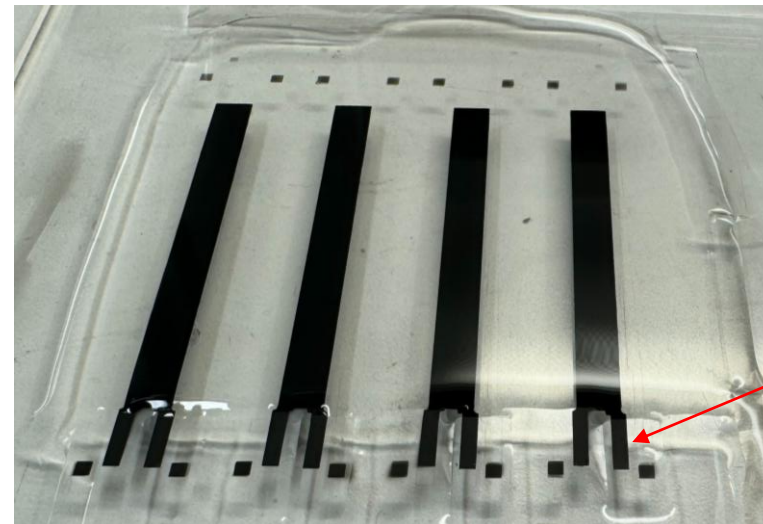
Step 3: Blade coat the top Ecoflex layer, but don't cover the exposed contact pad



Both contact pads are exposed

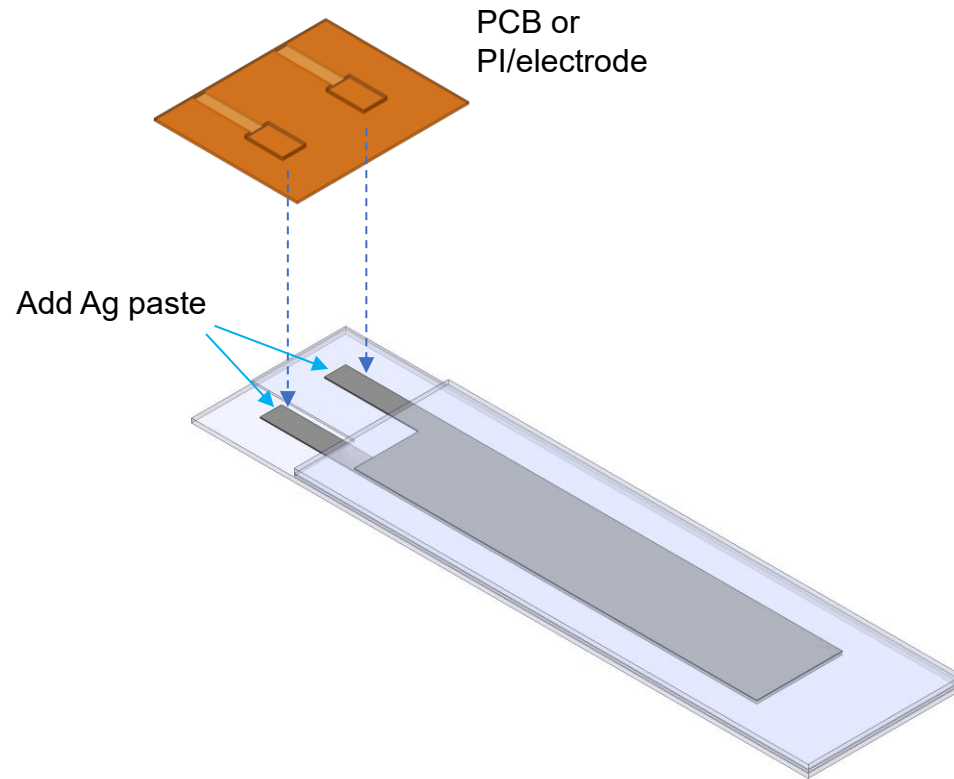


Cover the second contact pad with a film before blade coating the top Ecoflex layer



Both contact pads are exposed

Method 4: using single PI connector at the center of the sensor



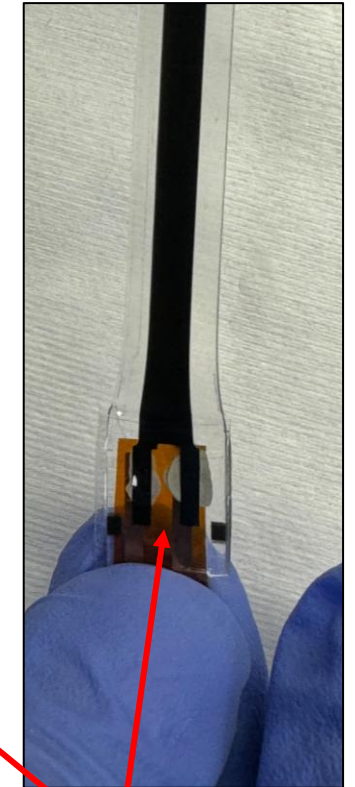
Step 4: prepare a PCB or PI/electrode with the two electrodes exposed, then bond it to the two CNT contact pads using Ag paste



126-49 Ag paste



Sputtered copper traces on a PI film



Extra stiffener layer and epoxy are added here to strengthen the connector when the sensor is stretched

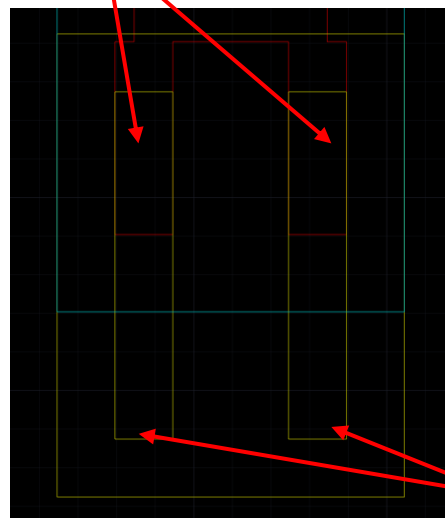


Blue trace:
sensor contour

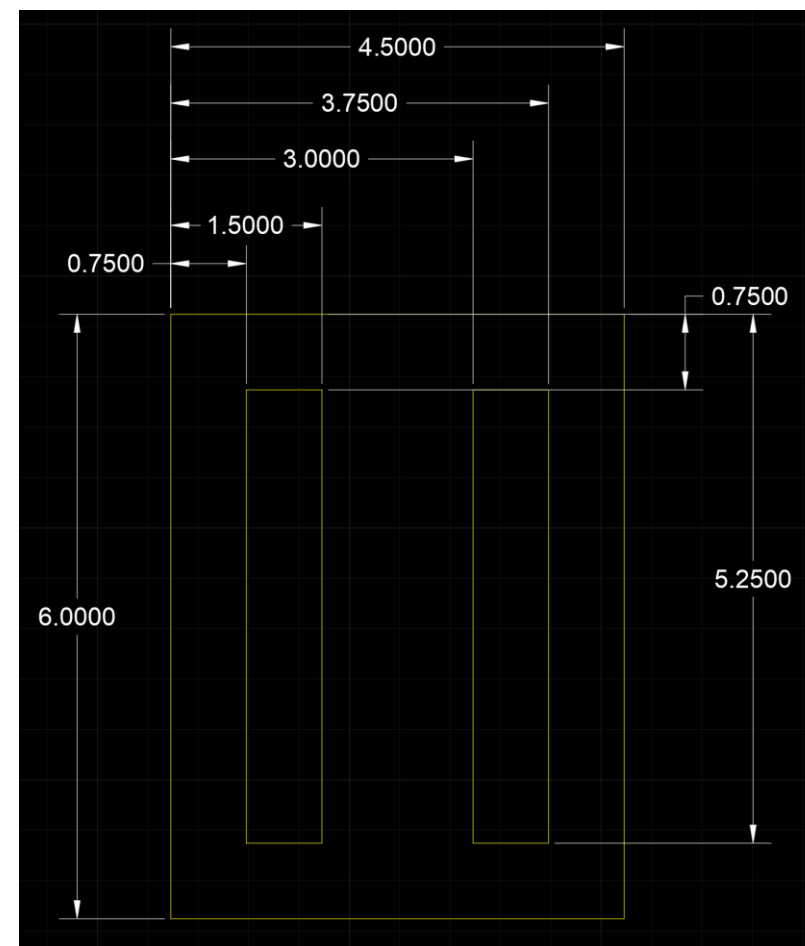
Red trace: CNT
region

Yellow trace: PI
stiffener/board

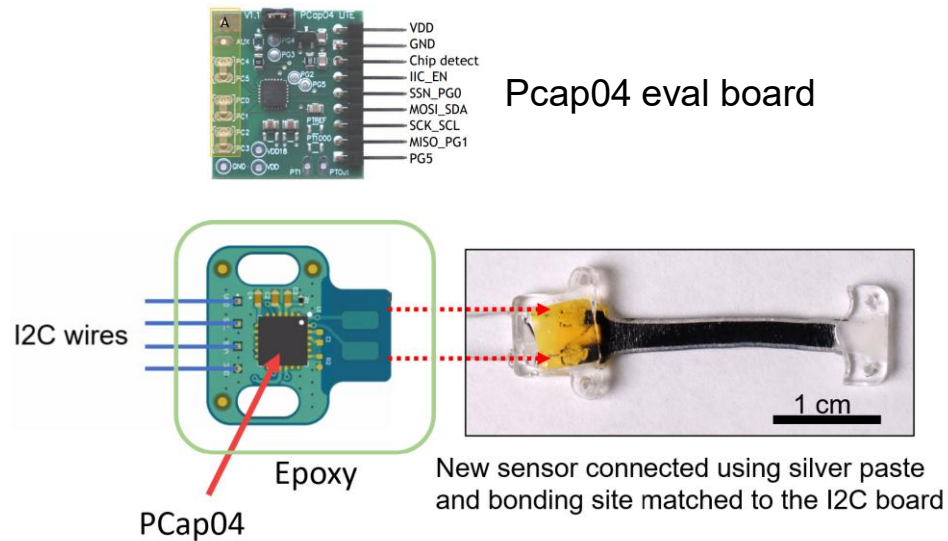
Silver paste
contacting CNT



Connect to
PCB



Sensor integrated with CapSense

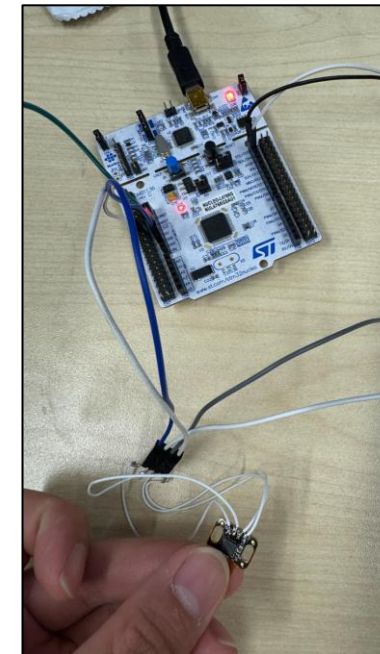


Successful reading from the evaluation board
using an STM32 nucleo board via I2C

```
pcap04 (CLOSED)
Uint32_t RESULT-> 0x07f8543b, 0x044cd581, 0Uuint32_t RESULT-> 0x07f860
Measured capacitance -> 9.96277907 pF, 5.39193558 pF, 3.08679511 pF.
Uuint32_t RESULT-> 0x07f858dc, 0x04612b7b, 0x02750e29.
Measured capacitance -> 9.96262745 pF, 5.47445944 pF, 3.07155763 pF.
Uuint32_t RESULT-> 0x07f88019, 0x04528ec6, 0x02782940.
Measured capacitance -> 9.96337586 pF, 5.40311115 pF, 3.08672276 pF.
Uuint32_t RESULT-> 0x07f85fea, 0x044e5282, 0x0278c981.
Measured capacitance -> 9.96276201 pF, 5.38243044 pF, 3.08977936 pF.
Uuint32_t RESULT-> 0x07f87d40, 0x0451ca25, 0x02783e37.
Measured capacitance -> 9.96332155 pF, 5.39936075 pF, 3.08712263 pF.
Uuint32_t RESULT-> 0x07f84e13, 0x0450bf9a, 0x027a5da1.
Measured capacitance -> 9.96242174 pF, 5.39427685 pF, 3.09748743 pF.
Uuint32_t RESULT-> 0x07f87bbf, 0x04534580, 0x027722ee.
Measured capacitance -> 9.96329286 pF, 5.40659638 pF, 3.08171940 pF.
Uuint32_t RESULT-> 0x07f86857, 0x045049d4, 0x027477a4.
Measured capacitance -> 9.96292272 pF, 5.39203050 pF, 3.06868670 pF.
Uuint32_t RESULT-> 0x07f86acf, 0x04504fbb, 0x02796faf.
Measured capacitance -> 9.96296980 pF, 5.39214308 pF, 3.09294898 pF.
```



CapSense PCB



```
3.90152970 pF,
5, 0x7fffffff.
4.53102649 pF,
2, 0x7fffffff.
5.31005374 pF,
, 0x7fffffff.
5.41336754 pF,
0, 0x7fffffff.
6.34774849 pF,
4, 0x7fffffff.
6.30502368 pF,
, 0x7fffffff.
7.43107318 pF,
, 0x7fffffff.
8.12821472 pF,
f, 0x7fffffff.
8.48915628 pF,
, 0x7ffd6ba6.
8.49943212 pF,
c, 0x7fffffff.
9.01595238 pF,
9, 0x7fffffff.
9.89253578 pF
```

Instruction:

- Please upload the “CapMonitor_STM32_V2” code to the STM32L476RG nucleo board.
- The Pcap04 chip on the CapSense PCB has 3 capacitance reading channel. The sensor capacitance will be recorded by the second channel. Open a serial monitor to read the real-time capacitance value.