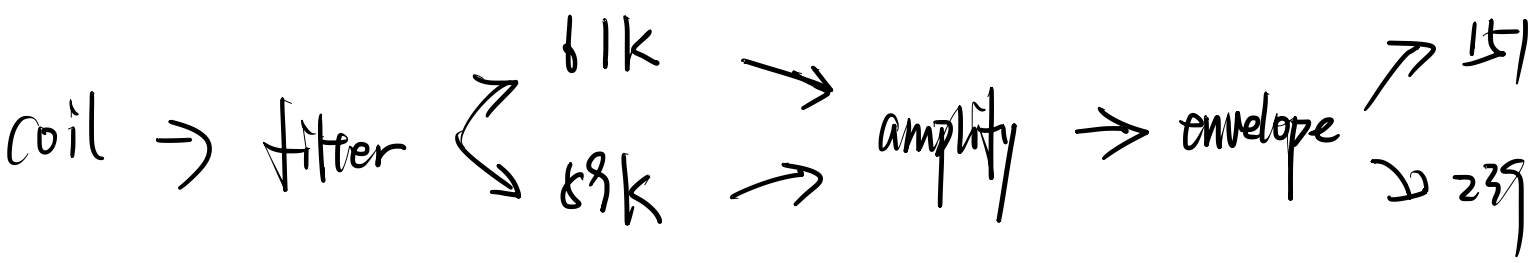
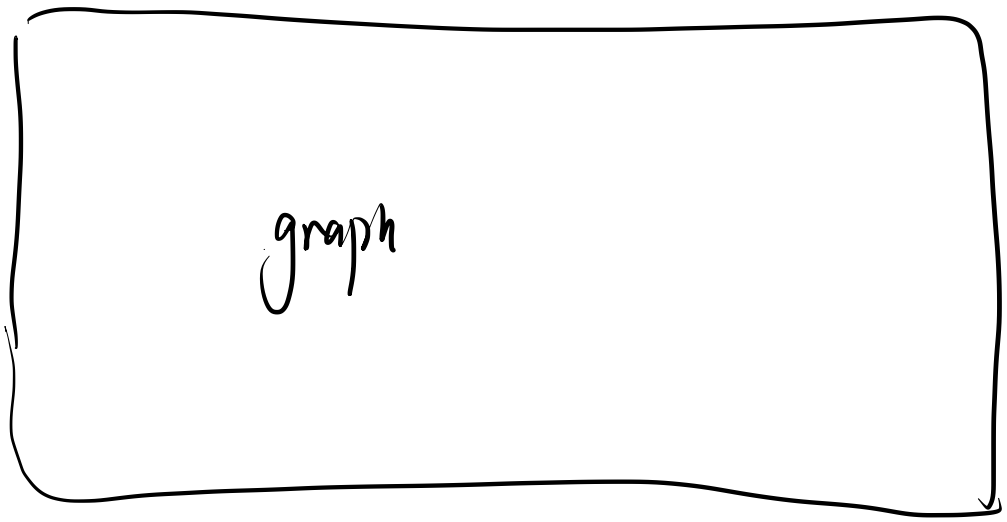
report for radio sensor.



use coil to receive radio wave.

(using same wire to wrap a coil)

observing the signal received



it is obviously that, the radio wave is combination of carrier wave and modulating wave, which is what we would like to have.

filter :

carrier frequency are 61KHz and 89KHz.

→

We build a band pass filter which range from 61KHz to 89KHz.

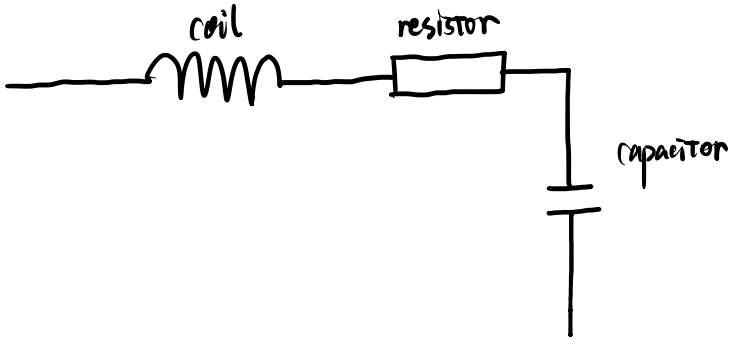
This could be built by a low pass filter of frequency 89KHz cascaded with a high pass filter of frequency 61KHz.

low pass filter : coil should be treated as a inductor.

Measure inductance of coil by RCL measurer

$L_{coil} = 55uH$

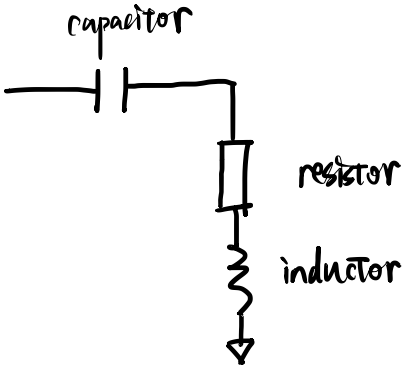
low pass filter we built :



$R = 1.85\Omega$

$C = 58nF$

high pass filter :



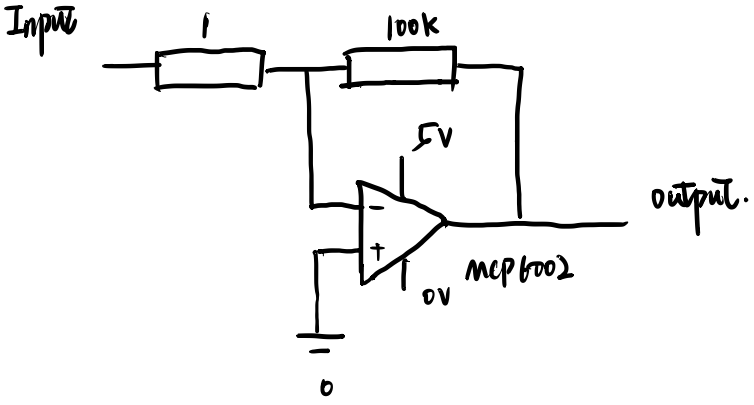
$L = 4.7\,mH$

$C = 1.4484nF$ (47pF + 390pF + 1nF)

$R = 18\,\Omega$ ($\zeta = 0.031145$)

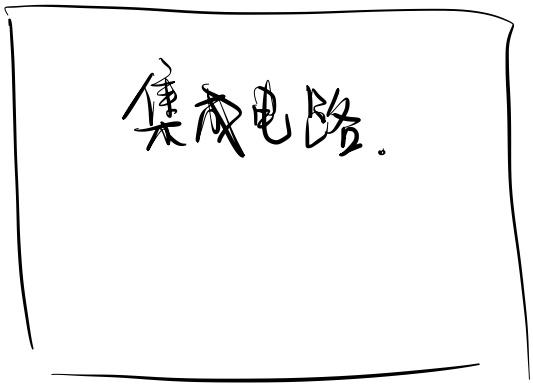
amplifier

I built an inverting amplifier firstly



Above circuit used opamp of mcp6002, essential data are provided below.

- Available in SC-70-5 and SOT-23-5 packages
- 1 MHz Gain Bandwidth Product (typ.)
- Rail-to-Rail Input/Output
- Supply Voltage: 1.8V to 5.5V
- Supply Current: I_Q = 100 µA (typ.)
- 90° Phase Margin (typ.)
- Temperature Range:
  - Industrial: -40°C to +85°C
  - Extended: -40°C to +125°C
- Available in Single, Dual and Quad Packages

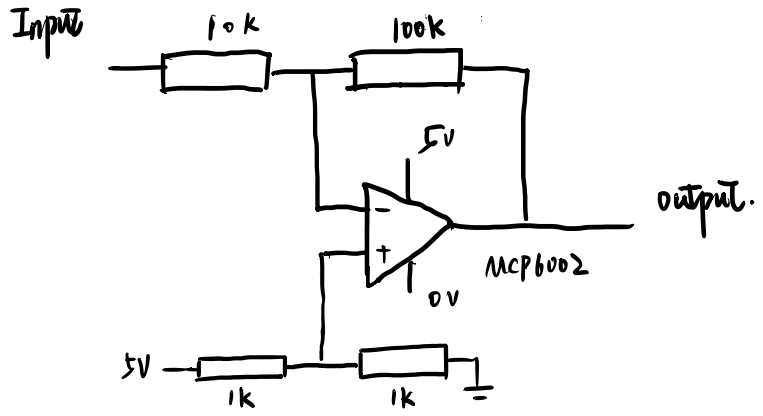


Hence,

$$\text{Gain} = \frac{1\ \text{MHz}}{89\ \text{kHz}} = 11.2$$, Gain should be smaller than 33.7

because of current mirror of inner structure of opamp, there is need to bias non-inverting input.

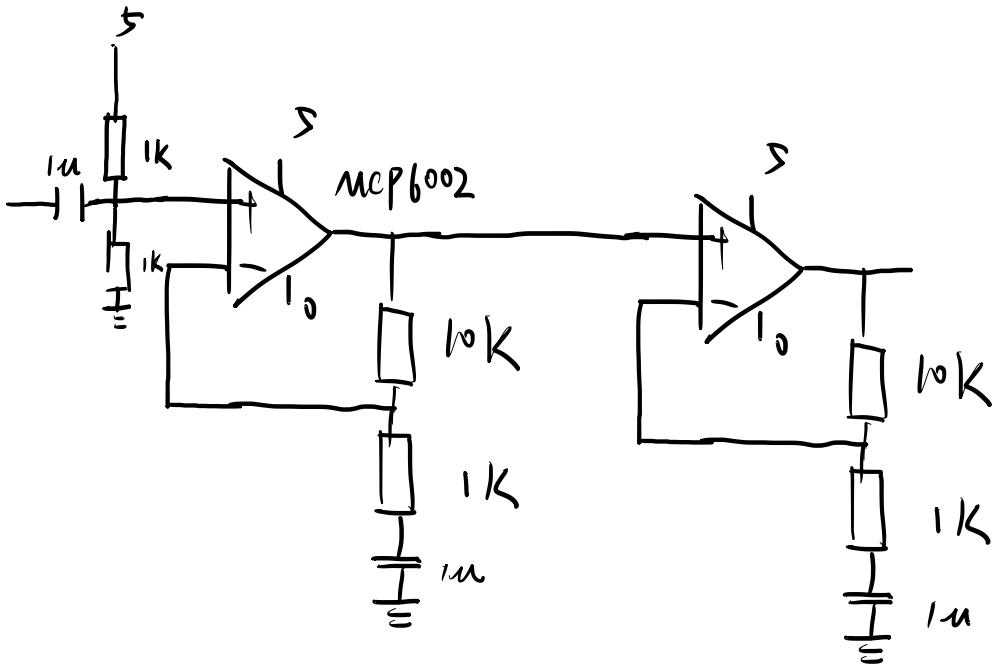
So I improved the circuit.



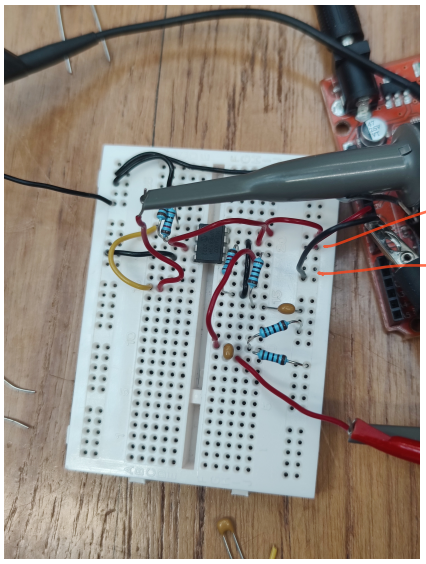
but we want to amplify with gain of 100. therefore, we should use two opamp to build the amplifier.

inverting amplifier will be more complicated than non-inverting amplifier

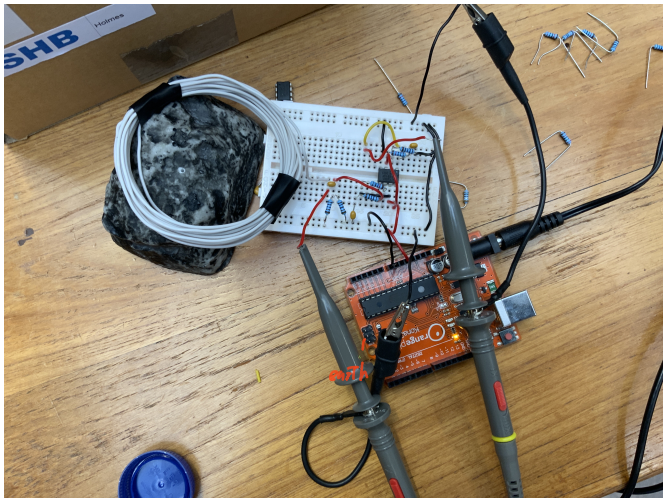
So I used non-inverting amplifier.



beside, we need use capacitor to block AC in order to make sure wave flow as we want.

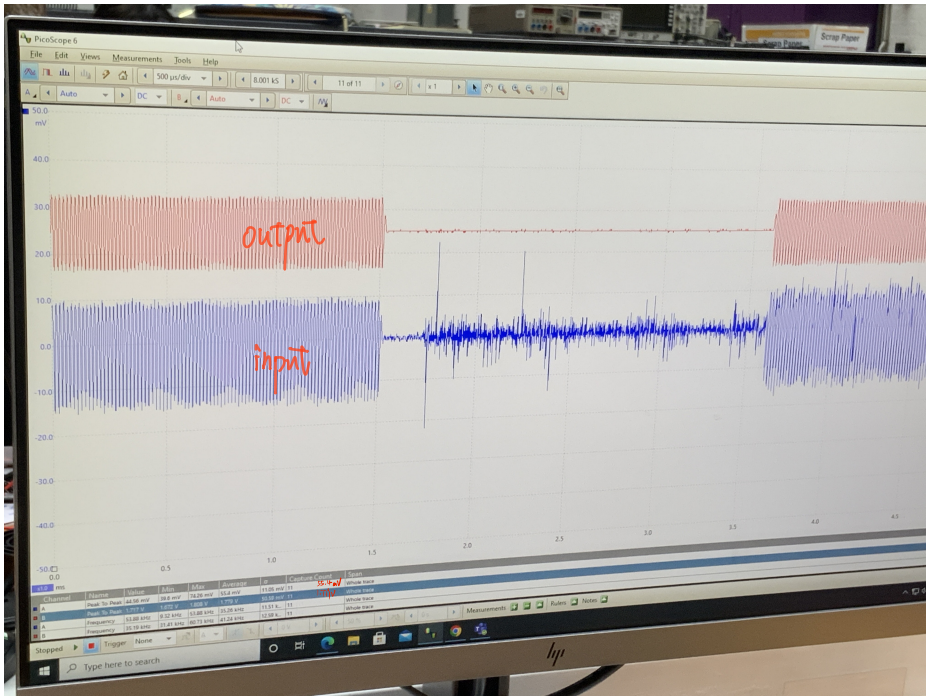


testing the amplifier individually, it works as expected.



testing amplifier by radio

the result is showed below.



it works as expected.

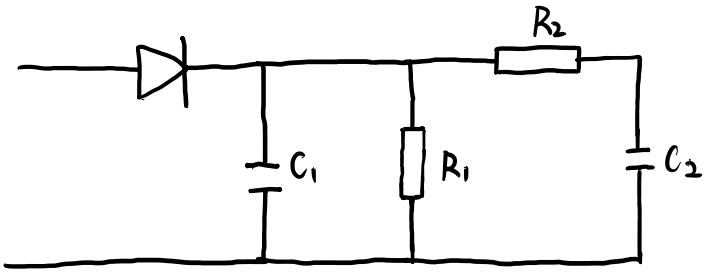
$A_{input} = 55.4\,mV$

$A_{output} = 1.779\,V$

$Gain = \frac{A_{output}}{A_{input}} \approx 32$

actual gain is smaller than theoretical gain, but reasonable.

envelope detector

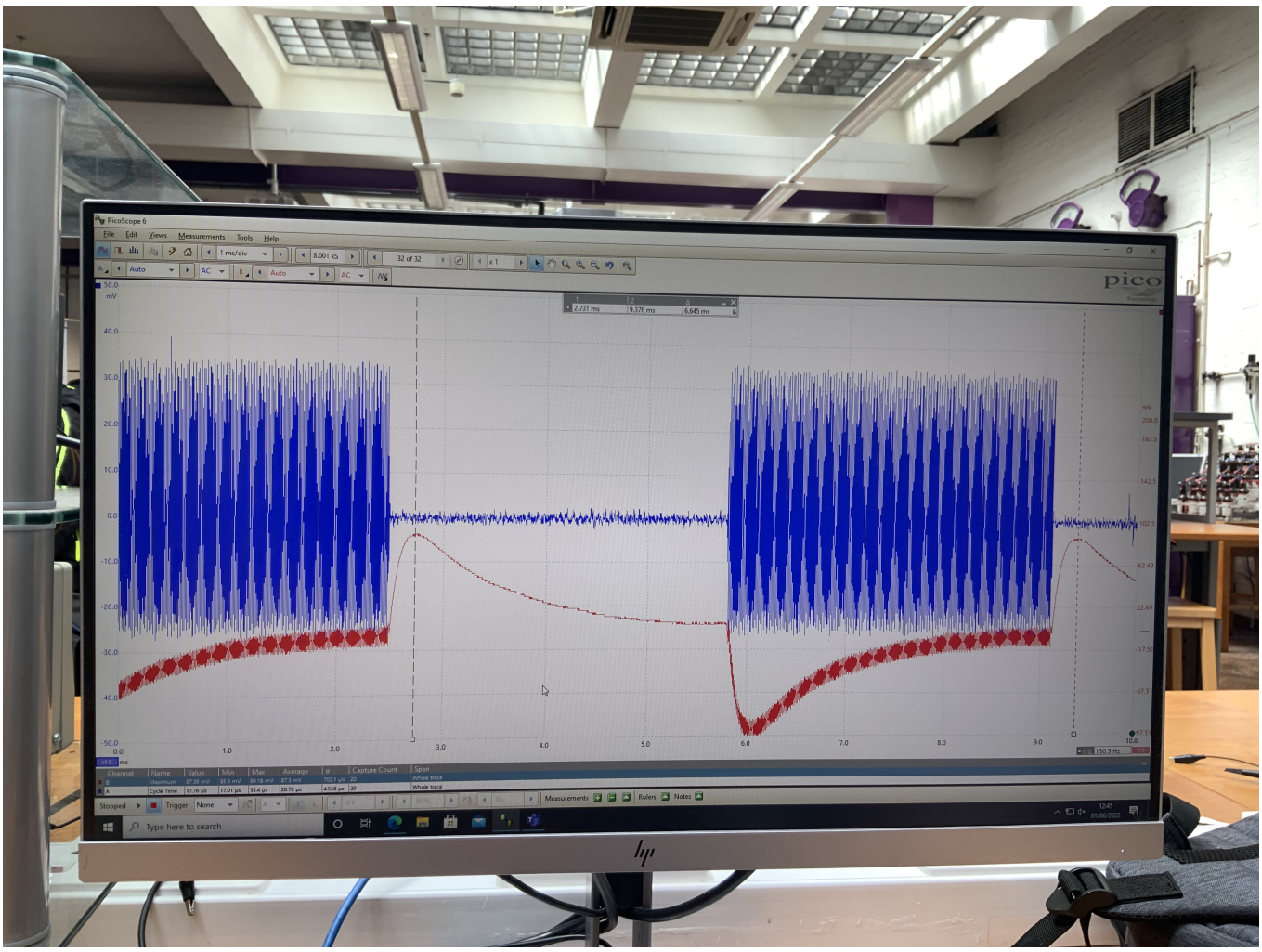


$C_1 = 10\,nF$

$C_2 = 1\,nF$

$R_1 = 1\,k\Omega$

$R_2 = 100\,k\Omega$



the red wave are modulating wave, which is reasonable.