EE230: Lab-3
Precision Rectifier using Opamp

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1 Overview of the experiment

1.1 Aim of the experiment

The aim of the experiment is to create a improved design of Hal-wave and full-wave rectifiers using Opamps and then simulate the designs in ngspice.

1.2 Methods

1.2.1 Half-wave Precision Rectifier

We use the opamp circuit file `ua741.txt` and `Diode_1N914.txt` file for Diode circuit. Using two different diode configurations we make two Half-Wave rectifier circuits working on alternate cycles of inputs

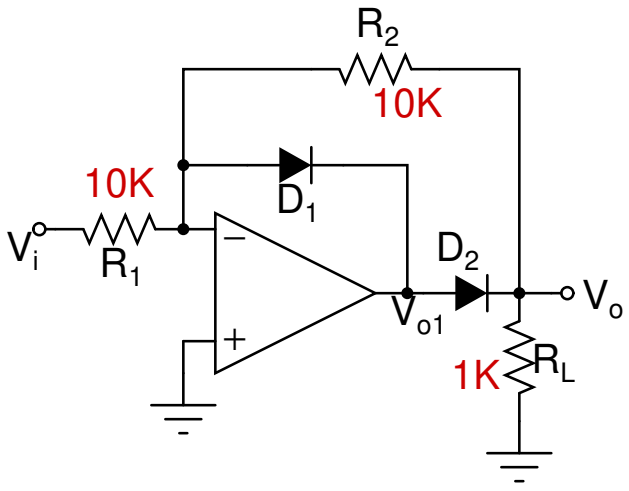
1.2.2 Full-wave Precision Rectifier

We use the opamp circuit file `ua741.txt` and `Diode_1N914.txt` file for Diode circuit. We start by defining subcircuits for Half-Wave rectifier and another subcircuit for Inverting-Summer. Then the netlist was used to describe connections.

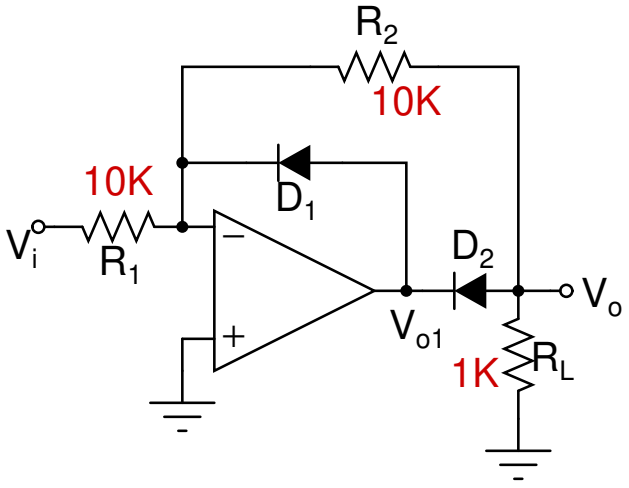
All the designs were simulated on Ngspice and exporting the values to a python script to plot them using Matplotlib.

2 Design

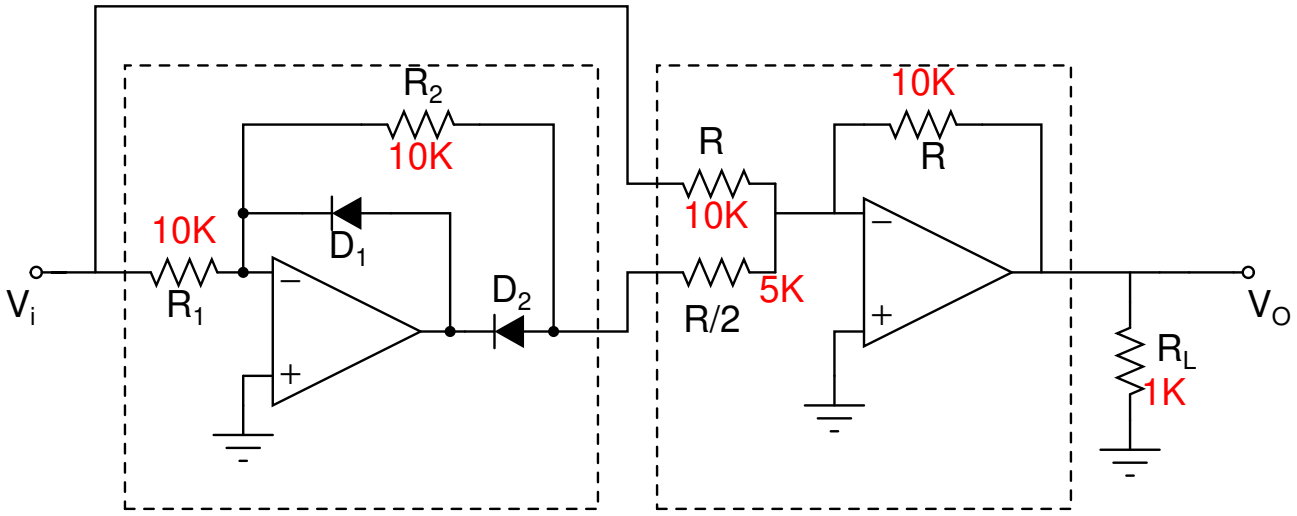
2.1 Half Wave Rectifier A



2.2 Half Wave Rectifier B



2.3 Full Wave Rectifier



3 Simulation results

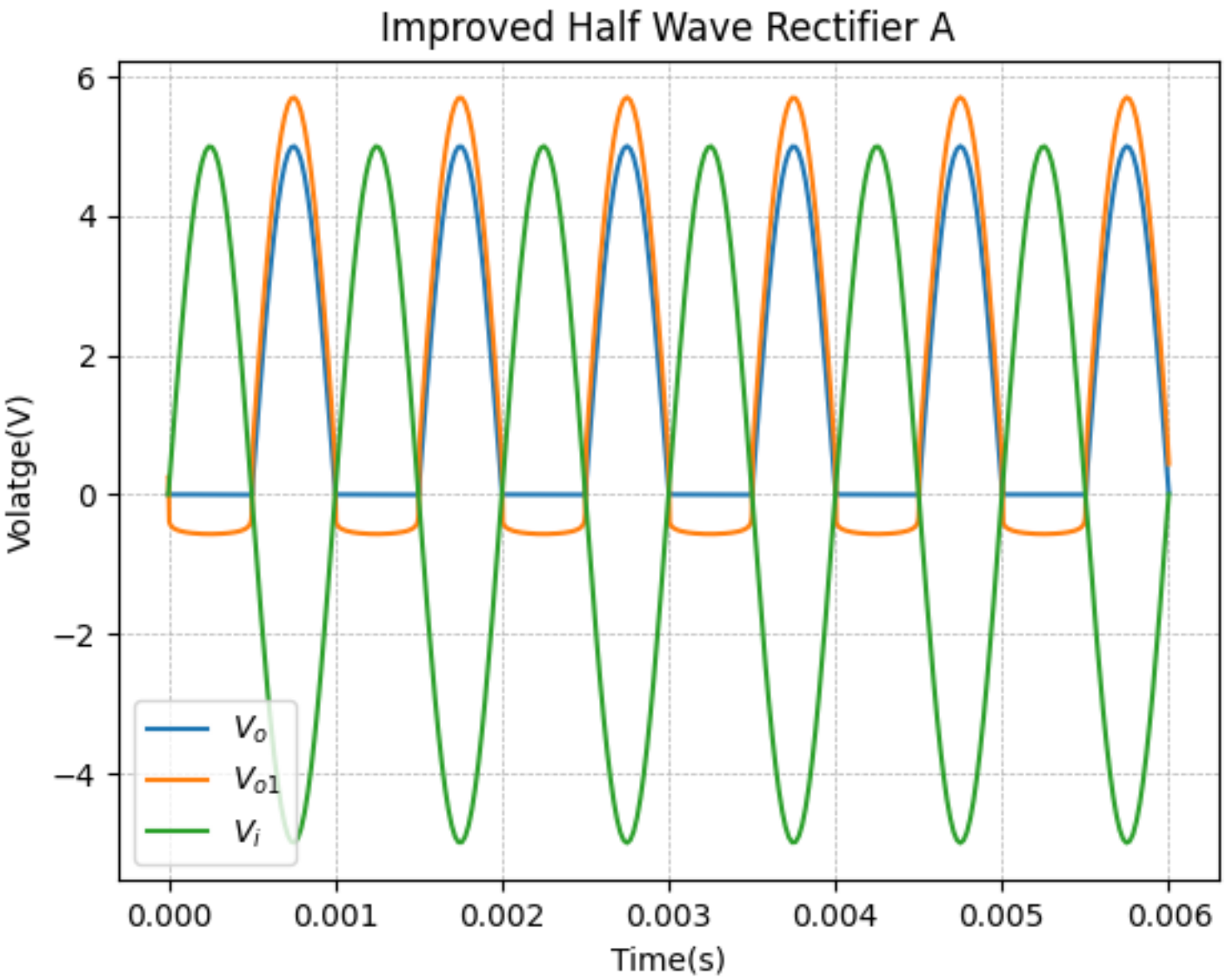
3.1 Half Wave Rectifier A

3.1.1 Code snippet

```
Improved-Half-Wave-Rectifier-A
*Including the predefined op-amp subcircuit file
.include ua741.txt
.include Diode_1N914.txt
*Connections as mentioned in subcircuit file
x1 0 1 2 3 6 UA741
d1 6 4 1N914
d2 1 6 1N914
r1 5 1 10k
r2 4 1 10k
rl 4 0 1k
vcc 2 0 dc 15v
vee 3 0 dc -15v
vin 5 0 sin (0 5 1k 0 0)
.tran 0.02ms 6ms
.control
run
```

```
plot v(4) v(6) v(5)
print v(4) v(6) v(5)
.endc
.end
```

3.1.2 Simulation results

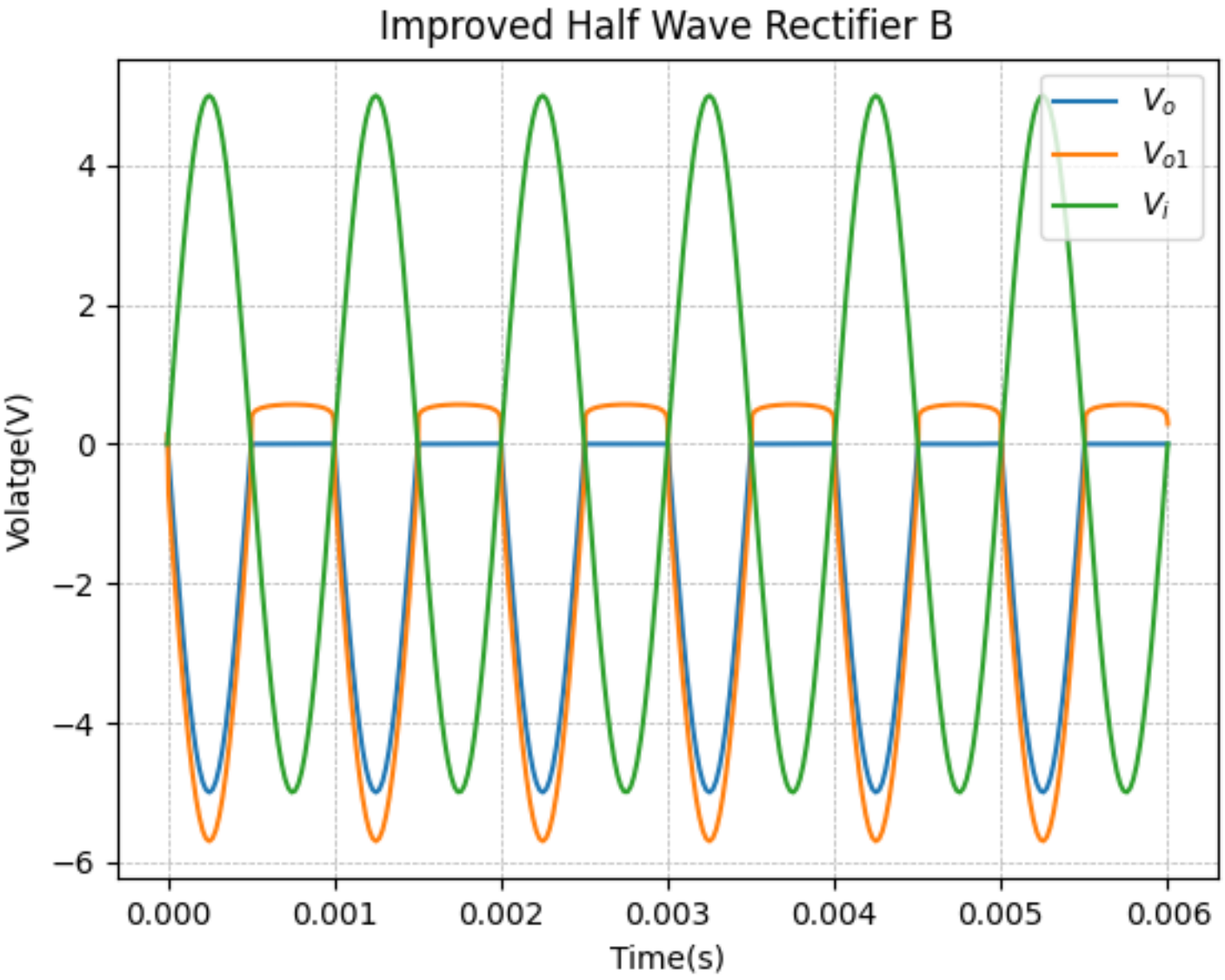


3.2 Half Wave Rectifier B

3.2.1 Code snippet

```
Improved-Half-Wave-Rectifier-B
*Including the predefined op-amp subcircuit file
.include ua741.txt
.include Diode_1N914.txt
*Connections as mentioned in subcircuit file
x1 0 1 2 3 6 UA741
d1 4 6 1N914
d2 6 1 1N914
r1 5 1 10k
r2 4 1 10k
rl 4 0 1k
vcc 2 0 dc 15v
vee 3 0 dc -15v
vin 5 0 sin (0 5 1k 0 0)
.tran 0.02ms 6ms
.control
run
plot v(4) v(6) v(5)
print v(4) v(6) v(5)
.endc
```

3.2.2 Simulation results

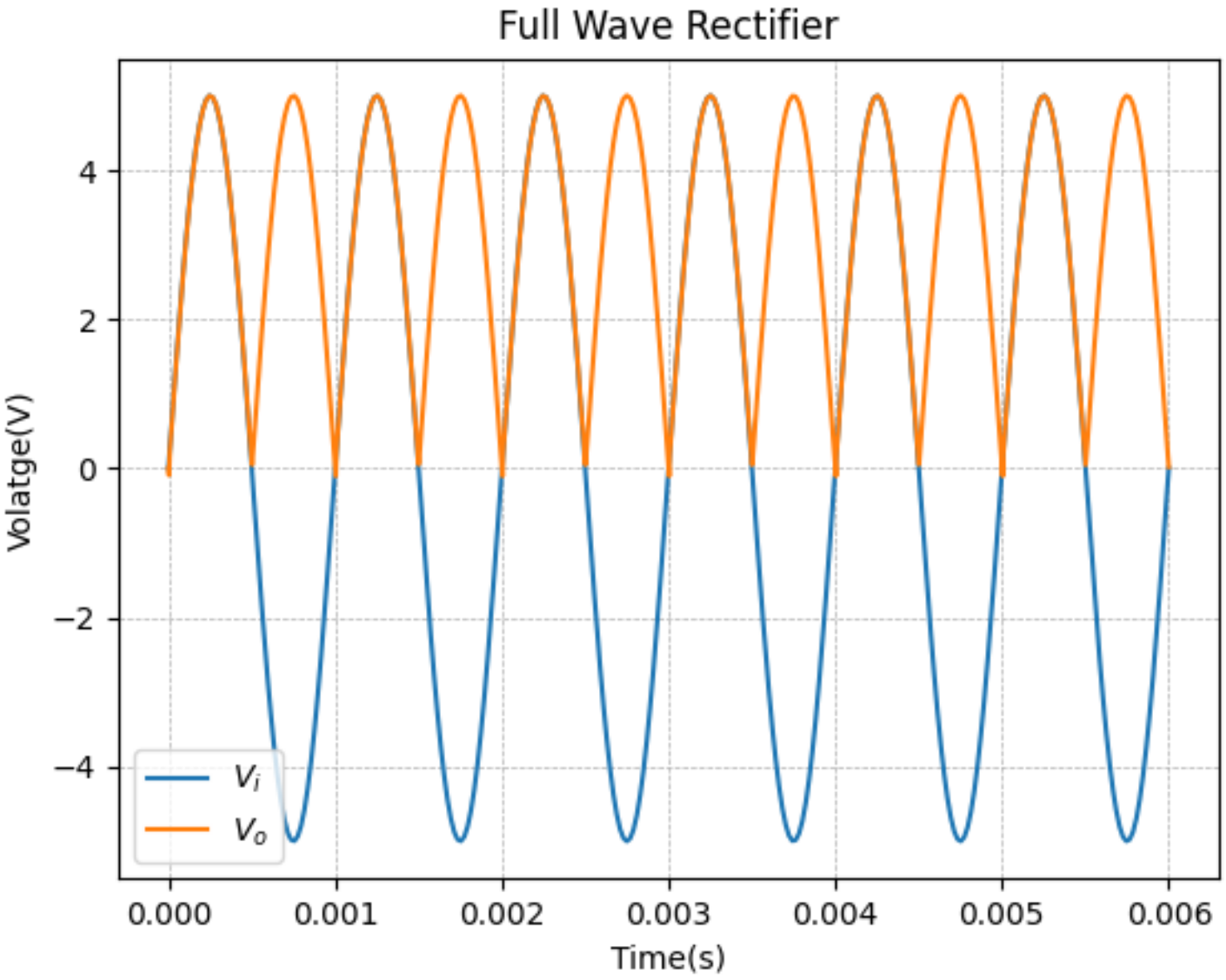


3.3 Full Wave Rectifier

3.3.1 Code snippet

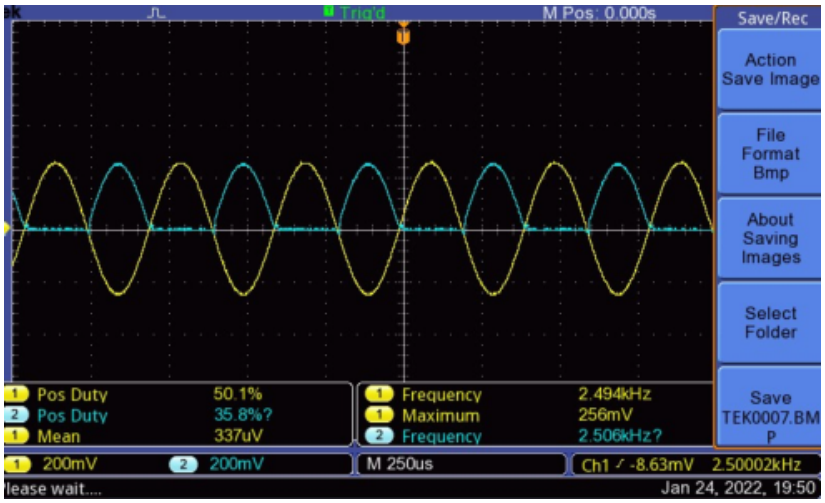
```
Improved-Half-Wave-Rectifier-A
*Including the predefined op-amp subcircuit file
.include ua741.txt
.include Diode_1N914.txt
*Connections as mentioned in subcircuit file

.subckt Improved_Half_Wave_Rectifier_B In Out com
x1 com 1 2 3 6 UA741
d1 Out 6 1N914
d2 6 1 1N914
r1 IN 1 10k
r2 Out 1 10k
rl Out com 1k
vcc 2 com dc 15v
vee 3 com dc -15v
.ends

.subckt Inverting_summer In1 In2 Out com
x1 com 1 2 3 Out UA741
r1 IN1 1 10k
r2 IN2 1 5k
r3 1 Out 10k
vcc 2 com dc 15v
vee 3 com dc -15v
.ends

xhw 1 2 0 Improved_Half_Wave_Rectifier_B
xis 1 2 3 0 Inverting_summer
vin 1 0 sin (0 5 1k 0 0)
Rl 3 0 1k
.tran 0.02ms 6ms
.control
run
plot v(3) v(1)
print v(1) v(3)
.endc
```

3.3.2 Simulation results



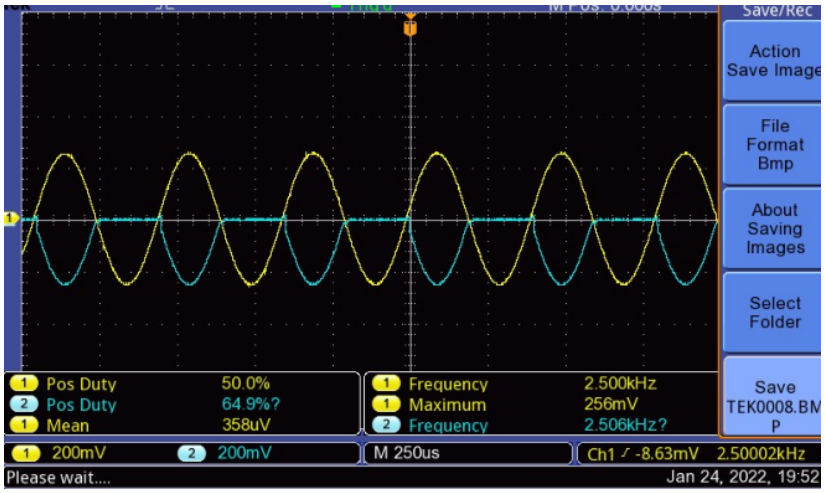
4 Experimental results

4.1 Half Wave Rectifier A



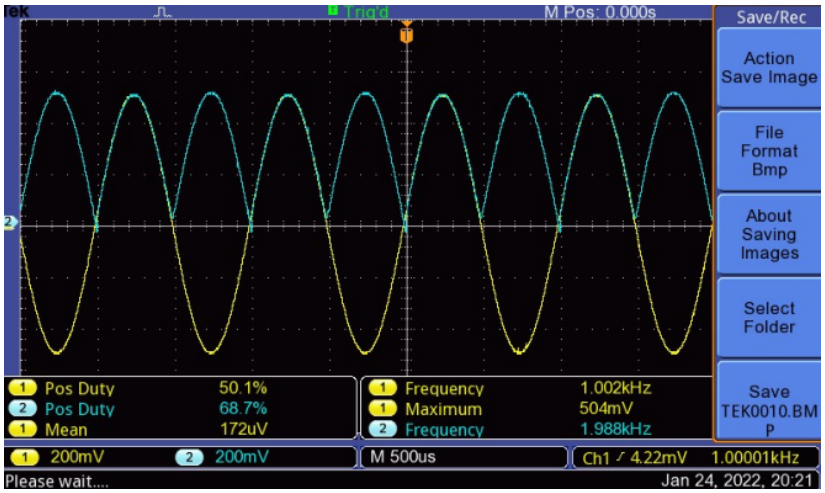
The experimental results match theoretical predictions quite well.

4.2 Half Wave Rectifier B



The experimental results match theoretical predictions quite well.

4.3 Full Wave Rectifier



The experimental results match theoretical predictions quite well.

5 Experiment completion status

All the sections were completed