Inspiring Excellence

Course Code: CSE251
Course Title: Electronic Devices and Circuits
Semester: Spring-2023

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Experiment Number: 04
Experiment Name: Study of Half-Wave and Full-Wave rectifiers
Group No: 03
Section: 12

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Data Sheet

Data Sheet

Experimental Observation: HW Rectifier

1. **HW Rectifier without Capacitor:**
   Peak output voltage, V_p (oscilloscope) = 4·29V
   Average or DC output voltage, V_{dc} (multimeter in DC mode) = 1.29 V
   RMS or AC output voltage, V_{r-rms} (multimeter in AC mode) = 1.599 V

2. **HW Rectifier with 1μF Capacitor:** C = 0.97 HF
   Peak output voltage, V_p (oscilloscope) = 4.29 V
   Peak to peak ripple voltage, $V_{r(p-p)}$ (oscilloscope) = 3.19 V
   Average or DC value of the ripple voltage, V_{dc} (multimeter in DC mode) = 2·23
   RMS or AC value of the ripple voltage, V_{r-rms} (multimeter in AC mode) = 1·062
   Ripple factor, $r = V_{r-rms}/V_{dc}$ = 0·476

3. **HW Rectifier with 4.7μF Capacitor:** C = 4·86 μF
   Peak output voltage, V_p (oscilloscope) = 4·08V
   Peak to peak ripple voltage, $V_{r(p-p)}$ (oscilloscope) = 1·28V
   Average or DC value of the ripple voltage, V_{dc} (multimeter in DC mode) = 3·387V
   RMS or AC value of the ripple voltage, V_{r-rms} (multimeter in AC mode) = 0·378
   Ripple factor, $r = V_{r-rms}/V_{dc}$ = 0·116

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Theoretical Calculation: HW Rectifier

1. **HW Rectifier Without Capacitor:**
   Peak output voltage, V_p (see the experimental observation) = 4·29
   Peak input voltage, V_m = 5V
   Diode voltage, V_{D0} = 0.7 V
   DC output voltage of the rectifier, $V_{dc} = \frac{V_m}{\pi} - \frac{V_{D0}}{2}$ = 1·29 V
   RMS or AC output voltage, $V_{r-rms} = \frac{V_p}{2}$ = 2·12

2. **HW Rectifier With 1μF Capacitor:**
   Peak output voltage, V_p (see the experimental observation) = 4·29
   Peak to peak ripple voltage, $V_{r(p-p)}$ (see the experimental observation)= 3·44
   DC value of the ripple voltage, $V_{dc} = V_p - \frac{V_{r(p-p)}}{2}$ = 2·52
   RMS value of the ripple voltage, $V_{r-rms} = \frac{V_{r(p-p)}}{2\sqrt{3}}$ = 0·993
   Ripple factor, $r = V_{r-rms}/V_{dc}$ = 0·394

3. **HW Rectifier with 4.7μF Capacitor:**
   Peak output voltage, V_p (see the experimental observation) = 4·08
   Peak to peak ripple voltage, $V_{r(p-p)}$ (see the experimental observation) = 1·28
   DC value of the ripple voltage, $V_{dc} = V_p - \frac{V_{r(p-p)}}{2}$ = 3·44
   RMS value of the ripple voltage, $V_{r-rms} = \frac{V_{r(p-p)}}{2\sqrt{3}}$ = 0·3695
   Ripple factor, $r = V_{r-rms}/V_{dc}$ = 0·1074

Experimental Observation: FW Rectifier

1. **FW Rectifier without Capacitor:**
   Peak output voltage, V_p (oscilloscope) = 3·68V
   Average or DC output voltage, V_{dc} (multimeter in DC mode) = 2·061
   RMS or AC output voltage, V_{r-rms} (multimeter in AC mode) = 1·281

2. **FW Rectifier with 1μF Capacitor:**
   Peak output voltage, V_p (oscilloscope) = 3·52V
   Peak to peak ripple voltage, $V_{r(p-p)}$ (oscilloscope) = 1·76
   Average or DC value of the ripple voltage, V_{dc} (multimeter in DC mode) = 2·621
   RMS or AC value of the ripple voltage, V_{r-rms} (multimeter in AC mode) = 0·540
   Ripple factor, $r = V_{r-rms}/V_{dc}$ = 0·206028

3. **FW Rectifier with 4.7μF Capacitor:**
   Peak output voltage, V_p (oscilloscope) = 3·44 V

Peak to peak ripple voltage, $V_{r(p-p)}$ (oscilloscope) = 0'64V
Average or DC value of the ripple voltage, V_{dc} (multimeter in DC mode) = 3'069
RMS or AC value of the ripple voltage, V_{r-rms} (multimeter in AC mode) = 0'148
Ripple factor, $r = V_{r-rms}/V_{dc}$ = 0'0482

Theoretical Calculation: FW Rectifier

1. **FW Rectifier without Capacitor:**
   Peak output voltage, V_p (see the experimental observation) = 3'68V 28/02/23
   Peak input voltage, V_m = 5V
   Diode voltage, $V_{D0} = 0.7$ V
   DC output voltage of the rectifier, $V_{dc} = \frac{2\,V_m}{\pi} - 2\,V_{D0}$ =
   RMS or AC output voltage, $V_{r-rms} = \frac{V_p}{\sqrt{2}}$ =

2. **FW Rectifier with 1μF Capacitor:**
   Peak output voltage, V_p (see the experimental observation) = 3'52
   Peak to peak ripple voltage, $V_{r(p-p)}$ (see the experimental observation) = 1'76
   DC value of the ripple voltage, $V_{dc} = V_p - \frac{V_{r(p-p)}}{2}$ = 2'64
   RMS value of the ripple voltage, $V_{r-rms} = \frac{V_{r(p-p)}}{2\sqrt{3}}$ = 0'508
   Ripple factor, $r = V_{r-rms}/V_{dc}$ = 0'192

3. **FW Rectifier with 4.7μF Capacitor:**
   Peak output voltage, V_p (see the experimental observation) = 3'44
   Peak to peak ripple voltage, V_p (see the experimental observation) = 0'64
   DC value of the ripple voltage, $V_{dc} = V_p - \frac{V_{r(p-p)}}{2}$ = 3'12
   RMS value of the ripple voltage, $V_{r-rms} = \frac{V_{r(p-p)}}{2\sqrt{3}}$ = 0'184
   Ripple factor, $r = V_{r-rms}/V_{dc}$ = 0'058

Table for Comparison

Use the experimental and theoretical data for comparison.

		Experimental Observation			Theoretical Calculation		
	C(uF)	Vr-rms (V)	Vdc (V)	Ripple Factor	Vr-rms (V)	Vdc (V)	Ripple Factor
HW	1	1.062	2.23	0.476	0'993	2'52	0'394
	4.7	0.378	3.387	0.116	0'3695	3'49	0'1079
FW	1	0.540	2.621	0.206078	0'508	2'64	0'192
	4.7	0.148	3.069	0.0482	0'184	3'12	0'058

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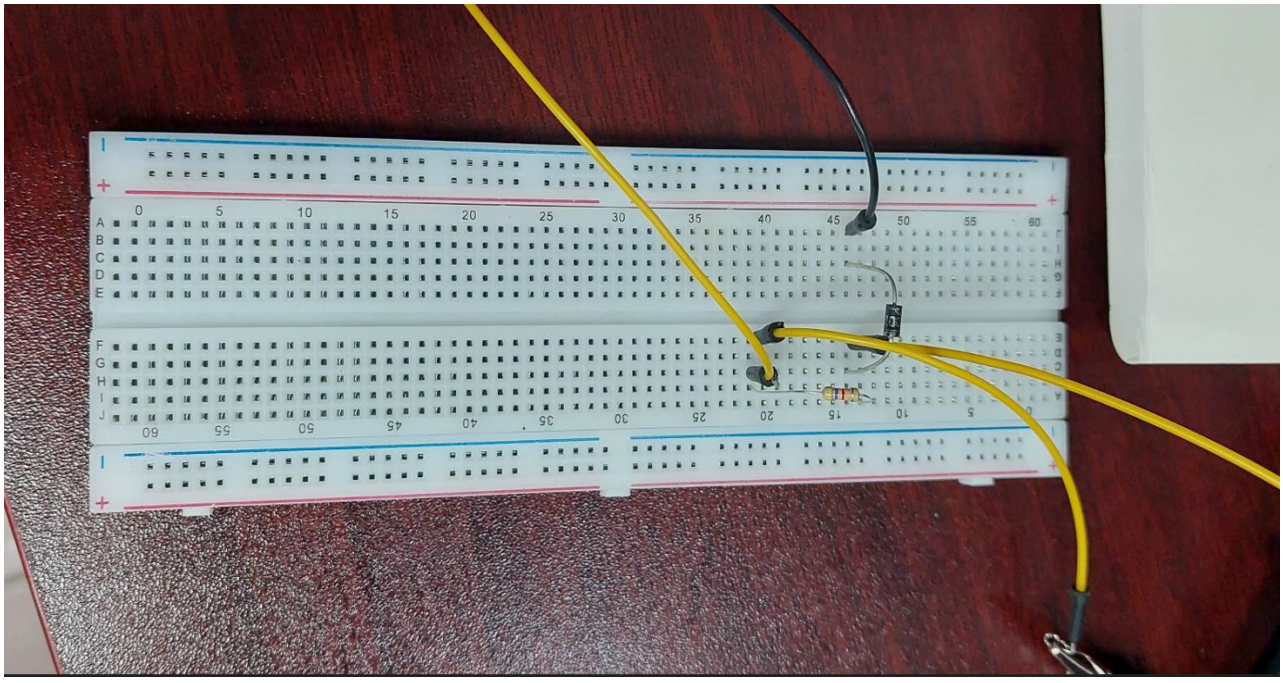
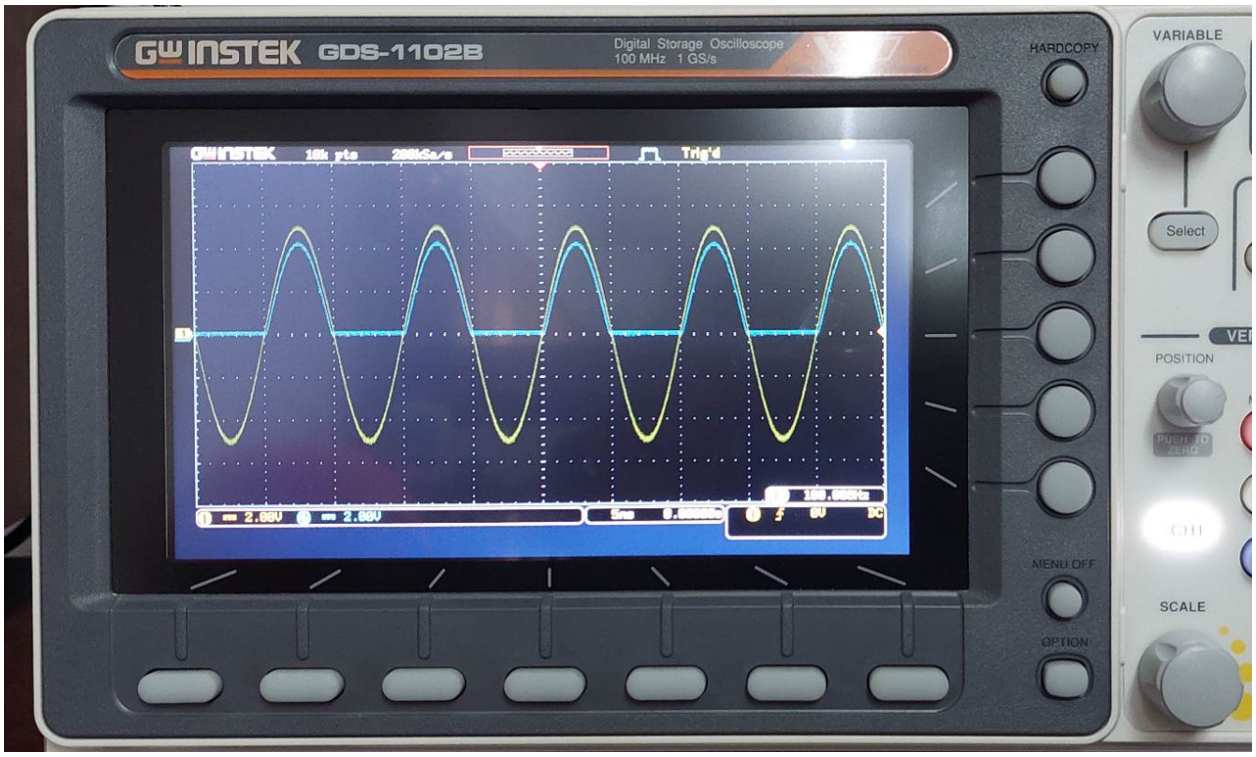
Half-Wave rectifier

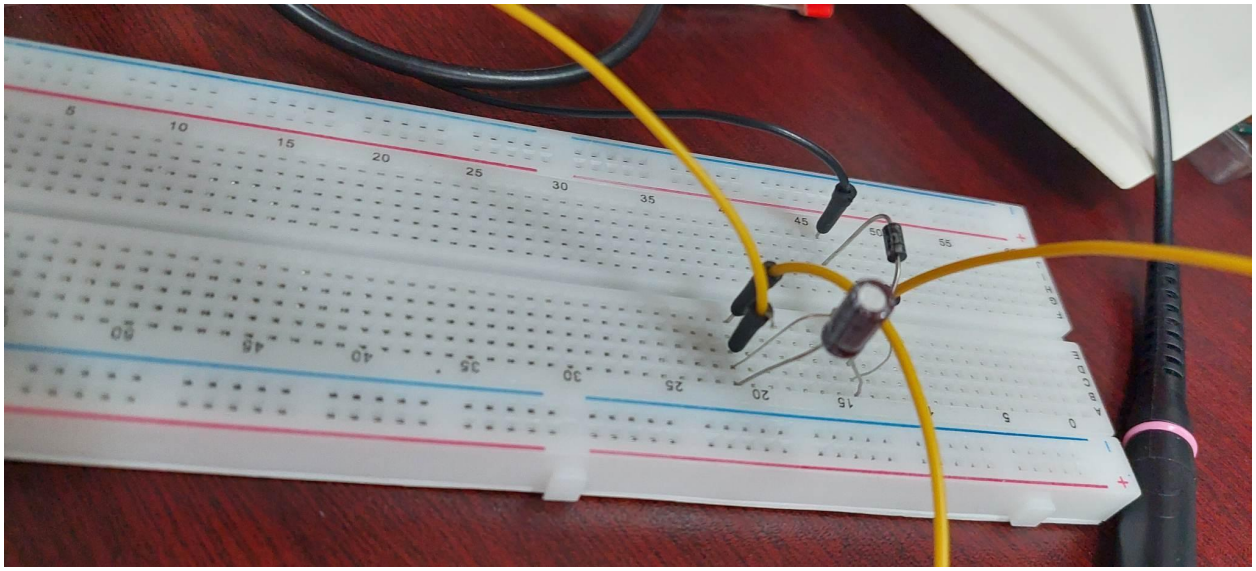
Circuit: Half-Wave rectifier (Without capacitor)



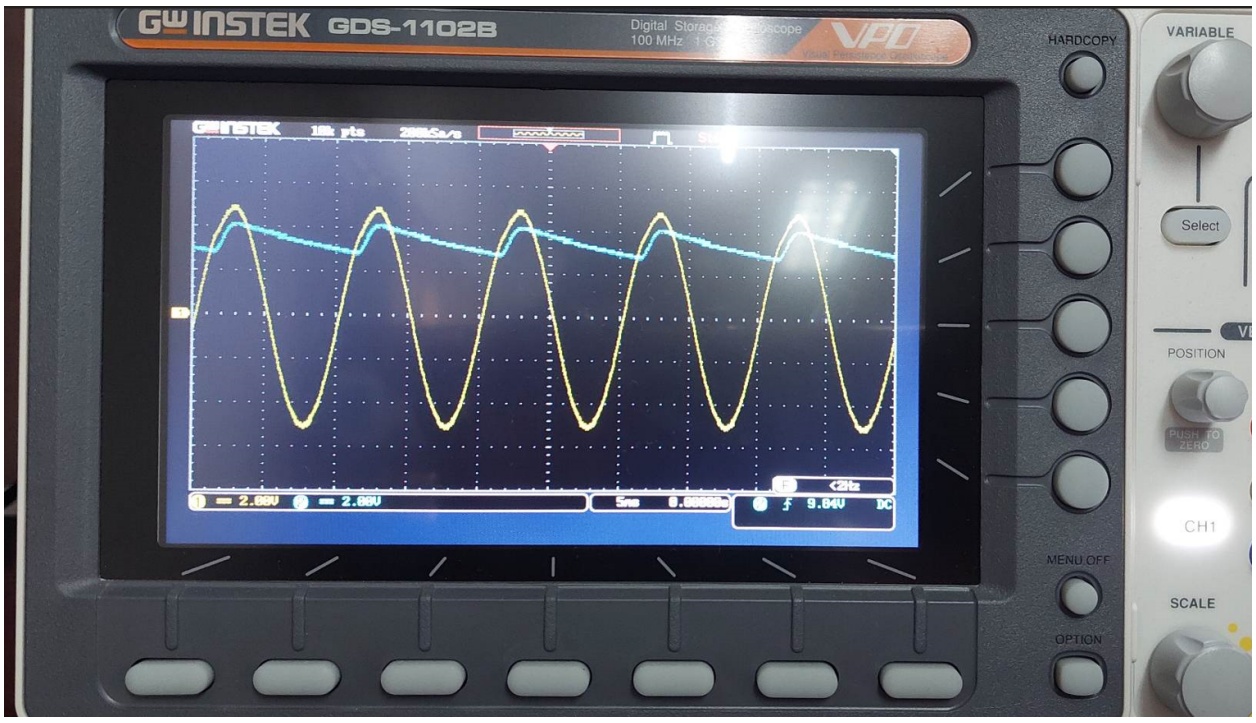
Graph: Input & output for Half-wave rectifier (Without capacitor)



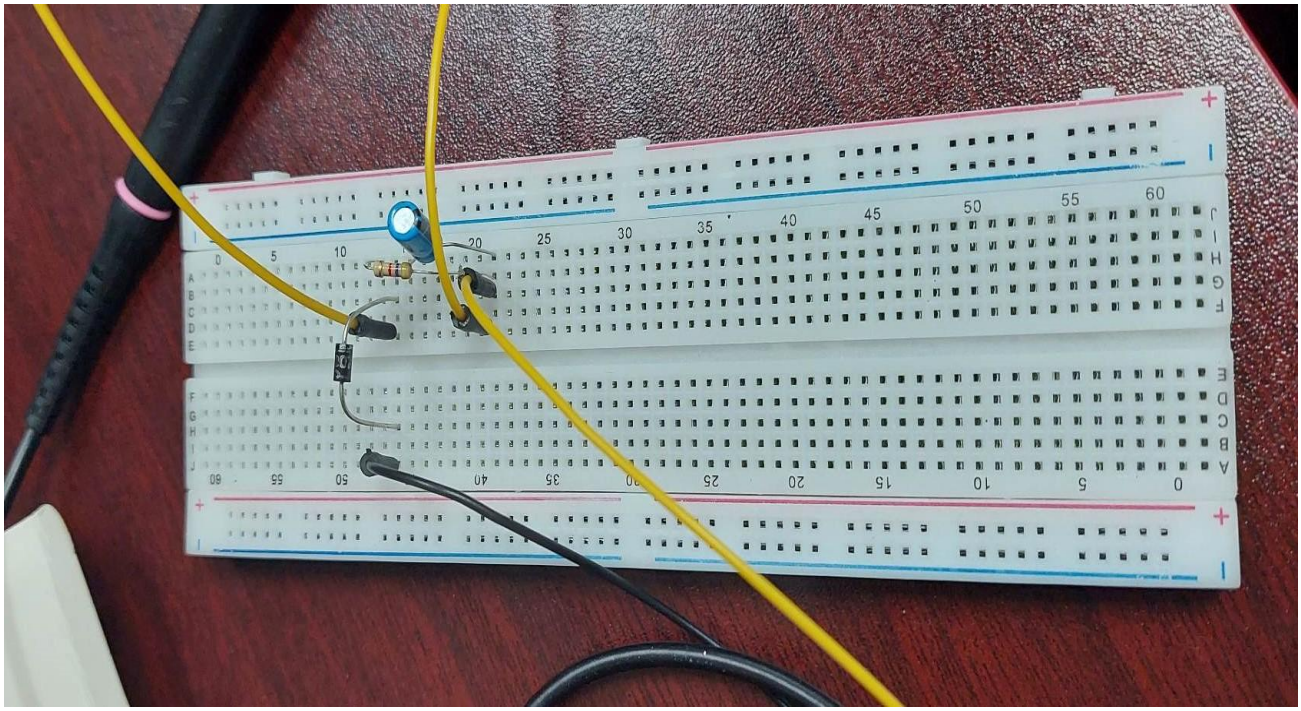
Circuit: Half-Wave rectifier (Using 1uF capacitor)



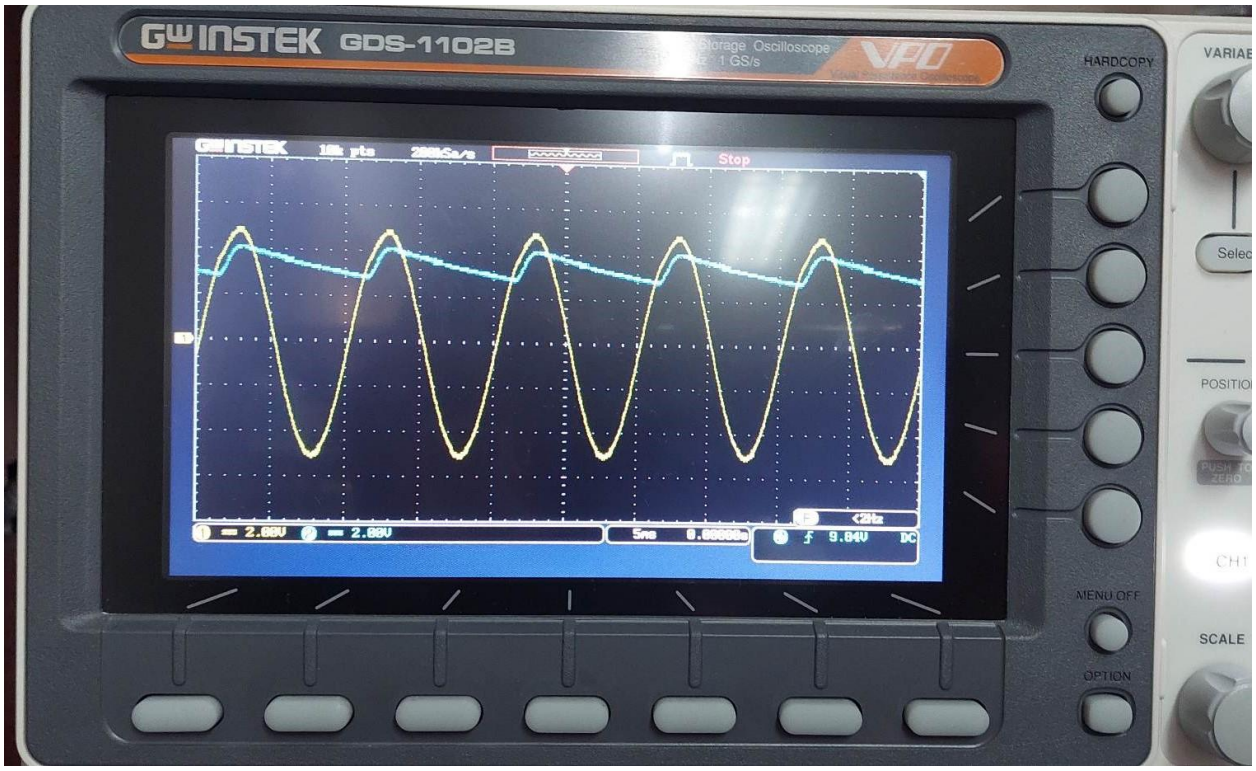
Graph: Input & output for Half-Wave rectifier (Using 1 uF capacitor)



Circuit: Half-wave rectifier (Using 4.7 uF capacitor)

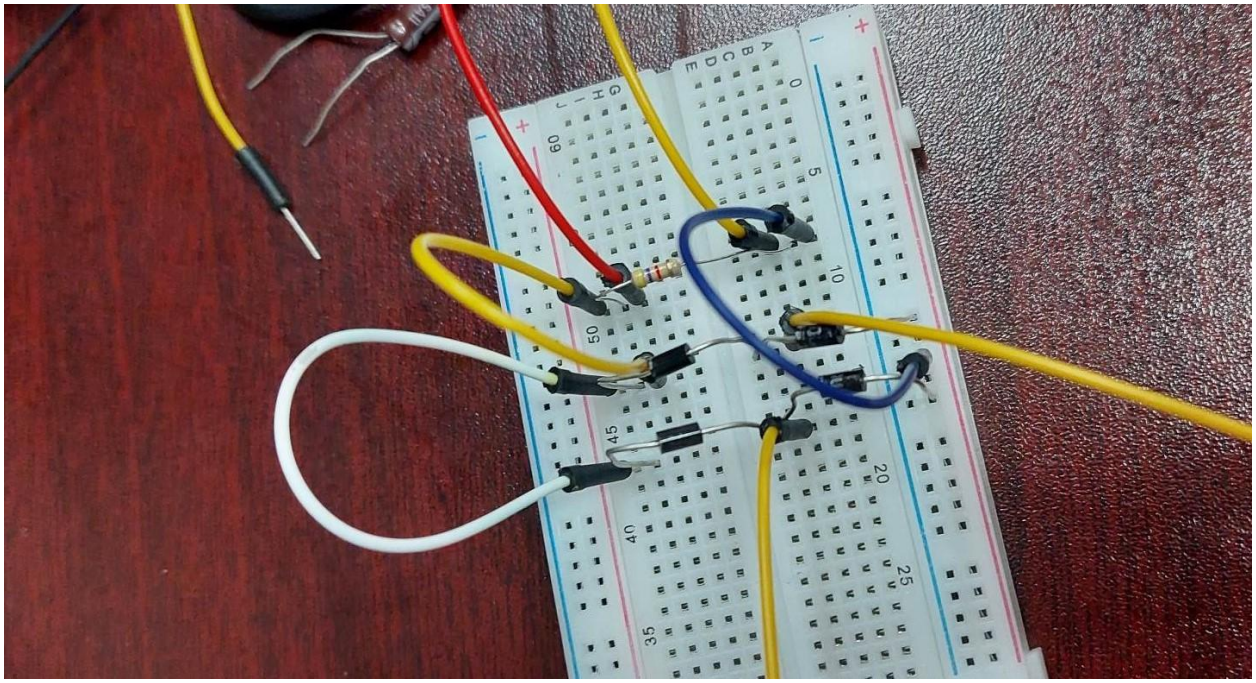


Graph: Input & output for Half-Wave rectifier (Using 4.7 uF capacitor)

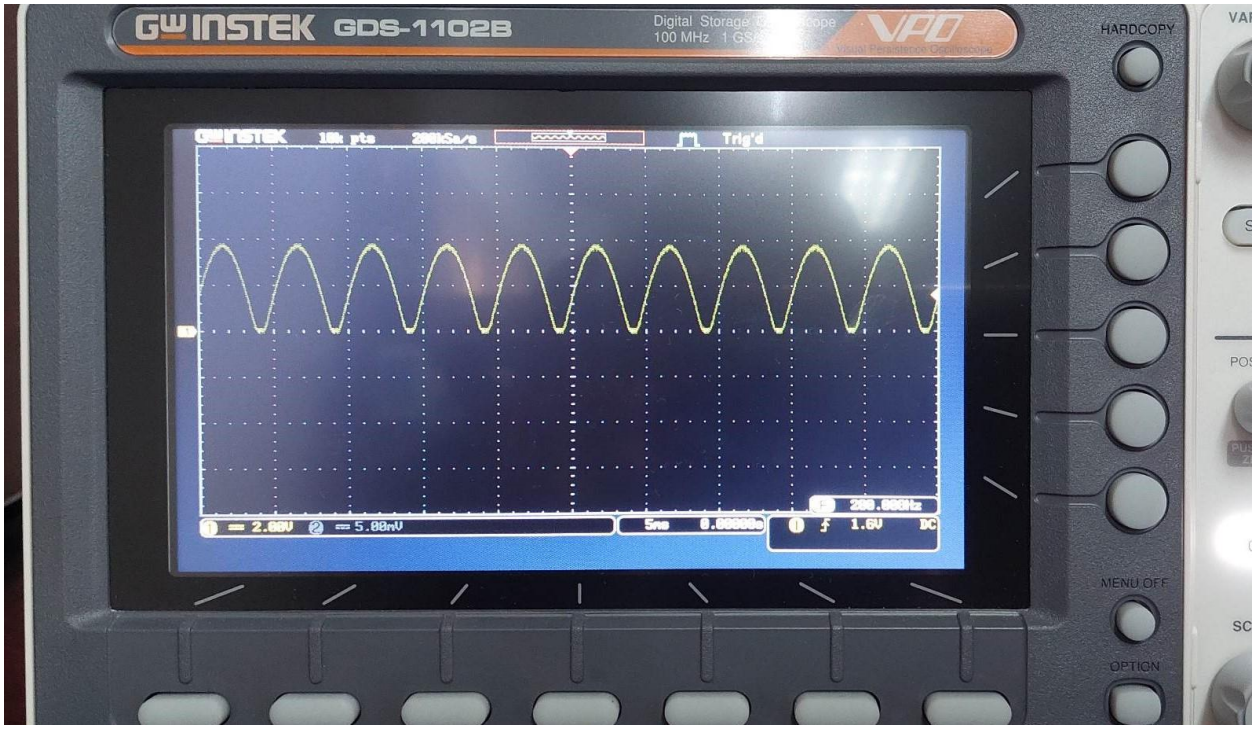


Full-Wave rectifier

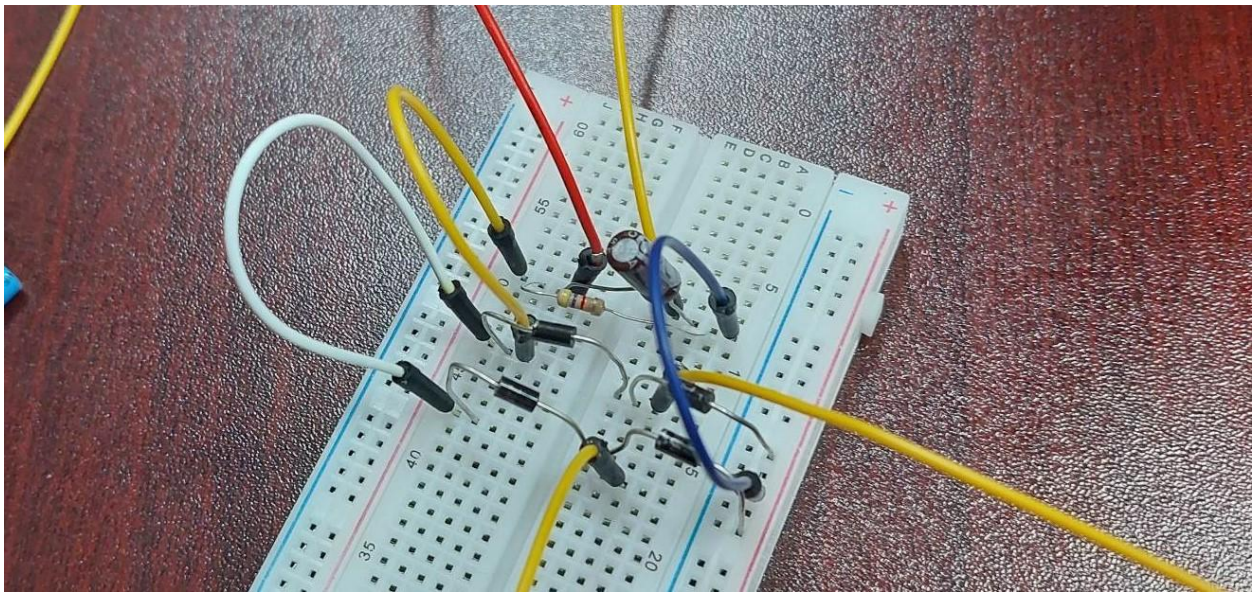
Circuit: Full-Wave rectifier (without capacitor)



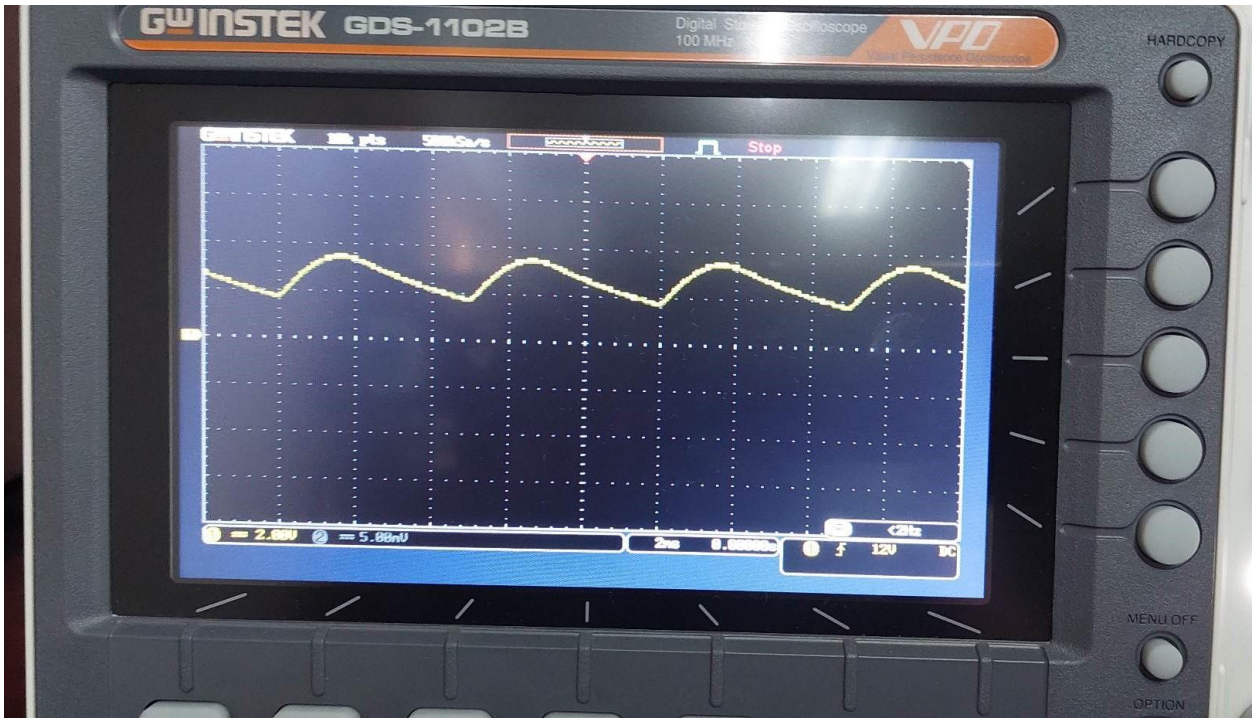
Graph: Output for Full-Wave rectifier (Without capacitor)



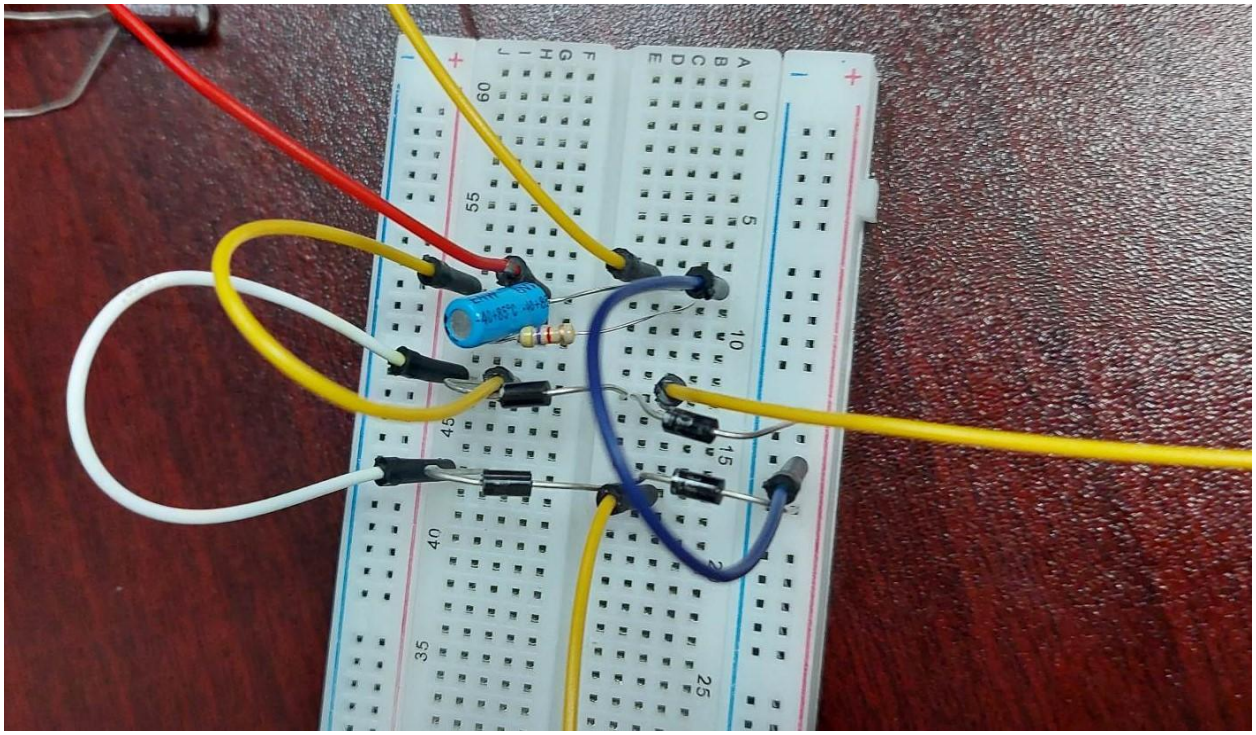
Circuit: Full-Wave rectifier (Using 1 uF capacitor)



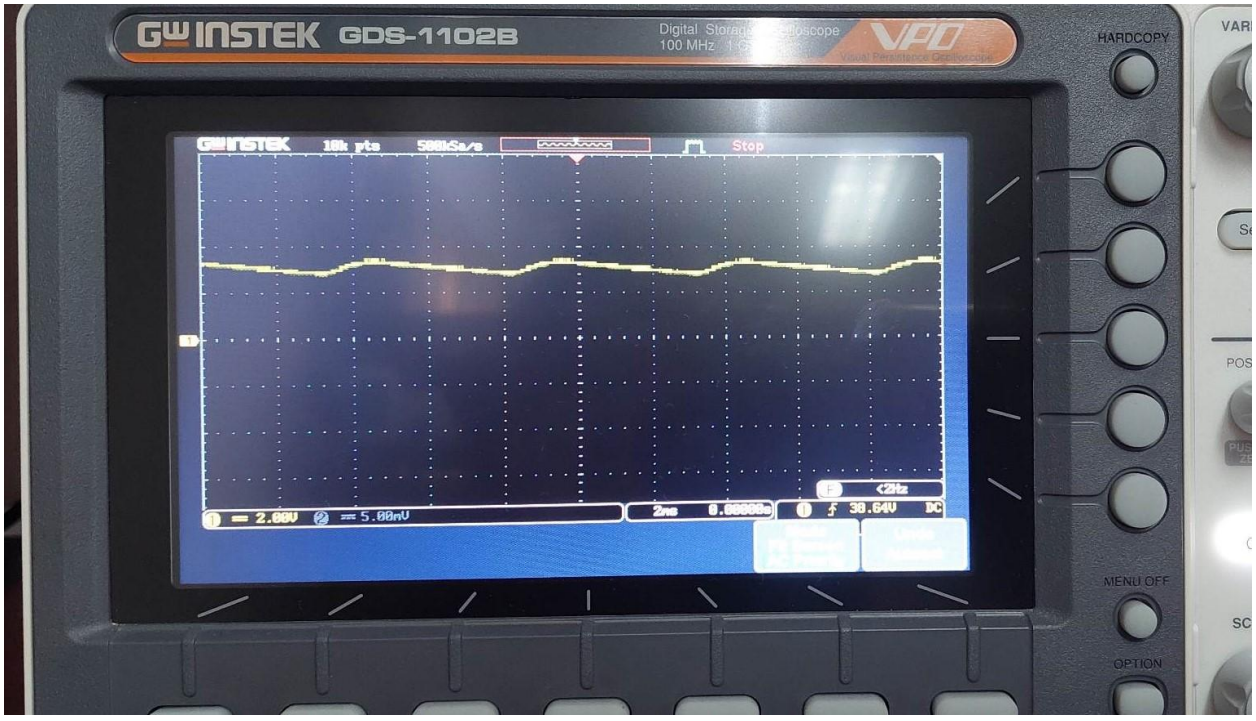
Graph: Output for Full-Wave rectifier (Using 1 uF capacitor)



Circuit: Full-Wave rectifier (Using 4.7 uF capacitor)



Graph: Output for Full-Wave rectifier (Using 4.7 uF capacitor)



Discussion

Initially, for the half-wave rectifier, a function generator set at 5V with a 100kΩ resistor and diode connected in series and connected to channel 1 of the oscilloscope at 100Hz, and channel 2 connected to the resistor. Channel 1 and channel 2 of the oscilloscope are used to view the input and output. Here, 1uF and 4.7uF capacitors are used to observe the smoothness of the resulting curves. Otherside, for a full-wave rectifier, it is put together through connecting two diodes in series with another two diodes in series. Series diodes are connected in parallel. To find the output, a 100k resistor is connected in parallel to the diodes other hand channel 2 is connected to the resistor. Here, 1uF and 4.7uF capacitors are used to observe the smoothness of the resulting curves.

If considering between half and full-wave rectifiers, in this case full-wave rectifier is better because diode does not turn off in -ve half cycle and current is not likely to flow in the circuit as it is forward-biased.

The problem I encountered while doing the experiment was that the output curve of the full-wave rectifier was not correct. To solve this problem, the capacitor was attached to one of the wires tied to the resistor, which was connected to channel 2.