

Voltage_Multipliers -- Overview



OBJECTIVES

After performing this lab exercise, learner will be able to:

- Generate different type of Voltage Multiplier from the single pulsating power source
- Voltage doubler and Voltage Tripler

EQUIPMENT

To carry out this experiment, you will need:

- TBS1KB - Digital Oscilloscope from Tektronix
- Diodes (1N4001)
- Capacitors (103 – 100 pF)
- Voltage probe (provided with oscilloscope)
- Breadboard and connecting wires

THEORY

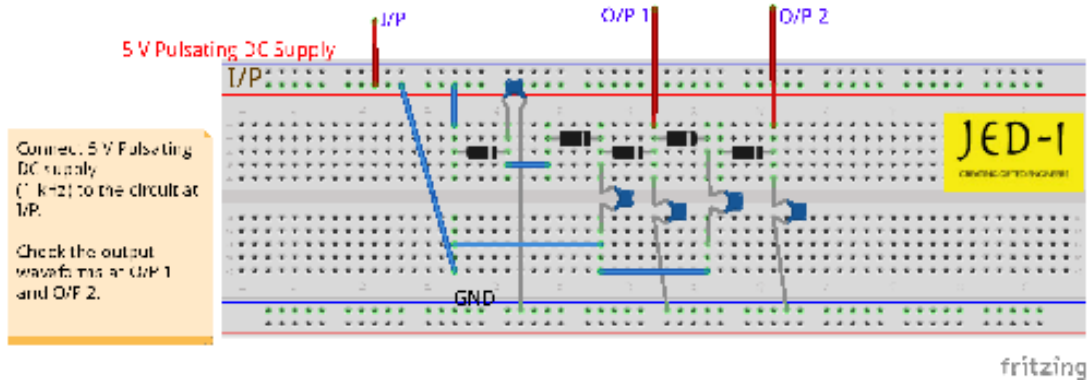
- We all have learned simple half-wave rectifier. We use simple diode and capacitor in series to rectify the AC signal or Pulsating signal to DC. Then we use smoothing capacitor for the constant smooth output voltage.
- But we have never tried changing the position of capacitor and diode, have you tried? If yes then you must have noticed some magic happens at the output. Yes! It doubles the voltage value! So now you can see shifted waveform by the same amount of voltage at output pin.
- A voltage multiplier is an electronic circuit which charges capacitors from the input voltage and switches these charges in such a way that, in the ideal case, exactly twice the voltage is produced at the output as at its input. It is the voltage doubler circuit.
- We can add more blocks at the output and we will get the multiplier circuit. For example, if we add Three levels then we will get voltage Tripler!

Voltage_Multipliers -- Procedures

Step 1

DUT / SOURCE SETUP

- Connect the components according to the diagram shown above.
- Connect the 5 V pulsating power supply at I/P line.
- Take the output from mentioned probing point(s) .



Step 2

MEASUREMENT / SCOPE SETUP

- Power ON the oscilloscope
- Connect the Channel 1 probe of the oscilloscope to I/P
- Connect the Channel 2 probe of the oscilloscope to O/P-1
- Acquire the signal(s) from circuit on oscilloscope

Step 3

- Do the Autoset on the scope to efficiently capture and view the signal .
- If AUTOSSET feature is not enabled, then manually set the horizontal and vertical scale, and trigger condition to view 3-4 cycles of waveform without any clipping.

Step 4

- From the measurement menu, configure MAXIMUM measurement on acquired channel.
- You should find this type of Output waveform. This is Voltage Doubler circuit. It is known as Dickson charge-pump voltage doubler.

Step 5

- You would see -
 - Input signal is at 5 Volts and 1 kHz of the signal.
 - Output signal is approximately 9.4 Volts constant DC. Ideally it should be 10 Volts but this voltage drop is because of the

voltage drop at diode. It is the voltage doubler.

Step 6

- Connect the Channel 2 probe of the oscilloscope to O/P-2 now .
- You should find this type of Output waveform. This is Voltage Tripler circuit.

Step 7

- You would see -
 - Input signal is at 5 Volts and 1 kHz of the signal.
 - Output signal is approximately 13.6 Volts constant DC. Ideally it should be 15 Volts but this voltage drop is because of the voltage drop at diode. It is the voltage doubler.

Step 8

CAN YOU ANSWER THIS?

1) As the name suggests, it should double the input voltage in the second stage. (It should be $9.4 \text{ V} \times 2 = 18.8 \text{ Volts}$ approximately.) but both the stages are actually Voltage doubler only. why it was multiply by three?

2) Let's say if i keep 5 more stages then output voltage would be ideally 25 Volts (If you get above question's answer correct) then from where all these voltage is coming from? We are gaining the voltage but at the same time we are loosing something. What is that and How?