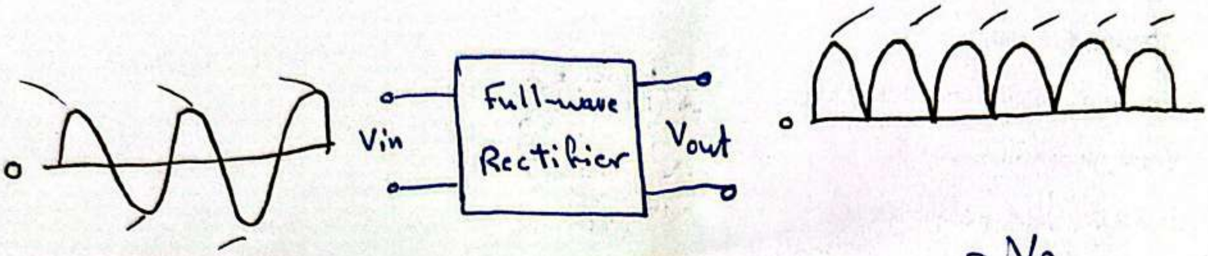
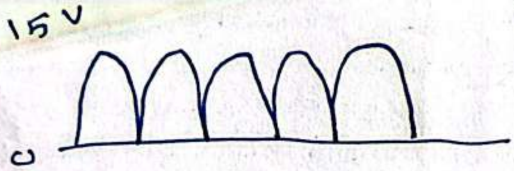
2-3:- full-wave Rectifier

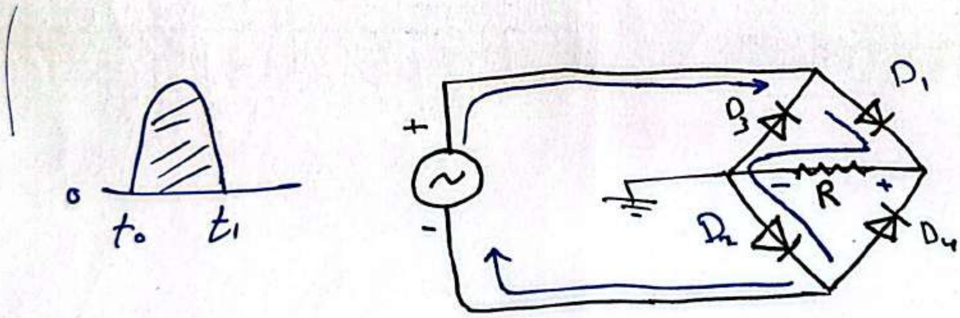


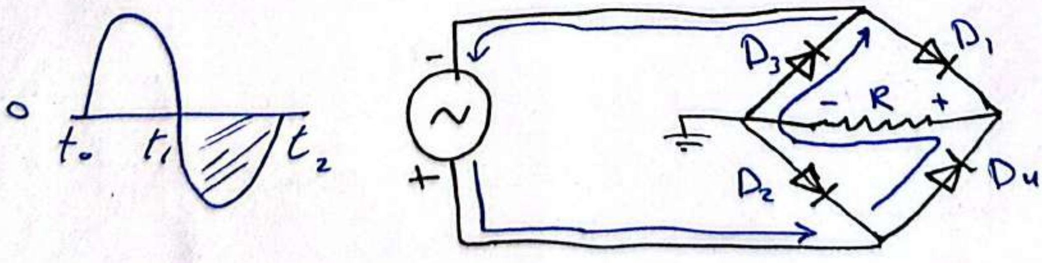
$$V_{dc} = V_{AVG} = \frac{2V_p}{\pi}$$



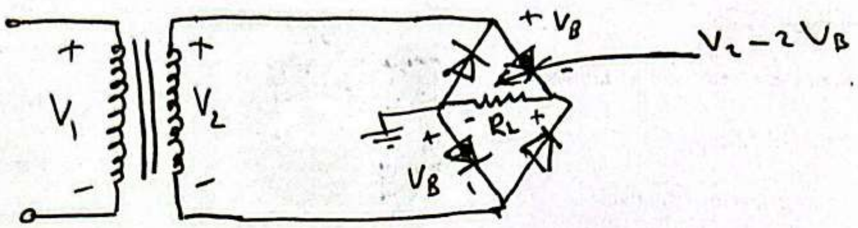
$$V_{dc} = V_{AVG} = \frac{2V_p}{\pi} = \frac{2(15V)}{\pi} = 9.55\,V$$

2-3.1 full-wave Bridge Rectifier:





Bridge output voltage.

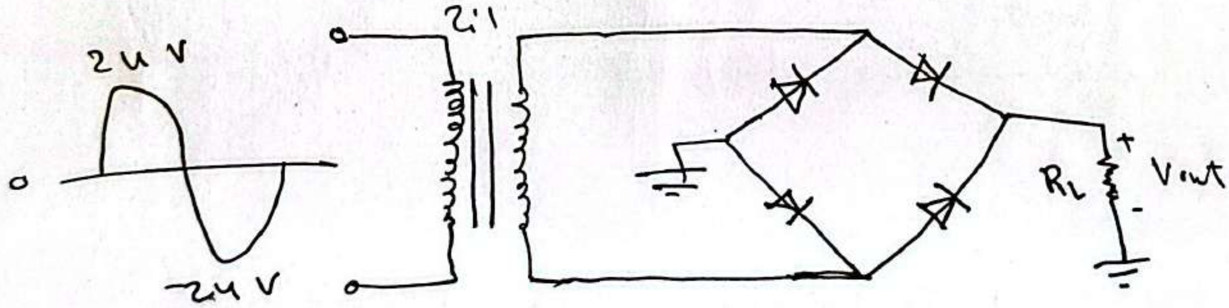


$V_{out} = V_2 - 2V_B$

Peak Inverse voltage (PIV) = Vout

ابي كزد بس الب من إلى

ex) Determine the output voltag for the bridge rectifier. what minimum PIV rating is required for the silicon diodes?



$V_{p(out)} = V_2 - 2V_B$

$= \frac{1}{2} V_{p(in)} - 2V_B$

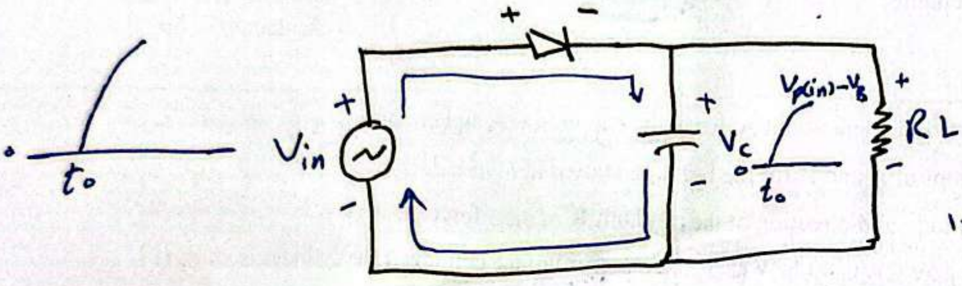
$= \frac{1}{2}(24\,V) - 1.4\,V = 12 - 1.4 = 10.6\,V$

PIV for each diode

$PIV = V_{p(out)} = 10.6\,V + 0.7\,V = 11.3$

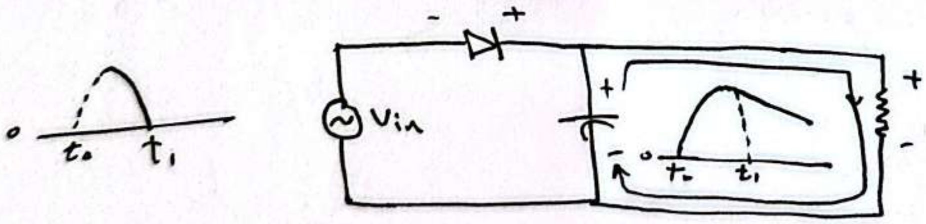
2-4 Capacitor-Input filter:

* During The positive first quarter- cycle of The input (دائرة الربع / خلال)
The diode is forward-biased. allowing The capacitor to charge to within a diode drop of The input peak (فجوة)



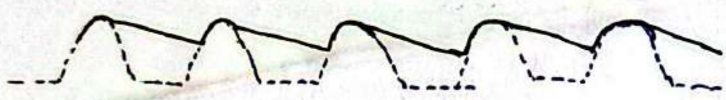
Initial charging

* when The input begins to decrease below its peak, The capacitor retains (يحتفظ) its charge and The diode becomes reverse-biased.
During (خلال) The remaining (المتبقي) part of The cycle, The capacitor can discharge (تفريغ) only Through The load (مقاومة) resistance (مقاومة) at a rate (معدل) determined by $R_L C$ time constant. The larger the time constant, The less The capacitor will discharge.



Ripple :-

The capacitor quickly charges at the beginning of ~~a cycle~~ a cycle and slowly ~~dis cha~~ discharges after the positive peak (when the diode is reverse-biased). The variation in the output voltage due to the charging and discharging is called the ripple.



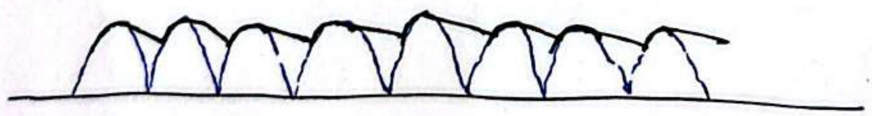
Half-wave ripple voltage

The ripple factor is an indication of the effectiveness of the filter and is defined as

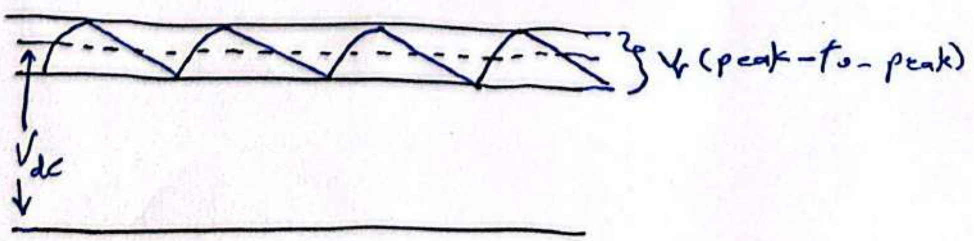
$$r = \frac{V_r}{V_{dc}}$$

where V_r : is the rms ripple voltage ~~and~~

V_{dc} : is the dc (average) value of the filter's output voltage.



full-wave ripple voltage.



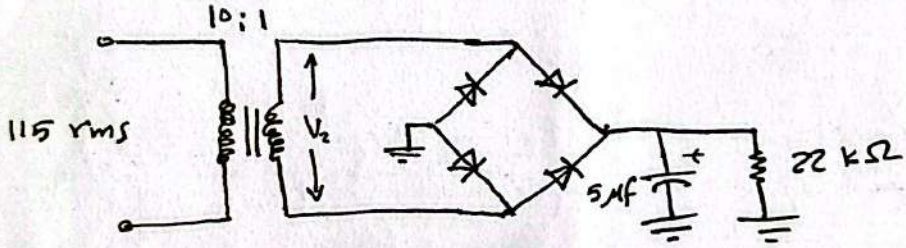
for a full-wav rectifir

$$V_{dc} = \left(1 - \frac{0.00417}{R_L C}\right) V_{p(in)}$$

$$V_r = \frac{0.0024}{R_L C} V_{p(in)}$$

where $V_{p(in)}$ is The peak rectified voltage applied to The filter.

ex) Determine The ripple factor for The filtered bridg rectifier



solution The peak primary voltage is

$$\frac{V_p}{\sqrt{2}} = V_{rms}$$

$$V_{p1} = (1.414)\,115\text{ V} = 162.6\text{ V}$$

The peak secondary voltage is

$$V_{p2} = \left(\frac{1}{10}\right) 162.6\text{ V} = 16.26\text{ V}$$

The peak full-wave rectified voltage at The filter input is

$$V_{p(in)} = V_{p2} - 2V_B = 16.26\text{ V} - 1.4\text{ V} = 14.86\text{ V}$$

The filtered dc output voltage is

$$V_{dc} = \left(1 - \frac{0.00417}{R_L C}\right) V_{p(in)}$$

$$= \left(1 - \frac{0.00417}{(22\,k\Omega)(5\,\mu F)}\right) 14.86\,V$$

$$= (1 - 0.0379)\, 14.86\,V$$

$$= 14.3\ V$$

The rms ripple is

$$V_r = \frac{0.0024\, V_{p(in)}}{R_L C}$$

$$= \frac{0.0024(14.86\,V)}{(22\,k\Omega)(5\,\mu F)} = 0.324\ V$$

The ripple factor is

$$r = \frac{V_r}{V_{dc}} = \frac{0.324\,V}{14.3}$$

$$= 0.0227$$

The percent of ripple is 2.27%.

أنتي

- Inductor Input Filter :-

when a choke (الكابت) is added to the filter input, a reduction (تخفيض) in the repple voltage is achieved (يتحقق).

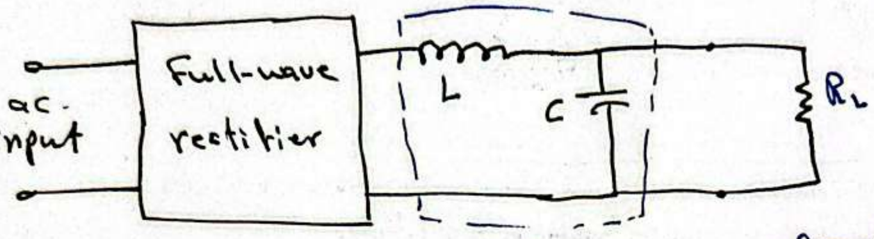


fig: Rectifier with an LC filter

The choke (الكابت) has a high reactance (ازدواجية) at the ripple frequency, and the capacitive reactance is low compared to both X_L and R_L. The two reactances form an ac voltage divider.

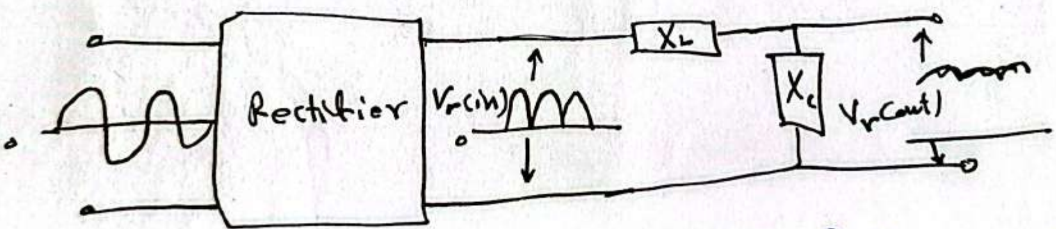


fig:- The LC filter as it Looks to the ac component

The magnitude of the ripple voltage out of the filter is determined with the voltage divider equation.

$$V_{r(out)} = \left(\frac{X_C}{|X_L - X_C|} \right) V_{r(in)}$$

where The amount (مقدار) of rms input ripple using formula ~~der~~ for The rms ripple of an unfiltered full-wave rectifier signal.

$$V_{r(in)} = 0.308\ V_p$$

The dc output voltage is determined as follows

$$V_{dc(out)} = \left(\frac{R_L}{R_w + R_L}\right) V_{dc(in)}$$

where R_w:- winding (لف) resistance for The choke (خانق)

R_L:- load resistance.

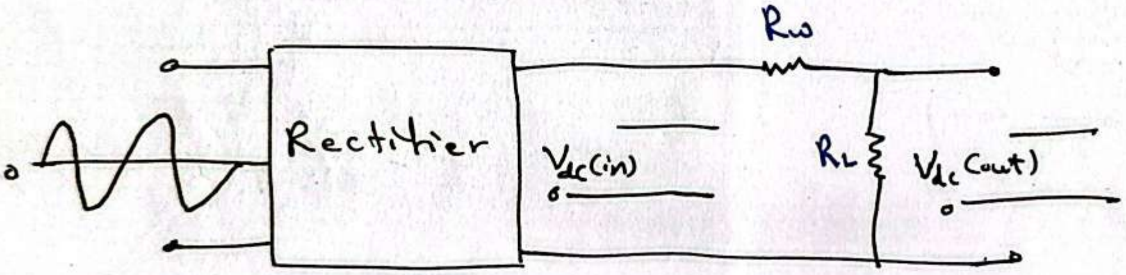
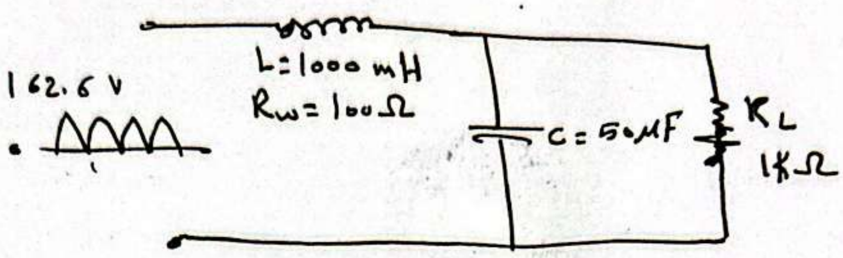


fig:- The LC filter as looks to The dc component.

ex) A 120 Hz full-wave rectified voltage with a peak value of 162.6 v is applied to The LC filter. Determine The filter output in terms of it's dc value and The rms repple voltage. what is The ripple factor?



Solution

$$V_{dc}(in) = V_{AVG} = \frac{2V_p}{\pi}$$

$$= \frac{2(162.6\ V)}{\pi}$$

$$= 103.5\ V$$

$$V_r(in) = 0.308\ V_p$$

$$= 0.308(162.6\ V)$$

$$= 50.1\ V$$

$$V_{dc}(out) = \left(\frac{R_L}{R_w + R_L}\right) V_{dc}(in)$$

$$= \left(\frac{1k\Omega}{1.1k\Omega}\right) 103.5\ V = 94.1\ V$$

$$X_L = 2\pi f L = 2\pi(120\ Hz)(1000\ mH) = 754\ \Omega$$

$$X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi(120\ Hz)(50\ \mu F)} = 26.5\ \Omega$$

$$V_r(out) = \left(\frac{X_C}{|X_L - X_C|}\right) V_r(in) = \left(\frac{26.5\ \Omega}{|754\ \Omega - 26.5\ \Omega|}\right) 50.1\ V$$

$$= 1.82\ V\ rms$$

The ripple factor is

$$r = \frac{V_r(out)}{V_{dc}}$$

$$= \frac{1.82\ V}{94.1\ V}$$

$$= 0.0193$$

26/ Diode clipper and clamper circuits:-

Diode circuits are sometimes used to clip off (يقص) portions (اجزاء) of signal voltages above or below certain (معين - مؤكد) levels. These circuits are called clipping. Another type of diode circuite is used to restore (يعالج - يعيد) a dc level to an electrical signal; These are called clampers.

- Clippers (معتراض)

a diode circuit That clips (يقص) The positive part of The input voltage. As The input signal goes positive, The diode becomes forward-biased. Since the cathode is at ground potential (0V), The anode cannot exceed (يتجاوز) 0.7 V (assuming silicon). So point A is clipped at +0.7 V when The input exceed (يتجاوز) This value.

when The input goes back below 0.7 V The diode reverse-biases and appers (يظهر) as an open. The output voltage looks like The negative part of The input, but with a magnitude determined by The R_S and R_L voltage divider as follows:

$$V_{out} = \left(\frac{R_L}{R_S + R_L}\right) V_{in}$$

if R_s is small compared to R_L, The $V_{out} = V_{in}$.

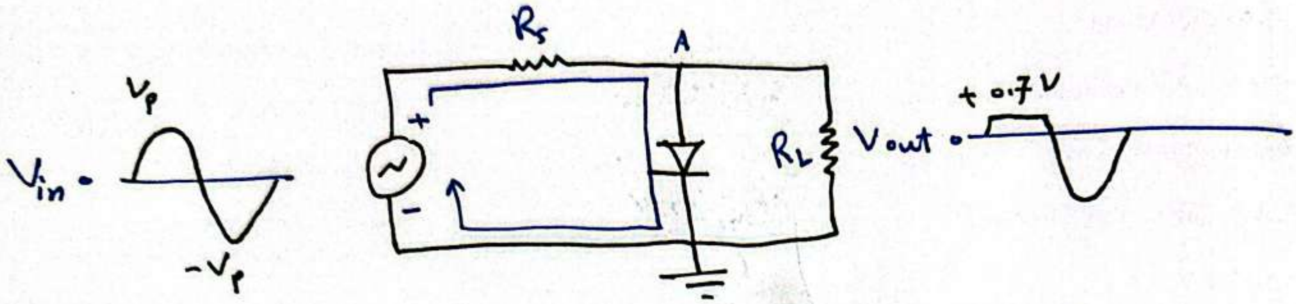


fig: clipping of positive alternation

Now, turn the diode around, and the negative part of input is clipped off. when the diode is forward-biased during (خلال) The negative part of The input, point A is held (يبقى) at $-0.7V$ by the diode drop. when the input goes above $-0.7V$, the diode is no longer forward-biased and voltage appears (تظهر) across (عبر) R_L proportional (تتناسب مع) to the input.

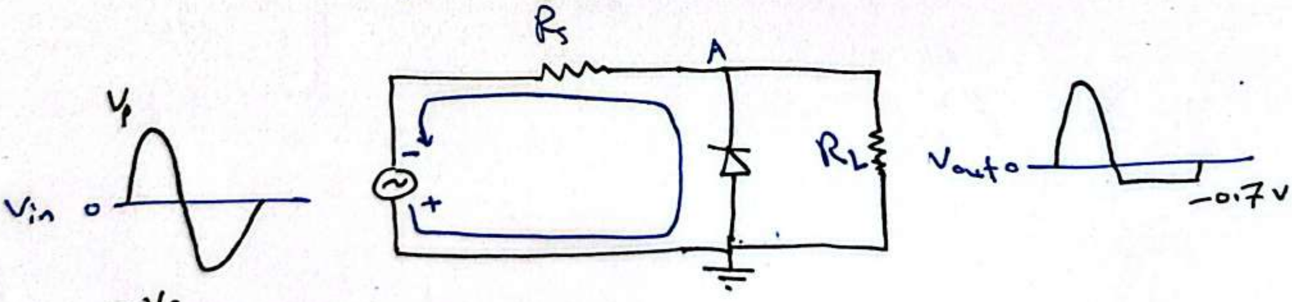
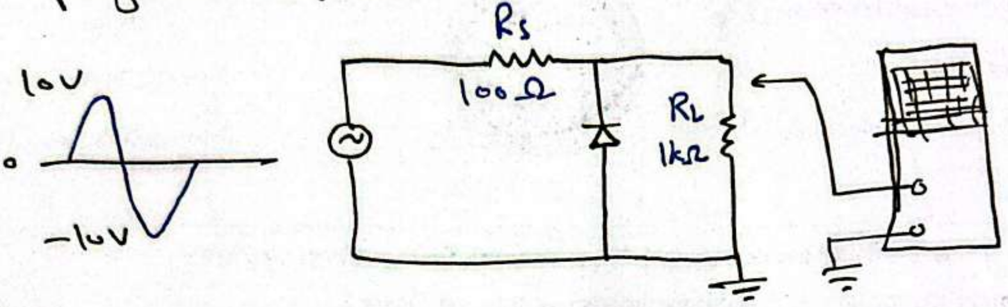


fig:- clipping of The negative alternation.

Ex) what would you expect (يتوقع) to see displayed on an osciloscope connected as shown in figure below:



Solution

The diode conducts when the input voltage goes below $-0.7V$.

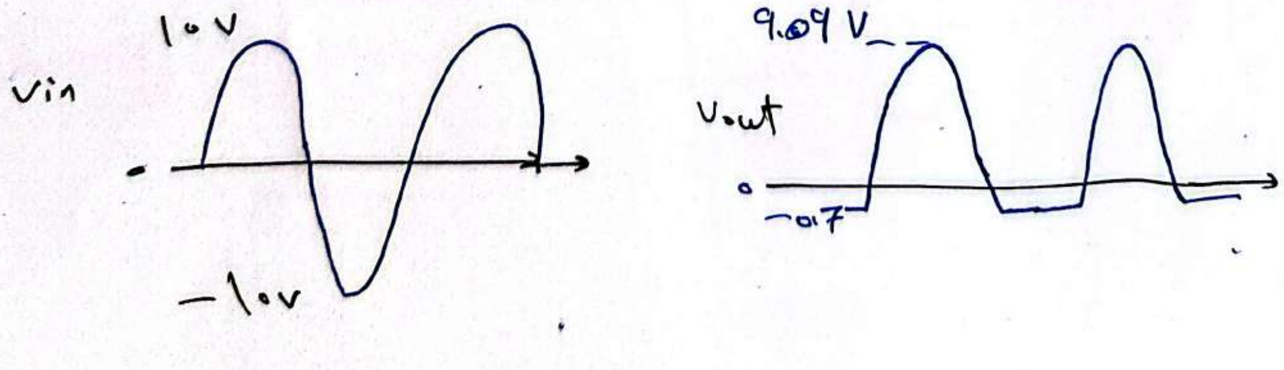
So, we have negative clipper with a peak output voltage determined by the following equation

$$V_{p(out)} = \left(\frac{R_L}{R_S + R_L}\right) V_{p(in)}$$

$$= \left(\frac{1k\Omega}{1.1k\Omega}\right) 10V$$

$$= 9.09V$$

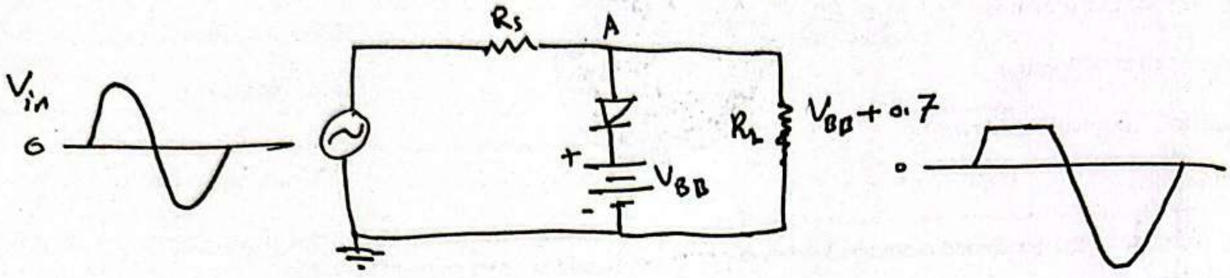
The scope will display an output waveform as



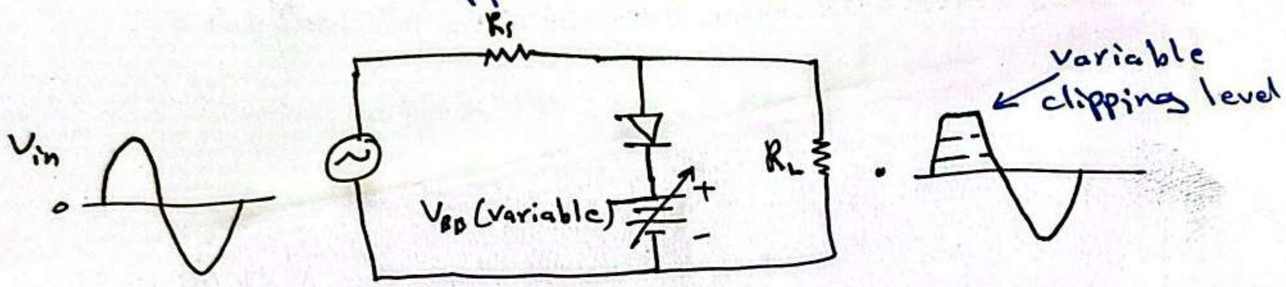
ضبط / تعديل

- Adjustment of The clipping level.

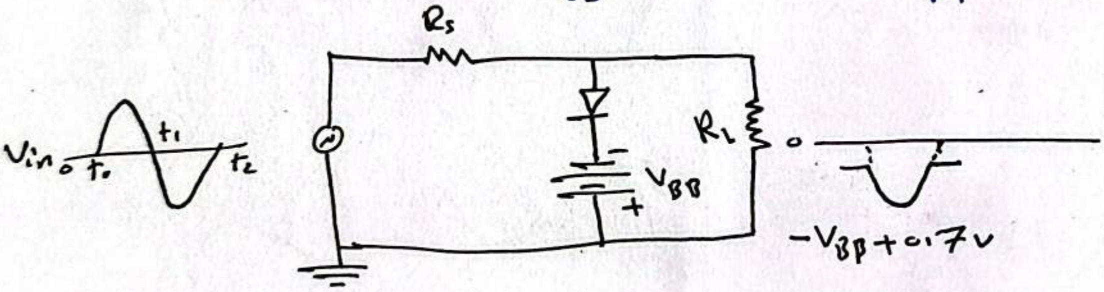
Positively biased clipper



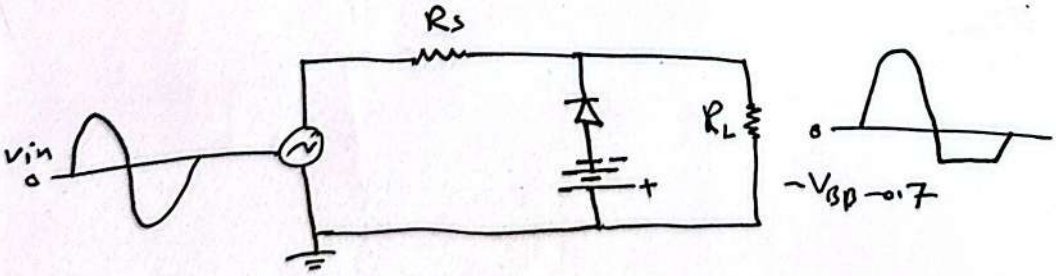
positive clipper with variable bias.



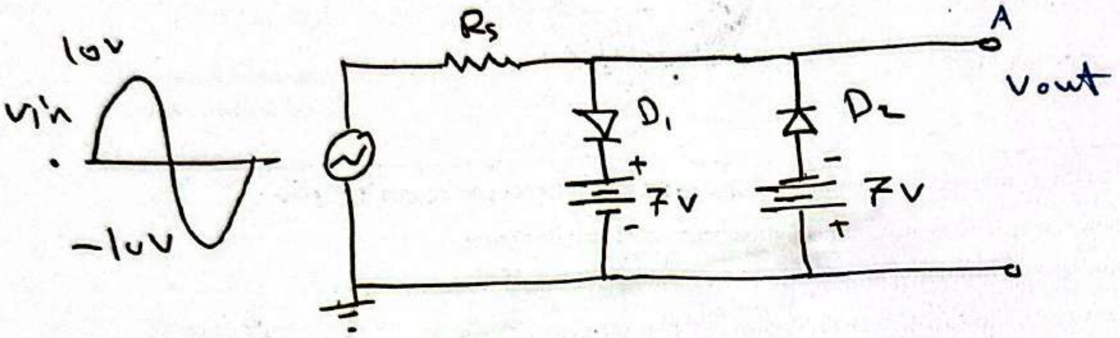
If The polarity of The bias voltage is reversed, voltages above $-V_{BB}+0.7$ are clipped.



Negative biased clipper



5a) Determine the output waveform of the following circuit combining a positive-biased clipper with a negative-biased clipper.



Solution when the voltage at point A reaches +7.7 V, diode D_1 conducts and clips the waveform at +7.7 V. Diode D_2 does not conduct until the voltage reaches −7.7 V.