Buck converter [step down].

24Vin - 1Amp.

desired o/p = 5V, current increases.

efficiency : 90%

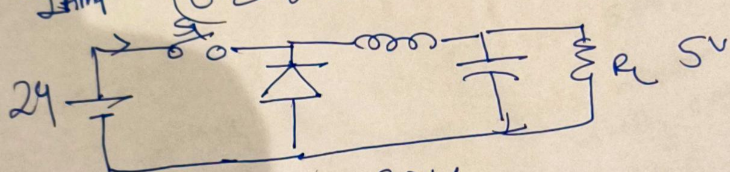
$V_{out} = V_{in}(D)$.

$\therefore 5 = 24(D)$

$\therefore D = 0.20833$

$\therefore D = \frac{5}{24} = \frac{5\text{msec on}}{24\text{msec off}}$

IAmp (0.20833)




90%.

$P_{in} = V \cdot I = 24 \cdot 1 = 24W$

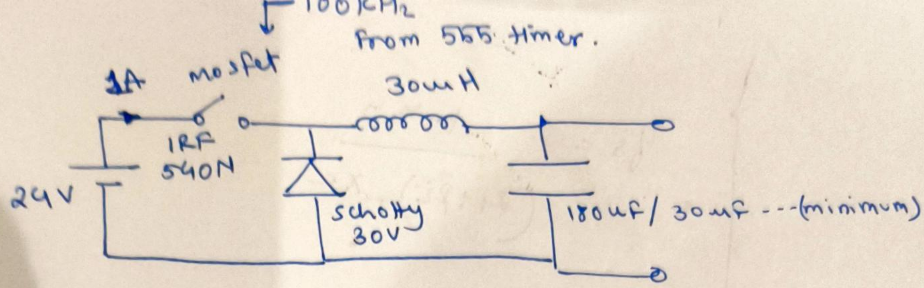
$P_{out} = 90\% \times 24W = 21.6W$

$P_{out} = V_{out} \times I_{out}$

$\therefore 21.6 = 5 \times I_{out}$

$\therefore I_{out} = 4.32A$

hence, At 90% efficiency our buck converter should step down the voltage to 5V & step up the current to 4.32A




$V_{in} = 24V$

$V_{out} = 5V$

$D = \frac{V_{out}}{V_{in}} = 0.208$

$P_{in} = 24 \times 1 = 24$ Watt

$P_{out} = 24 \times 0.9 = 21.6$ Watt

$\therefore I_{out} = \frac{21.6}{5} = 4.32A$

Assume, $f_s = 100$ KHz [from 555]

$\Delta I_L = 30\%$ [ripple inductor current usually 20%-40%.]

$\therefore \Delta I_L = I_{out} \times 0.3 = 1.296.$

$\therefore L = \frac{V_{out} \times (V_{in} - V_{out})}{\Delta I_L \times f_s \times V_{in}} = \frac{5 \times (24 - 5)}{1.296 \times 100 \times 10^3 \times 24} = 30.54 \times 10^{-6} H \approx \underline{\underline{30 uH}}$

$\Delta V_{out}$ is the output ripple voltage usually 1% $V_{out}$

$\therefore \Delta V_{out} = 0.05V.$

$\therefore C_{out} = \frac{\Delta I_L}{8 \times f_s \times \Delta V_{out}} = 32.4 \times 10^{-6} \approx \underline{\underline{30 uF}}$ --- (minimum)

$C = \frac{I_{out} \times D}{f_s \times \Delta V_{out}} = \frac{4.32 \times 0.208}{100 \times 10^3 \times 0.05} = 179.7 \times 10^{-6} \approx \underline{\underline{180 uF}}$ ---- (Ideal)

for diode, Schotty diode: $V_{RRM} \geq V_{in}$ (24V, 30 maximum).

current rating $I_D \geq V_{out}$ (4.32A)

$\boxed{\text{SB530}}$

For 555 timer,

$$f_s = \frac{1.44}{(R_1+R_2) \times C_1}$$

$$D = \frac{R_2}{R_1+R_2}$$

Assume $R_1 = 10k\Omega$

$\cancel{C_1 = 10\,uF}$

$$\therefore D = \frac{R_2}{R_1+R_2}$$

$$\therefore D = \frac{R_2}{10K + R_2}$$

$$\therefore 10\times10^3 + R_2 = \frac{R_2}{D}$$

$$\therefore 10\times10^3 + R_2 = \frac{R_2}{0.208}$$

$$\therefore (10\times10^3+R_2)\,0.208 = R_2$$

$$\therefore 2080 + 0.208R_2 = R_2$$

$$\therefore 2080 = R_2 - 0.208R_2$$

$$\therefore 2080 = R_2(1-0.208)$$

$$\therefore 2080 = R_2(0.792)$$

$$\therefore R_2 = 2626.26$$

$$\therefore R_2 = 2.6K\Omega$$

$$f_s = \frac{1.44}{(R_1+R_2)\times C}$$

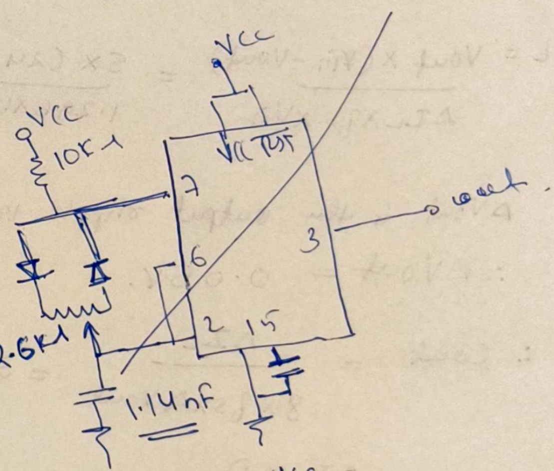
$$\therefore 100\times10^3 = \frac{1.44}{(10\times10^3 + 2626.26)\cdot C}$$

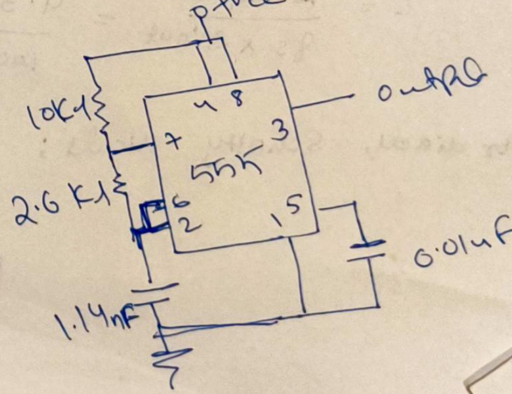
$$\therefore 100\times10^3 = \frac{1.44}{12626.26\,C}$$

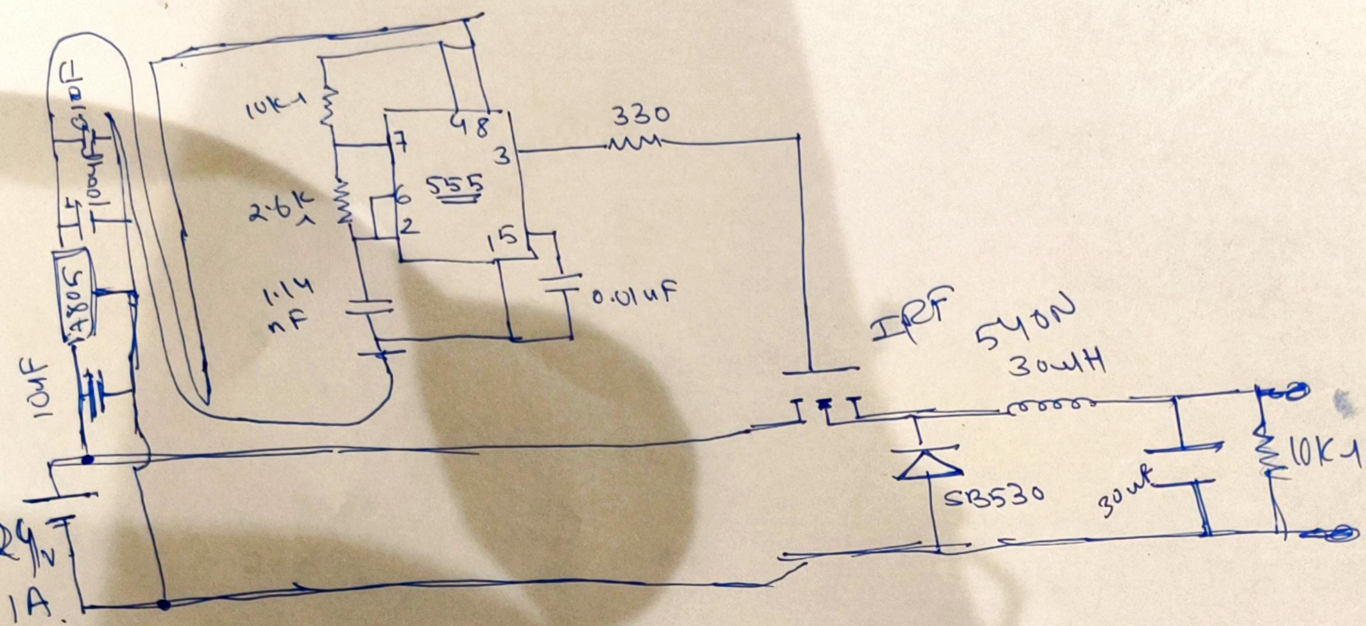
$$\therefore 12626.26\,C = \frac{1.44}{100\times10^3}$$

$$\therefore 12626.26\,C = 0.0000144$$

$$\therefore C = 1.14\,nF$$





10uF
7805
100uF
0.1uF
24V
1A.
10K
2.6K
1.14 nF
555
4 8
7
3
6
2
1 5
0.01uF
330
IRF 540N
30uH
SB530
30uF
10K