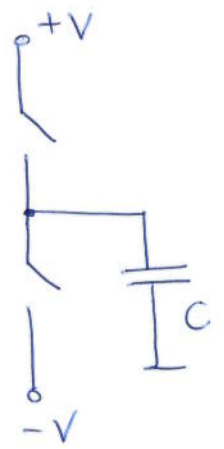
Driving a Positive & Negative Power



$$P_c = \frac{1}{2} C V^2 f$$

The cap 'c' goes from positive supply to negative supply (or vice versa)

$$P_c = \frac{1}{2} C (2V)^2 f = 2CV^2 f$$

Power drawn from driver supply

$P_c = 4CV^2 f$ → +ve supply

$= 4CV^2 f$ → -ve supply

Take a Test Probe

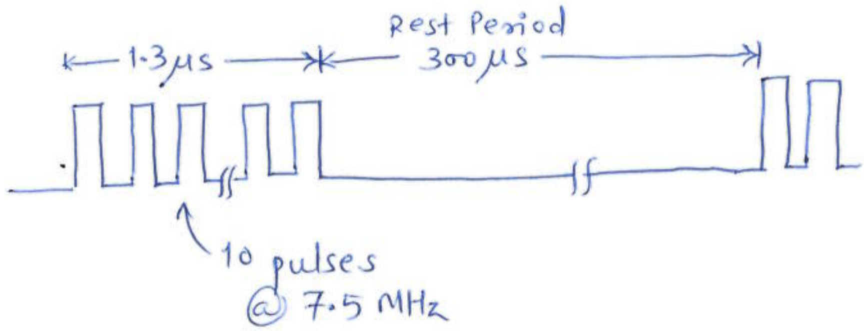
No. of channels (n) = 128

C = 470pF

f = 7.5 MHz

Energy E = 12.5 μJ

Standard waveform



$$P_c = 4 \times 128 \times 470p \times (100)^2 \times 7.5M$$

$$\boxed{P_c = 18 \text{ kW}}$$

$$P_{av} = \frac{18 \text{ kW}}{300} \times 1.3 = 78 \text{ W}$$

$$\boxed{P_{av} = 78 \text{ W}}$$

Assuming o/p cap at 100 V DC $\quad I_{pk} = \frac{18 \text{ kW}}{100} = \underline{180 \text{ A}}$

For a 20V dip on C_{out} (output cap of power supply) $\Rightarrow V_0 = \frac{I_0 \cdot t}{C_{out}}$

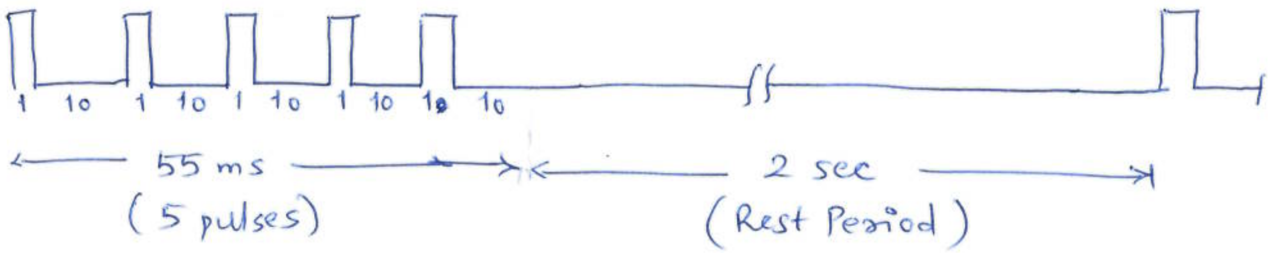
$$C_{out} > \frac{180}{20} \times 1.3\mu$$

$C_{out} > 11.7\mu F$ is ok

Taking $C_{out} = 470\mu F$, $\quad V_0 = \frac{180}{470} \times 1.3\mu = \underline{0.49 \text{ V}}$

A Regulator is not needed at output

Elastography waveform



$$P_{av} = P_c \times \frac{1}{11} \times \frac{55}{2055} = \underline{\underline{43.7\ W}}$$

Average power needed for elastography is lesser than the standard waveform

Assuming $V_{dip} = 20V$ $\longrightarrow$ $C = \frac{180}{20} \times 1\ ms$

$$= 9000\ \mu F$$

However, this needs to be replenished in $\underline{10\ ms}$

Assuming a $P_o = 80W$ for the power supply, the system would be current limited to $\frac{80W}{100} = 0.8\ A$

$$V_{dip} = \frac{I}{C} \times t = \frac{0.8}{9000\mu} \times 10m = 0.9\ V$$

The charging current needed $\longrightarrow$ $I = \frac{20 \times 9000\mu}{10m} = 18\ A$

This means we need a 1kW power supply

- seems very large
- can be done with a push-pull