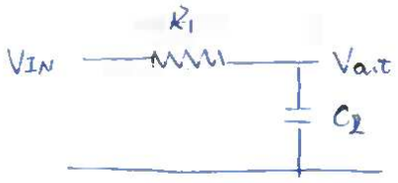
RC Filter → How much voltage can be passed ?

Is there any attenuation ?

PWM signal with 7.32 Hz



$$V_{out} = V_{IN}\left(\frac{R_2}{Z_1 + Z_2}\right)$$

$$= V_{IN} \times \left(\frac{X_c}{\sqrt{R_1^2 + X_c^2}}\right) \qquad X_c = \frac{1}{2\pi f c}$$

↑ freq.

$$V_{out}\text{ - 1Hz} = V_{IN} \times \frac{\frac{1}{2\pi \times 1 \times C}}{\sqrt{R_1^2 + \frac{1}{4\pi^2 \times 1 \times C^2}}}$$

let say 10kΩ & 10μF

100kΩ & 1μF → 1.5fHz cut-off.

$$V_{out}\text{ - 1Hz} = V_{IN} \times \frac{\frac{1}{2\pi \times 10 \times 10^{-6}}}{\sqrt{(10k)^2 + \frac{1}{4\pi^2 \times 10^{-10}}}} \qquad \text{in } \mu\text{F}$$

$$= V_{IN} \times \frac{\frac{1}{2\pi \times 10^{-5}}}{\sqrt{10^8 + \frac{1}{4\pi^2 \times 10^{-10}}}} = 0.8467\, V_{IN}$$

15fHz, I

at 1Hz

at 0.1Hz 0.01Hz

$$\rightarrow \frac{\frac{1}{2\pi f \times 10^{-5}}}{\sqrt{10^8 + \frac{1}{4\pi^2 f^2 \times 10^{-10}}}} = 1 \sim$$ Amplitude x duty

$$R = R_1 + \frac{1}{2\pi f C_2}$$

$$P = I^2 R = \frac{V^2}{R} = \frac{V_{in}^2}{R_1 + \frac{1}{2\pi f C_2}} \downarrow \text{ at } f \to 0$$

as small as possible

$P_{max} = V_{in}^2 \times 2\pi f C \approx 0$ (f small, C ↓) ✓

$\frac{V_{in}^2}{R_1 + \frac{1}{2\pi f C}} \uparrow$ at $f \to +\infty$ $P_{max} = \frac{V_{in}^2}{R} \times 1 = \frac{V_{in}^2}{R}$

as big as possible

therefore small R

Small R → good filtering at high ~~voltage~~ freq

small C → good passing at small freq ✓

pick big R & small C → good at small freq.

↓

add more stages small current → small losses

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>      //Download it here: https://www.electronoobs.com/eng_arduino_liq_crystal.php
//////////////////////////////Library for ADS1115 ADC//////////////////////////////////
#include <Adafruit_ADS1015.h>       //Download here: https://www.electronoobs.com/eng_arduino_Adafruit_ADS1015.php
Adafruit_ADS1115 ads(0x48);         //Define i2c address
/////////////////////////////////////////////////////////////////////////////////////////


// Sometimes the address is 0x27 or 0x3f (try both)
LiquidCrystal_I2C lcd(0x27, 16, 2); //Address, columns, rows

const float multiplier = 0.0001875; //In order to pass from 16bits to real value voltage
int Buzzer = 3;                     //Pin for a buzzer (not yet used)
float offset = 0.004;               //Constant offset (in A) that the read has (yours might be different)

void setup() {
  Serial.begin(9600);

  pinMode(Buzzer,OUTPUT);
  digitalWrite(Buzzer,LOW);

  ads.begin();
  delay(10);

  lcd.init();
  lcd.backlight();
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("  ELECTRONOOBS  ");
  analogWrite(Buzzer,200);
  delay(100);
  analogWrite(Buzzer,LOW);
  delay(300);
  lcd.setCursor(0,1);
  lcd.print(" CONSTANT  LOAD ");
  delay(1500);
}

void loop() {
  float set_val, real_val;
  real_val = ads.readADC_Differential_0_1();      //Read DIFFERENTIAL voltage between ADC0 and ADC1
  set_val  = ads.readADC_SingleEnded(2);          //Read voltage on potentiometer (this will be our setpoint)

  set_val = (set_val * multiplier) - offset;      //Pass to real voltage and substract offset
  real_val = real_val * multiplier - offset;

  //If we have negative value, we stay at 0.
  if(real_val < 0)
  { real_val = 0;   }
  if(set_val < 0)
  { set_val  = 0;   }

  //Print data on LCD
  //lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Set:     ");
  lcd.print(set_val,3);
  lcd.print(" A");
  lcd.setCursor(0,1);
  lcd.print("Current: ");
  lcd.print(real_val,3);
  lcd.print(" A");
  delay(100);                                     //Small delay
}
```

Gain (10)
5 ~ 1.25V

1A ~ 0.25A per branch
0.5V ~ 0.125V ✅ Use

for 4 stages
→ 4A ~ 1A ⇒ ~~2V ~ 0.5V~~

for one stage
→ < 1A ⇒ < 0.5V need current sense amplifier.
Gain (10)

0.5Ω
30.3 × 0.5 = 15.15mV

for 1Ω
30.3mV → 1V
→ Gain → 10 → 303mV
Gain → 20 → 606mV ✓ 20~30 gain → 40~60.
Gain → 60 → 1.818V ✓
Gain →

But for high Current.
1A per branch.
↓
~~0.5A~~
0.5V → max input V = 10V
20 max gain