# Solving second order analogue filter

Second order polynomial:

Coefficients:

Substitutions:

Hence,

For filter with gain K=1, equations from Texas Instruments:

where

Solving for ratio of m and n

The above gives us a graph for n to m ratio. Here we are free to pick any convenient ratio for the filter.

Choose

Desired

Substituting in the equations from Texas Instruments to obtain C and R near standard values:

As R is predetermined by internal resistance on each output of ADXL:

Choose (standard value)

(standard value as well)

Results:

Check the actual cutoff frequency

- a bit lower than expected

Let’s adjust value for as we can choose it freely as long as stays around 0.707

Try:

Check for

(expected 0.707)

As is so far off, behaviour of filter might be altered. That calls for reworking coefficients and

Choose , since it is easy to find capacitors for such ratio

As it is predetermined by ADXL that

(table value)

Compute actual

Now, calculate for chosen

(table value)

(table value)

Results:

Check for actual

Taking into account tolerance of 15% on , is expected to be within 23.7 – 27.6Hz

Finally, check for actual

- very close to expected 0.707

Taking into account tolerance of 15% on , is expected to be within 0.679 – 0.742

To negate very low tolerance on , it was decided to not use the resistor from ADXL and rather place another 32K resistor with higher tolerance, separated from ADXL using buffer amplifier.

**Appendix:**

1. **Graph for n and m**

A screenshot of a graphing graph

AI-generated content may be incorrect.

1. **Another trial for m and n:**

Choose n=2.2, m = 1.87

Hence R1 = 32K (from datasheet)

R2 = 17.65 ~ 18K

Calculate C for cutoff frequency 25Hz

C = 0.17 microF – not table value. Try again

Can be used if fc is changed to 29Hz or 18-19Hz

1. **Calculations brief (for slides)**Second order polynomial:

From the coefficients of the polynomial:

For filter with gain K=1, equations from Texas Instruments:

where

Solving for ratio of m and n we get the graph for m

Choose , since it is easy to find capacitors for such ratio

After choosing and calculating the rest of components:

Check for actual

Finally, check for actual