INTEGRATOR AND DIFFERENTIATOR

In a differentiator circuit, the output voltage is the differentiation of the input voltage. There are two types of differentiator called passive differentiator and active differentiator. The active differentiator using active components like op-amp.

The output voltage is given by

$$Vout = - 1/ (RfCf) [dVin / dt]$$

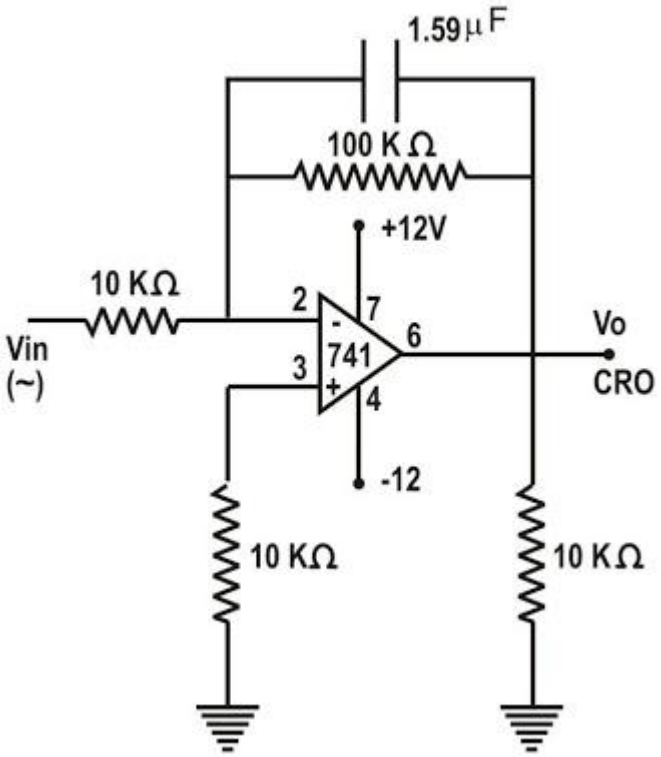
$$\text{Time constant} = - RfCf$$

The negative sign indicates that there is a phase shift of 180 degree between input and output. The main advantage of such an active differentiator is the small time constant which gives perfect differentiation.

Sometimes a compensation resistance is needed to connect to the non-inverting terminal to provide the bias compensation. The compensation resistance values is given by Rcomp = (Rf parallel with R1).

CIRCUIT DIAGRAM

INTEGRATOR



DESIGN

Integrator design

The output voltage is given by

$$Vout = - 1/ (RfCf) \quad Vin (t) + Vo (0)$$

$$\text{Time constant} \quad = Rf\ Cf$$

1) To find Cf

The gain value is given by $A = (Rf / R1) / (1 + j\omega\ RfCf)$ ---------- ---- (1)

The corner frequency is fc = 1 / 2∏RfCf ----------

--- - (2)

Choose, fc = 100Hz and

Rf = 10KΩ

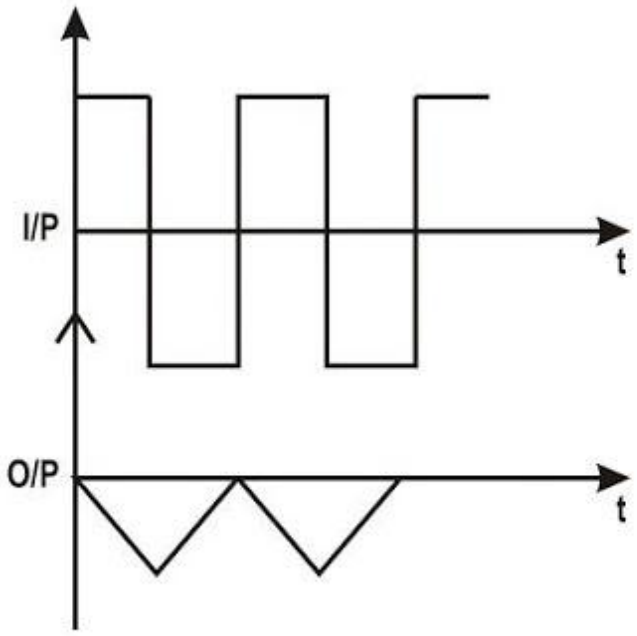
By substituting all in equation (2), calculate the value of Cf .

2) To find R1

Let Gain (A) = 1 and substitute all remaining values in equation (1), then find the value of R1.

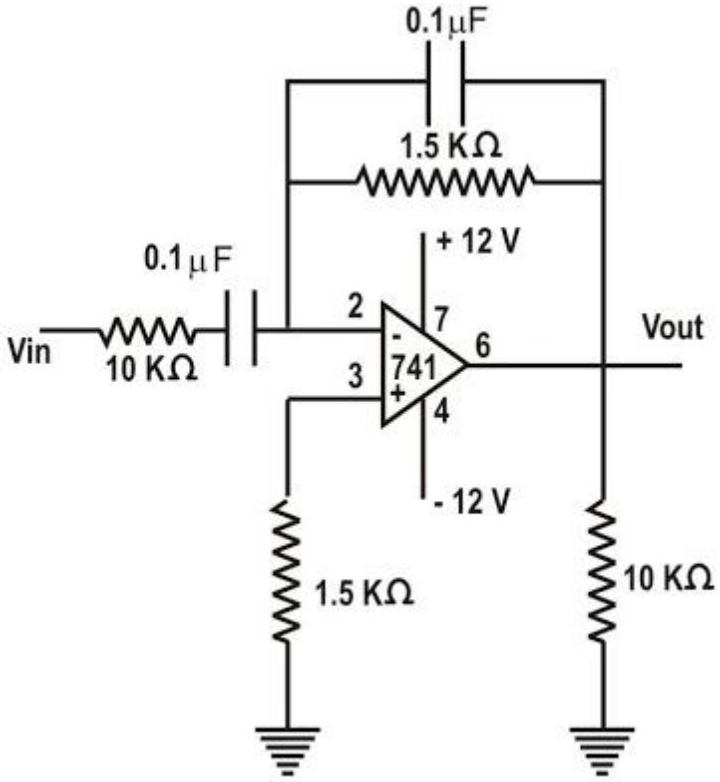
MODEL GRAPH

INTEGRATOR



CIRCUIT DIAGRAM

DIFFERENTIATOR



DESIGN

Differentiator design

The gain value is given by A = - jω RfC1 / (1 + jω R1C1)2 ----------

--------- (1)

The lower corner frequency is fa = 1 / 2∏R1C1 ----------

------- (2)

The upper corner frequency is fb = 1 / 2∏RfC1 ----------

------ (3)

Always assume fa < fb < fc and Rf C1 < T. Where T is time constant.

Design procedure

1. Choose fa as the highest frequency of the input signal. i.e. fa = 100Hz

2. Choose C1 to be less than 1 micro Farad and calculate the value of R1.

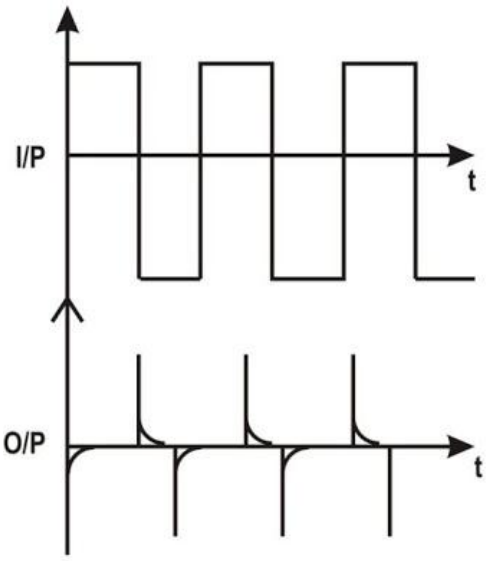
Choose C = 1micro Farad and from equation (2) and Calculate R1.

3. Choose fb as 10 times fa which ensures that fa < fb. That is fb =10 fa. Now find Rf.

4. To find Cf , use RfC1 = R1C1 and Rcomp = R1 parallel with Rf .

MODEL GRAPH

DIFFERENTIATOR



Source: http://mediatoget.blogspot.in/2012/01/integrator-and-differentiator.html