Operational Amplifier: Amplifier (cont.)

TE201414 - Rangkaian Elektronika 2

Program Studi Teknik Elektro

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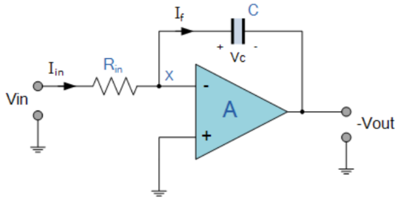
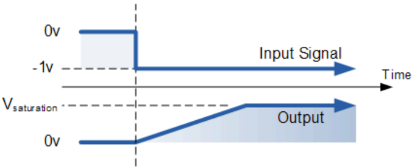
Integrator

Integrator

op-amp as integrator is an amplifier that execute integration operation.





where:

$$V_+ = V_- = 0V$$

$$I_{in} = I_C$$

$$\frac{V_{in}}{R_{in}} = C\frac{\partial V_C}{\partial t}$$

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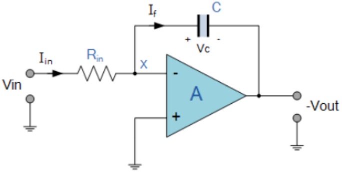
$$\partial V_C = \frac{1}{V_{in}R_{in}} V_{in}\partial t$$

$$V_C = \frac{1}{CR_{in}}\int V_{in}\partial t$$

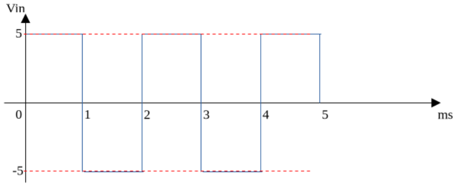
$$\boxed{V_{out} = -\frac{1}{CR_{in}}\int V_{in}\partial t}$$

Integrator



$$R_{in} = 1k\Omega$$
$$C = 1\mu F$$

$$Vin(t) = \begin{cases} 5v & n<t<(n+1), n= 0,2,4,.. \\ -5v & n<t<(n+1), n= 1,3,5,.. \end{cases}$$



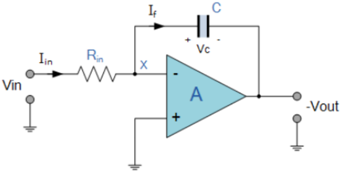
Integrator

for even n:

$$V_{out} = -\frac{1}{1k1\mu F}\int 5\partial t$$
$$V_{out} = -1000 * 5t$$

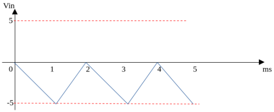
for odd n:

$$V_{out} = -\frac{1}{1k1\mu F}\int -5\partial t$$
$$V_{out} = 1000 * 5t$$

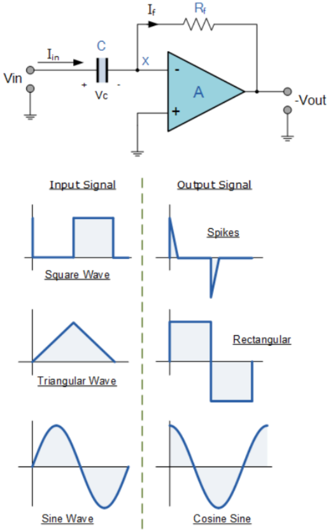


$R_{in} = 1k\Omega$
$C = 1\mu F$

$$Vin(t) = \begin{cases} -5000t + c & \text{n<t<(n+1),n= 0,2,4,..} \\ -5000t + c & \text{n<t<(n+1),n= 1,3,5,..} \end{cases}$$



Differentiator



op-amp as differentiator is an amplifier that execute differentiation operation.
where:

$$V^{+} = V^{-} = 0V$$

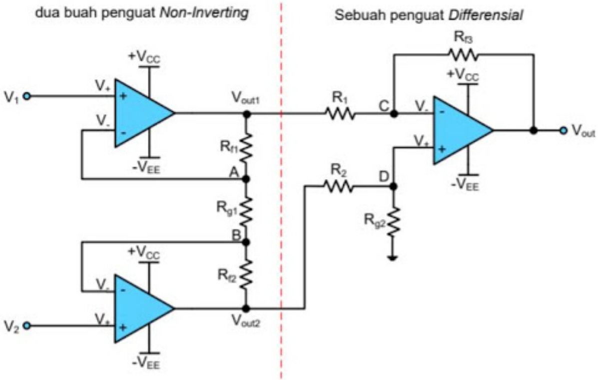
$$I_{in} = I_C$$

$$C\frac{\partial V_{in}}{\partial t} = -\frac{Vout}{R_f}$$

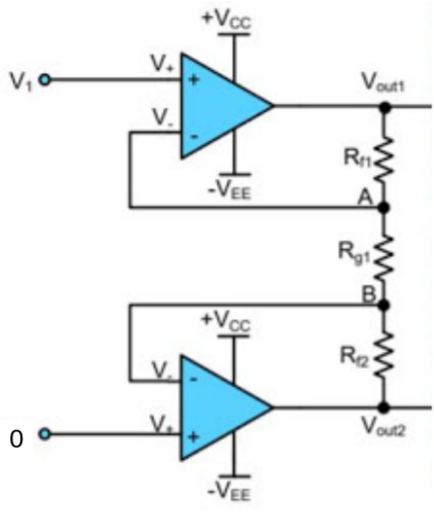
$$V_{out} = -R_f C \frac{\partial V_{in}}{\partial t}$$

Penguat Instrumentasi

instrumentation amplifier is most-commonly used for amplify signal in industrial, biomedical, etc. the advantages of using intrumentation amplifier is high input impedance. high input impedance makes sure that all signal transmitted being dissipated by the circuit.



Penguat Instrumentasi



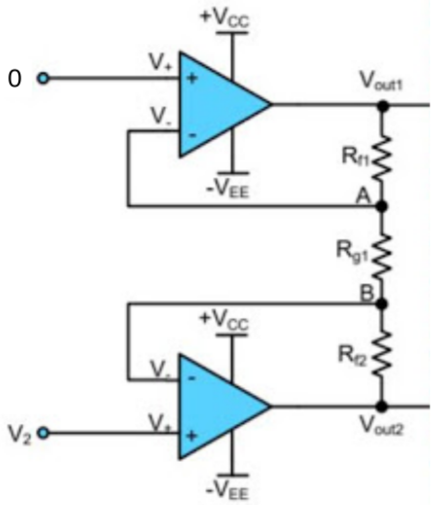
V_{out1} output is non-inverting from V_1:

$$V_{out1} = (1 + \frac{R_{f1}}{R_{g1}})V_1$$

V_{out2} output is inverting from V_1:

$$V_{out2} = -\frac{R_{f2}}{R_{g1}}V_1$$

Penguat Instrumentasi

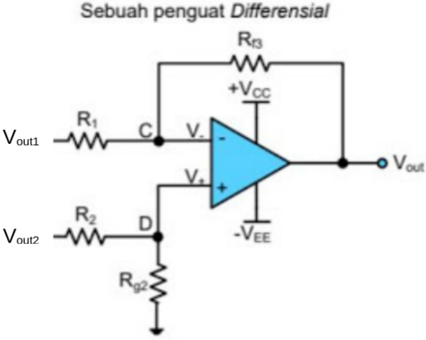


V_{out1} output is inverting from V_2:

$$V_{out1} = -\frac{R_{f1}}{R_{g1}} V_2$$

V_{out2} output is non-inverting from V_2:

$$V_{out2} = (1 + \frac{R_{f2}}{R_{g1}}) V_2$$



$V_{out1} = (1 + \frac{R_{f1}}{R_{g1}})V_1 - \frac{R_{f1}}{R_{g1}}V_2$
$V_{out2} = (1 + \frac{R_{f2}}{R_{g1}})V_2 - \frac{R_{f2}}{R_{g1}}V_1$
differential amplifier:

References

Floyd,T.L., Fundamentals of Analog Circuits, Prentince Hall, .
Malvino,A., Electronic Principle, McGrawHill, 2016.
Boylestad, R.L., Nashelsky,L., Electronics Devices and Circuit Theory, Pearson, 2014.

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