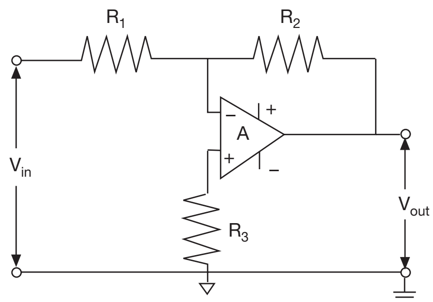
Typical Resistor Network Applications

The following are circuit diagrams of operational amplifiers and their use of standard resistor networks. These diagrams are supplied to illustrate typical resistor network applications using Vishay Thin Film's standard precision, low noise, stable resistor networks.

CIRCUIT DIAGRAMS

Inverting Amplifier with I_{OFF} Compensation

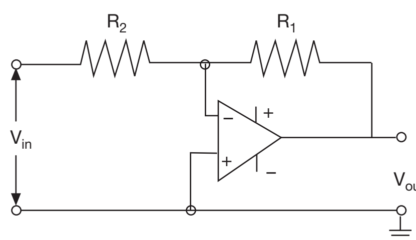


$$A = \frac{V_0}{V_{in}} = \frac{R_2}{R_1}$$

$$R_3 = \frac{R_1 \times R_2}{R_1 + R_2}$$

For A = 1	Use VTF1087
For A = 2	Use VTF1088
For A = 5	Use VTF1089
For A = 10	Use VTF1090

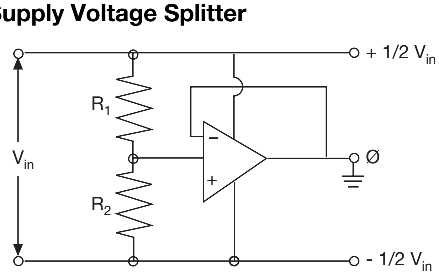
Inverting Amplifier



$$A = \frac{V_0}{V_{in}} = \frac{R_1}{R_2}$$

For A = 1	Use VTF209 thru 218
For A = 10	Use VTF282 thru 283

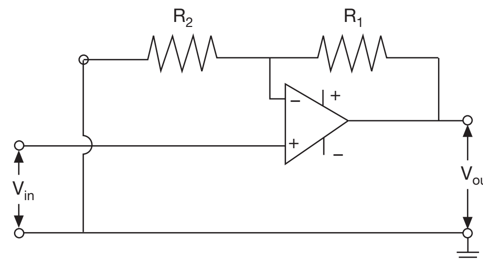
Power Supply Voltage Splitter



$R_1 = R_2$

R_1 = 50K	Use VTF214
= 100K	Use VTF215
= 200K	Use VTF216
= 500K	Use VTF217
= 1M	Use VTF218

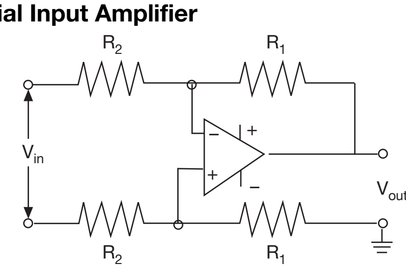
Non Inverting Amplifier



$$A = \frac{V_0}{V_{in}} = \frac{R_1 + R_2}{R_2}$$

For A = 10	Use VTF193, 280 and 281
For A = 2	Use VTF209 thru 218
For A = 11	Use VTF282 or 283

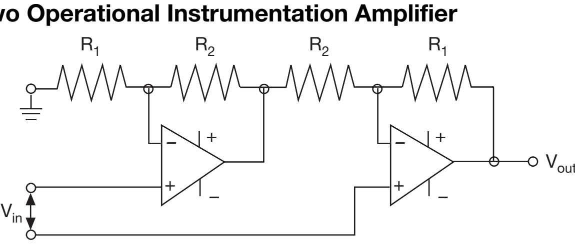
Differential Input Amplifier



$$A = \frac{R_1}{R_2}$$

For A = 20		
	R_1 = 10K	Use VTF1073
	= 50K	Use VTF1074
For A = 10		
	R_1 = 10K	Use VTF328
	= 100K	Use VTF284
	= 1M	Use VTF285
For A = 5		
	R_1 = 10K	Use VTF1007
	= 100K	Use VTF1008
For A = 2		
	R_1 = 10K	Use VTF1009
	= 100K	Use VTF1010
For A = 1		
	R_1 = 5K	Use VTF225
	= 10K	Use VTF286
	= 100K	Use VTF219
	= 1M	Use VTF287

Two Operational Instrumentation Amplifier

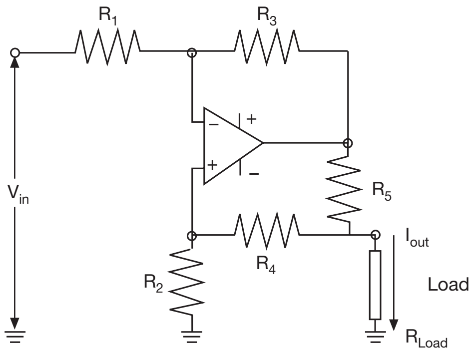


$$\text{GAIN at } 1 + \frac{R_1}{R_2} = 10$$

$R_1 + R_2$ = 10K	Use VTF280
= 100K	Use VTF193
= 1M	Use VTF281

CIRCUIT DIAGRAMS

Current Driver



$I_{out} = V_{in}(R_1 + R_2)R_5$
For $R_3 + R_4 + R_5$ at $R_1 + R_2$

I_{out} at $\frac{V_{in}}{R_5}$

Max $I_L = \frac{V_{0\ MAX}}{R_5 + R_L}$

For $R_1 = R_2 = R_3 = R_4 = R$

I_{out} at $V_{in}\left(\frac{1}{R_5} + \frac{1}{2R}\right)$ and

If R is large then, I_{out} at $\frac{V_{in}}{R_5}$

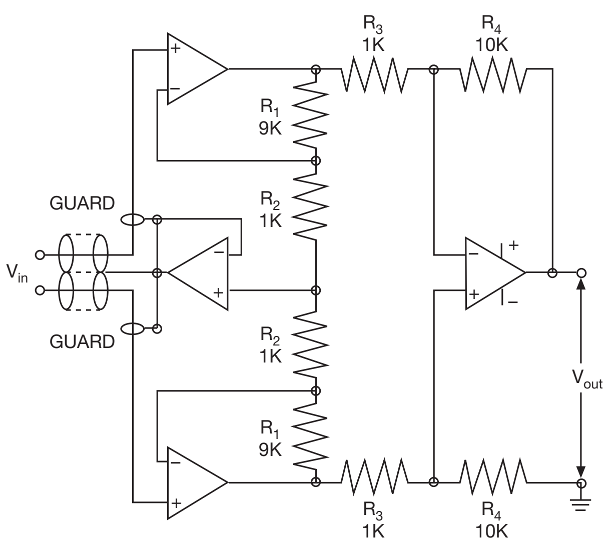
For R_1, R_2, R_3, R_4

100K	Use VTF219
1 M	Use VTF287

Note

- OP-AMP must be able to carry the desired output current.

Instrumentation Amplifier with Guard Driver



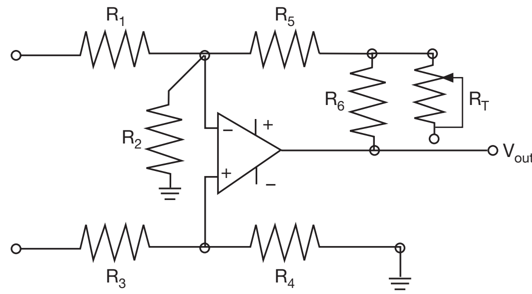
$$A = \frac{R_4}{R_3}\left(1 + \frac{R_1}{R_2}\right) = 100$$

Use VTF272

Note

- OP-AMP references AD713, LTC1058, RMAX479

High Common Mode Voltage Rejection Unity Gain Differential Amplifier



$\frac{R_1}{R_2}$ = CMV Rejection Ratio = CMVRR

$R_1 = R_3 = 1\ M\Omega$

Optional External CMVRR Trim

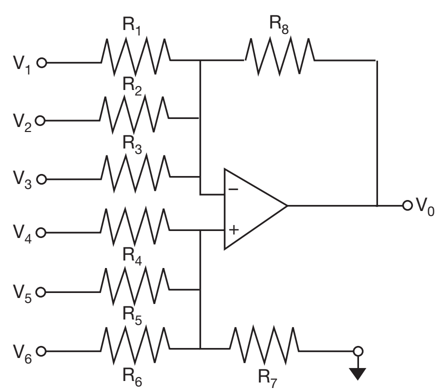
$R_T = 2R_6$

CMVRR = 250	Use VTF442
= 100	Use VTF443
= 50	Use VTF444
R_6 = 1M	Use VTF442
= 1M	Use VTF443
= 1M	Use VTF444

Note

- With optional adjustment (RT) over 120 dB, common mode voltage rejection is possible.

Adder - Substractor



If R_1 thru R_6 = R and $R_7 = R_8 = R_1$ then

$$V_0 = \frac{R_1}{R} \times (V_1 + V_2 + V_3 - V_4 - V_5 - V_6)$$

R_1 thru R_4 = 10K	Use VTF366
R_1 thru R_4 = 100K	Use VTF367

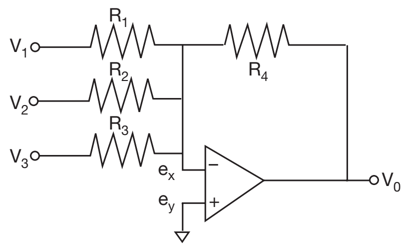
Notes

(1) Unused source inputs must be grounded

(2) Circuit assumes the source impedance of all voltage sources are buffered or low (impedance adds to input resistors)

CIRCUIT DIAGRAMS

Non Inverting Two Input Adder



$$\frac{V_1}{R_1}+\frac{V_2}{R_2}+\frac{V_3}{R_3}-\frac{V_0}{R_4}=0$$

If $R_1 = R_2 = R_3$ then

$$V_1+V_2+V_3=\frac{R}{R_4}\times V_0$$

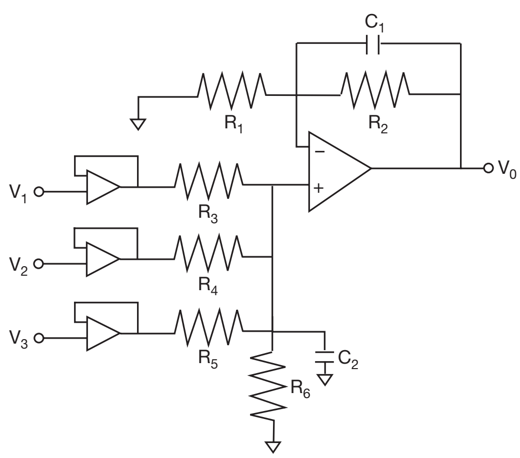
$$\text{A GAIN} = \frac{R_4}{R}$$

R_1 thru R_4 = 10K	Use VTF366
R_1 thru R_4 = 100K	Use VTF367

Note

- Potential at two inputs of OP-AMP are always equal. $e_x = e_y$

Three Adder Buffer Input Non Inverting



Networks for R_1 and R_2 use VTF212, 213 or 215
For R_3, R_4, R_5 and R_6 use VTF366 or 367 where
$R_3 = R_4 = R_5 = R_6$

Note

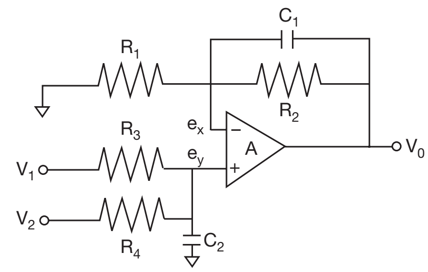
- Capacitor values should be determined for desired cut off frequency and $R_2C_1 = \frac{1}{4} R_3C_2$.

  For amplifier use AD713, LT1058 or RMAX479 these contain all four OP-AMP in one package.

  For best results all unused inputs should be grounded.

These diagrams are supplied to illustrate typical resistor network applications. Vishay assumes no responsibility for specific use of performance.

Two Input Adder



Always two inputs of OP-AMP at same potential $e_x = e_y$

$$\frac{V_1-e_y}{R_3} \neq \frac{V_2-e_y}{R_4} = 0 \qquad e_x = \frac{V_0R_1}{R_1+R_2} = e_y$$

If R_3 = Ry the $V_1 + V_2 = 2e_y = \frac{2V_0R_1}{R_1+R_2}$

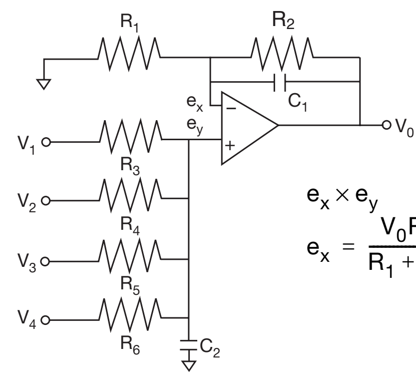
If we make $R_1 = R_2$ then $V_1 + V_2 = V_0$ VTF215, 216, 218 or 218

If we make $\vartheta R_1 = R_2$ then $V_1 + V_2 = \frac{V_0}{5}$ VTF193 or 281

Notes

(1) Circuit assumes the source impedance is very low or incorporated in R_1 and R_2
(2) Unused inputs should be grounded otherwise equations will not hold true
(3) C_1 and C_2 should be chosen $R_2C_2 = \frac{R_3R_4}{R_3+R_4}\ C_2$

Four Input Adder



$$e_x \times e_y$$

$$e_x = \frac{V_0R_1}{R_1+R_2}$$

$$\frac{V_1-e_x}{R_3}+\frac{V_2-e_x}{R_4}+\frac{V_3-e_x}{R_5}+\frac{V_4-e_x}{R_6}$$

If $R_3 = R_4 = R_5 = R_6$ then

$$V_1+V_2+V_3+V_4 = 4e_x = \frac{4V_0R_1}{R_1+R_2}$$

If we use VTF280 for $R_1 + R_2$ and VTF367 for R_3, R_4, R_5 and R_6 then

$$V_1+V_2+V_3+V_4 = \frac{4V_0}{10} = \frac{V_0}{2{,}5} \text{ or } A = 2{,}5$$

or for R_1, R_2 use VTF212

$$V_1+V_2+V_3+V_4 = \frac{4V_0}{2} = 2V_0 \text{ or } A = 0{,}5$$

Notes

(1) Unused source inputs must be grounded
(2) Circuit assumes the source impedance of all voltage sources are buffered or low (impedance adds to input resistors)