



**PDHonline Course E272 (5 PDH)**

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# **Operational Amplifier Fundamentals and Design**

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**PDH Online | PDH Center**

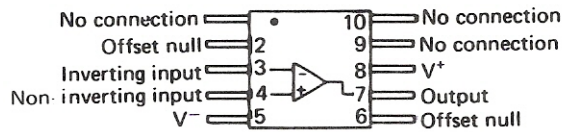
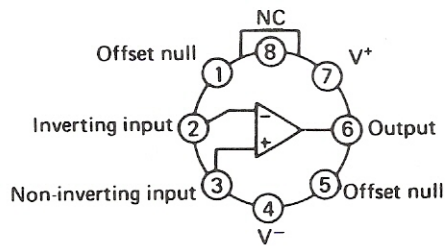
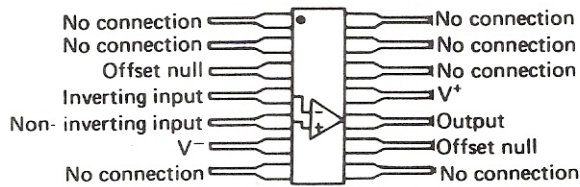
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# Appendix A

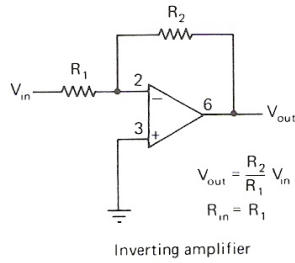
## The 741 Operational Amplifier

Parameters	Minimum	Typical	Maximum
$A_{VOL}$	Open loop voltage gain	50,000	200,000
$V_{io}$	Input offset voltage	1 mV	6 mV
$I_B$	Input bias current	80 nA	500 nA
$I_{io}$	Input offset current	20 nA	200 nA
$R_o$	Output resistance	75 $\Omega$	
CMR (dB)	Common mode rejection	70 dB	90 dB
$R_i$	Input resistance	300 k $\Omega$	2 M $\Omega$

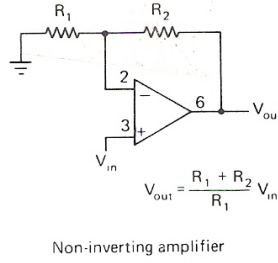


# Appendix B

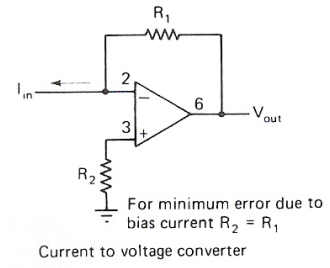
## Common Op Amp Applications



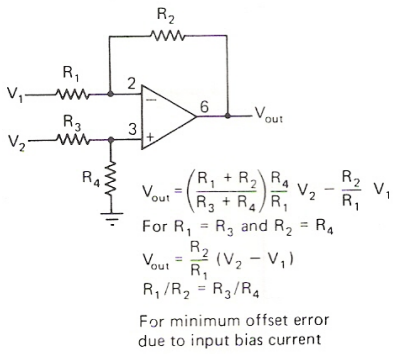
Inverting amplifier



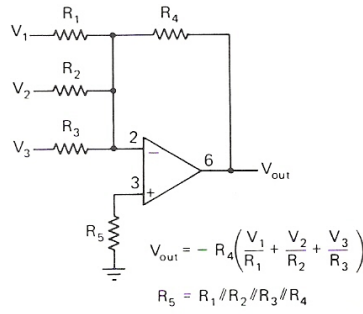
Non-inverting amplifier



Current to voltage converter

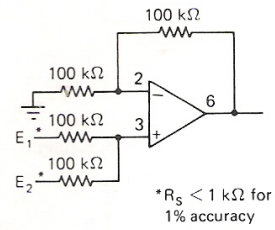


Difference amplifier

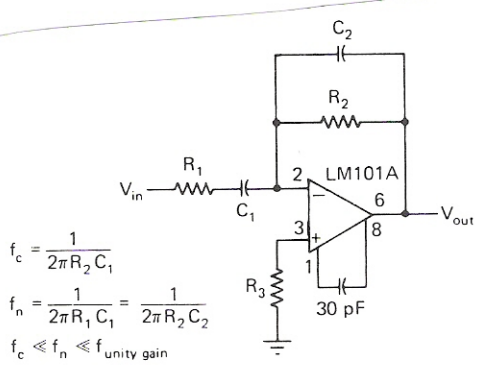


For minimum offset error due to input bias current

Inverting summing amplifier



Non-inverting summing amplifier

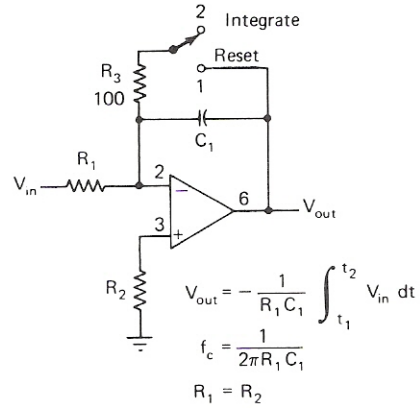


$$f_c = \frac{1}{2\pi R_2 C_1}$$

$$f_n = \frac{1}{2\pi R_1 C_1} = \frac{1}{2\pi R_2 C_2}$$

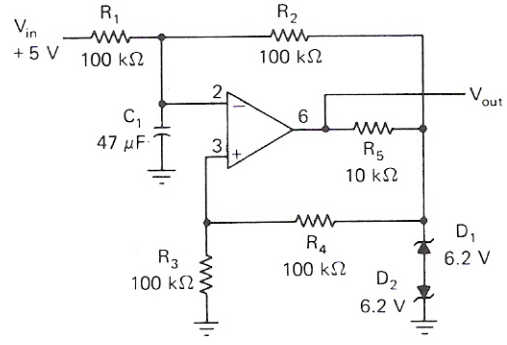
$$f_c \ll f_n \ll f_{\text{unity gain}}$$

Practical differentiator



For minimum offset error due to input bias current

Integrator



Pulse width modulator