1436 Non-inverting Op Amp

Eight-pin IC, LM741CN
Op Amp Amplifier Basics

- There are two basic forms in which an Op Amp (Operational Amplifier) can be used as an amplifier:
  - Inverting configuration
  - Non-inverting configuration
741 DIP Pinout Diagram

8 Pin DIP or DIL (Dual In Line Package)
Non-inverting Op Amp Schematic

To Trainer Positive Supply

R2 330Ω

R3 1kΩ Pot (on trainer)

R4 330Ω

To Trainer Negative Supply

To Trainer Positive Supply (+12V)

E_F

4.7kΩ

R_F

4.7kΩ

R5 2.2kΩ

E_IN

Trainer Ground

To Trainer Ground

E_OUT

To Trainer Negative Supply (-12V)
Practical Considerations for the 741 Non-inverting Op Amp

- The input bias current is about 80 nA
- The input offset current is about 10 nA
- The input impedance is about 2 Meg Ohms
The common mode voltage should be within +/-12V for +/-15V supply.
The output impedance is about 75 ohms.
The voltage gain rolls off 6dB per octave starting at 100kHz.
Maximum output Current: 20mA
There is a finite input offset which must be zeroed by a resistor between pins 1 and 5. The input offset is typically 2mV to <6mV.

The slew rate is 0.5V/microsecond.

There is some temperature dependence.
Positive input voltages yield positive output voltages
Negative input voltages yield negative output voltages
Thus, the non-inverting amplifier does not invert the phase of the input signal
The feedback voltage will have the same polarity and amplitude
The voltage between the two input terminals of a normally operating Op Amp is always zero volts.

The maximum output-voltage swing of an Op Amp should ideally be equal to the value of the applied voltage.

The actual maximum output swing of the 741 Op Amp is actually a little less than the theoretical maximum.

(Applied Voltage)
The op amp will no longer operate linearly if you try to exceed this value.

The accuracy of the circuits to meet the calculated values is dependent on the actual values of the components used. (Values with their tolerances)
Remember resistors have a tolerance.

- The calculated gain of the amplifier will very likely be different than the measured gain.

- This is true for capacitors and pretty much any component manufactured by man.
Voltage Gain of Non-inverting Operational Amplifier

- The voltage gain can easily be determined in two ways

- Calculation; using the following formula:
  \[ A_V = 1 + \frac{R_F}{R_1} \]

- Measurement by calculation:
  \[ A_V = \frac{E_{out}}{E_{in}} \]
Non-inverting Op Amp Schematic

To Trainer Positive Supply

$R_2 = 330\,\Omega$

To Trainer Negative Supply

$R_3 = 1k\,\Omega$

Pot (on trainer)

$R_4 = 330\,\Omega$

$E_{IN}$

Trainer Ground

To Trainer Positive Supply ($+12V$)

$E_F$

$R_1 = 4.7k\,\Omega$

$R_5 = 2.2k\,\Omega$

To Trainer Negative Supply ($-12V$)

$R_F = 4.7k\,\Omega$

$E_{OUT}$

Trainer Ground
1436 Fig 2 Constructed
1436 Fig 2  Ckt 1 Close-up
Gain for Non-inverting Op Amps in Circuit 2

- Voltage Gain is $A_V$
- Formula for the theoretical voltage gain for each $R_F$ to $R_1$ combination in a Non-inverting Op Amp configuration.

$$A_V = 1 + \frac{R_F}{R_1}$$
Measured $A_V$ Formula

$A_V = \frac{E_{\text{OUT}}}{E_{\text{IN}}} \text{ or } \frac{V_{\text{OUT}}}{V_{\text{IN}}}$

The output voltage, of Circuit 2 in Experiment 1, is supposed to be set to 2.5V for all values of the resistances.
Additional Discussion

- Remember: the theoretical and measured Voltage Gains can vary as much as 20% due to the resistor tolerances.
- It is not unusual to see gains from 1 to approximately 11 with the values of resistances used.
Schematic for circuit 2 Exp. 1

To Trainer Sine Terminal

$10\mu F$

To Trainer Positive Supply (+12V)

100k$\Omega$

$R_3$

(to trainer)

See table in Exp. 1 for R value

See table in Exp. 1 for R value

$E_F$

To Trainer Negative Supply (-12V)

$E_{in}$

$2.2k\Omega$

$R_2$

$E_{out}$

$E_{out}$

$E_{out}$

Trainer Ground

Trainer Ground
1436 Exp 1, Ckt. 2, Fig 5 Close-up
Meter Isolation Ckt for Ckt 2

To Trainer Positive Supply (+12V)

Connect to point to be measured

To Trainer Negative Supply (-12V)

ACV Meter

Trainer Ground
QUESTIONS?
Resources


The End

Developed and Produced by the Instructors in the CIE Instruction Department.

© Copyright 01/2012
All Rights Reserved / Jan. 2012