1436 Voltage Follower
Op Amp

Eight-pin IC, LM741CN

Cleveland Institute of Electronics Lesson 1436  Request a course catalog
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

- Offset Null: Pin 1
- Inverting Input: Pin 2
- Non-inverting Input: Pin 3
- -V: Pin 4
- 741 Op Amp
- 8 Pin DIP or DIL (Dual In Line Package)
- Not Connected: Pin 8
- +V: Pin 7
- Output: Pin 6
- Offset Null: Pin 5
Voltage Follower Op Amp Schematic

- To Trainer Positive Supply (+12V)
- To Trainer Positive Supply (+12V)
- To Trainer Negative Supply (-12V)
- Trainer Ground
- Trainer Ground
- DCV Meter

- $R_1\ 1\ k\Omega$
- $E_{in}$
Practical Considerations for the 741 Voltage Follower Op Amp

- The input signal is applied to the non-inverting input.
- Because of this, the output signal is not inverted or in phase with the input.
Inverting input is connected to the output pin of the Op Amp

One assumption is the $R_F$ is zero Ω

$R_1$ is shown to be of infinite resistance

This amplifier has unity gain and does not invert the phase of the input signal
- Unity gain means the gain is 1
- This also means you have a 1:1 ratio from the output to the input
- This also means what you put into the Op Amp is what you get out

\[ A_v = 1 + \frac{R_F}{R_1} \]

\[ A_v = 1 + \frac{0}{\infty} = 1 \]
Practical Considerations for the 741 Operational Amplifier

- 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 $\pm 12V$ for $\pm 15V$ 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 0.3V to 0.5V/microsecond.

There is some temperature dependence.
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)
0 The op amp will no longer operate linearly if you try to exceed this value

0 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 also true for capacitors and pretty much any component manufactured by man.
Non-Inverting Amp Voltage Gain

\[ A_V = 1 + \frac{R_F}{R_1} \]

\[ A_V = 1 + \frac{0}{\infty} = 1 \]
Voltage Follower Voltage Gain

\[ V_{\text{OUT}} = V_{\text{IN}} \quad E_{\text{OUT}} = E_{\text{IN}} \]
Additional Discussion

- The Voltage Follower provides impedance matching
  - This means this Op Amp provides a high resistance to a signal source that would otherwise be severely loaded down by a low resistance value.
As stated earlier, the output impedance is about 75 Ohms and can drive loads with relatively low resistance values.

You will be applying both positive and negative voltages to the following voltage follower circuit.

You should see the gain is 1 or unity and no phase inversion take place.
Unity Gain Op Amp Schematic

To Trainer Positive Supply (+12V)

To Trainer Positive Supply (+12V)

R₁
1 kΩ

Eᵢᵣ

Trainer Ground

To Trainer Negative Supply (-12V)

DCV Meter

Trainer Ground
1436 Exp. 3 Ckt. 1 Constructed
1436 Exp. 3  Ckt 1 Close-up
Schematic for circuit 3 Exp. 2
1436 Exp. 3, Ckt. 2, 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.

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