Attenuator - Inverter

Simple voltage attenuator and inverter utility module for Analog Synthesizer

1. Features

- Simple, low parts count
- Small footprint
- Can *attenuate* a voltage signal
- Can *invert* a voltage signal
- -12 / +12V Power supply

2. Application

The Attenuator – Inverter utility module is typically employed for altering the incoming Control Voltage signal from a CV source, in a typical Analog Synthesizer.

It is great, for example, for modifying the amount of CV you want to apply to your VCF cutoff frequency or for your VCA Envelope input: Full clockwise, your CV is $output = input \times 1$ (unchanged). Full Anti-Clockwise, your CV is reversed ($output = input \times -1$). See example below.

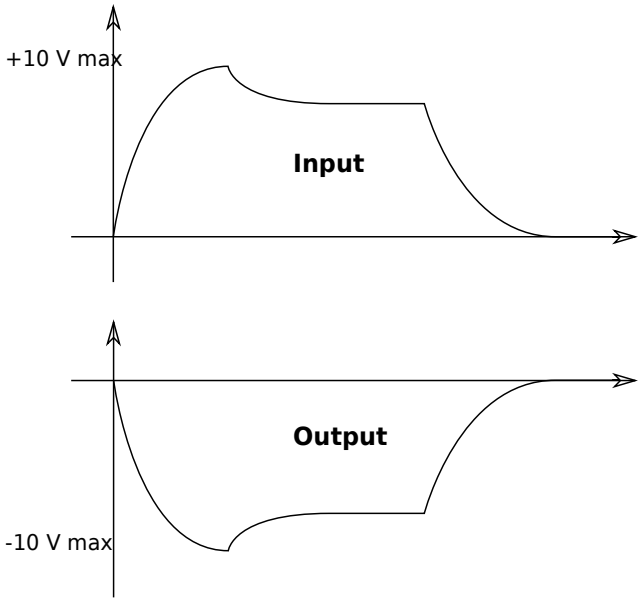


Figure 1: Example of an inverted signal. Top is the input signal, bottom, the output signal

It's also useful for reversing a LFO signal (decreasing ramp instead of increasing ramp) or any audio signal.

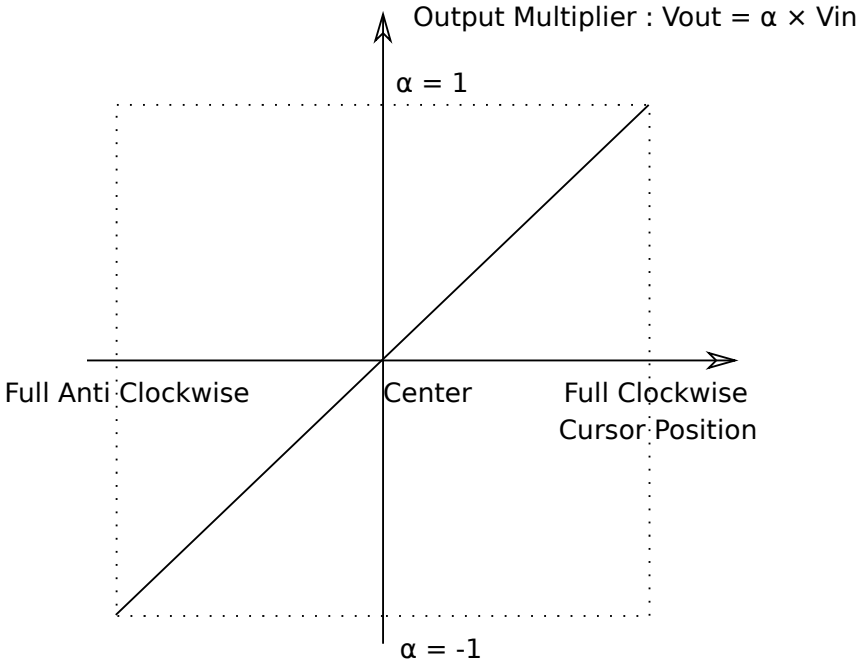
3. Description

The attenuator – inverter is based on a single op amp solution (U1). The potentiometer R1 modifies the way the whole circuit behaves. Three major situations can be identified:

When the cursor is turned fully clockwise, the input signal goes straight into U1's positive input. The op amp's negative input is at the same potential as the positive input. So, R2 has no current flowing through it, and then as no current goes through the negative input of U1 too (FET high input impedance), R3 has no voltage drop across it. The voltage on U1's output pin is equal to the voltage on the positive input pin.

When the cursor is turned fully anti-clockwise, U1's positive input pin is connected to ground. The input signal goes only to U1's negative input pin, through R2. In this scenario, U1 is a typical inverting amplifier. No current flows through U1's negative input and its voltage is equal to the positive input pin, 0V. This is the "virtual ground". So, all the current going through R2 goes also through R3. That current is flowing from the *virtual ground* to the output, creating a *negative* voltage, relative to ground. Of course, if the input voltage is negative, the current goes in the opposite way, thus creating a *positive* output voltage.

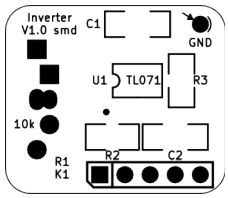
When the cursor is in center position, U1's positive pin is at half the input signal. The negative pin follows it at the same voltage (no voltage drop between inputs). R2 has a voltage drop of half the input voltage. The current going through R2 goes through R3, creating an equivalent but negative voltage drop across R3. As R3 is referenced to half the input voltage, its voltage drop is subtracted to the input voltage halve, thus giving a null value.

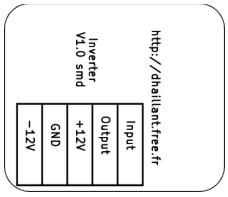


The input impedance is determined by the potentiometer resistance.

4. BOM

Designation	Qty	Reference
100 nF 1206 SMD	2	C1, C2
5x1 Pin array male or female	1	K1
10k 9 mm Linear potentiometer	1	R1
10k Ohm 1206 SMD Resistor	2	R2, R3
TL071 SMD SOIC8	1	U1





5. Build instructions

Start by soldering the SMD components. Solder U1 first, then C1, C2 and R2, R3.

Refer to manual SMD soldering technique guides and videos.

Before soldering R1, remove if necessary the potentiometer protruding tab (use pliers).

6. Wiring

You can connect wires directly for K1, or use either a female or a male connector.

Pin 1	Input signal (+/-10V max for +/-12V power supply)
Pin 2	Output signal
Pin 3	+12V power input (+15V max)
Pin 4	Ground (GND)
Pin 5	-12V power input (-15V max)

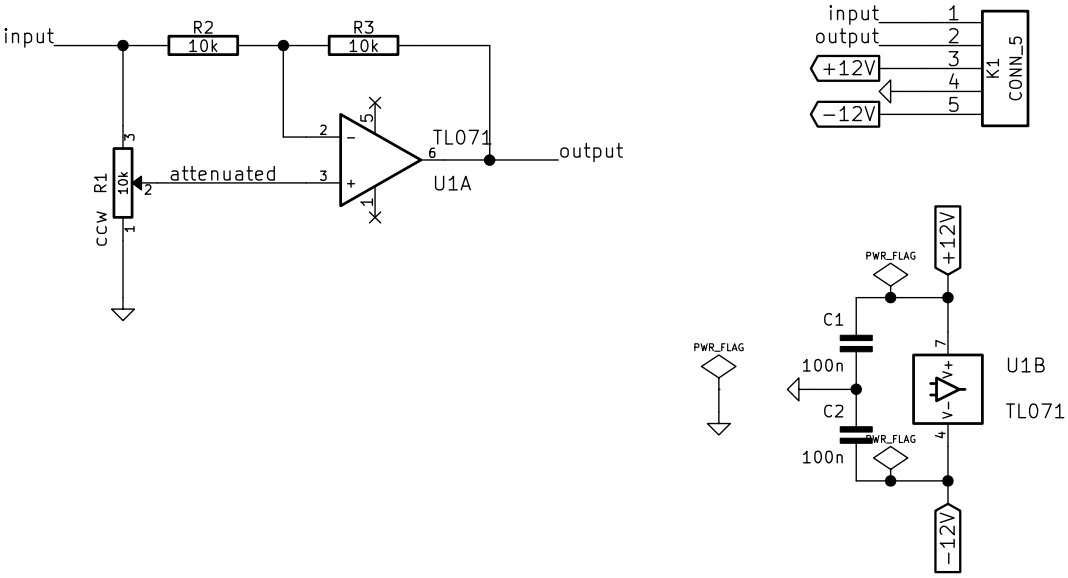
Table 1: Input/Output Connections

Connect Pin 3, 4 and 5 to a power supply. The module needs a split power supply (positive and negative voltages, plus ground) and can be powered with values ranging from +/-9V up to +/-15V. (Check TL081 Datasheet for details).

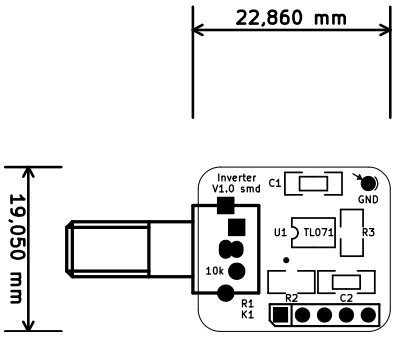
Feed the input pin with voltages between -10 and +10V if powered at +/-12V. If the input signal is higher, the circuit will saturate.

Collect the output signal on Pin 2. Do not overload the output (an Opamp cannot drive low impedance loads such as speakers).

7. Schematics



8. Layout and Dimensions



9. Contacts

Need help? Please contact me :

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