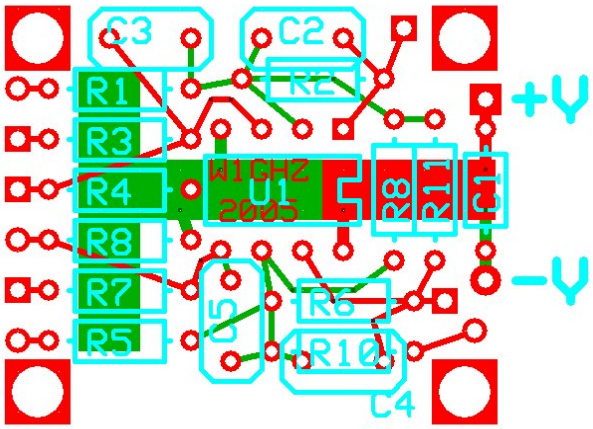
Utility Board for Op-amps and Comparators

Paul Wade W1GHZ ©2005
w1ghz@arrl.net

The operational amplifier, or op-amp, is a basic analog building block. The basic idea is to approximate an ideal amplifier, with infinite gain, high input impedance and low output impedance. The amplifier is used in circuits where the actual gain and impedance are predictable and controlled by external resistors, while the bandwidth and frequency response are tailored by external capacitors.

I'm not going to attempt to explain all the uses of an op-amp, but rather refer you to National Semiconductor, www.national.com, with a number of good data sheets and application notes. Start with the LM358 data sheet and application notes AN-20 and AN-116. If you'd like to try some simple experiments, see http://www.national.com/rap/meritbadge.html by Bob Pease, one of the gurus of analog circuits. For some of the amazing number of uses for op-amps, there are several "cookbooks" full of circuits. Linear Technologies (www.linear.com) and Analog Devices (www.analog.com) also offer many op-amps, data sheets, and application notes.

A multitude of op-amps are available, but most ham applications will be satisfied with a dirt-cheap general purpose variety like the LM358. Even better, almost all op-amps use the same pinout, in an 8-pin DIP package for single and dual versions, and a 14-pin DIP for quad versions. Thus, we can substitute a better op-amp as needed. Even better, since most of the circuits use the same resistor connections in various combinations, we can make a utility board that has locations for all the common circuit variations, and hack it up for unusual ones.



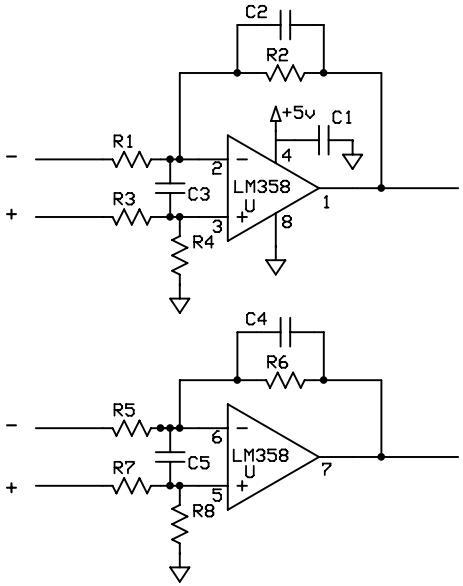
A dual op-amp is the same size as a single version, and roughly the same price, so the second one is free, even if we don't use it. The quad is twice as big, and a board gets crowded if all sections are used. Figure 1 is the layout of the utility PC board, and Figure 2 shows the schematics for the most common op-amp circuits, to guide in stuffing and wiring.

A comparator is another useful analog building block. It acts like an op-amp with too much gain, so that the output is stuck at the positive or negative supply voltage. When the voltage at the + input is higher than the — input, the output is high, at the positive voltage, and when the + input is lower, the output is low, at ground or the negative supply. If the inputs are equal or changing very slowly, then it can amplify random noise and appear to be oscillating. Sometimes hysteresis is added to prevent this.

Most comparators use the common op-amp pinout, so the utility board has additional uses. A good dirt-cheap general-purpose comparator is the LM393, which has a very useful open-collector output, like an on-off switch. See the data sheet and application note AN-74 (the LM339 is a quad version of the LM393, so the same circuits apply) for some of the uses for comparators.

The board will work with a dual op-amp or a dual comparator, but sometimes we need one of each. An op-amp can be a poor comparator, or a comparator can be used as a poor op-amp, but a better choice is the LM392, which contains one of each and fits in the same pinout.

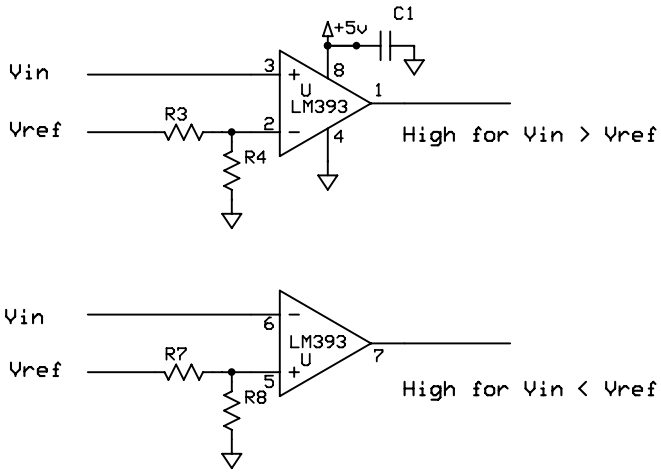
Next time you need a small amplifier or need to compare voltages or currents, try one of these circuits rather than trying to build it from transistors and loose parts. The result may be smaller, cheaper, and perform as expected.



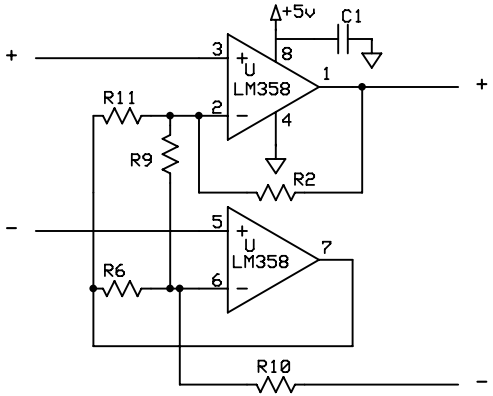
DUAL OP AMP
Populate as needed

Inverting Amplifier
Vout = R2/R1 * Vin(-)

Non-Inverting Amplifier
Vout = (R1+R2)/R1 * Vin(+)



DUAL COMPARATOR
Populate as needed



N1EKV DIFFERENTIAL AMP

R2 = R10

R6 = R11

R9 = Gain Adjust

NOTES:

Pinout is good for nearly all dual op-amps and comparators.

LM358 is good, cheap op-amp,
and LM393 is good, cheap comparator.
Many higher performance types are available.

See AN-20 at www.national.com

"An Applications Guide to Op Amps"

W1GHZ		
Utility Dual Op Amp Board		
W1GHZ	Rev 1.1 1/20/2005	Page # or name