The 74HCU04 – A Miser's Dream

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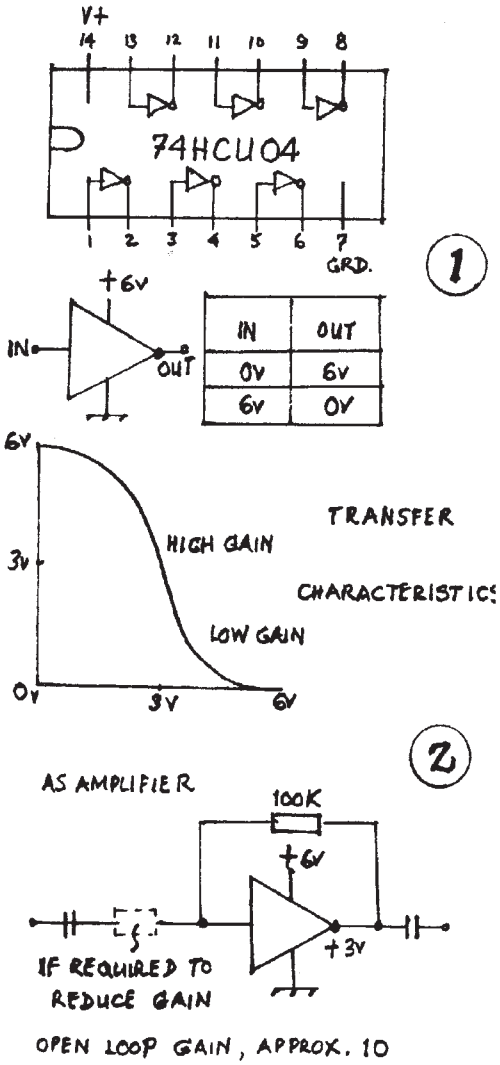
Reproduced from Lo-Key, the CW Operators' QRP Club Journal, September 1996

Ever since I discovered that the 74HCU04 could be used as a linear amplifier, I have been using the little blighters for all sorts of things. The more I play around with them the more I am convinced that they can be used as a sort of "universal" amplifier from DC to RF to replace bipolar and FET transistors and even op-amps. The fact they cost very little is worth thinking about; especially of you are a "careful" person like myself!



The 74HCU04 is a High-Speed CMOS Unbuffered Hex Inverter chip intended for digital use. It comes in a 14-pin DIL package and will work on any voltage between 2 and 6 volts.

Each inverter consists of an N channel and a P channel Mosfet connected in a totem pole configuration. The inverters will sink or source 4mA and have protection diodes fitted to the input and output pins. If a resistor is connected from input to output the inverter will bias itself into the linear mode. The input and output pins will settle to a DC voltage of approximately half the rail voltage.

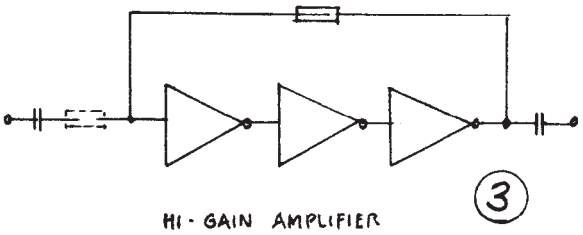
The inverter will now operate as an amplifier, the gain depending on the value of the feedback resistor and the input resistor (if fitted).

The configuration is similar to an op-amp with an inverting input only. As the open loop gain is only 10, there is seldom need to fit an input resistor.

The input impedance is high and depends upon the resistor[s] fitted. The output impedance is fairly low and is probably less than 1000 ohms. One disadvantage of the device is that each inverter draws about 15mA when in linear mode (5 volt supply).

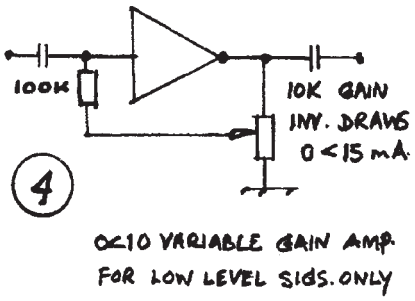
As well as being used in the digital mode, the inverters can be used as DC, audio and RF amplifiers up to about 50MHz. They also make fine AF and RF oscillators and can be used for VFOs and buffers.
One problem here could be noise. As the only test equipment here is a 6 volt pea lamp with test leads (!), I would appreciate results from anyone doing tests in this respect.

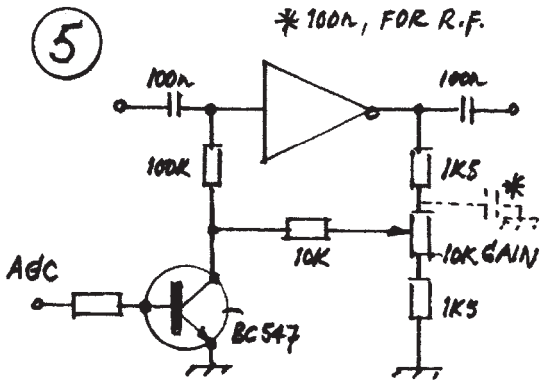
When using the 74HCU04, as with all CMOS chips, it is essential that ALL UNUSED INPUTS BE CONNECTED TO GROUND OR TO A POSITIVE RAIL. The inverters will draw virtually no current in this mode.



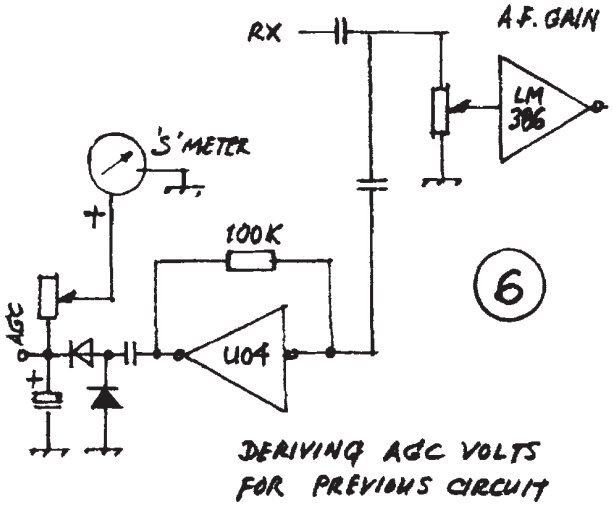
To obtain more gain from the chip, it is possible to directly connect 3 (or 5) of the inverters in a series amplifier circuit. To increase the output drive you can connect 2 or more inverters in parallel. It is possible to control the gain of a single stage by connecting a pot between the output pin and ground.

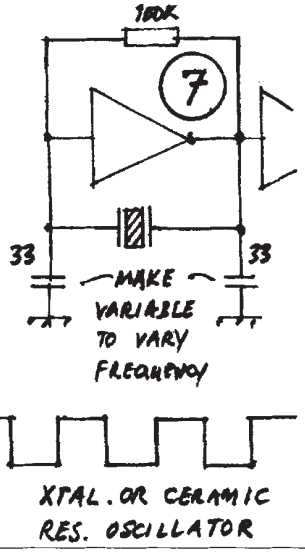
A high value resistor is then connected from the slider of the pot to the input pin. The gain can be varied from zero to about 10. With a 5 volt supply, the current drawn will vary from zero to about 15mA.





This circuit lends itself to automatic gain control for low level RF and audio stages. You may need to think about heatsinks if using 3 or more inverters in the linear mode as they get a bit hot. It pays not to use more than about four of the inverters on one chip at the same frequency, as they tend to become unstable.





Due to some of the "rats nests" that have evolved,
I have changed my thinking on the use of these chips.
I now use a separate chip for each section of the circuit.
This makes for better layout and easier wiring.
The surplus inverters can be biased off
and if this redundancy worries you –
remember they are cheap!

A few typical circuits are given here.

There are probably many more uses for this chip.
If you are looking for a versatile, easily tamed,
low gain device, good to 50MHz –
try the 74HCU04.

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