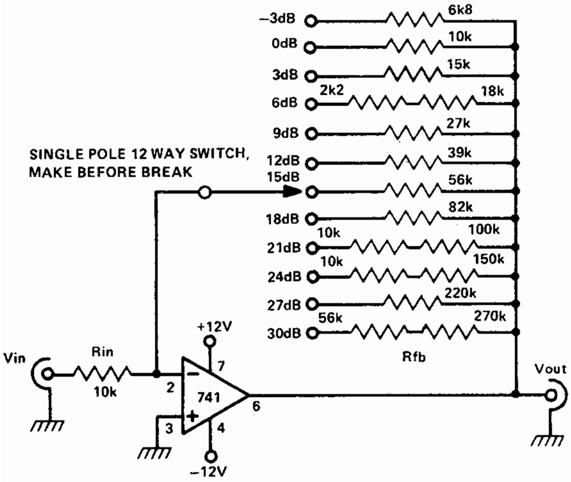
DB STEPPED GAIN CONTROL



VOLTAGE GAIN = Rfb/Rin
NOTE: AMPLIFIER INVERTS SIGNAL

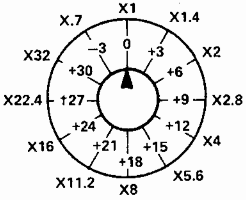
A handy little piece of test equipment is a preamplifier with stepped gain control selected by a rotary switch. The circuit here uses a single IC, a 741, 14 resistors and a single-pole, 12-way rotary switch.

The voltage gain of an op-amp (and that is what the 741 is) is determined by the ratio of R_{FB}/R_{in}; thus by having R_{fb} switched, the voltage gain can be varied.

The input impedance of the preamplifier is set by R_{in} to 10k. Having the gain set in decibel (dB) intervals is most useful in audio applications because our hearing, like dBs, is logarithmic. The gain in dB is defined as being equal to $20\times\log_{10}$ (Voltage Gain) which equals $20\times\log_{10}(R_{FB}/R_{in})$. Therefore a voltage gain of 1 is $20\times\log_{10} 1 = 0$dB but a voltage gain of 2 is $20\times\log_{10} 2 = 6$dB.

Although this may at first seem like a complex approach, the decibel is an easy to use method for describing gain and attenuation since all you have to do is add and subtract them. For instance, say a

DIAL MARKER
OUTER RING – VOLTAGE GAIN
INNER RING – VOLTAGE GAIN IN dB



signal passes through four devices with gains of 9dB, 15dB, —3dB and —3dB, the overall signal gain is 9+15—3—3 which is 18dB (this is a voltage gain of times 8). Note that negative dB means attenuation (reduction in strength). Now consider the same situation without using dB; a signal passes through four devices with gains of 2.8, 5.6, 0.7 and 0.7. The overall signal path is $2.8\times5.6\times0.7\times0.7$ which comes to the same result but a lot more difficult to calculate than adding and subtracting.