Chopper_Amp_Theory

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*   CMOS SWITCHES

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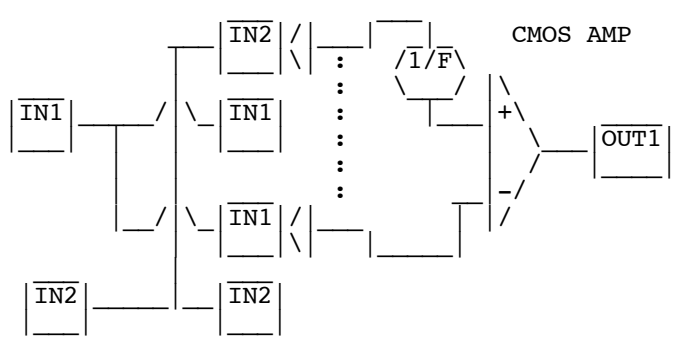

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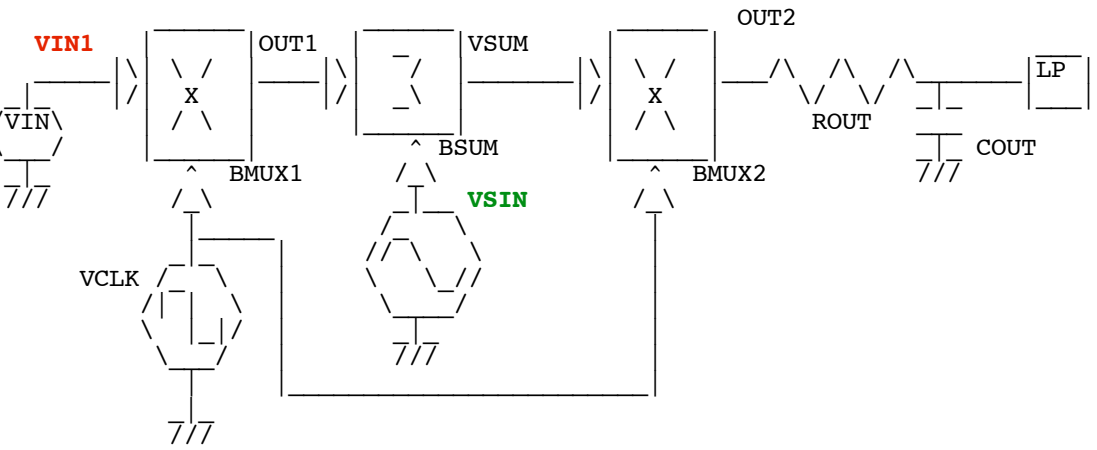

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```
VSIN        VSIN  0    SIN( 0 1.3u 100)
VCLK        VCLK  0    PULSE( -.7 .7 1n 1n 1n .1m .2m)
VIN1        VIN1  0    DC    1.1u
BMUX1       OUT1  0    V  = u(V(VCLK))*V(VIN1) -1*u(-1*V(VCLK))*V(VIN1)
BSUM        VSUM  0    V  = V(OUT1) + V(VSIN)
BMUX2       OUT2  0    V  = u(V(VCLK))*V(VSUM) -1*u(-1*V(VCLK))*V(VSUM)
ROUT        LP    OUT2 3k
COUT        LP    0    3u

.control
set pensize = 2
```

```
tran        1u   10m    0  1u
plot        v(vin1) v(vsin)
plot        v(vsum)
plot        v(out2)
plot        v(vin1)  v(lp) v(vsin)

.endc

.end
```

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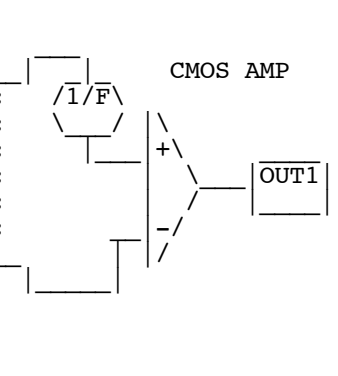
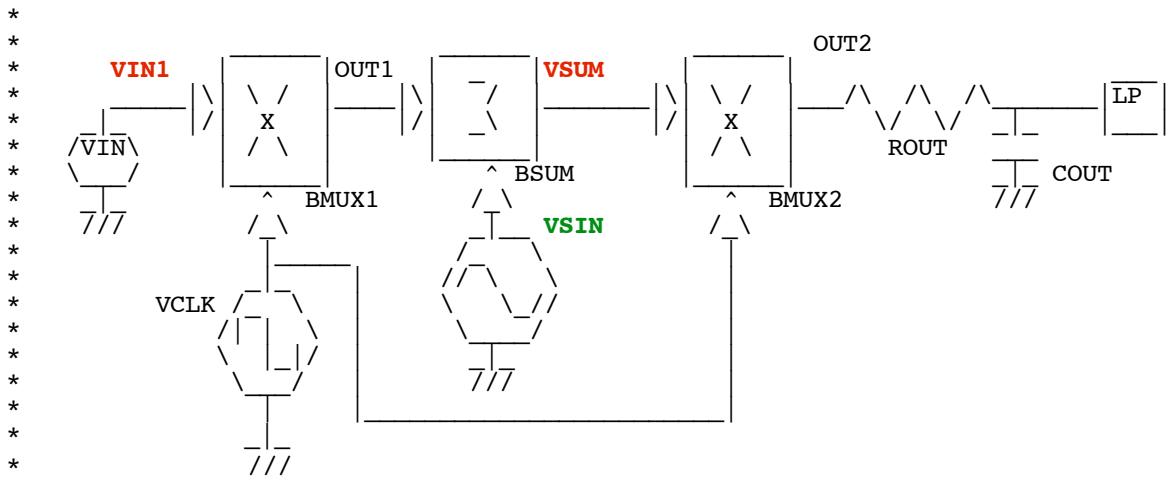
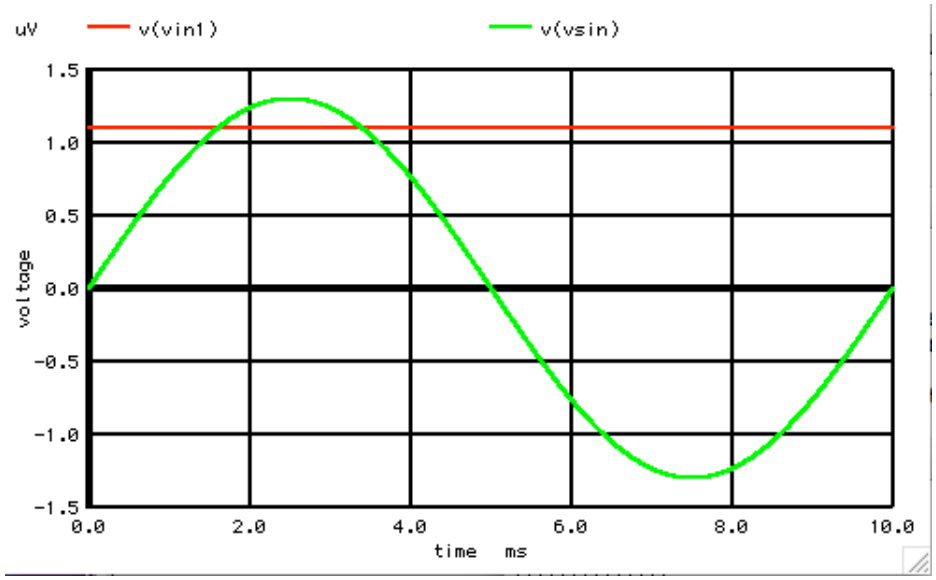
The Chopper Amplifier takes advantage of the availability of effectively perfect switches. While vacuum tubes and transistors introduces errors like DC offset and 1/f noise, switches come close to being just either on or off.



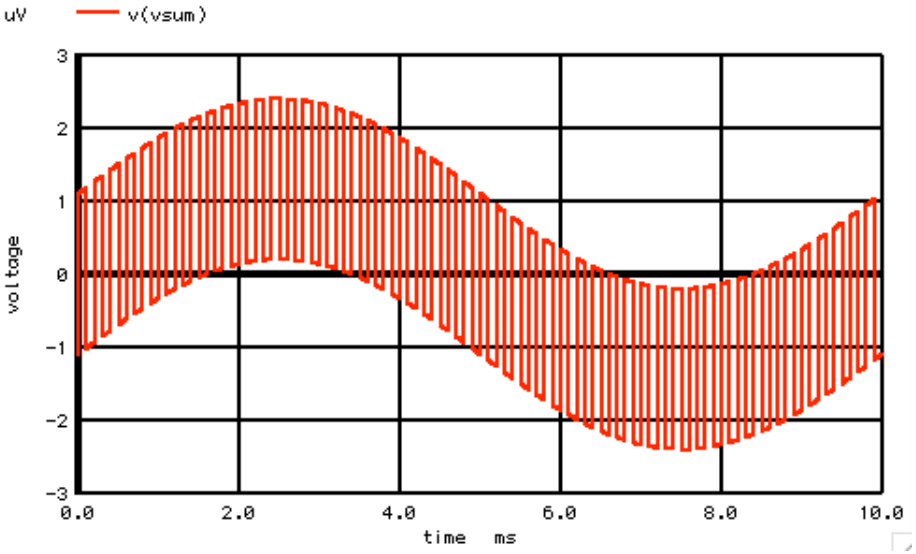
Chopping the input signal using switches is really just modulating or multiplexing a low frequency signal up to the chopping frequency. If the chopping frequency is high enough, the modulated input signal is well above the offset and 1/f noise of any amplifier which follows the chopping switches. This is the trick where signal gets placed where it can be distinguished from everything else.



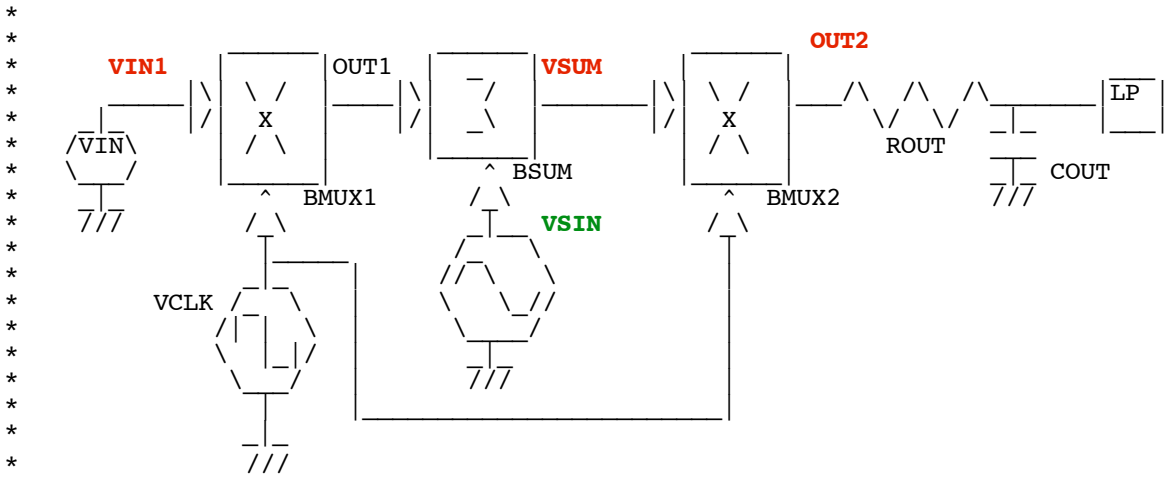
The simulation shows how this is done by applying a 1.1uV DC voltage in front of the input choppers and summing the output with a 100Hz sign wave to represent 1/f noise.



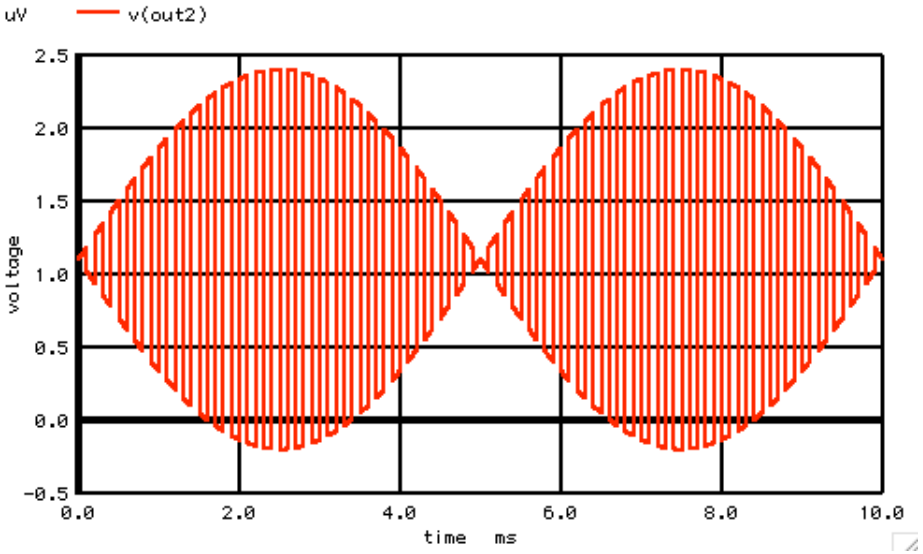
The sum of the modulated DC signal and the AC signal are shown below.



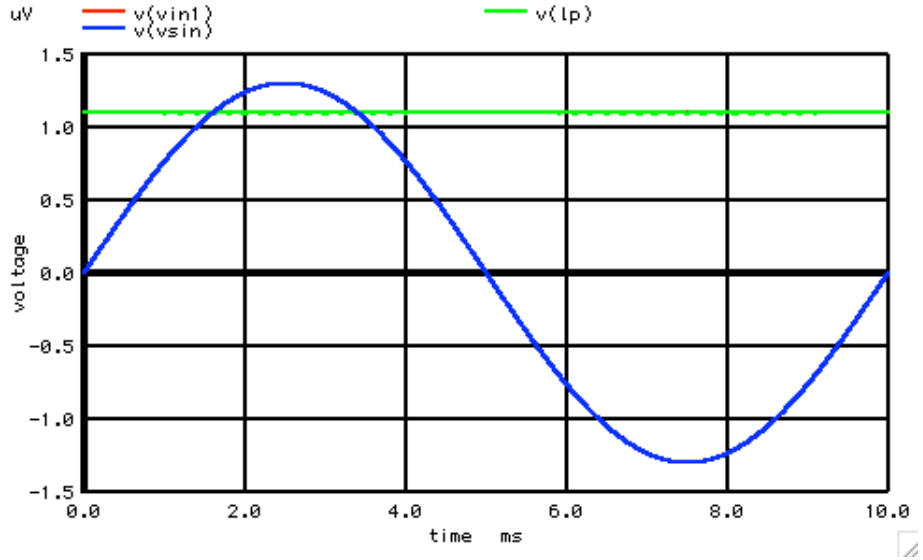
When this signal get remodulated by the same clock, the DC signal will return back to its original form. But the AC signal is now being modulated by the same chopping clock frequency.



If signal is gained up high enough before applying to the second modulator, a standard four quad multiplier circuit will do the job.



The desired 1.1uV VIN1 signal can be extracted by applying a low pass filter.



The chopper effectively passes the desired input signal through unchanged while it modulate all other undesirable signals up to the chopping frequency where they can be lowpass filtered out.