Noisemaker Workshop

Ring Modulation and Oscillator Sync (and more!)

May 14, 2009

Outline

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Real Ring Modulation

What is it?

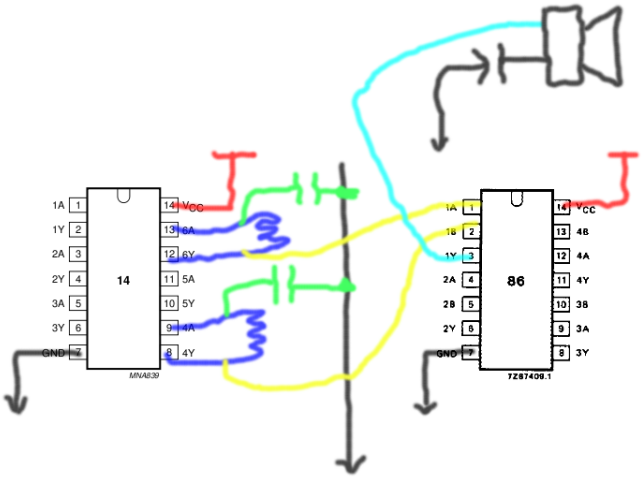
- Combine two signals into one by multiplying their voltages
- Ring modulation creates a signal with the sum and the difference of the input signals
- Stripped-down example: Two sine waves, 100 Hz and 600 Hz
- Ring-modulating them results in a two tones superimposed: one at 500Hz (the difference) and one at 700 Hz (the sum)
- Neat property: if you ring-modulate a signal with another (carrier) then ring-modulate the result with the carrier again, you get the original signal back
- Cool use: carrier is a noisy stream, can use to encode audio
- Pedestrian use: radio transmitters ring-modulate the audio signal with a RF carrier,
  receivers ring-modulate with the carrier to get audio back (tuning)

XOR "Ring Modulation"

XOR Logic

- The XOR ("exclusive or") function gives an output that's high when one or the other oscillator is high, *but not both*
- Logic Table:
  0 0 $\rightarrow$ 0
  1 0 $\rightarrow$ 1
  0 1 $\rightarrow$ 1
  1 1 $\rightarrow$ 0
- XOR'ing makes new frequencies like true ring modulation. Sometimes they're harmonically related, sometimes not.
- XOR'ing also has the encode/decode property of real ring modulation, but for digital signals

XOR Ring Modulation Circuit



Outline

Sync

Saw this before?

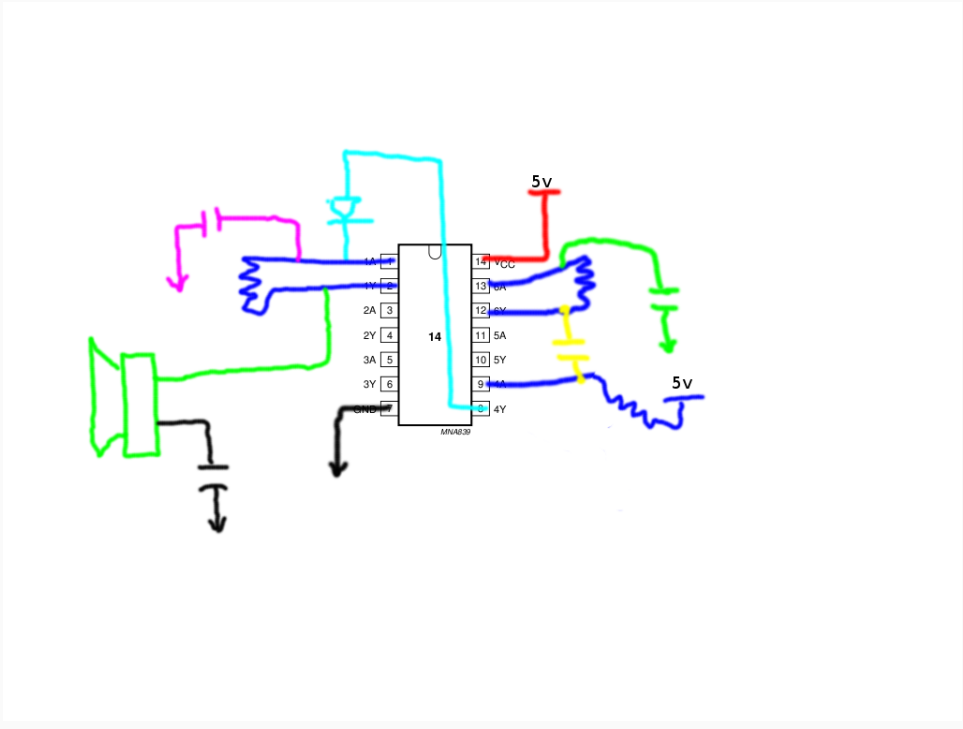
- Use a diode (valve) to reset one oscillator from the output of another
- Fun noises when you change the sync'ing frequency
- I mention this again, because it's fun with ring modulation

Pulse-Width

Creating non-symmetric oscillations

- To create a pulse, connect output of one oscillator to the input of the other with a capacitor
- The capacitor passes a small bit of current at the start of the pulse, but none of the low-frequency stuff
- Then use a resistor to keep the input high most of the time
- How quickly the input goes high again (after a low pulse through the cap) depends on the value of a resistor that pulls it high
- Pulse-width modulation by changing resistor makes phaser sounds

Sync



Sync with Multiple Oscillators

More fun

- If you're syncing a bunch of oscillators, makes a neat sound
- Plus, it's sweet to ring-modulate the results
- Make the sync pulse very thin, nearly instant
- Take the pulse out (cyan line in the above circuit), link it in to other oscillators with a bunch of diodes.

Diode Mixing

As long as we're talking about diodes...

- Run output of two oscillators together into same output, it's just like playing them through two speakers
- Instead, combine them with two diodes, and they add together but never subtract.

The End

Outline