Interfacing and controlling your bends

Colin Raffel

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Interfacing

- More than just switches and knobs
- Modulation of bends
- Automated switching
  - Rhythm
  - New sounds
  - Talking between devices (syncing)

What is a bend?

- Change in resistance
  - Variable
  - Fixed resistance
  - Switched resistance (0 ohms)
- Change in capacitance
- Change in inductance
- Change in voltage
- We will be focusing on the first and last.
- "Other"

Resistive ≈ Voltage Controlled

- Digital vs analog circuits
  - Analog = variable
  - Digital = switched
- Controlling analog
  - Control voltages
  - Voltage >> resistance
- Controlling digital
  - Multiplexers
  - Digital sequencing & switching

What is a control voltage?

- Variable voltage
- Changes some parameter
- Traditionally used in synthesizers
- Typical ranges
  - ±15V or ±12V >> ±5V or ±10V
  - +9V >> +5V
  - +5V >> +5V (digital)
  - Arbitrary

Voltage to resistance

- Vactrols
  - Homebrew
  - Vactec/ParkinElmer
- H11F3
- Other methods
  - No resistance (just CV)
  - Fast switching
  - LM13700

Vactrol - Quick & Dirty

- Simply an LED coupled with an LDR
- Cheap, easy to make in a pinch
- Resistance range depends on LDR
- Doesn't work well for 0 - >5k
- Doesn't work well with fast resistance changes
- May require extra circuitry to work like you want it to

H11F3 - Clean & Precise

- LED coupled with OptoFET
- Roughly $1 each, no DIY option
- Consistent resistance range unit to unit
- Very large range: 100 ohm - 100M
- Can work with pretty much any range
- Very fast
- Sometimes picky in audio circuits
- May require extra circuitry to work like you want it to

CCR not VCR

- LEDs aren't really voltage controlled
- Resistance depends on current
- Current ≈ voltage… sometimes
- In many (simple) cases, no problem
- For precision, and in many other cases, we need extra circuitry

Buffers

- Varying voltage >> buffer >> voltage source
- No (very little) output resistance
- When do you need them?
- Play it safe
- Remember clipping
- Transistor vs. op amp vs. CMOS

Some CV circuits

- Voltage dividers
- Simple LFOs (555, square waves)
- Complex LFOs (VC, triangle, saw, etc)
- Envelope controls
- Sequencers
- Other

Side note - Expression pedals

- Non-standardization
- Converting one resistance range to another
- Expression pedals: Just voltage dividers
- With buffers, a voltage source
- With VCRs, a varying resistance
- With an H11F3, any range

When a bend is digital…

- Digital is two states: on/off
- Much simpler and easier to deal with
- Many switches & keypads are really digital inputs
- On/off bends (switched) can be digitally controlled
- Sequencers and square waves are inherently digital

Multiplexers

- Automatic switches
- Normally can switch analog or digital signals
- In a digital circuit, logic can be used instead
- Some common types:
  - CD4051
  - CD4052
  - CD4053
  - CD4066/4016
  - Relays
  - Other/"Special Function"

Synced switching

- Squarewaves: Digital on/off
  - 555
  - CMOS-type
- Flip-flops: Divide by two (by two… by two…)
- Sequencers: Clock signal >> stepped outputs
- Microcontrollers: All of this at once
- Not limited to a single device - fanout

Combining analog & digital

- Digital signals can also control vactrols and H11F3

- Square >> triangle (or anything else) is very hard

- Analog multiplexers can take analog inputs >> analog sequencer

- The ultimate circuit