BTV 222 - Thursday 9 November 2006

Handout

Shows square waves at various frequencies (multiples of SMPTE time code frequency).

Shows an inverted 9600 Hz square wave. How to get it inverted? Pass it through an inverter (7404). *Diagram* 1.

Schmitt Trigger Inverter

Has a hysteresis loop on the symbol. 7414.

Cleans up a wave form. Hysteresis says we have to reach a certain voltage level before it triggers the change. This eliminates a lot of the false triggering caused by noise. *Diagram* 2

Works on the principle of it taking some time before it reacts to a signal change. Waits to verify that the value is actually changing. There's a little bit of a delay recognizing the state change, but that won't hurt anything. Noise should not affect it nearly as much. Jitter also should not affect it very much.

Back to Handout

Also have an inverted 4800 square wave.

Want 2400 Hz square wave shifted by 90 degrees (so rising edges are in the middle of the two spots in the SMPTE time code). How to combine 2400 Hz and 4800 Hz square waves so we get 2400 Hz < 90 degrees? Could do it with a D flip flop, which would set the value held at the 2400 Hz wave (we'd use an inverted 4800 Hz square wave so we'd have a rising edge which is what triggers the D flip flop). This shifts the square wave output of the D flip flop by 90 degrees from the input 2400 Hz square wave. *Diagram* 3. D flip flop actually acts as a **latch** here, since it remembers the value presented to D at the clock signal rising edge.

T flip flop? Has no clock input, just a T (toggle) input. Could do 4800 bar into a T flip flop. T means toggle. But has no control of the initial state of the T flip flop, so that could be a problem.

Could XOR the 4800 and 2400 together to get 2400 shifted by 90 degrees.

So, why shift by 90 degrees? Want to look at the middle of the region that we know will be stable within SMPTE time code. Changes only occur at 2400 Hz or 4800 Hz boundaries, so by shifting 90 degrees we sample in the middle of the unchanging region.

Then, would latch each sample, and XOR the values together.

Assignment for Tuesday

Based on what we discussed in class today, what kind of clocks go in to the decoding circuit? Specify what frequency and phase. Data is running 2400 Hz for zero and 4800 Hz for one.

De-bounce

Start out with a switch. *Diagram* 4. Open, outputs 5 volts. Closed, outputs 0 volts.

If we stretched time out, when close the switch, the contacts come together. Stretch out time; when contacts barely touch, isn't infinite resistance anymore, but is still fairly high resistance. So, the voltage at the output starts to fall.

Switches fail because the points pit. Like points on a car ignition system. Burns out those molecules. If threshold for TTL at the voltage level where the bouncing occurs, the inverter starts outputting a high frequency square wave during the bounce period. TTL will react to this as data. This is called switch bounce. It is mechanical because the contacts are apparently opening at short times (measured in picoseconds).

How to get around this? Use a capacitor, but don't want to mess up the logic input. Want a sharp rise (fast transition) when data value changes. Use a **one-shot** (aka **monostable multi-vibrator**). One stable state, once it is at that state, it stays there. Only looks at the very first change and ignores the rest of the changes. Is the opposite in behavior of a Schmitt trigger.

Can use a SPDT (single-pole double throw) switch to debounce. *Diagram* 5. Move switch one way, it presets the flip-flop. Move switch the other way, it resets/clears the flip-flop. Set/preset, reset/clear. When the switch goes one way, when the connection happens it sets or resets depending on the pole; at the times that the connection is intermittent during the bounce period, the connection is broken, but the set or reset input won't do anything at those times. When the connection reestablishes, it just takes the same action as it did just a moment ago.

Tristate Logic

High, low, high impedance are the three states. Bus drivers. Buses of wires carrying information in two directions. Data bus. On the data bus have different things that are both controlling and listening to the bus. One device on the bus may tell another device on the bus to turn on, but all these other devices are on the bus too. When the controller goes out of high impedance mode and goes to zero, the device that is supposed to receive the signal receives it and the other devices ignore it. *Diagram* 6.

Next Class

How to separate the data from the data stream and display it.