Quiz

Second in a series, on oscillators.

Homework

Due Tuesday April 24. List 20 or more steps, things to include to create the perfect black book. How you personally make the black book work for you.

Next Quiz

A week from Tuesday. Give ideas on what the quiz should be on.

Answers to Questions

Why do we use coax to send video signals? Shielding from noise. Send signal down one wire. If got rid of the shield and just used earth ground on both sides, what might the signal look like when it gets to the load from the source? It will have a lot of garbage, including all the RF that this wire (now an antenna) picks up. In a perfect world, the shield blocks all noise. Any RF energy and static energy that hits the shield will drain to ground. Practically, the shield limits noise.

How would we use CAT-5 or CAT-6 cable to transmit video? Category cables are groups of twisted pairs. Twists are very symmetrical and uniform. Each twisted pair in a category cable is twisted a different uniform amount, maybe to reduce crosstalk. That's why there are timing issues between pairs in a video situation; Belden does make a non-spec category cable for video situations, according to Stephen Lampen at the Sacramento Ennes workshop. Why are the pairs twisted? The line is balanced, so it makes the pair uniform so that noise is more likely to be cancelled. How to deal with noise induced across the twisted pair? Invert and add. Inverting cancels the noise which has induced identical energy into each wire of the twisted pair. Inverting and adding also doubles the signal voltage, since the out-of-phase video becomes in phase. CAT-6 twists the set of twisted pairs. Plastic in center controls the twist of the set of twisted pairs in CAT-6; not present in CAT-5.

As long as transmit in **common mode** (one positive and one negative, opposite phases), we have noise cancellation, quantified by **common mode rejection ratio** (CMRR).

Answers to Quiz from Tuesday

When transmitting with amplitude modulation, and there is no modulating signal, what percentage of maximum carrier appears at the antenna?

50%. If average the upper and lower parts of the modulation envelope, get 50%. Although, this isn't really carrier. This is based on the oscilloscope view that sums the carrier and sidebands in order to see that so-called modulated carrier. If it is based on the knowledge that all the energy goes into the carrier when no sidebands exist (no modulation), the answer would be 100%.

When transmitting with frequency modulation, and there is no modulating signal, what percentage of maximum carrier appears at the antenna?

100%. This isn't the same as AM since the carrier in FM is at the same amplitude regardless of modulation percentage. This is easier to see due to the definition of frequency modulation being that the amplitude isn't modified (amplitude is constant).

When transmitting FM stereo, the monaural is directly modulated onto the carrier. How are the stereo Left and Right signals transmitted?

L+R and L-R. L+R is monaural, transmitted on the FM carrier. L-R is AM'd onto a 38K subcarrier above the L+R. The subcarrier and the L+R are all FM'd onto the FM carrier. Also send a 19 kHz pilot as a continuous wave within the same frequency modulation carrier that also modulates the L+R and AM'd L-R.. L+R goes up to 15 kHz.

Stereo creates a three-dimensional effect due to delays in sounds between left and right channels. If put left and right microphones next to a single singer, L+R will have the signal and L-R will have no signal (ideally). If put separate sources onto left and right microphones, L+R and L-R will have both sources. If put singer on L, guitar on R, and drums in center, L+R has all, L-R has singer and guitar and not much drum.

When receiving an FM stereo transmission, the receiver normally indicates its status by lighting a stereo lamp. What part of the FM process causes this lamp to light?

The pilot. Can't use L+R since that is always there. The 38 kHz subcarrier is suppressed; just the sidebands are transmitted. When LC circuit sees the 19 kHz, turns on a light. Need the pilot to replace the removed subcarrier. According to Brian's book, the 38 kHz subcarrier is balanced modulated so there won't even be a subcarrier without a modulating signal. So, the subcarrier can't be used to detect the stereo transmission.

The 19 kHz signal at the transmitter controls the entire system. If it drifts, the pilot drifts and the 38 kHz carrier drifts accordingly, and the receiver uses the drifting pilot to synchronize so that there is no problem receiving the signal.

Color burst is actually a pilot for color (which is also balanced modulated, except that it is double balanced modulated (QAM)).

What differences exist between FM stereo and NTSC TV stereo in the baseband carrier modulation process?

Pilot frequency: FM stereo at 19 kHz, NTSC TV at 15734 Hz (horizontal sync frequency). Why not keep TV at 19 kHz like FM had been doing this for years? Is enough room in the channel for this. Good chance that could result in beat frequencies if these two frequencies got out of sync; this would be audible (4 kHz tone) and would be annoying to the viewer.

Subcarrier at two times the pilot.

What polarization is used in television transmission?

Horizontal, but really circular. To get maximum signal, should receive with a horizontally or vertically polarized antenna.

For parabolic dish, it's the feed horn orientation that determines this.

What method of modulation is used in OTA ATSC television transmission?

8-VSB.

What method of modulation is used in CABLE DTV television transmission?

Flavors of QAM. 64-QAM for example. 8 points in phase and 8 points in quadrature; multiplied together get 64.

OTA and cable are not compatible.

What method of modulation is used in SATELLITE DTV television transmission?

Flavors of QAM, like 256-QAM. DSS has an odd standard since they came out with digital even before 8-VSB came out.

What method of modulation is used in OTA European television transmission?

COFDM. Coded orthogonal frequency division multiplexing.

Handout

One page on tape storage and tape sensing system diagrams. Other side has block diagram of record/reproduce servo system.

Tape Recorders

Quad was one of early VTRs. Huge amount of circuitry to do its job. Used 2 inch wide tape, due to tape technology being not that great.

Tape storage system. Folds without damaging tape. Meant for high speed access.

Figure 6-13. Sensing position of tape, detects if will run out soon.

Figure 6-11. Vacuum column used to control tape tension. Stretch tape across head. Tape is fragile; vacuum is easy on tape.

Figure 6-12. Like 6-11 except uses photoelectric cells to adjust the vacuum via feedback.

Figure 6-14. Used tension arms to sense tape.

Block Diagram

Block diagram on other side of handout. Frequency standard; a stable oscillator. Reference frequency is 60 Hz (cps).

Control Track

Control track oscillator. What's a control track? A track with control information on it. It is an audio track dedicated to control signals. What's different between audio recorder and video recorder where we might have to add a control track? Record video at a slant, motor driving video head, must spin the head, else would have to move the tape across the head much faster, which would wear out the tape much faster. Adjusts tape position so will record at the right spot.

Control track puts a mark signal down a dedicated audio channel once per revolution of the scanning head (60 Hz) (the field rate). Every vertical pulse generates this mark. Every tape machine isn't the same; some heads will spin at different speeds, and other differences(?). Some physical adjustments (**tracking**) to control the relationship of the control track pulses and the position of the scanning head. Shifting the tape position slightly with respect to the tape head. Tape is actually phase-related to the head in this way. So, we need this control track.

Recording

When recording, synchronize control track oscillator, go through direct record amplifier to control head. Frequency standard also goes to a power amplifier to drive a capstan. What is a capstan? It is the thing that moves the tape. Capstan is a 60 Hz induction motor. Rubber pinch roller pinches tape between roller and capstan. Puts pressure on tape but that is what we have even today. Not a huge amount of pressure else would deform the tape. Enough pressure to avoid slippage of tape.

Phase Comparator, Oscillator Controller, VCO to power amplifier and capstan when record/play switch is switched. In record, we use our frequency standard to drive the capstan. In play, locks onto demodulated control track signal, compares with frequency standard, generates comparison voltage (just like a PLL), so capstan runs at speed at which the recording was recorded.

Must control phase of tape position relative to the video head. How to change the phase slightly? There is a phase locked loop which is adjusted so that the tape phase can be adjusted slightly, then the phase will stay the same and the head will synchronize with what's on the control track. Oscillator controller is probably the equivalent of the filter in a PLL.

Audio tape recorder generally synchronized to 60 Hz power line. If speed varies not really noticed.

Servos depend on phase locked loops. Servos are when part of the tape recorder controls another part of the tape recorder.

Next Quiz

On networking. Know OSI layers. On the Tuesday after NAB week.