

Chapter 3: The Video Signal and Videotape

Overview of the Video Recording Process

When we look at a scene, our brains seem to take in all the information all at once. When a camera looks at a scene, it too appears to take in all that information at once; but in fact it doesn't.

Every camera has one or more pick-up devices (formerly picture tubes, but nowadays, computer chips) that scan the scene horizontally, SCAN LINE by SCAN LINE. And at every point in every scan line, the camera translates the visual information it sees into a very low voltage signal that gets sent through cables to other video equipment. This signal may be mixed with other signals in a Special Effects Generator (SEG), or changed in various ways by a Time Base Corrector (TBC).

Usually, this signal is fed into a TV monitor or receiver whose job is to undo what the camera did: Turn a low-voltage current back into a recognizable picture of what the camera saw.

And at some point, this signal gets recorded onto tape by a Videotape Recorder (VTR). The videotape consists of a long strip of plastic coated with a layer of very fine metallic oxide particles which become magnetized by the low voltage video (and audio) signals.

The Video Signal

The video signal isn't really just one signal, but three signals multiplexed together. To insure that the same TV signal can be seen by owners of black and white and color sets, the camera's pick-up devices separately determine what the Luminance (Y) is and what the Chrominance (C) is for every point in its field of view. Luminance refers to the brightness of a picture, chrominance to its color (hue and saturation).

What's the third signal? Imagine if you were a TV set being fed a long, unbroken voltage signal that you had to turn back into a picture with luminance and chrominance. How would you know when to move down and draw the next scan line, and when to stop and begin drawing the next screenful of information? You would need some kind of regulator, or Synchronizing signal to tell you how to do your job.

How It Works: Picture Scanning and Sync

All TV pictures are composed of 525 horizontal lines, called SCAN LINES. (Note: this is different from the resolution that TV salespeople talk about, which refers to how many vertical lines can be separately distinguished.) The camera generates a signal by scanning the first line left to right, turning off and returning to the left margin, then scanning the third line left to right, turning off and returning to the left margin, then scanning the fifth line left to right, and so on. At the end of each horizontal line scan, the camera adds an invisible HORIZONTAL SYNC PULSE to the picture

signal. This sync pulse instructs the TV, which has to redraw the picture scanline by scanline, to move to the next scanline. After scanning line 525, the camera adds an invisible VERTICAL SYNC PULSE to the picture signal to instruct the TV to move back to the top of the screen and begin drawing the even numbered scanlines.

Each complete set of odd scanlines makes up one FIELD, the odd field. Each complete set of even scanlines makes up one FIELD, the even field. The two Fields together make up one FRAME.

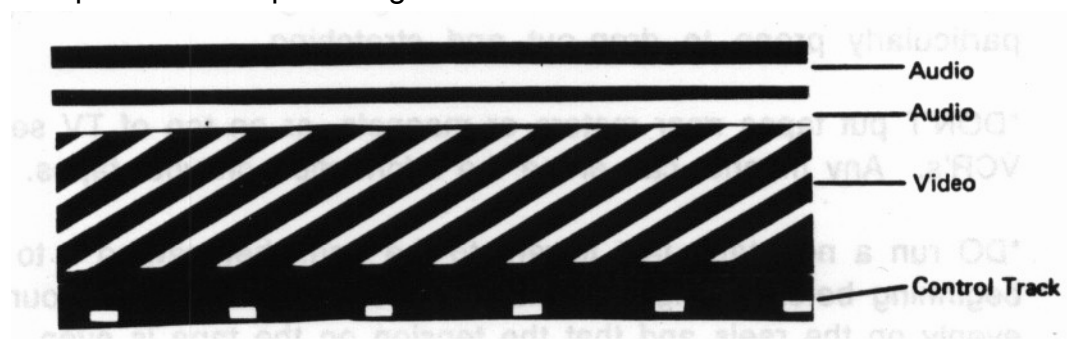
This scanning must happen very quickly, otherwise we would see it. U.S. standards require cameras draw the frame 30 times per second (30 Hertz, 30 Hz), which corresponds to drawing 60 fields per second.

The reason that the scanlines are INTERLACED, i.e. that the odd lines are scanned first and then the even lines are scanned, is to prevent the appearance of flickering. If cameras scanned straight down from top to bottom in one pass, even at 30 times a second, the phosphors in the TV sets would start to dim. But thanks to the human mind's ability to fill in the blanks and to the fact that our eyes briefly retain images when we stop looking at something (an attribute called Persistence of Vision), the camera engineers get away with showing us half the information in half the time and letting our minds and eyes fill in the other half.

Information Tracks on Videotape

Three types of information are recorded on the videotape, in separate longitudinal tracks running the length of the tape, as illustrated below.

- 1) The video signal is recorded in the middle of the tape in an angular pattern called helical scanning.
- 2) Two normal audio channels are recorded along one edge of the videotape, next to the video signal.
- 3) The vertical sync pulses (which, remember, the camera adds when the video signal is recorded) get recorded along the other edge of the tape in an area called the Control Track. The control track acts like an electronic pulse, which keeps all the electronics working together. In many ways, it functions like the sprocket holes in film, regulating the speed of the tape through the machines.



As the videotape threads through the VTR, separate heads read the information from the various tracks. Newer equipment gives you the option of also recording Hi-Fi audio tracks, which give a higher-quality, higher-

fidelity sound than the normal audio tracks. The problem is that Hi-Fi audio gets recorded on the videotape in the same place as the video signal, and cannot be edited independently from the video. For this reason, CCTV's edit suites are set up to use the Normal audio tracks, not the Hi-Fi tracks. If you want to work with audio recorded in Hi-Fi, you should make sure when reserving the edit facilities that CCTV's technician or other qualified staffer will be available to rewire the equipment as needed when you come to edit.

Videotape Formats & Brands

Formats in General

Even though most videotapes are similar in how the information tracks get recorded on them, all videotapes are NOT the same. The most fundamental differences pertain to the width of the tapes, the size and shape of the cassettes they come packaged in, and the types of machines that can work with them. Simply put, videotape comes in all kinds of formats, each of which requires its own kind of machine.

VHS or ½" Probably the kind of VCR you have at home. The winner of the battle with Betamax many years ago for the consumer market, pioneered by JVC and Panasonic.

S-VHS Super-VHS is a higher quality format that retains some compatibility with VHS as outlined in this table.

	S-VHS Equipment	VHS Equipment
S-VHS Videotape	Record in S-VHS or VHS mode; best quality comes from recording in S-VHS mode	No big advantage: You can record only in VHS mode, and you cannot play an SVHS recording.
VHS Videotape	Record only in VHS mode	Record only in VHS mode

8 mm Comparable to but not compatible with VHS, pushed by Sony.

Hi-8 Comparable to but not compatible with S-VHS, though more fragile for editing purposes. Similar table applies to the compatibility of 8 mm and Hi-8 as applies to VHS and S-VHS.

3 / 4" Was a popular format for low-end broadcasters. The quality is comparable to or better than S-VHS or Hi-8. More durable than either, but also bulkier and more expensive.

1" & 2" Until a few years ago, the choice of those who could afford it. Bulky and expensive, these are reel-to-reel formats.

Betacam Not to be confused with Betamax, this is the analog tape of choice for those who can afford it. Comes in cassettes smaller than ¾" cassettes, but offers much better recording quality, especially over multiple generations.

Some formats also make compact versions for use in remote field applications; but these smaller cassettes are usually designed to fit into the full-size VTRs. If you're not sure, ask someone who knows!

Formats Used at CCTV

	Source (From)	Record (To)
Edit One	VHS or S-VHS	VHS or S-VHS
Edit Two	VHS or S-VHS	VHS or S-VHS
	3 / 4"	VHS or S-VHS
Edit Three	VHS or S-VHS	VHS, S-VHS, 3 / 4", 8 mm, or Hi-8
	3 / 4"	VHS, S-VHS, or 3/4"
	8 mm or Hi-8	VHS, S-VHS, or 3 / 4"
Studio	VHS	VHS, S-VHS, or 3 / 4"
	S-VHS	VHS or 3 / 4"
	3 / 4"	VHS or S-VHS
Cablecast	VHS or S-VHS	

Brands

Remember what we said about formats: All videotape is NOT the same. The same goes for brands. Yes, any VHS machine will work with any brand of VHS tape. But the quality of the recording depends not only on the quality of the machine, but also on the quality of the tape. How do you choose what brand tape to get?

- * Ask your friends what brands they like and don't like.
- * Ask the salesperson which brands other people seem to be buying regularly.
- * Buy brands made by a company that's in the electronics business, not the grocery or pharmacy business.
- * Generally speaking, the more the tape costs the better it is. So, the most important thing you should do is buy the best videotape you can afford.

Do not try to minimize your production costs with the least expensive item, videotape. The few dollars extra you'll save by buying a \$3 tape instead of an \$8 tape is not worth the risk of a noticeably poorer recording.

Do's and Don'ts Regarding Videotape

- * DON'T touch the tape inside the cassette with your hands.
- * DON'T put tapes near motors or magnets, or on top of TV sets, VCR's, or other magnetic appliances. Any magnet can erase the information on your tapes.
- * DON'T record your program on the first and last few minutes of any cassette. Instead, use the first minute or two of the tape to lay down your Color Bars, Countdown, and Black preceding your program.

- * DO stretch out any brand new tape or any tape that has been unused for several months. To stretch a tape, simply fast forward it to the end, and rewind it back to the beginning. This ensures that the tape is wound evenly on the reels, that the tension is even throughout, and that any loose metallic particles are knocked off.
- * DO check that your videotape is record-enabled.
 - On VHS and S-VHS cassette tapes, there should be a plastic tab intact along the edge opposite the tape compartment door; if the tab is missing, tape over the hole.
 - On 3 /4" cassettes, look for a red or orange button on the bottom. If the button is missing, tape over the hole or get another button.
 - On 8 mm and Hi-8 videotape, there is a sliding orange tab along the edge opposite the tape compartment door. To record, be sure to slide the tab closed so that the hole underneath is exposed.
- * DO remove the tab or button (or, on 8 mm formats, slide the orange tab so that it covers the hole) after you have finished your recording, to ensure that no-one accidentally records over your material.

ALSO NOTE: CCTV respectfully requests that you use 30- or 60-minute tapes in the camcorders because they have very weak motors. Extensive use of 120-minute cassettes may force the camcorder motors to work harder than they are designed to, and cause them to break down. Thank you.