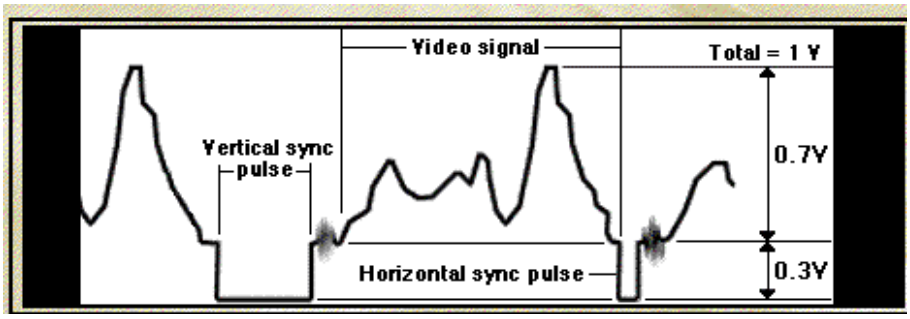
UNDERSTANDING THE VIDEO SIGNAL

Introduction
This article is part of the “Understanding CCTV Series” and is an abstract from STAM InSight - The Complete CCTV Program on CD-ROM for staff training and productivity enhancement.

In this article we will discuss the video signal, which is the basic electrical signal that starts at the camera and goes to the control room via a transmission system. In CCTV this signal is called Composite Video. It has maximum amplitude of one volt peak to peak. We explain the different components of the composite video signal and the purpose of each. The composite video is made up of the following parts:

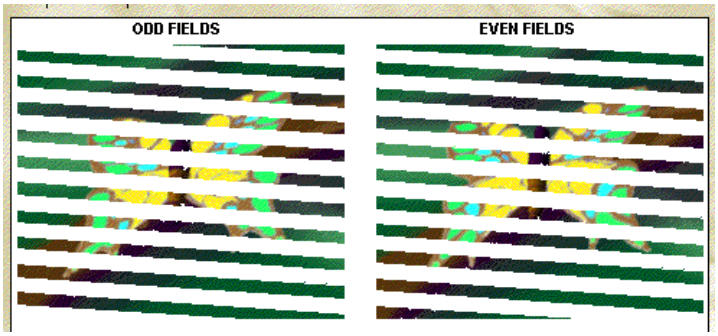
- Video signal
- Horizontal sync pulse
- Vertical sync pulse



Video signal
When light falls on a CCD chip, it generates a charge in the pixels, which is directly proportional to the light falling on them. More light means a greater charge. This charge is then read out from the CCD chip and is converted into a video signal. The methodology of reading this charge from the chip depends upon the type of CCD chip. The greater the amount of light on the pixel, the larger the amplitude of the video signal. In a composite video, the maximum amplitude of the video signal is 0.7 volts. In other words, the white or the bright part of the picture will have a signal strength of 0.7 volts, while the black or dark parts will have a signal of 0 volts.

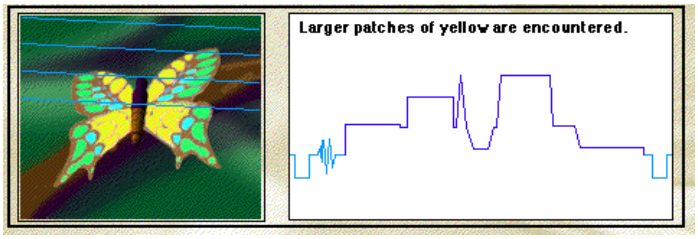
Vertical sync pulses

A video picture is made up of video frames. In NTSC there are 30 frames per sec, while PAL has 25 frames per sec. To avoid picture flickering in CCTV, this video frame is divided into 2 fields i.e. odd and even fields. These two fields are separated out at the camera point and then combined once again at the monitor end. This is also called interlacing of fields.



At the end of each frame or field, a vertical sync pulse is added. This sync pulse tells the electronic devices in the camera and other CCTV component that the field has come to an end and gets them ready to receive the next frame or field. The duration of the pulse depends upon the time the electronic devices take to receive the next field. The amplitude of this pulse is a 0.3 volts. This when added to the video signal, gives a total amplitude of 1 volt peak to peak.

Horizontal sync pulse



A video frame is made of lines. In NTSC there are 525 lines per frame, while PAL has 625 lines per frames. Each point in the line reflects the intensity of the video signal. At the end of each line, a horizontal sync pulse is added. This sync pulse tells the electronic devices in the CCTV system that a line has come to an end and to get ready for the start of the next line. This also has amplitude of 0.3 volts.

The above is a quick overview of the components of a composite video. Below are some statistics and additional information about a video signal.

Horizontal and vertical scanning frequencies

The following table details the different frequencies under the PAL and NTSC system

	NTSC	**PAL**
Frame Frequency	30 per sec	25 per sec
Duration of each frame	1/30 sec	1/25 sec
No of fields per frame	2	2
Field frequency	60 per sec	50 per sec
Duration of each field	1/60 sec	1/50 sec
No of lines per frame	525	625
No of lines per field	262.5	312.5
No of lines per sec	525 X 30 = 15750	625 X 25 = 15625
Duration of each line	1/15750 sec or 63.5 us	1/15625 sec or 64 us

Horizontal and vertical blanking

Retrace or fly back is the time required to move from the end of one line to the start of the next line or from the end of one field to the start of the next field. No picture information is scanned during the retrace and therefore must be blanked out. In television blanking means " going to black level".

The retrace must be very rapid, since it is wasted time in terms of picture information. The time needed for horizontal blanking is approximately 16% of each horizontal line. The time for the vertical blanking is approximately 8% of the vertical field.

	NTSC	PAL
Field duration	1/60 sec	1/50 sec
Vertical blanking	1/60 * .08 = 1333 us	1/50* .08 = 1600 us
Line loss due to vertical blanking	1333/63.5 = 21 lines	1600/64 = 25 lines
Line duration	63.5 us	64 us
Horizontal blanking	63.5 * .16=10.2 us	64 * .16=10.25 us
Visible trace time	53.3 us	53.75 us

Horizontal and vertical synchronization

The blanking pulse puts the video signal at the black level, the synchronization pulse starts the actual retrace in scanning. Each horizontal sync pulse is inserted in the video signal within the time of the horizontal blanking pulse and each vertical sync pulse is inserted in the video signal within the time of the vertical blanking time. The following is the frequency of each synchronization pulse.

	NTSC	PAL
Vertical	60 Hz	50 Hz
Horizontal	15750 Hz	15625 Hz

The colour signal

A colour video signal is the same as monochrome except that the colour information in the scene is also included, which is transmitted separately. The following two signals are transmitted separately:

1. Luminance signal: known as the Y signal, it contains the variations in the picture information as in a monochrome signal and is used to reproduce the picture in black and white.

2. Chrominance signal: known as the C signal, it contains the colour information. It is transmitted as the modulation on a sub carrier. The sub carrier frequency is 3.58 MHz for NTSC and 4.43 MHz for PAL.

In a color receiver, the chrominance signal is recovered and combined with the luminance signal to give a color picture. In a monochrome receiver, the chrominance signal is not used and the picture is reproduced in black and white.

Construction of the composite video signal

The composite video has the following parts:
- Camera signal output corresponding to the variation of light in the scene
- The sync pulses to synchronize the scanning
- The blanking pulses to make the retrace invisible
- For color signals, the chrominance signal and color sync burst are added.

About the author

Jayant Kapatker is an international authority on CCTV and is the brain behind STAM InSight The Award Winning CCTV Program. This interactive multimedia contains over 14 hours of CCTV content. This series of articles have been based upon the subjects covered in the STAM CCTV – A complete review web based training course. For more information visit: www.stamweb.com or email: sales@stamweb.com