

Video Glossary

- 0_H** The reference point of horizontal sync. Synchronization at a video interface is achieved by associating a line sync datum, 0_H, with every scan line. In analog video, sync is conveyed by voltage levels "blacker than black". 0_H is defined by the 50% point of the leading (or falling) edge of sync.
- In component digital video, sync is conveyed using digital codes 0 and 255 outside the range of the picture information.
- 0_V** The reference point of vertical (field) sync. In both NTSC and PAL systems the normal sync pulse for a horizontal line is 4.7 μs. Vertical sync is identified by broad pulses, which are serrated in order for a receiver to maintain horizontal sync even during the vertical sync interval. The start of the first broad pulse identifies the field sync datum, 0_V.
- 1-H** Horizontal scan line interval, usually 64 μs.
- 100/0/75/7.5** Short form for color bar signal levels, usually describing 4 amplitude levels.
1st number: white amplitude
2nd number: black amplitude
3rd number: white amplitude from which color bars are derived.
4th number: black amplitude from which color bars are derived.
- In this example: 75% color bars with 7.5 % setup in which the white bar has been set to 100% and the black to 0%.
- 100% Amplitude,
100% Saturation** Common reference for 100/7.5/100/7.5 NTSC color bars.
- 75% Amplitude,
100% Saturation** Common reference for 75/7.5/75/7.5 NTSC/EIA color bars.
- 2:2 Pull Down** The process of transferring 24-frames/sec film format into video by repeating each frame as two video fields.
- 3:2 Pull Down** A technique for presenting 24 frames/sec motion picture film on a 30 frame/sec interlaced television system. One film frame is shown for 3 TV fields and the next film frame is shown for 2 TV fields.
- 4:1:1** Digital component video format. The first number represents the sampling rate for Y, the second the sampling rate for Cb and the third the sampling rate for Cr.
- 4 stands for a sampling rate of 13.5 MHz,
2 represents a sampling rate of 6.25 MHz,
1 represents a sampling rate of 3.125 MHz.
- 4:2:0** Digital component video format used for DVD, where there is one Cb sample and one Cr sample for every four Y samples. *See 4:1:1.*
- 4:2:2** Digital component video format used for studio recordings. *See 4:1:1.*
- 4:4:4** Digital component video format for high-end studio recordings. *See 4:1:1.*
- 525/60** Other expression for NTSC television standard using 525 lines/frame and 60 fields/sec.
- 625/50** Other expression for PAL television standard using 625 lines/frame and 50 fields/sec.
- AC 3** Dolby® Digital Audio-Coding System. Also known as 5.1 channel Dolby. Providing 5 sound channels for left, centre, right, left-rear and right-rear, sub-bass.

Active Line

Active line time or active video.

The part of the video waveform (usually 64 μs), which occupies the visible part of the signal (without synch, blanking or burst). The active line time is usually 52 μs (PAL). See *Video Waveform*.

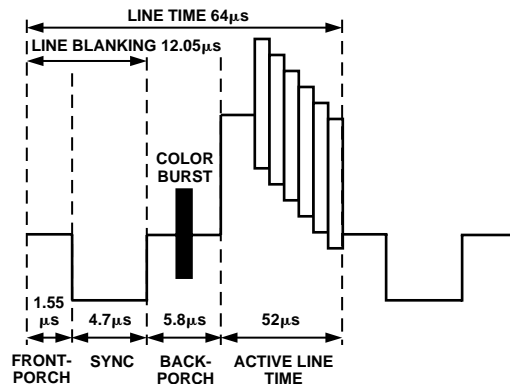


Figure 1. Video Waveform—One Horizontal Line (PAL)

Active Video

Synonym for active video time or active line time.

Acuity

The ability of the human eye to distinguish fine detail. It is usually expressed in seconds of arc.

Adaptive Filter

A filter which changes its parameters on a continual basis to guarantee a constant or desired output value.

ADC

Or A/D. Short form for analog-to-digital converter or conversion.

AES

Audio Engineering Society.

AES/EBU

Digital audio signal transmission standard for professional use, defined by the Audio Engineering Society and the European Broadcasting Union.

AFC

Automatic Frequency Control. Generally a device to maintain automatically the frequency of any source of alternating voltage within specified limits. The device is error-operated and usually consists of two parts: one part is a frequency discriminator that compares the actual and desired frequencies and produces a dc output voltage proportional to the difference between them, with the sign determined by the direction of drift; the other part is a reactor that forms part of the oscillator tuned circuit and is controlled by the discriminator output in such a way as to correct the frequency error.

AGC

Automatic gain control or automatic volume control. A device for holding the output volume of a radio receiver substantially constant despite variations in the input signal. A variable gain element in the receiver is controlled by a voltage derived from the input signal. Variations in the size of the input signal cause compensatory changes in gain in the receiver.

Aliasing

Introduction of unwanted low frequency signals during ADC due to choosing too low a sampling rate. To avoid aliasing a sample frequency of min. $2 \times$ signal frequency is required.

Alpha

A component of a pixel indicating the transparency between 0 (opaque) and unity (fully transparent) of the associated color components. Alpha can be "associated" in which case the color component values are assumed to have been premultiplied by the value of alpha or "unassociated" in which case they have not been premultiplied.

Amplitude Modulation

See *Modulation*.

ANSI

American National Standards Institute. A private, nonprofit making organization supported by a diverse constituency of private and public sector organizations. ANSI does not itself develop American National Standards, it rather facilitates development by establishing consensus among qualified groups.

Antialias Filter	A low-pass filter which ensures that no frequency of at least 1/2 the sample frequency is introduced into the circuit, usually before ADC.
Aperture Delay	Aperture delay is the time from an edge of the input clock of the ADC until the time the part actually takes the sample. Aim for a short delay.
Aperture Jitter	Variations or uncertainties in the aperture delay time.
Artifact	Some physical disruption of the image such as blemishes, noise, snow, spots.
Aspect Ratio	The ratio of the width of the picture to the height. For most current TVs, this ratio is 4:3. For HDTV, the ratio will typically be 16:9. The aspect ratio, along with the number of vertical scan lines that make up the image, determines what sample rate should be used to digitize the video signal.
ATV	Advanced Television. TV with significantly better video and audio than standard TV. Sometimes used interchangeably with HDTV but more accurately encompasses any improved television system. Also sometimes used interchangeably with the final recommended standard of the ATSC which is more correctly called DTV.
ATSC	Advanced Television Systems Committee. In 1978, the Federal Communications commission (FCC) empaneled the Advisory Committee on Advanced Television Service (ACATS) as an investigatory and advisory committee to broadcast television (ATV) standard for the United States. This committee created a subcommittee, the ATSC, to explore the need for and to coordinate development of the documentation of Advanced Television Systems. In '93 the ATSC recommended that efforts be limited to a digital television system (DTV), and in '95 issued its recommendation for a Digital Television System standard, which was approved with the exclusion of compression format constants (picture resolution, frame rate, and frame sequence).
Back Porch	The area of the video waveform between the rising edge of the horizontal sync and right before the active video. <i>See Video Waveform.</i>
Back Porch Clamping	<i>See Clamping.</i>
Bandwidth	The range of frequencies a circuit will respond to or pass through. Usually the lower and upper frequency limits are defined by the -3 dB points which is the frequency (or frequencies) where the response falls to 3 dB from the passband response (0 dB).
Baseband	When applied to audio and video, baseband means an audio or video signal that is not RF modulated (to channel 3 or 4 for example) or the signal band before further modulation is applied for transmission.
Baud Rate	The number of times per second that a system (transmission channel) changes state, where 1 baud = 1 bit/sec (binary channel) or 1 baud = 1 digit/sec (general channel).
BCA	Burst Cutting Area. A circular section near the center of a DVD disc where ID codes and manufacturing information can be inscribed in bar-code format.
Beat Frequency	The difference between color subcarrier frequency and sound subcarrier frequency, expressed in [Hz].
Betacam SP	An analog, component recording format developed by Sony. Luminance and chrominance are recorded on two separate tracks. The two color difference signals are compressed in time by two and recorded sequentially on a single track. The luminance is given a bandwidth of 4.5 MHz, the chrominance 1.5 MHz. Betacam SP is used for camcorders and VTRs. Broadcast stations and video production firms commonly use Betacam SP for source footage. The NTSC related Betacam format uses 714.3 mV peak video and includes 7.5% setup in the luminance channel. To maintain the 1 V p-p amplitude of the composite format, sync tip on luminance is -286 mV. The color difference channels, however have a range of 933.3 mV, which is 4/3 times the 700 mV range of SMPTE/EBU N10. In some cases Betacam equipment must be calibrated using 75% amplitude color bars. In the 75% luminance signal, the black to white video range is reduced from 660 mV to 495 mV. The 54 mV set up brings peak white to 549 mV. The color difference signals are reduced from 933 mV to 700 mV.

Bits per Pixel	The number of bits used to represent the color or intensity of each pixel in a bitmap. One bit allows only two values (black and white), two bits allow four values. Also called color depth or bit depth.
Black Level	The level of a video signal that corresponds to black. Conventionally 7.5 IRE for System M and EIA-343-A and 0 IRE in other systems. <i>See Pedestal.</i>
Black to White Excursion	The excursion from reference black to reference white. Conventionally 92.5 IRE (37/56 V or 660 mV); System M and EIA-343 A 100 IRE (or 700 mV) in other analog systems and codes 16–235 in component digital systems.
Blanking	<ol style="list-style-type: none">1. The process of turning off the beam in a CRT in order for a camera or monitor to accomplish beam retrace without disturbing the picture.2. The time interval for above process or the time interval during which a video signal is mandated to be at blanking level or sync level. This is also applicable in the vertical domain, the horizontal domain or both.
Block	In MPEG video a block is an 8-pixel by 8-line set of values of a luminance or a chrominance component.
BNC	BNC connector used or studio analog video that conforms to IEC 169-8. This standard defines a 75 Ω connector. BNC connections are commonly used for oscilloscopes, VCR Video IN/OUT and monitors. (The switch commonly found on monitors is used for matching impedances, since generally video systems use connectors with an impedance of 75 Ω).
Blanking Level	Or Blank Level. The level of the video signal during a blanking interval. 0 IRE by definition.
Book A	Specification for the DVD physical format (DVD ROM).
Book B	Specification for the DVD video format.
Book C	Specification for the DVD audio format.
Book D	Specification for the DVD record-once format (DVD-R).
Book E	Specification for the rewriteable DVD format (DVD-RAM).
B-Picture	One of the three picture types used in MPEG video. The others are I-pictures and P-pictures. B-pictures use past and future pictures as reference. B-pictures usually use the least number of bits or are the most compressed picture formats. They do not propagate coding errors since they are not used as a reference by other pictures. <i>See MPEG.</i>
Breezeway	The part of the video waveform between rising edge of the horizontal sync and before the start of the color burst. <i>See Active Line.</i>
Brightness	This is the intensity of the video level and refers to how much light is emitted by the display. <i>See HSI.</i>
Broad Pulse	A pulse which is part of the field sync sequence that remains at sync level for a substantially longer duration than normal line sync. Conventionally a broad pulse has a duration of 1/2 line time less the duration of normal line sync.
BT.470	Short for ITU-R BT.470. Formerly known as CCIR 470, this recommendation specifies the various NTSC, PAL, and SECAM video standards used around the world. SMPTE 170M also specifies the (M) NTSC video standard used in the United States.
BT.601	Short for ITU-R BT.601. Formerly known as CCIR 601, this recommendation was developed for the digital form of component video signals (YUV and RGB). BT.601 deals with color space conversion from R'G'B' to Y'CbCr, the digital filters, sample rates, and the horizontal and vertical resolutions. Both 4:3 and 16:9 aspect ratios are supported.

BT.653	Short for ITU-R BT.653. Formerly known as CCIR 653, this recommendation defines the various teletext standards used around the world. Systems A, B, C, and D for both 525-line and 625-line TV systems are defined.
BT.656	Short for ITU-R BT.656. Formerly known as CCIR 656, this recommendation was developed for the transmission of BT.601 Y'CbCr digital video between equipment. It defines both a parallel and serial interface.
BT.709	Short for ITU-R BT.709. Formerly known as CCIR 709, this recommendation defines the primaries for High Definition TV. These primaries are closely representative of contemporary monitors in studio video, computing and computer graphics.
Burst	<i>See Color Burst.</i>
B-Y, R-Y	General term for color difference video signals carrying blue and red color information, where the brightness, Y, has been subtracted from the blue and red RGB signals to create B-Y and R-Y color difference signals.
C_B C_R	The components of digital color difference video signals carrying blue and red color information, where the brightness, Y, has been subtracted from the blue and red RGB signals to create B-Y and R-Y color difference signals. <i>See YCrCb.</i>
CBR	Constant Bit Rate. Data compressed into a stream with a fixed data rate. The amount of compression is varied to match the allocated data rate (data rate is held constant while quality is allowed to vary), but as a result quality may suffer during high compression periods.
CCIR	Comite Consultatif International des Radiocommunications or International Radio Consultative Committee. The CCIR no longer exists, it has been absorbed into the parent body, the ITU (International Telecommunication Union). The previously known standards CCIR (extension) are now to be found under ITU-R (extension) or ITU-B (extension).
CGMS	Copy Guard Management system for NTSC systems. A method of preventing copies or controlling the number of sequential copies allowed. CGMS is transmitted on line 20 for odd fields and line 283 for even fields for NTSC. For digital formats it is added to the digital signal conforming to IEEE 1394.
Chroma	Synonym for Chrominance.
Chroma Bandpass	In a NTSC or PAL video signal, the luma (black and white) and the chroma (color) information are combined together. For decoding a NTSC or PAL video signal, the luma and chroma must be separated. The chroma bandpass filter removes the luma from the video signal, leaving the chroma relatively intact. This works reasonably well except in images where the luma information and chroma information overlap, meaning that luma and chroma occupy the same frequency. The filter can't detect the difference between the two and passes everything within a certain area. This can result in a distorted picture at certain frequencies (i.e., highly saturated colors). This problem can be overcome by using a <i>comb filter</i> , <i>chroma trap</i> or a chroma bandpass filter for Y/C separation.
Chroma Burst	Synonym for Color Burst.
Chroma Demodulator	After the NTSC or PAL video signal makes its way through the Y/C separator, (using a chroma band pass, chroma trap or comb filter) the colors must be decoded. A chroma demodulator takes the chroma output of the Y/C separator and recovers two color difference signals (typically I and Q or U and V) using the color subcarrier. With the luma information and color difference signals, the video system can figure out what colors to put on the display.
Chrominance	The color information contained in a picture or signal. It is independent of the luminance.
Chroma Trap	In an NTSC or PAL video signal, the luminance and the chrominance signals are combined together. To decode the video signals, both signals have to be separated. The chroma trap is another method to do this, the others are chroma bandpass or comb filter.

Here, the composite video signal is fed to a bandstop filter. The bandstop filter is designed with a response to remove the chrominance so that the output of the filter only contains the luminance. Some images the luminance may overlap the chrominance information and since there is no filter with an ideal response, some of the luminance signal is not well removed. This has the effect that the picture is degraded in some way. Using a comb filter for the Y/C separation yields better results than using the chroma trap or chroma bandpass method. *See Chroma Bandpass and Comb Filter.*

- CIE** Commission Internationale de l'Eclairage (International Commission on Illumination). The voluntary international standards organization that sets colorimetry standards.
- CIE D_{65}** The CIE standard spectrum or chromaticity of white, representative of northern daylight and having a color temperature of approximately 6500 Kelvin. *See Reference White.*
- CIE Luminance (CIE Y)** The CIE has defined an objective quantity related to brightness. Luminance is defined as radiant power weighted by the spectral sensitivity function (the sensitivity to power at different wave lengths) that is characteristic of vision. The luminous efficiency is defined numerically, is everywhere positive and peaks at about 550 nm (green/yellow). When a spectral power distribution is integrated using the weighting function, the result is CIE luminance. *See Luminosity Curve.*
- CIF** Common Interface Format. This video format was developed to easily allow video phone calls between countries. The CIF format has a resolution of 352×288 active pixels and a refresh rate of 29.97 frames per second. *See QCIF.*
- Clamp** This is basically another name for the dc-restoration circuit. It can also refer to a switch used within the dc-restoration circuit.
- Closed Captioning** A service which decodes text information transmitted with the audio and video signal and displays it at the bottom of the display.
- See the EIA-608 specification for (M) NTSC usage of closed captioning.
- Codec** Coder/Decoder Circuit. Circuitry or computer software that encodes and decodes a signal.
- CMYK** This is a color space primarily used in color printing. CMYK is an acronym for Cyan, Magenta, Yellow, and Black. The CMYK color space is subtractive, meaning that cyan, magenta, yellow and black pigments or inks are applied to a white surface to remove color information from the white surface to create the final color. The reason black is used is because even if a printer could put down hues of cyan, magenta, and yellow inks perfectly enough to make black it would be too expensive since colored inks cost more than black inks.
- Coherent** Two or more periodic signals that are phase-locked to a common submultiple. The subcarrier of a studio quality composite video signal is coherent with its sync.
- Color Bars** This is a test pattern used to check whether a video system is calibrated correctly. A video system is calibrated correctly if the colors are the correct brightness, hue, and saturation. This can be checked with a vector scope.
- Color Burst** A brief sample of 8 to 10 cycles of color subcarrier inserted by an encoder in the back porch of a composite color signal in order for a receiver to regenerate the color subcarrier and, therefore, the color of a picture. *See Video Waveform.*
- Color Difference** In video it is common to utilize a set of three signals: a luminance signal and two color difference signals. The luminance signal contains brightness information and the two color difference signals contain color information. The advantage of color difference coding over RGB is that spatial and/or temporal filtering may be applied to substantially reduce the information rate of the color difference components with respect to luminance without being visually perceptible. Example: $U = 0.492 (B' - Y)$.
- Color Decoder** A circuit in a video system that uses the chrominance signal of the composite video signal to derive the two color difference signals. The decoder needs a 3.58 MHz signal (for NTSC systems) that is phase locked to the color burst signal in order to recreate the correct color.

Color Killer	A color killer is a circuit that shuts off the color decoding if the incoming video does not contain color information. If no color burst is present in the signal the color killer shuts off the color decoding. For example, a color TV is going to receive material recorded in black and white. Since the black and white signal does not contain a color burst, the color decoding is shut off. Color killer circuits are used since the color decoder is still generating a small amount of color even if a black and white transmission was received. This is due to small errors in the color decoder, causing a black and white program to have faint color spots throughout the picture.
Color Primaries	Red, green and blue light.
Color Space	A color space is a mathematical representation for a color. The difference between color spaces used is how the color is represented in a video system. For example, the RGB color space is based on a Cartesian coordinate system and the HSI color space is based on a polar coordinate system. <i>See CMYK, RGB, YCrCb, YUV, HSI.</i>
Color Standard	The parameters associated with transmission of color information. Not the same as Raster Standard. Example: RGB, YCbCr or MAC component color standards or NTSC, PAL or SECAM composite color standards.
Color Subcarrier	A sine wave signal used as the basis of quadrature modulation or demodulation of chroma information in an NTSC or PAL composite color system. The color difference signals or chrominance information is modulated onto a subcarrier of frequency 3.58 MHz (NTSC) or 4.43 (PAL).
Color Temperature	Color temperature is measured in degrees Kelvin. If a TV has a color temperature of 8,000 degrees Kelvin, the whites have the same shade as a piece of pure carbon heated to that temperature. Low color temperatures have a shift towards red; high color temperatures have a shift towards blue. The standard for (M) NTSC in the United States is 6,500 degrees Kelvin. Thus, professional TV monitors use a 6,500-degree color temperature. However, most consumer TVs have a color temperature of 8,000 degrees Kelvin or higher, resulting in a bluish cast. By adjusting the color temperature of the TV, more accurate colors are produced, at the expense of picture brightness.
Color Under	A degenerate form of composite color in which the subcarrier is crystal stable but not coherent with line rate. The term derives from the recording technique used in U-Matic, Betamax, VHS and 8 mm videotape recorders, where chroma is heterodyned onto a subcarrier whose frequency is a small fraction of that of NTSC or PAL. The heterodyning process loses the phase relationship of color subcarrier to sync.
Constant Luminance CIE	In a color TV system that conveys luma in one component, the property that CIE luminance reproduced at the display is unaffected by the characteristics of transmission of the other two components. Conventional systems such as NTSC, PAL and YCrCb are close to exhibiting the constant luminance property but their color difference signals are computed from gamma corrected primaries, hence the color difference channels influence reproduced luminance as a second order effect.
Comb Filter	A digital filter which can be used to separate the chrominance from the luminance part of a composite video signal. It uses one or more line delay elements in order to exploit the line-interleaving of chroma to separate chroma from luma. Other methods for Y/C separation use chroma bandpass filters or a chroma trap. <i>See Chroma Bandpass, Chroma Trap.</i>
Component Color	A video system that conveys three color component signals independently, free from mutual interference. Examples: RGB, YCrCb, MAC.
Component Video	A video signal which keeps luminance and each of the two color difference signals separate through transmission and processing as opposed to the composite video signal which combines all the three signals into one signal. Composite signals are used in TV systems and TV transmission. Component signals are mainly used in digital video systems, video games, computer systems and multimedia systems. Example: YCrCb, YUV, S-Video.

Composite Sync	A deprecated term that means sync. The word sync alone implies both horizontal and vertical synchronization elements, so composite is redundant.
Composite Video	<ol style="list-style-type: none">1. A video signal including a sync component.2. A video signal including sync, luminance, chrominance and color burst (subcarrier) components. Example: NTSC TV signal, PAL TV signal.
Contouring	An image artifact caused by insufficient quantization resolution on low level video signals and results in an error signal which is visible on low frequency signals such as backgrounds or scenes with low movement.
Contrast	Refers to how far the “whitest white”s are from the “blackest blacks” in a video waveform. If the peak white is far away from the peak black, the image is said to have high contrast.
Cropping	To trim or remove a section of the video picture in order to make it conform to a different shape. Cropping is used in the pan & scan process but not in the letterbox process. <i>See Pan & Scan, Letterbox.</i>
CPU	Central Processing Unit. The integrated circuit chip that forms the brain of a computer or other electronic device.
Cross Color	An artifact of composite color encoding and/or decoding that involves the erroneous interpretation of luminance information as color. The cross color artifact appears frequently when luma information, having a frequency near that of the color subcarrier appears as a wirling color rainbow pattern.
Cross Luminance	An artifact of composite color encoding and/or decoding that involves the erroneous interpretation of color information as luminance. Cross luminance frequently appears as dot crawl or hanging dots.
Cross Modulation	A condition when one signal erroneously modulates another signal.
Crosstalk	Interference from one signal that is detected on another.
CRT	Cathode Ray Tube. A video display device that operates by electron beam bombardment of an electroluminescent phosphor in a vacuum.
CVBS	Color Video Blanking and Sync. Another term for composite video.
D1	The first component (4:2:2) digital video tape format, uncompressed, using a tape width of 19 mm, having a tape speed of 286.6 mm/s and a play time of 101 min (L), conforming to ITU-R BT.601 standard. Used in high-end post-production.
D2	Digital composite video tape format for NTSC (525/59.94) or PAL (625/50) sampled at $4 \times F_{SC}$, uncompressed. Using a tape width of 19 mm, having a tape speed of 131.7 mm/s and a play time of 208 min (L).
D2-MAC	A MAC system, based on 625/50/ 2:1 scanning and is used in Europe for satellite broadcasting. <i>See MAC.</i>
DCT	<i>See Discrete Cosine Transform.</i>
Decimation	A form of subsampling or sampling to reduce the amount of data. Decimation filters are used to discard existing samples. The resulting information is reduced in size but may suffer from aliasing. Spatial decimation is used for pixels, temporal decimation is used for pictures.
Decoder	<ol style="list-style-type: none">1. A circuit that decodes compressed audio or video taking an encoded input stream and producing an output such as audio or video.2. A circuit that converts composite video to component video or matrixed audio to multiple channels.
De-Emphasis	Also referred to as post-emphasis and post-equalization. De-emphasis performs a frequency-response characteristic that is complementary to that introduced by pre-emphasis. <i>See Pre-Emphasis.</i>

De-Emphasis Network	A circuit used to restore the pre-emphasized frequency response to its original form. <i>See Pre-Emphasis.</i>
Demodulation	The process of recovering an original signal from a modulated carrier.
Demodulator	In video, demodulation is the technique used to recover the color difference signals in NTSC or PAL systems. <i>See the definitions for chroma demodulator and color decoder; those are two other names for a demodulator used in a video application.</i>
Differential Gain	In a composite video system, a nonlinear effect that causes the luminance level to affect the subcarrier amplitude. It shows up as a variation of color saturation with image brightness. <i>See CCIR Rec 654 for more detail.</i>
Differential Phase	In a composite video system, a nonlinear effect that causes the luminance level to affect the subcarrier phase. It shows up as a variation in color hue with image brightness. <i>See CCIR Rec 654 for more detail.</i>
Digital Video	<i>See DV.</i>
Discrete Cosine Transform	DCT is part of the compression methods used for still pictures and moving pictures. Compression of video or picture data reduces the actual amount of data to be stored or to be transmitted. DCT is commonly used for JPEG and MPEG standards. It is a mathematical process (Fourier Transform) which transforms blocks of pixel values into blocks of spatial frequency values. This process in itself "reduces" the data by a half. The lower frequency components are organized into the upper left corner of these blocks (8 × 8 pixel values) and high frequency components in the lower right corner. Since the sensitivity of the eye decreases as spatial frequency increases, high frequency components are discarded above a given threshold. The data is then requantized, read out in zig-zag format resulting in a series of zeroes. The amount of data can then further be reduced using RLC and VLC. <i>See Run Length Coding, Variable Length Coding.</i>
Display Rate	The number of times/sec the image in a video system is refreshed. Progressive scan systems such as film or HDTV change the image once per frame. Interlace scan systems such as standard TV change the image twice per frame, with two fields in each frame. Film has a frame rate of 24 fps but each frame is shown twice by the projector for a display rate of 48 fps. NTSC TV has a rate of 29.97 fps, PAL 25 fps.
Down Converter	A circuit used to lower one or more high-frequency signals to a lower, intermediate range.
Down Link	The frequency, carrier satellites use to transmit data to earth stations, usually in 4 GHz region. The uplink frequency is the frequency to transmit from earth to satellite, is usually in the 6 GHz region.
DV	Digital Video. Usually refers to the digital videocassette standard developed by Sony and JVC. It uses a 4:1:1 component format and 5:1 intra-frame compression onto a 6.35 mm tape.
Dynamic Range	Amplitude range a system can handle before it introduces distortion into the signal. Measured in [dB] as the range between the noise floor and the loudest signal possible before distortion. Dynamic range is not the same as signal-to-noise ratio. <i>See Signal-to-Noise Ratio.</i>
DVD-Video	Digital Video Disc. This standard specifies a single layer DVD-ROM with a capacity of 4.7 Gbytes (8.5 Gbytes double layered) that is able to store 2 h 13 min of broadcast quality video. The compression standard for video is MPEG2. Sound quality is improved supporting AC3 for NTSC countries and a similar version, MPEG2 audio for European countries.
DVD-ROM	The base format of DVD. A DVD-ROM can store essentially any form of digital data, writing to the disc is not possible.
ECC	Error Correction Code.
EDTV	Enhanced Definition Television. A system which uses existing transmission equipment to send an enhanced signal which looks the same on existing receivers but carries additional information to improve the picture quality on new enhanced receivers. Example: PAL plus.
EIA	Electronics Industries Association.

Encoder	<ol style="list-style-type: none">1. A circuit which converts digital component video into analog composite video.2. A circuit which takes 2 color difference signals and combines them into one chrominance signal.3. A circuit which compresses data before transmission.
Equalization Pulses	<p>In both 525/59.94 and 625/50 systems the horizontal sync pulse has a duration of 4.7 μs. Vertical sync is identified by broad pulses, which are serrated in order for a receiver to maintain horizontal sync even during the vertical interval. The start of the first broad pulse identifies the field sync datum (0_V). Narrow equalization pulses are present during intervals immediately before and immediately following the broad pulses. They last half the sync pulse duration at twice the line rate.</p> <p>Originally the equalization pulses were the ones interposed between the line syncs, but the term now refers to all of the narrow pulses. The absence of sync level between the end of a broad pulse and the start of the following sync was called serration.</p> <p>As said before, an equalization pulse has half the duration of a normal sync. The duration of a vertical or broad pulse is half the line time, less a full sync width.</p> <p>A 525/59.94 system has three lines of pre-equalization pulses, three lines of vertical sync, and three lines of post-equalization pulses.</p> <p>A 625/60 system has two and one-half lines (5 pulses) of each of pre-equalization, broad and post-equalization pulses.</p>
Even Field	<p>In a 2:1 interlaced system, the field that begins with a broad pulse halfway between two line syncs. For NTSC that is line 262 1/2 – 525, for PAL that is line 312 1/2 – 625.</p>
Excursion	<p>The amplitude difference between two levels.</p>
Euro Scart	<p>A 21-pin connector which allows mono or stereo audio, composite video, S-Video and RGB video to be transmitted between equipment using a single cable.</p>
F_H	<p>Line frequency (horizontal) 15 374 lines/sec Hz for NTSC (525 lines \times 29.97 Hz).</p>
Field	<p>The smallest time interval of a video signal that contains a set of scanning lines covering the entire picture height, along with the associated sync elements. NTSC field contains 262 1/2 lines, PAL 312 1/2 lines.</p>
Field Rate	<p>The rate at which fields are displayed on a TV screen. To maintain persistence of vision or to avoid flicker, a rate of ca. 30 pictures/sec is necessary.</p> <p>Example: In a PAL system the Field Rate is 50 Hz (50 Fields/sec) or 25 Frames/sec.</p>
Field Scan Frequency	<p>Synonym for Field Rate. <i>See Field Rate.</i></p>
Field Sync	<p>The sync pulse pattern that occurs once per field and defines the start of a field. Field sync contains the 0_V datum. In interlaced systems field sync is a sequence comprising pre-equalization pulses, broad pulses and post-equalization pulses.</p>
FIFO	<p>First-In First-Out Memory. A sequential memory in which the stored data can only be read from in the order in which it was written to.</p>
FIR	<p>Finite Impulse Response Filter. A type of digital filter which has a finite output response, as opposed to a IIR filter with an infinite output response. It needs usually more coefficients to define signal performance than an IIR filter but on the other hand it can not become unstable.</p> <p>A common way to express the FIR response is: $y(n) = x(n) + x(n-1)$.</p> <p>i.e., present output = present input + previous input where n = time interval; x = input; y = output.</p>
Firewire	<p>A standard for transmission of digital data between external peripherals, including consumer audio and video devices. The official name is IEEE 1394, based on the original firewire design by Apple Computer.</p>
Flicker	<p>Flicker occurs when the frame rate of the video is too low. This means the eye can perceive the rate at which a program is shown, i.e., the scene is not perceived as continuous motion.</p>

Flicker Filter	Video data from a VGA is not interlaced. This data must be converted into interlaced format for display on a TV. If every second line is discarded of the noninterlaced data, flicker may occur if, for example, video information is contained in just one noninterlaced line. Flicker will also be perceptible at the top and bottom of multiline objects. A flicker filter overcomes these problems in computing a weighted average of two or three adjacent lines (noninterlaced) for each line of output (interlaced).
Flyback	Synonym for Retrace.
FM	Frequency Modulation. <i>See Modulation.</i>
Frame	In a system with 2:1 interlace, a frame comprises 2 fields. Each of which contains half the scanning lines and half the picture lines of the frame. Example: In a PAL system a field is made up of 312.5 lines, a frame consists of 2 fields (625 lines) and is transmitted 25 times a second.
Frame Buffer	A memory device which is able to store the information of one frame of video data. The size of the buffer will depend on horizontal resolution, number of scan lines and the color space used (RGB, YIQ or YUV etc.). Example: 640 pixels horizontal resolution, 480 scan lines, RGB color space will need: $640 \times 480 \times 3 = 921\,600 \text{ bytes or } 900 \text{ KB.}$ Frame buffers are used to display interlaced video data on computer screens which use a noninterlaced display mode. Generally the video source is frame rate converted to generate a new frame rate that matches the computer display frame rate. Most solutions simply store the video and redisplay the video frames at the computer display rate. The video frame therefore must be stored in a frame buffer to allow it to be displayed for multiple computer display frames.
Frame Doubler	A video processor which increases the frame rate (or display rate) in order to create a smoother looking video display.
Front Porch	This is the area of the video waveform that sits between the start of horizontal blank and the leading edge of (start of) horizontal sync. <i>See Video Waveform.</i>
F_{sc}	Subcarrier frequency onto which the color signal is modulated. For NTSC 3.58 MHz, for PAL 4.43 MHz.
Gamma Correction	For mathematical simplicity in applications such as filtering, color space correction, image compression etc., the video signal is assumed to be linear. However, the video signal from the camera or picture tube is not. The characteristics of the displays using phosphors are nonlinear. In terms of light input to voltage output this means, if an equal-increment staircase waveform is applied to the electrical input of the picture tube, the light output will not go up in corresponding steps. At high brightness levels the radiations will be emphasized or stretched, whereas low-key steps will be compressed. This means that the video signal needs to pass through a compensating circuit, with a gain/level characteristic equal and opposite to that of the tube or camera. The process of taking a nonlinear video source and making it linear is called gamma correction. The term is often used in photography. Many display devices use a cathode ray picture tube (CRT). The transfer function of the CRT produces intensity that is proportional to some power of signal voltage (usually about 2.5). This power value is called gamma. As a result high-intensity ranges are expanded and low-intensity ranges are compressed, as can be seen in the figure below. Gamma correction is applied at two stages: 1. To compensate for the signal/CRT transfer function, usually:

$$R_{\text{display}} = R_{\text{received}}^{0.45}$$

$$G_{\text{display}} = G_{\text{received}}^{0.45}$$

$$B_{\text{display}} = B_{\text{received}}^{0.45}$$

2. To compensate for the CRT/signal transfer function, usually:

$$R_{\text{display}} = R_{\text{received}}^{2.2}$$

$$G_{\text{display}} = G_{\text{received}}^{2.2}$$

$$B_{\text{display}} = B_{\text{received}}^{2.2}$$

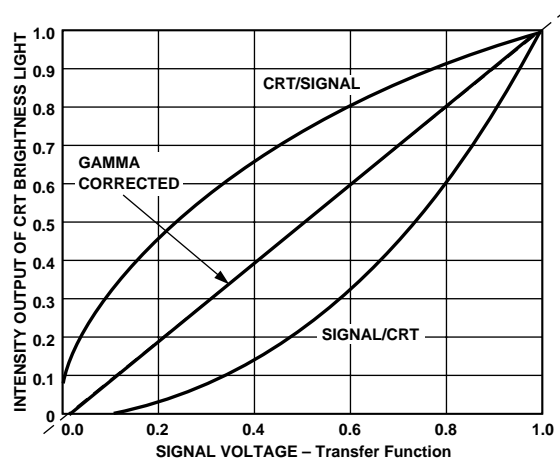


Figure 2. Gamma-Correction Curves for Light Output Compensation in a CRT

By gamma correcting the video signal before use the intensity output of the CRT is roughly linear and transmission-induced noise is reduced.

Typical gamma values for NTSC are: 2.2, 2.35, 2.55 and their according reciprocal values: 0.455, 0.426, 0.392.

Typical gamma values used for PAL systems: 2.2, 2.8 and their according reciprocal values: 0.455, 0.357.

GCR Ghost Cancellation Reference Signal. A reference signal on (M) NTSC scan lines 19 and 282 and (B, D, G, H, I) PAL scan line 318 that allows the removal of ghosting from TVs. Filtering is employed to process the transmitted GCR signal and determine how to filter the entire video signal to remove the ghosting. ITU-R BT.1124 defines the standard each country uses.

Genlock A video signal provides all of the information necessary for a decoder to reconstruct the picture. This includes brightness, color, and timing information. To properly decode the video signal, the decoder must be "genlocked" to the video signal. The decoder identifies the color burst of the video signal and reconstructs the original color subcarrier that was used by the encoder. This is needed to properly decode the color information. The decoder also generates a sample clock (done by looking at the sync information within the video signal), used to clock pixel data out of the decoder into a memory or another circuit for processing.

The circuitry within the decoder that does all of this work is called the genlock circuit. Although it sounds simple, the genlock circuit must be able to handle very bad video sources, such as the output of VCRs. In reality, the genlock circuit is the most complex section of a video decoder.

Gray Scale The term gray scale has several meanings. In some instances it means the luma component of color video signals. In other cases, it means a black-and-white video signal.

Green Book A document developed in 1987 by Philips and Sony as an extension to CD-ROM XA for the CD-i system. It allows the synchronized interleaving of audio and video data for interactive digital movies.

H.320, H.261 ITU-T H.320 is a family of standards developed for video conferencing using ISDN. It references H.261 (for video); G.711, G.722, and G.728 (for audio); H.221, H.230, H.231, H.233, H.234, H.242 and H.243 (for control).

H.324, H.263	ITU-T H.324 is a family of standards developed for video conferencing using conventional phone lines. It references H.261 and H.263 (for video); G.723 (for audio); H.223 and H.245 (for control).
Hanging Dots	A cross luminance artifact that results from a comb filter decoder, appearing as fine stationary patterns of dark and light dots along a horizontal edge in a picture having a saturated vertical color transition.
Harmonics	A signal of a periodic quantity, present in a complex wave, having a frequency that is an integral multiple of the fundamental frequency.
High Definition Television, HDTV	This term refers to high-resolution TV standards. HDTV are defined as having twice the vertical and twice the horizontal resolution of conventional television, a picture aspect ratio of 16:9, a frame rate of at least 24 Hz and at least two channels of CD quality sound. HDTV is capable of generating pictures substantially brighter, sharper and of better colorimetry than 35 mm motion picture film. HDTV equipment is now commercially available and HDTV is expected to be of great importance in industrial, scientific and medical applications as well as in entertainment.
High Frequency Subcarrier Pre-Emphasis	<i>See Pre-Emphasis.</i>
Horizontal Blanking	The time interval between the end of the picture information on one line and the start of the picture information on the following line. <i>See also Video Waveform.</i>
Horizontal Drive	A pulse containing horizontal synchronization information that begins at the end of the picture information on a line and ends at the trailing edge of the sync. <i>See also Video Waveform.</i>
Horizontal Line Rate	Measure of lines over time. For NTSC systems : 525 horizontal lines/frame, where each frame is send at a rate of 29.97 Hz, so that the horizontal line rate would be: 15,737.25 lines/sec.
Horizontal Line Resolution	Basic measurement of how much information is on the screen. The horizontal line resolution for NTSC and PAL is 720 pixels/active line.
Horizontal Retrace	Synonym for horizontal sync. <i>See Horizontal Sync.</i>
Horizontal Scan Rate	This is how fast the scanning beam in a display is swept from side to side. In the NTSC system this rate is 63.556 μ s/line, or 15.734 kHz. That means the scanning beam in the TV moves from side to side 15,734 times a second.
Horizontal Sync	This is the portion of the video signal that indicates the display where to place the image in the left-to-right dimension. The horizontal sync pulse tells the receiving system where the beginning of the new scan line is. <i>See Video Waveform.</i>
Horizontal Sync Pulses	Synonym for horizontal sync. <i>See also Video Waveform.</i>
Horizontal Sync Signal	Synonym for horizontal sync pulses.
House Sync	Synonym for black burst.
Horizontal Scaling	<i>See Scaling.</i>
HSI	HSI stands for Hue, Saturation and Intensity. HSI is based on polar coordinates, while the RGB color space is based on a three-dimensional Cartesian coordinate system. The intensity, analogous to luma, is the vertical axis of the polar system. The hue is the angle and the saturation is the distance out from the axis. HSI is more intuitive to manipulate colors as opposed to the RGB space. For example, in the HSI space, to change red to pink requires to increase the saturation. In the RGB space this is not possible. In the HSI space, to change the color from purple to green, requires to adjust the hue. Again, this is not possible in the RGB space.
HSL	This is similar to HSI, except that HSL stands for Hue, Saturation and Lightness. <i>See HSI.</i>
HSV	This is similar to HSI, except that HSV stands for Hue, Saturation and Value. <i>See HSI.</i>
HSYNC	Abbreviation for horizontal sync.

Hue	Hue refers to the wavelength of the color. Hue is known in common terms as the actual color, whereas saturation refers to the level of white contents in a color and brightness refers to the intensity of the color. <i>See also HSI.</i>
I²C	Inter Integrated Circuit. Is a bidirectional, two line interface to interface integrated circuits. Capable of transmitting 100 Kbits/sec in normal mode or 400 Kbits/sec in fast mode. In conjunction with a processor it can be used to control TV reception, TV decoders/encoders, AD or DA conversion. In audio it can be used to control tone, volume, AD or DA conversion, amplification, etc.
IDTV	Improved Definition TV. IDTV is different from HDTV. IDTV is a system that improves the display of NTSC or PAL systems by adding processing in the receiver.
IEC	International Electrotechnical Commission. The IEC aim is to promote international cooperation on all questions of standardization and related matters, such as the assessment of conformity to standards in the fields of electricity, electronics and related technologies. The IEC works closely with the Comite Europeen de Normalization Electrotechnique (CENELEC) and the ITU. The US member of IEC is the United States National Committee (USNC).
IEEE	Institute of Electrical and Electronics Engineers. The IEEE is the world's largest technical professional society. The IEEE is a member of ANSI which serves as a representative to the IEC and ISO through the USNC.
IF	Intermediate Frequency. A term used in radio reception in which the incoming signal is fed into a mixer and mixed with a locally generated signal from a local oscillator. The output consists of a signal of the carrier frequency equal to the difference between the locally generated signal and the carrier frequencies but containing all the original modulation. This signal is called the intermediate frequency signal or IF and is then amplified and detected in an intermediate frequency amplifier and passed on to the audio frequency amplifier.
IIR	Infinite Impulse Response filter. A type of digital filter which has a infinite output response, as opposed to a FIR filter with a finite output response. It needs usually less coefficients to define signal performance than a FIR filter but on the other hand it can become unstable since part of the output is fed back to the input. A common way to express the IIR response is: $y(n) = x(n) + y(n-1)$ i.e., present output = present input + previous output where n = time interval; x = input; y = output.
Image Buffer	Synonym for frame buffer .
Image Compression	Image compression is used to reduce the amount of data required to store or transmit pictures. Image compression methods include JPEG for still pictures and MPEG for moving pictures. The actual compression methods use DCT or wavelet technology. <i>See MPEG, JPEG, DCT.</i>
Intensity	Synonym for brightness.
Interframe	In TV systems, any action that makes use of the content of more than one frame. Example: Interframe compression which in principle is using a system that is based on how much change there was between two adjacent frames.
Interlace	An interlaced raster system is one where generally two interleaved fields are used to scan out one video frame. Therefore, the number of lines in a field are 1/2 of the number of lines in a frame. For NTSC: 262.5 lines/field 525 lines/frame For PAL (B, D, G, H, I): 312.5 lines/field 625 lines/frame Each field is drawn on the screen consecutively.

	The interlaced system originated from the frame rate. A large TV screen that was updated at 30 frames/sec would flicker, i.e., the image would begin to fade away before the next one was drawn on the screen. By using two fields, each containing 1/2 of the information that makes up the frame and each field being drawn on the screen consecutively, the field update rate is 60 fields/sec.
Interleave	In digital systems, a technique used in error correction that rearranges the data in a specified way, usually to cause bursts of transmission errors to be spread out in the data.
Interpolation	A mathematical method to regenerate missing or needed information. The principle is very simple in taking two samples (previous and next) and calculating the average value of these two samples and inserting the result between the two (present). Interpolation is used in error correction and in resolution conversions (4:2:2 to 4:4:4).
Intraframe	In TV systems, any action that uses only information from a single frame.
I-Picture	Or Intra Pictures. One of the three picture types used in MPEG video. The others are B-pictures and P-pictures. I-pictures are coded using only information present in the picture itself. I-pictures provide potential random access points in the compressed video data. They typically use about 2 bits per coded pixel. <i>See MPEG.</i>
IQ	Color difference signals used in NTSC systems. $U = 0.492 (B' - Y)$ $V = 0.877 (R' - Y)$ $I = V \cos 33^\circ - U \sin 33^\circ$ $Q = V \sin 33^\circ - U \cos 33^\circ$
IRE	An arbitrary unit used to describe the amplitude characteristics of a video signal. Pure white is defined to be 100 IRE and the blanking level is defined to be 0 IRE.
ISO	International Standardizing Organization. A worldwide cooperative organization responsible for standards in many fields. The mission of ISO is to promote the development of standardization and related activities in the world with a view to facilitate the international exchange of goods and services and to develop cooperation in the spheres of intellectual, scientific, technological and economic activity. ISO's work results in international agreements which are published as International Standards. The scope of ISO is not limited to any particular branch. It covers all standardization fields except electrical and electronic engineering, which is the responsibility of the IEC and ITU. The work in the field of information technology is carried out by a joint ISO/IEC technical committee (JTC1).
ITU	International Telecommunications Union is an intergovernmental agency. It is comprised of governments or nations. In addition to the primary governmental membership there are so called Sector Members. Sector Members are nongoverning who serve in advisory capacities. ITU Standards are organized by series and cover two main sectors: Radio Communication Sector, former CCIR and the Telecommunication Standardization Sector, former CCITT. ITU-R BT stands for ITU standard, sector Radio Communications, series Broadcasting service for TV.
ITU-R BT.470	See BT.470.
ITU-R BT.601	See BT.601.
ITU-R BT.653	See BT.653.
ITU-R BT.656	See BT.656
Jitter	Short-term instabilities in either amplitude or phase of a signal. It has the effect of causing momentary displacements of the image on the screen, giving it a jerky or jittery appearance. In video systems it is caused by momentary errors of synchronization between the scanner and receiver in a TV and will result in jitter of the received images. Jitter in digital audio recording is equivalent to wow and flutter in an analog tape recording system.

JPEG	Joint Photographic Experts Group was formed to define an open system coding scheme for the compression of still images in such a way that they could be easily stored and transferred between computers on Local Area Networks or across the Internet. In order to do this it was recognized that a significant amount of compression would be needed. JPEG compresses each frame without reference to the previous one. Two identical frames sent sequentially will each be coded in the same way despite the fact that in reality hardly any new information is contained in the second frame. It is therefore unsuitable for moving pictures. JPEG allows a compression factor of more than 10 without loss of picture quality.
KELL Factor	<p>A value between 0.7 – 0.85 (usually 0.745).</p> <p>The relationship between the total number of scanning lines per field and the corresponding bandwidth of the video signal is given by the Kell factor. In video systems employing horizontal and vertical scanning, a factor that expresses the ratio of the observed vertical resolution to the total number of scanning lines.</p>
Key	A component signal indicating the transparency of the associated color components. Where “0” represents opaque and “unity” full transparency. A key is implicitly assumed not to have been pre-multiplied by the value of alpha. So a subsequent compositing operation is performed as $\text{composite} = \text{key} \times \text{foreground} + (1-\text{key}) \times \text{background}$. <i>See also Alpha.</i>
Letterbox	A form of video where black horizontal mattes are added to the top and bottom of the display area. The letterbox method preserves the entire video picture, as opposed to pan & scan. DVD-Video players can automatically letterbox a widescreen picture (aspect ratio of 16:9) for display on a standard TV screen with an aspect ratio of 4:3.
Level	The amplitude of a video signal or one of its components. Expressed in units of volts, mV, IRE units or digital code value.
Line Doubler	A video processor that doubles the number of lines in the scanning system in order to create a display with scan lines that are less visible. Line doublers are used in interlaced to progressive scan conversion.
Line Store	A line store is a memory buffer used to hold one line of video and is used in systems which process one video line at a time.
Line Time	The time interval between O_H data or the time taken for a complete scan line. Example: In a PAL system the line time is 64 μs .
Line	Same as a horizontal scan line or horizontal line. <i>See also Video Waveform.</i>
Line Frequency	<ol style="list-style-type: none">1. The frequency of horizontal scanning for conventional video: 15.7 kHz.2. AC power line frequency or mains frequency: 50 Hz or 60 Hz.
Line Scan Frequency	Synonym for line frequency. <i>See Line Frequency.</i>
Line Sync	The sync signal pulse transition that defines the start of a scan line. Line sync may be the start of a normal sync or the start of an equalization or broad pulse. <i>See also O_H Datum.</i>
Linearity	Any device that has an output directly proportional to the value of the input and varies continuously with it.
Locked	When a PLL (Phase Locked Loop) is accurately producing horizontal syncs that are lined up precisely with the horizontal syncs of the incoming video source, the PLL is said to be “locked.” When a PLL is locked, the PLL is stable and there is minimum jitter in the generated pixel clock.
Longitudinal Time Code	<i>See LTC.</i>
Loop Filter	Is used in a PLL design to smooth out tiny inaccuracies in the output of the phase comparator that might drive the loop out of lock. The loop filter helps to determine how well the loop locks, how long it takes to lock and how easy it is to cause the loop out of lock.

Low-Pass Filter	A filter which allows all signals below the given cut-off frequency to pass through a system. All signals above the given cut-off frequency are cut off or significantly reduced in amplitude.
LTC	Longitudinal Time Code. Time code information is stored on audio tracks, requiring an entire field's time to store the time code information.
Luma	A video signal representative of the monochrome component of a scene, i.e., black and white TV. In conventional 525 and 625 line TV systems, it is standard to compute the luminance from the gamma corrected red, green and blue primaries R', G', B' as $Y' = 0.299 R' + 0.587 G' + 0.114 B'$.
Luma Bandpass	A filter used to pass luma information only. It is used for the same purpose as a chroma bandpass filter. <i>See Chroma Bandpass.</i>
Luma Delay	Luma delay is used in PAL/NTSC encoding and color decoding in TV systems and processing of luminance in VTRs. The Y signal occupies a greater bandwidth than the low definition, narrowband chroma. This also means, that the signal is delayed less as the bandwidth of a circuit increases. Without a delay, the chroma would be printed slightly later than the corresponding luminance signal.
Luminance	Synonym for Luma.
Luminosity Curve	A function that expresses the apparent brightness of the spectral colors. It is used in video systems to calculate the luminance signal.

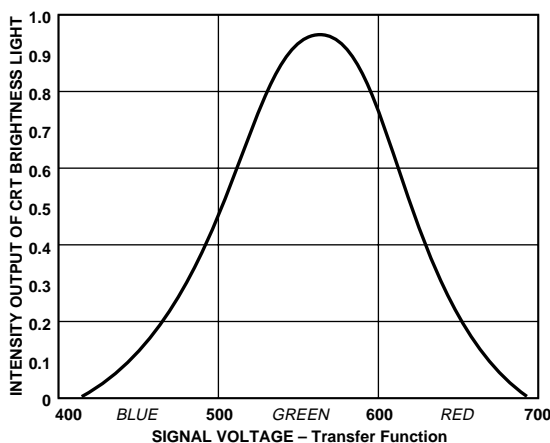


Figure 3. Luminous Efficiency Function

Lumped	Any circuit parameter, such as inductance, capacitance or resistance that can be treated as a single parameter at a point in the circuit for the purposes of circuit analysis over a specified range of frequencies. As opposed to distributed parameters, such as transmission lines where the parameter value is considered to be distributed along its length and is not the same at any one point along the line.
MII	A component video format developed by Matsushita. It can be considered to be one of the most popular broadcast quality component formats with quality similar to BetacamSP. Large users of MII include NHK, NBC. Recording techniques are similar to BetacamSP. MII uses some enhancements which compensate for the lower tape speed. The signal consists of a luminance component, a scaled R-Y and a scaled B-Y component. MII has a range of 647 mV with a maximum value of 700 mV and a minimum value of 53 mV. The sync bottom level is at -300 mV, the p-p value 1000 mV.
Main Level	MPEG 2 standard has four levels which define the resolution of the picture, ranging from SIF to HDTV and five profiles which determine the set of compression tools used.

The four levels can be described as:

1. Low Level: SIF resolution used in MPEG 1 (up to 360×288 pixels)
2. Main Level: using 4:2:0 standard (720×576 pixels)
3. High 1440 Level: aimed at HDTV (up to 1440×1152 pixels)
4. High Level: wide screen HDTV (up to 1920×1152 pixels)

See Main Profile.

Main Profile

MPEG2 standard uses 4 levels (see above) which define picture resolution and five profiles which define the compression tools used.

1. Simple profile: is defined in order to simplify the encoder and the decoder at the expense of a higher bit rate.
2. Main profile: best compromise with current technology between compression rate and cost.
3. SNR profile: a quality tradeoff is made against SNR performance. A low bit rate decoder will have full resolution but will have less signal-to-noise ratio than a high bit rate one.
4. Spatial profile: A tradeoff against spatial resolution. The low bit rate receiver produces a picture with less resolution than the full bit rate one.
5. High profile: intended for HDTV broadcast applications in 4:2:0 or 4:2:2.

Table I. MPEG Levels and Profiles

	Simple	Main	SNR	Spatial	High
High		4:2:0 1920 × 1152 80 Mbits/s I, B, P Pictures			4:2:0 or 4:2:2 1920 × 1152 100 Mbits/s I, B, P Pictures
High 1440		4:2:0 1440 × 1152 60 Mbits/s I, B, P		4:2:0 1440 × 1152 60 Mbits/s I, B, P	4:2:0 or 4:2:2 1440 × 1152 80 Mbits/s I, B, P
Main	4:2:0 720 × 576 15 Mbits/s I, P	4:2:0 720 × 576 15 Mbits/s I, B, P	4:2:0 720 × 576 15 Mbits/s I, B, P		4:2:0 or 4:2:2 720 × 576 20 Mbits/s I, B, P
Low		4:2:0 360 × 288 4 Mbits/s I, B, P	4:2:0 360 × 288 4 Mbits/s I, B, P		

MAC

Multiplexed Analogue Components. A hybrid system introduced as a prestage to digital broadcasting using satellite transmission. The system aimed for improved picture and sound quality in using FM transmission and digital sound. To receive MAC signals it is necessary to have an add-on unit to conventional TV sets.

The digital part of the MAC format contains audio and facilities for voice channels, multilingual, teletext, computer access to Internet, captioning, picture format and control messages.

The analog part of the MAC format contains U or V information and Y information, they are kept separate.

Macro Block

The MPEG standard defines a hierarchy or data structures in the video stream consisting of: video sequence, group of pictures, pictures, slices, macro blocks, block.

A macro block consist of a 16 pixels by 16 lines section of luminance components and the corresponding 8 pixels by 8 lines section of the two chrominance components. A macro block contains four luminance blocks and one block for each color component. *See Block.*

Macrovision

An antitaping process for VHS video tapes and digital video systems. The digital video source may be from a satellite, digital VCR, cable system etc. Macrovision works due to the differences in the way VCRs and TVs operate. The automatic gain control circuits within a TV are designed to respond slowly to change. Those for a VCR are designed to respond quickly to change. The Macrovision technique attempts to take advantage of this by modifying the video signal so that a TV will still display it but the VCR will not record a viewable picture.

MESECAM	Middle East SECAM or (B, G, D, K) SECAM. France uses (L) SECAM.
Mixer	Synonym for frequency changer. A device that is used in superheterodyne reception to produce an output signal of different frequency from the input signal. The received amplitude modulated carrier wave is mixed with a locally generated signal from a beat-frequency oscillator to produce an intermediate-frequency signal that retains the amplitude modulation characteristics of the original signal. The amplitude of the output signal has a fixed relationship to the input signal amplitude and is usually a linear function of it.
Modulation	<p>In general, the alteration or modification of any electronic parameter by another. In particular, a process by which certain characteristics of one wave (carrier) are modulated or modified in accordance with a characteristic of another wave or signal (modulator). Expressed in another way, impressing of a signal waveform (usually video, sound or digital pulses) onto a carrier wave. The resultant composite signal is the modulated wave.</p> <p>The characteristics of the carrier that may be modulated are the amplitude (amplitude modulation) or the phase angle (angle modulation). Particular forms of angle modulation are phase modulation and frequency modulation.</p> <p>The nature of the carrier wave is dependent on the medium to be traversed (space, cable, optical fibre), the distance to be covered and the nature of the information to be carried.</p> <p>For example, the MF frequency band is suitable for long-distance broadcasts of rather indifferent quality sound signals but quite useless for TV. SHF is well suited to a "beamed" TV broadcast service from an orbiting satellite. For the actual programme material, the carrier is irrelevant because it acts purely as a vehicle on which the wanted signal travels, being discarded at the receiving end once its usefulness has been realized.</p> <p>The most common modulation types used for TV and video systems are amplitude modulation (AM) and frequency modulation (FM).</p> <p>AM is a modulation or coding scheme, where the carrier's amplitude is changed in accordance to amplitude changes in programme material as opposed to FM where the carrier's frequency is changed in accordance to amplitude changes in programme material.</p> <p>Whatever type of modulation is used, sidebands are produced. The modulated signal can be shown to become a "group" consisting of a central frequency (carrier) with a pair of symmetrical "wings" consisting of a number of signals whose displacement from the carrier wave and amplitude depend on the excursions of the modulation signal. This results in a spread of signals across the frequency spectrum.</p> <p>The production of sidebands are slightly different for AM and FM.</p> <p>In AM the modulation results in a dc level, components at the modulating and carrier frequencies, components at the sum and difference of these frequencies and harmonics at these frequencies.</p> <p>In FM the sidebands are spaced on either side of the carrier by multiples of the modulating frequency, although only those relatively close to the carrier are significant in the reception process. Also, in FM the spread of sidebands is infinite.</p> <p>The required bandwidths are:</p> <p>For AM: $2 \times (\text{base band})$</p> <p>For FM: $2 \times (\delta_{\text{MAX}} + \text{base band})$, where</p> <p style="margin-left: 40px;">δ_{MAX} = maximum frequency shift caused by the signal or the maximum change in frequency [Hz] or</p> <p style="margin-left: 40px;">$\beta = \delta_{\text{MAX}} / f_{\text{SIGNAL}}$, where</p> <p style="margin-left: 40px;">β = modulation index</p> <p style="margin-left: 40px;">f_{SIGNAL} = highest signal frequency</p> <p>These bands of frequencies have to pass through the various types of equipment (amplifiers, aerial systems, detectors etc.) in its passage from programme source to the viewer's home. The given bandwidth of any such equipment will determine how much of the original signal gets through.</p>

If the bandwidth performance of the equipment is too small, it will eliminate some of the “detail” information (usually high frequency end) or distort the signal in some way.

If the bandwidth is too large, it would allow undue “noise” and other unwanted signals to enter the system and thus detract from the quality of the programme material.

In any case the bandwidth spread of any transmission must be limited to the minimum possible spectrum space to conserve valuable band space and prevent mutual interference with adjacent channels (rigidly-kept channel widths are specified for all types of transmission).

Modulator	A circuit that combines two different signals in such a way that they can be separated at a later stage.
Moire	Error signal introduced into a wanted picture. Moire effect occurs when a pattern is created on the screen where there should not be one. A Moire is typically generated when two different frequencies beat together to create a new, unwanted frequency.
Monochrome	Or black and white TV. A monochrome signal is a video source having only one component containing brightness information only, which is sufficient for a black and white TV picture.
Monotonic	A term used in D/A conversion and is used to indicate that the magnitude of the DAC output voltage increases every time the input code increases.
Motion Compensation	In MPEG compression a technique for exploiting frame to frame redundancy. The aim of this process is to reduce the frame data before it gets coded by techniques similar to JPEG compression. The principle is to determine the parts of each frame that have moved or changed from the preceding frame and code only the changes, which are called residuals. Each frame is then built by adding the decoded residuals to the prediction based on the previous frame. <i>See MPEG.</i>
Motion Estimation	In MPEG compression the process of estimating motion vectors using MPEG encoding. The term is often used interchangeably with motion compensation. <i>See MPEG.</i>
Motion Vector	<p>A measurement of motion. When an object moves across the TV screen it may appear in a different place in each picture but it does not change very much in appearance. The picture difference can be reduced by measuring the motion at the MPEG encoder. This is sent to the MPEG decoder as a vector.</p> <p>Specifically it is a two-dimensional spatial vector used for MPEG motion compensation to provide an offset from the encoded position of a block in a reference picture (I- or P-picture) to the predicted position in a P- or B-picture. <i>See MPEG.</i></p>
MP@ML	Term used in MPEG compression meaning: Main profile at Main level. <i>See Main Profile, Main Level.</i>
MPEG	<ol style="list-style-type: none">1. Moving Pictures Expert Group. An international committee that developed the MPEG family of audio and video compression systems.2. Video compressed according to the MPEG encoding system, such as MPEG1, MPEG2, MPEG3 and MPEG4. <p>MPEG compression uses a variety of coding techniques applied sequentially to allow non important data to be removed and the rest compressed in a form that allows the signal to be reconstituted by a decoder. MPEG addresses the compression, decompression and synchronization of both video and audio signals.</p> <p>Generally, digital video compression begins with a component video format, usually 4:2:2, consisting of one luminance and two chrominance components.</p> <p>Compression is a process by which the information content of an image or group of images is reduced by making use of redundancy present in video signals. This can be achieved by analyzing the statistical predictability of a signal. The majority of signals have some degree of predictability. After redundancy has been identified, it is removed from the bit stream. MPEG makes use of two compression methods:</p> <ol style="list-style-type: none">1. Intraframe Compression <p>Identification of the spatial redundancy present in each field or frame of video. This is done by applying the Discrete Cosine Transform throughout the image. The DCT is a loss less, reversible</p>

mathematical process which converts spatial amplitude data into spatial frequency data. This calculation is made on 8×8 blocks of luminance samples and the corresponding chrominance samples. The DCT coefficients are requantized which basically reduces the number of bits which represent each coefficient. This data is then further reduced using variable length coding and run length coding.

Intraframe compression does not use any information from previous or future pictures it is therefore used for JPEG compression and I-picture compression.

2. Interframe Compression

This compression method makes use of the fact that for a given sequence the picture content generally varies little from frame to frame. Motion estimation in MPEG consists of dividing the picture into macroblocks which are 16×16 pixels and a search carried out to determine its location in a subsequent frame. A successful search will result in a motion vector for that macroblock.

Based on the control of the interframe compression, three types of pictures are developed: I-pictures (Intraframe coded), P-pictures (forward predicted from I-pictures or P-pictures), B-pictures (bidirectionally predicted from I-pictures and/or P-pictures). These are sent out sequentially in a structure such as: I – B – B – P – B – B – I.

The compressed audio and video are then formed into Elementary Streams and further formed into Packetized Elementary Streams which are further packed into Transport Streams. *See PES.*

Uncompressed video in 4:2:2 format requires a transmission rate of approximately 200 Mbits/sec, 15 min of this video would require approximately 22 Gbytes of storage space.

MPEG 1 is designed to provide broadly VHS quality video at a compressed rate of 1.2 Mbits/sec.

MPEG 2 is designed to work at full PAL or NTSC resolution at compressed data rates of 4-15 Mbits/sec.

MPU	Microprocessor Unit. The primary control and arithmetic element of a microcomputer system.
Multiplexer	Combining multiple signals or data streams into one single signal or stream. Usually achieved by interleaving at a low level.
Mutual Interference	<i>See Modulation.</i>
NAB	National Association of Broadcasters.
NABTS	North American Broadcast Teletext Specification (EIA-516). This is also ITU-R BT.653 525-line system C teletext.
Noise	Any random high frequency signal that shows up in the display. The noise may also be referred to as snow, flecks, blips, hash.
Noninterlaced	Opposed to interlacing, all of the lines in the frame are scanned out sequentially, one after the other. The term "field" does not apply in a noninterlaced system. Another term for a noninterlaced system is progressive scan.
Notch Filter	A filter used to pass all frequencies except one specific frequency which is intended to be suppressed.
NTSC	National Television Standards Committee. Formed in the USA in order to devise some way in which color information could be transmitted and received as normal monochrome video on black and white TV sets. Likewise, black and white TV transmissions were to be viewable on color TVs. The composite TV signal is a combination of luminance and color information. The luminance information is contained in voltage variations of the signal and color information is contained in phase differences as compared to a color subcarrier reference signal (3.58 MHz). The composite waveform contains all of the video information for one horizontal scan line. In NTSC a frame consists of 525 of such scan lines. They are sent at a frame rate of 29.97 fps. NTSC is mainly used in the US.
NTSCM	The NTSC standard as it is known to be used in the US and all countries using NTSC.

Odd Field	In TV systems using 2:1 interlacing, the field that begins with a broad pulse coincident with line sync. For NTSC that is Line 1– 262 1/2, for PAL that is Line 1–312 1/2. <i>See Even Field.</i>
Offset Sampling	A digital video system in which the luma samples of a frame are arranged spatially such that the samples of one line are offset one-half the sample pitch from the previous line.
OIRT	Organization Internationale de Radiodiffusion-Television.
Orange Book	Provides formats for write-once and magneto-optical CD technologies. Within each standard are variations called modes, forms and levels. These variations describe how the data within the sectors on the CD are used.
Oversampling	<p>Using a sampling rate which is greater than the Nyquist rate (1/2 highest signal frequency). Neither sampling theory nor quantizing theory requires oversampling to be used to obtain a given signal quality, but Nyquist rate conversion places extremely high demands on component accuracy when a converter is implemented. Oversampling allows a given signal quality to be reached without requiring very close tolerances and therefore expensive components.</p> <p>The use of a sampling rate considerably above the Nyquist rate allows the antialias filter and reconstruction filter to be realized with a much more gentle cut-off slope. There is then less likelihood of phase linearity and ripple problems in the passband. Furthermore filters with a less defined slope are cheaper and easier implemented.</p>
PAL	<p>PAL stands for Phase Alternation Line. It was first introduced in '67 and is mainly used in Europe. PAL is similar to NTSC in many ways. However, with PAL certain video color information is inverted in polarity (180 degrees in phase) with every other scan line. The purpose of this phase alternation is to assist the eye in cancelling slight color changes caused by phase distortions in alternating scan lines.</p> <p>There are 8 different versions of PAL: B, D, G, H, I, M, N and combination N.</p>
PALplus	PALplus is 16:9 aspect ratio version of PAL, designed to be transmitted using normal PAL systems. 16:9 TVs without the PALplus decoder, and standard TVs show a standard picture.
PAL WST	PAL World Standard for Teletext.
Pan & Scan	A technique of reframing a picture to conform to a different aspect ratio by cropping part of the picture. DVD-Video players can automatically create a 4:3 screen aspect ratio pan & scan version from wide screen video (16:9) by using a horizontal offset encoded with the video.
PCM	Pulse Code Modulation. A digital representation of an analog signal. The waveform is sampled at regular intervals and a series of pulses in coded form (usually quantized) and generated to represent the amplitude. The digital representation is uncompressed.
Peak White	The highest point in the video waveform that the video level can reach and still stay within specification.
Pedestal	<p>An offset used to separate the active video from the blanking level. When a video system uses a pedestal, the black level is above the blanking level by a small amount. When a video system does not use a pedestal, the black and blanking levels are the same.</p> <p>Pedestal systems : NTSC Nonpedestal systems: B, D, G, H, I PAL and SECAM</p>
Pel	Synonym for pixel.
PES	Packetized Elementary Stream. For practical purposes, the continuous elementary streams carrying audio or video from compressors, such as MPEG codecs, need to be broken into packets. These packets are identified by headers that contain time stamps for synchronizing. PES packets can be used to create program streams or transport streams. The PES, an endless elementary stream is divided into packets of a convenient size for the application. This size might be a few hundred kilobytes, although this would vary with the application. Each packet is preceded by a PES packet header. The packet begins with a start code prefix of 24 bits and a stream ID that identifies the contents of the packet as video or audio and further specifies the type of audio coding. These two

parameters, start code prefix and stream ID, comprise the packet start code that identifies the beginning of a packet. PES used in this configuration is not the PES used in transport streams.

Phase Adjust	A term used to describe a method of adjusting the color in a NTSC video signal. The phase of the color subcarrier is moved or adjusted relative to the color burst. This adjustment affects the hue of the picture.
Phase Locked Loop	A phase locked loop is part of any genlocked system. Simplified, a PLL is a means of providing a very stable clock that is based or referenced to some other signal. It is a circuit that synchronizes a local oscillator to an incoming signal. Phase locked loops are used to synchronize an analog TV receiver to the horizontal scanning and color subcarrier of the incoming signal.
Picture Excursion	The excursion from blanking to reference white. 100 IRE by definition. 714 mV for System M and EIA-343-A, 700 mV in other systems.
Picture Line	A raster line that contains picture information as distinguished from a line that contains vertical sync elements or vertical interval signals.
Picture-to-Sync Ratio	The ratio between the excursion from blanking to reference white and the excursion from sync tip to blanking. Conventionally 10:4 for System M and EIA-343-A and 7:3 in other systems.
Pixel	A picture element which is the smallest division that makes up the raster scan line for computers or TV displays. Example: full resolution PAL has 720×576 pixels/screen.
Pixel Aspect Ratio	The ratio of width to height of a single pixel. Often means sample pitch aspect ratio (when referring to sampled digital video). Pixel aspect ratio for a given raster can be calculated as $(y/x) \times (w/h)$ where x and y are the raster horizontal pixel counts and vertical pixel counts and w and h are the display aspect ratio width and height.
Pixel Clock	A pixel clock is used to divide the incoming horizontal line of video into pixels. This pixel clock has to be very stable relative to the incoming video or the picture will not be stored correctly. The higher the frequency of the pixel clock the more pixels will appear on the screen.
Pixel Count	Number of pixels on a display. The first number usually stands for horizontal and the second number for vertical resolution. Example: PAL 720×576 pixels/ screen.
Pixel Depth	Synonym for Color Depth. The number of levels of color that can be represented by a pixel. Generally expressed as a number of bits or a number of colors. The color depth of MPEG video in DVD is 24 bits, although the chroma component is shared across 4 pixels (averaging 12 actual bits per pixel).
P-Picture	Or Predicted Pictures. One of the three picture types used in MPEG video. The others are B-pictures and I-pictures. P-pictures are coded with respect to the nearest I-picture or P-picture. This technique is called forward prediction. Like I-pictures, P-pictures serve as a prediction reference for B-pictures and future P-pictures. P-pictures use motion compensation (prediction of the contents of a picture from a previous picture) to provide more compression than I-pictures but have the disadvantage of propagating errors from previous pictures. <i>See MPEG.</i>
Pre-Emphasis	A technique used to improve the signal-to-noise ratio in recording and communications systems. Pre-emphasis is mainly used in FM systems. The high frequency components of the modulating signal are boosted prior to the modulation process. The effect of this is to give a degree of high frequency lift to the baseband signal. In removing this with a filter, gain is effectively reduced at the high frequency end of the spectrum, with an accompanying useful reduction in noise level.
Progressive Scan	A video scanning system that displays all lines of a frame in one pass as opposed to interlaced systems. Progressive scan is used for HDTV and computer displays.
Pseudo Color	Pseudo color is a term used to describe a technique that applies color or shows where it does not really exist. Example: Satellite photos that show temperature differences across a continent of the multicolored cloud motion sequences on nightly weather report. These are real-world examples of

pseudo color. The color does not really exist. The computer adds the color so the information such as temperature or cloud height is viewable. Pseudo color is the opposite of true color.

PX64	Basically the same as H.261.
QCIF	Quarter Common Interface Format. A video format to allow the implementation of cheaper video phones. It has a resolution of 176×144 active pixels and a refresh rate of 29.97 frames per second. If this format would have to be displayed on a larger resolution screen it would look unsharp. Usually a low-pass filter is implemented to match the signal for such situations.
Quad Chroma	Refers to a technique where the pixel clock is four times the frequency of the chroma burst. Example: for NTSC the pixel clock is $4 \times 3.57955 \text{ MHz} = 14.31818 \text{ MHz}$. These frequencies are usually chosen since they facilitate the color decoding process.
Quadrature Modulation	<p>The modulation of two carrier components, which are 90° apart in phase.</p> <p>In TV systems each color difference signal (R'-Y; B'-Y) is amplitude modulated and then weighted to produce the U and V color difference signals which are 90 degrees out of phase. At a later stage they will be combined with the luminance signal. Prior to that they are added to produce one chroma signal.</p>
Quadrature	The term quadrature comes from the fact that there are $4 \times 90^\circ$ segments in a cycle, two signals with a 90° phase relationship are said to be in quadrature.
Quincunx Sampling	Synonym for <i>Offset sampling</i> .
Raster	A series of scan lines that make up a TV picture or a computer display.
Read Modify Write	An operation used in writing to DVD-RAM discs. Because data can be written by the host computer in blocks as small as 2 KB but the DVD format uses ECC (Error Correction Code) blocks of 32 KB an entire ECC block is read from the data buffer or disc, modified to include the new data and new ECC data, then written back to the data buffer and disc.
Real Time	Any system in which the time at which output is produced is significant. This is usually because the input corresponds to some movement in the physical world and the output has to relate to that same movement. The lag from input time to output time must be sufficiently small for acceptable timeliness. Timeliness is a function of the total system. Real-time systems are usually considered to be those in which the response time is of order milliseconds. Example: process control, embedded computer systems, computer aided testing.
Red Book	Defines the audio format for music CDs. This standard allows up to 76 min of playing time on each CD.
Reference Black	The level corresponding to picture black. In systems having 7.5% setup (such as 525/59.94 or NTSC) reference black is nominally 7.5 IRE units. In systems with zero setup (such as 625/50 or PAL) reference black is nominally 0 IRE units.
Reference White	The level corresponding to white. By definition 100 IRE. Conventionally white corresponds to light having the color properties of CIE Illuminant D ₆₅ .
Residual Subcarrier	This is the amount of color subcarrier information in the color data after decoding a composite color video signal. The number usually appears as[-n]dB.
Resolution	<p>This is a basic measurement of how much information is on the display. It is usually described as "some number" by "some number." The first number is the horizontal (across the screen) resolution and the second number is the vertical resolution (down the screen). The higher the number, the more detail is present.</p> <p>Examples: NTSC VHS: 240×485 pixels NTSC broadcast: 330×485 pixels</p>

	<p>NTSC laser disc: 425 × 485 pixels ITU-R BT.601 (525/60): 720 × 485 pixels Computer screen: 1280 × 1024 pixels</p>
Retrace	After the electron beam reaches the right-hand edge of the display it has to be traced back to the left-hand edge in order to start the next scan line (using a TV set with a CRT). Retrace happens during the blanking time. To make this process invisible the electron beam is switched off during blanking.
RF Modulation	A composite video signal that has been modulated onto a radio frequency (VHF or UHF) carrier in the range of 50 MHz to 900 MHz. RF modulated video in electrical form is usually conveyed with coaxial cable using type-F connectors, as in cable TV. A video connection from a VCR to a receiver is conventionally RF modulated onto Channel 3 or Channel 4.
R, G, B	Red, Green and Blue color components. In video usage, gamma correction is implicit (i.e., RGB signals are assumed to have been subjected to gamma correction). The precise color interpretation of RGB values depends on the chromaticity coordinates chosen for the RGB primaries and the chromaticity coordinates of reference white. The FCC 1953 BTSC standard, SMPTE RP-145 and EBU Tech. 3213 all specify different primary chromaticities.
RGB Color Space Conversion	<p>Color space is a mathematical representation of a set of colors. Three fundamental color models are RGB, YIQ (or YUV or YCrCb), CMYK. All of the color spaces in common use can be derived from the RGB information supplied by devices like cameras or scanners. RGB is used in color computer graphics and imaging and color TV. YIQ, YUV or YCrCb are used in are used in broadcast and TV systems. CMYK are used in color printing.</p> <p>Example: To convert from RGB to YUV:</p> $Y = 0.299R' + 0.587G' + 0.114B'$ $U = -0.147R' - 0.289G' + 0.436B'$ $V = 0.615R' - 0.515G' - 0.100B'$
RGB Video	Computers store images in RGB format. TV cameras record images in RGB format.
RS 170(A)	<p>Standard that was used for black and white TV. It defines voltage levels, blanking times, width of the sync pulses, etc. The specification spells out everything required for a receiver to display a monochrome picture.</p> <p>Example: the output of black and white security cameras conform to RS 170 specification. RS 170 (A) is the same specification as for color TV but without the color components. When NTSC decided on the color broadcast standard, they modified RS 170 slightly so that color could be added, with the result called RS 170 A.</p>
RS 343	Standard or specification for video. RS 343 is used for high resolution video (workstations) while RS 170 A is for lower resolution video.
R'-Y	In color television, the red minus luma signal. Also called color difference signal. When added to the luma (Y) signal it produces the red primary signal.
Run Length Coding	Algorithm used in data compression, such as MPEG and JPEG, where instead of sending a series of identical data, such as a series of zeroes, the compressed data is made up of a code for the zero value and the number of occurrences of that particular value.
SABC	South Africa Broadcasting Corporation.
Sample Rate	Generally, the amount of samples taken of a signal over time. Example: a sampling rate of 22 kHz means that an analog signal is measured at equal steps 22000 times per second.
SAP	Abbreviation for Secondary Audio Program. Generally used to transmit audio in a second language.
Saturation	Saturation is the amount of color present or how much "pigment" is used to make the color, it does not mean the brightness of the color. Effectively saturation level indicates the amount of white present in a color.

Example: a lightly saturated red looks pink, fully saturated red looks like crayon.

SAW Filter	Electrical filter using the surface Acoustic Wave Technology. SAW filters are capable of transfer functions that are not possible in lumped-element circuits. <i>See Lumped.</i>
SCH	Subcarrier to Horizontal phase. Defines the timing relationship between the 50% point of the leading edge of sync and the zero crossings of the reference subcarrier. SCH phase becomes important when signals from two or more sources are combined or switched sequentially. To prevent color shifts or horizontal jumps, correct timing of the sync edges is essential. These conditions can only be met simultaneously if the SCH phase relationship of the signals is the same.
S-Connector	S-video connector with 4 pins for Y signal, Y ground, C signal and C ground.
Scaling	Scaling is the act of changing the effective resolution of the image.
Scan Converter	A device which converts interlaced to progressive scan and/or vice versa.
Scan Line	Same as a horizontal scan line or horizontal line.
SCART	21-pin connector supported by many consumer audio/video components in Europe. It allows mono or stereo audio, composite video, S-video, and RGB video to be transmitted between equipment.
Screen Ratio	Synonym for aspect ratio which is the ratio of horizontal screen or display size over vertical screen or display size. Common TV has a screen ratio of 4:3 (4 parts horizontal, 3 parts vertical), wide screen DVD and HDTV 16:9.
SDTV	Standard-Definition Television. A term applied to traditional 4:3 TV in analog or digital form with a resolution of about 700×480 pixels. <i>See HDTV.</i>
SECAM	Sequential Couleur Avec Memoire. A composite color standard based on line-alternate color difference signals frequency modulated onto a color subcarrier. In use only for transmission in certain countries with 625/50 scanning (France, USSR). No SECAM production equipment exists since composite production for SECAM is done in PAL.
Secondary Program	<i>See SAP.</i>
Serration Pulses	Part of sync signals which occur during the vertical sync interval at twice the normal horizontal scan rate. The reason these exist was to ensure correct 2:1 interlacing in early televisions.
Setup	Another word for Pedestal.
Sideband Signals	<i>See Modulation.</i>
SIF	Standard or Source Input Format. A video format to allow the storage and transmission of digital video. 625/50 SIF format has a resolution of 352×288 active pixels and a refresh rate of 25 frames/sec. 525/59.94 systems have a resolution of 352×240 active pixels and a refresh rate of 29.97 frames/sec. For computer systems it is 320×240 active square pixels (NTSC) and 384×288 active square pixels (PAL).
Signal-to-Noise Ratio	The ratio between the "reference level" of a system and the noise floor. SNR is generally expressed in dB and any system should aim for an as high value as possible. <i>See Dynamic range.</i>
SMPTE	Society of Motion Picture and Television Engineers. An international research and standards organization. The SMPTE time code used for marking the position of audio or video in time was developed by this group.
SNR	<i>See Signal-to-Noise Ratio.</i>
Spatial	Relating to space, usually two-dimensional. Video can be defined by its spatial characteristics (information from the horizontal plane and vertical plane and its temporal characteristics (information at different instances of time).
Spatial Frequency Domain	Where the properties of the entire set of samples are considered all at once and cannot necessarily be separated into independent horizontal and vertical aspects. This is to say that the content of an image can be expressed as horizontal and vertical spatial frequency components. Spatial frequency is graphed using cycles/picture width as x-coordinates (C/PW) and cycles/picture height as y-coordi-

nates (C/PH). It is possible to gain insight into the operation of an imaging system by exploring its spatial frequency response.

Spatial Sampling	Where an image changes a given number of times per unit distance and is sampled at some other number of times per unit distance as opposed to temporal sampling where the input changes with respect to time at some frequency and is sampled at some other frequency.
Spatial Resolution	The clarity of a single image or the measure of detail in an image.
Square Pixel	Most modern displays for computers use a 1:1 aspect ratio for pixels or square pixels. Most consumer video displays currently use rectangular pixels. Without taking these differences into account, computer generated circles will become ellipses when processed by a video encoder. Similarly, circles as displayed on a TV will appear as ellipses when displayed on the computer. To compensate for the pixel differences video encoders and decoders are able to operate at special pixel clock rates and horizontal resolutions.
SSAF	Super Sub Alias Filter. A trademark of Analog Devices. A luma low-pass filter with a cut-off frequency of 6.217 MHz. Used in video encoders.
Subcarrier	A secondary signal containing additional information that is added to a main signal. For TV systems this means the carrier signal onto which the video information is modulated. For NTSC: 3.58 MHz, for PAL 4.43 MHz.
SVHS	Super VHS (Video Home System). An enhancement of the VHS videotape standard using better recording techniques and Y/C signals instead of a composite signal. S-VHS cassettes have similar running time and appearance to standard types but contain cobalt-oxide coated tape and can reproduce pictures with 400 line resolution. When the TV receiver or monitor is equipped with a suitable input socket and a large screen S-VHS format is capable of a picture performance superior to that available from a terrestrial broadcast system.
S-Video	A video interface standard that carries separate luma and chroma signals, usually on a four pin mini DIN connector. Also called Y/C. The quality of S-Video is significantly better than composite video since it does not require a comb filter to separate the signals but it is not quite as good as component video. Most high-end TVs have S-Video inputs. S-Video is not S-VHS.
S-Video 525	An S-Video interface which has structure and levels identical to the constituent signals of analog NTSC: if the two signals, Y and C are summed a legal NTSC signal results.
Swinging Burst	The inversion of burst from subcarrier, combined with the V-axis switch puts PAL burst at +135 degrees and -135 degrees on a vector scope display.
Sync	The sync signal tells the display where to "put the picture." The horizontal sync or HSYNC tells the display where to put the picture in the left-to-right dimension, while the vertical sync or VSYNC tells the display where to put the picture from top to bottom.
Sync Generator	A sync generator is a circuit that provides sync signals.
Sync Signals	<i>See Sync.</i>
Sync Tip	The level or duration of the most negative excursion of a sync pulse from blanking level.
Synthesizer	An analog or digital generator which can produce any wanted frequencies or sounds.
TDF	TeleDiffusion de France.
Teletext	Synonym for Video Text. An information service in which information can be displayed as pages of text on screen of a commercial TV receiver. The information may be transmitted as part of the commercial TV broadcast signal or as coded telephone signals. It is in the form of pulse code modulated signals that use two of the unused lines in an ordinary TV video signal transmitted during the normal vertical retrace period. Special decoding circuits are required for the extraction of teletext signals from the normal TV signals or from the telephone line and for decoding them.
Temporal	Relating to time. The temporal component of motion video is broken into individual still pictures. Because motion video can contain images (such as backgrounds) that do not change much over time, typical video has large amounts of temporal redundancy.

Temporal Domain	<i>See Temporal.</i>
Temporal Sampling	Sampling of an image so to represent motion, where the input changes with respect to time at some frequency and is sampled at some other frequency as opposed to spatial sampling where an image changes a given number of times per unit distance and is sampled at some other number of times per unit distance.
Temporal Resolution	The clarity of a moving image or moving object or the measurement of the rate of information change in motion video.
Tessellated Sync	Another word for serrated sync. Commonly used in Europe.
TTL	Transistor-Transistor Logic. A logic family based on bipolar transistors.
True Color	Each pixel in an image is individually represented using three color components, such as RGB or YCrCb. In addition, the color components of each pixel may be independently modified.
TVL	A unit of resolution used in TV systems having a dimension defined by the pitch between two adjacent scan lines. In an interlaced system, adjacent scan lines are in opposite fields. Horizontal and vertical resolution are commonly measured in units of TV lines, where there are two lines per cycle.
Transcoder	A circuit which converts one TV standard into another. Example: PAL-to-SECAM transcoder.
Trichromaticity	The human retina has three types of color photoreceptor cone cells, which respond to incident radiation with somewhat different spectral response curves. Because there are exactly three types of color photoreceptors, three numerical components are necessary and sufficient to describe a color, provided that appropriate spectral weighting functions are used. Color vision is inherently trichromatic.
Three-State	A gate having three possible output states: logic high, logic low and high Impedance. These gates are commonly used in parallel data transfer when several device outputs are connected in parallel. If two standard gate outputs are connected in parallel they can be damaged if they are at opposite logic levels. A logic low is approximately at ground potential. A logic high is about 3.5 V in a TTL device. If two connected outputs are at opposite levels current from the high output will flow towards the low through a relatively low impedance. This current is at a level above the rated value of either gate output and will damage them both over time. Three-state buffering allows two or more outputs to be connected to a single load without damage, provided only one of the outputs is enabled at a time. In high impedance state the output is neither high or low. It acts as an open circuit electrically isolating the output from any load it is connected to.
Tristimulus	A signal that measures radiant power, weighted by one of a set of three spectral sensitivity functions having significance with respect to trichromaticity as described above. A tristimulus signal represents linear light and is subjected to gamma correction as part of its conversion into a video signal.
UV	In the formation of NTSC, PAL or S-Video it is necessary to scale the color difference components so that the eventual composite signal will be contained within the amplitude limits of the signal processing and recording equipment. To this end $B'-Y'$ and $R'-Y'$, the color difference signals are scaled to U and V: $U = 0.49211 (B'-Y')$ $V = 0.877283 (R'-Y')$
UHF	Ultrahigh frequencies occupying the range from 0.3 GHz–3 GHz and are used for TV broadcast, satellite transmission.
USNC	United States National Committee, a member of the IEC, based in New York.
UXGA	An ultrahigh display resolution: 1600 × 1200 pixels.
VBI	Vertical Blanking Interval. During the vertical blanking interval, the video signal is at the blank level so as not to display the electron beam when it sweeps back from the bottom to the top side of the screen. VBI is also used to contain auxiliary information such as closed captioning.

	For NTSC these are Lines 7–21 and 270–284, for PAL these are Lines 7–21 and 319–33. They are divided into 3 categories: pseudo sync pulses, AGC pulses, and AGC pulse cycling.
Vector Diagram	Two instruments, a vector scope and a waveform monitor are the most commonly used for testing video signals. A vector scope demodulates the signals and displays R'-Y versus B'-Y allowing to accurately evaluate the chroma portion of the signal. This display is called a vector diagram.
Vertical Blanking	The number of scan lines in a field that are mandated by a raster standard to contain nothing except field sync elements and blanking. It is time interval taken during which the electron beam sweeps back from the bottom to the top side of the screen after completing a field.
Vertical Flyback	Synonym for vertical retrace.
Vertical Scan Rate	For noninterlaced video, this is the same as frame rate. For interlaced video this is usually considered to be twice the frame rate.
Vestigial Sideband	A sideband in which some of the spectral components are greatly attenuated. The information transmitted by a modulated carrier wave lies in both the sidebands (<i>see Modulation</i>). Each sideband carries the same information, in fact they are mirror-images of each other and so a duplication is present and more bandwidth than necessary is used up. It is possible to send a complete signal using one sideband only. However, it is not possible to filter one sideband cleanly off. Suppression usually takes the form of a gradual roll-off of the unwanted portion. The choice is to have this occurring either in the wanted sideband or in the unwanted one. Neither of these alternatives is really satisfactory. In the first case LF frequency energy is lost if the roll-off occurs in the wanted sideband, while in the second case incomplete suppression takes place and the bandwidth of the signal as a whole is still fairly large. In TV a compromise is sought, where the lower sideband is partially suppressed and because there is a vestige of it remaining, the scheme is known as vestigial sideband transmission.
Vertical Retrace	Vertical retrace takes place when the electron beam of the CRT reaches the right hand edge of the display after scanning a field to get back to the left hand edge to start scanning the next field to make up a complete frame.
Vertical Scaling	<i>See Scaling.</i>
Vertical Sync	Sync signal which is part of the composite video signal and indicates when to start vertical retrace.
Vertical Sync Pulses	<i>See Vertical Sync.</i>
VGA	Video Graphics Array. A hardware video display standard originally developed by IBM and widely used. VGA defines many different resolution and color modes. SVGA stands for super VGA and is an enhanced version of VGA that supports higher-resolution and higher-color modes. SVGA has become the current standard because it supports video modes that do a better job of reproducing realistic images.

Table II. Computer Scanning Standards

Resolution Mode	Color Mode	Frames/sec	Lines/Frame	Lines/sec	Data Rate [Mb/sec]
640 × 480 VGA	4bpp	60	525	31500	9.2
640 × 480 SVGA	8bpp	60	525	31500	18.4
640 × 480 SVGA	RGB16	60	525	31500	36.8
640 × 480 SVGA	RGB24	70	525	36750	64.5
1024 × 768 SVGA	8bpp	70	800	56000	55.0
1280 × 1024 SVGA	4bpp	70	1100	77000	45.9

- Video CD** An extension of CD, based on MPEG1 video and audio. Allows playback of near VHS quality video on a Video CD player, CD-i player or computer with MPEG decoding capability. Video CD is also known as the White Book Standard and was developed as a joint venture between JVC and Philips. It enables up to 74 min of VHS quality, full screen, full motion video to be held on one CD-ROM.
- Video Waveform** The actual video signal, consisting of several parts that are all required to make up a TV picture that can be accurately displayed.

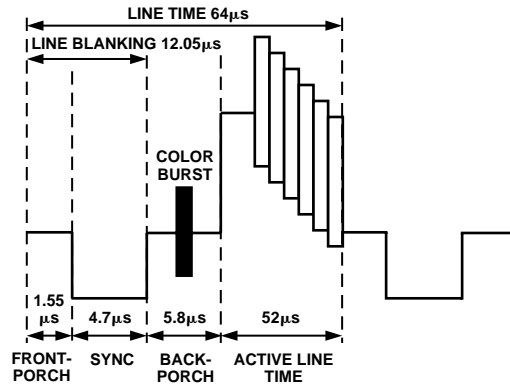


Figure 4. Video Waveform (PAL)

- VLC** Variable Length Code. A compression technique of assigning variable length codes to a known set of values. Values occurring most frequently are assigned the shortest codes. This technique is used in MPEG compression.
- VSYNC** Short form for vertical sync. Sync pulses which indicate the end or start of a field and therefore initiate vertical retrace.
- VTR** Video Tape Recorder.
- Weighting** A process which is applied to the two color difference signals. Effectively weighting is reducing the amplitude of each of the two color difference signals by a certain specific amount in order to improve signal quality. This is because at a later stage they will be added to the luminance signal and where a large subcarrier signal (corresponding to a highly-saturated color) coincides with an extreme excursion of the luminance signal (corresponding to a very light or very dark part of the picture) the combination of the two could lead to overmodulation of the transmitter. After recovery in the receiver's decoder, the subcarrier signals are restored to normal proportions by simple adjustment of amplifier gain in each color difference signal path.
- The weighting values usually are:
- $$V = 0.877 (R-Y)$$
- $$U = 0.493 (B-Y)$$
- White Book** Document from Sony, Philips and JVC begun in '93 that extended the Red Book compact disc format to include digital video in MPEG1 format. Commonly known as Video CD.
- White Clipping** White corresponds to the highest signal level (100 IRE). White Clipping would mean that every signal above this level will be cut.
- Wide Screen** A video image wider than the standard 4:3 aspect ratio. Wide screen usually implied an aspect ratio of 16:9 and is used in DVD and HDTV.
- WSS** Wide Screen Signalling. It is used on PAL (B, D, G, H, I) scan Line 23 to specify several new PAL video signal formats. WSS can tell the TV if PAL plus processing is required, the type of subtitles, aspect ratios etc.
- Y/C** Luminance(L) accompanied by chrominance (C). More properly referred to as S-Video.

YCrCb	<p>Luma (Y) and two color difference signals (Cr, Cb). A component digital video signal. The chroma components are usually adjusted for digital transmission according to ITU-R BT601. Cr and Cb are scaled versions of U and V in the YUV color space. Y is defined to have a nominal range of 16 to 235 and Cb and Cr are defined to have a range of 16 to 240, 128 being equal to zero. Sampling formats are 4:4:4, 4:2:2, 4:1:1 and 4:2:0.</p> <p>For a nominal range of 16 to 235:</p> $Y = (77/256) R' + (150/256) G' + (29 / 256) B'$ $Cb = -(44/256) R' - (87 / 256) G' + (131 / 256) B' + 128$ $Cr = (131/256) R' - (110 / 256) G' - (21 / 256) B' + 128$
Yellow book	<p>This format was established to provide a standard for data storage and retrieval. It adds a further layer of error checking to provide the greater reliability required for computer data. It provides two modes, one for computer data and the other for compressed audio and video data.</p>
YIQ	<p>YIQ color space is derived from the YUV color space and is used optionally by the NTSC composite color video standard. "I" stands for in-phase and "Q" for quadrature, which is the modulation method used to transmit the color information.</p> $Y = 0.299R' + 0.587G' + 0.114B'$ $I = 0.596R' - 0.275G' - 0.321B'$ $I = V \cos 33^\circ - U \sin 33^\circ$ $Q = 0.212R' - 0.523G' - 0.311B'$ $Q = V \sin 33^\circ - U \cos 33^\circ$
YPbPr	<p>YCrCb in analog form or component analog video. Pb and Pr are scaled from (B'-Y') and (R'-Y') are low pass filtered to about half the bandwidth of luma.</p>
YUV	<p>In a general sense, any form of color difference video signal containing one luma component and two chroma a components. Technically YUV is applicable only to the process of endcoding component video into composite video (one signal). <i>See UV.</i></p>
XGA	<p>A higher display resolution: 1024 × 768 pixels.</p>