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Errata to the 2nd, 3rd, and 4th printings, *A Technical Introduction to Digital Video*

This note contains errata to the second, third, and fourth printings of the book *A Technical Introduction to Digital Video*, by Charles Poynton (New York: Wiley, 1996). I encourage you to make these corrections in your copy of the book. Several replacement figures are provided here.

This note contains errata for the second, third, and fourth printings. To determine which printing of the book you have, turn to the copyright page of the front matter, page iv, and examine the bottom line: The rightmost digit of that line indicates which printing you have. If you have the first printing, obtain the *Errata* for that printing.

I revise this note as I discover errors, and I tag each entry with the date it was posted. I suggest that you annotate the back of the title page of your book with the revision date that you find at the bottom of this page. Then when you check future revisions of this document, you can determine if additional corrections need to be made.

In the entries below, I acknowledge individuals who have contributed corrections. All of the errors dated 1996-06-05 were identified by Chris Pirazzi of SGI. I am very grateful to him. Other entries without attribution are mine.

Chapter 1, Basic principles

1997-09-07: Page 14. In Figure 1.8, *Vertical sync waveform of 525/59.94*, the 0_V notation should lie under the fourth tick from the left, not the seventh. A replacement figure and caption can be found on page 7 of this document.

1999-06-30: Page 19. In Figure 1.11, *Frequency response*, bandwidth should refer to the frequency where amplitude has fallen to 0.707. A replacement figure and caption can be found on page 7 of this document.

1999-06-30: Page 20. In the penultimate line of the first paragraph, replace *half* with *0.707.*

1997-09-04: Page 25. To clarify that MPEG-2 chroma subsampling is different from the subsampling used in JPEG, H.261, and MPEG-1, I refined Figure 1.14 and its caption. A replacement figure and caption can be found on page 8 of this document.

1997-09-04: Page 26. To clarify JPEG, MPEG-1, and MPEG-2 subsampling, replace the 4:2:0 paragraph in the middle of page 26 with this:

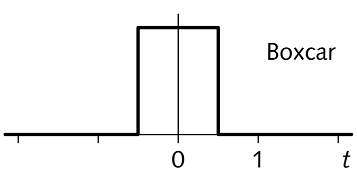
4:2:0

> JPEG, H.261, MPEG-1, and MPEG-2 usually use 4:2:0 sampling. C_B and C_R are each subsampled by a factor of 2 both horizontally and vertically; C_B and C_R are sited vertically halfway between scan lines. Horizontal subsampling is inconsistent. In MPEG-2, C_B and C_R are cosited horizontally. In JPEG, H.261, and MPEG-1, C_B and C_R are not cosited horizontally; instead, they are sited halfway between alternate luma samples.

Chapter 2, Raster images in computing

1996-12-09: Page 37. In the third paragraph under *Truecolor*, exchange the italicized word *truecolor* in the third line with the italicized words *direct color* in the last line.

Chapter 3, Filtering and sampling



1998-04-28: Page 44. In the first line of the lead paragraph under *Sampling theorem,* insert the word *be* between *to* and *digitized.*

1998-05-30: Page 52. In Figure 3.7 *Fourier transform pairs*, the two boxcar functions are improperly scaled: The function should have a value of unity across the range ±0.5 (not ±1).

1999-06-30: Page 57. In the penultimate line of the first paragraph in the section *Lowpass filter,* replace *half* with *0.707.* In the last line of the page, replace f_P by f_C.

1999-06-30: Page 58. In Figure 3.12, *Lowpass filter characterization*, bandwidth should refer to the frequency where amplitude has fallen to 0.707. A replacement figure and caption can be found on page 8 of this document.

Chapter 5, Luminance and lightness

1999-12-28: On page 82, replace the first paragraph with:

> *Intensity* measures the flow of power in a particular, specified direction – that is, power per unit solid angle. *Radiance* is intensity per unit area. It is measured with an instrument called a *radiometer*, and is what I call a *linear-light* measure, expressed in units such as watts per steradian per square meter ($W \cdot sr^{-1} \cdot m^{-2}$).

Also on page 82, in the *Luminance* section, second paragraph, second line, replace *radiant power* by *radiance*.

Chapter 6, Gamma

1999-12-28: On page 91, add this margin note:

> In physics, *intensity* is defined as radiant power per unit solid angle; it has units of watts per steradian ($W \cdot sr^{-1}$). Grayscale image data is normally based upon *relative luminance*, which is intensity per unit area, weighted by the spectral sensitivity of human vision, and normalized to a reference white. This chapter concerns the nonlinear mapping of relative luminance. In this chapter, I use the term *intensity* to emphasize the linear-light nature of the associated quantity. In the following chapter, I will detail luminance.

1997-12-29: At the top of page 102, on the *y*-axis (*Video signal*) of Figure 6.6, replace *0.099* by *0.081*. Thanks to Michael Laird of Avid.

Chapter 7, Color science for video

1999-10-07: On page 119, in the second line of the first paragraph, replace per *unit area* by *in a particular direction*. Replace the last two words of the paragraph, *square meter,* by *steradian*. In the second paragraph, replace the word *power* by *intensity (per unit area)*.

1997-07-01: On page 130, in the third line up from the bottom of the page, replace *or* by *of*.

1998-12-22: On page 135, the chromaticity diagram of Figure 7.12, all of the features associated with blue primary should be positioned about 1 cm lower than shown. A replacement figure is provided on page 10.

Chapter 8, Luma and color differences

1998-10-16: At the bottom of page 157, add the four words *analog lowpass filters that*. Thanks to Peter W. Rander.

1997-11-19: Page 165. The offset terms of Equation 8.2 need to be corrected by changing *0.0228* to *0.1115,* in three places. Thanks to Jan van Rooy of Philips, Breda. The correct equations are these:

Eq 8.2

$$R'_{240} = 1.1115\,R^{0.45} - 0.1115$$
$$G'_{240} = 1.1115\,G^{0.45} - 0.1115$$
$$B'_{240} = 1.1115\,B^{0.45} - 0.1115$$

1999-12-28: Page 166. Equation 8.5 was correct when printed, but ITU-R subsequently changed the Rec. 709 luma coefficients in the fourth decimal place. The correct coefficients are now these:

Eq 8.5

$$Y'_{709} = 0.2126\,R' + 0.7152\,G' + 0.0722\,B'$$

Chapter 9, Component video color coding

1998-04-28: Page 177. In the final line of the page, change the phrase *9-bit multipliers are required* to *multipliers having more than 8 bits are required*. Thanks to Chris Parazzi.

1997-11-14: Page 178. In the second paragraph of the section *Kodak PhotoYCC*, at the end of the fifth line, change *189* to *182*. In Eq. 9.12, change the subscript *189* to *182*.

Chapter 10, Composite NTSC and PAL

1996-06-27: Page 186. In the paragraph *Subcarrier regeneration*, in the fourth line, replace *cos* by *sin*.

1996-06-27: Page 187. In the second paragraph, under *Quadrature modulation*, in the third line of the second paragraph, exchange *cos* and *sin*. Change Equation 10.1 so as to appear:

Eq 10.1

$$C = U \sin \omega t + V \cos \omega t \qquad \omega = 2\pi f_{SC}$$

1996-06-27: Page 188, 189. Figures 10.3 and 10.4 contain wiring errors. Replacements are provided at the end of this note.

Chapter 11, Field, frame, line, and sample rates

1996-08-02: Page 205. In the last paragraph on the page, at the start of the fourth line from the bottom, insert *is* between *This* and *a hundred*. Thanks to Brian Murray.

Chapter 13, 525/59.94 Component video

1997-11-13: Page 216. In the second paragraph under *Component digital 4:2:2 interface*, in the third line, change *732* to *736*. In Figure 13.2 on the facing page, change two occurrences of *732* to *736*.

1996-12-30: Page 218. In the *y*-axis legend of Figure 13.3, replace 54 $^{4}/_{7}$ by 53 $^{4}/_{7}$, and replace –286 $^{5}/_{7}$ by –285 $^{5}/_{7}$.

Chapter 14, 525/59.94 NTSC composite video

1996-06-27: Page 223, *Color difference filtering*. Delete the second bulleted item. In Equations 14.1 and 14.2, exchange *cos* and *sin*, and add $\omega = 2\pi f_{SC}$:

Eq 14.1 $$C = U \sin \omega t + V \cos \omega t \qquad \omega = 2\pi f_{SC}$$

Eq 14.2 $$C = Q \sin(\omega t + 33°) + I \cos(\omega t + 33°) \qquad \omega = 2\pi f_{SC}$$

1996-12-30: Page 227. In the *y*-axis legend of Figure 14.4, replace 54 4⁄7 by 53 4⁄7, and replace –286 5⁄7 by –285 5⁄7.

Chapter 15, 625/50 scanning and sync

1997-11-13: Page 230, Table 15.1, *625/50 Line assignment*. The terms *odd* and *even* are ambiguous when referring to fields in 625/50 scanning. To avoid confusion, I recommend that you use the terms *first* and *second* instead. In the heading row, replace *Even* with *Second* and *Odd* with *First*. In the shaded area at the bottom right of the table, delete two instances of *Even* and two instances of *Odd*. On the facing page, delete *even* and *odd* from bullet items 1, 5, 6, and 10.

Chapter 16, 625/50 Component video

1997-11-13: Page 238. In the second paragraph under *Component digital 4:2:2 interface*, in the second line, change *736* to *732*. In Figure 16.1 on the facing page, change two occurrences of *736* to *732*.

Chapter 17, 625/50 PAL composite video

1996-06-27: Page 242. The three paragraphs under the heading *Burst* should be replaced; in addition, two marginal notes should be added. Page 11 of this *Errata* provides a complete replacement page.

1996-06-27: Page 243, under *Color difference filtering*, delete the second item in the bulleted list. In Equation 17.1, exchange *cos* and *sin*.

1997-10-15: Page 244. At the end of the penultimate paragraph, delete the phrase *with 7.5-percent setup*. Thanks to Vince Capizzo.

Chapter 18, Electrical and mechanical interfaces

1997-11-13: Page 248. At the end of the last paragraph on the page, change *instead of TRS* to *in addition to TRS*.

Chapter 20, Test signals

1998-10-16: Page 257, Figure 20.1, *Colorbars*. Replace two instances of *WHITE* by *100% WHITE.* In the narrow horizontal band between vertical coordinates 0.67 and 0.75, in the seventh column (underneath BLUE), change *BLUE* to *75% WHITE*. A replacement figure is provided.

Chapter 21, Timecode

1997-07-11: Page 267. In line 2 of the last paragraph, replace *1.2 Kb/s* with *2.4 kb/s*. Thanks to Ian Holland.

Glossary

1997-07-01: Page 293. Near the top of the page, in the last line of item 3 of *Resolution, limiting,* change *two cycles in a TV line* to *two TV lines in a cycle.* Thanks to David Farrant.

1998-12-30: Page 295. In the entry for S-video, in the third line, change *two only* to *exactly 2*.

Replacement figures and pages

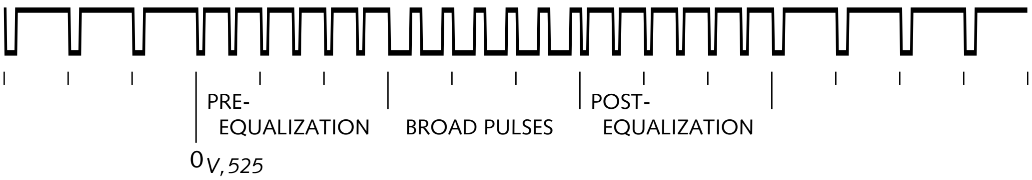
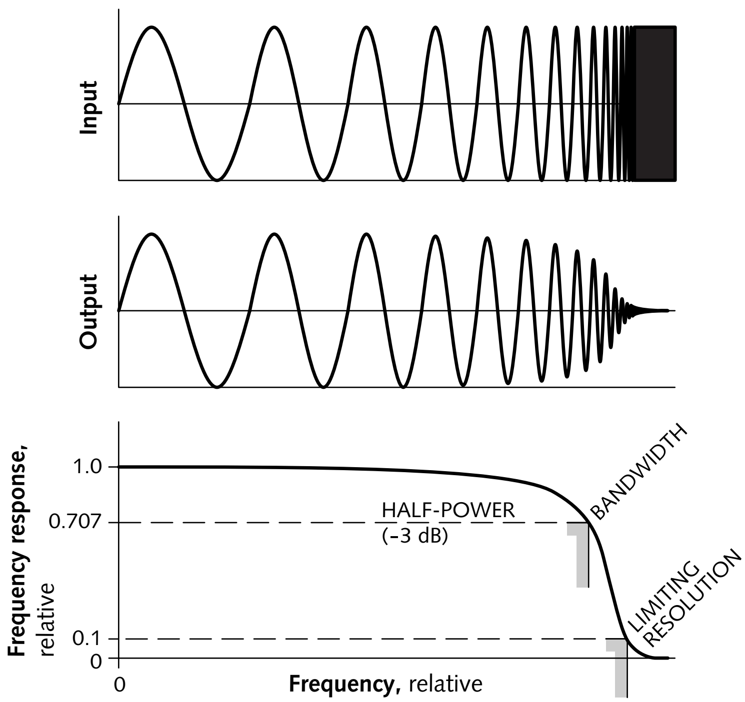


Figure 1.8 **Vertical sync waveform of 525/59.94.**

Figure 1.11 **Frequency response** of any electronic or optical system falls as frequency increases. Bandwidth is measured at the half-power point (–3 dB), where response has fallen to 0.707. Television displays are often specified at *limiting resolution*, where response has fallen to 0.1.



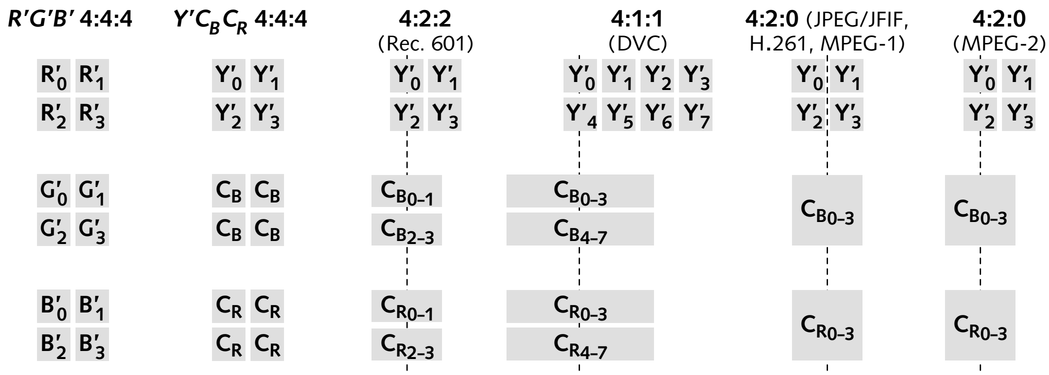


Figure 1.14 **Chroma subsampling.** A 2×2 array of *R'G'B'* pixels can be transformed to a luma component *Y'* and two color difference components C_B and C_R; color detail can then be reduced by subsampling, provided that full luma detail is maintained. The wide aspect of the C_B and C_R samples indicates their spatial extent. The horizontal offset of C_B and C_R is due to cositing. (JPEG, H.261, and MPEG-1 do not use cositing; instead, their C_B and C_R samples are taken halfway between luma samples.)

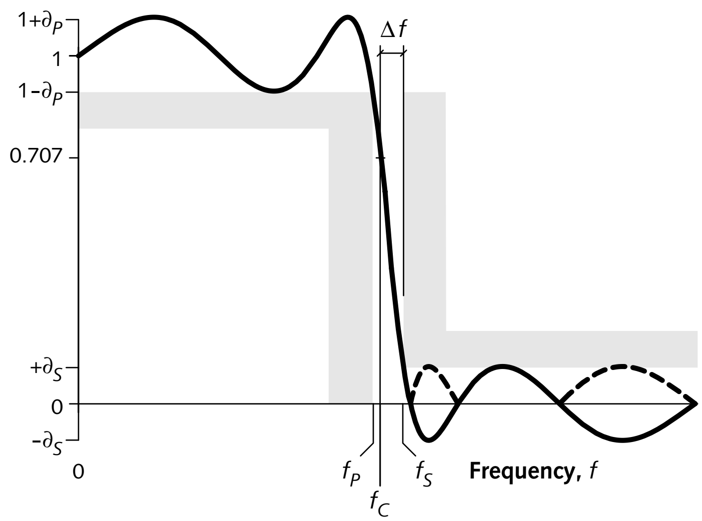


Figure 3.12 **Lowpass filter characterization.** A lowpass filter for use in video sampling or reconstruction has a cutoff frequency f_C, where the attenuation is 0.707. In the *passband*, response is unity within ∂_P, usually 1 percent or so. In the *stopband*, response is zero within ∂_S, usually 1 percent or so. The *transition band* lies between the cutoff frequency and the edge of the stopband. The solid line shows that at certain frequencies, the filter causes phase inversion. Filter response is usually plotted as magnitude; phase inversion in the stopband is reflected as the absolute values shown in dashed lines.

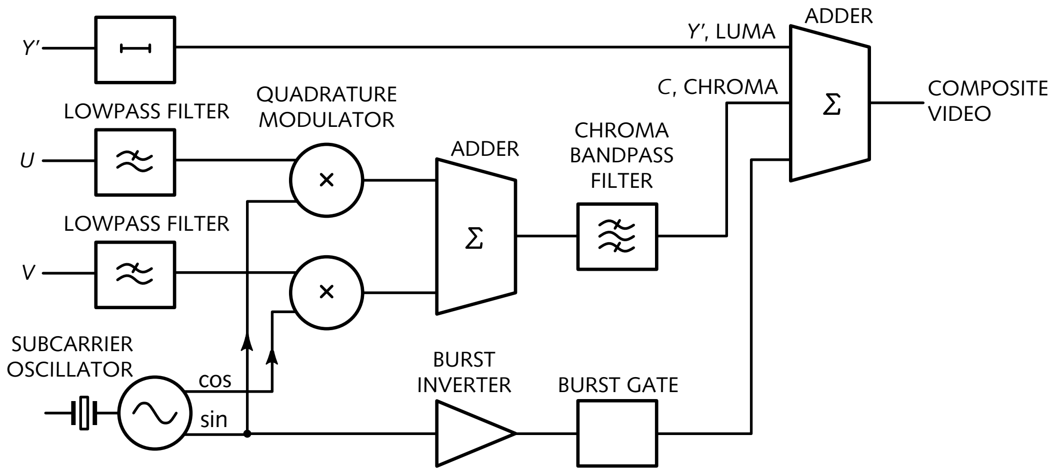


Figure 10.3 **NTSC encoder block diagram.**

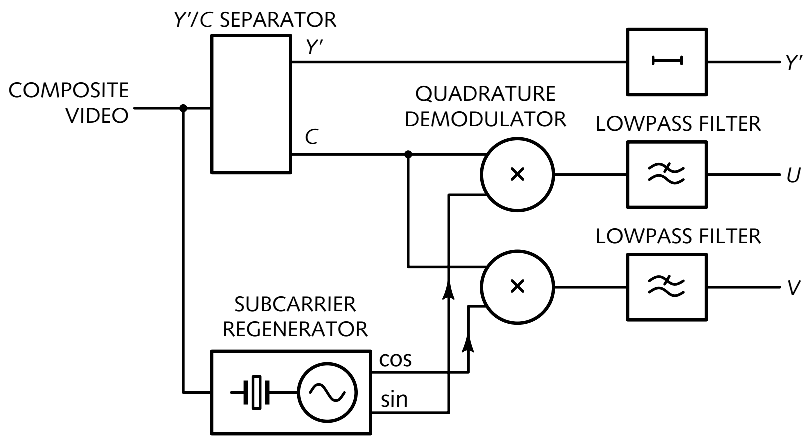
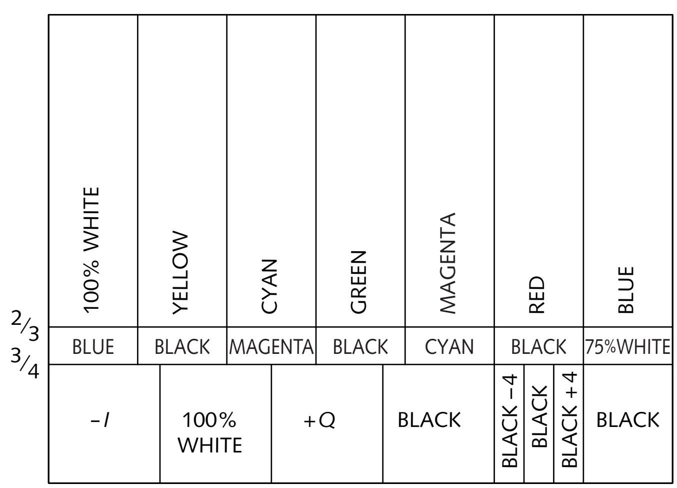


Figure 10.4 **NTSC decoder block diagram.**

Figure 20.1 **Colorbars.**



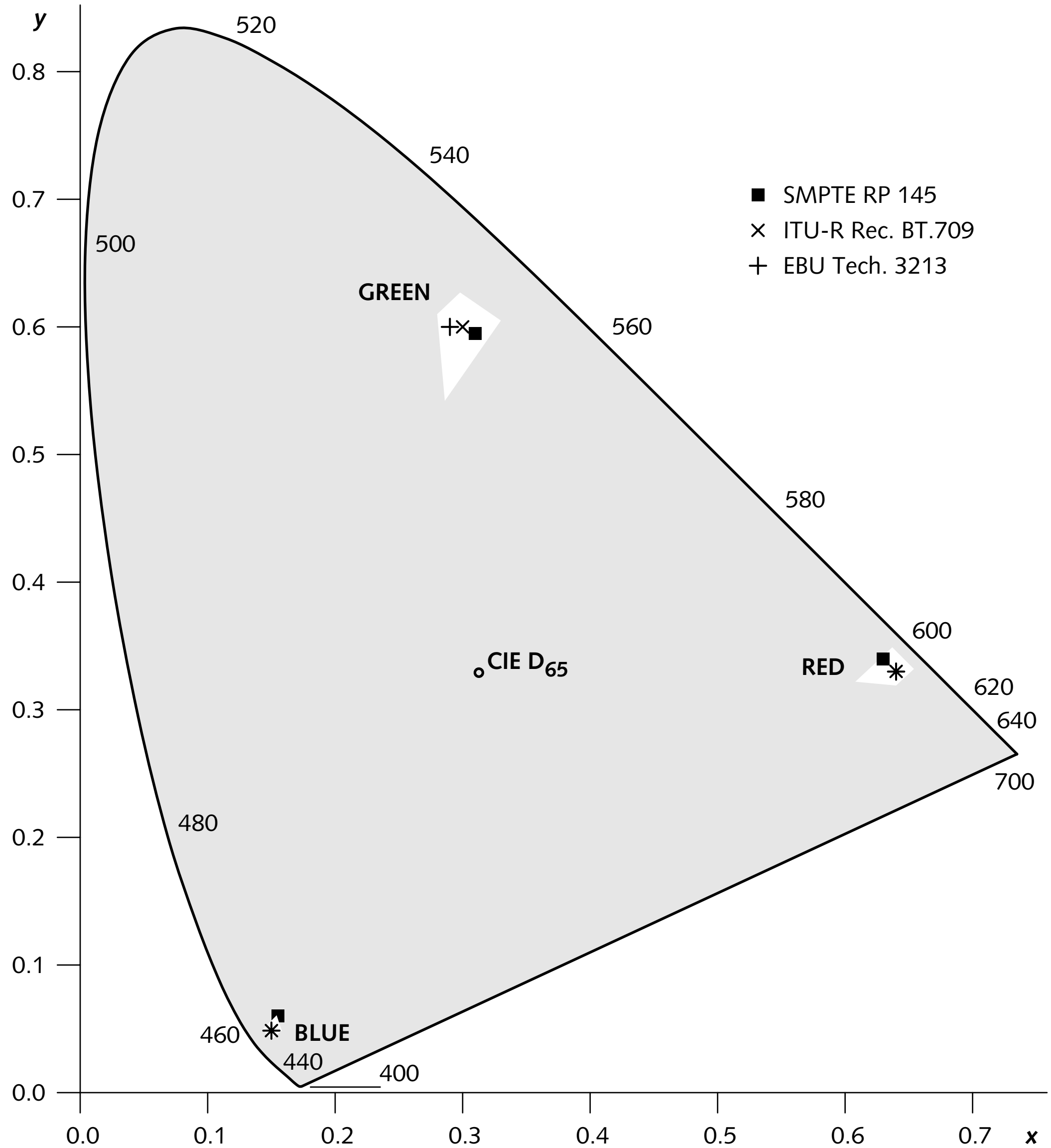


Figure 7.12 **RGB primaries of video standards** are plotted on the CIE (*x*, *y*) chromaticity diagram. The colors that can be represented in positive *RGB* values lie within the triangle formed by the primaries. The Rec. 709 standard specifies no tolerance. SMPTE tolerances are specified as ±0.005 in *x* and *y*. EBU tolerances are shown as white quadrilaterals; they are specified in *u'*, *v'* coordinates related to the color discrimination of vision. The EBU tolerance boundaries are not parallel to the (*x*, *y*) axes.

Burst

Burst – or *colorburst* – is formed by multiplying a phase-shifted version of subcarrier by a *burst gate* that has a duration of 10 ± 1 cycles of subcarrier, and is asserted to unity, 5.6 ± 0.1 µs after 0_H on every line that commences with a normal sync pulse (except lines 6, 310, 320, and 622, which are subject to *meander*, to be described in a moment). Burst gate has raised-cosine transitions whose 50 percent points are coincident with the time intervals specified above, and whose risetimes are 300^{+200}_{-100} ns.

PAL +135° burst lies on the *U* – *V* axis; –135° burst lies on the *U* + *V* axis. The choice of addition or subtraction depends on the polarity of the *V*-switch.

In NTSC, burst is based on the inverted *sin* subcarrier. PAL uses what is known as *swinging* burst: On one line, burst is advanced 135° from the *sin* subcarrier; on the next line, it is delayed 135° from the *sin* subcarrier. PAL burst is located at +135° and –135° (+225°) on a vectorscope display, compared to 180° for NTSC. The subcarrier regenerator of a typical PAL decoder does not process swinging burst explicitly, but relies on the loop filter to average the swinging burst to 180° phase.

A PAL decoder should recover *V*-switch polarity through burst averaging, not by detecting burst meander.

PAL systems have a burst-blanking *meander* scheme (also known as *Bruch blanking* or *Bruch burst*): Burst is suppressed from the first and last full lines of a field if it would take –135° phase. Burst is always suppressed from line 623. The suppression of burst ensures that the closest burst immediately preceding and following the vertical interval has +135° phase.

Color difference components, U, V

Color differences for PAL are computed by scaling *B'*–*Y'* and *R'*–*Y'* components to form *U* and *V* components, as described on page 180. The scaling limits the maximum value of the composite signal, to be defined in *Composite PAL encoding*, on page 244, to the range –1⁄3 to +4⁄3. The scale factors cause 100 percent colorbars to have an excursion from –33 1⁄3 percent to +133 1⁄3 percent of the picture excursion.The VHF/UHF PAL transmitter places no limit on composite picture excursion in this range (unlike NTSC, where the transmitter imposes a limit of 120 IRE).