

GROB

BASIC TELEVISION AND VIDEO SYSTEMS

FIFTH EDITION



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AND
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frequency is exactly 3.579545 MHz, which is generally considered as 3.58 MHz. Therefore 3.58 MHz is the frequency for color. It is generally labeled the *C signal* for chrominance, or chroma.

In a color television receiver, the color signal is combined with the luminance signal to recover the original red, green, and blue signals. Then these are used to reproduce the picture in color on the screen of a color picture tube. The color screen has phosphors that produce red, green, and blue. All colors can be produced as mixtures of red, green, and blue. A typical color television picture is shown in color plate I.

In monochrome receivers, the *Y* signal reproduces the picture in black and white. The 3.58-MHz color signal is just not used.

As a result, the color and monochrome systems are completely compatible. When a program is televised in color, the picture is reproduced in color by color receivers and in black and white by monochrome receivers. Moreover, programs televised in monochrome are reproduced in black and white by both monochrome and color receivers. The tricolor picture tube also can reproduce white by combining red, green, and blue.

Keep in mind that the color information starts with red, green, and blue at the camera and finishes with red, green, and blue at the picture tube, because these are the primary colors for television. Other color signals are just encoded information used for convenience in transmission. Methods of encoding the color information are explained in Chap. 8, "Color Television Circuits and Signals."

Test Point Questions 2-9

Answers at End of Chapter

Answer True or False.

- a. The *Y* luminance signal is for black-and-white picture information.
- b. The chrominance signal for color is at 3.58 MHz.

- c. The chrominance signal includes red, green, and blue picture information.
-

2-10

PICTURE QUALITIES

Assuming it is synchronized to stay still, the reproduced picture also should have high brightness, strong contrast, sharp detail, and the correct proportions of height and width. These requirements apply for both monochrome and color. In addition, the color picture should have strong color, or saturation, with the correct tints or hues.

BRIGHTNESS *Brightness* is the overall, or average, intensity of illumination, and it determines the background level in the reproduced picture. Individual picture elements can vary above and below this average brightness level. Brightness on the screen depends on the amount of high voltage for the picture tube and its dc bias in the grid-cathode circuit. In television receivers, the brightness control varies the dc bias of the picture tube.

The fluorescent screen of the picture tube is illuminated on only one small spot at a time. Thus the brightness of the complete picture is much less than the actual spot illumination. The bigger the screen is, the more light is needed from the spot to produce enough brightness.

CONTRAST By *contrast* we mean the difference in intensity between black parts and white parts of the reproduced picture. The contrast range should be great enough to produce a strong picture, with bright white and dark black for the extreme intensity values.

The amount of ac video signal determines the contrast of the reproduced picture. The ac signal amplitude determines how intense the white will be, compared with black parts of the signal. In television receivers, the contrast control varies the peak-to-peak (p-p) amplitude of the ac video

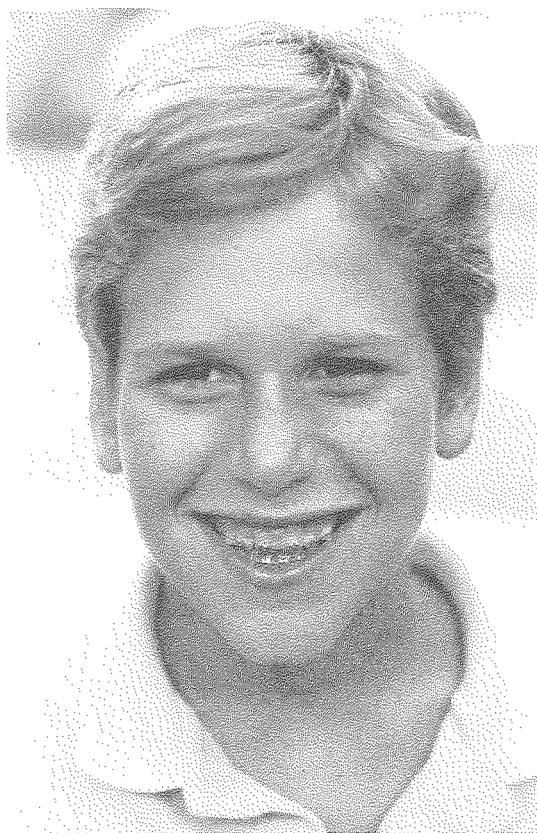
signal coupled to the grid-cathode circuit of the picture tube.

Actually, black in the picture is the same light level you see on the picture tube screen when the set is shut off. In a picture, this level looks black in contrast to the white fluorescence. However, the black cannot appear any darker than the room lighting reflected from the picture tube screen. So the surrounding illumination must be low enough to make black look dark. At the opposite extreme, the picture appears washed out, with little contrast, when it is viewed in direct sunlight because so much reflected light from the screen makes it impossible to have dark black.

DETAIL The quality of detail, which is also called *resolution*, or *definition*, depends on the number of picture elements that can be reproduced. With many small picture elements, the fine detail of the image is evident. Therefore, as many picture elements as possible should be reproduced to create a picture with good definition. This quality makes the picture clearer. Small details can be seen, and objects in the image are outlined sharply. Good definition also gives apparent depth to the picture by bringing out background details. The improved quality of a picture with more detail can be seen in Fig. 2-6, which shows how more picture elements increase the definition.



(a)



(b)

Fig. 2-6 Picture quality improves with greater detail. (a) Coarse structure with few details. Definition, or resolution, is poor. (b) Fine details for good quality.

TABLE 2-1
PICTURE QUALITIES

QUALITY	PICTURE	SIGNAL
Contrast	Range between black and white	Amplitude of ac video signal
Brightness	Background illumination	DC bias on picture tube
Resolution	Sharpness of details	Frequency response of video signal
Color saturation	Intensity or level of color	Amplitude of 3.58-MHz chroma signal
Hue	Tint of color	Phase angle of 3.58-MHz chroma signal

SELF-EXAMINATION

Answers at Back of Book

Fill in the missing word or number in the following statements:

1. Picture frames are repeated at the rate of _____ per second.
2. The number of scanning lines is _____ per frame.
3. The number of fields is _____ per frame.
4. The number of scanning lines is _____ per field.
5. The number of scanning lines is _____ per second.
6. The horizontal line-scanning frequency is _____ Hz.
7. The vertical field-scanning frequency is _____ Hz.
8. Video signal amplitude determines the picture quality called _____.
9. Light is converted to video signal by the _____ tube.
10. Video signal is converted to light by the _____ tube.
11. The bandwidth of a television channel is _____ MHz.
12. The type of modulation on the picture carrier signal is _____.
13. The type of modulation on the sound carrier signal is _____.
14. The assigned band for channel 3 is _____ MHz.
15. The difference between the picture and sound carrier frequencies for channel 3 is _____ MHz.
16. Scanning in the receiver is timed correctly by _____ pulses.
17. Retracers are not visible because of _____ pulses.
18. Black on the picture tube screen results from _____ beam current.
19. The color subcarrier frequency is approximately _____ MHz.
20. The amount of color saturation in the picture depends on the amount of _____ signal.

8 percent, the number of lines blanked out for the entire frame is 0.06×525 , or approximately 42 lines. Some of these lines occur during vertical retrace, and others are scanned at the top or bottom of the frame, but all are blanked out. Thus $525 - 42 = 483$ visible lines remain. With a utilization ratio of 0.7, the number of lines useful in showing vertical detail is

$$483 \times 0.7 = 338$$

This value represents the number of effective scanning lines.

Therefore, the maximum number of vertical details that can be reproduced with 483 visible scanning lines is about 338, with the exact value depending on the utilization ratio.

TOTAL NUMBER OF PICTURE ELEMENTS On the basis of the previous calculations, the maximum number of picture elements possible for the entire image is 426×338 , or about 144,000. This number is independent of the picture size.

A single frame of 35-mm motion-picture film has about 500,000 picture elements. The smaller 16-mm frame contains one-fourth as many, or about 125,000. So the televised reproduction can have about the same amount of detail as seen in 16-mm motion pictures.

Test Point Questions 7-8

Answers at End of Chapter

Give the maximum number of picture details for

- Each horizontal line
- Total picture area

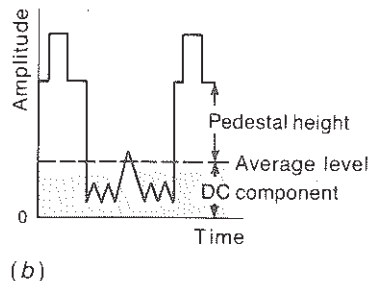
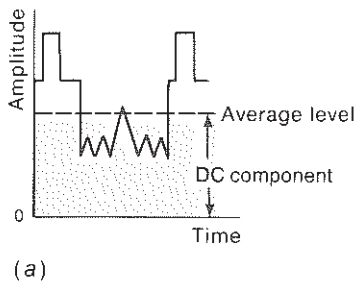


Fig. 7-13 Video signals with same ac variations but different average brightness levels. Only one line of a complete frame is illustrated. (a) Dark scene with average value close to black level. (b) Light scene with average value further from black level.

7-9

DC COMPONENT OF THE VIDEO SIGNAL

In addition to continuous amplitude variations for individual picture elements, the average value of the video signal must correspond to the average brightness in the scene. Otherwise, the receiver could not follow changes in brightness. As an example of the importance of the brightness level, the ac camera signal for a gray picture element on a black background is the same as the signal for white on a gray background, assuming there is no average-brightness information to indicate the change in background.

The *average level* of a signal is the arithmetic mean of all the instantaneous values measured from the zero axis. In Fig. 7-13a, the average level is higher than in Fig. 7-13b because the camera signal variations have higher amplitudes. Now, it is important to remember that the average value of any signal variation for a complete cycle is its dc component. Therefore, the dc component in Fig. 7-13a is closer to the black level than that in Fig. 7-13b. Although it is illustrated here for one scanning line (for convenience), the required dc component of the video signal is its average value for complete frames, since the background information of the frame indicates the brightness of the scene.

When the average value, or dc component, of the video signal is close to the black level, as in Fig. 7-13a, the average brightness is dark. The same ac signal variations in Fig. 7-13b have a lighter background because the dc axis is farther from the black level.