COLOR TELEVISION--NTSC STANDARDS--III

In the last issue the luminosity response of the human eye was discussed. In this issue the development of green-index signals and \( E_E \) is described.

As indicated in Figure 2 in the Volume 20, No. 1 issue, the high definition brightness signal that has been constructed is only step one of a two-step process. Step two is the addition of low definition color information. This will result in the "splashing" of low detail color to the high detail monochrome picture. The necessary voltages for a color reproduction are as shown at the picture tubes in Figure 7, \( E_E \) for the red tube, \( E_E \) for the green tube and \( E_E \) for the blue tube. In other words, for any fluctuation of the voltage out of the red camera that same fluctuation should be applied to the red picture tube. For reasons cited previously, \( E_E \) is being applied to all three receiving picture tubes. Therefore, what color signals must be added to \( E_E \) to give \( E_E \) and \( E_E \)? Apparently, three different signals are needed. One color signal when added to \( E_E \) must give \( E_E \). A second signal added to \( E_E \) must result in \( E_E \). Finally, a third signal must be used to give \( E_E \).

The next problem is the exact nature of these three signals. Looking at the signal to be applied to the red tube: Color Signal + \( E_E \) = \( E_E \)
so Color Signal = \( E_E \).

When this is done for the green and blue tubes also, the resulting color signals take the form:

\( E_E \)- \( E_E \)- \( E_E \)

When these color difference signals as they are called, are applied to their respective picture tubes, the results will be:

\((E_E - E_E) + E_E = E_E \) for the red tube
\((E_E - E_E) + E_E = E_E \) for the green tube
\((E_E - E_E) + E_E = E_E \) for the blue tube

A look at Figure 7 shows what the addition does to the color receiver. First, the signals \( E_E \), \( E_E \), \( E_E \), and \( E_E \) are derived from \( E_E \), \( E_E \), and \( E_E \). This is done by applying the outputs of the cameras into a matrix system, which is nothing more than a series of adding and subtracting circuits. The outputs are then fed through cables to the color receiver. The receiver is set up to feed \( E_E \) to all three adder circuits equally. In addition the \( E_E \) signal is applied to the red adder, \( E_E \) is applied to the green adder and \( E_E \) is applied to the blue adder. The outputs which are then fed to the picture tubes are \( E_E \), \( E_E \), and \( E_E \).

In order to clarify the exact nature of the brightness signal and the three color difference signals, a look at the make up of the signals for a color-bar pattern (Figure 8) would be advisable. This pattern consists of five vertical bars—white, red, green, blue, and yellow. The last four bars are 100% saturated colors. Figure 8 indicates the waveforms that would be observed with an oscilloscope synchronized on the horizontal scanning frequency. The starting point is the white bar since the initial camera adjustments are made for equal outputs for Illuminant C. Thus, the wave forms for \( E_E \), \( E_E \), and \( E_E \) are just 1 unit output for white. As saturated bars are used, notice that there is 1 unit for \( E_E \), when scanning the red and yellow bars, the output is zero for the blue and green bars.

In a similar manner, \( E_E \) is 1 unit for the green and yellow bars and zero for the blue and red bars. Also, \( E_E \) is one unit for the blue bar only. It is zero for the red, green, and yellow bars.

The next step is the development of the \( E_E \) signal.

\( E_E = .30E_E + .59E_E + .11E_E \)

Using the above formula for the white bar, \( E \) is:

\( E \) (White) = (.30 X 1.0) + (.59 X 1.0) + (.11 X 1.0) = 1.0 units

For the red bar \( E \) is:

\( E \) (Red) = (.30 X 1.0) + (.59 X 0) + (.11 X 0) = .30 units

For the green bar \( E \) is:

\( E \) (Green) = (.30 X 0) + (.59 X 1.0) + (.11 X 0) = .59 units

For the blue bar \( E \) is:

\( E \) (Blue) = (.30 X 0) + (.59 X 0) + (.11 X 1.0) = .11 units

and finally the yellow bar is:

\( E \) (Yellow) = (.30 X 1.0) + (.59 X 1.0) + (.11 X 0) = .88 units

Recalling the purpose of the brightness signal, how would this color-bar pattern show up on a monochrome receiver? The more signal applied to the picture tube grid, the brighter the bar. Therefore, the bars would have different values of brightness. The brightest would be white, then yellow, green, red, and the dimmest blue. A glance at Figure 4 in the last issue, will show that these various brightness levels are logical since they correspond approximately to the response curve of the eye.

The remaining signals to be developed in Fig. 8 are the color difference signals. These are achieved in simple adding circuits just as the \( E_E \) signal was developed. \( E_E \) is put through a phase inverter to give \( E_E \), and added to \( E_E \) and \( E_E \). The resulting voltages are \( E_E \), \( E_E \), and \( E_E \).

For example, \( E_E \) is formed by taking the waveform \( E_E \), inverting it to give \( E_E \), and adding it to the waveform \( E_E \).

For the white bar \( E_E = 1 \) unit and \( E_E = 1 \) unit. \( E_E \) is therefore 0 for white. This is a point worth remembering. There is no color-difference signal for white.

For the red bar \( E_E = 1 \) unit and \( E_E = .59 \) units. So, \( E_E = .70 \) units.

For the green bar \( E_E = .59 \) units and \( E_E = .59 \) units. So, \( E_E = .59 \) units for this bar. Notice that, although it is not possible to have negative values of \( E_E \), \( E_E \), or \( E_E \), negative values of color-difference signals do exist and occur quite frequently.

For the blue bar \( E_E = 0 \) units and \( E_E = .11 \) units. Therefore, \( E_E = .11 \) units for this bar.

The color difference signals, \( E_E \), \( E_E \), and \( E_E \), are formed in the same manner. The results of which can be seen also in Figure 8.
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Winter, 1969

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The new edition contains a number of improvements which will make this booklet easier to use and even more practical in electronic servicing.

One such improvement is the arrangement of base diagrams in a separate 64-page booklet which is included with each “Essential Characteristics.” All tube types using the same base drawing are listed with each diagram.

The listing of all tube types using the same busing diagram should be of considerable value, particularly when servicing older model receivers. If a tube type is not available, a check of the electrical characteristics for other tubes with the same busing will enable the technician to determine whether or not a substitute can readily be made with another type.

As before, the book includes typical characteristics curves, tube outline drawings, circuit diagrams showing typical applications of receiving tubes and construction data for speaker enclosures.

Tube classification charts have been expanded to facilitate reference to similar types. Cross-reference listings of prototypes for five-star and special-purpose types and a new comprehensive listing of Foreign Types and American near-equivalents are included.

New additions include outline drawings and characteristics for Entertainment Semiconductors.

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Techni-talk on AM, FM, TV Servicing, published quarterly by ELECTRONIC COMPONENTS DIVISION, GENERAL ELECTRIC COMPANY, OAK BROOK EXECUTIVE PLAZA, OAK BROOK, ILLINOIS 60521.

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