Amplitude dependent waveform distortions are often referred to as nonlinear distortions. This classification includes distortions that are dependent on APL (Average Picture Level) changes and/or instantaneous signal level changes.

Since amplifiers and other electronic circuits are linear over only a limited range, they tend to compress or clip large signals. The result is nonlinear distortion of one type or another. Nonlinear distortions may also manifest themselves as crosstalk and intermodulation effects between the luminance and chrominance portions of the signal.

The first three distortions discussed in this section are differential phase, differential gain, and luminance nonlinearity. These are by far the most familiar and most frequently measured nonlinear distortions. These parameters are included in the performance specifications of most video equipment and are regularly evaluated in television facilities. The other distortions are generally not measured as frequently, however, they are included in most measurement standards and performance checks.

It is recommended that nonlinear distortions be measured at mid APL and at the APL extremes. Some test signal generators provide signals with different APL by combining the test signal with a variable level pedestal. This is usually accomplished by alternating between one line of the test signal and a group of four lines of the pedestal with the sequence repeated throughout the field. Since in-service measurements cannot be made with full field test signals, measurements requiring control of APL are often excluded from routine testing.

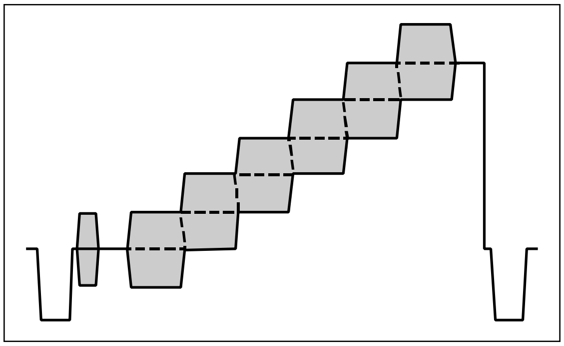

Figure 65. A 5-step modulated staircase signal.

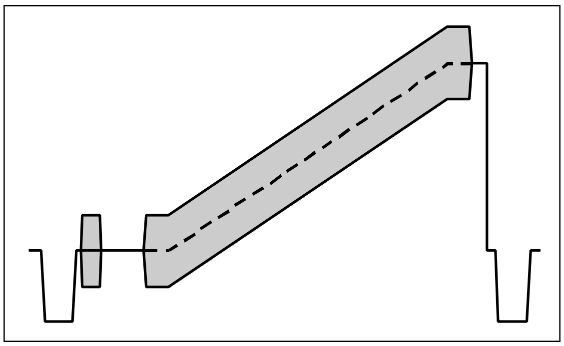

Figure 66. A modulated ramp signal.

DEFINITION

Differential phase distortion, often referred to as "diff phase" or "dP", is present when chrominance phase is affected by luminance level. This distortion occurs when chrominance information is not uniformly processed at all luminance levels.

Differential phase distortion is expressed in degrees of subcarrier phase. Since both positive and negative (lead and lag) phase errors may occur in the same signal, it is important to specify whether the peak-to-peak phase error or maximum deviation from zero is being quoted. In general, NTSC measurement standards (and this booklet) refer to peak-to-peak measurements.

Differential phase should be measured at different average picture levels and the worst error quoted.

PICTURE EFFECTS

When differential phase distortion is present, changes in hue occur when picture brightness changes. Colors may not be properly reproduced, particularly in high brightness areas of the picture.

TEST SIGNALS

Differential phase is measured with a test signal that consists of uniform phase chrominance superimposed on different luminance levels. A modulated staircase (5 or 10 step) or a modulated ramp is typically used (see Figures 65 and 66). A ramp is normally used when performing measurements on devices and systems that convert the signal from analog to digital and back to analog.

MEASUREMENT METHODS

Differential phase can be easily measured after the chrominance has been demodulated and presented on a vector display. Although a standard vector display can indicate the presence of large amounts of distortion, a vectorscope equipped with a special DIFF PHASE mode or an automatic measurement set such as the VM700T is required for precision measurements.

Vectorscope Display. In a vectorscope display, elongation of the dot in the direction of the graticule circumference indicates the presence of differential phase. Measurements are made by using the vectorscope variable gain control to bring the signal vector out to the graticule circle and reading the amount of distortion from the graticule. Vectorscope graticules generally have marks on the left-hand side to help quantify the error (see Figure 67).

R-Y Sweep. Although errors show up in the vectorscope display, there are some advantages to be gained by examining the demodulated R-Y signal in a voltage versus time display. (Recall that the R-Y signal drives the vertical axis of a vectorscope.) First of all, more gain and therefore more measurement resolution is possible in waveform displays. Secondly, the sweep display facilitates correlation of the R-Y signal with the original test signal in the time dimension. This allows determination of exactly how the effects of differential phase vary with luminance level or how they vary over a field.

Precise measurements of differential phase are therefore made by examining a voltage versus time display of the demodulated R-Y information. Distortions manifest themselves as tilt or level changes across the line.

Two different types of R-Y displays, known as "single trace" and "double trace" , can be used to make this measurement. As described below, different measurement techniques are used with the two displays. In the 1780R, these modes are both accessed by selecting DIFF PHASE in the MEASURE menu. The SINGLE/DOUBLE touchscreen selection determines which of the two displays will appear.

R-Y Sweep - Single Trace Method. In the single trace mode, distortions are quantified by comparing the R-Y waveform to a vertical graticule scale.

To make a measurement, first set the signal vector to the reference (9 o'clock) phase position. Use the vectorscope variable gain control to set the signal vector out to the edge of the vectorscope graticule circle. Make sure the 1780R waveform monitor gain is in the calibrated (1 volt full scale) setting.

The R-Y display appears on the waveform (right-hand) screen in the 1780R. Each major division (10 IRE) on the vertical graticule scale corresponds to one degree when the R-Y waveform is being displayed. The amount of differential phase distortion may be determined by measuring the largest vertical deviation between two parts of the signal (see Figure 68).

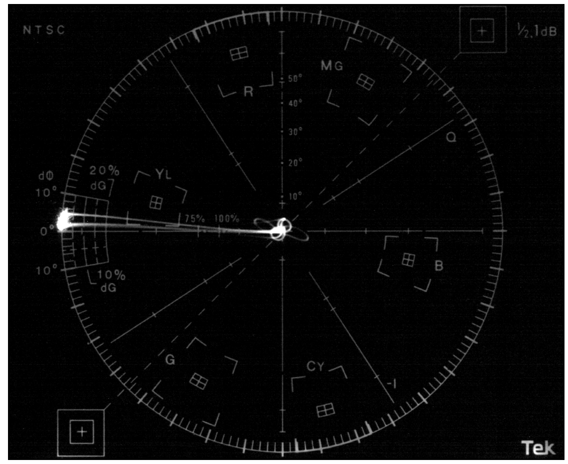

Figure 67. A vectorscope display showing a 5 degree differential phase distortion.

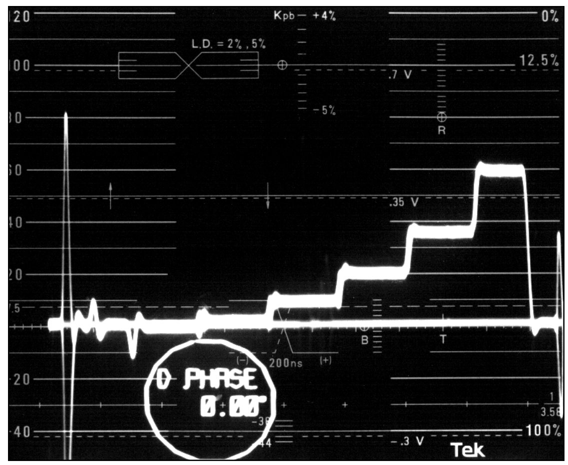

Figure 68. The 1780R single trace DIFF PHASE display indicating 6 degrees of differential phase distortion. The 0.00 D PHASE readout indicates a properly adjusted display, ready for the measurement result to be read from the graticule.

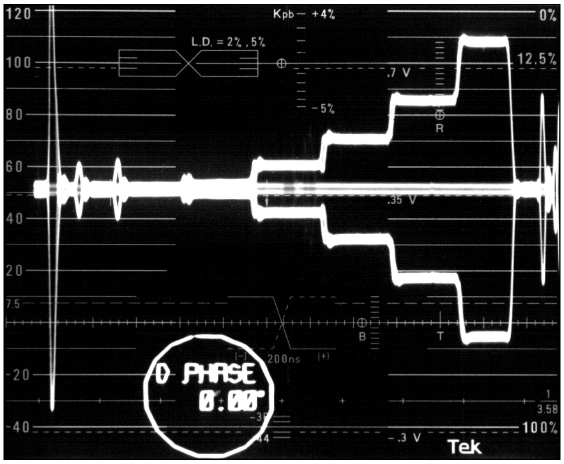

Figure 69. The 1780R double trace DIFF PHASE display with the phase readout zeroed.

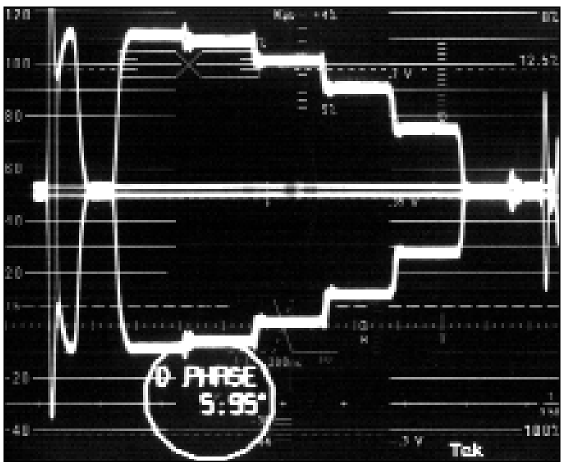

Figure 70. The double trace DIFF PHASE display with the measurement results indicated on the readout.

R-Y Sweep - Double Trace Method. The double trace method provides a more accurate way of measuring the tilt in a one-line sweep of the R-Y information. Instead of comparing the waveform to a graticule, the vectorscope calibrated phase shifter is used to quantify the error.

The double trace display, which appears on the waveform screen in the 1780R, is produced by displaying the single trace R-Y information non-inverted for half the lines and inverted for the other half. As shifting phase moves the two traces vertically with respect to each other, measurements can be made by introducing calibrated amounts of phase shift with the vectorscope phase control. The basic technique involves establishing a reference at one extreme of the tilt by bringing the inverted and non-inverted traces together at that point. The amount of phase shift required to bring the two traces together at the other extreme of the tilt is the differential phase distortion.

Select DOUBLE in the 1780R DIFF PHASE mode to make this measurement. Use the phase shifter to set the signal vector to the reference (9 o'clock) phase position. Neither vectorscope or waveform monitor gain is critical in this mode (see Note 22), however, setting the vector to the graticule circle is a good starting point. Use the phase shifter to bring the largest negative excursion of the upper (non-inverted) waveform to meet its mirror image. When they just touch, press REF SET to set the phase readout to 0.00 degrees (see Figure 69). Now use the phase shifter to bring the largest positive excursion in the upper trace to meet its mirror image. The readout will indicate the amount of differential phase distortion (see Figure 70).

A similar DOUBLE MODE technique is used with the 520A Vectorscope. Start by setting the CALIBRATED PHASE dial to zero. Use the A or B phase control to null the largest negative excursion and then use the calibrated phase shifter to null the largest positive excursion. The number above the calibrated phase dial will indicate the amount of differential phase.

VM700T Automatic Measurement. To make an automatic measurement of differential phase with the VM700T, select DG DP in the MEASURE mode. Both differential phase and differential gain are shown on the same display (see Figure 71). The lower graph is differential phase. These measurements are also available in the AUTO mode.

NOTES

22. 1780R Waveform and Vector Gains. In the single trace mode, the vector gain must be set so the signal vector extends to the graticule circle. The waveform gain must be in the calibrated position. The graticule is calibrated to one degree per division only under these conditions.

With the double mode display, however, more gain may be used for greater resolution. Additional vectorscope gain and/or waveform vertical gain can be selected without affecting the measurement results.

23. Signal Vector. The test signals used for measuring differential phase and gain may have either 20 IRE or 40 IRE chrominance at the same phase as color burst. With 40 IRE chrominance the burst and signal vectors coincide on the vectorscope display. With a 20 IRE signal, the burst and signal vectors will have the same phase but different amplitudes. In this case, be sure to set the 20 IRE signal rather than the 40 IRE burst out to the vector graticule circle. The signal gain is what must be normalized.

24. Noise Reduction Filter. A digital recursive filter is available in the 1780R to facilitate differential phase and gain measurements in the presence of noise. Select the NOISE REDUCTION ON touch-screen selection in the DIFF PHASE or DIFF GAIN menu to enable the filter. The filter removes approximately 15 dB of noise from the signal without any loss of bandwidth or horizontal resolution. This mode is particularly useful for VTR and transmitter measurements.

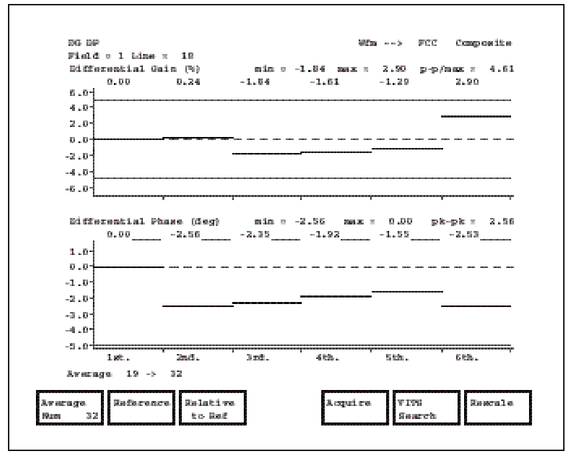

Figure 71. The VM700T DG DP display.

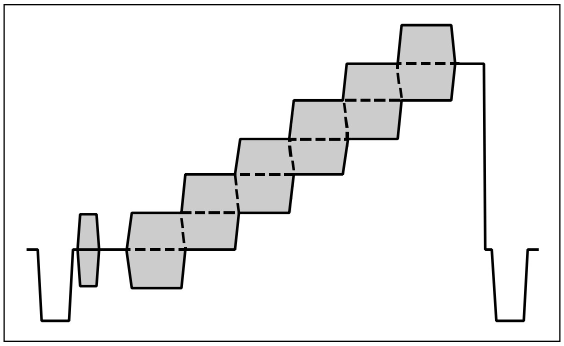

Figure 72. A 5-step modulated staircase signal.

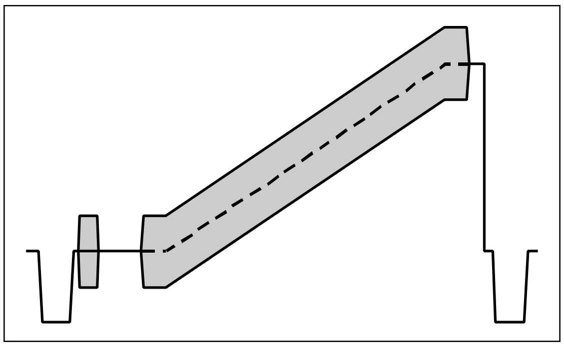

Figure 73. A modulated ramp signal.

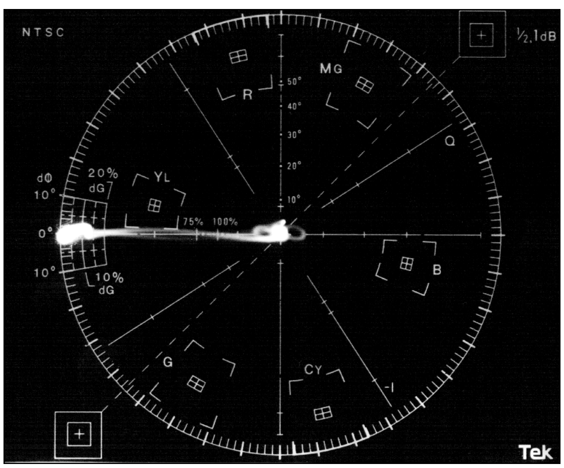

Figure 74. A vectorscope display indicating 15% differential gain.

DEFINITION

Differential gain, often referred to as "diff gain" or "dG", is present when chrominance gain is affected by luminance level. This distortion occurs when chrominance information is not uniformly processed at all luminance levels.

The amount of differential gain distortion is expressed in percent. Since both attenuation and peaking of chrominance can occur in the same signal, it is important to specify whether the maximum overall amplitude difference or the maximum deviation from the blanking level amplitude is being quoted. In general, NTSC measurement standards (and this booklet) specify the largest amplitude deviation between any two levels expressed as percent of the largest chrominance amplitude.

Differential gain should be measured at different average picture levels and the worst error quoted.

PICTURE EFFECTS

When differential gain distortion is present, changes in color saturation occur when picture brightness changes. Colors may not be properly reproduced, particularly in high brightness areas of the picture.

TEST SIGNALS

Differential gain is measured with a test signal that consists of uniform amplitude chrominance superimposed on different luminance levels. A modulated staircase (5 or 10 step) or a modulated ramp is typically used (see Figures 72 and 73).

MEASUREMENT METHODS

Differential gain distortions can be quantified in a number of ways. Chrominance amplitudes can be measured directly with a waveform monitor and large distortions can be seen on a vectorscope display. For precision measurements, however, a vectorscope with a special DIFF GAIN mode or an automatic measurement set such as the VM700T is required.

Vectorscope Display. Elongation of the dot in the radial direction indicates the presence of differential gain in a vectorscope display. Measurements can be made by using the vectorscope variable gain control to bring the signal vector out to the graticule circle and reading the amount of distortion from the graticule. Most vectorscope graticules have special marks on the left side to help quantify the error (see Figure 74).

Waveform Monitor/Chrominance Filter. Differential gain measurements can also be made with a waveform monitor. This process is facilitated by enabling the chrominance filter which passes only the chrominance portion of the signal. Peak-to-peak chrominance amplitude can be easily measured in the resulting display. To make a measurement, first normalize the peak-to-peak amplitude of the highest chrominance level to 100 IRE. Then measure the peak-to-peak amplitude of the lowest chrominance level. The amplitude difference, expressed in percent, is the amount of differential gain distortion (see Figure 75).

This measurement can also be made by using the 1780R voltage cursors in the RELATIVE mode. Define the peak-to-peak amplitude of the highest chrominance level as 100%. Then move the cursors to measure peak-to-peak amplitude of the lowest chrominance level. The amplitude difference, expressed in percent, is the amount of differential gain distortion.

In either case, remember that it is the difference between the highest and lowest chrominance amplitudes that represents the amount of differential gain distortion. If the lowest chrominance level is 90% of the highest, a differential gain error of 10% should be quoted.

B-Y Sweep. Some vectorscopes are equipped with a special mode for making accurate differential gain measurements. A line sweep of demodulated B-Y information is displayed with errors manifested as tilt or level changes across the line. Like the R-Y display used to measure differential phase, this display provides greater resolution and an indication of how distortion varies over a line or field. In the 1780R, both "single trace" and "double trace" versions of this display are available. Both are accessed by selecting DIFF GAIN in the MEASURE menu.

B-Y Sweep - Single Trace Method. The single trace differential gain display is familiar to users of the 520A Vectorscope and is also available in the 1780R by selecting SINGLE in the DIFF GAIN menu. Errors are quantified by comparing the demodulated waveform to a vertical graticule scale.

Use the phase shifter to set the signal vector to the reference (9 o'clock) position prior to making this measurement. Adjust the vectorscope variable gain control so the signal vector extends to the edge of the graticule circle. Make sure the 1780R waveform gain is in the calibrated (1 volt full scale) setting.

In the 1780R, the differential gain display appears on the waveform screen. Compare the waveform to the vertical scale on the graticule and measure the largest deviation between any two parts of the signal. One major graticule division (10 IRE) is equal to one percent (see Figure 76).

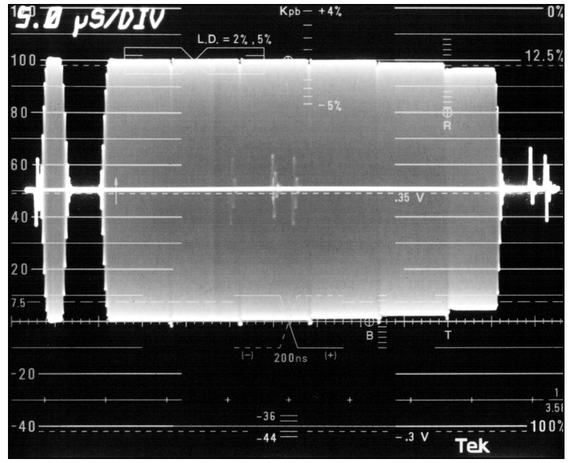

Figure 75. A chrominance filter display indicating about 7% differential gain.

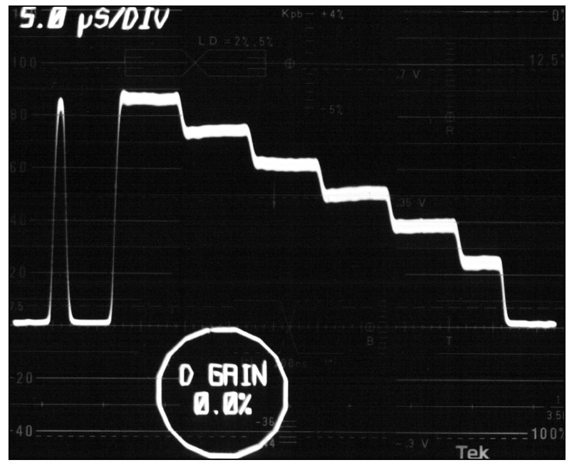

Figure 76. The 1780R single trace DIFF GAIN display indicating a distortion of 6%. As with diff phase, the single trace diff gain measurement result is read off the graticule, not the D GAIN readout.

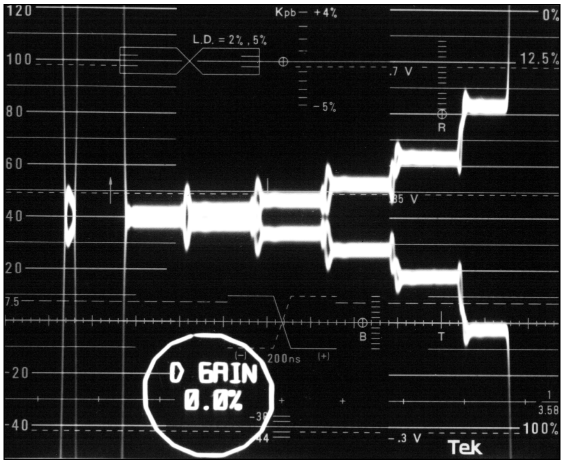

Figure 77. The 1780R double trace DIFF GAIN display with the gain readout zeroed.

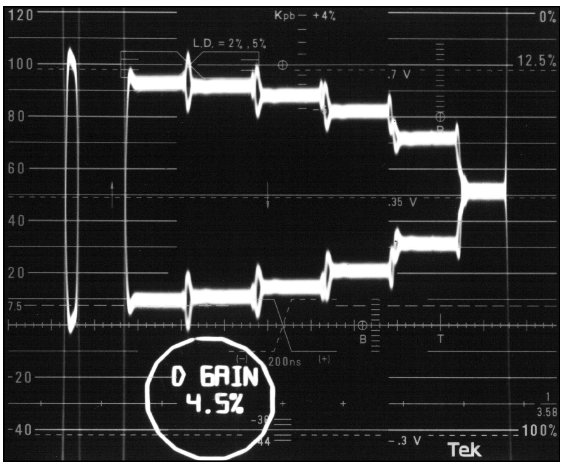

Figure 78. The 1780R double trace DIFF GAIN display with the measurement results indicated on the readout.

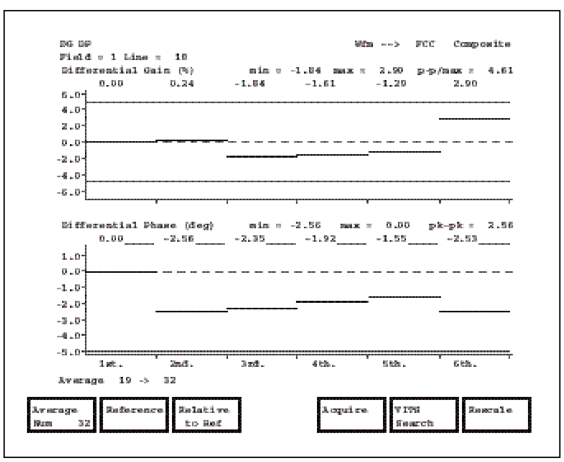

Figure 79. The VM700T DG DP display.

B-Y Sweep - Double Trace Method. The double trace method provides a highly accurate way of measuring the amount of tilt in a one-line sweep of the B-Y information. This method is very similar to the differential phase double trace method, however, a calibrated gain control rather than a calibrated phase control is used to null the traces.

Select DOUBLE in the 1780R DIFF GAIN menu to make this measurement. Use the phase shifter to set the vector phase to the reference (9 o'clock) position. The vectorscope variable gain must be adjusted so the signal vector reaches the graticule circle. The 1780R waveform monitor gain setting is not critical in this mode (see Note 26).

Start the measurement procedure by using the large knob to bring the largest negative excursion of the upper (non-inverted) waveform to meet its mirror image. Press REF SET to set the readout to 0.00 percent (see Figure 77). Use the large knob to bring the largest positive excursion of the upper trace to meet its mirror image. The readout will indicate the amount of differential gain distortion (see Figure 78).

VM700T Automatic Measurement. To make an automatic measurement of differential gain with the VM700T, select DG DP in the MEASURE mode. Both differential phase and differential gain are shown on the same display. The upper graph is differential gain. These measurements are also available in the AUTO mode (see Figure 79).

NOTES

25. Demodulated "B-Y" Signal. It should be noted that in instruments such as the 520A and the 1780R, the displayed signal is not simply the B-Y demodulator output of the vectorscope. Rather, an envelope (square law) detector scheme is used. The demodulated signal is derived by multiplying the signal by itself rather than by a constant-phase CW subcarrier as in a synchronous demodulator. The primary advantage of this method is that in the presence of both differential phase and differential gain, synchronous detection yields a phase-dependent term while square law detection does not. Thus the presence of differential phase does not affect the differential gain result.

26. 1780R Waveform and Vector Gains. When using the single trace mode, the vector gain must be set to the graticule circle and the waveform gain must be in the calibrated position. The graticule is calibrated to one percent per division only under these conditions.

In the double mode display, more gain may be introduced in the waveform vertical (X5 or VAR) for greater resolution. However, it is critical that the vectorscope gain be set to the graticule circle to obtain correct measurement results.

27. Simultaneous Display of DP and DG. It is sometimes useful to have a display that shows both differential phase and differential gain, particularly when adjusting equipment for minimum distortion. A display which shows a one-line sweep of differential phase on the left and a one-line sweep of differential gain on the right can be accessed by selecting DP & DG in the 1780R MEASURE menu (see Figure 80). The VM700T DG DP display also shows both distortions simultaneously.

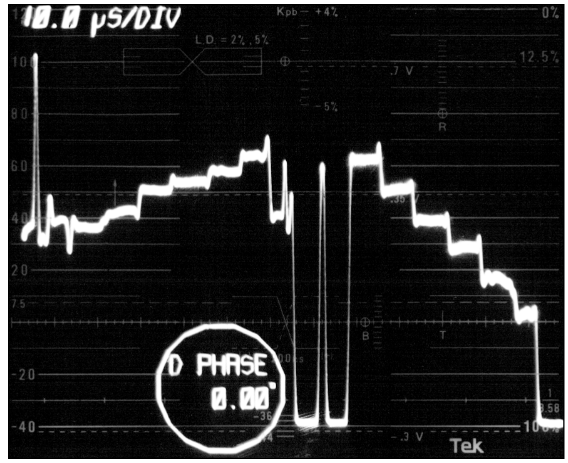

Figure 80. The 1780R DP & DG display (single trace mode only).

Luminance Nonlinearity

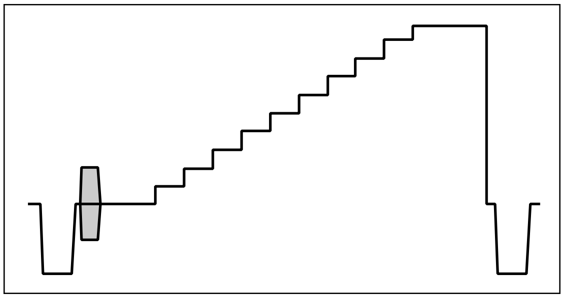

Figure 81. A 10-step staircase test signal.

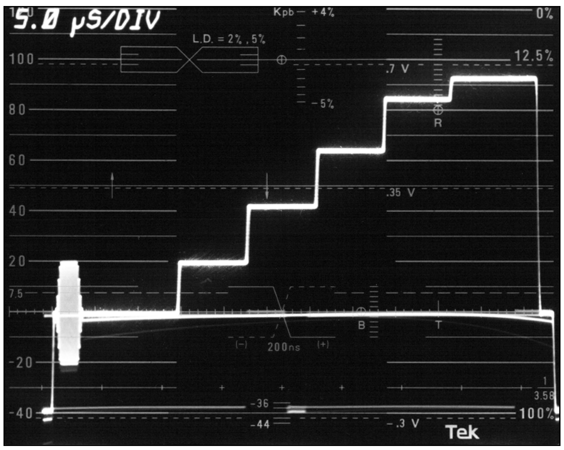

Figure 82. An example of luminance nonlinearity distortion.

DEFINITION

Luminance nonlinearity, or differential luminance, is present when luminance gain is affected by luminance level. In other words, there is a nonlinear relationship between the input and output signals in the luminance channel. This amplitude distortion occurs when luminance information is not uniformly processed over the entire amplitude range.

The amount of luminance nonlinearity distortion is expressed as a percentage. Measurements are made by comparing the amplitudes of the individual steps in a staircase test signal. The result is the difference between the largest and smallest steps expressed as a percentage of the largest step.

Luminance nonlinearity should be measured at different average picture levels and the worst error quoted.

PICTURE EFFECTS

Luminance nonlinearity is not particularly noticeable in black and white pictures. However, if large amounts of distortion are present, loss of detail in the shadows and highlights may be seen. These effects correspond to crushing or clipping of the black and white information.

In color pictures, luminance nonlinearity is often more noticeable. This is because color saturation, to which the eye is more sensitive, is affected.

TEST SIGNALS

Luminance nonlinearity should be measured with a test signal that consists of uniform-amplitude luminance steps. Unmodulated 5 step or 10 step staircase signals are typically used.

If an unmodulated signal is not available, the measurement can also be made with a modulated staircase. This is generally not good practice, however, since both differential gain and luminance nonlinearity can have the same net effect on the signal.

MEASUREMENT METHODS

Luminance nonlinearities are quantified by comparing the step amplitudes of the test signal. Since the steps are generated at uniform height, any differences are a result of this distortion. The waveform in Figure 82 exhibits luminance nonlinearity. Note that the top step is shorter than the others.

Waveform Display. This measurement can be made with a waveform monitor by individually measuring each step in the test signal. It is most convenient to use the variable gain to normalize the largest step to 100 IRE so percentage can be read directly from the graticule. Voltage cursors can also be used to measure the steps. Although this method can yield very accurate results, it is time consuming and not frequently used in practice.

Waveform Monitor - Differentiated Step Filter. Some waveform monitors are equipped with a special filter, usually called a "diff step" filter, for measurement of luminance nonlinearity. When this filter is selected, each step transition appears as a spike on the display. As the amplitude of each spike is proportional to the corresponding step height, the amount of distortion can be determined by comparing the spike amplitudes.

Either the waveform monitor graticule or the voltage cursors can be used to measure the spikes. Use the variable gain to normalize the largest spike amplitude to 100 IRE when using the waveform monitor graticule. The difference between the largest and smallest spikes, expressed as a percentage of the largest, is the amount of luminance nonlinearity.

The 1780R voltage cursors should be in the RELATIVE mode for this measurement. Define the largest spike amplitude as 100%. Leave one cursor at the top of the largest spike, and move the other cursor to the top of the smallest spike. The readout will indicate the amount of luminance nonlinearity distortion (see Figure 83).

VM700T Automatic Measurement. Select LUMINANCE NONLINEARITY in the VM700T MEASURE menu to obtain a display of this distortion. The VM700T uses a differentiated step filter in making this measurement (see Figure 84). This measurement is also available in the AUTO mode.

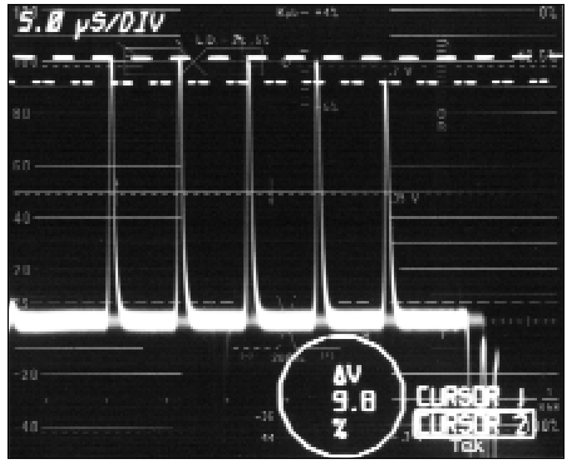

Figure 83. The 1780R voltage cursors indicate 9.8% luminance nonlinearity.

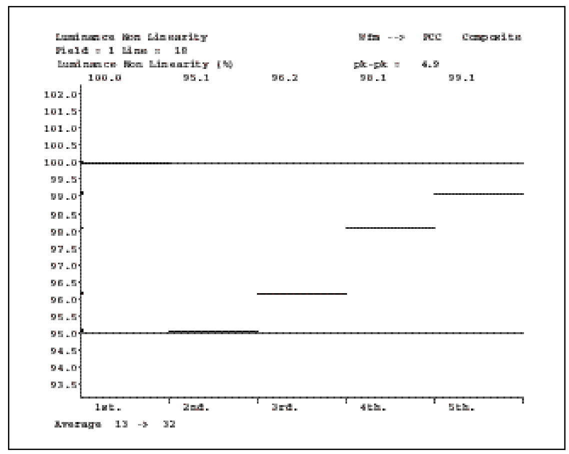

Figure 84. The VM700T Luminance Nonlinearity display.

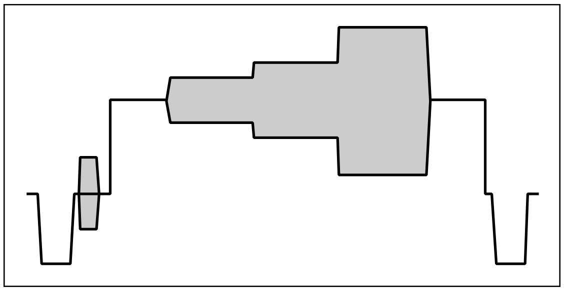

Figure 85. A modulated pedestal test signal.

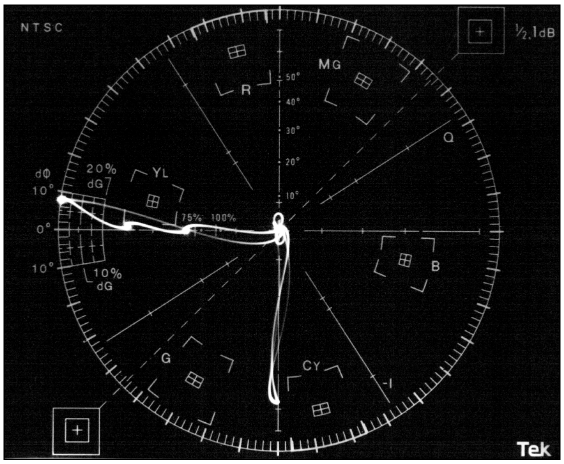

Figure 86. The 1780R vectorscope display indicating a chrominance nonlinear phase distortion of 8 degrees.

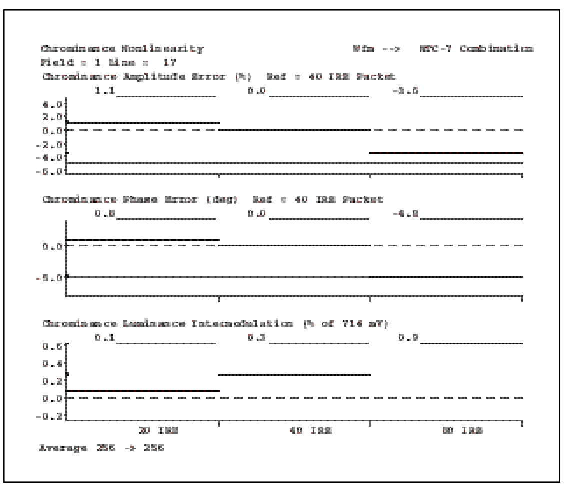

Figure 87. The VM700T Chrominance Nonlinearity display. Chrominance nonlinear phase is shown in the center graph.

DEFINITION

Chrominance nonlinear phase is present when chrominance phase is affected by chrominance amplitude. This distortion occurs when all amplitudes of chrominance information are not uniformly processed.

Chrominance nonlinear phase distortion is expressed in degrees of subcarrier phase. This parameter should be measured at different average picture levels and the worst error quoted.

PICTURE EFFECTS

Chrominance nonlinear phase distortion will cause a shift in hue as color saturation increases. The effect is most noticeable in high amplitude chrominance signals.

TEST SIGNALS

Chrominance nonlinear phase is measured with a modulated pedestal test signal. This signal consists of a single phase, three level chrominance packet superimposed on a constant luminance level (see Figure 85). A typical modulated pedestal signal will have a 50 IRE luminance level and 20, 40, and 80 IRE chrominance levels.

MEASUREMENT METHODS

Chrominance nonlinear phase is quantified by measuring the phase change of the chrominance levels from their nominal phase value. In some cases, this distortion is defined as the peak-to-peak phase change between the three levels.

Vectorscope. Since phase information is required, a vectorscope is used to measure chrominance nonlinear phase. Examine the three dots (which correspond to the three chrominance levels) and measure the maximum phase difference between the three signal vectors. This is easiest when the vectorscope variable gain is adjusted to bring the largest vector out to the graticule circle (see Figure 86). When using a 1780R or a 520A Vectorscope, the calibrated phase shifter can be used to obtain a precise reading.

VM700T Automatic Measurement. Select CHROMA NONLINEARITY in the VM700T MEASURE mode to obtain a display of this distortion. The chrominance nonlinear phase measurement is the middle graph in the display (see Figure 87). These measurements are also available in the AUTO mode.

DEFINITION

Chrominance nonlinear gain is present when chrominance gain is affected by chrominance amplitude. This distortion occurs when all amplitudes of chrominance information are not uniformly processed.

Chrominance nonlinear gain distortion is expressed in IRE or percent. This distortion should be measured at different average picture levels and the worst error quoted.

PICTURE EFFECTS

Chrominance nonlinear gain distortion will cause a change in color saturation as chrominance amplitude increases. The effect is most noticeable in high amplitude chrominance signals.

TEST SIGNALS

Chrominance nonlinear gain is measured with a modulated pedestal test signal. This signal consists of a single phase, three level chrominance packet superimposed on a constant luminance level (see Figure 88). A typical modulated pedestal signal will have a 50 IRE luminance level and 20, 40, and 80 IRE chrominance levels.

MEASUREMENT METHODS

Chrominance nonlinear gain distortion is quantified by measuring the amplitude deviation of the chrominance levels from their nominal values with the 40 IRE level used as the reference.

Waveform Monitor. The waveform monitor graticule should be used for this measurement. First use the waveform monitor variable gain to normalize the middle subcarrier packet to its nominal value of 40 IRE. The chrominance nonlinear gain distortion is the largest deviation from nominal value of the other two levels. The result may be expressed in IRE or as a percentage of the nominal amplitude of the affected packet. The waveform in Figure 89 exhibits 14 IRE of chrominance nonlinear gain distortion.

VM700T Automatic Measurement. Select CHROMA NONLINEARITY in the VM700T MEASURE mode to obtain a display of this distortion. The chrominance nonlinear gain measurement is the top graph in the display (see Figure 90). These measurements are also available in the AUTO mode.

NOTES

28. Chroma Filter. It is sometimes recommended that the chroma filter on the waveform monitor be enabled when measuring chrominance nonlinear gain. While the chroma filter will make the display more symmetrical, the same results should be obtained either way since it is the peak-to-peak amplitudes being measured. A possible exception is a case where chrominance harmonic distortion is present. The chrominance filter can remove the effects of harmonic distortion which are likely to be different for each chrominance level.

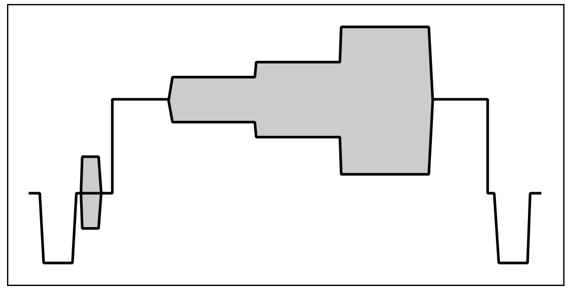

Figure 88. A modulated pedestal test signal.

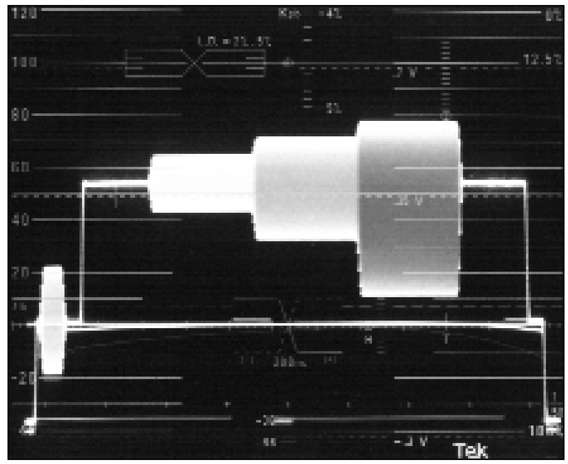

Figure 89. A chrominance nonlinear gain distortion of 14 IRE is shown in this display.

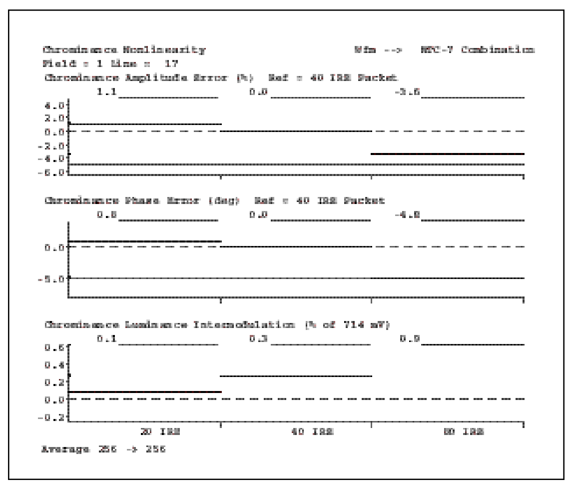

Figure 90. The VM700T Chrominance Nonlinearity display. Chrominance nonlinear gain is shown on the upper graph.

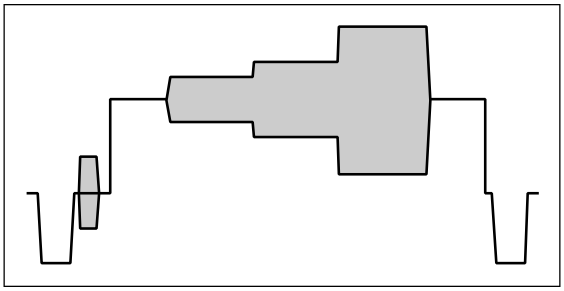

Figure 91. A modulated pedestal test signal.

DEFINITION

Chrominance-to-luminance intermodulation, also known as crosstalk or cross-modulation, is present when luminance amplitude is affected by superimposed chrominance. The luminance change may be caused by clipping of high-amplitude chrominance peaks, quadrature distortion, or crosstalk.

The deviation in the pedestal level may be expressed:

- In IRE with pedestal level normalized to 50 IRE.
- As a percentage of the pedestal level.
- As a percentage of the measured white bar amplitude.
- As a percentage of 714 millivolts.

These definitions will yield different results under some conditions so it is important to standardize on a single method of making intermodulation measurements.

PICTURE EFFECTS

Chrominance-to-luminance intermodulation will cause variations in brightness due to color saturation changes.

TEST SIGNALS

Chrominance-to-luminance intermodulation is measured with a modulated pedestal test signal. This signal consists of a single phase, three level chrominance packet superimposed on a constant luminance level (see Figure 91). A typical modulated pedestal signal will have a 50 IRE luminance level and 20, 40, and 80 IRE chrominance levels.

MEASUREMENT METHODS

Chrominance-to-luminance intermodulation is quantified by measuring the change in luminance level caused by the chrominance information superimposed on it. This process is facilitated by removing the chrominance information from the display with a waveform monitor filter.

Waveform Monitor. The chrominance information can be filtered off with either the luminance or lowpass filter in the 1780R. The lowpass filter should be selected if using the 1480. The IRE filter is not really suitable because some chrominance remains in the display. The Y display of the 520A vectorscope also works well.

Details of the measurement method will depend on how the amount of distortion is expressed. In general, first use the variable gain on the waveform monitor to normalize the portion of the pedestal without superimposed chrominance to the measurement reference level. For an absolute value measurement, this would be the nominal pedestal level. For a percent measurement, this could be 100 IRE (see Figure 92). With the pedestal level normalized, measure the largest level shift at the top of the pedestal.

The 1780R voltage cursors can be used in RELATIVE mode to make this measurement. In Figure 92, the amplitude deviation is 9.2% of the pedestal level.

VM700T Automatic Measurement. Select CHROMA NONLINEARITY in the VM700T MEASURE mode to obtain a display of this distortion. The chrominance-to-luminance intermodulation measurement is the bottom graph in the display (see Figure 93). These measurements are also available in the AUTO mode.

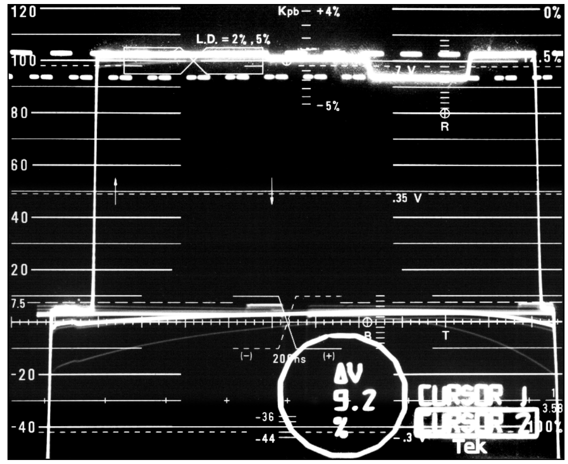

Figure 92. A chrominance-to-luminance intermodulation distortion of 9.2%.

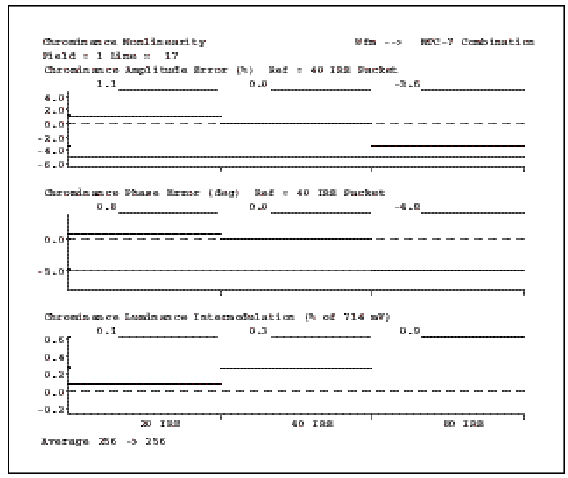

Figure 93. The VM700T Chrominance Nonlinearity display. Chrominance-to-luminance intermodulation is shown in the lower graph.

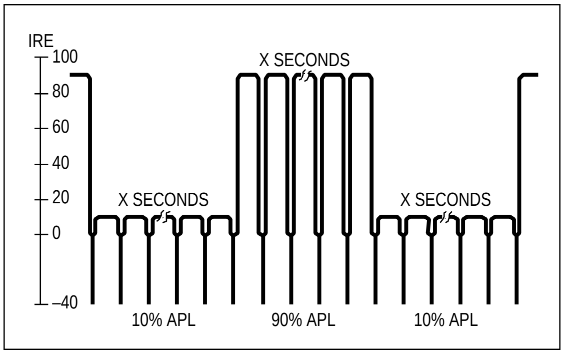

Figure 94. A flat field bounce test signal.

DEFINITION

Transient gain distortion, also referred to as transient nonlinearity, is present when abrupt changes in APL temporarily affect signal amplitude. For the synchronizing signal, the error is defined as the maximum transient departure in the amplitude of sync from the amplitude before the change in APL. It is generally expressed as a percentage of the original amplitude, however, some standards specify a percentage of the largest amplitude. Measurement of this distortion requires an out-of-service test. Both low-to-high and high-to-low APL changes should be evaluated.

PICTURE EFFECTS

If only the sync portion of the signal is affected, this distortion does not generally cause perceptible picture effects. However, the rest of the signal often suffers from the same type of distortion. When this occurs, sudden switches between high APL and low APL pictures can cause transient brightness effects in the picture.

TEST SIGNALS

Transient gain distortion is measured with a flat field test signal (black burst with pedestal). A generator with a "bounce" feature can be used to make the APL transitions if the time interval between transitions is considerably longer than any transient effect (see Figure 94).

MEASUREMENT METHODS

Transient gain changes are measured by abruptly changing APL and observing the transient effects on a waveform monitor.

Waveform Monitor. This distortion is easiest to evaluate with the test signal displayed on a waveform monitor with the differentiated step filter selected. (Recall that this filter produces spikes with amplitudes proportional to signal transitions). The waveform monitor DC restorer must be turned off for this measurement.

Depending on the nature of the distortion, it may be possible to observe it with the waveform monitor operating in the field sweep mode. Otherwise it will be necessary to use the 1780R SLOW SWEEP mode. (Some 1480s are equipped with the SLOW SWEEP option). A waveform photograph may make the measurement easier.

Adjust the waveform monitor variable gain to set the amplitude of the positive spike, which corresponds to the trailing edge of sync, equal to 100 IRE. Switch between extreme APL levels, typically 10% and 90%. The resulting envelope of the sync spikes represents the transient error. Measure the maximum departure from 100 IRE and express that number as a percent to obtain the amount of transient sync nonlinearity.

The 1780R voltage cursors can also be used to make this measurement. In the RELATIVE mode, define the positive sync spike as 100%. Then use the cursors to measure the largest deviation from that amplitude.

DEFINITION

Dynamic gain distortion of the picture signal is present when luminance amplitude is affected by APL. Dynamic gain distortion of the sync signal is present when sync amplitude is affected by APL.

The amount of distortion is usually expressed as a percent of the amplitude at 50% APL, although sometimes the overall variation in IRE units is quoted. This is an out-of-service test.

PICTURE EFFECTS

When luminance levels are APL dependent, picture brightness may seem to be incorrect or inconsistent as scenes change.

TEST SIGNALS

Dynamic gain change is measured with a test signal that extends to 100 IRE and has an APL that can be varied from 10% to 90% (see Figure 95). A staircase signal with variable pedestal is commonly used.

MEASUREMENT METHODS

Waveform Monitor. Dynamic picture gain change is evaluated by measuring amplitude at various APL levels. First select 50% APL and use the waveform monitor variable gain to set the top step of the staircase to 100 IRE. Vary the APL of the signal to 10% and then to 90%. At each APL level, record the level of the staircase top step. The peak-to-peak variation of the top staircase level, expressed in percentage, is typically quoted as the amount of dynamic picture gain change. This measurement can be made with the 1780R voltage cursors in the RELATIVE mode.

A similar procedure is used for dynamic sync gain. Figures 96 and 97 illustrate the measurement procedure.

NOTES

29. Transient vs. Dynamic Gain Changes. The terminology used to describe the two different types of APL dependent nonlinear gain distortions is inconsistent from standard to standard and can be quite confusing. It is necessary to distinguish between the effects of different APL, and effects of changes in APL. Most frequently, the two measurements are referred to as DYNAMIC and TRANSIENT respectively. This booklet adheres to this definition.

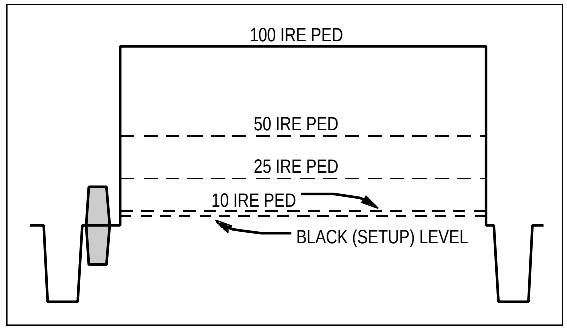

Figure 95. A variable pedestal is multiplexed with a 100 IRE test signal for this measurement.

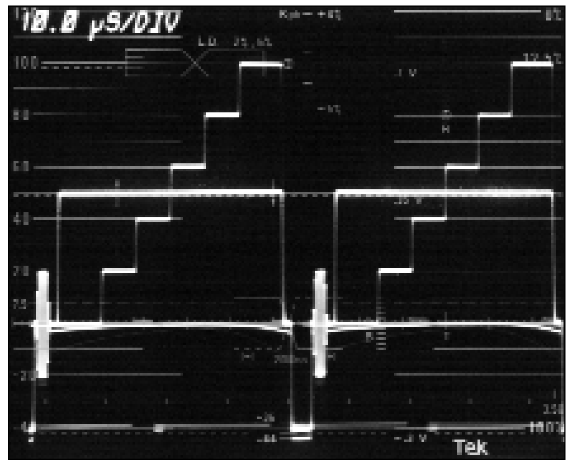

Figure 96. At 50% APL, the sync pulse amplitude is 40 IRE.

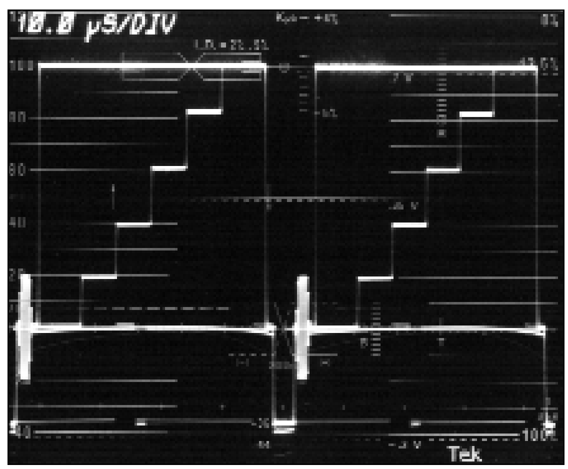

Figure 97. At high APL, the sync pulse amplitude is 36 IRE. This indicates a dynamic sync gain change of 10%.