DESIGN NOTES

An Adjustable Video Cable Equalizer – Design Note 92

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This design note presents a voltage controlled cable equalizer based on the LT®1256 video fader. The circuit features ease of adjustment, simplicity and the capability for remote control. The amount of equalization can be adjusted continuously from the maximum allowed by the passive components to none at all. While the example shows video, this high performance equalizer can be used in any system using long runs of coaxial cable or twisted pair to transmit analog signals.

A voltage or current controlled equalizer is essential in systems which automatically set cable compensation. In systems where cable equalization is set manually, a voltage controlled equalizer is still preferred as it does not require routing the signal path to the control. Instead, only a DC control voltage passes from the front panel to the equalizer.

Automatic equalization is possible for properly characterized video cables. Maximum equalization is set to coincide with the maximum length of cable expected; the equalizer is controlled by a servo loop. One method of generating the necessary control voltage is to sample the color burst amplitude and compare this with a reference voltage using a summing integrator. Since the frequency roll-off of the cable is known (and fixed for a given cable) only the amount of equalization needs to be adjusted.

In many applications color video is transmitted down long runs of coaxial or twisted-pair cable. Losses in the cable increase with signal frequency and cable length. The type of cable will determine the rate of high frequency loss. Color information in NTSC video is contained primarily in the high frequency portion of the spectrum. Besides causing a loss of detail in the picture, excessive high frequency loss will make reliable decoding of the composite color signal more difficult or impossible. Most commercial distribution amplifiers have provisions for equalizing the cable losses, but many times these units come at a high cost.

Figure 1 is a complete schematic of the cable equalizer. The LT1256 (U1) is a two input, one output 40MHz current feedback amplifier with a linear control circuit that

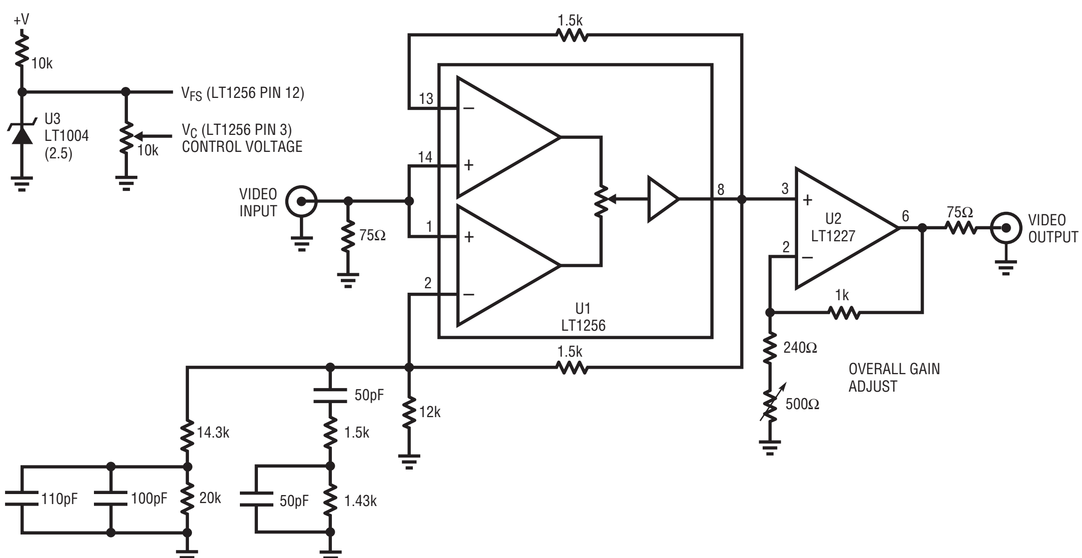

Figure 1. LT1256 Cable Equalizer

sets the amount each input contributes to the output. One amplifier (input pins 13 and 14) of the LT1256 is configured as a gain of one with no frequency equalization. The other amplifier (input pins 1 and 2) has frequency equalizing components in parallel with the 12k gain resistor. The equalization components for this demonstration circuit where chosen empirically as no data on the cable was available. As the control voltage is varied the output contains a summation of the two separate input channels; one containing the input video with no compensation and the other with the maximum depth of equalization. By adjusting this mix it is possible to smoothly adjust the equalizer depth. An additional amplifier (U2, LT1227) is used to set the overall gain. Two amplifiers were used here to make setting the gain a single adjustment, but in a production circuit the LT1256 can be configured to have the necessary gain and the whole function can be done with one chip.

In this demonstration a spool of over 250 feet[1] of good quality coax was used to transmit NTSC video. The LT1256 equalizer is placed at the receive end[2] and is adjusted with the use of a test pattern and a video waveform monitor (or oscilloscope). Figure 2 shows the video after transiting the cable and without equalization. Three standard video test signals were used; the multiburst, the 2T and the 12.5T. The 2T and the 12.5T test signals are sensitive indicators of phase and amplitude distortion in the video signal. The effect of the equalization circuit is shown in Figure 3. The resultant frequency response is flat and the time domain behavior is also excellent. Network analyzer plots of gain vs frequency for various settings of equalizer depth are given in Figure 4.

[1]It should also be noted that the LT1256 can be used to equalize much longer coaxial and twisted-pair cable than the one in this demonstration.

[2]Since the equalizer provides gains at high frequencies there is a possibility of overload if the circuit is placed at the transmit end of the cable rather than the receive end of the cable, especially if there is a need for a great deal of equalization. For example, 2000 feet of Belden 8281 precision video cable will have about 11dB of loss at 5MHz. This requires the driving amp to swing 3.5 times normal if the transmit end is boosted to compensate for the cable.

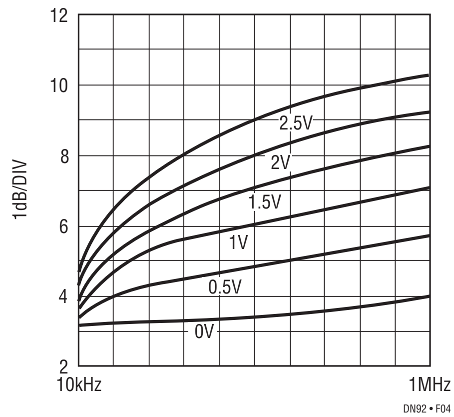

Figure 4. Frequency Response vs Control Voltage

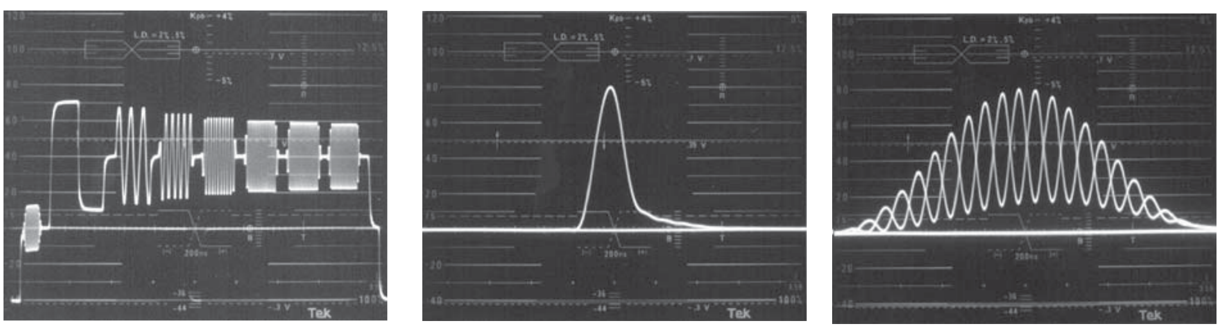

Figure 2. Multiburst, 2T and 12.5T After 250 Feet of Coax

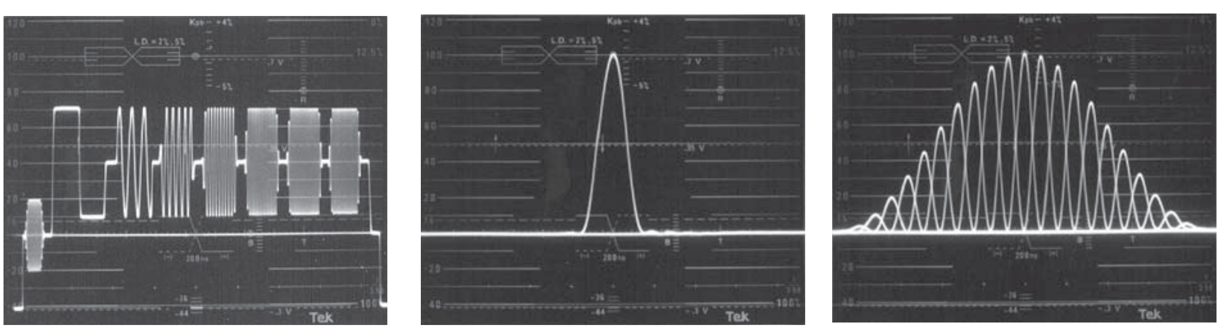

Figure 3. Multiburst, 2T and 12.5T After 250 Feet of Coax and Equalization, Circuit in Fig. 1

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