Video Transmission Over Twisted Pair Wire

National Semiconductor
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John Bittner
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The circuits in *Figure 1* and *Figure 2* transmit NTSC video signals over twisted pair wire. They were designed and tested for transmitting video on inexpensive CAT-3 twisted pair wire. Even when transmitting on 1000 feet of wire, good quality color video was displayed on a monitor with an NTSC input. Both the transmit and receive circuits use the LMH6643 dual op-amp which has the proper bandwidth and slew rate for this application.

The Video Driver is shown in *Figure 1*. It converts a single-ended input signal from a camera or DVD player into a differential signal that drives the twisted-pair line. The input receives an NTSC composite video signal with $1V_{PP}$ amplitude, and the output drives the twisted-pair with a $2V_{PP}$ differential signal. A 50Ω source resistor is in series with the outputs of both op-amps, matching the Video Driver output resistance to the twisted-pair characteristic impedance.

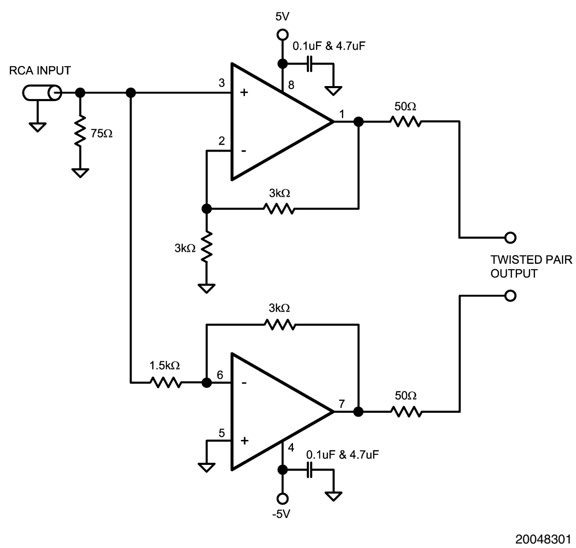

FIGURE 1. Twisted Pair Video Driver

In the receiver circuit of *Figure 2*, R2 is adjusted so that the overall gain of the system is unity (gain of the last op-amp is greater than one to compensate for signal loss). C1 and R1 provide a zero-pole function that compensates for attenuation of higher frequency signals in the twisted pair. The proper values for R1, C1, and R2 can be set by transmitting a $1V_{PP}$ square wave with a frequency of about 300KHz, and adjusting these components for an optimized square wave at the output. This can be done with the following procedure. First, adjust R2 so that the square wave at the receiver output has an amplitude of $1V_{PP}$ (with the output driving a 75Ω load). Next, set C1 and R1 to optimize the risetime/falltime and damping of this square wave. In the demonstration circuit that transmits video on 1000 feet of wire, R1 = 3.9k, C1 = 68pF, and R2 = 3.6k.

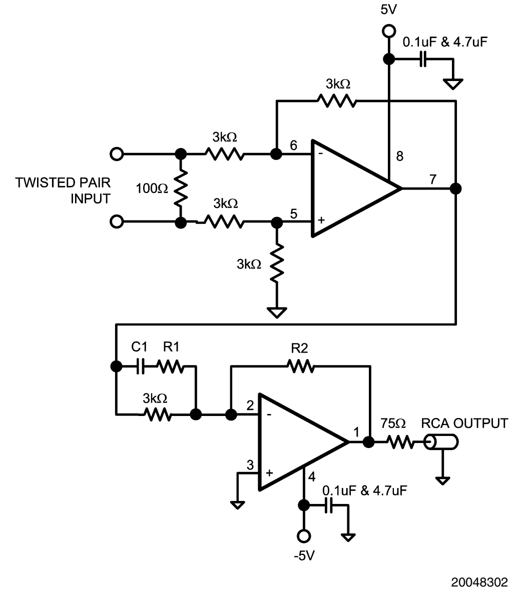

FIGURE 2. Twisted Pair Video Receiver

Figure 3 shows the response of this system when transmitting a square wave. The transitions of the output signal have rise and fall times of 160ns with about 5% of overshoot. Note that 1,000 feet of twisted pair wire delays the input signal by 1.4µs.

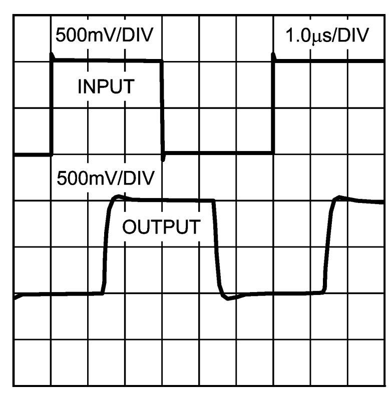

FIGURE 3. System Square Wave Response

Differential gain and phase of the system was measured with an HP3577A Network Analyzer. A $0.55V_{PP}$ sinewave test signal was applied to the input, and the gain and phase were measured at 3.58MHz (NTSC reference frequency). When the DC offset of the test signal changed from 0 to 1V, the gain changed -0.028dB (differential gain), and phase changed 0.23˚ (differential phase).

Notes

National Semiconductor Corporation
Americas
Email: support@nsc.com

www.national.com

National Semiconductor Europe
Fax: +49 (0) 180-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 69 9508 6208
English Tel: +44 (0) 870 24 0 2171
Français Tel: +33 (0) 1 41 91 8790

National Semiconductor Asia Pacific Customer Response Group
Tel: 65-2544466
Fax: 65-2504466
Email: ap.support@nsc.com

National Semiconductor Japan Ltd.
Tel: 81-3-5639-7560
Fax: 81-3-5639-7507