

## ***AN-1240 Video Transmission Over Twisted Pair Wire***

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### **ABSTRACT**

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 that has the proper bandwidth and slew rate for this application.

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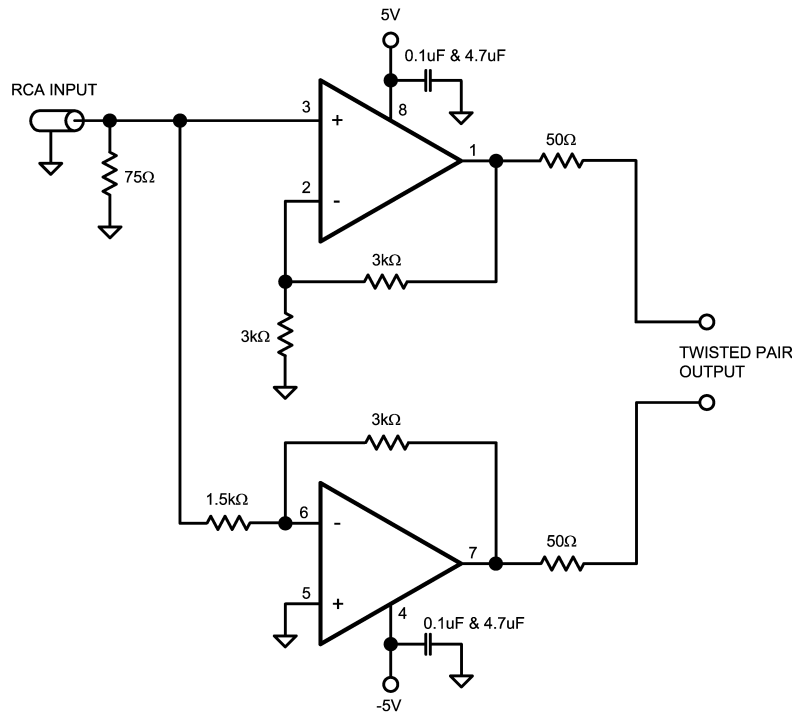
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## 1 Introduction

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  $1 V_{PP}$  amplitude, and the output drives the twisted-pair with a  $2 V_{PP}$  differential signal. A  $50 \Omega$  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  $1 V_{PP}$  square wave with a frequency of about 300 KHz, and adjusting these components for an optimized square wave at the output.

This can be done using the following procedure:

- Adjust R2 so that the square wave at the receiver output has an amplitude of  $1V_{PP}$  (with the output driving a  $75 \Omega$  load).
- Set C1 and R1 to optimize the risetime and falltime, and damping of this square wave. In the demonstration circuit that transmits video on 1000 feet of wire, R1 = 3.9k, C1 = 68 pF, and R2 = 3.6k.

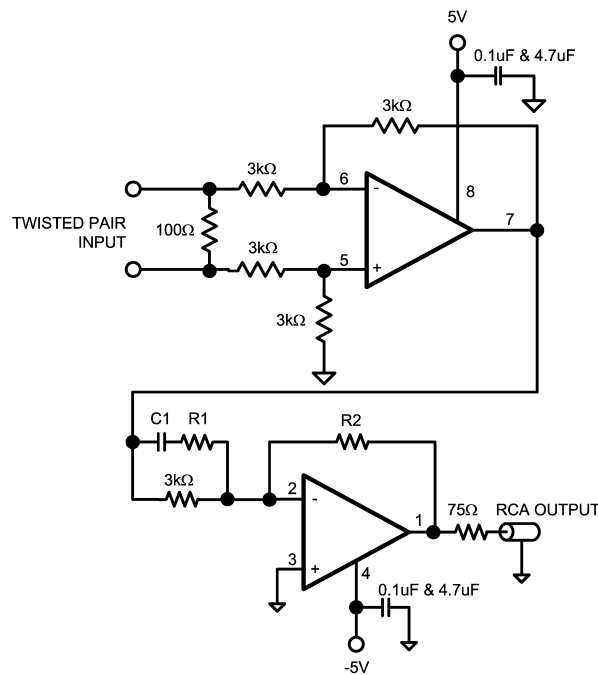


Figure 2. Twisted Pair Video Receiver

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 160 ns with about 5% of overshoot. Note that 1,000 feet of twisted pair wire delays the input signal by 1.4 μs.

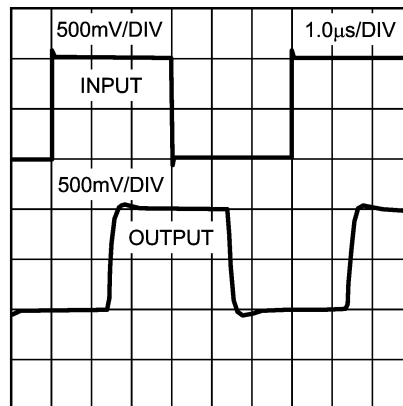


Figure 3. System Square Wave Response

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

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