APPLICATION NOTE

TSH94 STANDBY USED IN A MODE SIGNAL MULTIPLEXING

by G. AUGUSTONI

INTRODUCTION

The TSH94 is a quad low power video operational amplifier with two operators having an independant complementary standby mode.

This standby mode decreases the consumption of the corresponding operator and puts its output in high impedance state. In this note, the two amplifiers are used to multiplex signals.

TSH94 can handle video and audio signal thanks to its 100MHz follower bandwidth, 110V/µs slew rate and its low voltage noise of 4.2nV/$\sqrt{Hz}$.

Furthermore, the high switching speed of the standby mode of 200ns, allows simultaneous transmission of small banwidth signal as audio signals. Driving current of standby inputs is less than 2pA and Input/Output isolation in standby mode is 70dB at 10MHz.

DESCRIPTION

The operational amplifiers are used as followers, outputs and standby pins are connected together forming a very simple circuit. The only external components are the supply decoupling capacitors.

Figure 2 shows 20KHz triangle and sine wave signals of 4Vpp multiplexed at 400KHz rate. This principle can be used to transmit up to 100 audio signals on a single line using 2MHz multiplexing speed and 40KHz sample rate.

Figure 1 : Signal Multiplexing

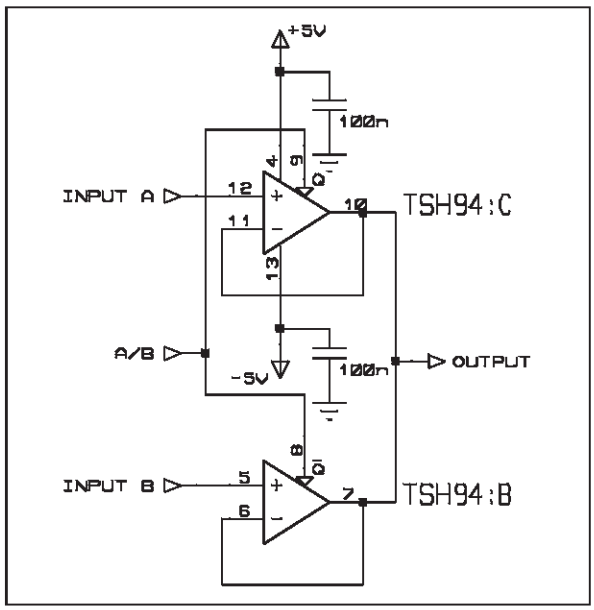


Figure 2 : Standby (1) and Output (2)

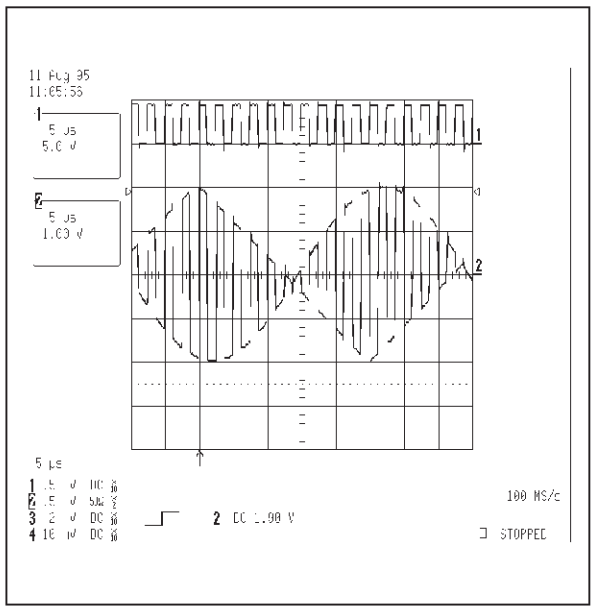


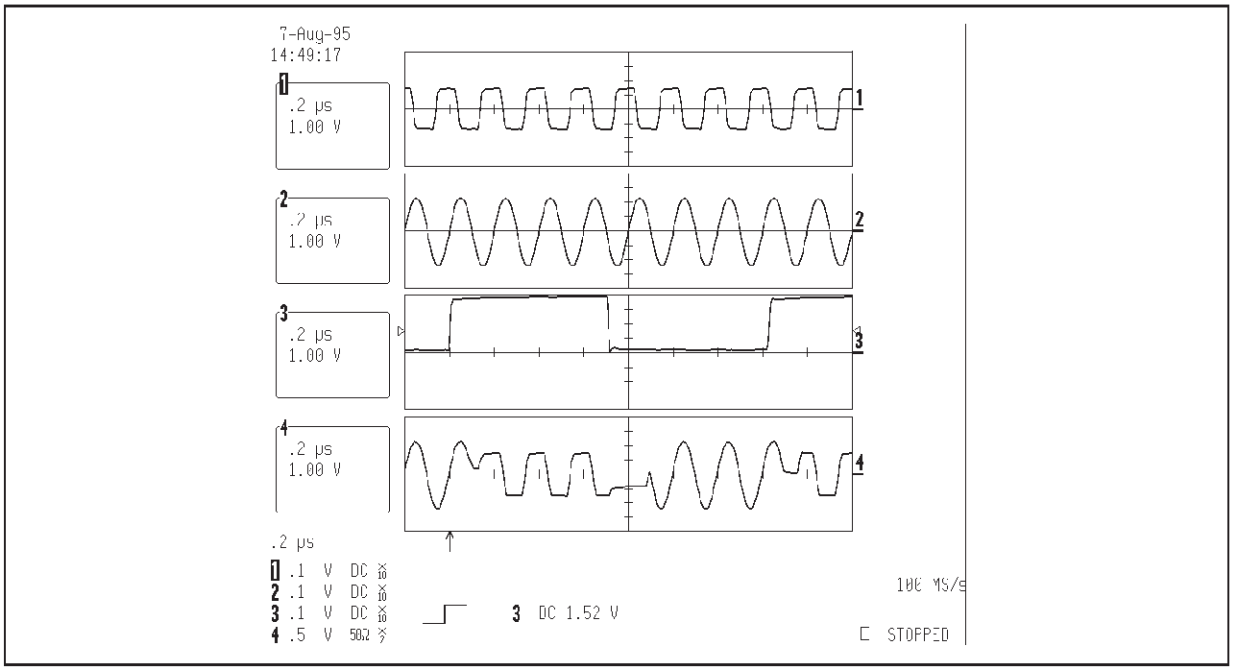
Figure 3 shows a 5MHz, 3Vpp square wave on A input and a 5MHz, 4.5Vpp sine wave on B input multiplex with a 700KHz signal.

SPECIAL PRECAUTIONS

In this configuration, output swing is limited by differential input voltage maximum rating at +-5V.

This limitation can be avoided by using a gain circuit. Inverting input voltage is then divided by feedback resistors ratio.

Figure 3 : Input A (1), Input B (2), Standby (3) and Output (4)



VIDEO LINE TRANSCEIVER WITH REMOTE CONTROL

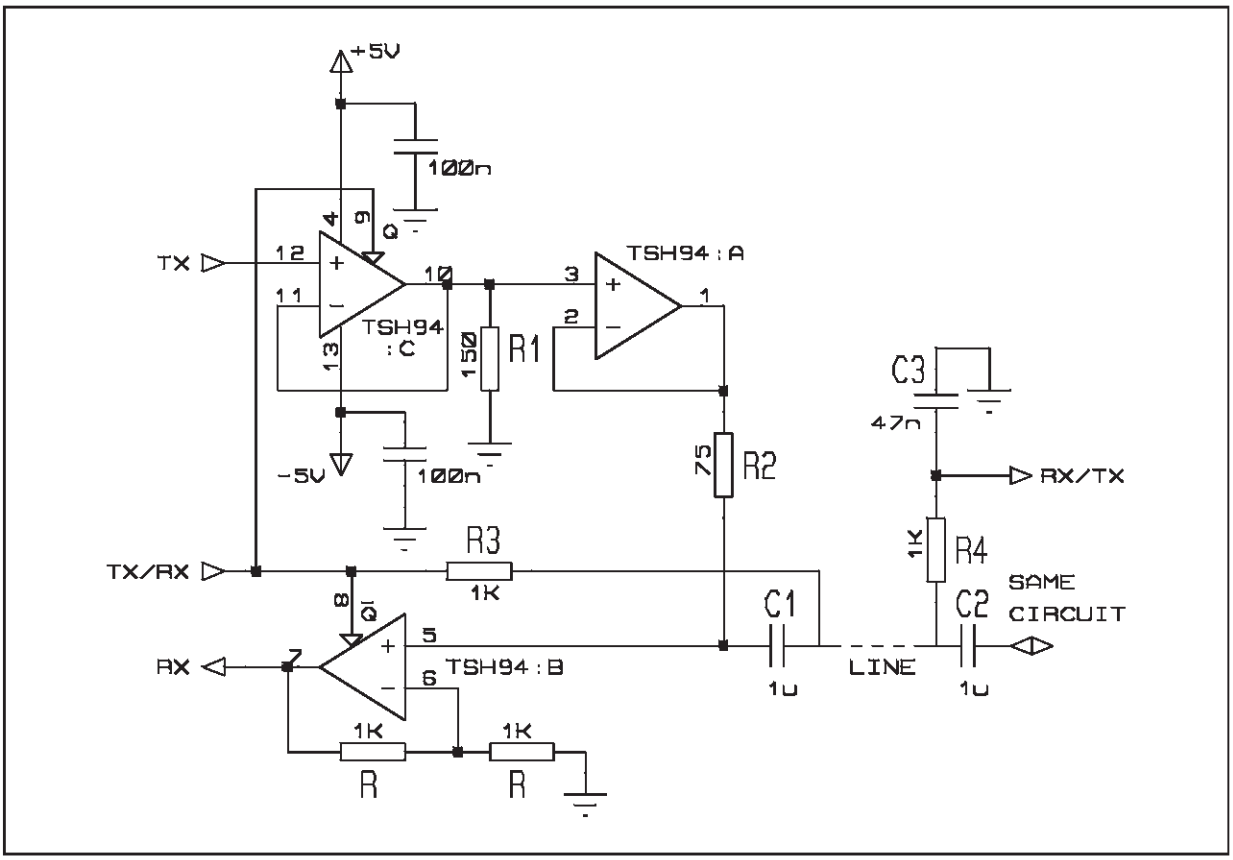
INTRODUCTION

The TSH94 is a quad low power video operational amplifier with two operators having an independent complementary standby mode.
This standby mode decreases the consumption of the corresponding amplifier and puts its output in high impedance state. The TSH94 has high video performances, a 100MHz follower bandwidth, 0.03% differential gain and 0.07° differential phase.
In this note, three amplifiers are used to transmit and receive video bandwidth signals on a single line. A remote control function is added to control the equipment on the other side of the line.

DESCRIPTION

Two operational amplifiers are used for transmission as followers. TSH94:C is a switch, to have on TSH94 : A input the TX signal during transmission, and a ground in reception. Thus, output of TSH94:A drive the line in transmission and shows a virtual ground in reception allowing good impedance matching at cable end.
In reception, TSH94:B is a +2 amplifier to compensate the necessary voltage loss due to impedance matching resistors.
The remote control is achieved using a coupling capacitor on each line side, allowing to use the DC

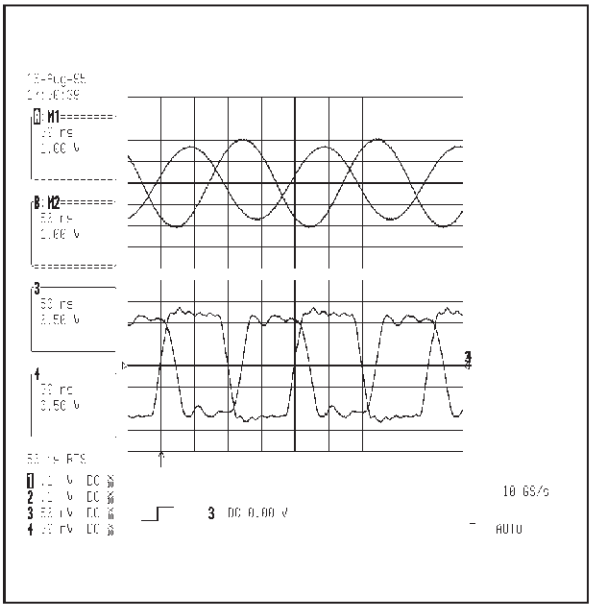
Figure 1 : Electrical Schematic



component for TX/RX signal. A RC network is sufficient on slave side to average video signal before driving RX/TX input. On slave side, operators B and C must be inverted.

Figure 2 shows two pairs of signals acquired at different times, on each cable side. The cable is a 25 meters RG59, 75Ω. At the top is a 4Vpp 5MHz sine wave and at the bottom a 2.4Vpp 5MHz square wave. One can see the 120ns delay and 25% attenuation due to the cable.

Figure 2 : Two TX and RX Example Signals

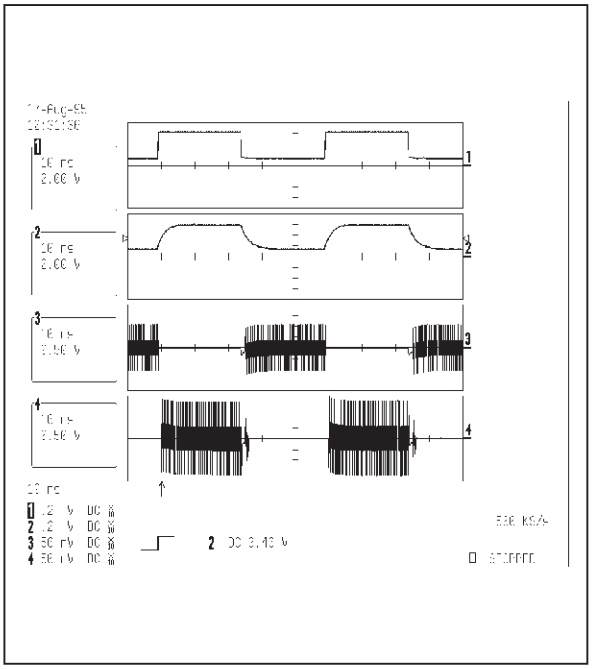


SPECIAL PRECAUTIONS

A compromise must be found between the low frequency bandwidth limit and the amplitude of the transmitted signal, and the switching speed of the remote control. It can be adjusted by modifying R3, R4, C1, C2 and C3 values. To transmit the 20Hz low frequency limit of video signal, C1 and C2 must have values above 100µF.
For better performance, TX/RX driving signal will be adjusted around standby threshold level, i.e. Vcc+ - 1.6V.
Note that ESD rating of TSH94 is more than 3KV-HBM on output and inputs.

Figure 3 shows the reception signal on each side and the standby signals with a 20Hz TX/RX.

Figure 3 : TX/RX(1), RX/TX(2), RX1(3), RX2(4)



SAMPLES AND HOLD USING TSH94 STANDBY MODE

INTRODUCTION

The TSH94 is a quad low power video operational amplifier with two operators having an independent standby mode. This standby mode decreases the consumption of the corresponding operator and puts its output in high impedance state. It is coupled here with a TSH151, a single MOS input video operational amplifier. This note shows how to use these features to build a simple sample and hold circuit. It allows sampling speed up to 2MHz and hold time of 1s with less than 5mV drift with a 4.7nF tank capacitor.

DESCRIPTION

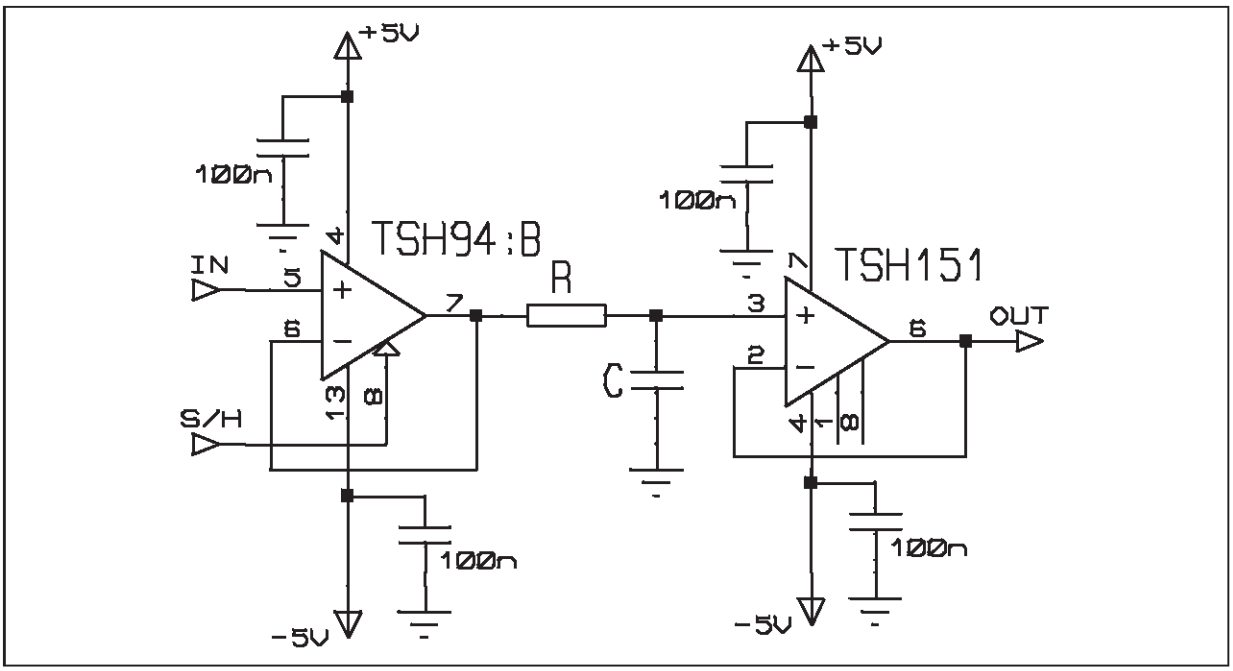
The TSH94 in follower drives a tank capacitor and goes in high impedance state on logic threshold signal on standby pin. The output voltage then remains at the capacitor charge level. It is followed with a high impedance buffer to allow voltage reading without discharging the capacitor.

The only external components required are a resistor, the sampling capacitor and the decoupling capacitors.

C is the tank capacitor that must remain charged at constant voltage between two samples. The accuracy and the bandwidth depend on its value.

As the input current of the TSH151 is 2pA typ. and the leakage current of the TSH94 output and inverting input in standby mode is less than 20pA, it is possible to reach long hold time with small capacitor size.
R resistor is used to prevent the TSH94 from oscillating when using large C capacitor. A 10Ω value allows to drive any capacitor without oscillating.

Figure 1 : Electrical Schematic



SPECIAL PRECAUTIONS

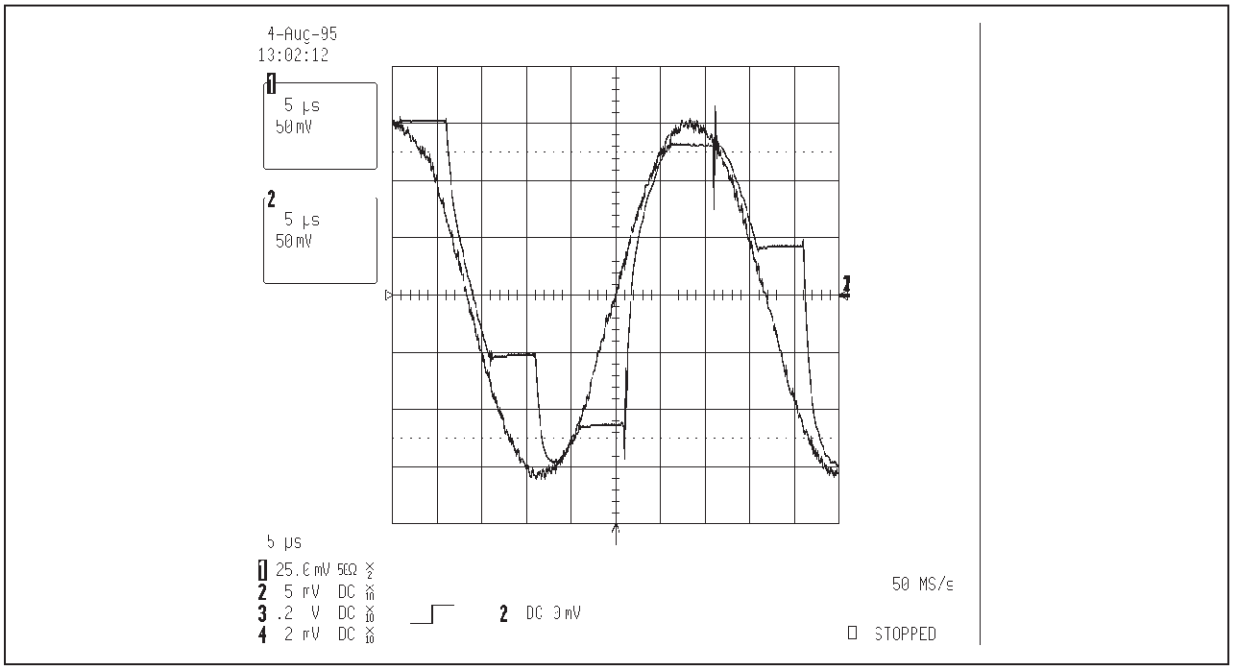
At standby turn on, output voltage shift of a constant voltage before going in high Z state due to internal different switching speed of positive and negative supply. It can be attenuated using a larger C capacitor, but maximum bandwidth and rise time are then decreased.

Following table shows typical results with different C capacitor values.

C	-3dB BW	Verror	Vdrift	tr 1V
65pF	100MHz	160mV	0.5V/s	7ns
4.7nF	4MHz	25mV	3mV/s	100ns
68nF	350KHz	2mV	0.3mV/s	1.5µs

Figure 2 shows input and output signals with a 30KHz, 300mVpp sine wave sampled at 100KHz with C=68nF and R=10Ω.

Figure 2 : Input and Output



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