

AN-2059 Replacing the CLC001 Cable Driver With the LMH0001

ABSTRACT

This application report discusses the process of replacing the CLC001 cable driver with the LMH0001 cable driver.

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1 Introduction

The LMH0001 SD-SDI cable driver can replace the CLC001 cable driver in many applications. The LMH0001 and CLC001 are both cable drivers designed to drive 75Ω coaxial cable, primarily for the SMPTE 259M interface. The supported data rates are similar between the two devices. Both cable drivers are powered from a 3.3V supply and rated for industrial temperature range operation (-40°C to +85°C).

The LMH0001, the newer generation SDI cable driver, has improved performance and is pin compatible with the LMH0002 HD/SD-SDI cable driver and the LMH0302 3G/HD/SD-SDI cable driver. This allows a forward migration path from SD to HD to 3G. The LMH0001 provides improved output return loss along with a 46% power savings over the CLC001, with typical power of 125 mW in comparison with 231 mW for the CLC001.

Table 1 shows the key differences between the CLC001 and LMH0001.

Table 1. CLC001 and LMH0001 Key Differences

	CLC001	LMH0001
Supply Current (I_{CC}) (Typical)	70 mA	38 mA
Package	8-pin SOIC	16-pin LLP
Data Rates	DC to 622 Mbps	DC to 540 Mbps
Output Rise/Fall Time (Typical)	400 ps	560 ps
ESD Rating	≥±7 kV HBM	≥±5 kV HBM
Input Interface	0.05V to 3.25V common mode	1.6V + $V_{SDI}/2$ to $V_{CC} - V_{SDI}/2$ common mode (self biased)
Output Interface	Requires external 75Ω resistor to GND	Requires external 75Ω resistor to V_{CC}
R_{REF} Resistor (800 mV_{P-P} Output)	1.91 kΩ to ground	750Ω to V_{CC}
Output Return Loss	Compliant to SMPTE spec	Meets SMPTE spec with margin using recommended network

2 How To Replace the CLC001 With the LMH0001

Replacing the CLC001 with the LMH0001 requires a few simple steps. The device packages and pinouts are different so this change requires a new PCB layout. To replace the CLC001 with the LMH0001, follow these steps:

1. Check the output common mode voltage of the driving device to determine if it is compatible with the LMH0001 input common mode range—if so, it is preferred to DC couple the inputs, and if not, add AC coupling capacitors in series with the inputs, prior to the input termination. When AC coupling, remove any bias applied to the inputs as this is not required for the LMH0001 since the inputs are self-biased.
2. Replace the 75Ω resistors to ground on the output with 75Ω resistors to V_{CC} . These pullup resistors should be placed as close as possible to the LMH0001 output pins.
3. Add a return loss network in series with the LMH0001 outputs in order to meet the SMPTE return loss specification. This network typically consists of a 5.6 nH inductor in parallel with a 75Ω resistor, immediately following the 75Ω pullup. If only one output is used, the return loss network is not necessary on the unused output.
4. Change the output coupling capacitor from 1 μF to 4.7 μF for SMPTE applications. Using this larger AC coupling capacitor value is good practice when dealing with the large DC shifts associated with the SMPTE pathological signals.
5. For 800 mV_{P-P} output, change the R_{REF} resistor from 1.91 kΩ connected to ground to 750Ω connected to V_{CC} . For 1.0 V_{P-P} output, change the R_{REF} resistor from 1.5 kΩ connected to ground to 590Ω connected to V_{CC} .

Figure 1 shows the typical application for the CLC001, and Figure 2 shows the typical application for the LMH0001.

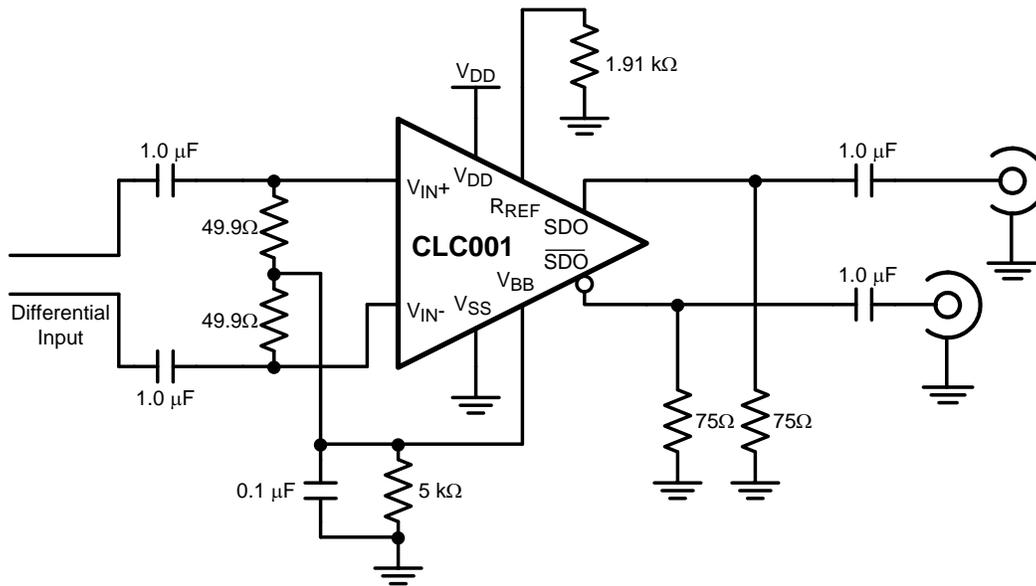


Figure 1. CLC001 Typical Application

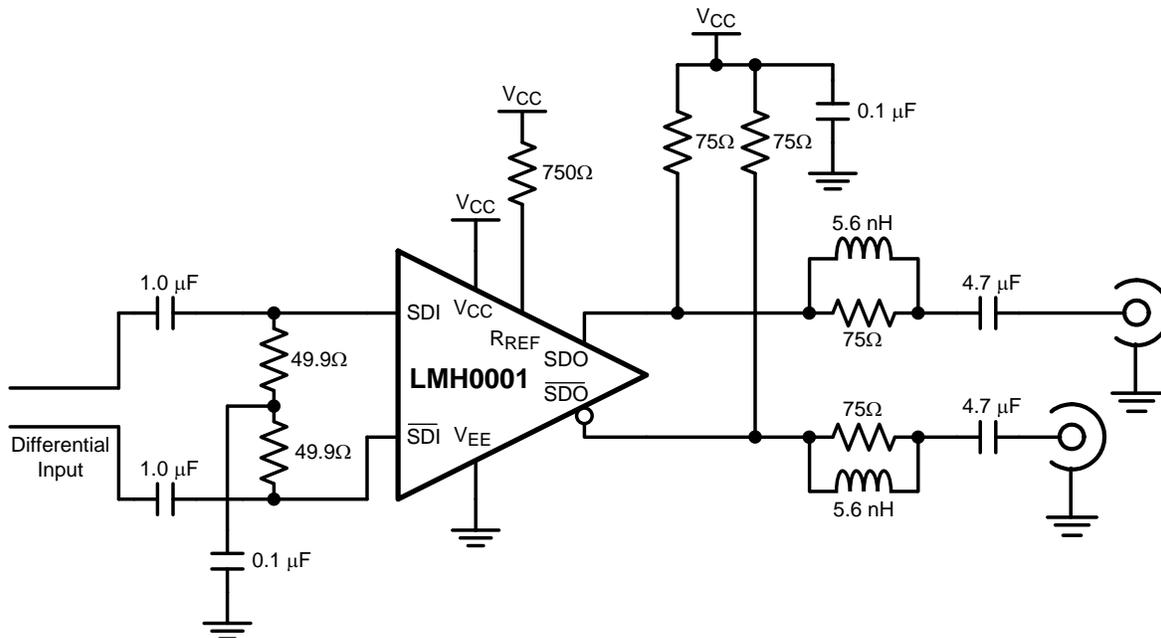


Figure 2. LMH0001 Typical Application

2.1 Input Interface

The input common mode voltage range of the CLC001 is between 0.05V and 3.25V, and the minimum differential input amplitude is 100 mV. The CLC001 inputs require a DC bias voltage to be applied when the inputs are AC coupled, and the V_{BB} pin may be used for this. When driven differentially, the CLC001 inputs are typically terminated with a 100 Ω resistor placed across the input pins, or two 50 Ω resistors with a center tap capacitor to ground.

The LMH0001 input interface is similar to that of the CLC001, but it does not support rail-to-rail inputs like the CLC001. The input common mode voltage range of the LMH0001 is from $1.6V + V_{SDI}/2$ to $V_{CC} - V_{SDI}/2$, with the same minimum differential input amplitude as the CLC001. The LMH0001 inputs are self-biased, so no DC bias voltage is necessary when the inputs are AC coupled. When driven differentially, the LMH0001 inputs are typically terminated with a 100 Ω resistor or two 50 Ω resistor like the CLC001.

2.2 Output Interface

The CLC001 outputs are designed to drive 75 Ω AC-coupled coaxial cable. They are current mode and ground referenced, requiring 75 Ω resistors to ground to generate the output voltage. The output level is controlled by the R_{REF} resistor.

The LMH0001 outputs are also current mode and designed to drive 75 Ω AC-coupled coaxial cable. But the LMH0001 outputs are positive supply referenced and require 75 Ω pullups to V_{CC} to generate the output voltage. Like the CLC001, the LMH0001 output level is controlled by the R_{REF} resistor.

2.3 Output Level Control (R_{REF} Resistor)

The R_{REF} resistor controls the output driver amplitude. The output amplitude for both the CLC001 and LMH0001 is adjustable from below 800 mV_{P-P} to above 1.0 V_{P-P}. For the CLC001, the R_{REF} resistor is connected to ground, and for the LMH0001, the R_{REF} resistor is connected to V_{CC} . The output amplitude is inversely proportional to the value of R_{REF} and approximately linear. For the CLC001, R_{REF} is 1.91 k Ω for 800 mV_{P-P} output and 1.5 k Ω for 1.0 V_{P-P} output. For the LMH0001, R_{REF} is 750 Ω for 800 mV_{P-P} output and 590 Ω for 1.0 V_{P-P} output.

2.4 Output Return Loss

The LMH0001 output structure provides improved return loss over the output structure used for the CLC001. This allows the LMH0001 to exceed the SMPTE return loss specification on the SD001SQ evaluation board with the recommended return loss network consisting of a 5.6 nH inductor in parallel with a 75 Ω resistor. Return loss is dependent on board design so this return loss network may need to be optimized depending on the specific PCB design and BNC connector used.

3 LMH0001 Enhancements Over the CLC001

The LMH0001 is a solid upgrade and good replacement for the CLC001. It is designed in a newer, more advanced process. The LMH0001 offers much lower power and better output return loss. The LMH0001's smaller, space-saving package allows for more compact designs. In addition, the LMH0001's pin compatibility with HD-SDI and 3G-SDI cable drivers offers an easy upgrade path and allows future-proof designs.

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