Replacing the CLC014 Adaptive Cable Equalizer with the LMH0074

National Semiconductor
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Introduction

The LMH0074 SD-SDI adaptive cable equalizer can replace the CLC014 adaptive cable equalizer in many applications. The LMH0074 and CLC014 are both adaptive cable equalizers designed to recover data sent over long cables, primarily for the SMPTE 259M interface. The supported data rates and cable lengths are similar between the two devices. The LMH0074 and CLC014 are both rated for industrial temperature range operation (-40°C to +85°C).

The LMH0074, the newer generation SDI equalizer, has more advanced features and is pin compatible with the LMH0044 HD-SDI equalizer and the LMH0344 or LMH0384 3G-SDI equalizer. This allows a forward migration path from SD to HD to 3G. The LMH0074 also offers a lower supply voltage (3.3V), enabling system designers to migrate to lower-power designs. The LMH0074 provides a 28% power savings over the CLC014, with typical power of 209 mW in comparison with 280 mW for the CLC014.

Table 1 shows the key differences between the CLC014 and LMH0074.

TABLE 1. CLC014 and LMH0074 Key Differences

	CLC014	LMH0074
Power Supply (V_{CC})	5.0V	3.3V
Package	14-pin SOIC	16-pin LLP
Data Rates	50 to 650 Mbps	125 to 540 Mbps
ESD Rating	≥±500V HBM	≥±8 kV HBM
Input Interface	Requires 100Ω series resistor on each input	Requires return loss network of 6.8 nH in parallel with 75Ω on active input
Output Structure	Open collector, requires external 75Ω pullups to 5V	CML with internal 50Ω pullups (to 3.3V)
AEC Capacitor Value	100 pF	1.0 µF
Carrier Detect / Mute Polarity	CD, $\overline{\text{MUTE}}$	$\overline{\text{CD}}$, MUTE
Other Features	OEM	MUTE_{REF}, BYPASS

How To Replace the CLC014 with the LMH0074

Replacing the CLC014 with the LMH0074 requires a few simple steps. The device packages and pinouts are quite different so this change requires a new PCB layout; however, the equalizer core and features are similar. To replace the CLC014 with the LMH0074, follow these steps:

1. Change the power supply from 5V to 3.3V.
2. Remove the 100Ω series resistors at the input to the equalizer.
3. Add an input return loss network consisting of a 6.8 nH inductor in parallel with a 75Ω resistor on the active input between the BNC and the 75Ω termination.
4. Removed the 75Ω pullups on the output and replace with a 100Ω differential termination located at the input of the next stage. The outputs may also be AC coupled, but no pullups are required.
5. Replace the 100 pF AEC capacitor with a 1.0 µF AEC capacitor.

Figure 1 shows the typical application for the CLC014, and *Figure 2* shows the typical application for the LMH0074.

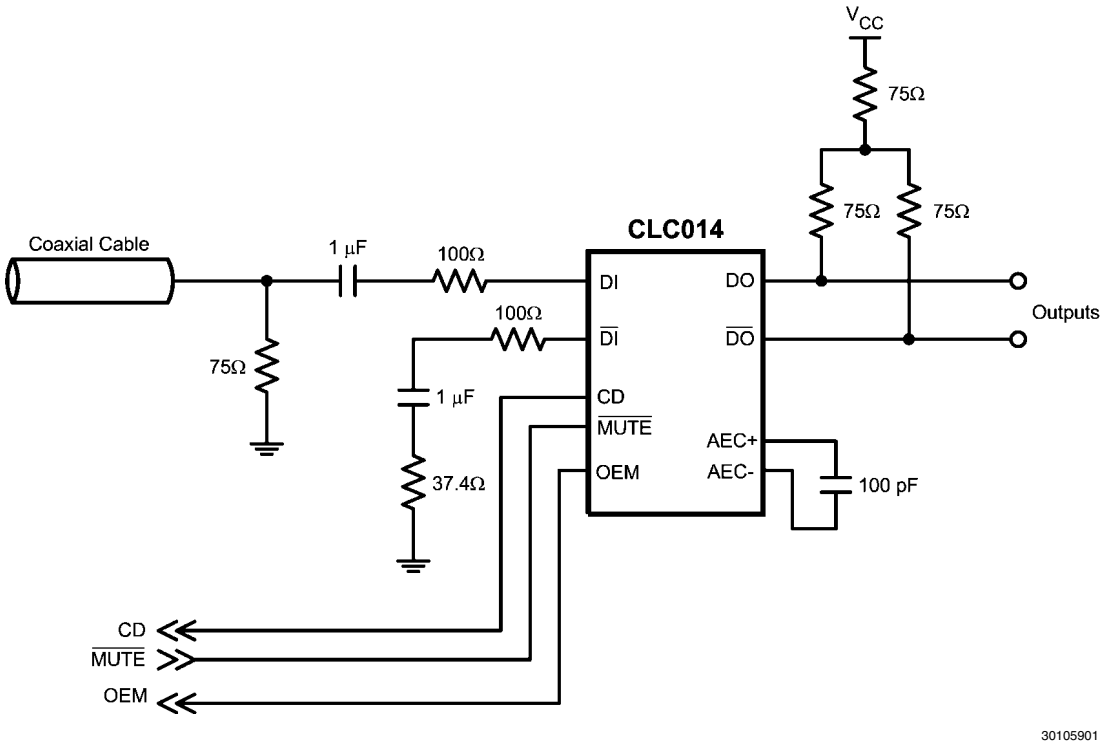

FIGURE 1. CLC014 Typical Application

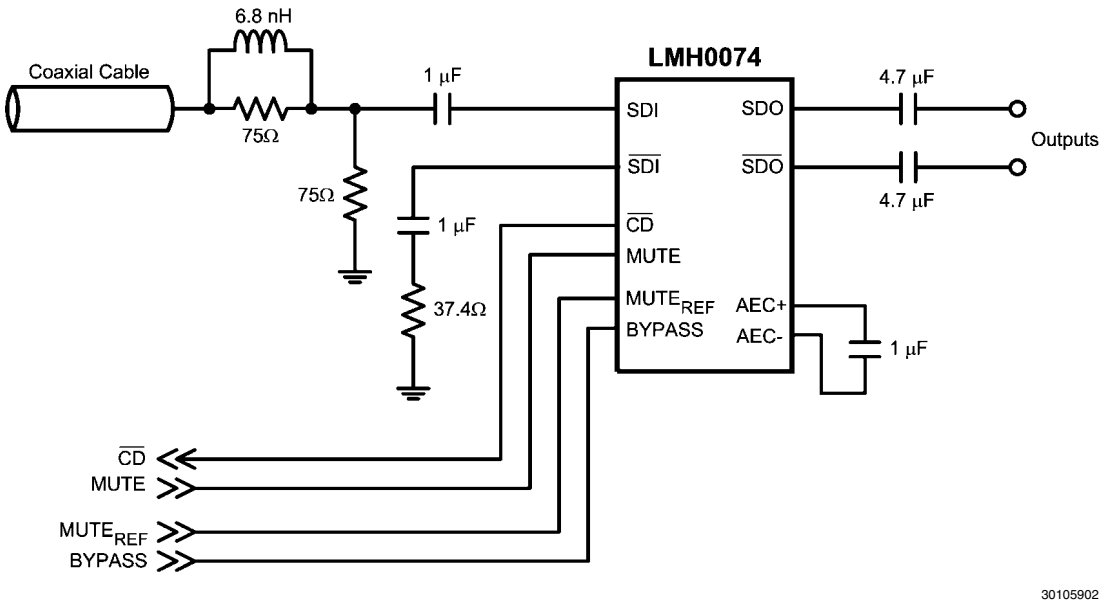

FIGURE 2. LMH0074 Typical Application

INPUT INTERFACE

For the typical input interface, the equalizer receives a single-ended signal over 75Ω coaxial cable. The CLC014 requires a 75Ω termination to ground, a 1.0 µF input coupling capacitor, and a 100Ω series resistor on each input. On the unused input, the 75Ω termination to ground is replaced by 37.4Ω to match the impedance on the active side (which has the 75Ω cable in parallel with the 75Ω termination).

The 100Ω series resistors are not required for the LMH0074; however, a 6.8 nH inductor in parallel with a 75Ω resistor should be added in series on the active input between the input BNC and the 75Ω pulldown resistor (see *Figure 2*). This network provides excellent input return loss. All of these components should be placed close to the LMH0074 input pins.

OUTPUT INTERFACE

The CLC014 outputs are open collector and require 75Ω pullups to 5V to generate an output voltage. This structure has some limitations when interfacing to non-5V systems. The CLC014 outputs are essentially cut off if the DO output voltage drops below V_{CC}-1.6V (typically 3.4V), so this prevents DC-coupling to other 3.3V devices.

The LMH0074 provides much more flexibility. The LMH0074 outputs are CML with internal 50Ω pullups to 3.3V. They may be DC coupled to many more types of inputs, including the LMH0026 or LMH0036 reclocker and the LMH0001 cable driver. Typically only a far-end differential termination (a simple resistor) is required. If the LMH0074 output common mode voltage is not compatible with the input common mode voltage of the receiving device, the outputs may be AC coupled as shown in *Figure 2*. The outputs do not require pullups to V_{CC}.

AEC CAPACITOR VALUE

The CLC014 AEC capacitor is typically 100 pF and may be changed to change the adaptive loop time constant. For the LMH0074, the AEC capacitor should be 1.0 µF only. The LMH0074 was designed and optimized for a 1.0 µF AEC capacitor and it should not be changed.

CARRIER DETECT AND MUTE

In CLC014 applications, the carrier detect pin (CD) is typically tied to the $\overline{\text{MUTE}}$ pin to inhibit the output when there is no input signal. For the LMH0074 this can be done as well. The only difference is that the polarity of the carrier detect and mute is reversed for the LMH0074; the carrier detect pin, $\overline{\text{CD}}$, is active low, and the mute pin, MUTE, is active high.

OTHER FEATURES

The CLC014 has an Output Eye Monitor which shows the equalized eye pattern prior to the output comparator. This feature is not included in the LMH0074; however, the LMH0074 includes features in addition to those in CLC014, such as the $\text{MUTE}_{\overline{\text{REF}}}$ and BYPASS functions. $\text{MUTE}_{\overline{\text{REF}}}$ sets the threshold for $\overline{\text{CD}}$ and (with $\overline{\text{CD}}$ tied to MUTE) determines the amount of cable to equalize before muting the outputs. This may be useful to limit the maximum cable length that can be equalized, or for very noisy environments where $\overline{\text{CD}}$ would need to be less sensitive. BYPASS passes the input signal through to the output with no equalization. This may be useful for very low data rate applications.

100Ω DIFFERENTIAL TWISTED PAIR CABLE APPLICATIONS

The equalizers can both be used for differential twisted pair cable applications. *Figure 3* shows the differential twisted pair input interface for the CLC014 and *Figure 4* shows the differential twisted pair input interface for the LMH0074.

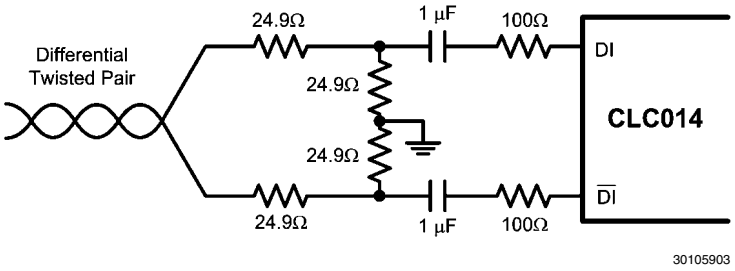

FIGURE 3. CLC014 Differential Twisted Pair Input Interface

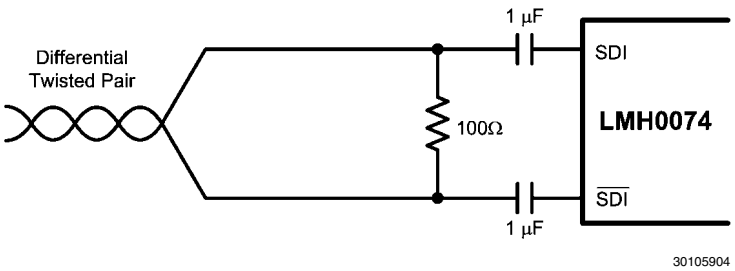

FIGURE 4. LMH0074 Differential Twisted Pair Input Interface

LMH0074 Enhancements over the CLC014

The LMH0074 is a solid upgrade and good replacement for the CLC014. It is designed in a newer, more advanced process. The LMH0074 offers lower power, better ESD protection, a more flexible output interface, and new features such as the ability to bypass equalization. The LMH0074's smaller, space-saving package allows for more compact designs. The PCB layout is simpler as the LMH0074 requires less PCB components overall than the CLC014. In addition, the LMH0074's pin compatibility with HD-SDI and 3G-SDI equalizers offers an easy upgrade path and allows future-proof designs.

Notes

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