Application Report
SNLA130A–July 2011–Revised April 2013

AN-2156 Configuring the LMH0387 for an Equalizer-Only Application

ABSTRACT

This application note discusses how to configure the LMH0387 for an equalizer-only application.

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1 Introduction

The adaptive cable equalizer is an important component in the Serial Digital Interface (SDI) used for transmission of digital video signals. It restores the SDI signal after it passes through hundreds of meters of coaxial cable, automatically adjusting to reverse the effects of the cable loss. The cable driver's role is to set the appropriate amplitude, slew rate, and eye shape to drive an SDI signal into the coaxial cable so that it can be properly recovered by the equalizer at the other end.

The LMH0387 SDI configurable I/O accomplishes both of these tasks with a single pin, allowing a BNC attached to the device to be used as either an input or output. It provides the full functionality of an adaptive cable equalizer and cable driver. The LMH0387 includes an integrated return loss network which enables very good return loss and easy compliance to the Society of Motion Picture and Television Engineers (SMPTE) return loss specifications. The versatility of the LMH0387 allows it to replace an equalizer or cable driver (or both) while providing several additional benefits.

2 How to Configure the LMH0387 for Equalizer-Only Use

In sockets that only require the equalizer function (input only), the LMH0387 may be configured as an equalizer by disabling the internal cable driver. One method to do this is to set the device per the typical application (see the datasheet) with the TX_EN pin tied low to disable the cable driver. While disabled, the cable driver consumes a small amount of power (4 mW). With this configuration, the cable driver can be enabled to change the port from input to output by pulling the TX_EN pin high.

Alternatively, if the cable driver will never be used, the LMH0387 can be configured for equalizer-only mode (with no cable driver option) by connecting all pins associated with the cable driver to ground. This saves components, reduces power consumption, and simplifies the PCB layout.

To configure the LMH0387 for equalizer-only use in this manner, connect the following nine LMH0387 pins to ground as shown in Table 1. The cable driver will consume no power and only the equalizer portion of the LMH0387 will be active. Figure 1 shows the complete LMH0387 circuit for equalizer-only mode.

Table 1. LMH0387 Connections for Equalizer-Only Mode

Pin	Name	Connection
2, 3, 43	V_{CCTX}	GND
33, 34	SDI, $\overline{SDI}$	GND
36	R_{REF}	GND
40	TX_EN	GND
44	SD/$\overline{HD}$	GND
45	$TERM_{TX}$	GND

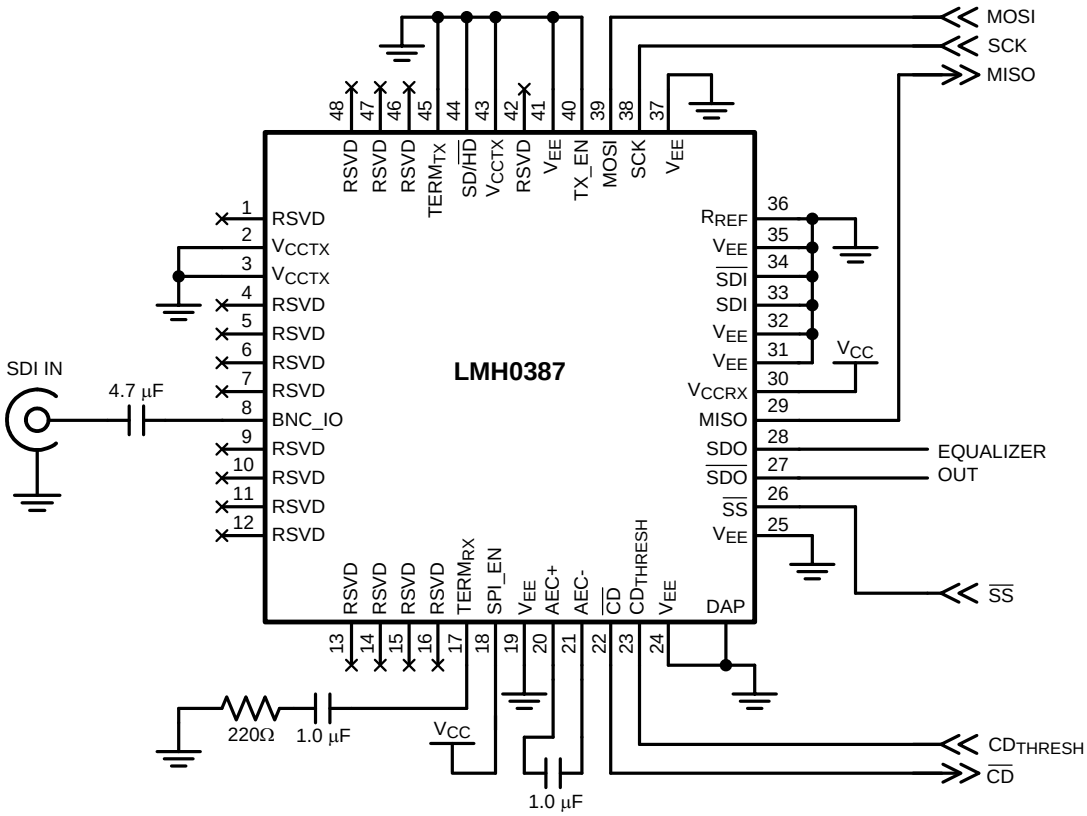

Figure 1. LMH0387 Circuit for Equalizer-Only Mode

3 LMH0387 Benefits over Dedicated Equalizer

The LMH0387 configured as an equalizer provides several important benefits over a dedicated adaptive cable equalizer (such as the LMH0384 or LMH0344), as described in the following sections.

3.1 Superior Return Loss

The LMH0387's integrated return loss network provides superior return loss with no additional external components required. SMPTE standards specify the requirements for the return loss of input and output ports on video equipment (see Section 5). Return loss is essentially a measure of the impedance matching, and is intended to prevent reflections.

This SMPTE requirement necessitates a return loss network consisting of inductors, resistors, and capacitors to compensate for the input capacitance of the equalizer circuit. For good return loss, the proper component choice and placement of this network are critical. By integrating this network inside the package, the LMH0387 allows easy return loss compliance, with greater than 5 dB of margin above the SMPTE specification.

Figure 2 shows the typical input return loss of the LMH0387, as measured on the SD387 evaluation board. The LMH0387 input network on the SD387 evaluation board consists of an edge-launch BNC connector, a 4.7 uF AC-coupling capacitor, and a ¼-inch 75Ω PCB trace between the BNC and the LMH0387 (with a similar layout to what is shown in Figure 4). Good return loss is achievable with the LMH0387 using a variety of PCB layouts and BNC connectors (see Section 5).

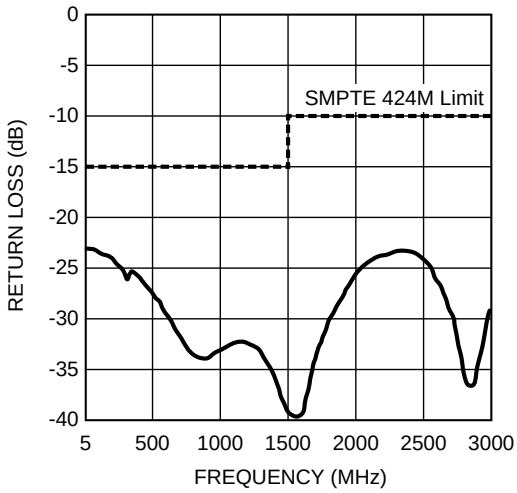

Figure 2. LMH0387 Input Return Loss

3.2 Reduced BOM Costs

The LMH0387 reduces bill of materials (BOM) costs and simplifies the PCB circuit required for equalizer operation. The passive components required for return loss and the equalizer input termination are all integrated within the package, greatly reducing the number external components.

Figure 3 shows the schematic of the input network typically required for a dedicated equalizer and the corresponding schematic for the LMH0387. For the LMH0387, only a single capacitor is required between the input pin and the BNC.

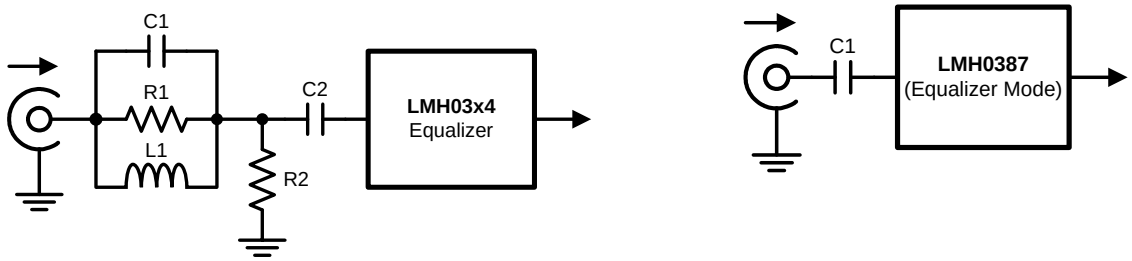

Figure 3. Input Circuit Required for Dedicated Equalizer *(left)* **and LMH0387** *(right)*

3.3 Simplified Layout and PCB Space Savings

The LMH0387 greatly simplifies PCB layout while saving board space. For a dedicated equalizer, the layout of the input network components is crucial for optimal operation and good return loss. This is not a concern for the LMH0387 since this network is integrated. The LMH0387 layout is simple since all that is required is the AC-coupling capacitor, and the placement of this capacitor is not critical.

While the LMH0387 device package is larger than the device package for a dedicated equalizer, the PCB board area required for the LMH0387 is actually less than the area required for a dedicated equalizer such as the LMH0384 or LMH0344, due to the additional external components necessary for the dedicate equalizer. The LMH0387 can be placed closer to the BNC.

Figure 4 shows the PCB layout for the input network of a dedicated equalizer and the corresponding PCB layout for the LMH0387.

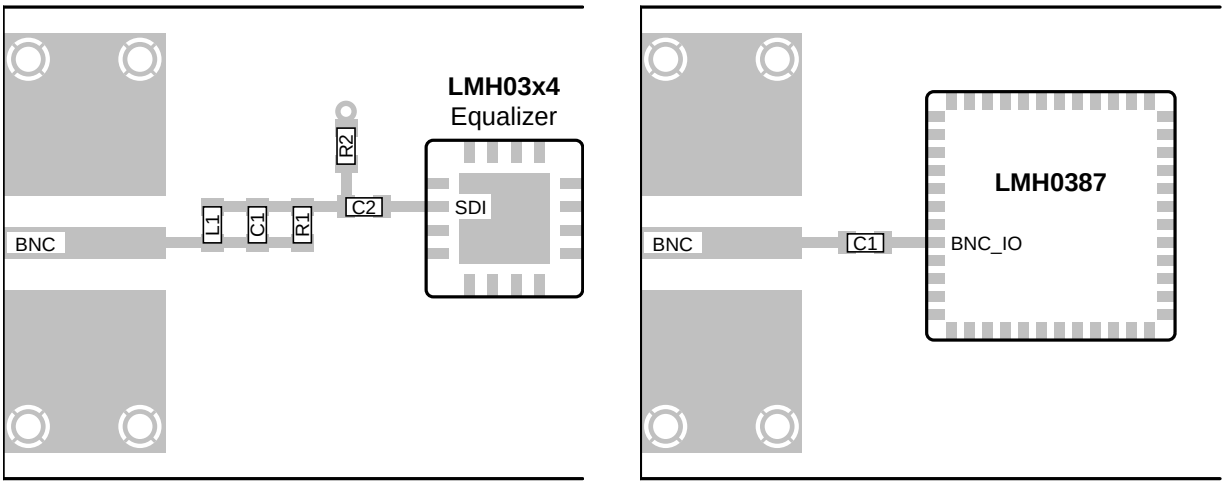

Figure 4. Input Circuit PCB Layout for Dedicated Equalizer *(left)* **and LMH0387** *(right)*

4 Conclusion

The LMH0387 configurable I/O can replace a dedicated adaptive cable equalizer in many SDI applications. It is simple to configure the LMH0387 for equalizer-only use, and it provides several benefits, including superior return loss, reduced BOM costs, easier PCB layout, and board space savings.

5 References

1. The SMPTE 424M, 292M, and 259M standards specify the requirements for the Serial Digital Interface (SDI) used for transmission of digital video signals over a coaxial cable at 3G, HD, and SD data rates, respectively. These standards specify the return loss requirements, and are listed below:
   - SMPTE 424M-2006: 3 Gb/s Signal/Data Serial Interface
   - SMPTE 292M-1998: Bit-Serial Digital Interface for High Definition Television Systems
   - SMPTE 259M-2006: SDTV Digital Signal/Data – Serial Digital Interface
2. Return loss is dependent on board design. The following references discuss how to optimize PCB board layout for SDI designs:
   - Tsun-Kit Chin, *Optimizing BNC PCB Footprint Designs for Digital Video Equipment* (videsignwire.com/optimizing-bnc-pcb-footprint-designs-for-digital-video-equipment/).
   - Tsun-Kit Chin, *High-Speed Board Layout Challenges in FPGA/SDI Sub-Systems* (SNLA158).
3. *LMH0387 3 Gbps HD/SD SDI Configurable I/O Adaptive Cable Equalizer / Cable Driver Data Sheet* (SNLS315).

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