

# SD394EVK

## LMH0394 Evaluation Board

### User Guide

National Semiconductor  
EVK User Manual

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## Overview

The SD394 Evaluation Kit (EVK) enables evaluation of the LMH0394 3G/HD/SD SDI Adaptive Cable Equalizer.

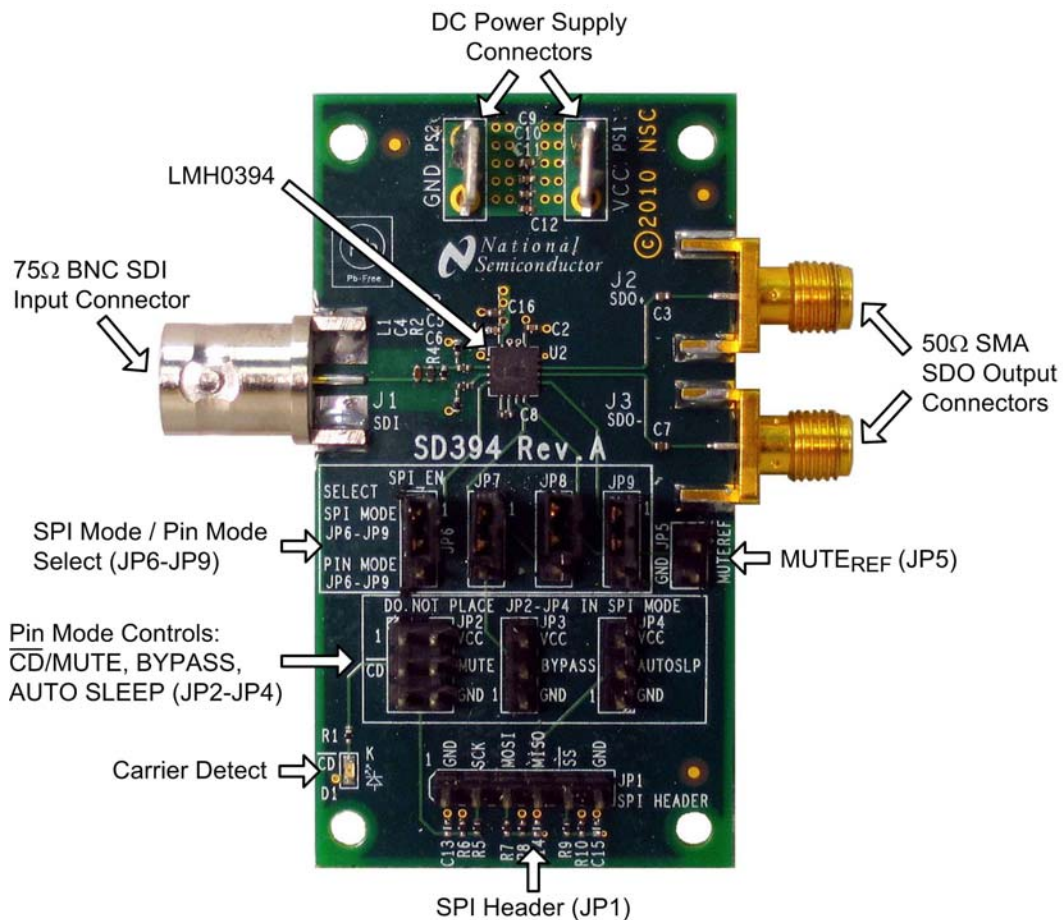
## Evaluation Kit Contents

The EVK contains the following parts:

- SD394EVK board assembly with the LMH0394 cable equalizer
- SD394EVK User Guide

## Evaluation Board Description

Figure 1 shows the SD394 evaluation board and highlights some of its features.



**FIGURE 1. SD394 Evaluation Board**

## SDI Input and SDO Output

The SDI input connector (J1) is a 75Ω BNC connector. The SDI input should conform to the SMPTE 424M, SMPTE 292M, or SMPTE 259M standards.

The SDO output connectors (J2 and J3) are 50Ω SMA connectors. The SDO output connectors have onboard 4.7μF AC coupling capacitors (C3 and C7). When using only one side of the output pair, the other side should be terminated with a 50Ω SMA termination. For example, when only using the SDO output, SDO should be terminated with a 50Ω SMA termination.

## DC Power Connectors

The VCC and GND power connectors, PS1 and PS2 respectively, should be powered with a DC input voltage of 2.5V ± 5%.

## SPI Mode / Pin Mode Select (JP6 – JP9)

JP6, JP7, JP8, and JP9 are used to select between SPI Mode or Pin Mode. To select Pin Mode, set these jumpers in the down position as shown in Figure 2. To select SPI Mode, set these jumpers in the up position as shown in Figure 3. For proper operation, either Pin Mode or SPI Mode must be selected. **Do not leave JP6-JP9 open.**

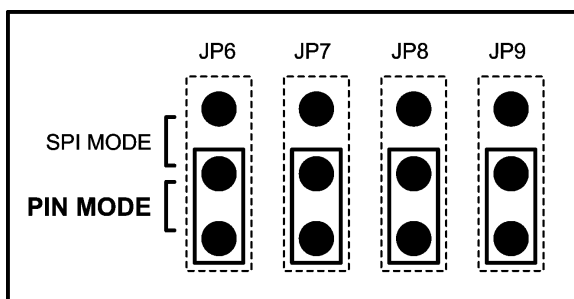


FIGURE 2. Pin Mode Select

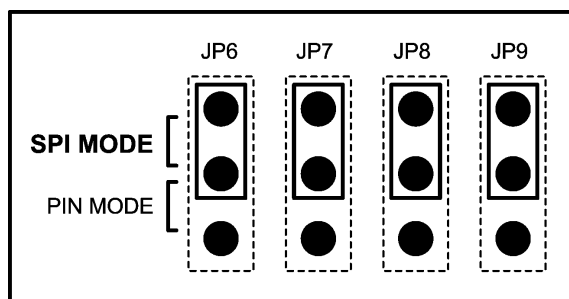


FIGURE 3. SPI Mode Select

## MUTE<sub>REF</sub> (JP5)

JP5 allows control of the MUTE<sub>REF</sub> function and may be used in either Pin Mode or SPI Mode. MUTE<sub>REF</sub> is an input voltage used to set the threshold for  $\overline{CD}$ . The MUTE<sub>REF</sub> DC input voltage should be between 0V and 2.5V. Refer to the LMH0394 datasheet for details. Leave JP5 unconnected for normal operation.

## Pin Mode Controls (JP2 – JP4)

JP2, JP3, and JP4 are used to control the  $\overline{CD}$  and Mute, Bypass, and Auto Sleep functions while the device is configured in Pin Mode. **Do not place jumpers on JP2, JP3, or JP4 while the device is configured for SPI Mode.**

## $\overline{CD}$ and MUTE (JP2)

JP2 allows Carrier Detect ( $\overline{CD}$ ) monitoring and MUTE control.  $\overline{CD}$  is high when no input signal is present. MUTE may be used to force the outputs on or off, or tied to  $\overline{CD}$  to allow automatic mute operation if the SDI signal is not present. To activate mute and force the outputs into a muted condition, set the jumper to pull MUTE to VCC. To

turn off mute so that the outputs will never mute, set the jumper to tie MUTE to GND. For normal operation, set the jumper to tie  $\overline{CD}$  to MUTE for automatic mute control. The MUTE pin has an internal pulldown (to disable mute), so JP2 may be left unconnected and the device will never mute.

### **BYPASS (JP3)**

JP3 allows control of the equalization BYPASS function. To put the device into bypass mode, set the jumper to pull BYPASS to VCC. To turn off bypass (for normal operation) set the jumper to pull BYPASS to GND. The BYPASS pin has an internal pulldown (to disable bypass), so JP2 may be left unconnected for normal operation.

### **AUTO SLEEP (JP4)**

JP4 allows control of the AUTO SLEEP function. To put the device into auto sleep mode in which it will power down when no input is detected, set the jumper to pull AUTO SLEEP to VCC. To turn off auto sleep and prevent the LMH0394 from automatically powering down, set the jumper to pull AUTO SLEEP to GND. The AUTO SLEEP pin has an internal pullup (to enable auto sleep), so JP4 may be left unconnected to enable auto sleep mode.

### **SPI Header (JP1)**

JP1 is the SPI (Serial Peripheral Interface) header. It allows access to the SPI pins ( $\overline{SS}$ , MISO, MOSI, and SCK) while the LMH0394 is in SPI mode. These pins may be connected to a standard SPI controller to access the LMH0394 SPI registers. Refer to the LMH0394 datasheet for details.

### **Carrier Detect LED (D1)**

D1 shows the status of Carrier Detect. This LED is GREEN when an input signal has been detected, and OFF when no input is detected. D1 shows the status of Carrier Detect while in Pin Mode or SPI Mode.

# Typical Performance

## Equalizer Output

Figures 4, 5, and 6 show output waveforms for the SD394 with various Belden 1694A cable lengths. The input signal is a 2.97 Gbps PRBS10, and the output signal is measured on the Agilent DCA-J 86100C oscilloscope.

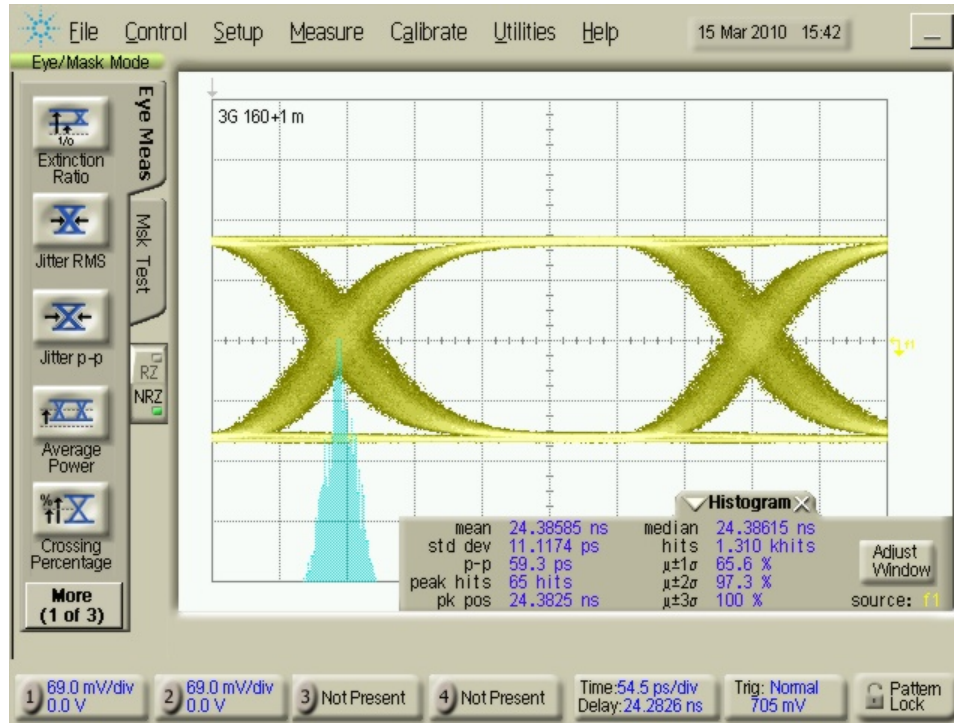


FIGURE 4. SD394 Output Waveform at 2.97 Gbps with 160m Belden 1694A Cable

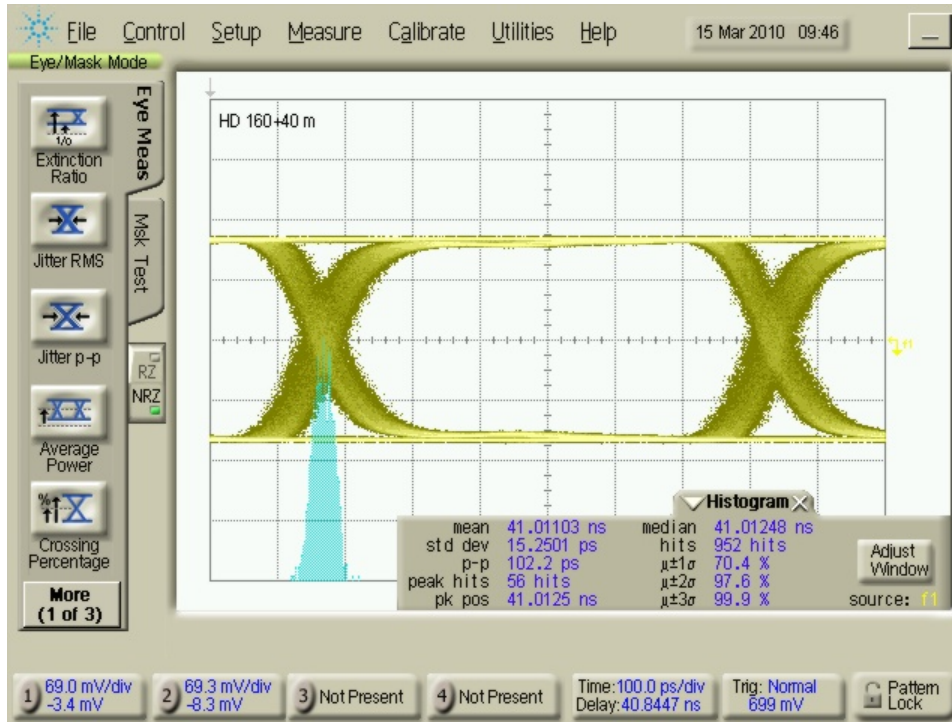


FIGURE 5. SD394 Output Waveform at 1.485 Gbps with 200m Belden 1694A Cable

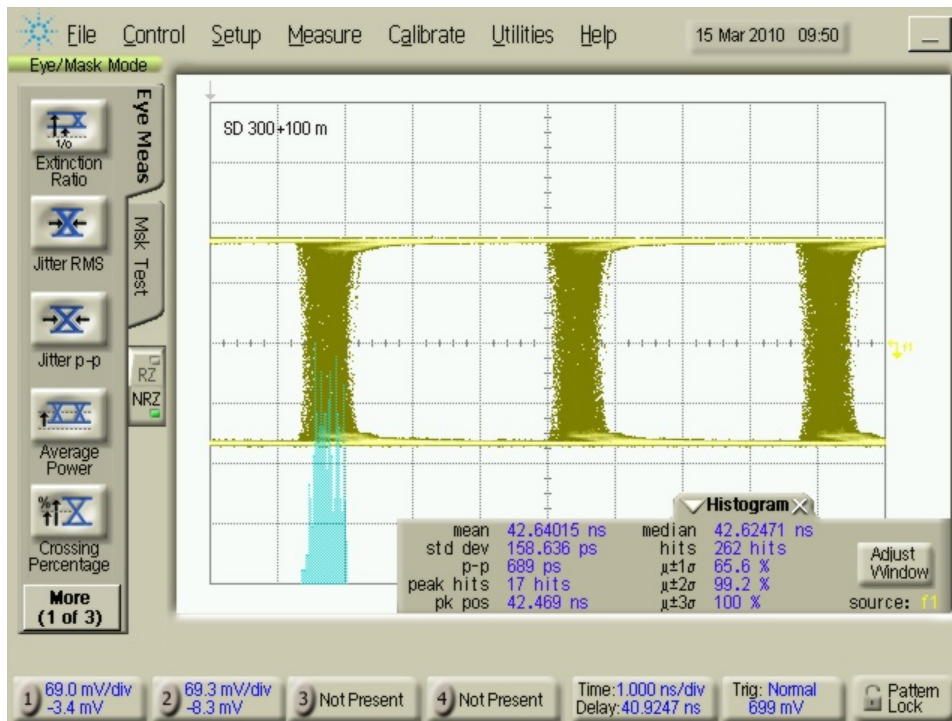


FIGURE 6. SD394 Output Waveform at 270 Mbps with 400m Belden 1694A Cable

## Input Return Loss

Figure 7 shows input return loss of the LMH0394 as measured at the BNC on the SD394. The return loss is measured using the Agilent 8722ES VNA with a 75Ω BNC to 75Ω Type N connector on the input. Note that return loss is layout dependent.

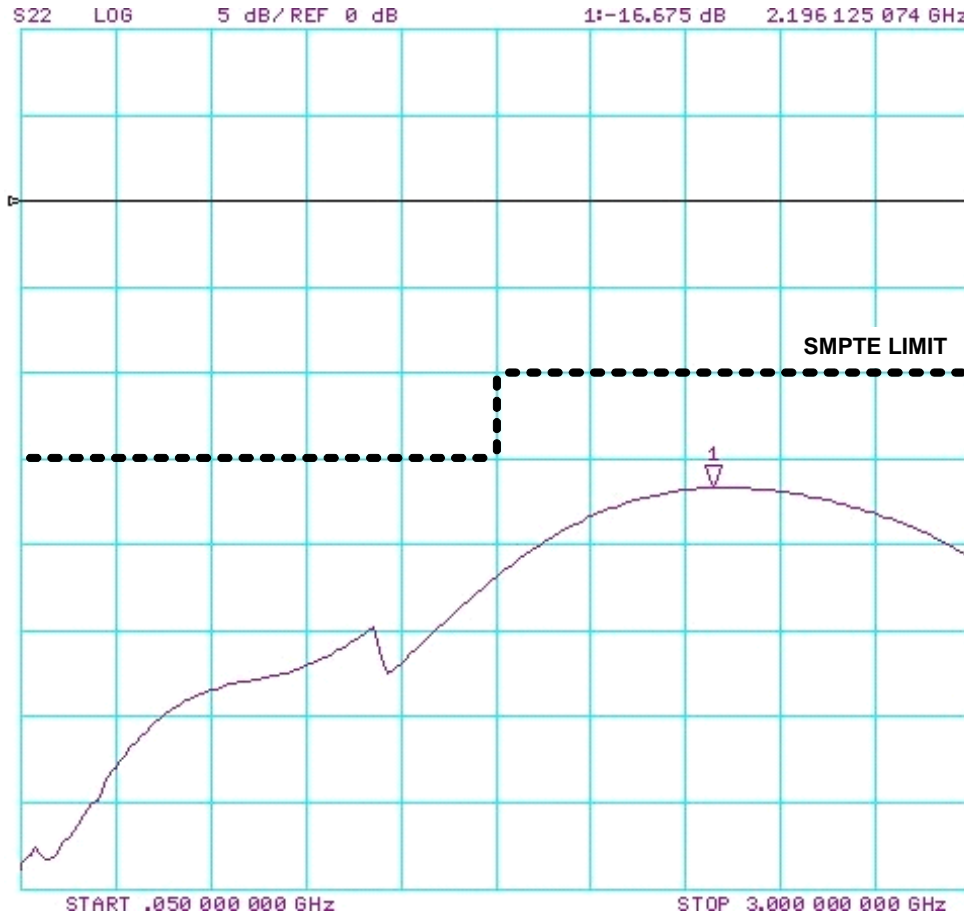


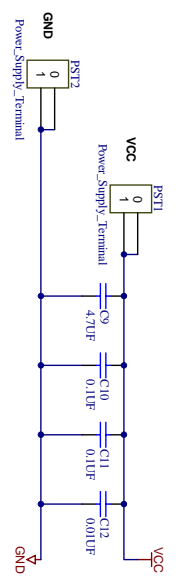
FIGURE 7. SD394 Input Return Loss

## SD394 Bill of Materials

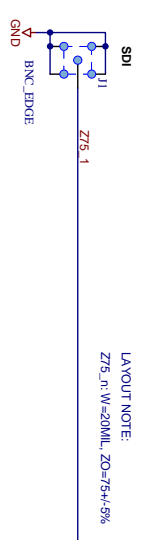
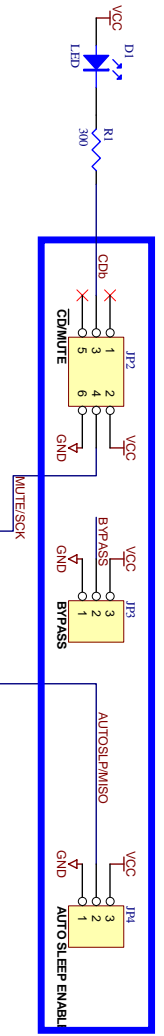
Reference Designator	Qty	Description	Manufacturer	Manufacturer Part No.
C1, C2, C12	3	Capacitor, 0.01uF, 16V, X7R, 0402	Panasonic - ECG	ECJ-0EB1C103K
C3, C7, C9, C16	4	Capacitor, 4.7uF, 6.3V, X5R, 0402	Panasonic - ECG	ECJ-0EB0J475M
C5, C6	2	Capacitor, 1uF, 6.3V, X5R, 0402	Panasonic - ECG	ECJ-0EB0J105M
C10, C11	2	Capacitor, 0.1uF, 16V, X7R, 0402	Kemet	C0402C104K9RACTU
D1	1	LED, Green, 0603	Lite-On	LTST-C190GKT
J1	1	BNC, 75-ohm, Amphenol, edge launch	Amphenol	031-6009
J2, J3	2	SMA, 50-ohm, edge launch	Johnson Components	142-0701-851
JP1	1	Header, 6x1, 0.1"	3M/ESD	929647-01-06-I
JP2	1	Header, 3x2, 0.1"	3M/ESD	929665-01-03-I
JP3, JP4, JP6, JP7, JP8, JP9	6	Header, 3x1, 0.1"	3M/ESD	929647-01-36-I
JP5	1	Header, 2x1, 0.1"	3M/ESD	929647-01-02-I
L1	1	Inductor, 5.6nH, 0402	Murata	LQP15MN5N6B02D
PST1, PST2	2	Power Supply Terminal	Keystone	1287-ST
R1	1	Resistor, 300-ohm, 1/10W, 5%, 0603	Panasonic - ECG	ERJ-3GEYJ301V
R2, R3	2	Resistor, 75-ohm, 1/16W, 1%, 0402	Yageo America	RC0402FR-0775RL
R4	1	Resistor, 37.4-ohm, 1/16W, 1%, 0402	Vishay/Dale	CRCW040237R4FKED
R5, R7, R9	3	Resistor, 3.16k-ohm, 1/10W, 1%, 0402	Panasonic - ECG	ERJ-2RKF3161X
R6, R8, R10	3	Resistor, 9.76k-ohm, 1/10W, 1%, 0402	Panasonic - ECG	ERJ-2RKF9761X
R11	1	Resistor, 0-ohm, 1/10W, 5%, 0402	Panasonic - ECG	ERJ-2GE0R00X
U2	1	LMH0394 Cable Equalizer, LLP-16	National Semiconductor	LMH0394SQ

**Schematic (next page)**

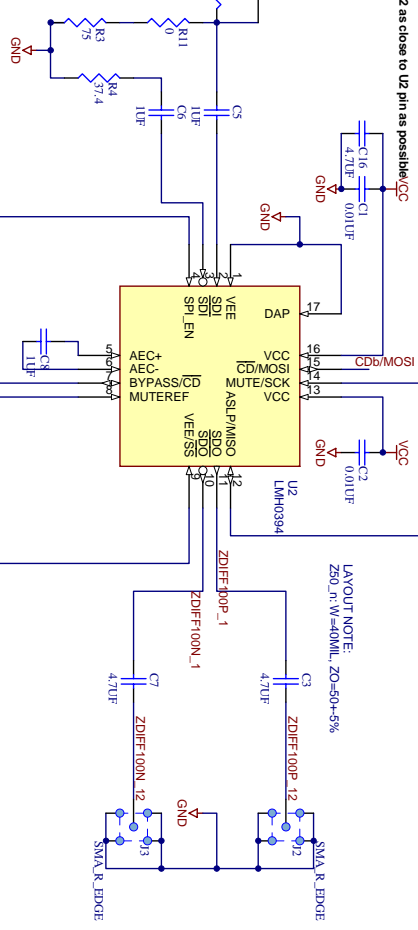
	LMH0394	LMH0384
VCC(PST1)	2.5V	3.3V
R5	3.16K	0
R7	3.16K	0
R9	3.16K	0
R6	9.76K	Do Not Load
R8	9.76K	Do Not Load
R10	9.76K	Do Not Load



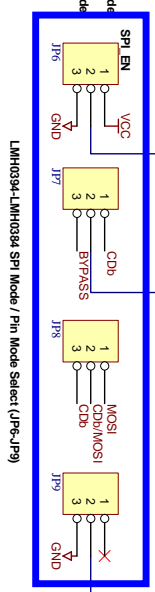
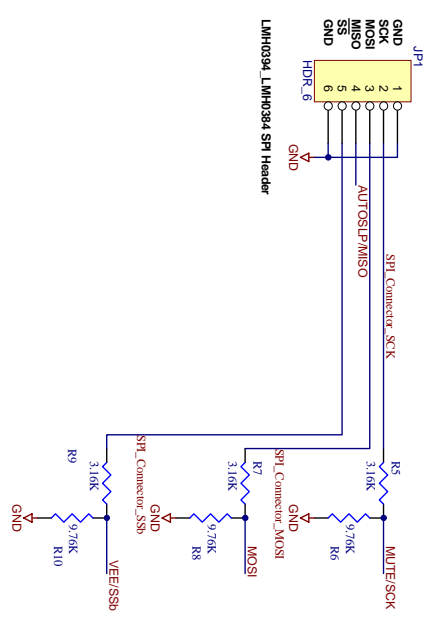
Do not place Jp2-Jp4 in SPI Mode



LAYOUT NOTE:  
ZT5\_n:W=20mIL, ZO=75+-5%



LAYOUT NOTE:  
Z50\_n:W=40mIL, ZO=50+-5%



LMH0394-LMH0394 SPI Mode / Pin Mode Select (Jp6-Jp9)



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