

## LMH0001 SMPTE 259M / 344M Serial Digital Cable Driver

Check for Samples: [LMH0001](#)

### FEATURES

- SMPTE 259M and SMPTE 344M Compliant
- Data Rates to 540 Mbps
- Supports DVB-ASI at 270 Mbps
- Differential Input
- 75Ω Differential Output
- Adjustable Output Amplitude
- Single 3.3V Supply Operation
- Industrial Temperature Range: –40°C to +85°C
- 125mW Typical Power Consumption
- 16-pin WQFN Package
- Footprint Compatible with the LMH0002SQ and the GS9078A.

### DESCRIPTION

The LMH0001 SMPTE 259M / 344M Serial Digital Cable Driver is designed for use in SMPTE 259M / 344M serial digital video applications. The LMH0001 drives 75Ω transmission lines (Belden 8281, Belden 1694A or equivalent) at data rates up to 540 Mbps.

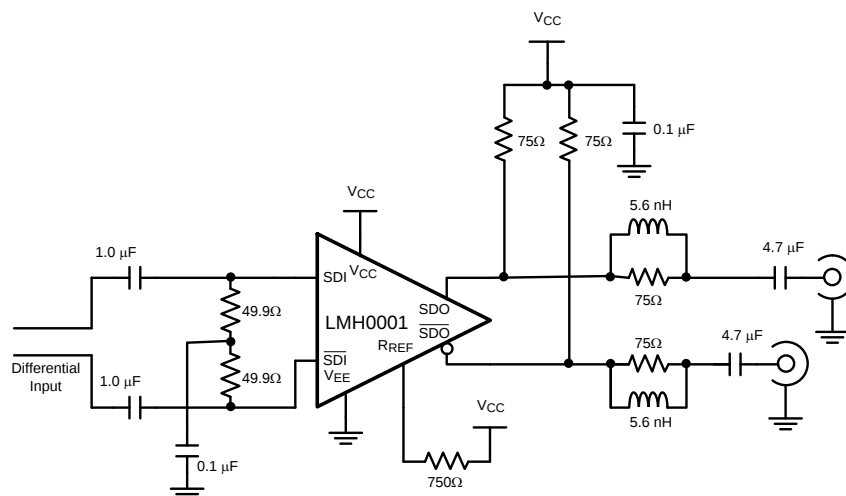
The output voltage swing of the LMH0001 is adjustable via a single external resistor.

The LMH0001 is powered from a single 3.3V supply. Power consumption is typically 125mW. The LMH0001 is available in a 16-pin WQFN package.

### APPLICATIONS

- SMPTE 259M and SMPTE 344M Serial Digital Interfaces
- DVB-ASI Applications
- Sonet/SDH and ATM Interfaces
- Digital Routers and Switches
- Distribution Amplifiers
- Buffer Applications
- Set Top Boxes
- Security Cameras

### Typical Application



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

All trademarks are the property of their respective owners.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

Copyright © 2007–2013, Texas Instruments Incorporated



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## Absolute Maximum Ratings <sup>(1)</sup>

|                                                                                      |                        |
|--------------------------------------------------------------------------------------|------------------------|
| Supply Voltage:                                                                      | -0.5V to 3.6V          |
| Input Voltage (all inputs)                                                           | -0.3V to $V_{CC}+0.3V$ |
| Output Current                                                                       | 28mA                   |
| Storage Temperature Range                                                            | -65°C to +150°C        |
| Junction Temperature                                                                 | +150°C                 |
| Lead Temperature<br>(Soldering 4 Sec)                                                | +260°C                 |
| Package Thermal Resistance<br>$\theta_{JA}$ 16-pin WQFN<br>$\theta_{JC}$ 16-pin WQFN | +78.9°C/W<br>+42.7°C/W |
| ESD Rating (HBM)                                                                     | 5kV                    |
| ESD Rating (MM)                                                                      | 250V                   |

- (1) Absolute Maximum Ratings are those parameter values beyond which the life and operation of the device cannot be ensured. The stating herein of these maximums shall not be construed to imply that the device can or should be operated at or beyond these values. The table of [Electrical Characteristics](#) specifies acceptable device operating conditions.

## Recommended Operating Conditions

|                                          |                |
|------------------------------------------|----------------|
| Supply Voltage ( $V_{CC} - V_{EE}$ ):    | 3.3V $\pm 5\%$ |
| Operating Free Air Temperature ( $T_A$ ) | -40°C to +85°C |

## DC Electrical Characteristics

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified <sup>(1)(2)</sup>.

| Parameter   | Test Conditions            | Reference             | Min               | Typ                | Max                  | Unit              |
|-------------|----------------------------|-----------------------|-------------------|--------------------|----------------------|-------------------|
| $V_{CMIN}$  | Input Common Mode Voltage  | SDI, $\overline{SDI}$ | $1.6 + V_{SDI}/2$ |                    | $V_{CC} - V_{SDI}/2$ | V                 |
| $V_{SDI}$   | Input Voltage Swing        |                       | 100               |                    | 2000                 | mV <sub>p-p</sub> |
| $V_{CMOUT}$ | Output Common Mode Voltage | SDO, $\overline{SDO}$ |                   | $V_{CC} - V_{SDO}$ |                      | V                 |
| $V_{SDO}$   | Output Voltage Swing       |                       | 750               | 800                | 850                  | mV <sub>p-p</sub> |
|             |                            |                       | 900               | 1000               | 1100                 | mV <sub>p-p</sub> |
| $I_{CC}$    | Supply Current             |                       |                   | <sup>(3)</sup> 38  | 43                   | mA                |

- (1) Current flow into device pins is defined as positive. Current flow out of device pins is defined as negative. All voltages are stated referenced to  $V_{EE} = 0$  Volts.  
 (2) Typical values are stated for  $V_{CC} = +3.3V$  and  $T_A = +25^\circ C$ .  
 (3) Maximum  $I_{CC}$  is measured at  $V_{CC} = +3.465V$  and  $T_A = +70^\circ C$ .

## AC Electrical Characteristics

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified <sup>(1)</sup>.

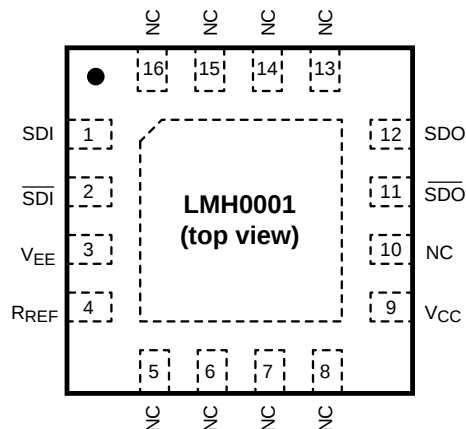
| Parameter                       | Test Conditions             | Reference                                   | Min               | Typ | Max | Unit  |
|---------------------------------|-----------------------------|---------------------------------------------|-------------------|-----|-----|-------|
| DR <sub>SDI</sub>               | Input Data Rate             | <sup>(2)</sup> SDI, $\overline{\text{SDI}}$ |                   |     | 540 | Mbps  |
| t <sub>jit</sub>                | Additive Jitter             | 270 Mbps                                    |                   | 18  |     | pSp.p |
| t <sub>r</sub> , t <sub>f</sub> | Output Rise Time, Fall Time | 20% – 80%                                   | 400               | 560 | 800 | ps    |
|                                 | Mismatch in Rise/Fall Time  | <sup>(2)</sup>                              |                   |     | 30  | ps    |
|                                 | Duty Cycle Distortion       | <sup>(2)</sup>                              |                   |     | 100 | ps    |
| t <sub>OS</sub>                 | Output Overshoot            | <sup>(2)</sup>                              |                   |     | 8   | %     |
| RL <sub>SDO</sub>               | Output Return Loss          |                                             | <sup>(3)</sup> 15 | 20  |     | dB    |

(1) Typical values are stated for V<sub>CC</sub> = +3.3V and T<sub>A</sub> = +25°C.

(2) Specification is ensured by characterization.

(3) Output return loss is dependent on board design. The LMH0001 meets this specification on the SD001SQ evaluation board from 5MHz to 1.5GHz.

## CONNECTION DIAGRAM



**Figure 1. 16-Pin WQFN Package**  
See Package Number RUM0016A

## PIN DESCRIPTIONS

| SOIC Pin No. | WQFN Pin No.                   | Name                    | Description                                                                                     |
|--------------|--------------------------------|-------------------------|-------------------------------------------------------------------------------------------------|
| 1            | 1                              | SDI                     | Serial data true input.                                                                         |
| 2            | 2                              | $\overline{\text{SDI}}$ | Serial data complement input.                                                                   |
| 3            | 3                              | V <sub>EE</sub>         | Negative power supply (ground).                                                                 |
| 4            | 4                              | R <sub>REF</sub>        | Output driver level control. Connect a resistor to V <sub>CC</sub> to set output voltage swing. |
| 5            | 9                              | V <sub>CC</sub>         | Positive power supply (+3.3V).                                                                  |
| 7            | 11                             | $\overline{\text{SDO}}$ | Serial data complement output.                                                                  |
| 8            | 12                             | SDO                     | Serial data true output.                                                                        |
| —            | 5, 6, 7, 8, 10, 13, 14, 15, 16 | NC                      | No connect.                                                                                     |
| —            | DAP                            | V <sub>EE</sub>         | Connect exposed DAP to negative power supply (ground).                                          |

## DEVICE OPERATION

### INPUT INTERFACING

The LMH0001 accepts either differential or single-ended input. The inputs are self-biased, allowing for simple AC or DC coupling. DC-coupled inputs must be kept within the specified common-mode range.  $\overline{\text{SDI}}$  and  $\overline{\text{SDI}}$  are self-biased at approximately 2.1V with  $V_{CC} = 3.3\text{V}$ . Figure 2 shows the differential input stage for  $\overline{\text{SDI}}$  and  $\overline{\text{SDI}}$ .

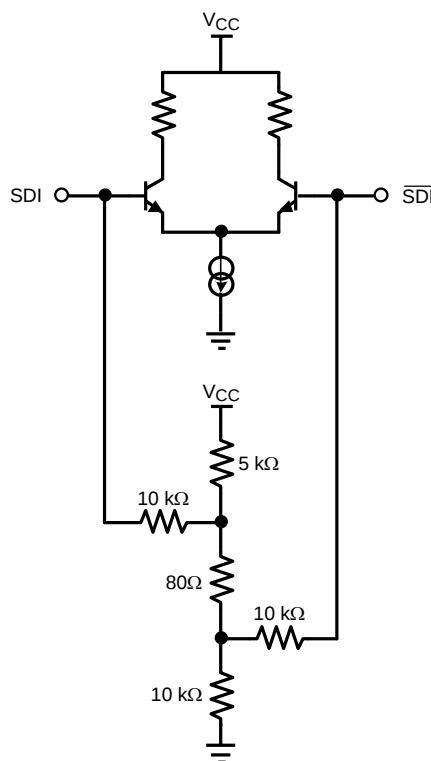


Figure 2. Differential Input Stage for  $\overline{\text{SDI}}$  and  $\overline{\text{SDI}}$ .

### OUTPUT INTERFACING

The LMH0001 uses current mode outputs. Single-ended output levels are 800 mV<sub>P-P</sub> into 75Ω AC-coupled coaxial cable (with  $R_{REF} = 750\Omega$ ). Output level is controlled by the value of the  $R_{REF}$  resistor connected between the  $R_{REF}$  pin and  $V_{CC}$ .

The  $R_{REF}$  resistor should be placed as close as possible to the  $R_{REF}$  pin. In addition, the copper in the plane layers below the  $R_{REF}$  network should be removed to minimize parasitic capacitance.

## REVISION HISTORY

| Changes from Revision B (April 2013) to Revision C         | Page              |
|------------------------------------------------------------|-------------------|
| • Changed layout of National Data Sheet to TI format ..... | <a href="#">4</a> |

## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LMH0001SQ/NOPB   | ACTIVE        | WQFN         | RUM                | 16   | 1000           | Green (RoHS<br>& no Sb/Br) | SN                      | Level-1-260C-UNLIM   | -40 to 85    | L001                    | <a href="#">Samples</a> |
| LMH0001SQE/NOPB  | ACTIVE        | WQFN         | RUM                | 16   | 250            | Green (RoHS<br>& no Sb/Br) | SN                      | Level-1-260C-UNLIM   | -40 to 85    | L001                    | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.



**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

| Device          | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LMH0001SQ/NOPB  | WQFN         | RUM             | 16   | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LMH0001SQE/NOPB | WQFN         | RUM             | 16   | 250  | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |

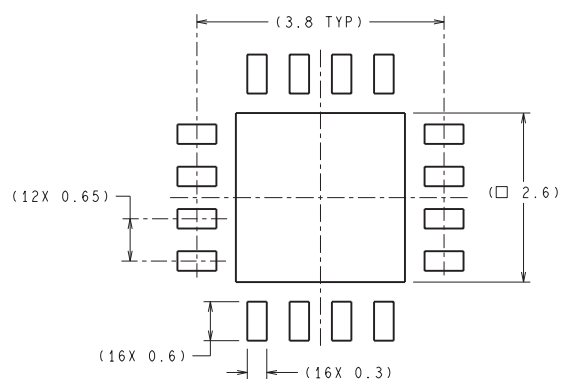
## TAPE AND REEL BOX DIMENSIONS



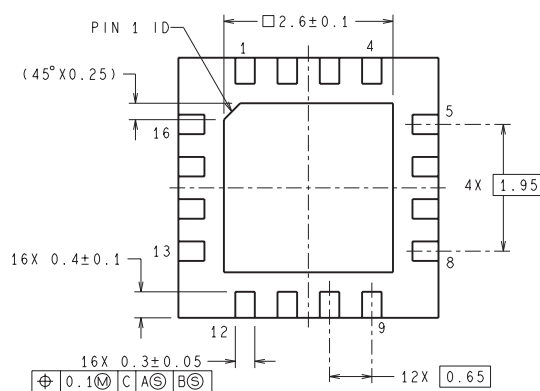
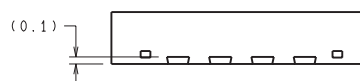
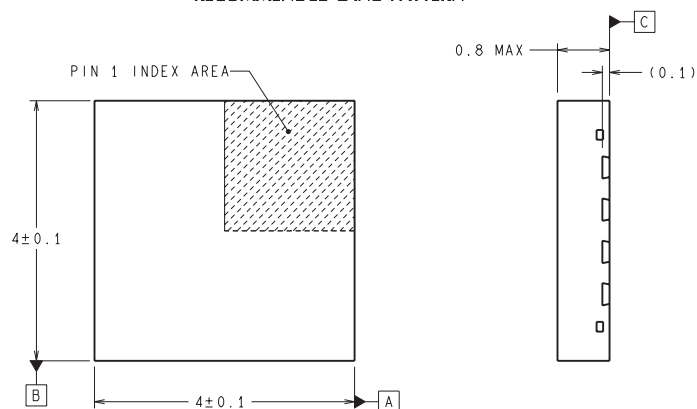
\*All dimensions are nominal

| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LMH0001SQ/NOPB  | WQFN         | RUM             | 16   | 1000 | 210.0       | 185.0      | 35.0        |
| LMH0001SQE/NOPB | WQFN         | RUM             | 16   | 250  | 210.0       | 185.0      | 35.0        |

RUM0016A



RECOMMENDED LAND PATTERN



SQB16A (Rev A)

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale ([www.ti.com/legal/termsofsale.html](http://www.ti.com/legal/termsofsale.html)) or other applicable terms available either on [ti.com](http://ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2020, Texas Instruments Incorporated