



**THE DATASHEET OF
LMH0002SQX/NOPB**



LMH0002 SMPTE 292M / 259M Serial Digital Cable Driver

Check for Samples: [LMH0002](#)

FEATURES

- SMPTE 292M, SMPTE 344M and SMPTE 259M Compliant
- Supports DVB-ASI at 270 Mbps
- Data Rates to 1.485 Gbps
- Differential Input
- 75Ω Differential Output
- Selectable Slew Rate
- Adjustable Output Amplitude
- Single 3.3V Supply Operation
- Operating Temperature Range: Commercial 0°C to +70°C (LMH0002MA) or Industrial –40°C to +85°C (LMH0002TMA and LMH0002SQ)
- Typical Power Consumption: 125 mW in SD Mode and 149 mW in HD Mode
- 8-pin SOIC or 16-pin WQFN Package
- Replaces the GS1528, GS1528A, or GS1578A

APPLICATIONS

- SMPTE 292M, SMPTE 344M, and SMPTE 259M Serial Digital Interfaces
- Sonet/SDH and ATM Interfaces
- Digital Routers and Switches
- Distribution Amplifiers
- Buffer Applications
- Set Top Boxes
- Security Cameras

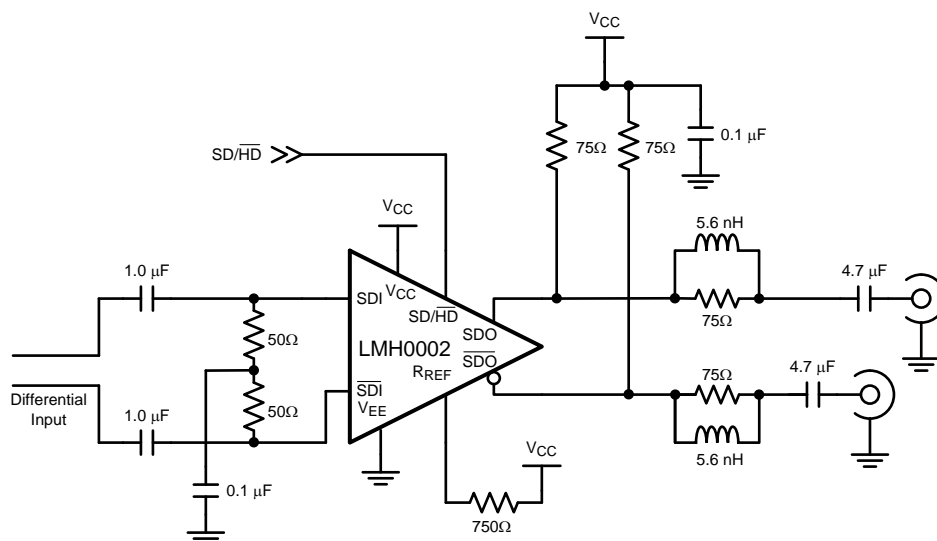
DESCRIPTION

The LMH0002 SMPTE 292M / 259M serial digital cable driver is a monolithic, high-speed cable driver designed for use in SMPTE 292M / 259M serial digital video and ITU-T G.703 serial digital data transmission applications. The LMH0002 drives 75Ω transmission lines (Belden 8281, Belden 1694A or equivalent) at data rates up to 1.485 Gbps.

The LMH0002 provides two selectable slew rates for SMPTE 259M and SMPTE 292M compliance. The output voltage swing is adjustable via a single external resistor.

The LMH0002 is powered from a single 3.3V supply. Power consumption is typically 125 mW in SD mode and 149 mW in HD mode. The LMH0002 is available in an 8-pin SOIC or 16-pin WQFN package.

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.

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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⁽¹⁾

| | |
|------------------------------------|------------------------|
| Supply Voltage: | -0.5V to 3.6V |
| Input Voltage (all inputs) | -0.3V to $V_{CC}+0.3V$ |
| Output Current | 28 mA |
| Storage Temperature Range | -65°C to +150°C |
| Junction Temperature | +150°C |
| Lead Temperature (Soldering 4 Sec) | +260°C |
| Package Thermal Resistance | |
| θ_{JA} 8-pin SOIC | +160°C/W |
| θ_{JA} 16-pin WQFN | +78.9°C/W |
| θ_{JC} 8-pin SOIC | +105°C/W |
| θ_{JC} 16-pin WQFN | +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) | |
| LMH0002MA | 0°C to +70°C |
| LMH0002TMA and LMH0002SQ | -40°C to +85°C |

DC Electrical Characteristics

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

| Symbol | Parameter | Conditions | Reference | Min | Typ | Max | Units |
|-------------|-----------------------------------|--|-----------------------|-------------------|--------------------|----------------------|-------------------|
| 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 | Differential | | 100 | | 2000 | mV _{P-P} |
| V_{CMOUT} | Output Common Mode Voltage | | SDO, \overline{SDO} | | $V_{CC} - V_{SDO}$ | | V |
| V_{SDO} | Output Voltage Swing | Single-ended, 75Ω load, $R_{REF} = 750\Omega$ 1% | | 750 | 800 | 850 | mV _{P-P} |
| | | Single-ended, 75Ω load, $R_{REF} = 590\Omega$ 1% | | 900 | 1000 | 1100 | mV _{P-P} |
| | SD/ \overline{HD} Input Voltage | Min for SD | SD/ \overline{HD} | 2.4 | | | V |
| | | Max for HD | | | | 0.8 | V |
| | SD/ \overline{HD} Input Current | | | 3.7 | | | μA |
| I_{CC} | Supply Current | SD/ $\overline{HD} = 0$ ⁽³⁾ | | | 45 | 49 | mA |
| | | SD/ $\overline{HD} = 1$ ⁽³⁾ | | | 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⁽¹⁾.

| Symbol | Parameter | Conditions | Reference | Min | Typ | Max | Units |
|------------|-----------------------------|---|-----------------------|-----|-----|------|-------------------|
| DR_{SDI} | Input Data Rate | ⁽²⁾ | SDI, \overline{SDI} | | | 1485 | Mbps |
| t_{jit} | Additive Jitter | 1.485 Gbps | SDO, \overline{SDO} | | 26 | | pS _{P-P} |
| | | 270 Mbps | | | 18 | | pS _{P-P} |
| t_r, t_f | Output Rise Time, Fall Time | SD/ $\overline{HD} = 0$, 20% – 80%, ⁽³⁾ | | | 120 | 220 | ps |
| | | SD/ $\overline{HD} = 1$, 20% – 80% | | 400 | 560 | 800 | ps |
| | Mismatch in Rise/Fall Time | ⁽²⁾ | | | | 30 | ps |
| | Duty Cycle Distortion | SD/ $\overline{HD} = 0$, ⁽²⁾ | | | | 30 | ps |
| | | SD/ $\overline{HD} = 1$, ⁽²⁾ | | | | 100 | ps |
| t_{OS} | Output Overshoot | ⁽²⁾ | | | | 8 | % |
| RL_{SDO} | Output Return Loss | ⁽⁴⁾ | | 15 | 20 | | dB |

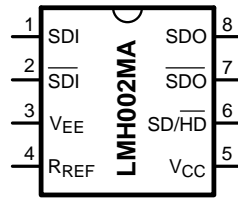
(1) Typical values are stated for $V_{CC} = +3.3V$ and $T_A = +25^\circ C$.

(2) Specification is ensured by characterization.

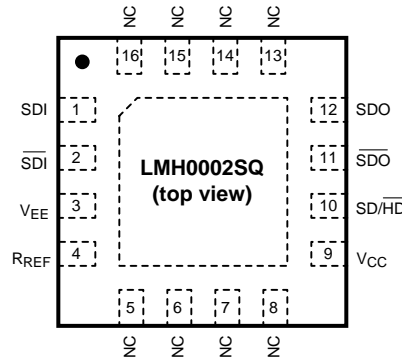
(3) Specification is ensured by characterization and verified by test.

(4) Output return loss is dependent on board design. The LMH0002 meets this specification on the SD002 evaluation board from 5MHz to 1.5GHz.

CONNECTION DIAGRAM



**Figure 1. 8-Pin SOIC
See D Package**



**Figure 2. 16-Pin WQFN
See RUM0016A Package**

Table 1. PIN DESCRIPTIONS

| SOIC Pin # | WQFN Pin # | Name | Description |
|------------|----------------------------|----------------------------------|---|
| 1 | 1 | SDI | Serial data true input. |
| 2 | 2 | $\overline{\text{SDI}}$ | Serial data complement input. |
| 3 | 3 | V_{EE} | Negative power supply (ground). |
| 4 | 4 | R_{REF} | Output driver level control. Connect a resistor to V_{CC} to set output voltage swing. |
| 5 | 9 | V_{CC} | Positive power supply (+3.3V). |
| 6 | 10 | $\text{SD}/\overline{\text{HD}}$ | Output slew rate control. Output rise/fall time complies with SMPTE 292M when low and SMPTE 259M when high. |
| 7 | 11 | $\overline{\text{SDO}}$ | Serial data complement output. |
| 8 | 12 | SDO | Serial data true output. |
| — | 5, 6, 7, 8, 13, 14, 15, 16 | NC | No connect. |
| — | DAP | V_{EE} | Connect exposed DAP to negative power supply (ground). |

APPLICATION INFORMATION

Device Operation

INPUT INTERFACING

The LMH0002 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. SDI and $\overline{\text{SDI}}$ are self-biased at approximately 2.1V with $V_{CC} = 3.3\text{V}$. Figure 3 shows the differential input stage for SDI and $\overline{\text{SDI}}$.

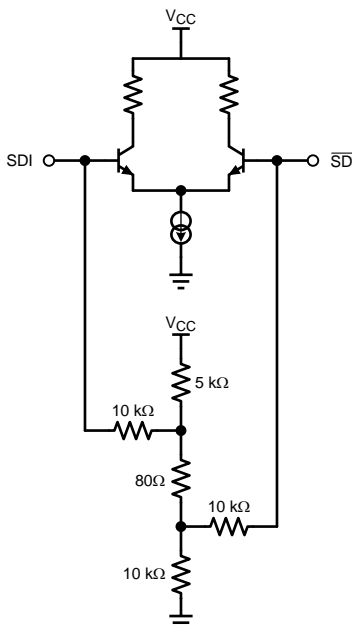


Figure 3. Differential Input Stage for SDI and $\overline{\text{SDI}}$.

OUTPUT INTERFACING

The LMH0002 uses current mode outputs. Single-ended output levels are 800 mV_{P-P} 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.

OUTPUT SLEW RATE CONTROL

The LMH0002 output rise and fall times are selectable for either SMPTE 259M or SMPTE 292M compliance via the SD/HD pin. For slower rise and fall times, or SMPTE 259M compliance, SD/HD is set high. For faster rise and fall times, or SMPTE 292M compliance, SD/HD is set low.

REPLACING THE GENNUM GS1528, GS1528A, and GS1578A

The LMH0002MA is form-fit-function compatible with the Gennum GS1528 and GS1528A. The LMH0002SQ is form-fit-function compatible with the Gennum GS1578A.

REVISION HISTORY

| Changes from Revision D (April 2013) to Revision E | Page |
|--|-------------------|
| • Changed layout of National Data Sheet to TI format | 5 |

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LMH0002MA/NOPB | ACTIVE | SOIC | D | 8 | 95 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 85 | L002 | Samples |
| LMH0002MAX/NOPB | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 85 | L002 | Samples |
| LMH0002SQ/NOPB | ACTIVE | WQFN | RUM | 16 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | | L002 | Samples |
| LMH0002SQE/NOPB | ACTIVE | WQFN | RUM | 16 | 250 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | | L002 | Samples |
| LMH0002TMA/NOPB | ACTIVE | SOIC | D | 8 | 95 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 85 | L002T | Samples |
| LMH0002TMAX/NOPB | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 85 | L002T | Samples |

(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.

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TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

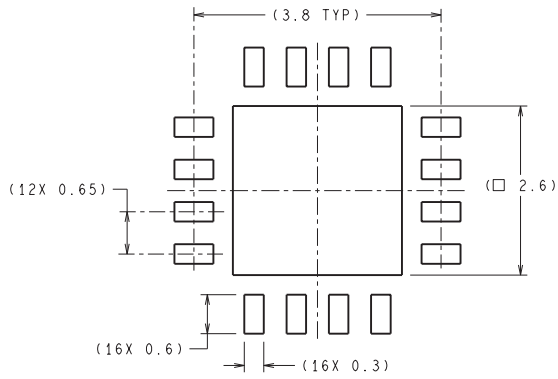
| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LMH0002MAX/NOPB | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.5 | 5.4 | 2.0 | 8.0 | 12.0 | Q1 |
| LMH0002SQ/NOPB | WQFN | RUM | 16 | 1000 | 178.0 | 12.4 | 4.3 | 4.3 | 1.3 | 8.0 | 12.0 | Q1 |
| LMH0002SQE/NOPB | WQFN | RUM | 16 | 250 | 178.0 | 12.4 | 4.3 | 4.3 | 1.3 | 8.0 | 12.0 | Q1 |
| LMH0002TMAX/NOPB | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.5 | 5.4 | 2.0 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

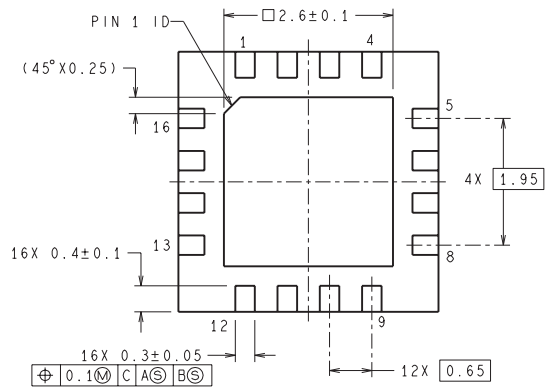
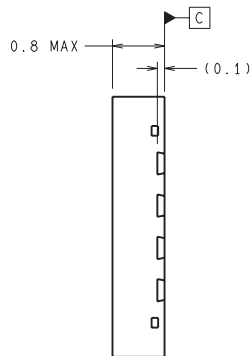
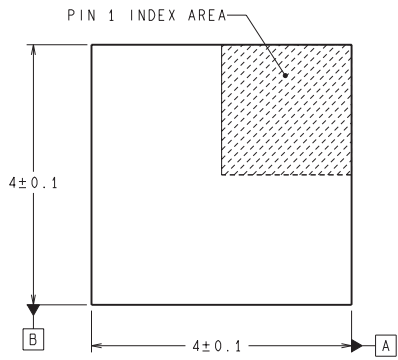
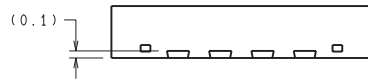
| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LMH0002MAX/NOPB | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 35.0 |
| LMH0002SQ/NOPB | WQFN | RUM | 16 | 1000 | 210.0 | 185.0 | 35.0 |
| LMH0002SQE/NOPB | WQFN | RUM | 16 | 250 | 210.0 | 185.0 | 35.0 |
| LMH0002TMAX/NOPB | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 35.0 |

RUM0016A



RECOMMENDED LAND PATTERN

DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS IN () FOR REFERENCE ONLY



SQB16A (Rev A)



D0008A

PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

NOTES:

- Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
- This dimension does not include interlead flash.
- Reference JEDEC registration MS-012, variation AA.

EXAMPLE BOARD LAYOUT

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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