LMH0024

LMH0024 3.3V SMPTE 259M / 344M Adaptive Cable Equalizer

Literature Number: SNLS210F

National Semiconductor

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3.3V SMPTE 259M / 344M Adaptive Cable Equalizer

General Description

The LMH0024 SMPTE 259M / 344M adaptive cable equalizer is a monolithic integrated circuit for equalizing data transmitted over cable (or any media with similar dispersive loss characteristics). The equalizer operates over a wide range of data rates from 125 Mbps to 540 Mbps and supports SMPTE 259M and SMPTE 344M.

The LMH0024 implements DC restoration to correctly handle pathological data conditions. DC restoration can be bypassed for low data rate applications. The equalizer is flexible in allowing either single-ended or differential input drive.

Additional features include a mute pin which can be used to manually mute the output and a cable length indicator which determines the amount of cable being equalized.

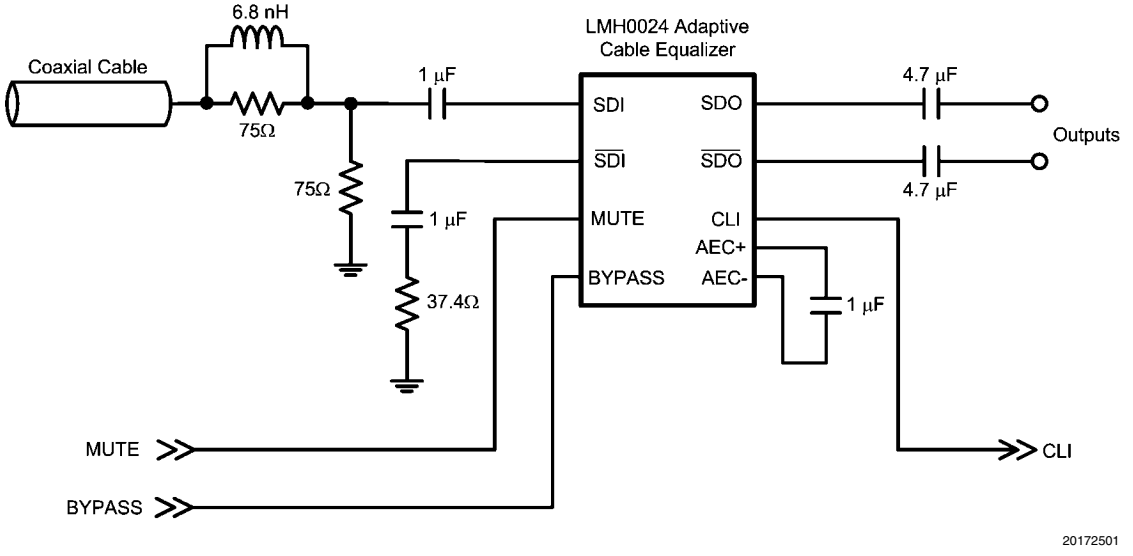
Features

- SMPTE 259M and SMPTE 344M compliant
- Supports DVB-ASI at 270 Mbps
- Data rates: 125 Mbps to 540 Mbps
- Equalizes up to 350 meters of Belden 1694A at 270 Mbps
- Manual bypass, cable length indicator, and output mute
- Single-ended or differential input
- 50Ω differential outputs
- Single 3.3V supply operation
- Industrial temperature range: −40°C to +85°C
- 198 mW typical power consumption with 3.3V supply
- Footprint compatible with the LMH0034 and the GS9064

Applications

- SMPTE 259M and SMPTE 344M serial digital interfaces
- Serial digital data equalization and reception
- Data recovery equalization

Typical Application



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Absolute Maximum Ratings ( )

Supply Voltage	−0.5V to 3.6V
Input Voltage (all inputs)	−0.3V to V_{CC}+0.3V
Storage Temperature Range	−65°C to +150°C
Junction Temperature	+150°C
Lead Temperature (Soldering 4 Sec)	+260°C
Package Thermal Resistance	
θ_{JA} 16-pin SOIC	+115°C/W
θ_{JC} 16-pin SOIC	+105°C/W
ESD Rating (HBM)	8 kV
ESD Rating (MM)	250V

Recommended Operating Conditions

Supply Voltage (V_{CC} – V_{EE})	3.3V ±5%
Input Coupling Capacitance	1.0 µF
AEC Capacitor (Connected between AEC+ and AEC-)	1.0 µF
Operating Free Air Temperature (T_A)	−40°C to +85°C

DC Electrical Characteristics

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

Symbol	Parameter	Conditions	Reference	Min	Typ	Max	Units
V_{CMIN}	Input Common Mode Voltage		SDI, $\overline{SDI}$		1.9		V
V_{SDI}	Input Voltage Swing	At LMH0024 input, (,)		720	800	950	mV_{P-P}
V_{CMOUT}	Output Common Mode Voltage		SDO, $\overline{SDO}$		V_{CC} – V_{SDO}/2		V
V_{SDO}	Output Voltage Swing	50Ω load, differential			750		mV_{P-P}
	CLI DC Voltage	0m cable, ( )	CLI		2.5		V
		Max cable, ( )			2.0		V
	MUTE Input Voltage	Min to mute outputs	MUTE	3.0			V
		Max to force outputs active				2.0	V
I_{CC}	Supply Current	( )			60	77	mA

AC Electrical Characteristics

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

Symbol	Parameter	Conditions	Reference	Min	Typ	Max	Units
BR_{MIN}	Minimum Input Data Rate		SDI, $\overline{SDI}$		125		Mbps
BR_{MAX}	Maximum Input Data Rate					540	Mbps
	Maximum Equalized Cable Length (with equalizer pathological)	270 Mbps, Belden 1694A, 0.2UI output jitter, ( )			350		m
		270 Mbps, Belden 8281, 0.2UI output jitter, ( )			280		m
		540 Mbps, Belden 1694A, 0.2UI output jitter, ( )			250		m
		540 Mbps, Belden 8281, 0.2UI output jitter, ( )			180		m
t_r,t_f	Output Rise Time, Fall Time	20% – 80%, ( )	SDO, $\overline{SDO}$		100	220	ps
	Mismatch in Rise/Fall Time	( )			2	15	ps
t_{OS}	Output Overshoot	( )			1	5	%
R_{OUT}	Output Resistance	single-ended, ( )			50		Ω
RL_{IN}	Input Return Loss	( )	SDI, $\overline{SDI}$	15	18-20		dB
R_{IN}	Input Resistance	single-ended			1.3		kΩ
C_{IN}	Input Capacitance	single-ended, ( )			1		pF

Note 1: "Absolute Maximum Ratings" are those parameter values beyond which the life and operation of the device cannot be guaranteed. 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.

Note 2: 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.

Note 3: Typical values are stated for V_{CC} = +3.3V and T_A = +25°C.

Note 4: Specification is guaranteed by characterization.

Note 5: Specification is guaranteed by design.

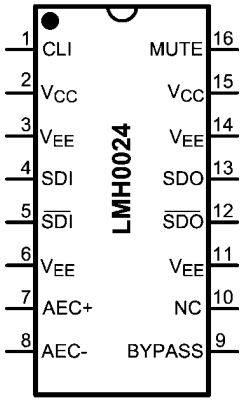
Note 6: The maximum input voltage swing assumes a nonstressing, DC-balance signal; specifically, the SMPTE-recommended color bar test signal. Pathological or other stressing signals may not be used. This specification is for 0m cable only.

Note 7: Input signal must be present for valid CLI. Refer to for typical results.

Note 8: Supply current depends on the amount of cable being equalized. The current is highest for short cable and decreases as the cable length is increased. Refer to .

Note 9: Input return loss is dependent on board design. The LMH0024 meets this specification on the SD024 evaluation board from 5MHz to 1.5GHz.

Connection Diagram



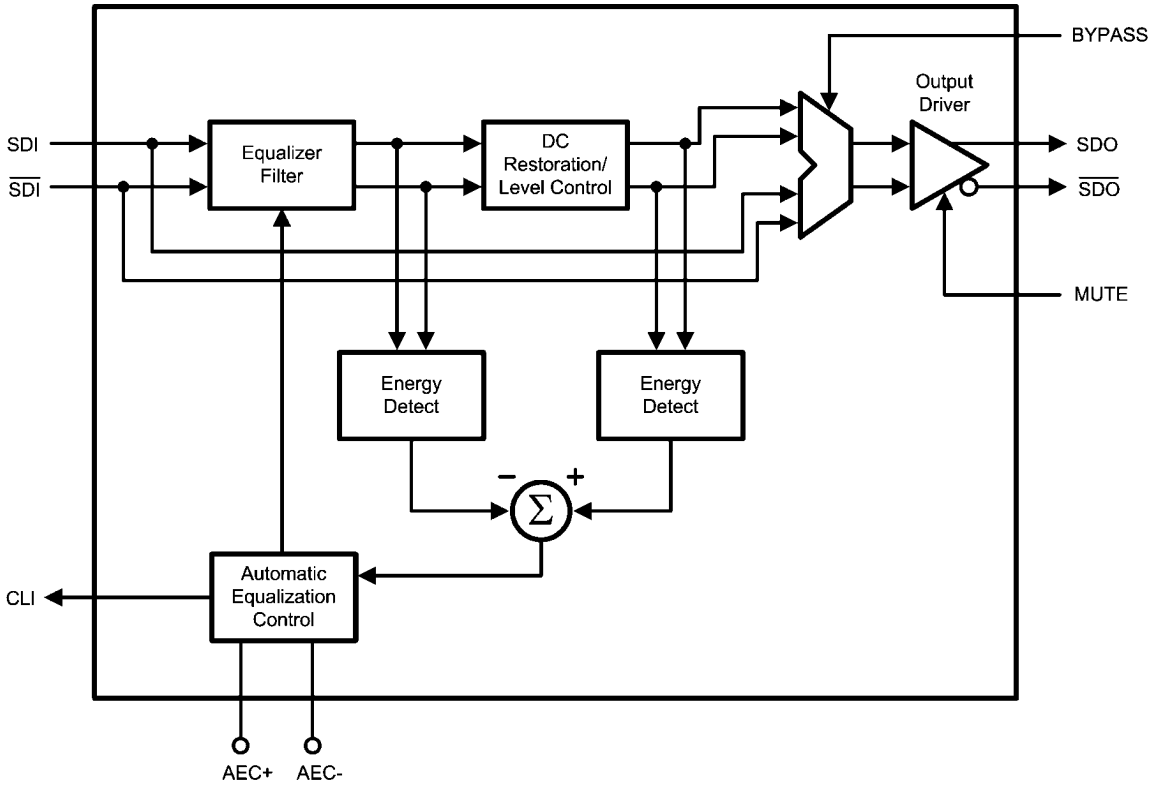
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16-Pin SOIC
Order Number LMH0024MA
See NS Package Number M16A

Pin Descriptions

Pin #	Name	Description
1	CLI	Cable length indicator. Provides a voltage inversely proportional to the cable length being equalized.
2	V_{CC}	Positive power supply (+3.3V).
3	V_{EE}	Negative power supply (ground).
4	SDI	Serial data true input.
5	$\overline{SDI}$	Serial data complement input.
6	V_{EE}	Negative power supply (ground).
7	AEC+	AEC loop filter external capacitor (1µF) positive connection.
8	AEC-	AEC loop filter external capacitor (1µF) negative connection.
9	BYPASS	Bypasses equalization and DC restoration when high. No equalization occurs in this mode.
10	NC	No connect.
11	V_{EE}	Negative power supply (ground).
12	$\overline{SDO}$	Serial data complement output.
13	SDO	Serial data true output.
14	V_{EE}	Negative power supply (ground).
15	V_{CC}	Positive power supply (+3.3V).
16	MUTE	Output mute. To force SDO and $\overline{SDO}$ to mute, tie to V_{CC}. To disable MUTE, tie to GND. Typical application is MUTE tied to GND to enable the outputs. MUTE must be tied either high or low; it may not be left unconnected.

Block Diagram



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Device Operation

BLOCK DESCRIPTION

The **Equalizer Filter** block is a multi-stage adaptive filter. If Bypass is high, the equalizer filter is disabled.

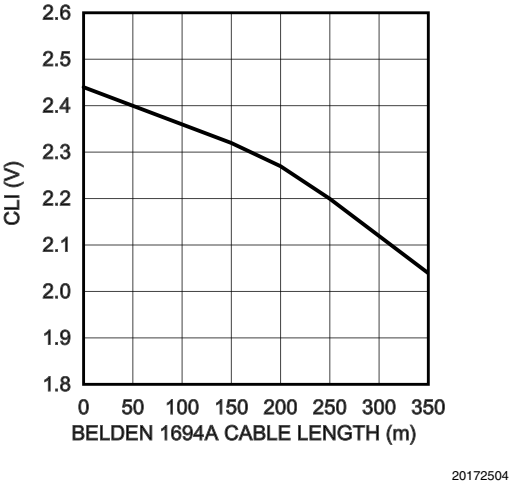
The **DC Restoration / Level Control** block receives the differential signals from the equalizer filter block. This block incorporates a self-biasing DC restoration circuit to fully DC restore the signals. If Bypass is high, this function is disabled.

The signals before and after the DC Restoration / Level Control block are used to generate the **Automatic Equalization Control (AEC)** signal. This control signal sets the gain and bandwidth of the equalizer filter. The loop response in the AEC block is controlled by an external 1µF capacitor placed across the AEC+ and AEC- pins. **Cable Length Indicator (CLI)** is derived from this block.

The **Output Driver** produces SDO and $\overline{\text{SDO}}$. SDO and $\overline{\text{SDO}}$ may be forced to mute by activating **MUTE**.

CABLE LENGTH INDICATOR (CLI)

The cable length indicator provides a voltage to indicate the length of cable being equalized. The CLI voltage decreases as the cable length increases. shows the typical CLI voltage vs. Belden 1694A cable length. Note: CLI is only valid when an input signal is present.



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FIGURE 1. CLI vs. Belden 1694A Cable Length

MUTE

MUTE can be used to manually mute or enable the LMH0024 outputs. MUTE must be tied to a low-level input or ground for SDO and $\overline{\text{SDO}}$ to be active. Applying a high input to MUTE will mute the LMH0024 outputs.

INPUT INTERFACING

The LMH0024 accepts either differential or single-ended input. The input must be AC coupled. Transformer coupling is not supported.

The LMH0024 correctly handles equalizer pathological signals for standard definition serial digital video, as described in SMPTE RP 178.

OUTPUT INTERFACING

The SDO and $\overline{\text{SDO}}$ outputs are internally loaded with 50Ω. They produce a 750 mV_{P-P} differential output, or a 375 mV_{P-P} single-ended output.

Application Information

PCB LAYOUT RECOMMENDATIONS

Please refer to the following Application Note for the CLC034 on National's website: **AN-1372, "LMH0034 PCB Layout Techniques."** The PCB layout techniques in this application note apply to the LMH0024 as well.

REPLACING THE GENNUM GS9064

The LMH0024 is footprint compatible with the Gennum GS9064. Pin 16 (MUTE) of the LMH0024 must be connect to ground for correct operation.

SUPPLY CURRENT VS. CABLE LENGTH

The supply current (I_{CC}) depends on the amount of cable being equalized. The current is highest for short cable and decreases as the cable length is increased. shows supply current vs. Belden 1694A cable length for 270 Mbps data.

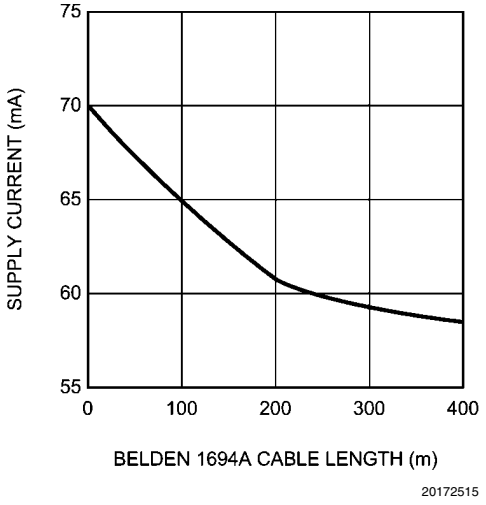
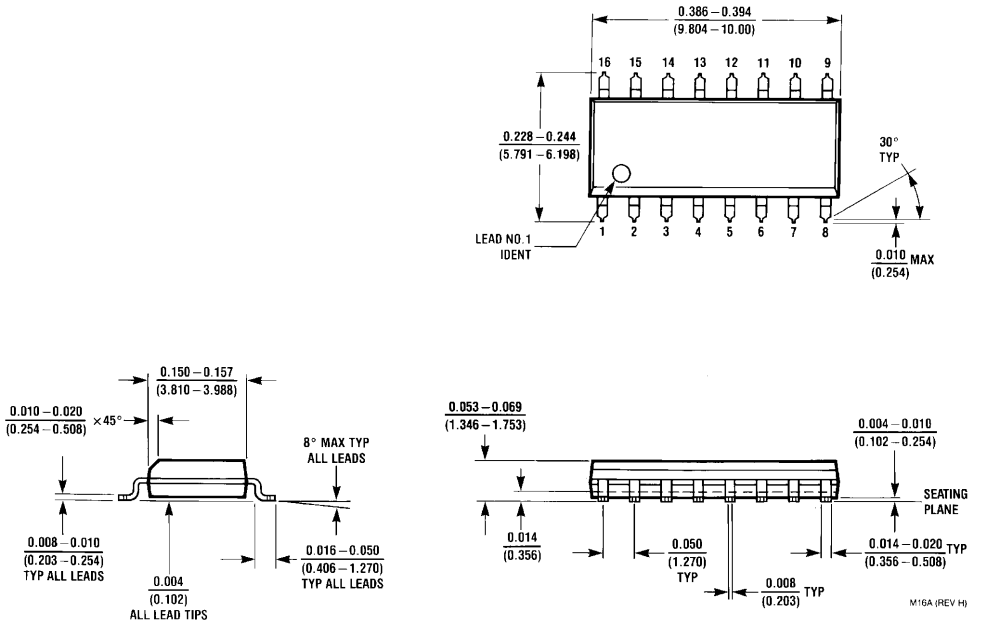


FIGURE 2. Supply Current vs. Belden 1694A Cable Length, 270 Mbps

Physical Dimensions inches (millimeters) unless otherwise noted



16-Pin SOIC
Order Number LMH0024MA
NS Package Number M16A

Notes

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