

3G-SDI Cable Equalizer Compatibility Guide – TI / MACOM

ABSTRACT

To facilitate design with TI's 3G-SDI portfolio, this guide provides a detailed description about cable equalizer devices that are drop-in compatible replacements for similar MACOM cable equalizers. In addition, this guide provides details about 3G-SDI cable equalizer part selection for new designs to enable improved performance and an easy future upgrade path from 3G to 12G.

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1 Introduction

TI offers a diverse 3G-SDI portfolio that includes cable equalizers, reclockers, and cable drivers. Many of these 3G-SDI devices are pin-compatible or functional equivalent replacement options with devices offered by other SDI IC vendors. This guide serves as a pin-by-pin reference with a detailed comparison of TI's 3G cable equalizers and similar cable equalizer devices offered by MACOM.

2 Cable Equalizer Compatibility Overview

These TI devices are pin-compatible with the following MACOM cable equalizers:

TI CABLE EQ	PIN-COMPATIBLE WITH...	DEVICE DETAILS
LMH0384 LMH0344	M21324	Single Output EQ 16-Pin QFN 4 mm x 4 mm
LMH0394	M21564, M21664, M31564	Single Output EQ 16-Pin QFN 4 mm x 4 mm
LMH0395	M21544, M21644, M31544	Dual Output EQ 24-Pin QFN 4 mm x 4 mm

3 LMH0384, LMH0344 Pin Compatibility With M21324

3.1 Key Schematic Differences

Figure 1 highlights key schematic differences between TI and MACOM drop-in compatible solutions in blue. For a detailed comparison of device pin functionality, refer to Section 3.2.

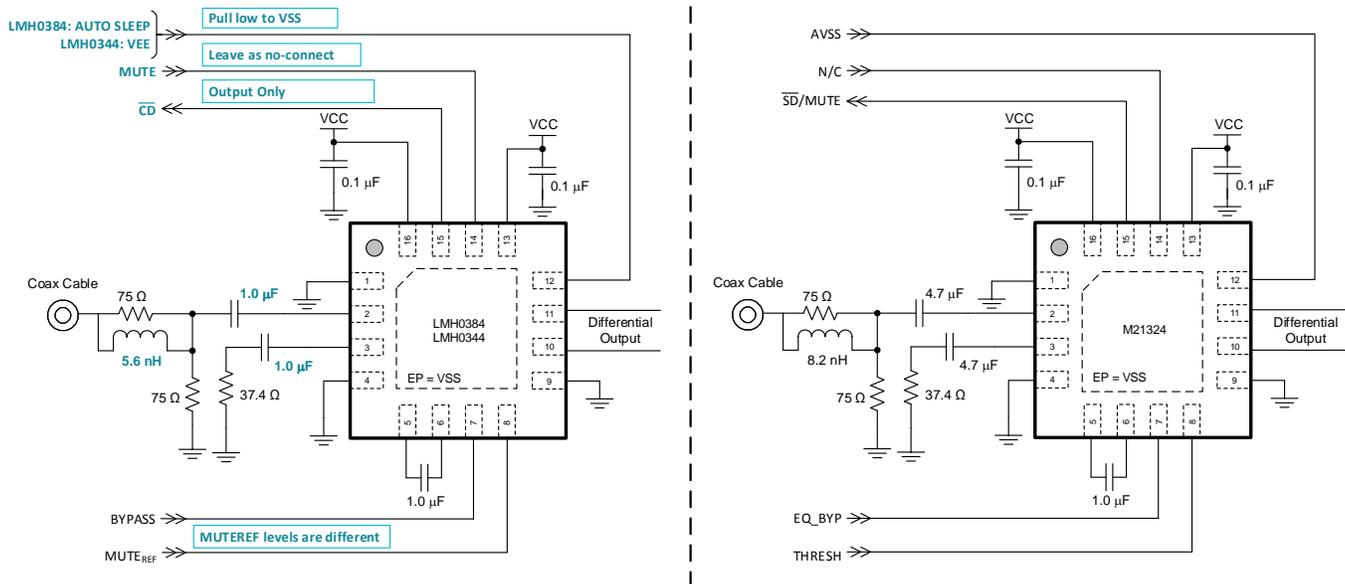


Figure 1. LMH0384, LMH0344 Pin Compatibility With M21324

3.2 Pin-By-Pin Comparison

PIN NO.	LMH0384 ⁽¹⁾ LMH0344	M21324	FUNCTIONAL DIFFERENCES AND NOTES
1, DAP	V _{EE}	AV _{SS}	None
2, 3	SDI, SDI	SDI, SDI	None
4	LMH0384: SPI_EN LMH0344: V _{EE}	AV _{SS}	LMH0384: Pull to V _{EE} for compatibility.
5, 6	AEC+, AEC-	AGC, AGC	None. 1-μF integration cap required
7	BYPASS	EQ_BYP	LMH0344: External pulldown required to disable bypass function.
8	MUTE _{REF}	THRESH	LMH0384/44: Leave as no connect for maximum cable reach. See LMH0384/LMH0344 data sheet for specific threshold levels.
9	V _{EE}	AV _{SS}	None
10, 11	SDO, SDO	SDO, SDO	None
12	LMH0384: AUTO SLEEP LMH0344: V _{EE}	AV _{SS}	LMH0384: Automatic Power Down in case of carrier loss. For compatibility, pull this pin low to disable automatic power down.
13	V _{CC}	AV _{DD}	None. 3.3-V Supply
14	MUTE	N/C	None
15	CD	SD/MUTE	None
16	V _{CC}	AV _{DD}	None. 3.3-V Supply

⁽¹⁾ LMH0384 pin descriptions in this table are shown for Pin Mode only. Although the TI LMH0384 also supports a programmable SPI Mode, the MACOM M21324 only supports Pin Mode operation.

3.3 External Component Differences

To replace the M21324, the following external component changes should be observed regarding the LMH0384/44:

COMPONENT(S)	CHANGE FROM...	CHANGE TO...
MUTE _{REF} Resistor Network	Leave as no connect for maximum cable reach. See LMH0384/LMH0344 data sheet for specific threshold levels.	
AC Coupling Capacitors	4.7 μ F	1.0 μ F
Return Loss Inductor	6.2 nH	5.6 nH

4 LMH0394 Pin Compatibility With M21564, M21664, M31564

4.1 Key Schematic Differences

Figure 2 and Figure 3 highlight key schematic differences between TI and MACOM drop-in compatible solutions in blue. For a detailed comparison of device pin functionality, refer to Section 4.2.

4.1.1 Pin Mode (Hardware Mode)

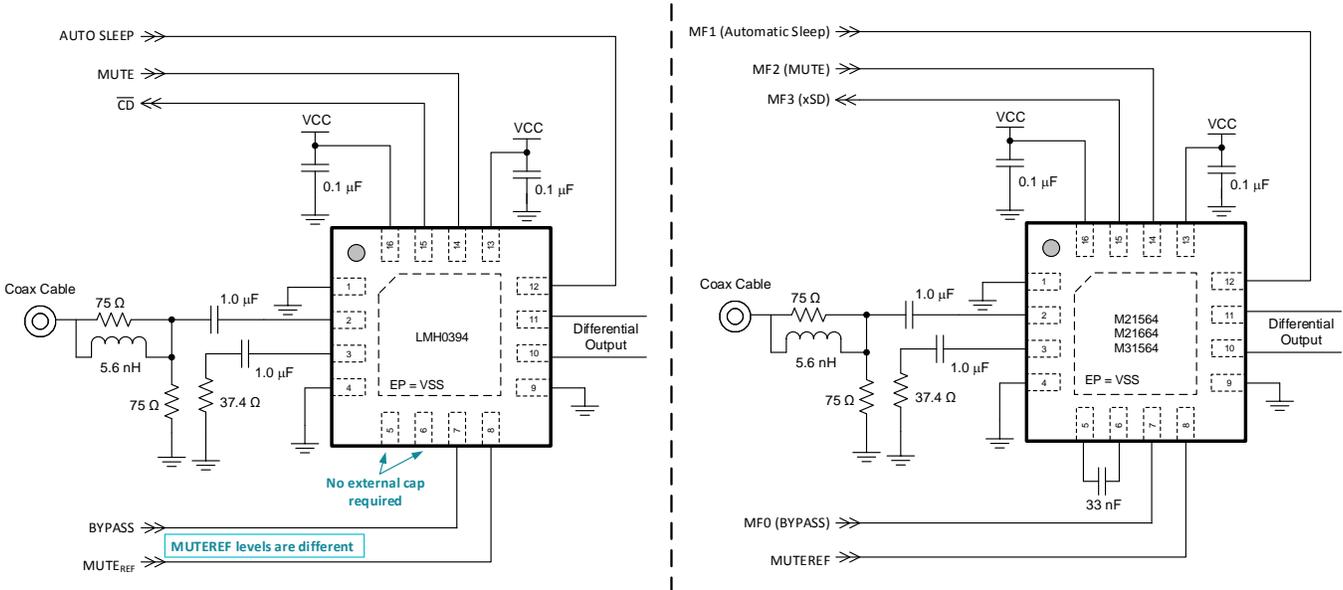


Figure 2. LMH0394 Pin Compatibility With M21564, M21664, M31564, Pin/Hardware Mode

4.1.2 SPI Mode (Software Mode)

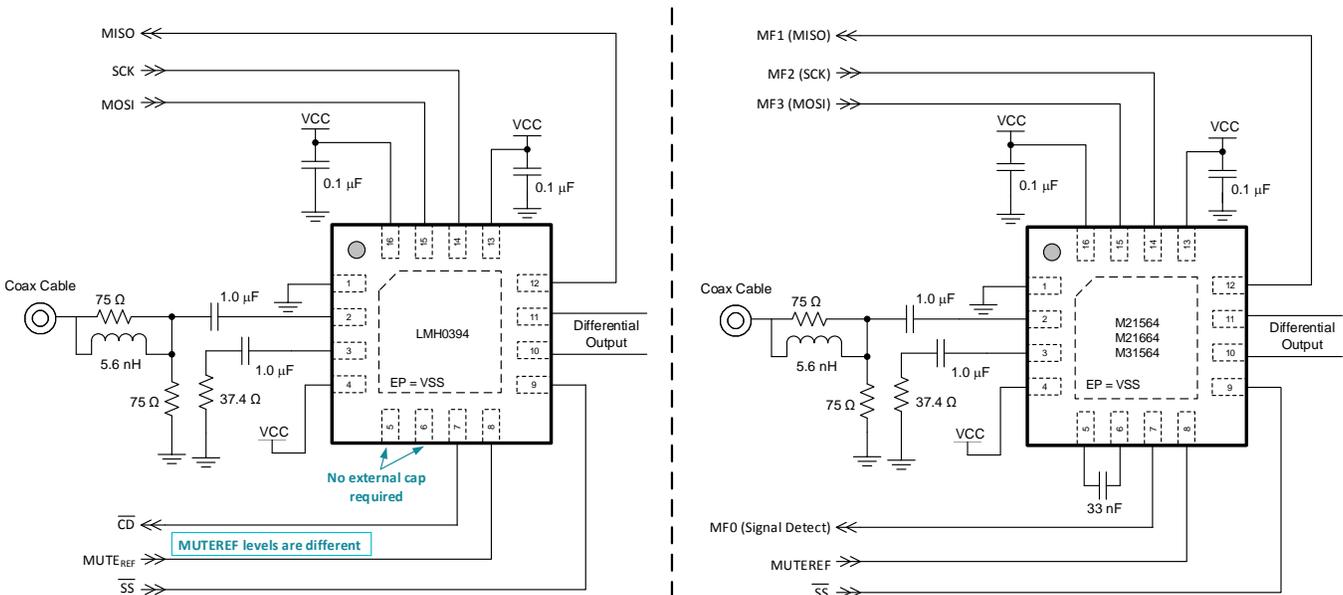


Figure 3. LMH0394 Pin Compatibility With M21564, M21664, M31564, SPI/Software Mode

4.2 Pin-by-Pin Comparison

PIN NO.	LMH0394 ⁽¹⁾	M21564 M21664 M31564	FUNCTIONAL DIFFERENCES AND NOTES
1, DAP	V _{EE}	V _{EE}	None
2, 3	SDI, SDT	SDIP, SDIN	None
4	SPI_EN	MODE_SEL	None. For comparison purposes, Pin Mode (TI) and Hardware Mode (MACOM) are identical terms. SPI Mode (TI) and Software Mode (MACOM) are also identical.
5, 6	AEC+, AEC-	AGC+, AGC-	LMH0394: Optional 1-μF integration capacitor (not required) M21564, M21664, M31564: 33-nF integration capacitor required
7	BYPASS (Pin Mode) \overline{CD} (SPI Mode)	MF0	None. In Hardware Mode (MODE_SEL = 0), MF0 functions as a BYPASS pin. In Software Mode (MODE_SEL = 1), MF0 functions as a \overline{CD} pin.
8	MUTE _{REF}	MUTEREF	LMH0394: Leave as no connect for maximum cable reach. See LMH0394 data sheet for specific threshold levels.
9	V _{EE} (Pin Mode) \overline{SS} (SPI Mode)	xCS	None. In Hardware Mode (MODE_SEL = 0), xCS must be tied to GND. In Software Mode (MODE_SEL = 1), xCS is the Chip Select complement pin.
10, 11	\overline{SDO} , SDO	SDON, SDOP	None
12	AUTO SLEEP (Pin Mode) MISO (SPI Mode)	MF1	None. In Hardware Mode (MODE_SEL = 0), MF1 functions as an AUTO SLEEP pin. In Software Mode (MODE_SEL = 1), MF1 functions as a MISO pin.
13	V _{CC}	V _{CC}	None. 2.5-V Supply
14	MUTE (Pin Mode) SCK (SPI Mode)	MF2	None. In Hardware Mode (MODE_SEL = 0), MF2 functions as a MUTE pin. In Software Mode (MODE_SEL = 1), MF2 functions as a SCK pin.
15	\overline{CD} (Pin Mode) MOSI (SPI Mode)	MF3	None. In Hardware Mode (MODE_SEL = 0), MF3 functions as an xSD signal detect pin. In Software Mode (MODE_SEL = 1), MF3 functions as a MOSI pin.
16	V _{CC}	V _{CC}	None. 2.5-V Supply

⁽¹⁾ LMH0394 Pin Mode is equivalent to M21564/M21664/M31564 Hardware Mode, and LMH0394 SPI Mode is equivalent to M21564/M21664/M31564 Software Mode.

4.3 External Component Differences

To replace the M21564/M21664/M31564, the following external component changes should be observed regarding the LMH0394:

COMPONENT(S)	CHANGE FROM...	CHANGE TO...
MUTE _{REF} Resistor Network	Leave as no connect for maximum cable reach. See LMH0394 data sheet for specific threshold levels.	
External Integration Capacitor	33 nF	No external cap required.

5 LMH0395 Pin Compatibility With M21544, M21644, M31544

5.1 Key Schematic Differences

Figure 4 and Figure 5 highlight key schematic differences between TI and MACOM drop-in compatible solutions in blue. For a detailed comparison of device pin functionality, refer to Section 5.2.

5.1.1 Pin Mode (Hardware Mode)

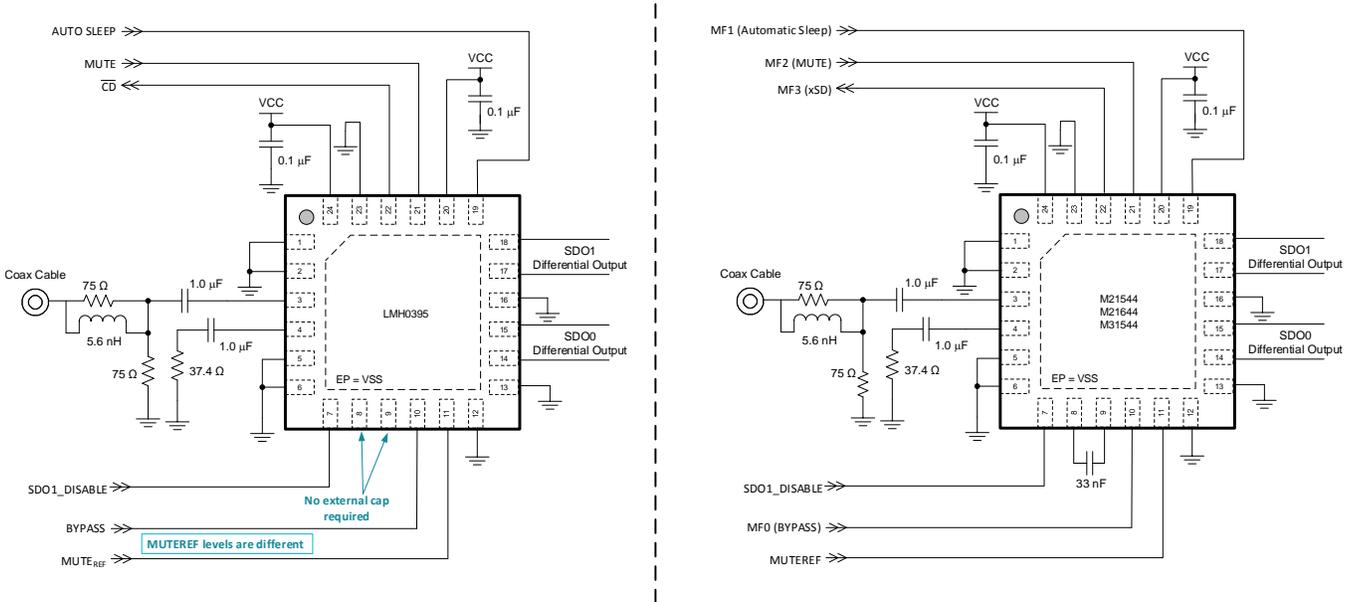


Figure 4. LMH0395 Pin Compatibility With M21544, M21644, M31544, Pin/Hardware Mode

5.1.2 SPI Mode (Software Mode)

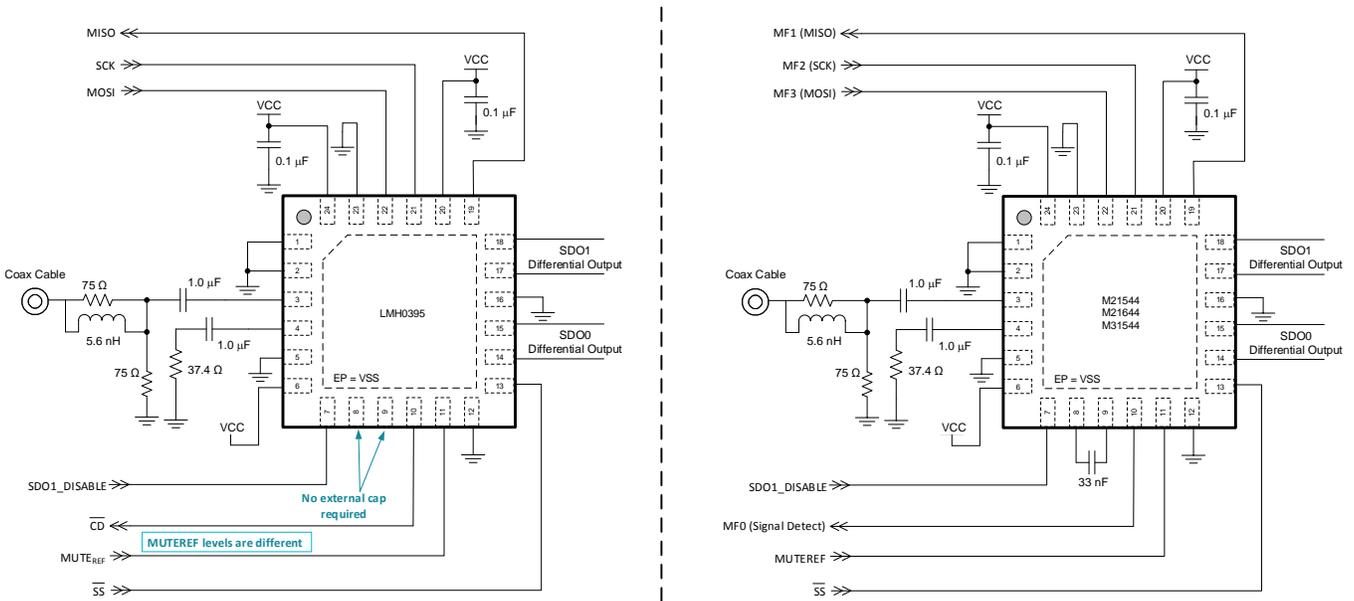


Figure 5. LMH0395 Pin Compatibility With M21544, M21644, M31544, SPI/Software Mode

5.2 Pin-By-Pin Comparison

PIN NO.	LMH0395 ⁽¹⁾	M21544 M21644 M31544	FUNCTIONAL DIFFERENCES AND NOTES
1, DAP	V _{EE}	V _{EE}	None
2	V _{EE}	V _{EE}	None
3, 4	SDI, SDI	SDIP, SDIN	None
5	V _{EE}	V _{EE}	None
6	SPI_EN	MODE_SEL	None. For comparison purposes, Pin Mode (TI) and Hardware Mode (MACOM) are identical terms. SPI Mode (TI) and Software Mode (MACOM) are also identical.
7	SDO1_DISABLE	SDO1_DISABLE	None
8, 9	AEC+, AEC-	AGC+, AGC-	LMH0395: Optional 1-μF integration capacitor (not required) M21544, M21644, M31544: 33-nF integration capacitor required
10	BYPASS (Pin Mode) CD (SPI Mode)	MF0	None. In Hardware Mode (MODE_SEL = 0), MF0 functions as a BYPASS pin. In Software Mode (MODE_SEL = 1), MF0 functions as a CD pin.
11	MUTE _{REF}	MUTEREF	LMH0395: Leave as no connect for maximum cable reach. See LMH0395 data sheet for specific threshold levels.
12	V _{EE}	V _{EE}	None
13	V _{EE} (Pin Mode) SS (SPI Mode)	xCS	None. In Hardware Mode (MODE_SEL = 0), xCS must be tied to GND. In Software Mode (MODE_SEL = 1), xCS is the Chip Select complement pin.
14, 15	SDO0, SDO0	SDO0N, SDO0P	None
16	V _{EE}	V _{EE}	None
17, 18	SDO1, SDO1	SDO1N, SDO1P	None
19	AUTO SLEEP (Pin Mode) MISO (SPI Mode)	MF1	None. In Hardware Mode (MODE_SEL = 0), MF1 functions as an AUTO SLEEP pin. In Software Mode (MODE_SEL = 1), MF1 functions as a MISO pin.
20	V _{CC}	V _{CC}	None. 2.5-V Supply
21	MUTE (Pin Mode) SCK (SPI Mode)	MF2	None. In Hardware Mode (MODE_SEL = 0), MF2 functions as a MUTE pin. In Software Mode (MODE_SEL = 1), MF2 functions as a SCK pin.
22	CD (Pin Mode) MOSI (SPI Mode)	MF3	None. In Hardware Mode (MODE_SEL = 0), MF3 functions as an xSD signal detect pin. In Software Mode (MODE_SEL = 1), MF3 functions as a MOSI pin.
23	V _{EE}	V _{EE}	None
24	V _{CC}	V _{CC}	None. 2.5-V Supply

⁽¹⁾ LMH0395 Pin Mode is equivalent to M21544/M21644/M31544 Hardware Mode, and LMH0395 SPI Mode is equivalent to M21544/M21644/M31544 Software Mode.

5.3 External Component Differences

To replace the M21544/M21644/M31544, the following external component changes should be observed regarding the LMH0395:

COMPONENT(S)	CHANGE FROM...	CHANGE TO...
MUTE _{REF} Resistor Network	Leave as no connect for maximum cable reach. See LMH0395 data sheet for specific threshold levels.	
External Integration Capacitor	33 nF	No external cap required.

6 LMH0324 3G-SDI Cable Equalizer for New Designs

For new 3G-SDI designs in the component-selection phase, TI recommends designing with the LMH0324. Using the LMH0324 enables an easy upgrade path to the LMH1219, a pin-compatible 12G-SDI cable equalizer with integrated reclocker. In addition, the LMH0324 offers lower power dissipation and improved cable reach compared to previous generation 3G-SDI cable equalizers, as shown in [Table 1](#).

Table 1. Belden 1694A Cable Reach Performance Comparison

FEATURES	LMH0324	LMH0395	M21644
3G Cable Reach, B1694A (m)	200	200	200
HD Cable Reach, B1694A (m)	280	220	200
SD Cable Reach, B1694A (m)	600	400	400

NOTE: The LMH0324 is *not* pin-compatible with the previously mentioned 3G-SDI devices (LMH0344, LMH0384, LMH0394, LMH0395).

Other advantages of the LMH0324 include the following:

- Lowest Power: 78 mW Typical
- Integrated Input and Output Terminations
- Integrated Return Loss Network
- Dual Output PCB Trace Drivers
- SMBus or SPI Control Programmability

For more information, visit the [LMH0324](#) product folder to request access to the full data sheet and other design documents.

7 Summary

TI offers a wide SDI portfolio with pin-compatible alternatives to MACOM 3G-SDI cable equalizer devices. With a few simple component changes to an existing SDI design and board layout, a MACOM 3G-SDI single or dual output cable equalizer can be replaced and improved with TI's pin-compatible 3G-SDI cable equalizers. For new 3G designs that are in the component selection phase, TI recommends the LMH0324 for improved performance and easy upgrade path to 12G.

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