Application Report
SNLA282–September 2017

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.

Contents

Trademarks

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 × 4 mm
LMH0394	M21564, M21664, M31564	Single Output EQ 16-Pin QFN 4 mm × 4 mm
LMH0395	M21544, M21644, M31544	Dual Output EQ 24-Pin QFN 4 mm × 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.

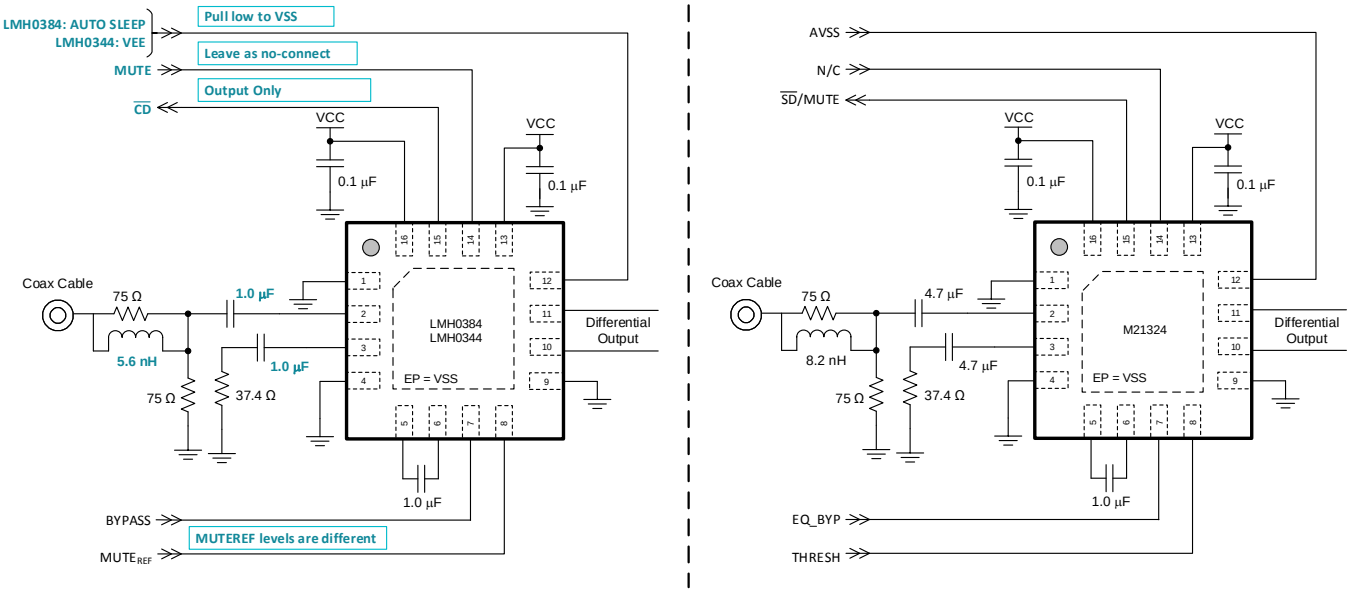

Figure 1. LMH0384, LMH0344 Pin Compatibility With M21324

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, $\overline{SDI}$	SDI, $\overline{SDI}$	None
4	LMH0384: SPI_EN LMH0344: V_{EE}	AV_{SS}	LMH0384: Pull to V_{EE} for compatibility.
5, 6	AEC+, AEC–	AGC, $\overline{AGC}$	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	$\overline{SDO}$, SDO	$\overline{SDO}$, 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	$\overline{CD}$	$\overline{SD}$/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 μF	1.0 μF
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)

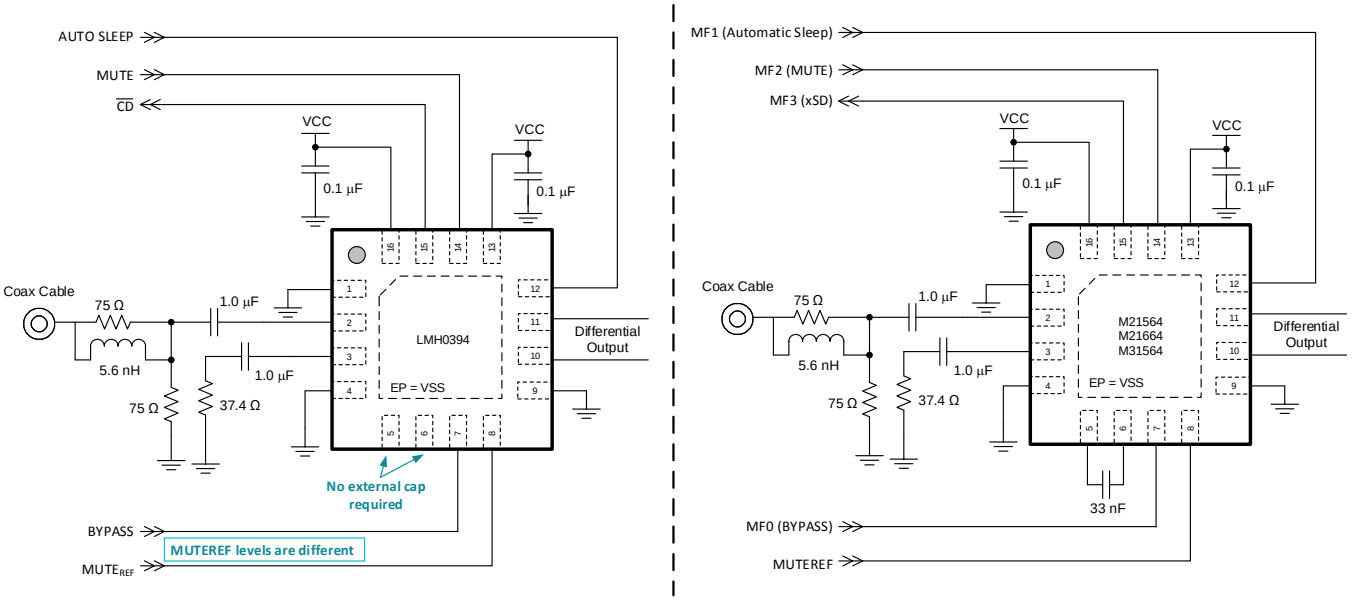

Figure 2. LMH0394 Pin Compatibility With M21564, M21664, M31564, Pin/Hardware Mode

4.1.2 SPI Mode (Software Mode)

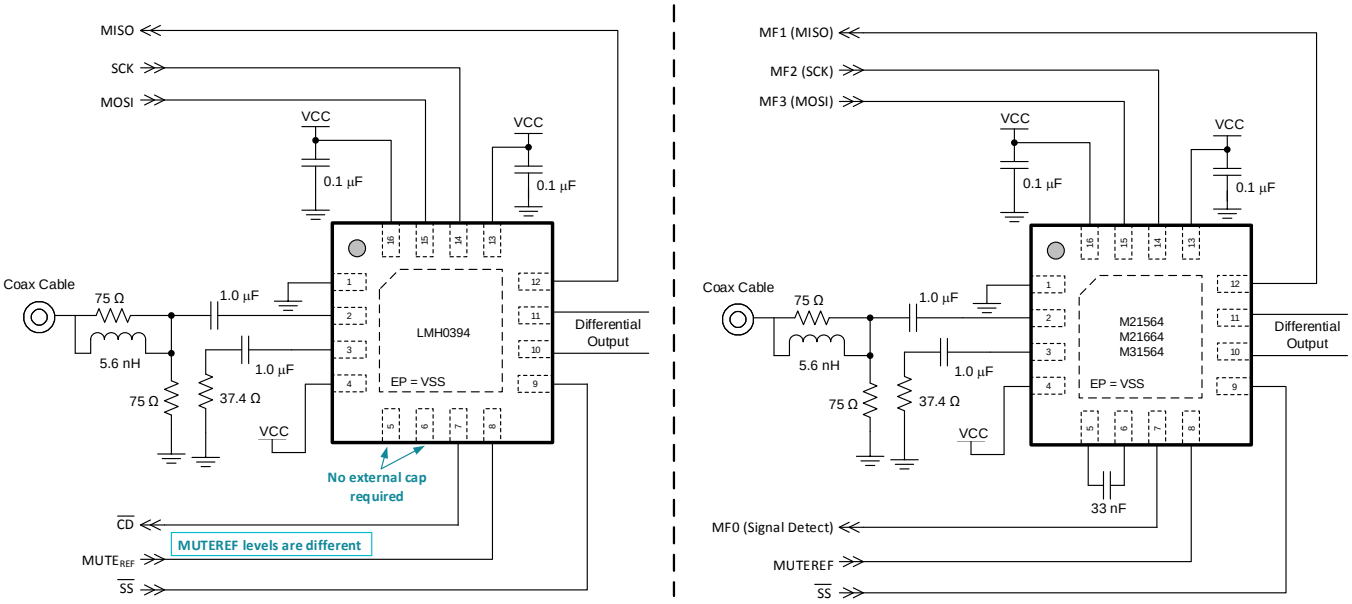

Figure 3. LMH0394 Pin Compatibility With M21564, M21664, M31564, SPI/Software Mode

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, $\overline{SDI}$	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)

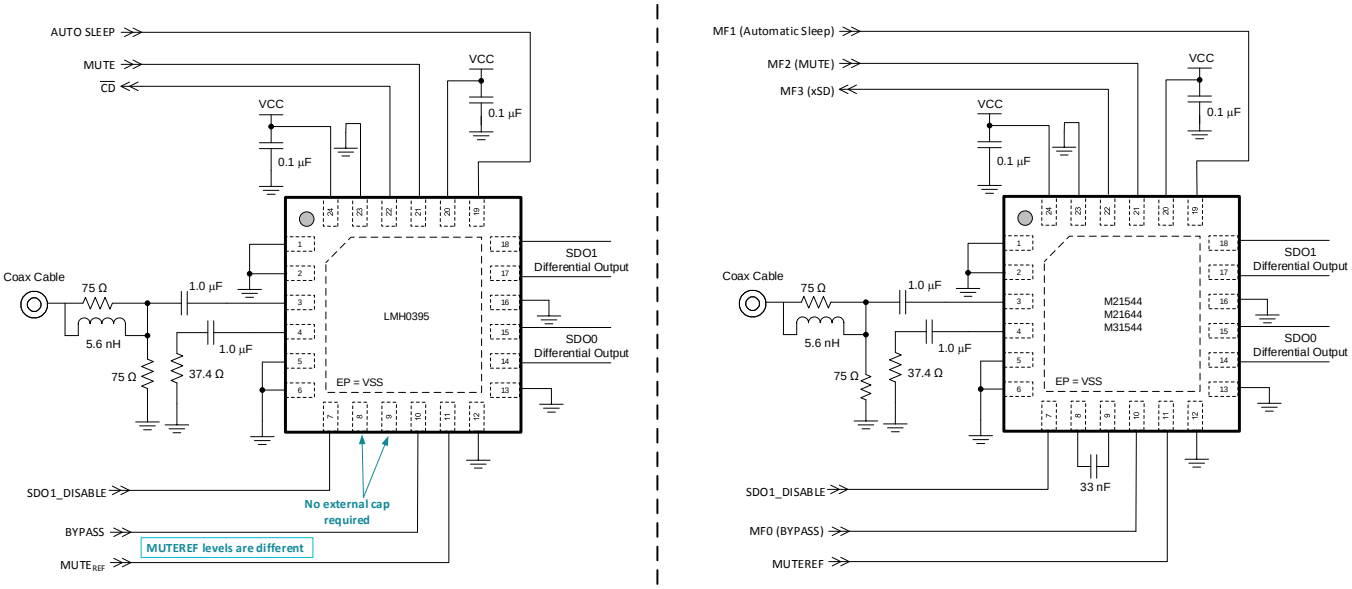

Figure 4. LMH0395 Pin Compatibility With M21544, M21644, M31544, Pin/Hardware Mode

5.1.2 SPI Mode (Software Mode)

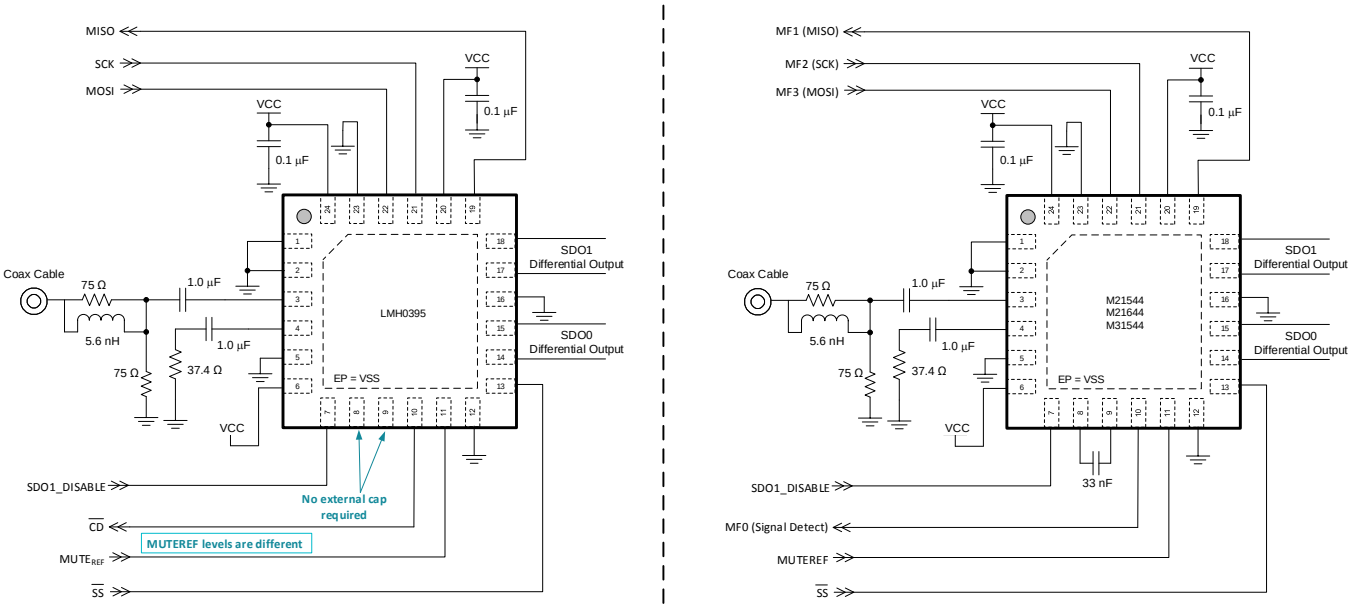

Figure 5. LMH0395 Pin Compatibility With M21544, M21644, M31544, SPI/Software Mode

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, $\overline{SDI}$	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) $\overline{CD}$ (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.
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) $\overline{SS}$ (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.
14, 15	$\overline{SDO0}$, SDO0	SDO0N, SDO0P	None
16	V_{EE}	V_{EE}	None
17, 18	$\overline{SDO1}$, 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	$\overline{CD}$ (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.
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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