

# M08048

## SD, HD, and 3G Cable Driver

The M08048 is a high-speed, low-power, low-jitter cable driver. It is designed to drive serial digital video data through a 75 Ω coaxial cable typically used in video applications. The M08048 cable driver is optimized for performance from 143 Mbps up to 2970 Mbps. The M08048 has selectable slew rates for SD-SDI and HD-SDI applications.

The typical output rise/fall time of the M08048 is 100 ps for HD and 3G rates. The device has a typical set slew rate of 600 ps at SD rates. The M08048 supports a maximum single ended output swing of 1600 mV<sub>PP</sub> when configured appropriately.

The device is packaged in a new high performance 3x3 mm QFN package to simplify the PCB and reduce package parasitics with resulting improvements in Output Return Loss (ORL). The device is available in an RoHS compliant package that is backward compatible with standard JEDEC SnPb processes.

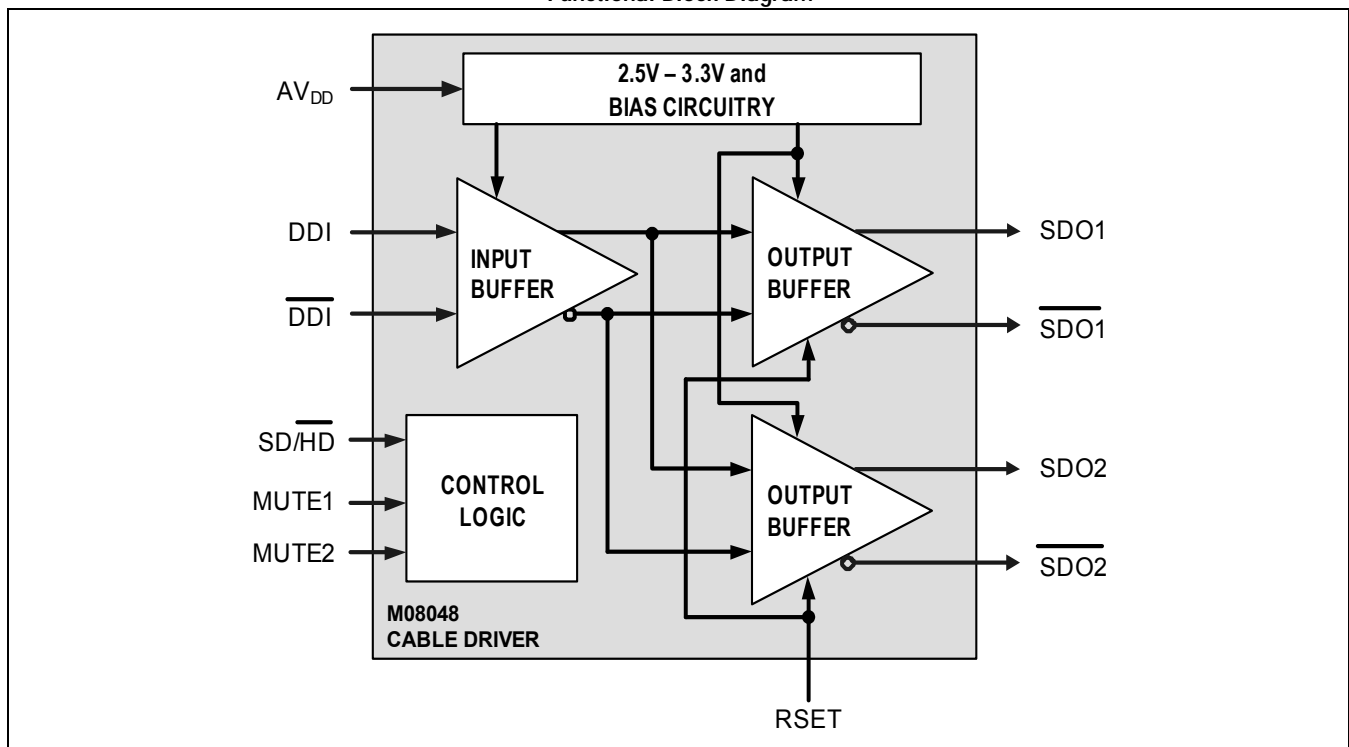
### Applications

- Surveillance/CCTV Cameras
- Industrial and Professional Cameras
- Digital Video Recorders (DVR)
- Video Mixers and Switchers
- Digital Image Transmitter Devices
- Distribution Amplifiers
- Repeaters

### Features

- 3G, HD and SD operation
- Dual Differential outputs, with individual mute control
- 800 mV<sub>PP</sub> single ended output swing (typical)
- 1600 mV<sub>PP</sub> maximum single ended output swing
- SD/HD slew rate control
- 2.5 V or 3.3 V supply
- Low P<sub>TOTAL</sub> (122 mW @ 2.5 V, 144 mW @ 3.3 V)
- RoHS compliant
- Small form factor (3x3 mm, 16-pin QFN package)

Functional Block Diagram



### Ordering Information

Part Number	Data Rates Supported	Package	Operating Temperature
M08048G-11*	143–2970 Mbps	3x3 mm QFN—16pins (RoHS compliant)	-10 °C to 85 °C

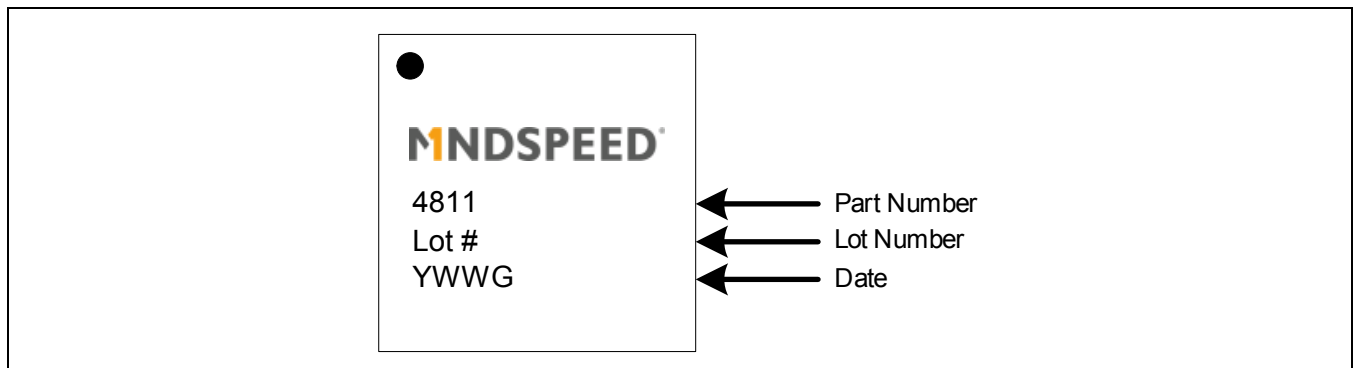
**NOTES:**

\* The letter 'G' designator after the part number indicates a RoHS-compliant package. Refer to [www.mindspeed.com](http://www.mindspeed.com) for additional information.

### Revision History

Revision	Level	Date	Description
B	Release	February 2012	Removed ASE packaging diagram.
A	Release	May 2011	Initial Release.

### Marking Diagram





# Table of Contents

---

Ordering Information	2
Revision History	2
Table of Contents	3
List of Figures	4
List of Tables	5
1.0 Electrical Characteristics	6
2.0 Pinout Diagram, Pin Descriptions, and Package Outline Drawing	10
2.1 Pin Descriptions	11
2.2 Package Drawing	12
2.3 Manufactureability	13
2.3.1 Electrostatic Discharge	13
2.3.2 Peak Reflow Temperature	13
3.0 Functional Description	14
3.1 Features	14
3.1.1 HD-SDI and SD-SDI Slew-rate Selection	14
3.1.2 Output Amplitude Adjustment	14
3.2 Pin Definitions	15
3.2.1 High-speed Inputs	15
3.2.2 High-speed Outputs	16
Appendix	17
A.1 Glossary of Terms/Acronyms	17
A.2 Reference Documents	18
A.2.1 External	18



# List of Figures

---

Figure 1-1.	Output Symbols Definition	9
Figure 2-1.	M08048 Pin Out	10
Figure 2-2.	M08048 Packaging Details—Amkor	12
Figure 3-1.	Typical Input Circuit—AC Coupled	15
Figure 3-2.	Typical Input Circuit—DC Coupled	15
Figure 3-3.	Output Matching/Back-termination Circuit (Both Outputs Used)	16
Figure 3-4.	Output Matching/Back-termination Circuit (Only One Output Used)	16



# List of Tables

---

Table 1-1.	Absolute Maximum Ratings	6
Table 1-2.	Recommended Operating Conditions	6
Table 1-3.	Power DC Electrical Specifications	7
Table 1-4.	CMOS Input Electrical Specifications	7
Table 1-5.	High-Speed Input Electrical Specifications	8
Table 1-6.	Cable Driver Output Electrical Specifications	8
Table 2-1.	Interface Pins	11
Table 2-2.	Power Pins	11
Table 2-3.	High-speed Signal Pins	11
Table 2-4.	Control Pins	11
Table 3-1.	Output Swing vs. Supply and Termination Voltage	14



# 1.0 Electrical Characteristics

**Table 1-1. Absolute Maximum Ratings**

Symbol	Parameter	Minimum	Maximum	Units
$V_{DD}$	Power	$AV_{SS} - 0.5$	$AV_{SS} + 3.47$	V
$V_{MAX, IO}$	Maximum/minimum input/output voltage on any input/output pin	$AV_{SS} - 0.5$	$AV_{DD} + 0.5$	V
$T_{STORE}$	Storage Temperature	-65	+150	°C
$V_{ESD, HBM}$	Human Body Model	2000	—	V
$V_{ESD, CDM}$	Charge Device Model	500	—	V

**NOTE:**  
1. No Damage.

**Table 1-2. Recommended Operating Conditions**

Symbol	Parameter	Notes	Minimum	Typical	Maximum	Units
$AV_{DD}$	$AV_{DD}$ Power	—	2.37	2.5/3.3	3.46	V
$AV_{SS}$	$AV_{SS}$ Ground	—	—	0	—	V
$T_A$	Ambient Temperature	—	-10	—	+85	°C
$\theta_{JA}$	Junction to ambient Thermal Resistance	1, 2	—	75	—	°C/W
$AV_{TERM}$	75 $\Omega$ Output Termination Voltage	See <a href="#">Table 3-1</a> .				

**NOTES:**  
1. Solder exposed underbody paddle with an array of thermal vias to optimize junction to ambient thermal resistance. Refer to Amkor Application Note (see [Section A.2.1](#)).  
2. Mounted on a multi layer board ( $\geq 4$  layers), airflow = 0.0 m/s.

**Table 1-3. Power DC Electrical Specifications**

Symbol	Parameter	Notes	Minimum	Typical	Maximum	Units
$I_{DD}$	Supply Current (one output enabled)	1, 2	—	27	36	mA
$I_{DD}$	Supply Current (two outputs enabled)	1, 2	—	48	—	mA
$I_{TERM}$	Current in external termination resistors	1, 2, 3	—	22	—	mA
$P_{TOTAL}$	Power dissipation ( $AV_{DD} = 2.5\text{ V}$ , $AV_{DDTERM} = 3.3\text{ V}$ )	1, 2, 4, 6	—	122	—	mW
$P_{TOTAL}$	Power dissipation ( $AV_{DD} = 2.5\text{ V}$ , $AV_{DDTERM} = 3.3\text{ V}$ )	1, 2, 5, 6	—	156	—	mW
$P_{TOTAL}$	Power dissipation ( $AV_{DD} = 2.5\text{ V}$ , $AV_{DDTERM} = 5.0\text{ V}$ )	1, 2, 4, 6	—	159	—	mW
$P_{TOTAL}$	Power dissipation ( $AV_{DD} = 2.5\text{ V}$ , $AV_{DDTERM} = 5.0\text{ V}$ )	1, 2, 5, 6	—	194	—	mW
$P_{TOTAL}$	Power dissipation ( $AV_{DD} = 3.3\text{ V}$ , $AV_{DDTERM} = 3.3\text{ V}$ )	1, 2, 4, 6	—	144	—	mW
$P_{TOTAL}$	Power dissipation ( $AV_{DD} = 3.3\text{ V}$ , $AV_{DDTERM} = 3.3\text{ V}$ )	1, 2, 5, 6	—	195	—	mW
$P_{TOTAL}$	Power dissipation ( $AV_{DD} = 3.3\text{ V}$ , $AV_{DDTERM} = 5.0\text{ V}$ )	1, 2, 4, 6	—	181	—	mW
$P_{TOTAL}$	Power dissipation ( $AV_{DD} = 3.3\text{ V}$ , $AV_{DDTERM} = 5.0\text{ V}$ )	1, 2, 5, 6	—	232	—	mW

**NOTES:**

1. Recommended operating conditions — see [Table 1-2](#).
2. 800 mV<sub>pp</sub> standard swing, terminated as in [Figure 3-3](#).
3. A portion of the power will be dissipated in the external 750ohm termination ( $P_{EXT} = V_{OD} \times I_{TERM}$ ).
4. One Output Enabled.
5. Two Outputs Enabled.
6. Does not include off-chip power dissipated by termination resistors.

**Table 1-4. CMOS Input Electrical Specifications**

Symbol	Parameter	Notes	Minimum	Typical	Maximum	Units
$V_{IH}$	Input Logic High Voltage	1	$0.75 \times AV_{DD}$	—	$AV_{DD} + 0.3$	V
$V_{IL}$	Input Logic Low Voltage	1	0	—	$0.25 \times AV_{DD}$	V
$I_{IH}$	Input Current (logic High)	1	-100	—	100	μA
$I_{IL}$	Input Current (logic Low)	1	-100	—	100	μA

**NOTE:**

1. Specified at recommended operating conditions — see [Table 1-2](#).

**Table 1-5. High-Speed Input Electrical Specifications**

Symbol	Parameter	Notes	Minimum	Typical	Maximum	Units
DR	Input Bit Rate (M08048)	1, 2	0	—	2970	Mbps
V <sub>IN</sub>	Input Differential Voltage	1, 3, 4	100	—	2000	mV <sub>PPD</sub>
V <sub>ICM</sub>	Input Common-Mode Voltage	1	1200	—	AV <sub>DD</sub>	mV
V <sub>IH</sub>	Maximum Input High Voltage	1	—	—	AV <sub>DD</sub> + 400	mV
V <sub>IL</sub>	Minimum Input Low Voltage	1	1.2	—	—	V
R <sub>IN</sub>	Single-ended input impedance	1	—	13.33	20	kΩ

**NOTES:**

1. Specified at recommended operation conditions — see [Table 1-2](#).
2. Part is DC coupled at the input.
3. Example 1200 mV<sub>PPD</sub> = 600 mV<sub>PP</sub> for each single-ended terminal.
4. Minimum input level defined as BER ≤ 10<sup>-12</sup>.

**Table 1-6. Cable Driver Output Electrical Specifications**

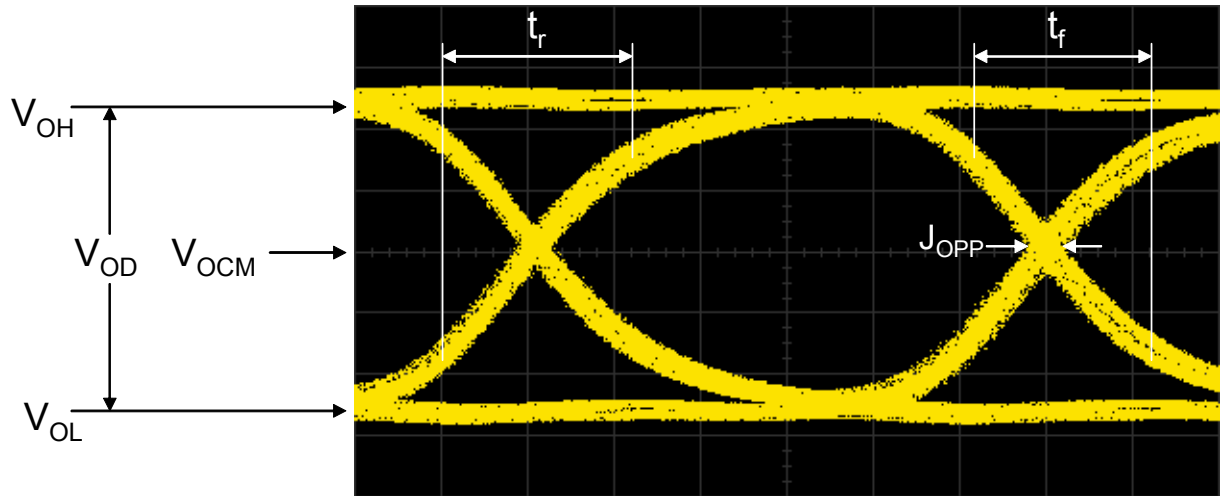
Symbol	Parameter	Notes	Minimum	Typical	Maximum	Units
DR	Output Bit Rates	1, 5	—	—	2970	Mbps
t <sub>R</sub> /t <sub>F</sub>	SD Rise/Fall Time (20–80%)	1, 3, 5	400	600	800	ps
	HD/3G Rise/Fall Time (20–80%)	1, 3, 5	—	100	135	ps
t <sub>R</sub> /t <sub>F</sub> Δ	Rise/fall mismatch (HD/3G Rate)	1, 2, 5	—	10	30	ps
	Rise/fall mismatch (SD Rate)	1, 2, 5	—	40	100	ps
V <sub>OUT, SE</sub>	Single-ended voltage swing	1, 2, 4, 5	500	800	1600	mV <sub>PP</sub>
V <sub>PP, TOL</sub>	Swing Level output variation at 800 mV <sub>PP</sub> [RSET = 750 Ω ± 1%] (Single-Ended)	1, 2, 3, 5	-7	—	+7	%
V <sub>OVER/UNDER</sub>	Overshoot/Undershoot	1, 2, 5	-10	—	+10	%
t <sub>JIT</sub>	Additive Output Jitter (HD/3G rate)	1, 5, 8	—	20	30	ps
	Additive Output Jitter (SD rate)	1, 5, 8	—	40	60	ps
DCD <sub>0</sub>	Duty Cycle Distortion (HD/3G Rate)	1, 2, 5, 6, 8	—	15	30	ps
	Duty Cycle Distortion (SD Rate)	1, 2, 5, 6, 8	—	20	70	ps
S <sub>22</sub>	Output Return Loss (5 MHz to 1.5 GHz)	1, 2, 5, 7	15	—	—	dB
S <sub>22</sub>	Output Return Loss (1.5 GHz to 3.0 GHz)	1, 2, 5, 7	10	—	—	dB

**NOTES:**

1. Entire table specified at recommended operating condition with 400 mV<sub>PPD</sub> input — see [Table 1-2](#).
2. Specification verified at 800 mV<sub>PP</sub> output with 1 m cable on MSPD test board. System results may vary.
3. Rated at 800 mV<sub>PP</sub> output swing (using a 750 Ω ± 1% resistor at RSET).
4. Output stage is an open collector differential pair, actual swing dependant on IC supply voltage and external termination voltage.
5. Into 75 Ω back termination and 75 Ω load and appropriate external termination voltage, see [Table 3-1](#), [Figure 3-3](#).
6. Duty Cycle Distortion (DCD) is defined as the difference in the intrinsic jitter at the 50% voltage level and the intrinsic jitter at the rising/falling edge crossing point. If the rising/falling edge crossing point is at the 50% voltage level, then DCD = 0.
7. Measured under DC conditions that simulate AC coupling, V<sub>T</sub> = 3.3 V.
8. Measured using a “1010” data pattern.



Figure 1-1. Output Symbols Definition



- $V_{OH}$ : Average voltage high level
- $V_{OL}$ : Average voltage low level
- $V_{OD}$ :  $(V_{OH}) - (V_{OL})$
- $V_{OCM}$ : Common Mode Voltage
- $J_{OPP}$ : Output Jitter Peak-Peak
- $t_r$ : 20-80% Rise Time
- $t_f$ : 80-20% Fall Time

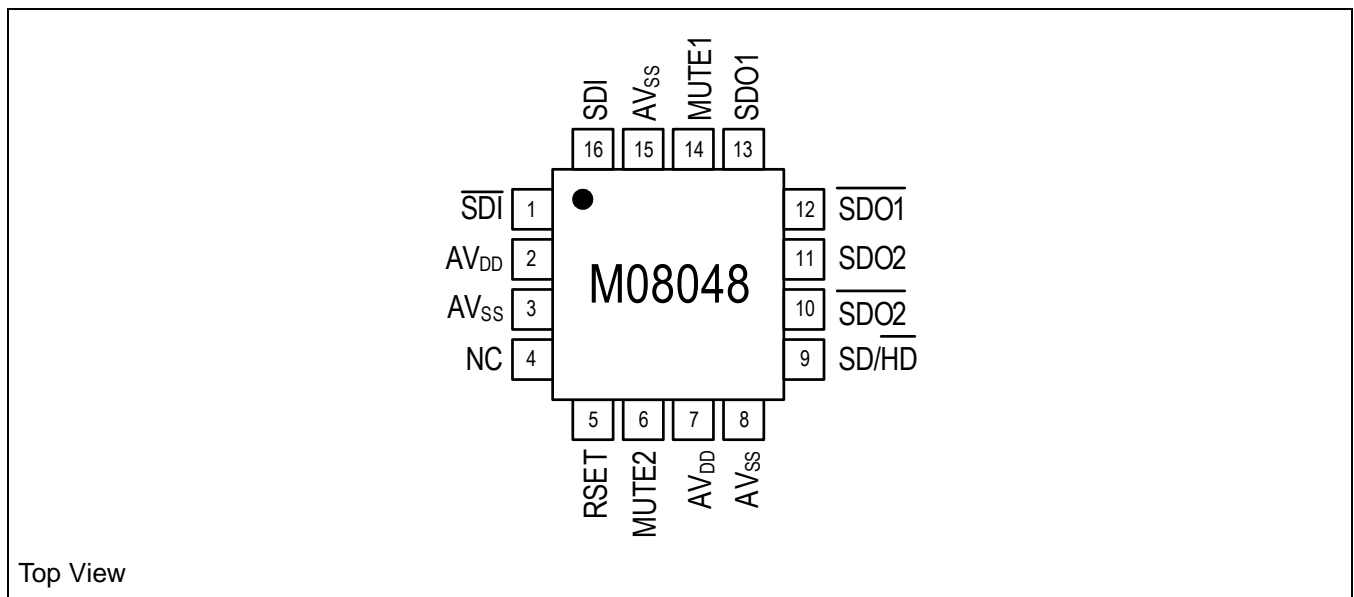
**NOTE:** Waveform above is differential.



## 2.0 Pinout Diagram, Pin Descriptions, and Package Outline Drawing

The M08048 is available in a 16-pin, 3x3 mm QFN IC package. The pinout is shown in [Figure 2-1](#).

**Figure 2-1. M08048 Pin Out**



## 2.1 Pin Descriptions

**Table 2-1. Interface Pins**

Pin Name	Pin #	Function	Default	Type
RSET	5	Input control signal for setting the single-ended output swing amplitude. Higher output swing levels or reduced variations with a $\pm 1\%$ tolerance external resistor. For 800 mV <sub>pp</sub> single-ended, a 750 $\Omega$ $\pm 1\%$ resistor to AV <sub>DD</sub> is recommended.	—	Analog Input

**Table 2-2. Power Pins**

Pin Name	Pin #	Function	Type
AV <sub>SS</sub>	3, 8, 15	Ground	Power
AV <sub>DD</sub>	2, 7	Positive Supply	Power
NC	4	Do not connect.	N/A

**Table 2-3. High-speed Signal Pins**

Pin Name	Pin #	Function	Default	Type
DDI/ $\overline{\text{DDI}}$	16, 1	Non-inverting and Inverting serial externally terminated inputs.	—	CML input
SD02/ $\overline{\text{SD02}}$	11, 10	Non-inverting and inverting serial unterminated data outputs to coaxial cable.	—	CML output
SD01/ $\overline{\text{SD01}}$	13, 12	Non-inverting and inverting serial unterminated data outputs to coaxial cable.	—	CML output

**Table 2-4. Control Pins**

Pin Name	Pin #	Function	Default	Type
MUTE2	6	A high mutes $\overline{\text{SD02/SD02}}$ outputs, low enables SD02/ $\overline{\text{SD02}}$ .	Pull-up	CMOS input
MUTE1	14	A high mutes $\overline{\text{SD01/SD01}}$ outputs, low enables SD01, $\overline{\text{SD01}}$ .	Pull-down	CMOS input
SD/ $\overline{\text{HD}}$	9	Input control signal to change the output slew rate. SD/ $\overline{\text{HD}}$ = High: Slow output slew rate for SD-SDI rate (143–540 Mbps). SD/ $\overline{\text{HD}}$ = Low: Fast output slew rate for HD and 3G-SDI rate.	Pull-up	CMOS input

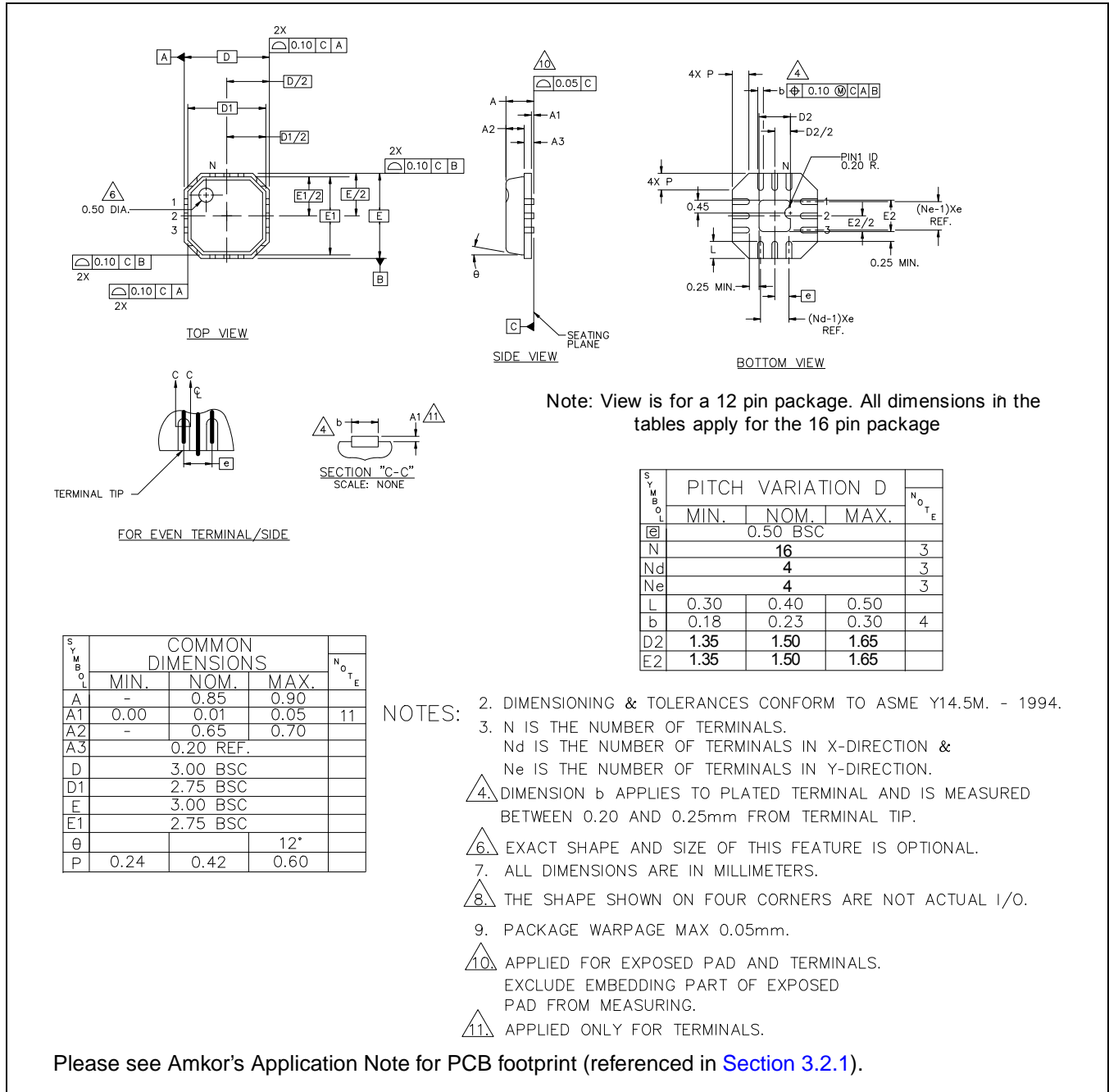
**NOTES:**

Internal pull-ups/pull-downs are 100 k $\Omega$ .

## 2.2 Package Drawing

The package for the M08048 is illustrated in [Figure 2-2](#) below.

**Figure 2-2. M08048 Packaging Details—Amkor**



## 2.3 Manufactureability

The values shown in this section may change; however, these are standard requirements.

### 2.3.1 Electrostatic Discharge

Tested per JESD22-A114. This device passes 2000 V of ESD Human Body Model (HBM) testing.

Tested per JESD22-C101. This device passes 500 V of ESD Charged Device Model (CDM) testing.

Tested per EIA/JESD78. This device passes 150 mA of trigger current at 85 °C during Latchup testing.

### 2.3.2 Peak Reflow Temperature

M08048G (RoHS compliant package): Peak reflow temperature is 260 °C per JEDEC standards.



## 3.0 Functional Description

---

### 3.1 Features

#### 3.1.1 HD-SDI and SD-SDI Slew-rate Selection

The output slew rate of the M08048 is selectable to conform with the different SD-SDI and HD-SDI specifications. The slew rate will vary depending on the output matching network and connector used.

With **SD/HD** = High, the rise/fall time is typically 600 ps. With SD/HD = Low, rise/fall time is typically 100 ps.

#### 3.1.2 Output Amplitude Adjustment

An external  $750\ \Omega \pm 1\%$  resistor at **RSET** to **AV<sub>DD</sub>** is recommended for a swing level of 800 mV<sub>PP</sub> within a tolerance that is less than  $\pm 10\%$ . The output amplitude can also be adjusted to range from 500 to 1600 mV<sub>PP</sub> single ended using the following formula:

$$\text{Output Swing} = (600/\text{RSET}) [\text{RSET in k}\Omega] \text{ (in mV}_{PP} \text{ Single Ended)}$$

The actual swing is set as a function of the IC supply voltage, the external termination voltage and the limitations are shown in [Table 3-1](#). In applications where lossy matching or splitting networks are used, the M08048 offers additional gain of up to 1600 mV<sub>PP</sub> swings. When using swings in excess of 1200 mV<sub>PP</sub>, there will be an increase in rise and fall times.

**Table 3-1. Output Swing vs. Supply and Termination Voltage**

AV <sub>DD</sub> (V)	AV <sub>DDTERM</sub> (V)	Maximum Swing (Single-ended mV <sub>PP</sub> )	Minimum Swing (Single-ended mV <sub>PP</sub> )
2.5–3.3	3.3	1200	500
2.5–3.3	5.0	1600	500

## 3.2 Pin Definitions

### 3.2.1 High-speed Inputs

The M08048 is designed to be operated with input signals as low as 100 mV<sub>PPD</sub> or up to 2000 mV<sub>PPD</sub>. The M08048 uses external 50 Ω input termination resistors to match 100 Ω differential impedance transmission lines for improved system level performance. The M08048 recommended input circuits are shown in Figure 3-1.

Note that AC coupling is not required when the M08048 is driven by Mindspeed digital video devices.

Figure 3-1. Typical Input Circuit—AC Coupled

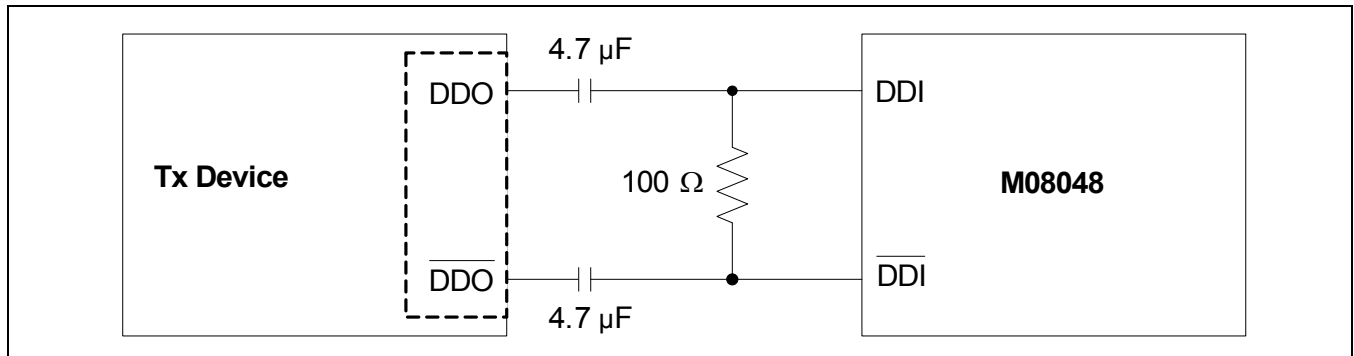
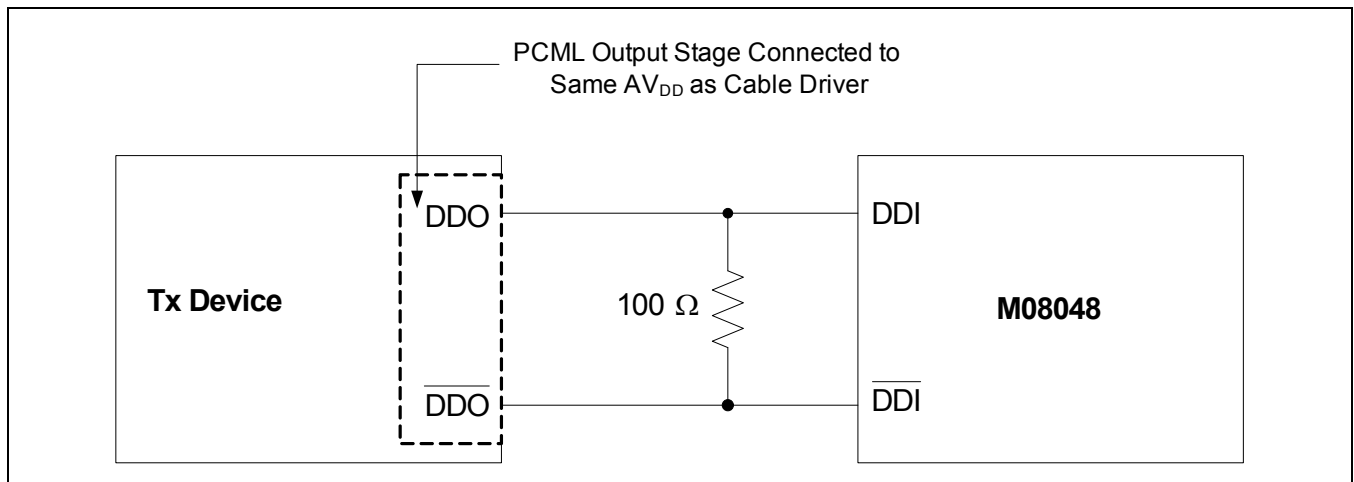


Figure 3-2. Typical Input Circuit—DC Coupled

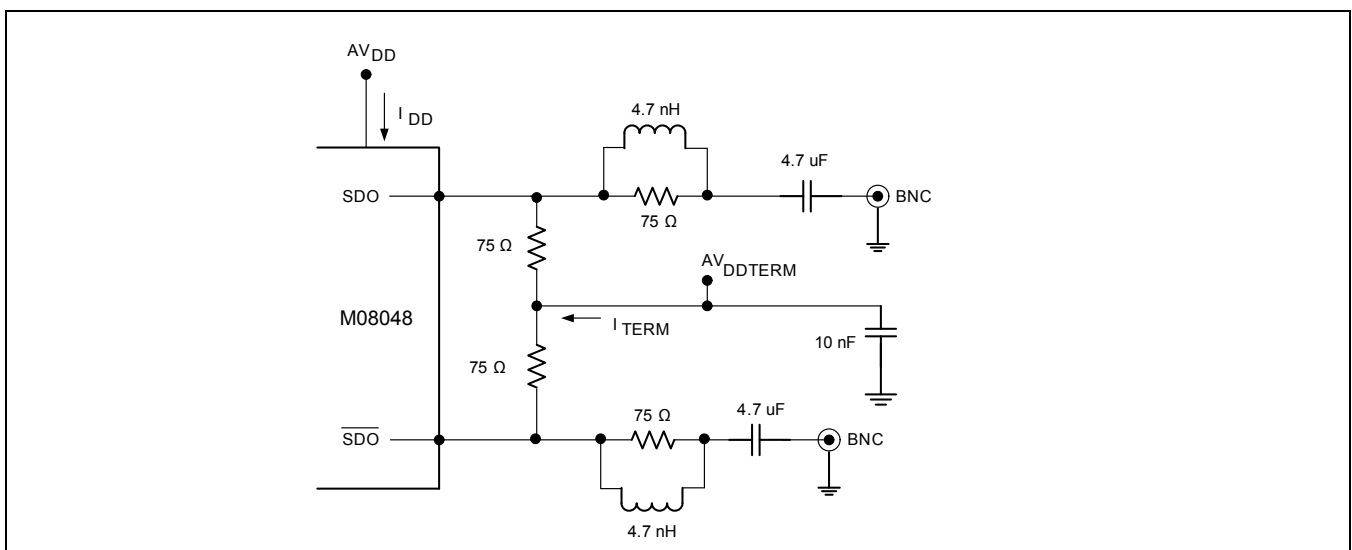


### 3.2.2 High-speed Outputs

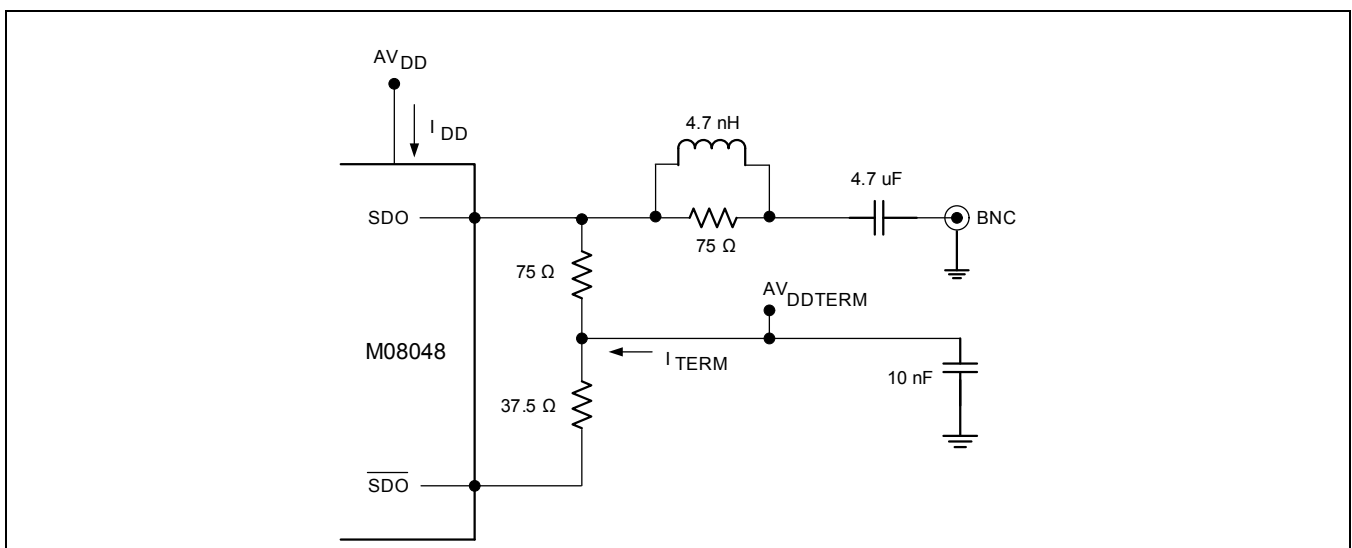
The M08048 output buffer is an open collector buffer that is designed for a return loss of 15 dB at SD and HD rates and 10 dB at 3G rates, using standard through-hole BNC connectors. A typical output matching circuit is shown in Figure 3-3. The Output Return Loss (ORL) is dependent on many factors such as the value and type of components used, PCB layout, PCB trace lengths, and type of PCB di-electric, therefore, the recommendations in the figure below should be used as starting guidelines only. Different output matching network topologies and different component values will result in different ORL performance.

The actual maximum output of the part depends on the applied IC voltage as well as the external termination voltage for the load termination. The limitations are discussed in Section 3.1.

**Figure 3-3. Output Matching/Back-termination Circuit (Both Outputs Used)**



**Figure 3-4. Output Matching/Back-termination Circuit (Only One Output Used)**







# Appendix

---

## A.1 Glossary of Terms/Acronyms

BER	Bit Error Rate
CD	Cable Driver
CDA	Cable Distribution Amplifier
CML	Current Mode Logic
CMOS	Complementary Metal Oxide Semiconductor
DPLL	Digital Phase Locked Loop
EMI	Electro Magnetic Interference
EQ	Equalizer or Equalization
GREEN	Environmentally friendly
HD	High Definition
HW	Hardware
IC	Integrated Circuit
ID	Identifier
I/O	Input/Output
PCB	Printed Circuit Board
QFN	Quad Flat No Lead
ORL	Output Return Loss
RoHS	Restriction of Hazardous Substances
SD	Standard Definition
SDI	Serial Digital Input
SDO	Serial Digital Output
SE	Single Ended

## A.2 Reference Documents

### A.2.1 External

The following external documents were referenced in this data sheet.

- Application Notes for Surface Mount Assembly of Amkor's Packages
- Amkor Technology Thermal Test Report TT-00-06 (See <http://www.amkor.com> for detailed information)

[www.mindspeed.com](http://www.mindspeed.com)

General Information:  
Telephone: (949) 579-3000  
Headquarters - Newport Beach  
4000 MacArthur Blvd., East Tower  
Newport Beach, CA 92660

© 2011 - 2012 Mindspeed Technologies®, Inc. All rights reserved.

Information in this document is provided in connection with Mindspeed Technologies® ("Mindspeed®") products. These materials are provided by Mindspeed as a service to its customers and may be used for informational purposes only. Except as provided in Mindspeed's Terms and Conditions of Sale for such products or in any separate agreement related to this document, Mindspeed assumes no liability whatsoever. Mindspeed assumes no responsibility for errors or omissions in these materials. Mindspeed may make changes to specifications and product descriptions at any time, without notice. Mindspeed makes no commitment to update the information and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to its specifications and product descriptions. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document.

THESE MATERIALS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MINDSPEED PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, CONSEQUENTIAL OR INCIDENTAL DAMAGES, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. MINDSPEED FURTHER DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. MINDSPEED SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS, WHICH MAY RESULT FROM THE USE OF THESE MATERIALS.

Mindspeed products are not intended for use in medical, lifesaving or life sustaining applications. Mindspeed customers using or selling Mindspeed products for use in such applications do so at their own risk and agree to fully indemnify Mindspeed for any damages resulting from such improper use or sale.