



## GS9074A HD-LINX® II Adaptive Cable Equalizer

### Features

- SMPTE 259M compliant
- Automatic cable equalization
- Multi-standard operation from 143Mb/s to 360Mb/s
- Supports DVB-ASI at 270Mb/s
- Small footprint (4mm x 4mm)
- Pb-free and RoHS compliant
- Manual bypass (useful for low data rates with slow rise/fall times)
- Performance optimized for 270Mb/s
- Typical maximum equalized length of Belden 1694A cable: 350m at 270Mb/s
- 50Ω differential output (with internal 50Ω pull-ups)
- Manual output mute or programmable mute based on max cable length adjust
- Single 3.3V power supply operation
- Operating temperature range: 0°C to +70°C

### Applications

- SMPTE 259M Coaxial Cable Serial Digital Interfaces

### Description

The GS9074A is a second-generation high speed BiCMOS integrated circuit designed to equalize and restore signals received over 75Ω co-axial cable.

The GS9074A is designed to support SMPTE 259M, and is optimized for performance at 270Mb/s.

The GS9074A features DC restoration to compensate for the DC content of SMPTE pathological test patterns.

A voltage programmable mute threshold (MCLADJ) is included to allow muting of the GS9074A output when an approximate selected cable length is reached for SMPTE 259M signals. This feature allows the GS9074A to distinguish between low amplitude SD-SDI signals and noise at the input of the device. The serial digital outputs of the GS9074A may be forced to a mute state by applying a voltage to the MUTE pin.

Power consumption is typically 215mW using a 3.3V power supply. The GS9074A is lead-free, and the encapsulation compound does not contain halogenated flame retardant (RoHS compliant).

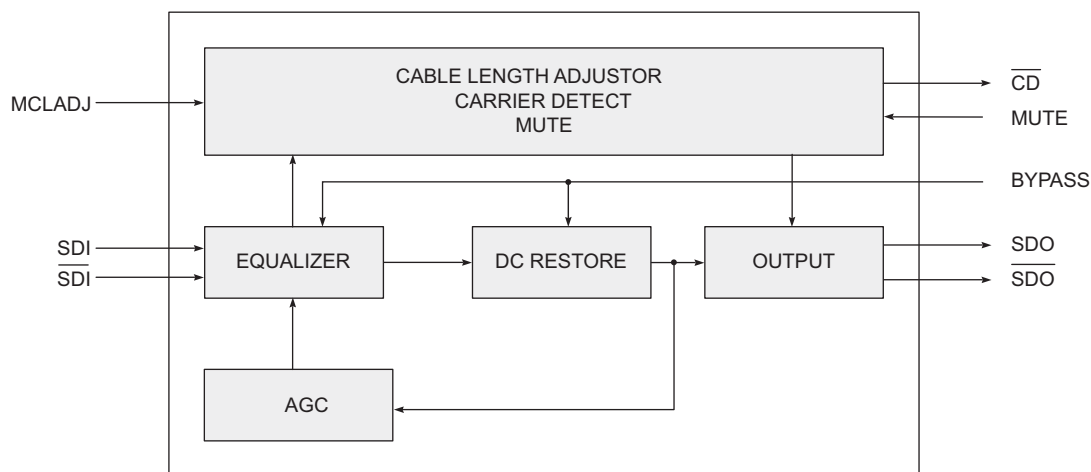


Figure A: GS9074A Functional Block Diagram

## Revision History

Version	ECR	PCN	Date	Changes and/or Modifications
5	157362	–	December 2011	Added 250pc tape & reel part number to <a href="#">Table 8-2: Ordering Information</a> .
4	153754	–	November 2009	Updated to latest Gennum template.
3	139635	38695	March 2006	Corrected pad standoff height and tolerances for pad width and package dimension. Corrected pad shape.
2	138357	37278	November 2005	Converted to Data Sheet.
1	137888	–	September 2005	Corrected process to BiCMOS.
0	136165	–	March 2005	Converted to Preliminary Data Sheet. Updated typical application circuit. Updated Input/Output circuits. Updated AC and DC electrical characteristics. Updated description of MUTE and $\overline{CD}$ functionality. Corrected minor typing errors. Updated center pad dimensions on PCB footprint.
A	135927	–	February 2005	New document.

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# 1. Pin Out

## 1.1 GS9074A Pin Assignment

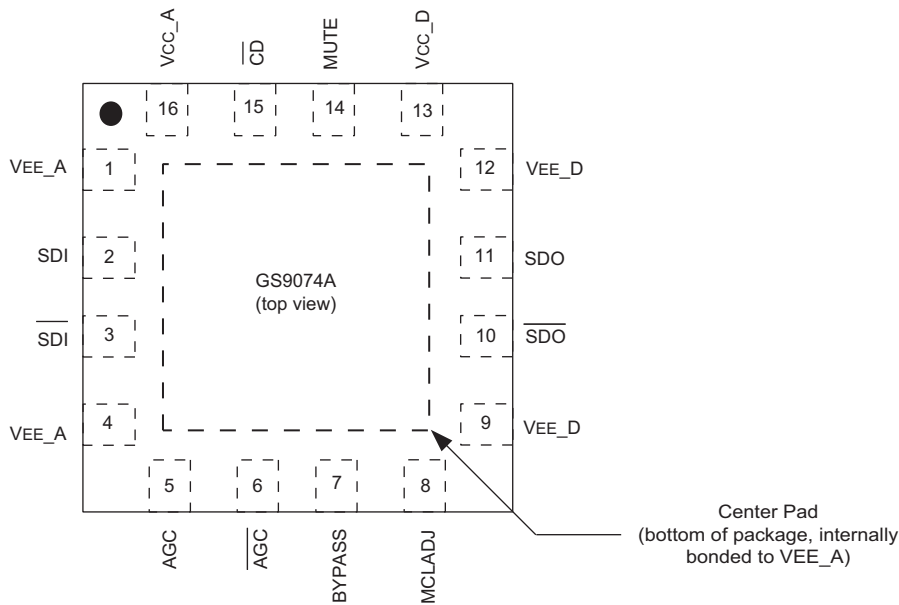


Figure 1-1: 16-Pin QFN

## 1.2 GS9074A Pin Descriptions

Table 1-1: Pin Descriptions

Pin Number	Name	Timing	Type	Description
1, 4	VEE_A	Analog	Power	Most negative power supply for analog circuitry. Connect to GND.
2, 3	SDI, $\overline{\text{SDI}}$	Analog	Input	Serial digital differential input.
5, 6	AGC, $\overline{\text{AGC}}$	Analog	–	External AGC capacitors. (See Section 7.1 Typical Application Circuit.)
7	BYPASS	Not Synchronous	Input	Forces the Equalizing and DC RESTORE stages into bypass mode when HIGH. No equalization occurs in this mode.
8	MCLADJ	Analog	Input	Maximum cable length adjust. Adjusts the approximate maximum amount of cable to be equalized (from 0m to the maximum cable length). The output is muted (latched to the last state) when the maximum cable length is achieved. NOTE: MCLADJ is only recommended for data rates up to 270Mb/s.

**Table 1-1: Pin Descriptions (Continued)**

Pin Number	Name	Timing	Type	Description
9	VEE_D	Analog	Power	Most negative power supply for the digital circuitry and output buffer. Connect to GND.
10, 11	$\overline{SDO}$ , SDO	Analog	Output	Equalized serial digital differential output.
12	VEE_D	Analog	Power	Most negative power supply for the digital circuitry and output buffer. Connect to GND.
13	VCC_D	Analog	Power	Most positive power supply for the digital I/O pins of the device. Connect to +3.3V DC.
14	MUTE	Not Synchronous	Input	CONTROL SIGNAL INPUT levels are LVCMOS/LVTTL compatible. (3.3V Tolerant) (Internal pull down resistor) When the MUTE pin is set HIGH by the application interface, the serial digital output of the device will be forced to a steady state. When the MUTE pin is set LOW, the serial digital output of the device will be active. NOTE: This pin may be connected directly to the $\overline{CD}$ pin to allow mute on loss of carrier.
15	CD	Not Synchronous	Output	STATUS SIGNAL OUTPUT Signal levels are LVCMOS/LVTTL compatible. Indicates the presence of a good input signal. When the $\overline{CD}$ pin is LOW, a good input signal has been detected. When this pin is HIGH, the input signal is invalid. This pin will indicate loss of carrier for data rates > 19Mb/s.
16	VCC_A	Analog	Power	Most positive power supply for the analog circuitry of the device. Connect to +3.3V DC.
-	Center Pad	-	Power	Internally bonded to VEE_A.

## 2. Electrical Characteristics

### 2.1 Absolute Maximum Ratings

Table 2-1 lists the absolute maximum ratings for the GS9074A. Conditions exceeding the limits listed may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those listed in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**Table 2-1: Absolute Maximum Ratings**

Parameter	Value
Supply Voltage	-0.5V to +3.6 V <sub>DC</sub>
Input ESD Voltage	2kV
Storage Temperature Range	-50°C < T <sub>s</sub> < 125°C
Input Voltage Range (any input)	-0.3 to (V <sub>CC</sub> +0.3)V
Operating Temperature Range	0°C to 70°C
Reflow Temperature	260°C
Supply Voltage	-0.5V to +3.6 V <sub>DC</sub>

### 2.2 DC Electrical Characteristics

Table 2-2 shows the DC electrical characteristics of the GS9074A where conditions are V<sub>DD</sub> = 3.3V, T<sub>A</sub> = 0°C to 70°C, unless otherwise shown.

**Table 2-2: DC Electrical Characteristics**

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
Supply Voltage	V <sub>CC</sub>	–	3.135	3.3	3.465	V	±5%
Power Consumption	P <sub>D</sub>	T <sub>A</sub> = 25°C	–	215	–	mW	–
Supply Current	I <sub>s</sub>	T <sub>A</sub> = 25°C	–	65	–	mA	–
Output Common Mode Voltage	V <sub>CMOUT</sub>	T <sub>A</sub> = 25°C	–	V <sub>CC</sub> - ΔV <sub>SDO</sub> /2	–	V	–
Input Common Mode Voltage	V <sub>CMIN</sub>	T <sub>A</sub> = 25°C	–	1.75	–	V	–
MCLADJ DC Voltage (to mute signal)	–	0m, T <sub>A</sub> = 25°C	–	1.3	–	V	–
MCLADJ Range	–	T <sub>A</sub> = 25°C	–	0.4	–	V	–

**Table 2-2: DC Electrical Characteristics (Continued)**

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
$\overline{\text{CD}}$ Output Voltage	$V_{\overline{\text{CD}}(\text{OH})}$	Carrier not present	2.4	–	–	V	–
	$V_{\overline{\text{CD}}(\text{OL})}$	Carrier present	–	–	0.4	V	–
Mute Input Voltage Required to Force Outputs to Mute	$V_{\text{Mute}}$	Min to Mute	2.0	–	–	V	–
Mute Input Voltage Required to Force Outputs Active	$V_{\text{Mute}}$	Max to Activate	–	–	0.8	V	–

## 2.3 AC Electrical Characteristics

Table 2-3 shows the AC electrical characteristics of the GS9074A where conditions are  $V_{\text{DD}} = 3.3\text{V}$ ,  $T_{\text{A}} = 0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ , unless otherwise shown.

**Table 2-3: AC Electrical Characteristics**

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
Serial input data rate	$\text{DR}_{\text{SDO}}$	–	143	–	360	Mb/s	–
Input Voltage Swing	$\Delta V_{\text{SDI}}$	$T_{\text{A}} = 25^{\circ}\text{C}$ , differential	720	800	950	$\text{mV}_{\text{p-p}}$	1
Output Voltage Swing	$\Delta V_{\text{SDO}}$	100 $\Omega$ load, $T_{\text{A}} = 25^{\circ}\text{C}$ , differential	–	750	–	$\text{mV}_{\text{p-p}}$	–
Maximum Equalized Cable Length	–	270Mb/s, Belden 1694A, 350m	–	0.2	–	UI	2
	–	270Mb/s, Belden 8281, 280m	–	0.2	–	UI	2
	–	360Mb/s, Belden 1694A, 190m	–	0.25	–	UI	2
	–	360Mb/s, Belden 8281, 140m	–	0.25	–	UI	2
Output Rise/Fall time	–	20% - 80%	–	80	220	ps	–
Mismatch in rise/fall time	–	–	–	–	30	ps	–
Duty cycle distortion	–	–	–	–	100	ps	–
Overshoot	–	–	–	–	10	%	–

**Table 2-3: AC Electrical Characteristics (Continued)**

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
Input Return Loss	-	-	15	-	-	dB	-
Input Resistance	-	single ended	-	1.64	-	k $\Omega$	-
Input Capacitance	-	single ended	-	1	-	pF	-
Output Resistance	-	single ended	-	50	-	$\Omega$	-

**NOTES:**

1. 0m cable length.
2. Equalizer Pathological.

### 3. Solder Reflow Profiles

The device is manufactured with Matte-Sn terminations and is compatible with both standard eutectic and Pb-free solder reflow profiles. MSL qualification was performed using the maximum Pb-free reflow profile shown in Figure 3-1. The recommended standard eutectic reflow profile is shown in Figure 3-2.

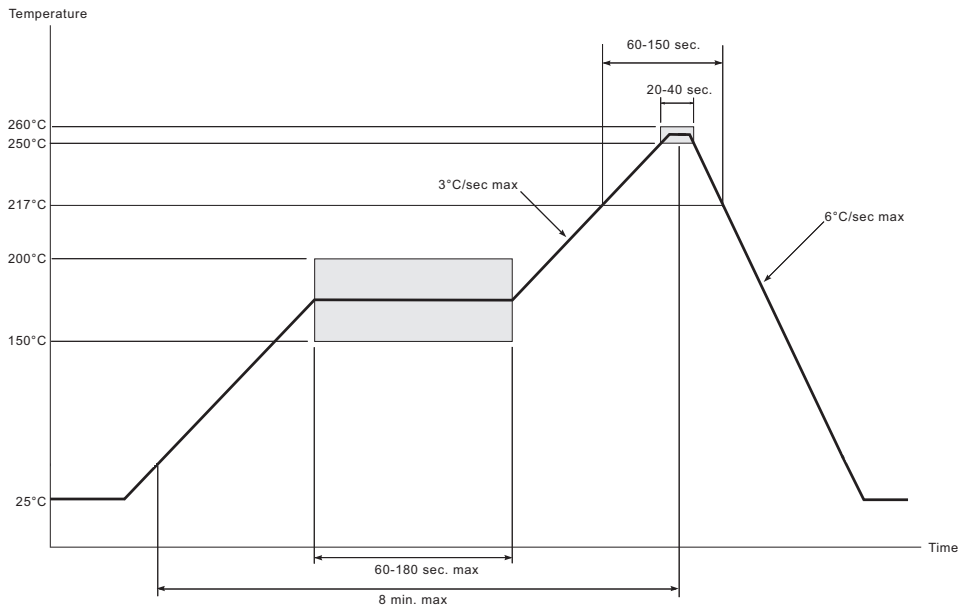


Figure 3-1: Maximum Pb-free Solder Reflow Profile (Preferred)

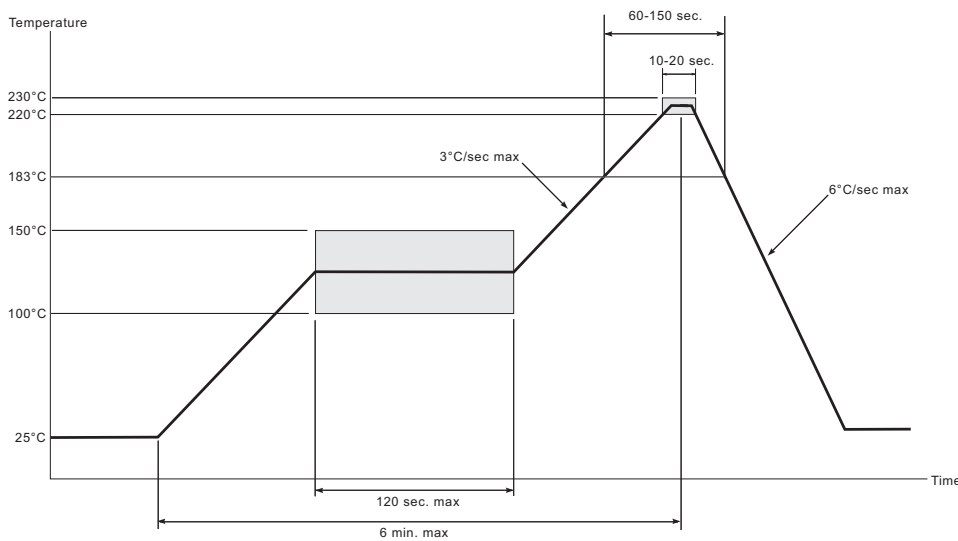


Figure 3-2: Standard Eutectic Solder Reflow Profile (Pb-free package)



## 4. Test Circuit

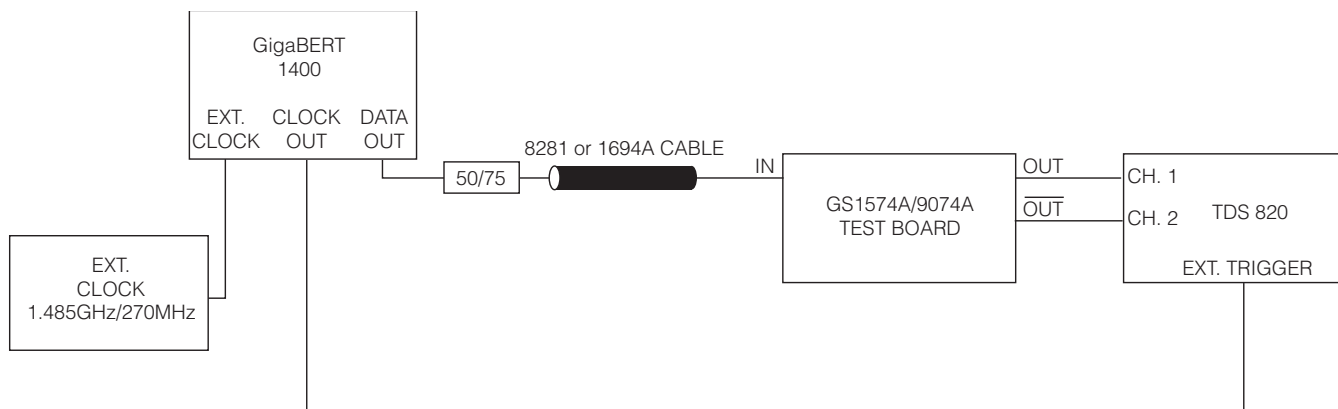


Figure 4-1: Test Circuit

# 5. Input / Output Circuits

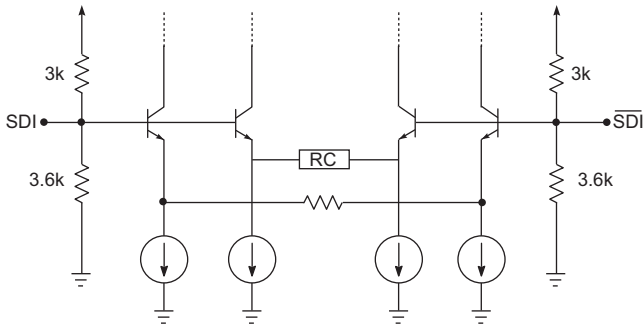


Figure 5-1: Input Equivalent Circuit

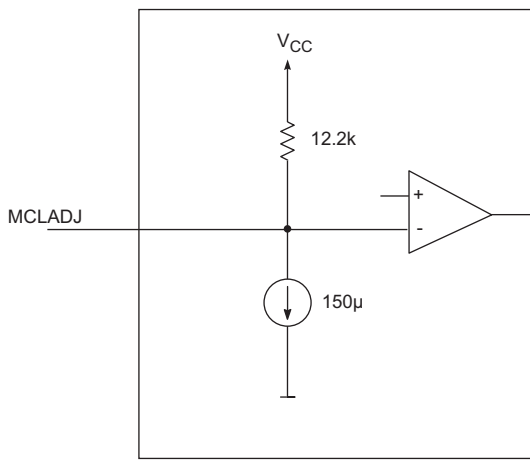


Figure 5-2: MCLADJ Equivalent Circuit

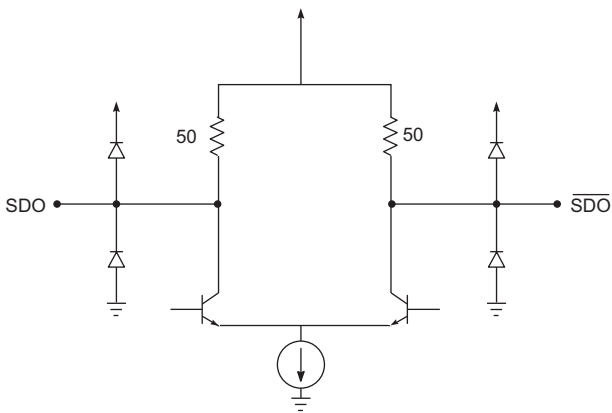


Figure 5-3: Output Circuit

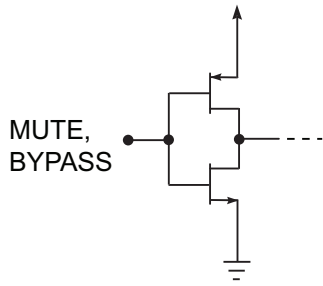


Figure 5-4: MUTE and BYPASS Circuits

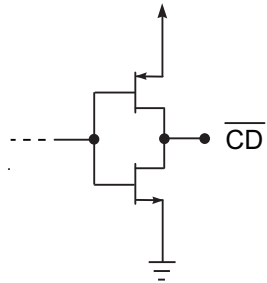


Figure 5-5:  $\overline{CD}$  Circuit

## 6. Detailed Description

The GS9074A is a high speed BiCMOS IC designed to equalize serial digital signals.

The GS9074A can equalize SD serial digital signals, and will typically equalize greater than 350m at 270Mb/s.

The GS9074A is powered from a single +3.3V power supply and consumes approximately 215mW of power.

### 6.1 Serial Digital Inputs

The serial data signal may be connected to the input pins (SDI/ $\overline{\text{SDI}}$ ) in either a differential or single ended configuration. AC coupling of the inputs is recommended, as the SDI and  $\overline{\text{SDI}}$  inputs are internally biased at approximately 1.8V.

### 6.2 Cable Equalization

The input signal passes through a variable gain equalizing stage whose frequency response closely matches the inverse of the cable loss characteristic. In addition, the variation of the frequency response with control voltage imitates the variation of the inverse cable loss characteristic with cable length.

The edge energy of the equalized signal is monitored by a detector circuit which produces an error signal corresponding to the difference between the desired edge energy and the actual edge energy. This error signal is integrated by both an internal and an external AGC filter capacitor providing a steady control voltage for the gain stage. As the frequency response of the gain stage is automatically varied by the application of negative feedback, the edge energy of the equalized signal is kept at a constant level which is representative of the original edge energy at the transmitter. The equalized signal is also DC restored, effectively restoring the logic threshold of the equalized signal to its correct level independent of shifts due to AC coupling. The digital output signals have a nominal voltage of 750mV<sub>pp</sub> differential, or 375mV<sub>pp</sub> single ended when terminated with 50Ω as shown in Figure 6-1.

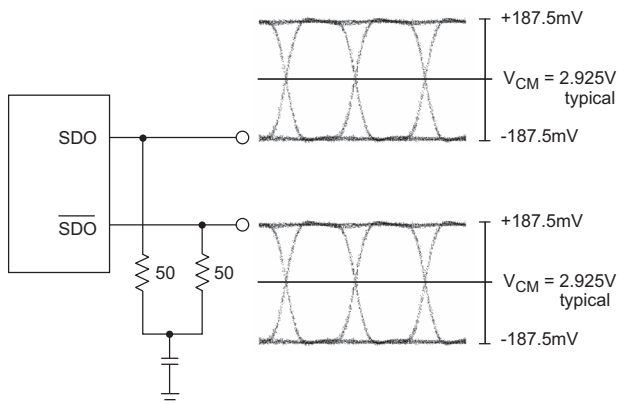


Figure 6-1: Typical Output Voltage Levels

## 6.3 Programmable Mute Output

The GS9074A incorporates a programmable threshold output mute (MCLADJ).

In applications where there are multiple input channels using the GS9074A, it is advantageous to have a programmable mute output to avoid signal crosstalk.

The output of the GS9074A can be muted when the input signal decreases below a certain input level. This threshold is determined using the input voltage applied to the MCLADJ pin. The MCLADJ pin may be left unconnected for applications where output muting is not required.

This feature has been designed for use in applications such as routers where signal crosstalk and circuit noise cause the equalizer to output erroneous data when no input signal is present. The use of a Carrier Detect function with a fixed internal reference does not solve this problem since the signal to noise ratio on the circuit board could be significantly less than the default signal detection level set by the on chip reference.

NOTE: MCLADJ is only recommended for data rates up to 360Mb/s.

## 6.4 Mute and Carrier Detect

The GS9074A includes a MUTE input pin that allows the application interface to mute the serial digital output at any time. Set the MUTE pin HIGH to mute SDO and  $\overline{\text{SDO}}$ . In this case, the outputs will mute regardless of the setting of the BYPASS pin.

A Carrier Detect output pin ( $\overline{\text{CD}}$ ) indicates the presence of a valid signal at the input of the GS9074A. When  $\overline{\text{CD}}$  is LOW, the device has detected a valid input on SDI and  $\overline{\text{SDI}}$ . When  $\overline{\text{CD}}$  is HIGH, the device has not detected a valid input.

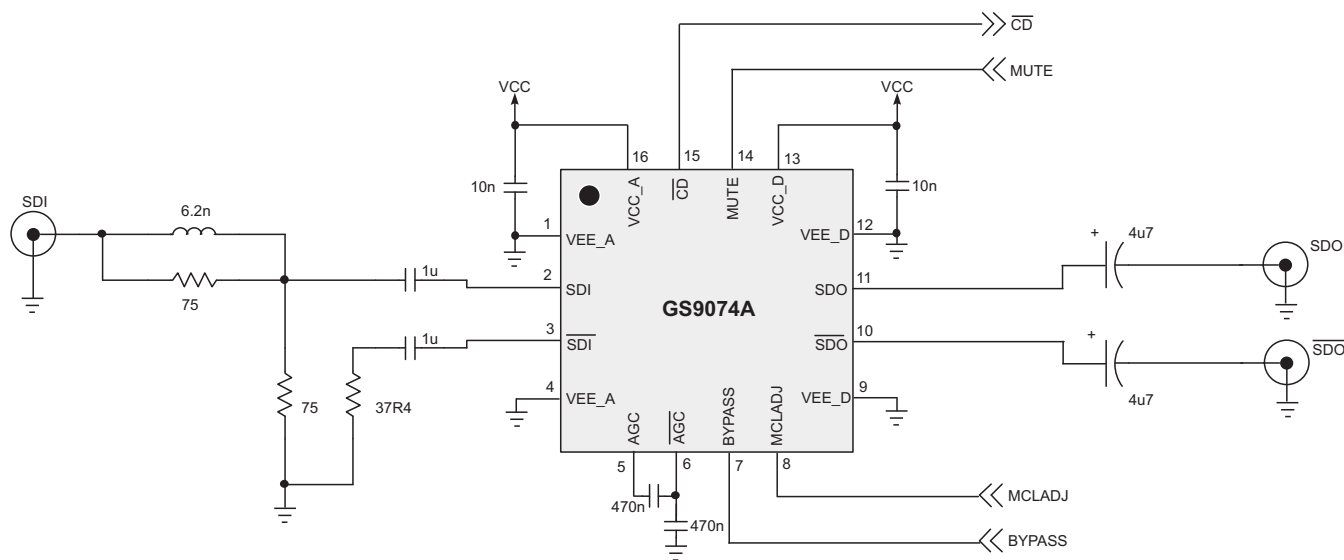
NOTE:  $\overline{\text{CD}}$  will only detect loss of carrier for data rates greater than 19Mb/s.

The  $\overline{\text{CD}}$  output pin may be connected directly to the MUTE input pin to enable automatic muting of the GS9074A when no valid input signal has been detected.

NOTE: If the maximum cable length is exceeded and the device is not in bypass mode the GS1574A will not assert the  $\overline{\text{CD}}$  pin even if a carrier is present.

# 7. Application Information

## 7.1 Typical Application Circuit



NOTE: All resistors in Ohms, capacitors in Farads, and inductors in Henrys, unless otherwise noted.

Figure 7-1: GS9074A Typical Application Circuit

# 8. Package and Ordering Information

## 8.1 Package Dimensions

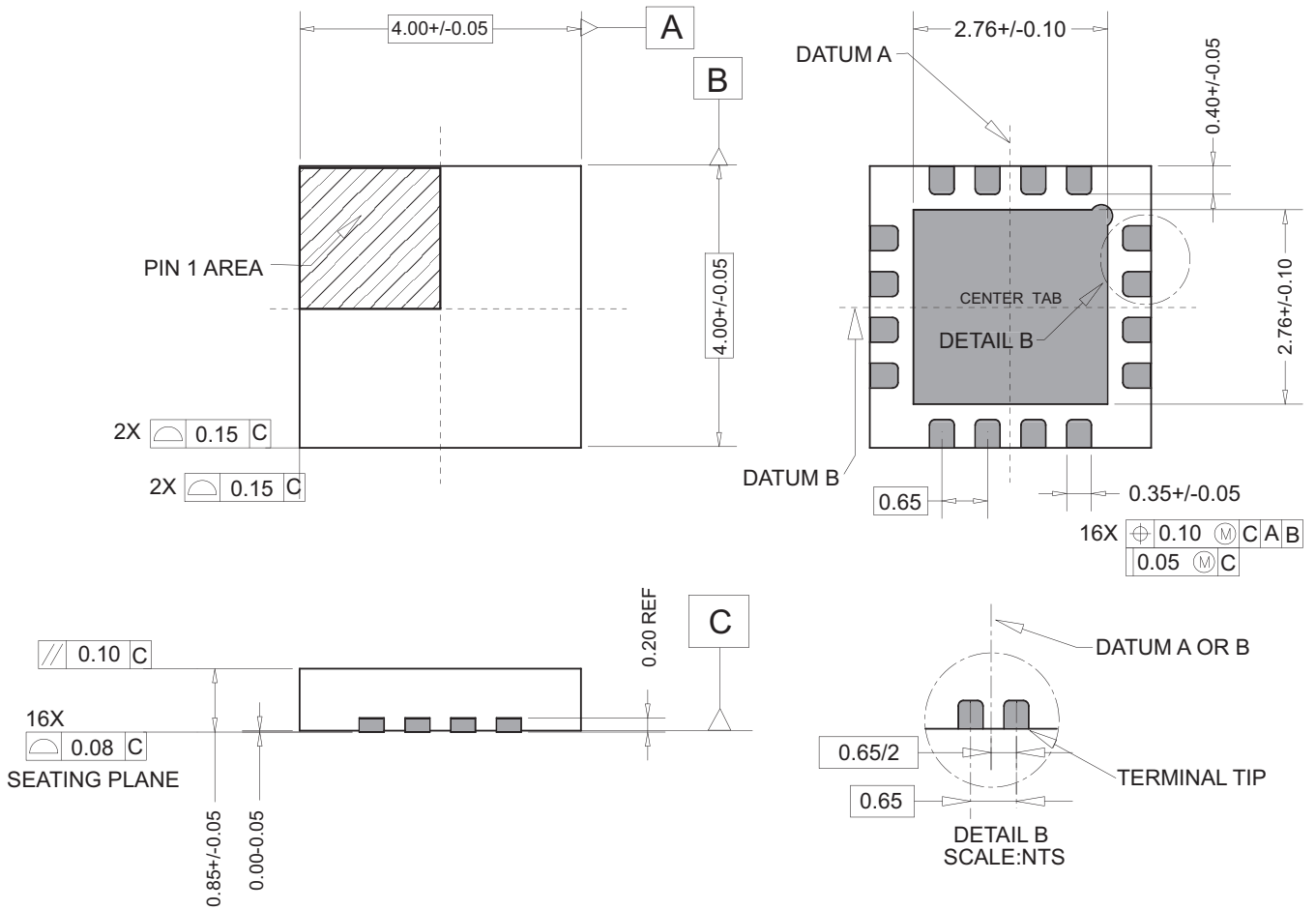
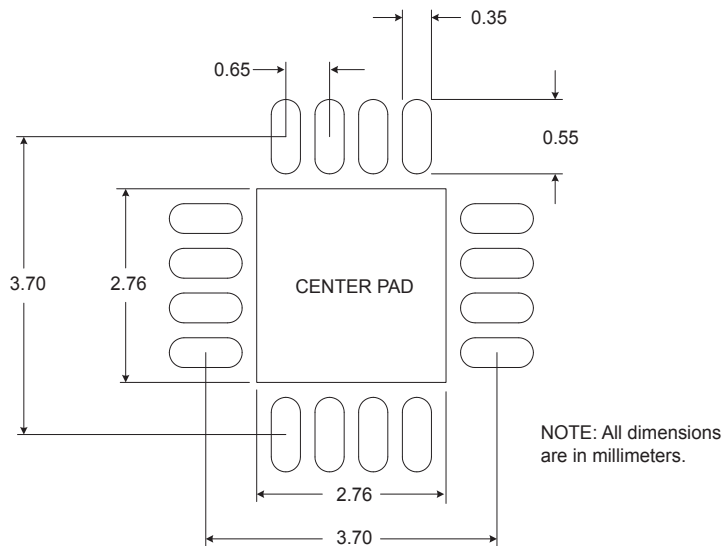


Figure 8-1: GS9074A Package Dimensions

## 8.2 Recommended PCB Footprint



The Center Pad should be connected to the most negative power supply plane for analog circuitry in the device (VEE\_A) by a minimum of 5 vias.

Note: Suggested dimensions only. Final dimensions should conform to customer design rules and process optimizations.

## 8.3 Packaging Data

Table 8-1: Packaging Data

Parameter	Value
Package Type	4mm x 4mm 16-pin QFN
Package Drawing Reference	JEDEC M0220
Moisture Sensitivity Level	3
Junction to Case Thermal Resistance, $\theta_{j-c}$	31.0°C/W
Junction to Air Thermal Resistance, $\theta_{j-a}$ (at zero airflow)	43.8°C/W
Psi	11.0°C/W
Pb-free and RoHS compliant	Yes



## 8.4 Ordering Information

Table 8-2: Ordering Information

Part Number	Package	Temperature Range
GS9074A	GS9074ACNE3 16-pin QFN (490pc tray)	0°C to 70°C
GS9074A	GS9074ACTE3 16-pin QFN (250pcs tape & reel)	0°C to 70°C

### DOCUMENT IDENTIFICATION DATA SHEET

The product is in production. Gennum reserves the right to make changes to the product at any time without notice to improve reliability, function or design, in order to provide the best product possible.

### CAUTION

ELECTROSTATIC SENSITIVE DEVICES  
DO NOT OPEN PACKAGES OR HANDLE EXCEPT AT A  
STATIC-FREE WORKSTATION



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