



## GS1578A HD-LINX® II Multi-Rate Dual Slew-Rate Cable Driver

### Features

- SMPTE 292M, SMPTE 344M and SMPTE 259M compliant
- Dual coaxial cable driving outputs with selectable slew rate
- 50Ω differential PECL input
- Pb-free and RoHS compliant
- Seamless interface to other HD-LINX® II family products
- Single 3.3V power supply operation
- Operating temperature range: 0°C to 70°C

### Applications

- SMPTE 292M, SMPTE 344M and SMPTE 259M Coaxial Cable Serial Digital Interfaces

### Description

The GS1578A is a second generation high speed BiCMOS integrated circuit designed to drive one or two 75Ω co-axial cables.

The GS1578A may drive data rates up to 1.485Gb/s and provides two selectable slew rates in order to achieve compliance to SMPTE 259M, SMPTE 344M and SMPTE 292M.

The GS1578A accepts a LVPECL level differential input that may be AC coupled. External biasing resistors at the inputs are not required.

Power consumption is typically 168mW using a 3.3V power supply. The GS1578A is Pb-free, and the encapsulation compound does not contain halogenated flame retardant.

This component and all homogeneous subcomponents are RoHS compliant.

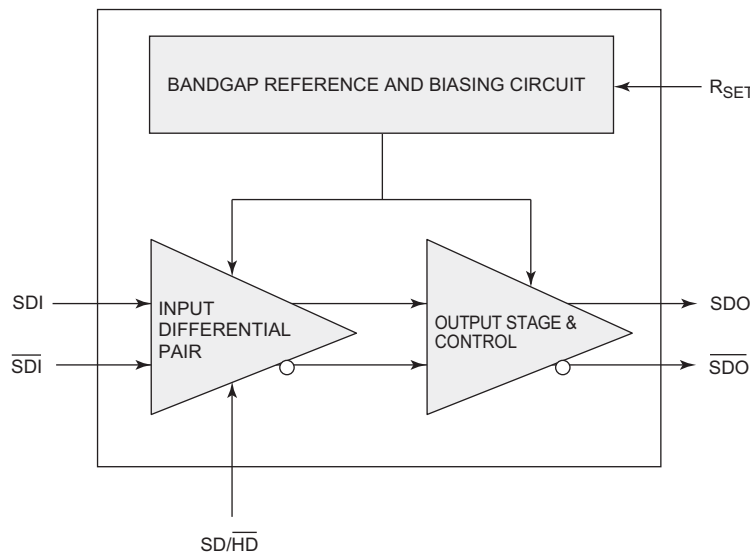


Figure A: GS1578A Functional Block Diagram

## Revision History

Version	ECR	PCN	Date	Changes and/or Modifications
5	153754	–	November 2009	Updated to latest Gennum template.
4	139637	38695	March 2006	Corrected pad standoff height and tolerances for pad width & package dimension. Corrected pad shape.
3	139113	38124	January 2006	Corrected Input Differential Swing to 2200mV.
2	137885	–	September 2005	Corrected process to BiCMOS. Updated eye diagrams in <a href="#">Section 5.2</a> .
1	137132	–	June 2005	Converted to Data Sheet. Changed title of <a href="#">Figure 3-2</a> to clarify that it is the Pb reflow profile. Updated 5D additive jitter number in the AC electrical characteristics table to be typically 20ps <sub>p-p</sub> . Updated dimensions on center pad of the PCB footprint in <a href="#">Section 7.2</a> to match the dimensions of the center pad of the device. Corrected part number in ordering information. Rephrased the RoHS Compliant statement.
0	136045	–	February 2005	Converted to Preliminary Data Sheet.
A	135502	–	February 2005	New document.

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# 1. Pin Out

## 1.1 GS1578A Pin Assignment

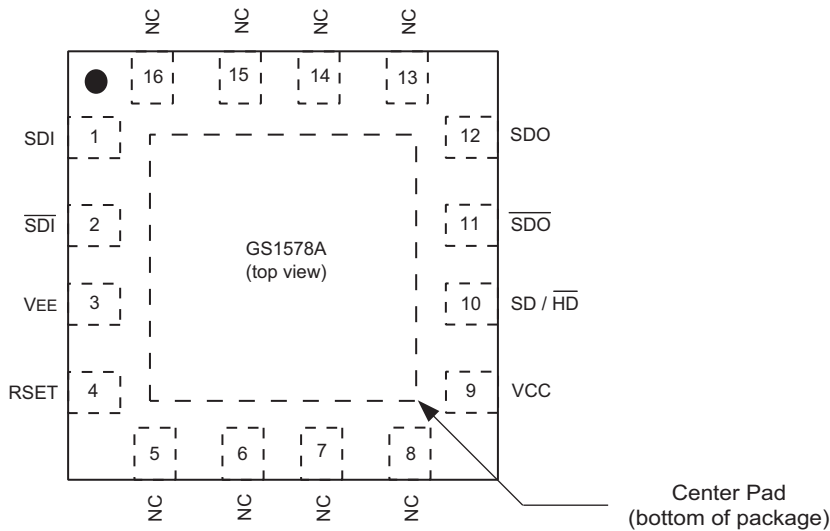


Figure 1-1: 16-Pin QFN

## 1.2 GS1578A Pin Descriptions

Table 1-1: Pin Descriptions

Pin Number	Name	Timing	Type	Description
1,2	SDI, $\overline{\text{SDI}}$	Analog	Input	Serial digital differential input.
3	$V_{EE}$	–	Power	Most negative power supply connection. Connect to GND.
4	$R_{SET}$	Analog	Input	External output amplitude control resistor.
5,6,7,8,13,14, 15,16	NC	–	–	No Connect. Not bonded internally.
9	$V_{CC}$	–	Power	Most positive power supply connection. Connect to +3.3V.
10	$\text{SD}/\overline{\text{HD}}$	Non Synchronous	Input	Output slew rate control. When set HIGH, the output will meet SMPTE 259M rise/fall time specifications. When set LOW, the serial outputs will meet SMPTE 292M rise/fall time specifications.
11,12	$\overline{\text{SDO}}$ , SDO	Analog	Output	Serial digital differential output.
–	Center Pad	–	Power	Connect to most negative power supply plane following the recommendations in <a href="#">Recommended PCB Footprint</a> on page 15.

## 2. Electrical Characteristics

### 2.1 Absolute Maximum Ratings

Table 2-1 lists the absolute maximum ratings for the GS1578A. 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
Solder 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 GS1578A where conditions are V<sub>DD</sub> = 3.3V ±5%, 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
Supply Voltage	V <sub>CC</sub>	–	3.135	3.3	3.465	V
Power Consumption	P <sub>D</sub>	T <sub>A</sub> = 25°C	–	168	–	mW
Supply Current	I <sub>s</sub>	T <sub>A</sub> = 25°C	–	51	64	mA
Output Voltage	V <sub>CMOUT</sub>	Common mode	–	V <sub>CC</sub> - V <sub>OUT</sub>	–	V
Input Voltage	V <sub>CMIN</sub>	Common mode	1.6 + ΔV <sub>SDI</sub> /2	–	V <sub>CC</sub> - ΔV <sub>SDI</sub> /2	V
SD/H $\bar{D}$ Input	V <sub>IH</sub>	–	2.4	–	–	V
	V <sub>IL</sub>	–	–	–	0.8	V

## 2.3 AC Electrical Characteristics

Table 2-3 shows the AC electrical characteristics of the GS1578A where conditions are  $V_{DD} = 3.3V$ ,  $T_A = 0^{\circ}C$  to  $70^{\circ}C$ , unless otherwise shown.

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

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
Serial input data rate	$DR_{SDO}$	–	–	–	1.485	Gb/s	1
Additive jitter	–	1.485Gb/s	–	22	–	ps <sub>p-p</sub>	–
	–	270Mb/s	–	20	–	ps <sub>p-p</sub>	–
Rise/Fall time	$t_r, t_f$	$SD/\overline{HD}=0$	–	–	220	ps	2
	$t_r, t_f$	$SD/\overline{HD}=1$	400	–	800	ps	2
Mismatch in rise/fall time	$\Delta t_r, \Delta t_f$	–	–	–	30	ps	–
Duty cycle distortion	–	$SD/\overline{HD}=0$	–	–	30	ps	–
	–	$SD/\overline{HD}=1$	–	–	100	ps	–
Overshoot	–	$SD/\overline{HD}=0$	–	–	10	%	–
	–	$SD/\overline{HD}=1$	–	–	8	%	–
Output Return Loss	ORL	–	15	–	–	dB	–
Output Voltage Swing	$V_{OUT}$	Single Ended into $75\Omega$ external load $R_{SET} = 750\Omega$	750	800	850	mV <sub>p-p</sub>	–
Input Voltage Swing	$\Delta V_{SDI}$	Differential	300	–	2000	mV <sub>p-p</sub>	–

**NOTES:**

1. The input coupling capacitor must be set accordingly for lower data rates.
2. Rise/Fall time measured between 20% and 80%.

### 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 Pb reflow profile is shown in Figure 3-2.

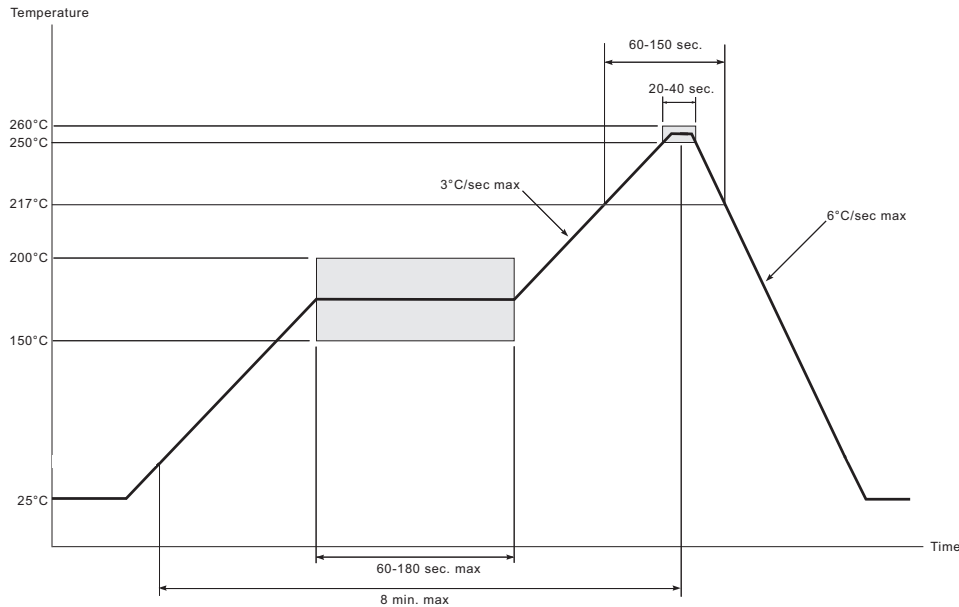


Figure 3-1: Maximum Pb-free Solder Reflow Profile (Preferred)

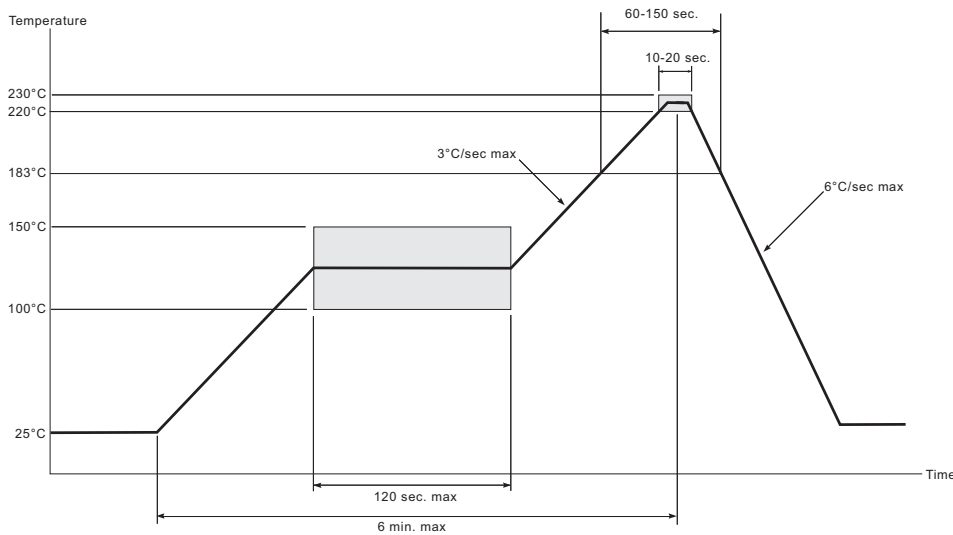


Figure 3-2: Standard Pb Reflow Profile (Pb-free package)

# 4. Input / Output Circuits

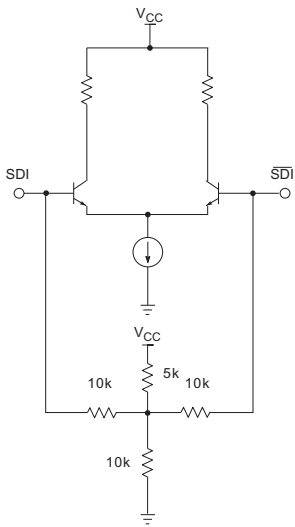


Figure 4-1: Differential Input Stage (SDI/ $\overline{\text{SDI}}$ )

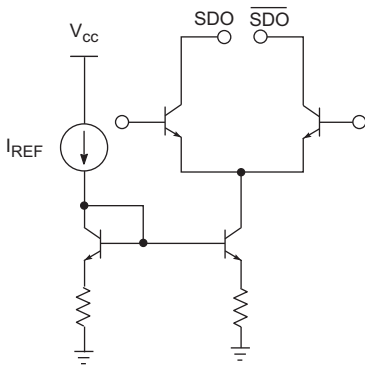


Figure 4-2: Differential Output Stage (SDO/ $\overline{\text{SDO}}$ )

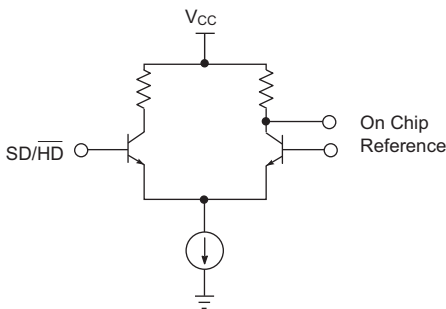


Figure 4-3: Slew Rate Select Input Stage



# 5. Detailed Description

## 5.1 Input Interfacing

SDI/ $\overline{\text{SDI}}$  are high impedance differential inputs. The equivalent input circuit is shown in [Figure 4-1](#).

Several conditions must be observed when interfacing to these inputs:

- The differential input signal amplitude must be between 300 and 2000mVp-p.
- The common mode voltage range must be as specified in the [DC Electrical Characteristics on page 5](#).
- For input trace lengths longer than approximately 1cm, the inputs should be terminated as shown in the Typical Application Circuit.

The GS1578A inputs are self-biased, allowing for simple AC coupling to the device. For serial digital video, a minimum capacitor value of 4.7 $\mu$ F should be used to allow coupling of pathological test signals. A tantalum capacitor is recommended.

### SD/ $\overline{\text{HD}}$ Input Pin

The GS1578A SDO rise and fall times can be set to comply with both SMPTE 259M/344M and SMPTE 292M. For all SMPTE 259M standards, or any data rate that requires longer rise and fall time characteristics, the SD/ $\overline{\text{HD}}$  pin must be set HIGH by the application layer. For SMPTE 292M standards and signals which require faster rise and fall times, this pin should be set LOW.

## 5.2 Output Interfacing

The GS1578A outputs are current mode, and will drive 800mV into a 75 $\Omega$  load. These outputs are protected from accidental static damage with internal static protection diodes.

The SMPTE 292M, SMPTE 344M and SMPTE 259M standards require that the output of a cable driver have a source impedance of 75 $\Omega$  and a return loss of at least 15dB between 5MHz and 1.485GHz.

In order for an SDI output circuit using the GS1578A to meet this specification, the output application circuit shown in [Typical Application Circuit on page 13](#) is recommended.

The value of  $L_{\text{COMP}}$  will vary depending on the PCB layout, with a typical value of 5.6nH. A 4.7 $\mu$ F capacitor is used for AC coupling the output of the device. This value is chosen

to ensure that pathological signals can be coupled without a significant DC component occurring. Please see [Application Information on page 13](#) for more details.

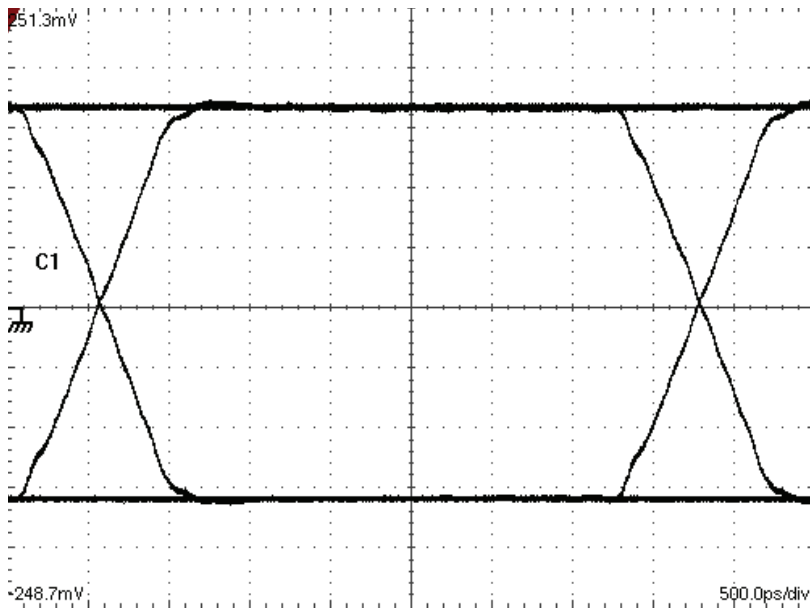


Figure 5-1: Output Signal for 270Mb/s Input

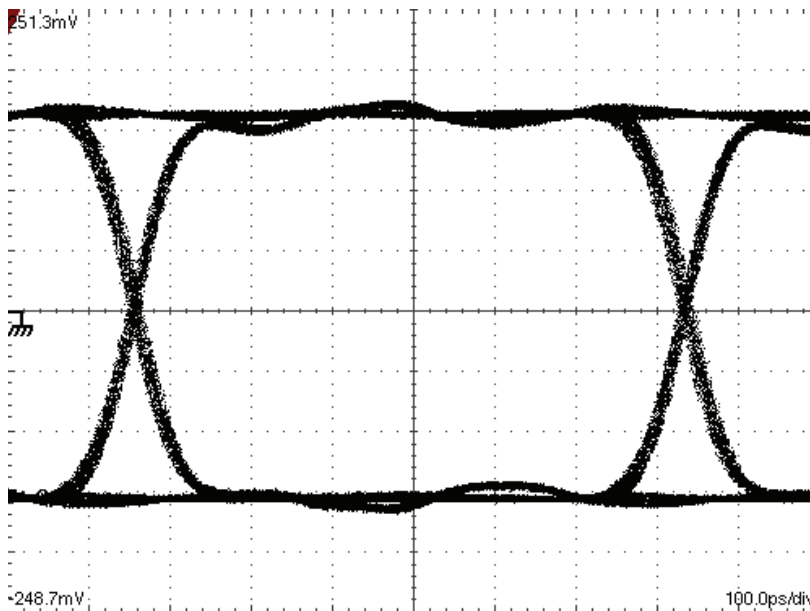


Figure 5-2: Output Signal for 1.485Gb/s Input

The output protection diodes act as a varactor (voltage controlled capacitor) as shown in [Figure 5-3](#). Therefore, when measuring return loss at the GS1578A output, it is necessary to take the measurement for both a logic high and a logic low output condition.

Consequently, the output capacitance of the device is dependent on the logic state of the output.

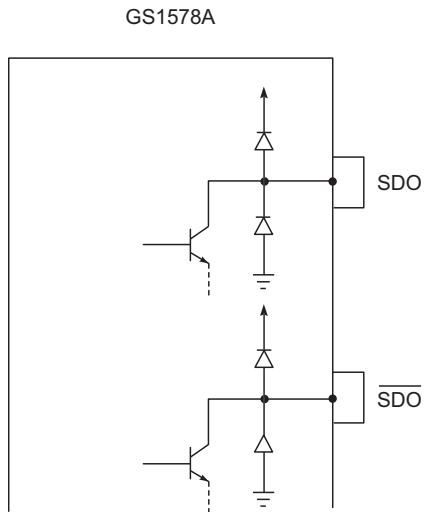


Figure 5-3: Static Protection Diodes

### 5.3 Output Return Loss Measurement

To perform a practical return loss measurement, it is necessary to force the GS1578A output to a DC high or low condition. The actual measured return loss will be based on the outputs being static at  $V_{CC}$  or  $V_{CC}-1.6V$ . Under normal operating conditions the outputs of the device swing between  $V_{CC}-0.4V$  and  $V_{CC}-1.2V$ , so the measured value of return loss will not represent the actual operating return loss.

A simple method of calculating the values of actual operating return loss is to interpolate the two return loss measurements. In this way, the values of return loss are estimated at  $V_{CC}-0.4V$  and  $V_{CC}-1.2V$  based on the measurements at  $V_{CC}$  and  $V_{CC}-1.6V$ .

The two values of return loss (high and low) will typically differ by several decibels. If the measured return loss is  $R_H$  for logic high and  $R_L$  for logic low, then the two values can be interpolated as follows:

$$R_{IH} = R_H - (R_H - R_L) / 4 \text{ and}$$

$$R_{IL} = R_L + (R_H - R_L) / 4$$

where  $R_{IH}$  is the interpolated logic high value and  $R_{IL}$  is the interpolated logic low value.

For example, if  $R_H = -18dB$  and  $R_L = -14dB$ , then the interpolated values are  $R_{IH} = -17dB$  and  $R_{IL} = -15dB$ .

## 5.4 Output Amplitude (RSET)

The output amplitude of the GS1578A is set to  $800\text{mV}_{\text{p-p}}$  with a tolerance of  $\pm 7\%$  using an RSET resistor of  $750\Omega$ . A  $\pm 1\%$  SMT resistor should be used.

The  $R_{\text{SET}}$  resistor is part of the high speed output circuit of the GS1578A. The resistor should be placed as close as possible to the  $R_{\text{SET}}$  pin. In addition, the PCB capacitance should be minimized at this node by removing the PCB groundplane beneath the  $R_{\text{SET}}$  resistor and the  $R_{\text{SET}}$  pin.

NOTE: Only an  $R_{\text{SET}}$  value of  $750\Omega \pm 1\%$  should be used. Using other values for  $R_{\text{SET}}$  is not recommended.

# 6. Application Information

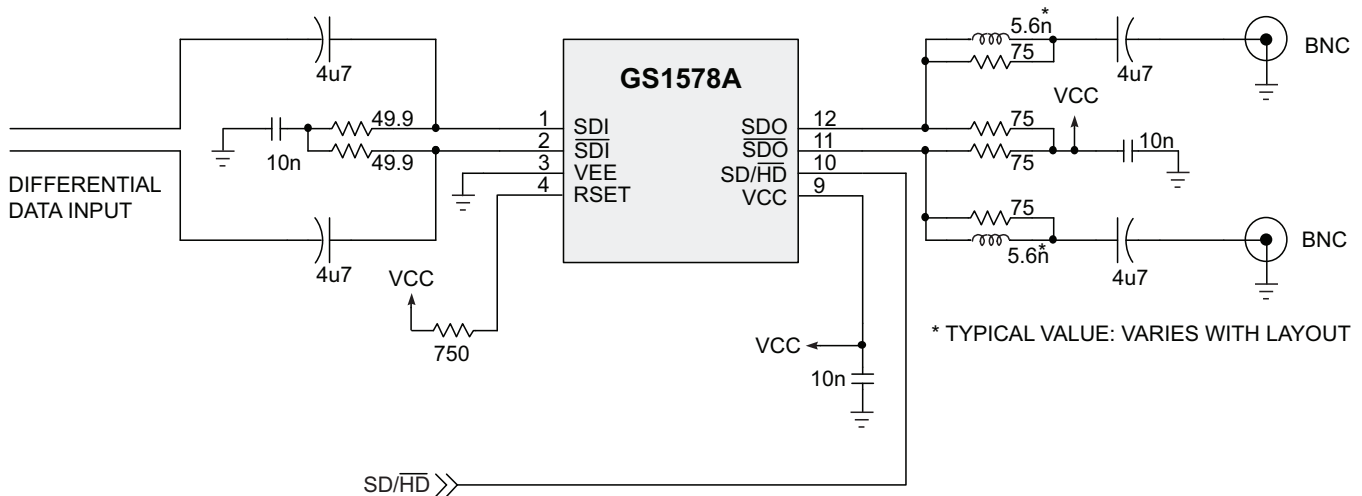
## 6.1 PCB Layout

Special attention must be paid to component layout when designing serial digital interfaces for HDTV.

An FR-4 dielectric can be used, however, controlled impedance transmission lines are required for PCB traces longer than approximately 1cm. Note the following PCB artwork features used to optimize performance:

- The PCB trace width for HD rate signals is closely matched to SMT component width to minimize reflections due to changes in trace impedance.
- The PCB groundplane is removed under the GS1578A output components to minimize parasitic capacitance.
- The PCB ground plane is removed under the GS1578A  $R_{SET}$  pin and resistor to minimize parasitic capacitance.
- Input and output BNC connectors are surface mounted in-line to eliminate a transmission line stub caused by a BNC mounting via high speed traces which are curved to minimize impedance variations due to change of PCB trace width.

## 6.2 Typical Application Circuit



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

Figure 6-1: Typical Application Circuit

# 7. Package and Ordering Information

## 7.1 Package Dimensions

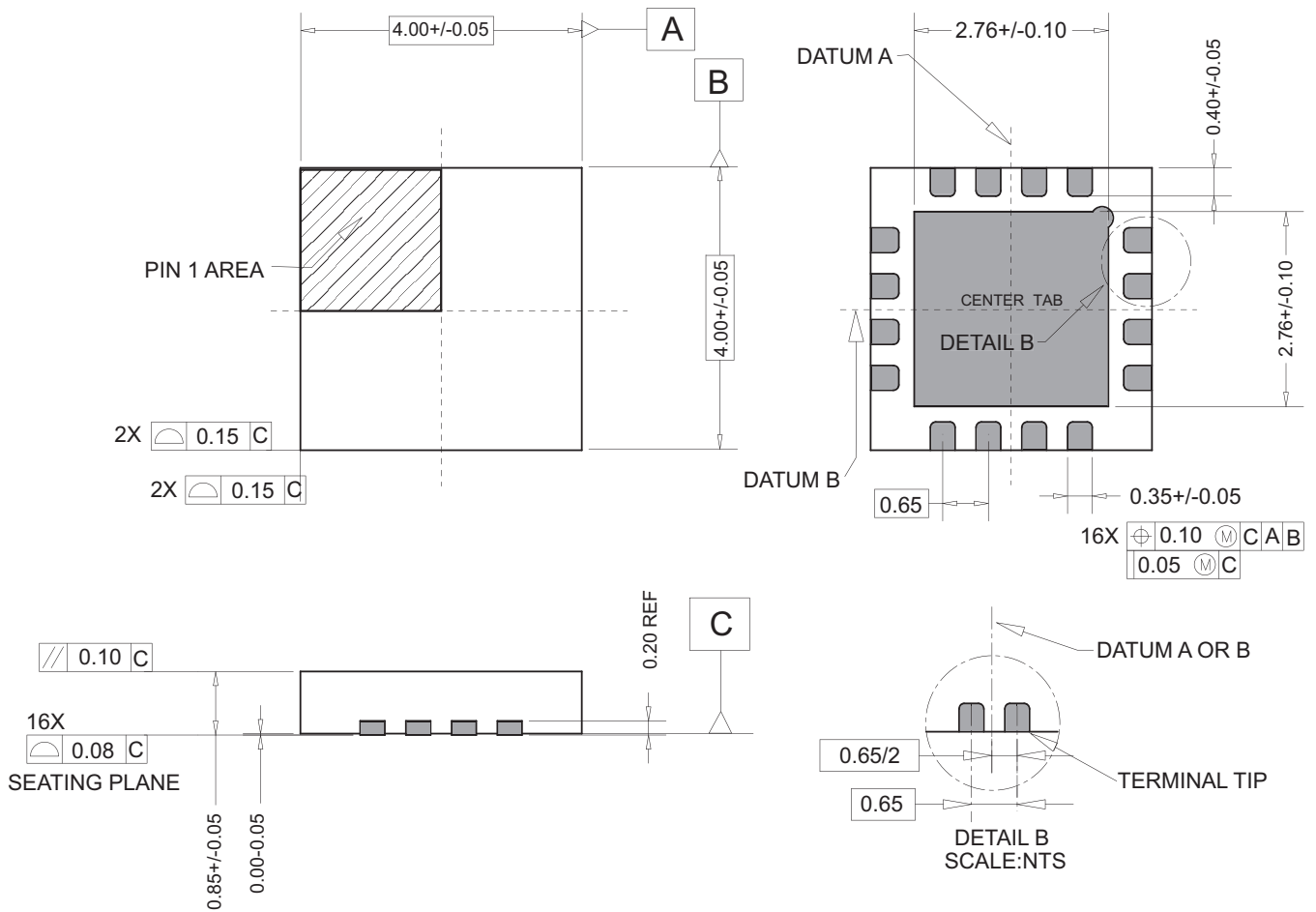
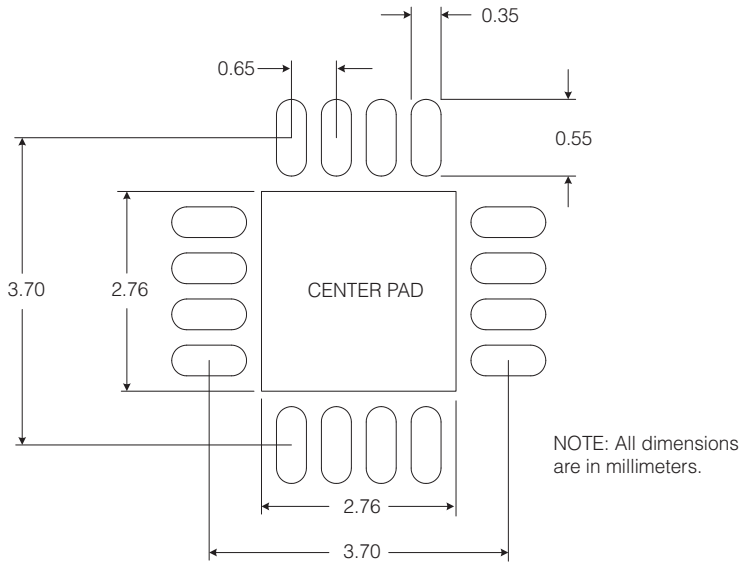


Figure 7-1: GS1578A Package Dimensions

## 7.2 Recommended PCB Footprint



The Center Pad should be connected to the most negative power supply plane (VEE) by a minimum of 5 vias.

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

## 7.3 Packaging Data

Table 7-1: 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

## 7.4 Ordering Information

Table 7-2: Ordering Information

	Part Number	Package	Temperature Range	
	GS1578A	GS1578ACNE3	16-pin QFN	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.

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