

#### 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

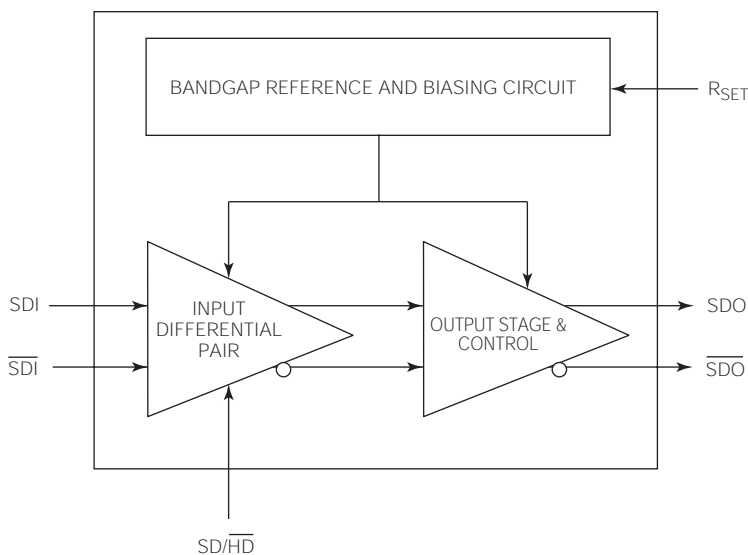
The GS1578A is a second generation high-speed BiCMOS integrated circuit designed to drive one or two 75Ω co-axial cables.

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.



**Functional Block Diagram**

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# 1. Pin Out

## 1.1 Pin Assignment

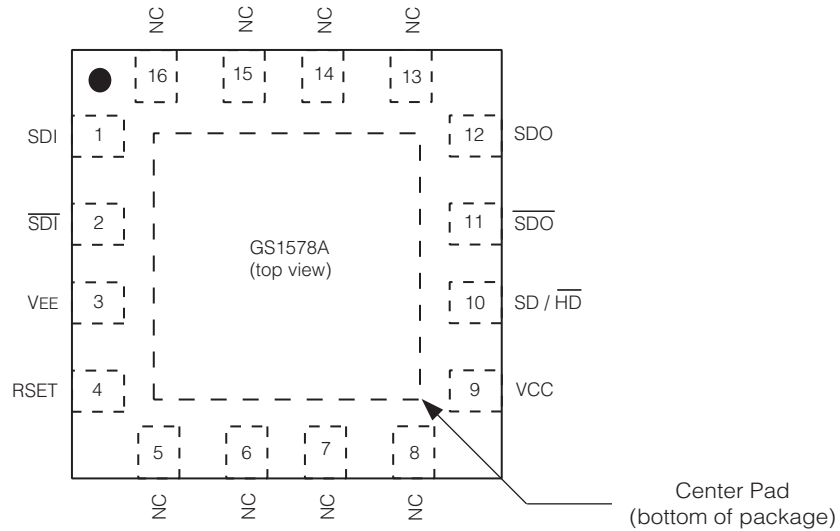


Figure 1-1: 16-Pin QFN

## 1.2 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	$\overline{\text{SD/HD}}$	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 on page 14</a> .

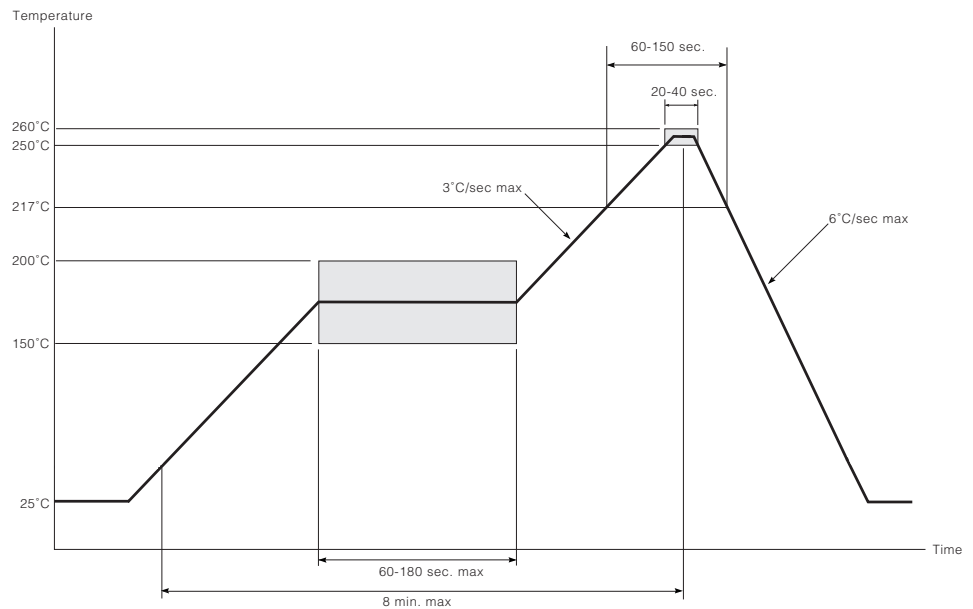
## 2. Electrical Characteristics

### 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

### 2.2 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 2-1](#). The recommended standard Pb reflow profile is shown in [Figure 2-2](#).



**Figure 2-1: Maximum Pb-free Solder Reflow Profile (Preferred)**

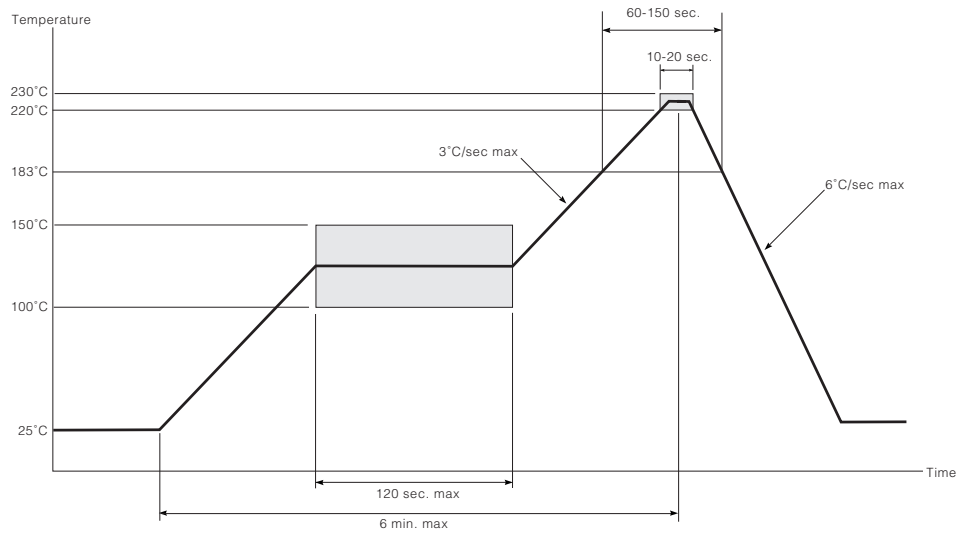


Figure 2-2: Standard Pb Reflow Profile (Pb-free package)

## 2.3 DC Electrical Characteristics

Table 2-1: DC Electrical Characteristics

$V_{DD} = 3.3V$ ,  $T_A = 0^\circ C$  to  $70^\circ C$ , unless otherwise shown

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply Voltage	$V_{CC}$	–	3.135	3.3	3.465	V
Power Consumption	$P_D$	$T_A = 25^\circ C$	–	168	–	mW
Supply Current	$I_s$	$T_A = 25^\circ C$	–	51	64	mA
Output Voltage	$V_{CMOUT}$	Common mode	–	$V_{CC} - V_{OUT}$	–	V
Input Voltage	$V_{CMIN}$	Common mode	$1.6 + \Delta V_{SDI}/2$	–	$V_{CC} - \Delta V_{SDI}/2$	V
SD/HD Input	$V_{IH}$	–	2.4	–	–	V
	$V_{IL}$	–	–	–	0.8	V

## 2.4 AC Electrical Characteristics

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

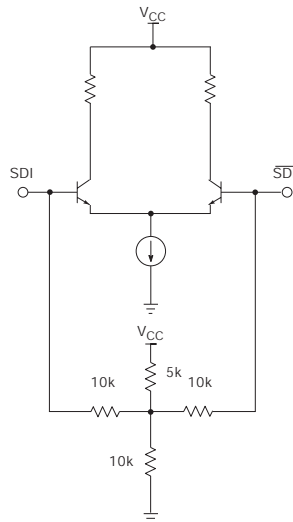
$V_{DD} = 3.3V$ ,  $T_A = 0^\circ C$  to  $70^\circ C$ , unless otherwise shown

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>	–

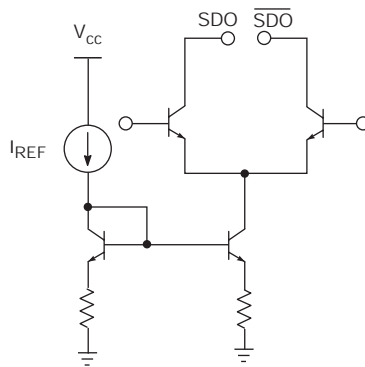
NOTES:

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

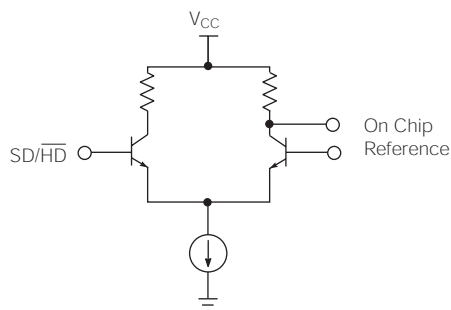
### 3. Input / Output Circuits



**Figure 3-1: Differential Input Stage (SDI/ $\overline{\text{SDI}}$ )**



**Figure 3-2: Differential Output Stage (SDO/ $\overline{\text{SDO}}$ )**



**Figure 3-3: Slew Rate Select Input Stage**

## 4. Detailed Description

### 4.1 Input Interfacing

SDI/ $\overline{\text{SDI}}$  are high impedance differential inputs. The equivalent input circuit is shown in [Figure 3-1](#).

Several conditions must be observed when interfacing to these inputs:

- The differential input signal amplitude must be between 300 and 2000mVpp.
- 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.

### 4.2 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 12](#) 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 12](#) for more details.



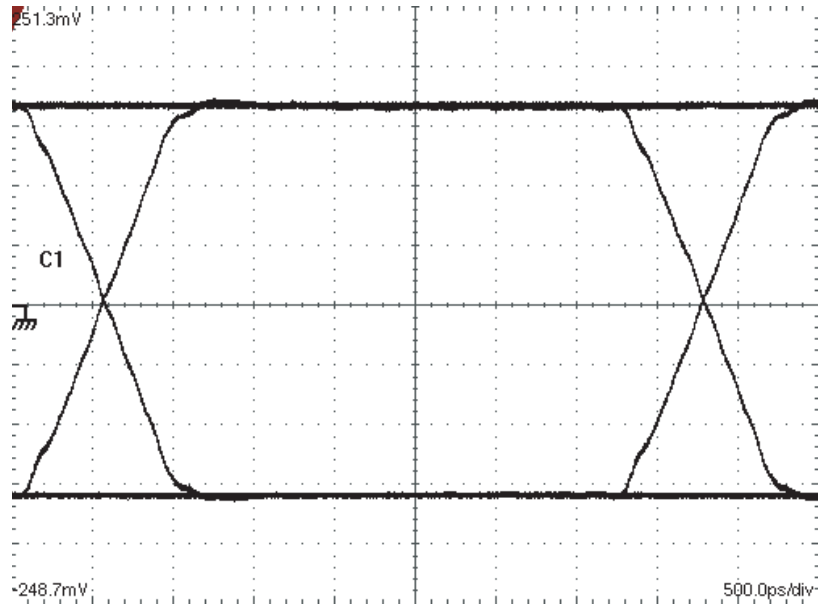


Figure 4-1: Output signal for 270Mb/s input

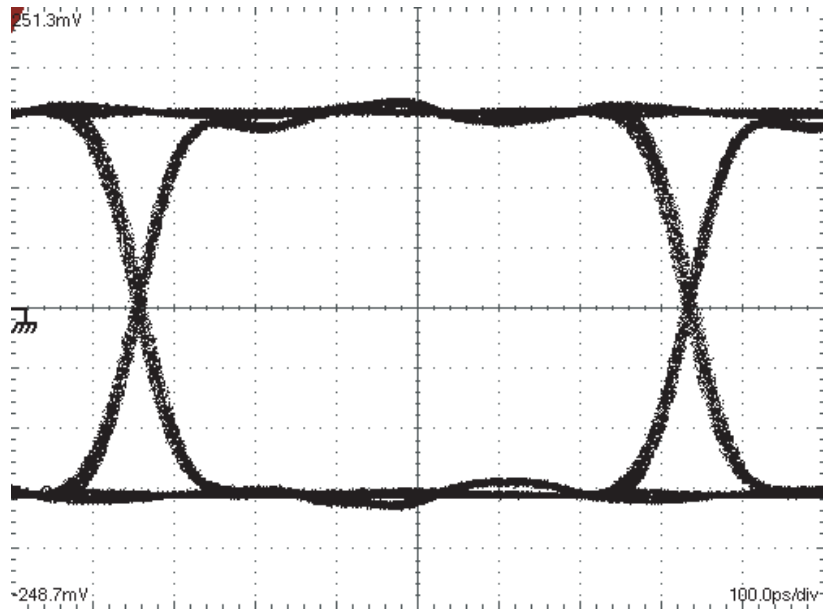
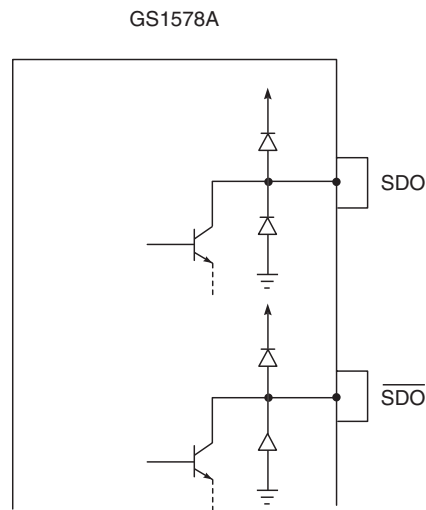


Figure 4-2: Output signal for 1.485Gb/s input

The output protection diodes act as a varactor (voltage controlled capacitor) as shown in [Figure 4-3](#). 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 4-3: Static Protection Diodes**

### 4.3 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  $R_{IL} = -15dB$ .

### 4.4 Output Amplitude (RSET)

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

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

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

## 5. Application Information

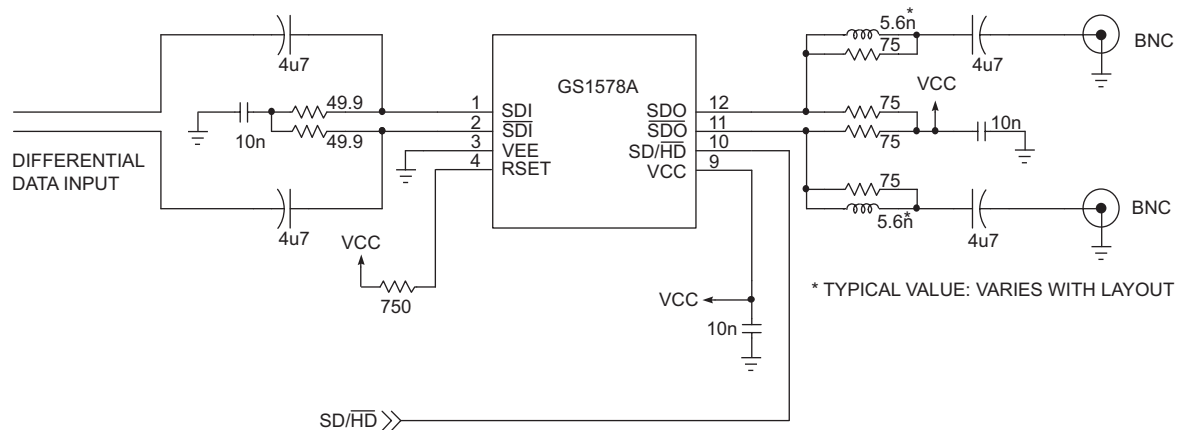
### 5.1 PCB Layout

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<sub>SET</sub> 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.

### 5.2 Typical Application Circuit

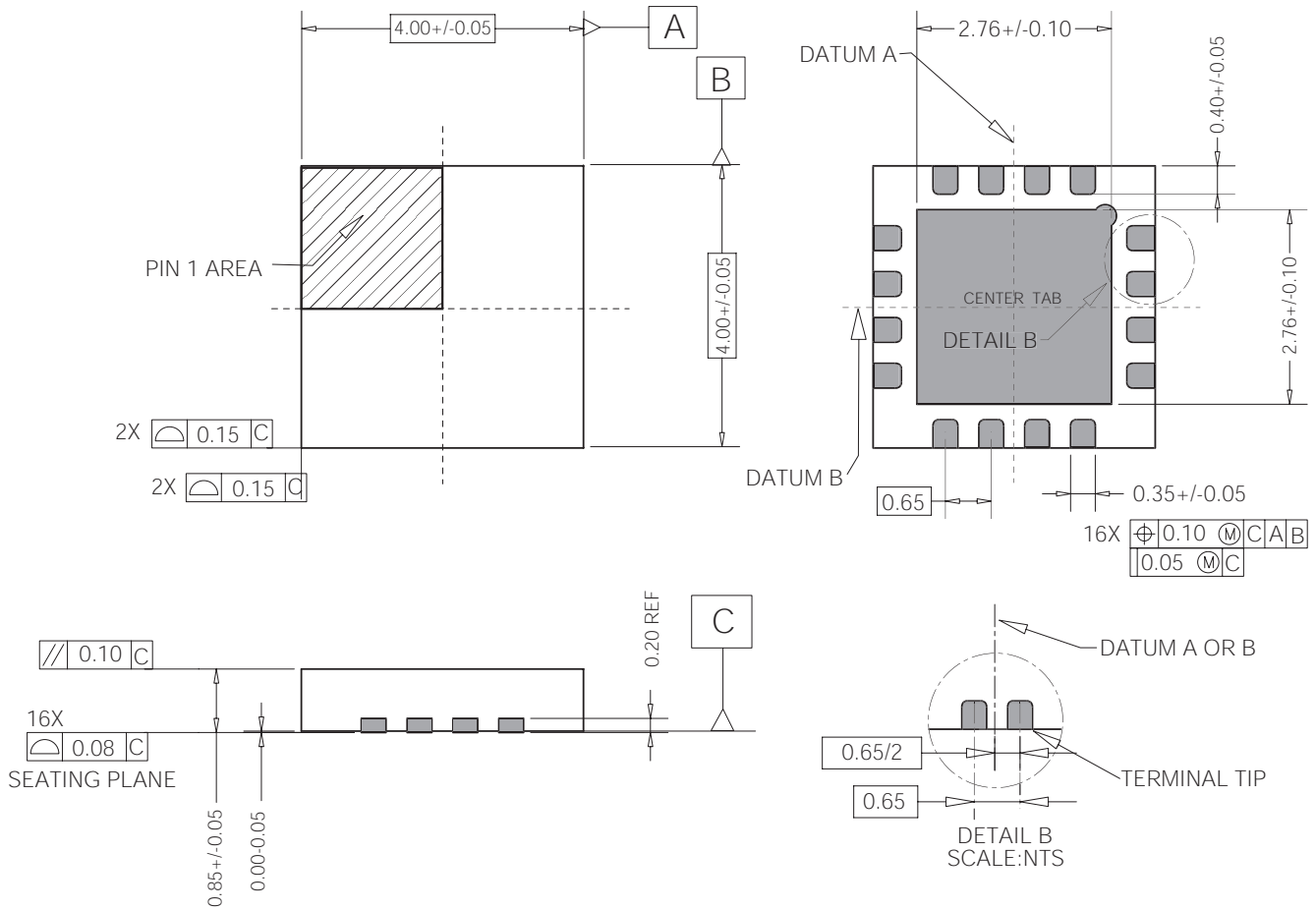


NOTE: All resistors in Ohms, capacitors in Farads, and inductors in Henrys, unless otherwise noted.

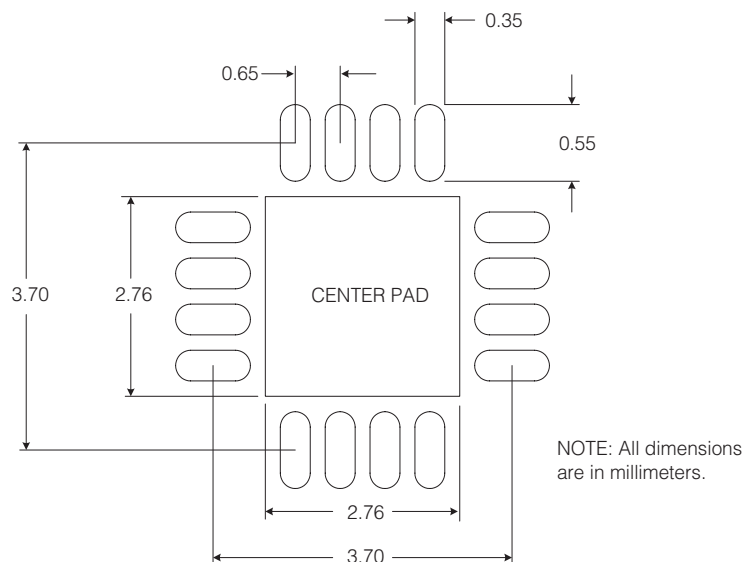
**Figure 5-1: Typical Application Circuit**

# 6. Package & Ordering Information

## 6.1 Package Dimensions



## 6.2 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.

## 6.3 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

## 6.4 Ordering Information

	Part Number	Package	Temperature Range
GS1578A	GS1578ACNE3	16-pin QFN	0°C to 70°C

## 7. Revision History

Version	ECR	PCN	Date	Changes and/or Modifications
A	135502	–	February 2005	New document.
0	136045	–	February 2005	Convert to Preliminary Data Sheet.
1	137132	–	June 2005	Converted to Data Sheet. Changed title of <a href="#">Figure 2-2</a> to clarify that it is the Pb reflow profile. Updated SD 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 6.2</a> to match the dimensions of the center pad of the device. Corrected part number in ordering information. Rephrased the RoHS Compliant statement.
2	137885	–	September 2005	Corrected process to BiCMOS. Updated eye diagrams in <a href="#">Section 4.2</a> .
3	139113	38124	January 2006	Corrected Input Differential Swing to 2200mV.
4	139637	38695	March 2006	Corrected pad standoff height and tolerances for pad width & package dimension. Corrected pad shape.

### CAUTION

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



### DOCUMENT IDENTIFICATION

#### DATA SHEET

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