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SDG 1000
User's Guide

Model SDG1000 Rate Sensor

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INTRODUCTION

This User's Guide describes the operation of the model SDG1000 Quartz Rate Sensor.

The envelope drawing for the SDG1000 is shown in Figure 1. This unit has an 11 pin interface, described in Table 2. The pin orientation is shown in Figure 1.

PART NUMBER IDENTIFICATION

The SDG1000 part number is as follows:

SDG1000-200-100

The SDG1000 designation refers to the basic rate sensor model number.
The –200 designation refers to the rate range of 200 °/second Full Scale.
The –100 designation refers to the standard performance / configuration unit.

SAFETY AND HANDLING INFORMATION

- **DO NOT DROP!** The SDG1000 is a precision instrument. Excessive shock can damage the unit, or destroy the sensing element.
- The SDG1000 can be damaged by electrostatic discharge (ESD). Use standard ESD practices when handling the unit. Wear a properly grounded ESD wrist strap when handling or soldering the interface pins to the system interface.
- Insure that input power pins are connected to the power supply with the proper polarity before applying power to the SDG1000.

PATENT INFORMATION

The SDG1000 is protected by the following patents: U.S. 5,396,144; U.S. 6,262,520; U.S. 6,507,141; U.S. 6,701,785; U.S. 5,047,734; US 5,185,585; Japan 2,518,600; Europe 0638783 plus other U.S. and foreign patents pending.

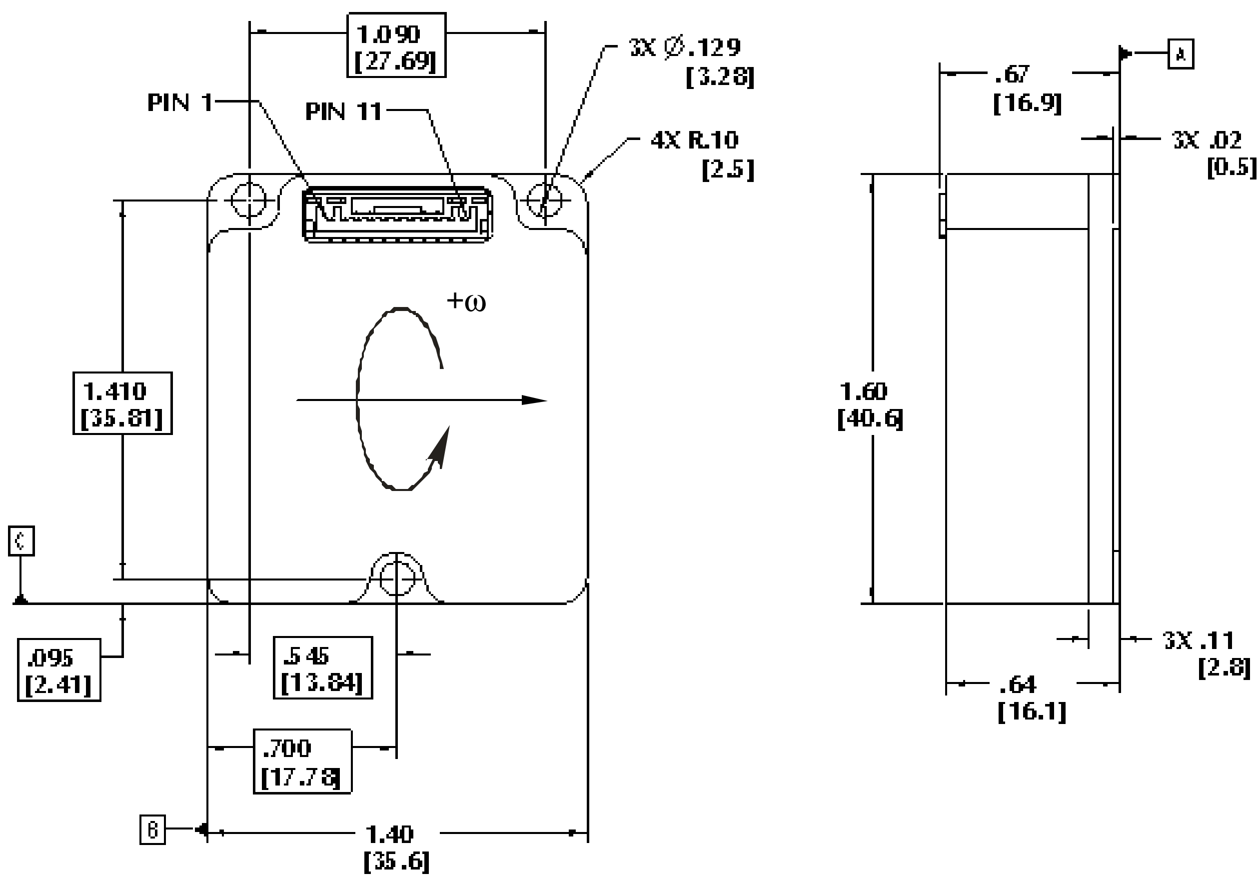
Table 1. Mounting and Connection Hardware

Standard	Part Description	Part Number	Qty
US	Screw, 4-40	4-40, UNC-2A Socket Head Cap Screw	3
US	Screw, 4-40, Optional	4-40, UNC-2A Fillister Head Screw	(3)
	Connector, 11 Pin	JST, P/N: GHR-11V-S	1
	Pin	JST, P/N: SSHL-002T-P0.2	11
	Crimp Tool	JST, P/N : YRS-1140	1

Notes:

1. The hardware listed in Table 1, is required for mounting the SDG1000 and preparing the mating connector. These items are not supplied with the SDG1000. Use 26 to 30 AWG gauge wire.

Figure 1. SDG1000 Envelope Drawing



Tol: .XXX: ± .005 .XX: ± .02

INSTALLATION

A. SDG1000 Mounting

1. The SDG1000 envelope drawing is shown in Figure 1 for reference purposes.

2. Prepare the mounting surface. The mounting surface should be sturdy and rigid, and must be flat within 0.005 inches. If the mounting surface flexes or vibrates, an error signal may show up in the rate output and the SDG1000's performance may be degraded.

3. The mounting hardware required to mount the SDG1000 is listed in Table 1.

4. Mount the SDG1000 as follows:
   Drill and tap 3 mounting holes in accordance with Figure 1.

5. Mount the SDG1000 using 3 Socket Head Cap Screws, as listed in Table 1. Note the sensitive axis orientation as shown in Figure 1. Optionally, 4-40 UNC-2A Fillister Head Screws can be substituted for the Socket Head Cap Screws.

6. When mounting the SDG1000 to an aluminum base, tighten screws to 2.9 in-lbs of torque. When mounting the SDG1000 to a steel base, tighten screws to 4.7 in-lbs of torque. Do not over-torque the screws or the SDG1000 may be damaged.

B. SDG1000 Connections

1. Verify power supply polarity before applying power to the SDG1000. The SDG1000's internal electronics are NOT protected against reverse-polarity of power. The pin orientation is shown in Figure 1.

2. Connect the SDG1000's pins, in accordance with Figure 1 and Table 2. The connector and pins are listed in Table 1. Use 26 to 30 AWG gauge wire. You can also use the optional Interface Cable, Model: SDG1000-CBL-100.

3. The Case Ground (Pin 11) is connected internally to the case of the SDG1000. This wire should be connected to the system ground.

4. Connect the Power Ground (Pin 1) to the common (ground) of the power supply. Use separate wires for power ground and signal return. This will prevent ground loops and ensure the accuracy of your Rate Output signal.

5. The Rate Output signal (Pin 6) should be referenced to Signal Return (Pin 5). Use separate wires for power ground and signal return. This will prevent ground loops and ensure the accuracy of your Rate Output signal.

6. Shielded power input wires and rate output wires are required if operating the SDG1000 in the presence of high levels of electromagnetic interference (EMI). Sources of EMI include switching power supplies and radio transmitters.

Electrostatic Discharge (ESD) –

The SDG1000 I/O Pins or wires are sensitive to Electrostatic Discharge (ESD). Care must be exercised with the SDG1000 I/O pins regarding Electrostatic Discharge (ESD).

Optional Interface Cable –

An optional Interface Cable is available at extra cost. The model number of the Interface Cable is: SDG1000-CBL-100. The wire colors for the optional interface cable are shown in Table 2.

Pin	Function	Optional Interface Cable Wire Color
1	Power Ground	Black
2	+Vdc Input	Red
3	-Vdc Input	Violet
4	Temp 1 Output	Orange
5	Signal Return	Gray
6	Rate Output	Blue
7	Built in Test	Green
8	Temp 2 Output	Yellow
9	No Connection	No Connection
10	Factory Test, Leave Open	No Connection
11	Case Ground	White

Table 2 SDG1000 Pin Connections

OPERATION AND TROUBLESHOOTING

When installed and connected in accordance with this user's guide, the SDG1000 will meet or exceed the specifications listed in Table 3. If the SDG1000 does not meet the performance parameters listed in Table 3, the following suggestions may help to resolve the problem. If none of these suggestions solve the problem and the SDG1000 is still not working to specification, please prepare a summary of your findings and call an Applications Engineer at Systron Donner Inertial: +1 866.234.4976.

A. Bias Not In Specification

1. **Structural Vibrations or Mounting Surface Movements:** The SDG1000 responds to very small angular movements. When noise or bias appear at the rate output, they may actually be the result of real input motions caused by structural vibrations or mounting surface movements. Retest the SDG1000 with all potential vibration sources removed and compare performance with previous results. If this does not solve the problem, try moving the SDG1000 to a different mounting location or change the sensitive axis direction.

2. **Bias Shifts:** Separate wires should be used for power ground and signal return. If this is not implemented, ground loops may result. Ground loops can cause a bias shift that affects instrument performance. Check the wiring layout for ground loops.

3. **Crosstalk Between SDG1000s:** Two or more SDG1000s directly connected from the same power supply can possibly crosstalk. This condition may cause increased output noise for each unit. To eliminate power supplies as a cause of crosstalk (see section 4 below), test a single SDG1000, after disconnecting all others. If the output noise decreases, consider using individual electrically isolated power supplies.

4. **Switching Power Supplies:** Switching power supplies have an internal square wave oscillator that generate high frequency noise. On some switching power supplies, this signal can radiate from the power supply and interfere with the operation of the SDG1000. This interference may cause an increase in noise in the output of the SDG1000. Linear power supplies use a large transformer instead of a square wave oscillator and do not generate this signal. To eliminate problems with switching power supplies, power one SDG1000 from a quality bench linear power supply, such as a Lambda Model LQD 422. If the output noise decreases, use a linear power supply or a lower noise switching power supply.

B. Output Tone at 300 Hz

Under certain conditions of shock and/or vibration, the SDG1000 can emit a narrow-bandwidth tone in the region of 300 Hz ±12 Hz. This tone may also be present to a lesser degree under static conditions. This tone is usually not observable in output signals, because the sensor has a bandwidth of approximately 100 Hz with a signal roll off of -12 dB per octave. If the tone becomes significant in your application, an appropriate filter may be used. Due to the SDG1000's inherent sensing element design characteristics, there is notable vibration sensitivity at the abovementioned frequency. Subjecting the SDG1000 to extended periods of vibration at or near this frequency can negatively affect output.

Table 3 SDG1000 Specifications

SDG 1000 Specifications	
PARAMETER	**SUMMARY SPECIFICTIONS**
Part Number	SDG1000-200-100
Input Voltage	+ and – 10 Vdc to 16 Vdc
Input Current	< 15mA (each supply, typical)
Performance	
Standard Range Full Scale	±200°/sec.
Full-Scale Output (Nominal)	±5.0 Vdc
Scale Factor (at 25°C)	0.025 ±0.004 Vdc/°/sec.
Scale Factor Over Temperature (Dev. From 25°C)	= 0.03%/°C
Bias Calibration (at 25°C)	= 1°/sec.
Bias Variation Over Temperature (Dev. From 25°C)	= 1°/sec.
Bias Stability (In-run at const. temp, Std. Dev.)	< 6°/hr
G Sensitivity	< 36°/hr/g
Start-Up Time	= 1.0 sec.
Bandwidth (-90°)	> 100 Hz
Damping Ratio	0.7 ±0.2
Non-Linearity (% of Full Range)	= 0.03%
Output Noise	< 0.1°/v hour (< 0.0017°/sec./vHz) (DC to 100 Hz)
Environments	
Operating Temperature	-55°C to +85°C
Storage Temperature	-55°C to +95°C
Vibration, Operating (flat profile, 20 to 2000 Hz)	5 g rms,
Vibration, Rectification	< 3.6°/hr/grms
Vibration, Survival	20 G rms,
Shock (Survival)	200 g, 2 milliseconds, ½ sine pulse
Weight	< 60 grams

C. Rate Output

The Rate Output outputs a voltage proportional to angular rate on pin 6. The Rate Output should be referenced to Signal Return (Pin 5).

The Rate Output has the following characteristics:

The Rate Output has a full scale output of ±5 Vdc which corresponds to ±200 °/sec.
The scale factor is: 25 mV/°/sec.
The Rate Output has an impedance of less than 1 ohm and can sink or source up to 5 mA.

D. BUILT IN TEST (TMD)

The SDG1000 has a BUILT IN TEST Output signal, (TMD stands for Tine Motion Detector), which senses that the SDG1000 Drive Electronics is operating properly. This signal is also referred to as Drive Output.

The BUILT IN TEST Output is an analog signal, provided on Pin 7. The BUILT IN TEST Output should be referenced to Signal Return (Pin 5).

If the BUILT IN TEST Output is greater than -6.0 Vdc and less than -3.0 Vdc, the unit is functioning properly.

During power turn-on, while the Drive Circuitry is building up the amplitude of motion of the Drive Tines, the BUILT IN TEST Output will be greater than -3.0 Vdc. After normal operation of the Drive is achieved, the Drive Output will be between -6.0 Vdc and -3.0 Vdc, which means that the unit is functioning normally. The BUILT IN TEST Output should remain in this range for the remaining period of time the unit is in normal operation.

The SDG1000 start-up, after power turn-on, is completed in less than one second.

The BUILT IN TEST Output signal provides a continuous signal equivalent to that of a spinning-wheel gyro's SMRD (Spin-Motor Rotation Detector). When the BUILT IN TEST Output is in the above range, see paragraph 4 above, it indicates that the entire drive system is functioning normally, confirming the presence of proper positive and negative supply voltages, and indicating that the SDG1000's circuitry is functioning normally.

The BUILT IN TEST Output has an impedance of less than 1 ohm and can sink or source up to 5 mA.

E. Factory Test

The SDG1000 has a Factory Test output which is also referred to as the Quadrature Output (Pin 10). This output signal is used for factory test. Do not connect anything to this pin. Trying to measure the Quadrature Output or connecting a wire to this pin may degrade the performance of the SDG1000.

F. Temperature Sensor Outputs

The SDG1000 Quartz Rate Sensor has two temperature sensor outputs. Both thermal sensor outputs provide an electrical signal that is proportional to the internal SDG1000 temperature over the operating temperature range.

The SDG1000 Temp 1 Output signal on Pin 4 monitors the temperature of the sensing element (nugget). Temp 2 Output is also provided on Pin 8 which monitors the temperature of the Printed Circuit Board. Both temperature outputs should be referenced to Signal Ground (Pin 5).

The Temp 1 Output signal has the following electrical characteristics:

1. The Temp 1 Output voltage of the SDG1000 will vary from unit to unit.
2. The Temp 1 Output voltage will be approximately +0.10 Vdc at +25°C.
3. The nominal Temp 1 Output voltage for a specific unit should be measured at 25 °C.
4. Once the nominal voltage is determined for a specific sensor, it will change with a positive, linear slope of nominally +0.020 V/°C.
5. The Temp 1 Output has an impedance of 50 ohms.

The Temp 2 Output signal has the following electrical characteristics:

1. The Temp 2 Output voltage of the SDG1000 will vary from unit to unit.
2. The Temp 2 Output voltage will be approximately +0.20 Vdc at +25°C.
3. The nominal Temp 2 Output voltage for a specific unit should be measured at 25 °C.
4. Once the nominal voltage is determined for a specific sensor, it will change with a negative, linear slope of -0.009 V/°C ± 0.0025 V/°C.
5. The Temp 2 Output has an impedance of less than 1 ohm and can sink or source up to 5 mA.

G. Functional Tests

The following tests can be used to check if the SDG1000 is functioning properly:

Quick Functional Test

1. While measuring the SDG1000's Rate Output, rotate SDG1000 quickly clockwise and counterclockwise about the sensitive axis.

2. If you get a changing Rate Output, the SDG1000 is functioning properly.

BUILT IN TEST Output

1. Measure the BUILT IN TEST Output on Pin 7 with common on Pin 5.

2. If the BUILT IN TEST output is between -6.0 Vdc and -3.0 Vdc, the SDG1000 is functioning properly.

H. Technical Assistance

SDI is committed to customer satisfaction. If you have questions or need assistance in operating your SDG1000, please call us. An Applications Engineer can be contacted at Systron Donner Inertial by telephone at: +1 866.234.4976 or by e-mail at: sales@systron.com.

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