# SDG 500
# User's Guide


## Model SDG500 Rate Sensor

## Systron Donner Inertial
### Sales and Customer Service

**Phone: (925) 979 - 4500**
**Fax: (925) 979 - 9827**
**E-Mail: sales@systron.com**

**Monday through Friday**
**7:00 am to 4:00 pm PT**
**Website: www.systron.com**

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# Tables and Figures

## INTRODUCTION

This User's Guide describes the operation of the model SDG500 Quartz Rate Sensor.

The envelope drawing for the SDG500 is shown in Figure 1. This unit has an 10 pin interface, described in Table 2. The pin orientation is shown in Figure 1.

### PART NUMBER IDENTIFICATION

The SDG500 part number is as follows:

**SDG500-00100-100**

The SDG500 designation refers to the basic rate sensor model number.
The –00100 designation refers to the rate range of 100 °/second Full Scale.
The –100 designation refers to the standard performance / configuration unit.

## SAFETY AND HANDLING INFORMATION

- **DO NOT DROP!** The SDG500 is a precision instrument. Excessive shock can damage the unit, or destroy the sensing element.
- The SDG500 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 SDG500.

## PATENT INFORMATION

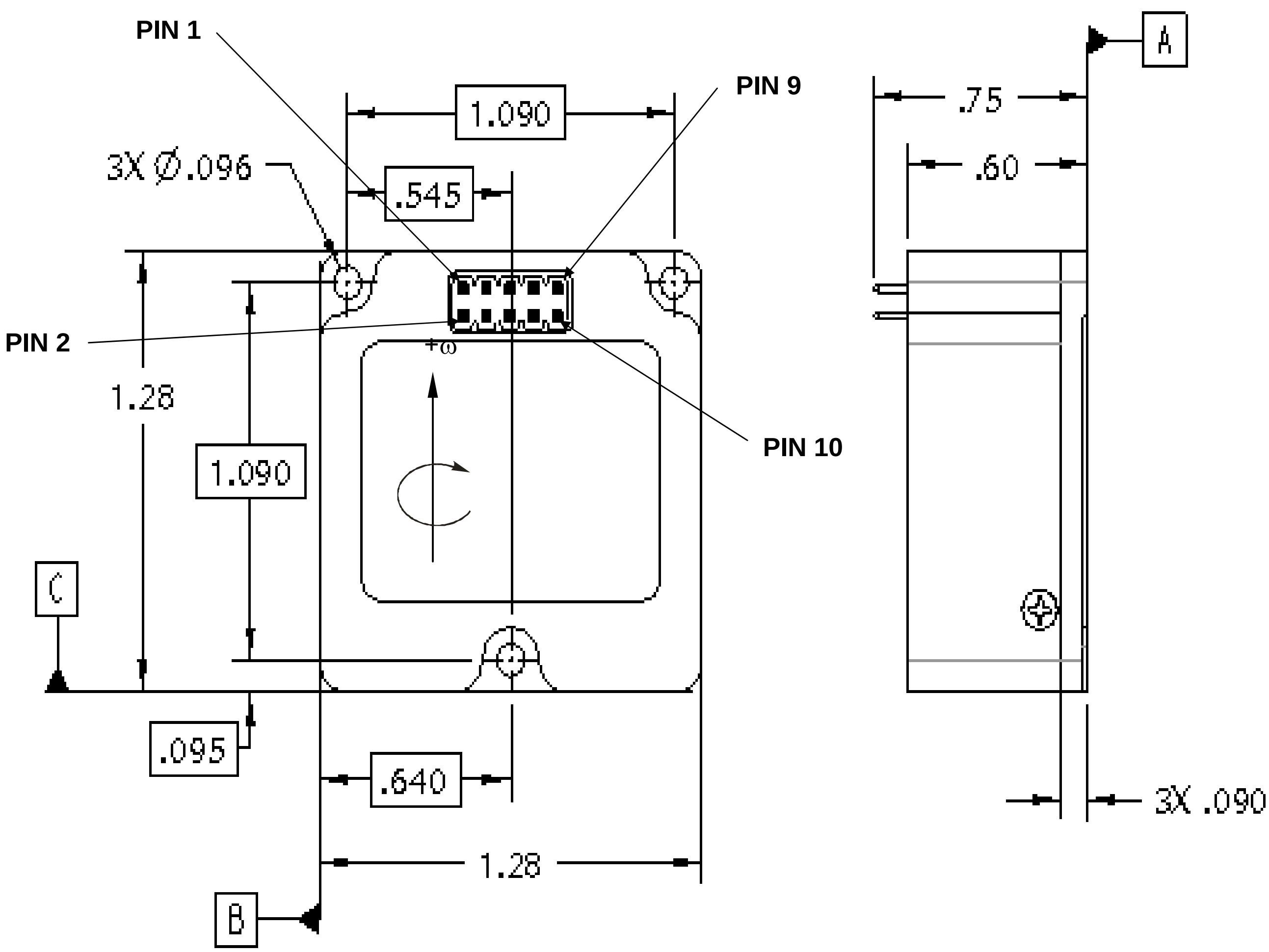
The SDG500 is protected by the following patents: U.S. 4,654,663; U.S. 4,524,619; U.S. 4,899,587; U.S. Re. 33,479, plus other U.S. and foreign patents pending.

**Table 1. Mounting and Connection Hardware**

| Standard | Part Description | Part Number | Qty |
|---|---|---|---|
| US | Screw, 2-56 | 2-56, UNC-2A<br>Pan Head Screw | 3 |
| | Connector, 10 Pin | Samtec, P/N: ESQT-105-02-G-D-310 | 1 |

**Notes:**

1. The hardware listed in Table 1, is required for mounting the SDG500 and connecting to the SDG500 I/O connector. This hardware is <u>not</u> supplied with the SDG500.




Tol: .XXX: ± .010 .XX: ± .02

**Figure 1. SDG500 Envelope Drawing**

# INSTALLATION

## A. SDG500 Mounting

1. The SDG500 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 SDG500's performance may be degraded.

3. The mounting hardware required to mount the SDG500 is listed in Table 1.

4. Mount the SDG500 as follows:
   Drill and tap 3 mounting holes in accordance with Figure 1.

5. Mount the SDG500 using 3 Pan Head Screws, as listed in Table 1. Note the sensitive axis orientation as shown in Figure 1.

6. When mounting the SDG500 to an aluminum base, tighten screws to 1.4 in-lbs of torque. When mounting the SDG500 to a steel base, tighten screws to 2.2 in-lbs of torque. Do not over-torque the screws or the SDG500 may be damaged.

## B. SDG500 Connections

1. Verify power supply polarity before applying power to the SDG500. The SDG500's internal electronics are NOT protected against reverse-polarity of power. The pin orientation is shown in Figure 1.

2. Connect the SDG500's pins, in accordance with Figure 1 and Table 2.

3. The Case Ground (Pin 9) is connected internally to the case of the SDG500. This wire should be connected to the system ground.

4. Connect the Power Ground (Pin 2) 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 ground. 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 SDG500 in the presence of high levels of electromagnetic interference (EMI). Sources of EMI include switching power supplies and radio transmitters.

**SDG500 I/O Pins –**

7. The SDG500 I/O Pins are positioned and held in place by a high temperature thermoplastic. The pins are phosphor bronze with a gold plating. When the SDG500 is installed in its final installation, the pins are intended to be soldered with individual wires or a Flex Strip. Care must be taken to avoid over heating these connections, see steps 12 through 15, Soldering to the SDG500 Pins.

**SDG500 Mating Connector –**

8. The Mating Test Connector is not supplied with the unit. The Test Mating Connector can be obtained from Samtec at www.samtec.com. You can obtain free sample connectors from Samtec's website. If you click the Sudden Service button, select Sudden Samples and click the Sample Form button. Fill out the form with the connector part number from Table 1 and they will promptly send you samples.
9. The SDG500 Mating Test Connector contacts are positioned and held in place by a high temperature thermoplastic which also is true of the Mating Test Connector Housing. The Mating Test Connector contacts are phosphor bronze with a gold plating. Individual wires may be soldered to the Mating Test Connector pins for connections to the appropriate test equipment. During initial SDG500 bench testing, the Mating Test Connector may be used for ease of connecting the SDG500 to the test equipment or for system check-out.
10. The SDG500 Mating Test Connector should be used for test purposes only and would normally not be used in the final system integration.
11. Please note that the SDG500 Mating Test Connector is not "keyed or clocked" to the SDG500 I/O pins. Exercise care to avoid a reverse Mating Test Connector installation. Serious rate sensor and/or system damage may result.

**Soldering To SDG500 Pins –**

12. The SDG500 is RoHS compliant. You should use a RoHS compliant solder when soldering to the SDG500 pins or mating connector. Regular tin-lead solder will work, but your system will no longer be RoHS compliant.

13. When soldering to the SDG500 I/O pins and the SDG500 Mating Test Connector pins, care must be exercised to avoid thermoplastic insulator heat breakdown.

14. Prior to soldering to the SDG500 I/O pins and the SDG500 Mating Connector pins, the pins must be clean and free of any contamination. The individual wires or Flex Strip should be pre-tinned and wires "shaped" to the SDG500 I/O pins to minimize the time of the soldering iron / heat application.

15. A temperature controlled soldering iron should be used. Set soldering iron temperature to appropriate temperature for the solder you are using. Apply heat to pins for no longer than 3 seconds, then immediately apply solder and remove the soldering iron tip from the SDG500 pins. Clean flux residue as required.

**Electrostatic Discharge (ESD) –**

The SDG500 I/O Pins or wires are sensitive to Electrostatic Discharge (ESD). Care must be exercised with the SDG500 I/O pins regarding Electrostatic Discharge (ESD).

**Table 2. SDG500 Pin Connections**

| Pin | Function |
|---|---|
| 1 | +Vdc Input |
| 2 | Power Ground |
| 3 | -Vdc Input |
| 4 | Temp Output |
| 5 | Signal Return |
| 6 | Rate Output |
| 7 | No Connection |
| 8 | Self Test Input |
| 9 | Case Ground |
| 10 | TMD |

## OPERATION AND TROUBLESHOOTING

When installed and connected in accordance with this user's guide, the SDG500 will meet or exceed the specifications listed in Table 3. If the SDG500 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 SDG500 is still not working to specification, please prepare a summary of your findings and call an Applications Engineer at Systron Donner Inertial: 866-BEI-GYRO (866-234-4976), Monday through Friday, 7:00-4:00 PST.

### A. Bias Not In Specification

1. **Structural Vibrations or Mounting Surface Movements:** The SDG500 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 SDG500 with all potential vibration sources removed and compare performance with previous results. If this does not solve the problem, try moving the SDG500 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 SDG500s:** Two or more SDG500s 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 SDG500, 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 SDG500. This interference may cause an increase in noise in the output of the SDG500. 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 SDG500 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 340 Hz

Under certain conditions of shock and/or vibration, the SDG500 can emit a narrow-bandwidth tone in the region of 340 Hz ±20 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 60 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.

**Table 3. SDG500 Specifications**

| SDG 500 Specifications | |
|---|---|
| **PARAMETER** | **SUMMARY SPECIFICTIONS** |
| Part Number | SDG500-00100-100 |
| | |
| Input Voltage | + and – 10 Vdc to 15 Vdc |
| Input Current | < 20 mA (each supply, typical) |
| **Performance** | |
| Standard Range Full Scale | ±100°/sec. |
| Full-Scale Output (Nominal) | ±5.0 Vdc |
| Scale Factor (at 25°C, typical) | 0.050 ±0.001 Vdc/°/sec. |
| Scale Factor Over Temperature (Dev. From 25°C) | ≤ ±0.1%/°C |
| Bias Calibration (at 25°C) | ≤ ±1.5°/sec. |
| Bias Variation Over Temperature (Dev. From 25°C) | ≤ ±5°/sec. |
| Bias Stability (In-run at const. temp, Std. Dev.) | < ±20°/hr. typical |
| G Sensitivity | < 0.06°/sec/g |
| Start-Up Time | < 1.0 sec. |
| Bandwidth (-90°C, includes temperature effect) | 60±15 Hz |
| Damping Ratio | 0.7 ±0.3 |
| Non-Linearity (% of Full Range) | ≤ 0.05% |
| Resolution / Threshold | < 0.004°/sec. |
| Output Noise | <0.005°/sec/√Hz (DC to 100 Hz) |
| **Environments** | |
| Operating Temperature | -40°C to +85°C |
| Storage Temperature | -55°C to +95°C |
| Vibration, Operating (20 to 2000 Hz, flat profile) | 5 g rms |
| Vibration, Rectification | < 36°/hr/grms |
| Vibration, Survival (5.83 grms, 20 to 2000 Hz) | D0160E, Curve C1 |
| Shock Survival (20g, 11ms, ½ sine pulse) | D0160E, Category B |
| **Weight** | < 25 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:

1. The Rate Output has a full scale output of ±5 Vdc which corresponds to ±100 °/sec.
2. The Scale Factor is: 50 mV/°/sec.
3. The Rate Output has an impedance of 100 ohms.

### D. TMD

1. The SDG500 has a TMD Output signal, which stands for Tine Motion Detector, which senses that the SDG500 Drive Electronics is functioning properly.

2. The TMD Output is an analog signal, provided on Pin 10. The TMD Output should be referenced to Signal Return (Pin 5).

3. If the TMD Output is greater than -4.2 Vdc and less than -1.5 Vdc, the unit is functioning properly.

4. During power turn-on, while the Drive Circuitry is building up the amplitude of motion of the Drive Tines, the TMD Output will be greater than -1.5 Vdc. After normal operation of the Drive is achieved, the Drive Output will be between -4.2 Vdc and -1.5 Vdc, which means that the unit is functioning normally. The TMD Output should remain in this range for the remaining period of time the unit is in normal operation.

5. The SDG500 start-up, after power turn-on, is completed in less than one second.

6. The TMD Output signal provides a continuous signal equivalent to that of a spinning-wheel gyro's SMRD (Spin-Motor Rotation Detector). When the TMD 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 SDG500's circuitry is functioning normally.

7. The TMD Output has an impedance of approximately 100 ohms.

**E. Self Test Input**

1. The Self Test Input is on pin 8.

2. Ground the Self Test Input (Pin 8) to Signal Return (Pin 5).

3. If the Rate Output increases by +1.5 Vdc, the SDG500 is functioning properly

**F. Temperature Sensor Output**

The SDG500 Quartz Rate Sensor has a temperature sensor output. The thermal sensor output provides an electrical signal that is proportional to the internal SDG500 temperature over the operating temperature range.

The SDG500 Temp Output signal on Pin 4 monitors the temperature of the Printed Circuit Board. The temperature output should be referenced to Signal Ground (Pin 5).

The Temp Output signal has the following electrical characteristics:

1. The Temp Output voltage of the SDG1000 will vary from unit to unit.
2. The Temp Output voltage will be between -0.050 Vdc and +0.050 Vdc at +25°C.
3. The nominal Temp 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 +0.0095 V/$^{O}$C ± 0.0025 V/°C.
5. The Temp Output has an impedance of 100 ohms.

**G. Functional Tests**

The following tests can be used to check if the SDG500 is functioning properly:

**Quick Functional Test**

1. While measuring the SDG500's Rate Output, rotate SDG500 quickly clockwise and counterclockwise about the sensitive axis.

2. If you get a changing Rate Output, the SDG500 is functioning properly.

**TMD Output**

1. Measure the TMD Output (Pin 10) with common on Signal Return (Pin 5).

2. If the TMD output is between -4.2 Vdc and -1.5 Vdc, the SDG500 is functioning properly.

**Self Test Input**

1. Ground the Self Test Input (Pin 8) to Signal Return (Pin 5).

2. If the Rate Output increases by +1.5 Vdc, the SDG500 is functioning properly

### H. Technical Assistance

SDI is committed to customer satisfaction. If you have questions or need assistance in operating your SDG500, please call us. An Applications Engineer can be contacted at Systron Donner Inertial by telephone at: 866-BEI-GYRO (866-234-4976) or by e-mail at: sales@systron.com.

## CONTACT INFORMATION


Systron Donner Inertial
355 Lennon Lane · Walnut Creek, California 94598

Customer Service: PH: 925-979-4500 · FAX: 925-979-9827
Sales and Technical Support: 866-BEI-GYRO (866-234-4976)
E-Mail: sales@systron.com · Web Site: www.systron.com

European Business Office: ++44 (0) 1227 776460 · FAX: ++44 (0) 1227 363289
E-Mail: bei.tech@ukonline.co.uk