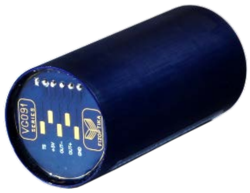

FIBER OPTIC GYROSCOPES

VG091 SERIES

Information Guide

Output	*Model*	*Extension*	*Key Features*	*Fiber length, m*
differential	*VG091*	*A*	*Ø24 x 52 mm*	*100*
		A-4LN	*North seeking capability, μ-shielded*	*200*
	VG191	*A*	*Ø24 x 40 mm*	*160*
digital	*VG191*	*AD*	*Built-in ADC*	*160*

Table of Contents

1. Introduction

1.1. Scope[1]

This guide describes fiber optic gyroscope main features. Suggestions on product use, handling and installation are given.

1.2. Product Description

The Fizoptika gyro is a complete gyro system which comprises a fiber optic sensing assembly and analog processing electronics. The sensing assembly (an open-loop minimum configuration) is fabricated from a single length of optical fiber by a fusion-tapering technique.

The series features thumb-sized design combined with instant start-up and low power consumption.

The basic model of the series is VG091A – the first smallest and lightest fiber optic gyro.

See product main parameters in Annex 1 (analog models) / Annex 2 (digital models), outline dimensions, pins assignment, axes definition in Annex 3 (analog models)/ Annex 4 (digital models).

With an exclusive technology of precise polarization control all the models acquire Minimum Magnetic Sensitivity about 3°/h/Gauss and for most of applications may be used without heavy magnetic shielding. The housing of some models is fabricated from µ-metal to get ultimate magnetic immunity (<0.1°/h/Gauss).

With the reinforced inner frame the gyros acquire negligible vibration sensitivity.

1.3. Essential

The gyro housing is silicone sealed. Keep the product dry during its whole lifetime.

Do not drop. Excessive shock can damage the unit.

Use standard ESD practices when handling the unit.

2. Electrical Characteristics

2.1. Powering

The gyro requires a clean and stable 5Vdc (±5%) power supply. Voltages greater than 5.5V (or reversing polarity) can cause some components to heat and eventually fail. Smooth voltage transient at power-on is recommended.

See the electrical diagram in Annex 5 (analog models) / Annex 6 (digital models).

2.2. Differential Output

The gyro provides output voltages via two leads (OUT+, OUT-) each biased at **U0=1V** to Common lead (GND).

U(+) = U0 + ½ SF · Ω **U(-) = U0 - ½ SF · Ω**

Output differential voltage **U(Ω)** = **U(+)**- **U(-)** = **SF·Ω**
The output voltage range is **±2V**.
The output impedance is 1kOm (to GND). 2nd order LPF cut-off frequency is ~1kHz (diagram Annex 8).

Diagnostics. If gyro fails**, U0 ≠ 1V**.

The SF and bias are slightly sensitive to supply voltage. The sensitivity coefficients are individual for each unit. Values for reference**:** SF – 0.05%/V, bias – 0.1 mV/V.

2.3. Temperature Output

The gyro provides temperature data via TS lead:

V(TS) = 0.5 + t°C/100 [V]

Temperature output is single-ended.

2.4. Digital Output

The digital model incorporates an analog processing circuit and digital circuit integrated into a single PCB. It is equipped with precise 24-bit ADC and powerful processor. It can be factory programmed to provide real time compensated data. The digital signal (RS422, 920kBd, 8kHz rate) contains angular rate raw data and set of gyro parameters used for data compensation and built-in test. Read more in Fiber Optic Gyroscope Digital Output.

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[1] The information contained in this document is believed to be correct. Fizoptika accepts no liability for any errors it might contain and reserves the right to alter specifications without prior notice. All pictures shown are for illustration purpose only. The actual product may vary due to the ongoing product enhancement.

2.5. Effect of Environment

♦ **Temperature**

· **Bias** ~ 0.1-1 µV / °C (temperature sensitivity of the components of analog processing circuit)

· **SF** ~ 0.02 -0.04% / °C (temperature dependence of SLD spectrum – optical sensor natural feature - **NF**)

♦ **Magnetic field** (minimized response, non-shielded)

· **Bias** ~ 3°/h/Gauss (along X axis, nonadjustable response -**NF**)

· **SF** is not sensitive (**NF**)

♦ **Vibration**

· **Bias** is not sensitive (no g and g^2 components - **NF**)

· **Noise** spectrum factor 1-20 µV/ g*Hz (direction dependent)

· **SF** is not sensitive (**NF**)

Typical plots of the bias and noise contributors - Annex 7.

3. Mounting Guidelines

The VG091 is extremely lightweight. There is no need for a strong joint to a mating frame (object). There is a variety of simple methods how to attach the gyro not deforming its housing. The adhesive mounting is most recommended as it does not deliver any stress to the gyro and is quite reliable. It also provides sufficiently high resonance of the joint with low Q-factor.

The clamping is another possible method. Using plastic tighteners, ties, adhesive tapes, etc. is proved to be practical.

3.1. Adhesive Mounting

- Apply silicon adhesive to the side surface of the gyro.
- Aim for an adhesive thickness of 0.2-0.4 mm.

3.2. Mating Frame

Resonances of the mating frame and the gyro to frame joints (adhesive or mechanical) should exceed vibration frequencies. Otherwise, an extra noise at the output is possible because the gyro may acquire much higher levels of vibration compared to the mating frame.

4. Analog output reading

The outputs are DC-coupled and can be used in either single-ended or differential mode. Differential mode offers the best performance since the common mode errors and noise are minimized. The positive and negative outputs of the unit should be connected to differential input amplifiers with an input impedance of at least 500kOhm referred to ground. The amplifier should also have a good common mode rejection and a suitable bandwidth for the application.

Annex 1. Product Main Parameters (analog models)

PERFORMANCE	VG091A	VG091A-4LN	VG191A
Input range (°/s)	300	60	250
Bias stability / Bias repeatability* (RMS, °/h)	3	1	1
Angle random walk (°/√h)	0.04	0.01	0.015
Bandwidth (kHz)		1	
SF stability / SF repeatability *(RMS, %)		0.02	
Magnetic response (°/h/Gauss)	3	0.03	4(0.1**)
ELECTRICAL INTERFACE			
Start-up (s)		0.03	
Powering (W)		0.5	
PHYSICAL PARAMETERS			
Dimensions (mm)	Ø24x52	Ø24x52	Ø24x40
Weight (gram)	30	50	30 (40**)
Volume (cl)	2.4	2.4	1.8
Housing material	Al alloy	μ-metal	Al alloy (μ-metal**)
ENVIRONMENT			
Operating temperature (°C)		-40…+70	
Endurance temperature (>2 h, °C)		-55…+85	
Vibration (RMS, 0.02 - 2 kHz, g)		18	
Shocks (g, 1 ms)	750	350	750
RELIABILITY			
MTBF / Lifetime (yrs)***		15	

* Day-to-day repeatability at fixed temperature and supply voltage
** Magnetically shielded
*** Humidity conditions applied

Annex 2. Product Main Parameters (digital model)

PERFORMANCE	VG191AD
Input range (°/s)	300
Bias stability / Bias repeatability*(RMS, °/h)	1
Angle random walk (°/√h)	0.012
Bandwidth (kHz)	1
SF stability / SF repeatability*(RMS, %)	0.02
Magnetic response (°/h/Gauss)	3 (0.05**)

ELECTRICAL INTERFACE	
Data rate (kHz)	8
Start-up (s)	0.03
Powering (W)	0.5

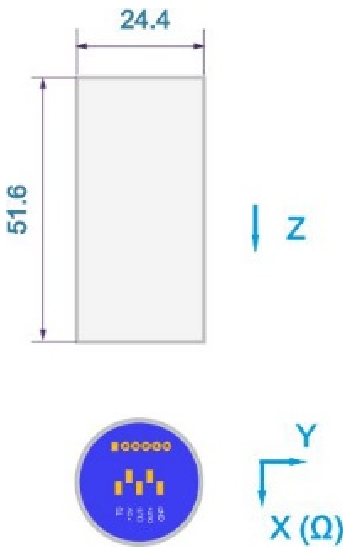
PHYSICAL PARAMETERS	
Dimensions (mm)	ø24 x 48
Weight (gram)	30 (45**)
Volume (cl)	2.2
Housing material	Al alloy (μ-metal**)

ENVIRONMENT	
Operating temperature (°C)	-40…+70
Endurance temperature (>2 h, °C)	-55…+85
Vibration (RMS, 0.02 - 2 kHz, g)	18
Shocks (g, 1 ms)	750

RELIABILITY	
MTBF / Lifetime (yrs)***	15

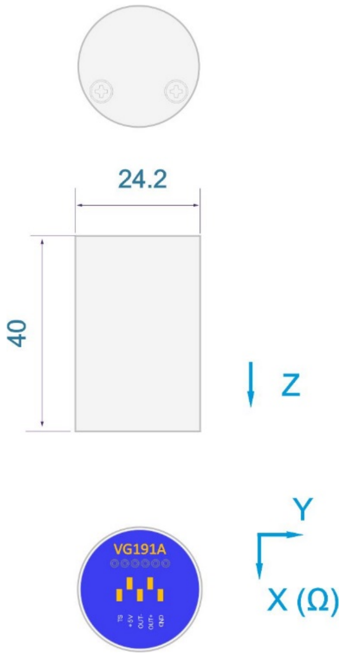
* Day-to-day repeatability at fixed temperature and supply voltage
** Magnetically shielded
*** Humidity conditions applied

Annex 3. Outline Drawings, Axes Definition*, Pads Assignment (analog models)



1	TS
2	+5V
3	OUT-
4	OUT+
5	GND

VG091A

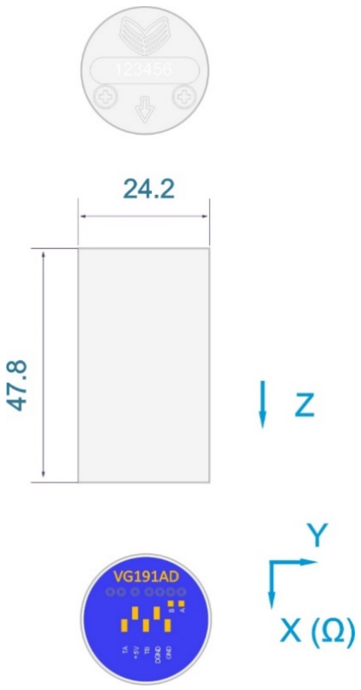


1	TS
2	+5V
3	OUT-
4	OUT+
5	GND

VG191A

* Sensing axis (X) to the main cylinder axis (Z) =90°+/-0.5', X to Y (contacts line) =90°+/-0.5°

Annex 4. Outline Drawings, Axes Definition*, Pads Assignment (digital models)



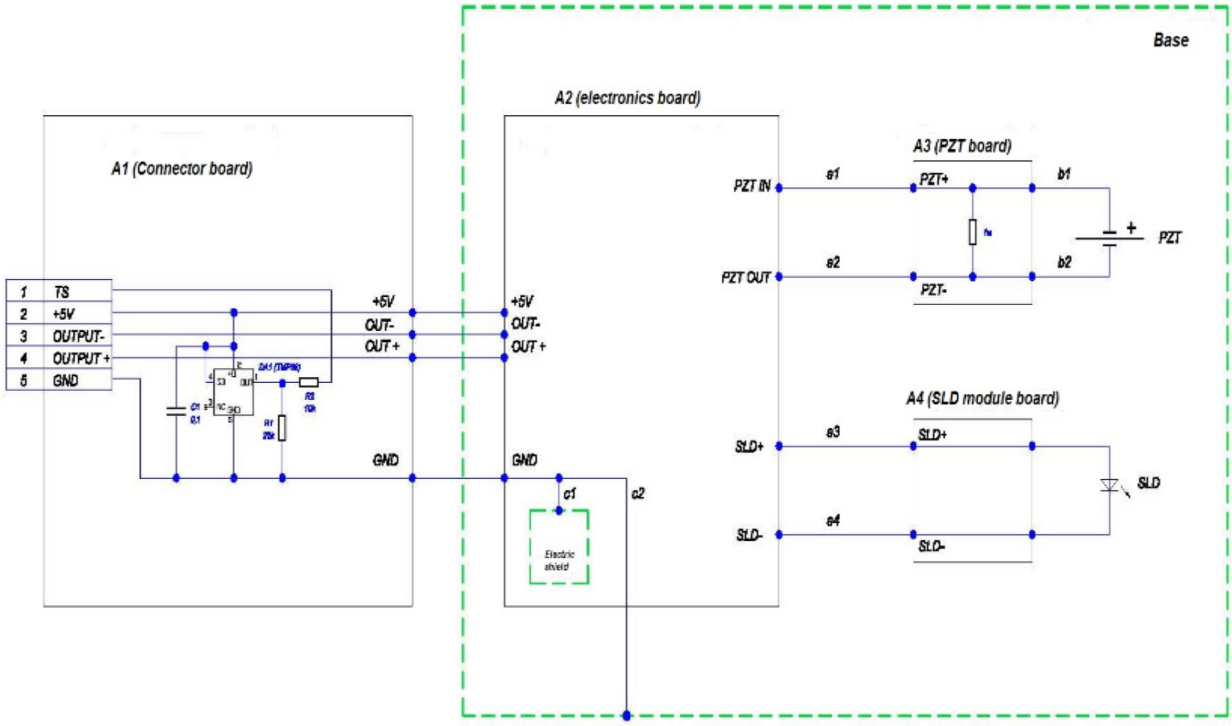
1	RS422TA
2	+5V
3	RS422 TB
4	D_GND
5	GND
	B (for factory use)
	A (for factory use)

VG191AD

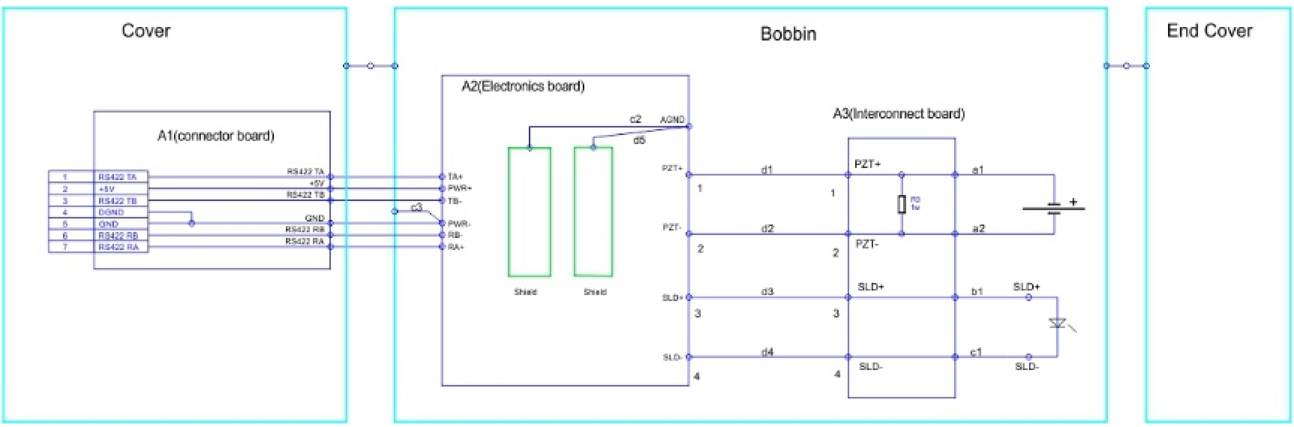
* Sensing axis (X) to the main cylinder axis (Z) =90°+/-0.5', X to Y (contacts line) =90°+/-0.5°

Annex 5. Electrical Diagram (analog models)

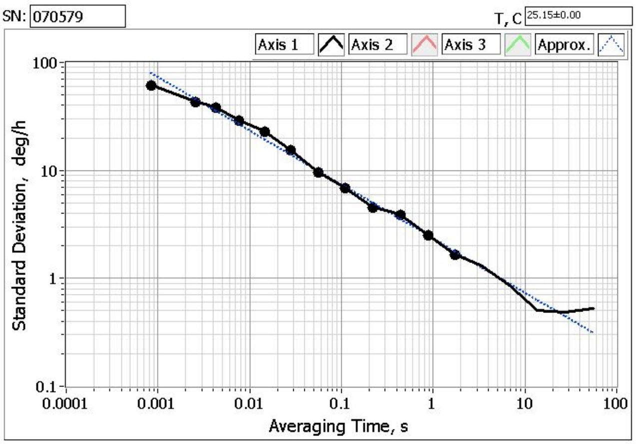
The minimal configuration electronics drives the internal light diode (SLD) and phase modulator (PZT) for signal conditioning. It performs precise demodulation of the optical signal to form gyro raw output (no error compensation).



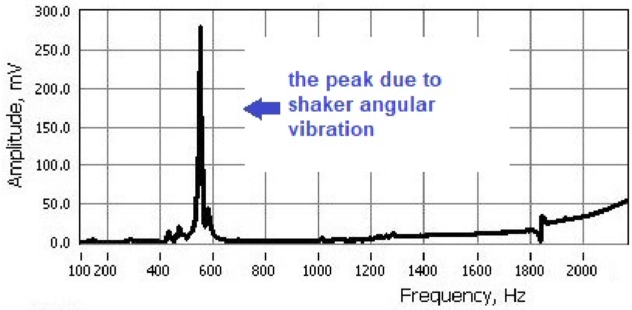
Annex 6. Electrical Diagram (digital models)



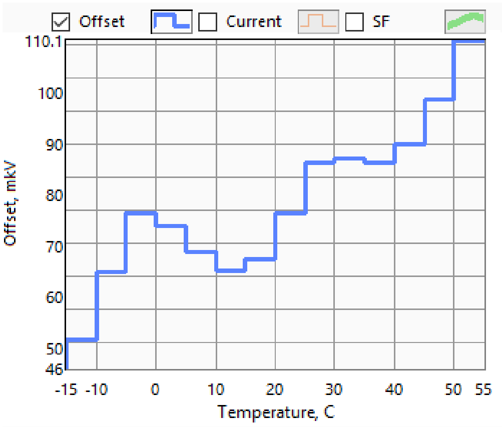
Annex 7. Typical Test Data



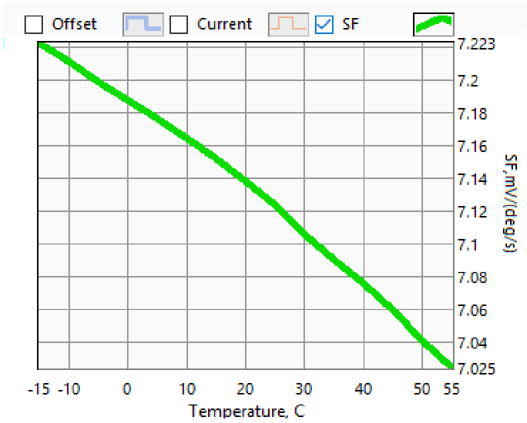
Allan Variance Plot



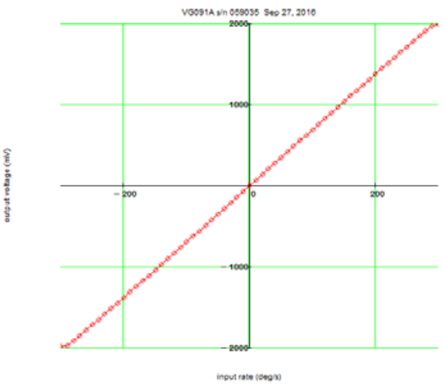
AC Component of the Output vs SINE Vibration
(2 g normalized, X - sensitivity axis)



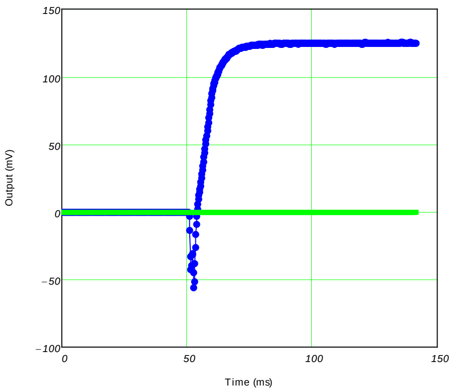
Bias vs Temperature



SF vs Temperature



Output Voltage vs Angular Rate



Power-on Transient (ms)
as gyro rotates 20 deg/s, time resolution 0.2ms

Annex 8. Output LP filter diagram