

Background and status of VG951

The VG951 was developed as a cost effective open-loop FOG to achieve performance $1^\circ/\text{hr}$. It is produced by the company since 1995. The design and production technique were proven by manufacturing and delivery to customers more than 700 gyros of this type. Main fabrication process based on a single-fiber in-line technique developed in Fizoptika. All fiber optic components of FOG's assembly (sensing fiber coil, modulator, couplers, polarizer) are fabricated step by step along a fiber length so that optical connections between components arise without splicing. Performance and quality of each component is a subject of in-process control. The VG951 features the following:

- * Low cost - only primary components are utilized for production.
- * High reliability - uses solid-state instruments.
- * Low power - less 1.5 Watt
- * Excellent bias stability - $< 0.5^\circ/\text{h}$ at $80^\circ/\text{s}$ input range

Rights protection. Entirely VG951, its main components and production technique are under protection of RF Patents NN 2000543, 2000585, 2018159, 2018160, 2054391

Advanced optical assembly.

Conventional "minimal" open-loop optical FOG configuration contains two couplers, polarizer and PZT modulator. Such configuration provides perfect optical "reciprocity" of the counter propagating waves ensuring optical bias stability. However some effects may still lead to a faulty bias. Advanced optical assembly was developed to improve bias stability and to suppress major error sources.

Electronic module with built-in bias calibration.

Electronics module OE141FOS was developed to reduce scale factor and bias instabilities and to suppress quadrature signal. The module is implemented as a single PCB (4 layers, SMT) which integrates photoamplifier and signal processing circuits. Single conditioned +5V power supply is required for operating. High processing accuracy was achieved due to built-in bias calibration and phase control of reference pulses.

GENERAL

VG951 reads absolute angular rate of a moving object. VG951 incorporates advanced optical sensing assembly (optical block-OB) and advanced processing electronics module OE141FOS. Electronics module converts OB optical signal into voltage proportional to angular rate. Output voltage is defined as voltage between contacts "Output" and "AGnd" (Analog ground). Sign of the output voltage corresponds to the direction of rotation around sensing axis. Powering of the sensor is conditioned +5V.

技术参数：

物理参数	
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重量	700 克
尺寸	150 mm 直径 x 31 mm (无边缘和连接件)
供电	
总耗电	< 1.5 watts, 1 watt 典型
电源	+ 5 V (250 mA)
启动时间	< 0.1s
性能	
偏移稳定性 *	1 ° /hr, 1 sigma
偏移变化*	0.3 ° /hr, 1sigma
刻度因子 (SF)	37 mV/° /s ± 10%
刻度因子稳定性	0.1%, 1sigma
刻度因子变化(OTR)	< 5%
随机漂移	< 0.02° /sqrt hr
带宽	150 Hz
工作范围 Operating range	± 80° /sec
重复性 Reliability	20,000 hrs MTBF (predicted @20° C)
环境 Environmental	
工作温度 Temperature	-30° C to +71° C
抗振 Vibration	2g, 20 Hz to 500 Hz
抗振 Shock , acceleration	40g

OTR = operating temperature range * at environmental limits may differ from specified at normal conditions.

附加技术参数 ADDITIONAL TECHNICAL DATA (NON SPECIFIED PARAMETERS)

刻度因子对电压的变化 SF vs supply voltage	1% / V
偏移对电压的变化 Offset vs supply voltage	< 1° /hr / V
刻度因子对温度的变化 SF vs temperature	- 0.05% / ° C
偏移对温度的变化 Offset vs temperature	0.1° /hr / ° C
偏移对外磁场的变化 Offset vs external magnetic field	< 1° /hr / Gauss
输出对加速度的增量 Output vs acceleration increment	1 arc sec / g

OPERATION

Light transmit time through a circular way in a rotating system depends on direction of circulation (Sagnac effect). In a ring fiber optic interferometer light is divided in two beams traversing fiber loop (coil) in opposite directions. After traveling beams are combined (interfere) together. Resultant optical power depends on Sagnac phase proportional to rotation. Factor $K=2p DL/c$ between angular rate and Sagnac phase is optical scale factor (OSF). Its value roughly determines input range $(-W_{Max}...+W_{Max})$. To enhance sensitivity PZT modulator adds high frequency phase. Electronics OE141FOS optimizes PZT and SLD operation to normalize FOG output. "Normalized" FOG output contains DC and AC components of certain

magnitudes. Normalized signal is detected at PZT working frequency and after LP filtering represents angular rate in the frequency range from DC to 100 Hz. VG951 generates output voltage just power is on.

MAIN COMPONENTS

200m of polarization maintaining fiber is wound to form a sensing coil with effective diameter 140mm. PZT modulator is a piezoelectric cylinder on which surface a part of the fiber is wound. PZT fundamental radial resonance frequency is about 80 kHz. Fiber optic couplers 2x2 are made by fusion technique and solder to quartz substrates for vibration and temperature stability. Fiber polarizer (polarization filter) is a key component reducing bias drift. It is fabricated by burying the tapered fiber in the highly birefringent optical media (monocrystal). Mode converter is made by controlled twist of a tapered fiber portion near loop coupler. SLD light module is fixed by soldering after SLD to fiber precise alignment. Its optical power exceeds 100 m W. SLD emits low coherent light giving to the sensor advantage of low noise. All optical components are mounted inside a sealed aluminum case. Processing electronics module OE141FOS is mounted on the OB top cover and is connected to it through internal pins and fiber lead section.

DESCRIPTION OF 15 PIN I/O CONNECTOR FUNCTIONS (for analog version)

TYPES	PIN No.	PIN NAME	DESCRIPTION
SIGNAL OUTPUTS	1	OUTPUT	Gyro output voltage proportional to rotation, scale factor 37mV/deg/s, Impedance 1000 Ohm. Output range ± 2.5 Volts min. Differential input recommended.
	2	DC return AGnd	DC return line for OUTPUT. Analog ground. Differential input recommended.
POWER INPUTS	3	+5VDC	+5 Volts DC regulated 4.9 to 5.5 VDC. Ripple 20mV max. Current temperature dependent, 250mA Max (150mA @ 20° C)
	4	DC return Gnd	DC return line for +5VDC, Ground
OTHERS	5	CASE	Connected to upper cover. Electrical contact to mounting flanges is not ensured.
	6 -15	-	Spare



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ATTACHMENT 1 . VG951D

VG951D is VG951 with digitized output and serial interface.