

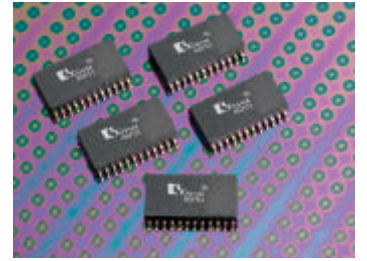
# KGF01 Series Data Sheet

Gyroscopes

Analog Output

**KGF01-1001** — 75°/sec Single Axis X

**KGF01-1002** — 250°/sec Single Axis X



## APPLICATIONS

*Motion Detection*

*Inertial Navigation and Ded(uctive) Reckoning*

*Vehicle Stability Control*

*Vehicle Roll Detection*

*Adaptive Cruise Control*

*Platform Stabilization*

*Guidance Systems*

## FEATURES

High Sensitivity @ 40mV/(°/sec)

Broad Dynamic Range

Low Noise

Excellent Temperature Performance

Compact 24-pin SOIC Package

Self-test Function

User-Defined Low-pass Filter

Low Current Consumption

## PROPRIETARY TECHNOLOGY

Kionix high performance silicon micromachined angular rate sensors consist of a sensor element and an ASIC packaged in a 24-pin SOIC open cavity package. The sensor element is fabricated from single-crystal silicon with proprietary Deep Reactive Ion Etching (DRIE) processes, and is protected from the environment by a hermetically-sealed silicon cap wafer at the wafer level.

The **KGF01** series is designed to provide a high-signal-to-noise ratio with excellent performance over temperature. Sensitivity is factory programmable allowing customization for applications requiring  $\pm 50^\circ/\text{sec}$  to  $600^\circ/\text{sec}$  ranges. Maximum sensor bandwidth is 75Hz. Lower settings are user-definable.

The sensor element functions on the principle of the Coriolis Effect and a capacitive-based sensing system. Rotation of the sensor causes a shift in response of an oscillating silicon structure resulting in a change in capacitance. An ASIC, using a standard CMOS manufacturing process, detects and transforms changes in capacitance into an analog output voltage, which is proportional to angular rate. The sensor element design utilizes differential capacitors and symmetry to significantly reduce errors from acceleration and off-axis rotations.



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# KGF01 Series

## PRODUCT SPECIFICATIONS

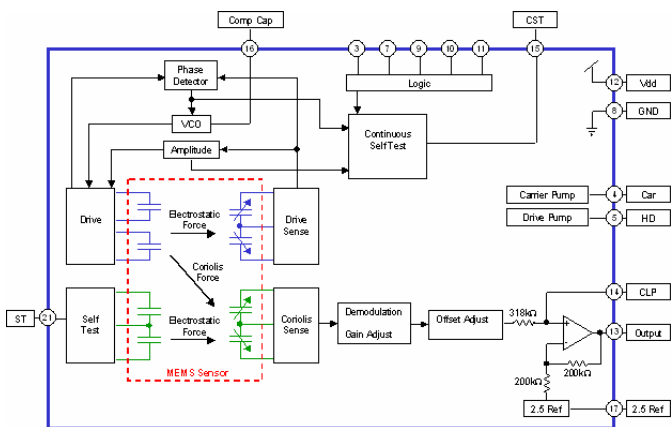
PERFORMANCE SPECIFICATIONS				
PARAMETERS	UNITS	KGF01-1001	KGF01-1002	CONDITION
Range	°/sec	±75	±250	Factory Set
Sensitivity <sup>1</sup>	mV/(°/sec)	26.7	8.0	Factory Set
Span	mV	±2000		
Noise Density	°/sec/Hz <sup>1/2</sup>	.05		
Noise	°/sec	.35		DC..50Hz
Bandwidth <sup>2</sup>	Hz	75 (default) or lower		Hz @ 3dB
Operating Temp.	°C	-40 to 125		
Zero Rate Bias <sup>3</sup>	V	2.500 ± 0.100		Room Temp
Temp. Drift of Zero Bias	°/sec	±5.0		Over chosen temp range
Temp. Drift of Sensitivity	%	±3.0		Over chosen temp range
Non-Linearity	% of FS	±1.0		
Non-ratiometric Error <sup>3</sup>	%	±3.0		
Cross-Axis Sensitivity	% of FS	±2.0		Y Axis
		±1.0		Z Axis
Power Supply	V	5.0 ± 0.25		Voltage
	V	-0.3 (min) 7.0 (max)		Absolute min/max
	mA	25mA (max)		Current draw

ENVIRONMENTAL SPECIFICATIONS				
PARAMETERS	UNITS	KGF01-1001	KGF01-1002	CONDITION
Storage Temperature	°C	-55 to 150		
Mechanical Shock <sup>4</sup>	g	2000		Powered
		3000		Unpowered
ESD	V	3000		Human body model

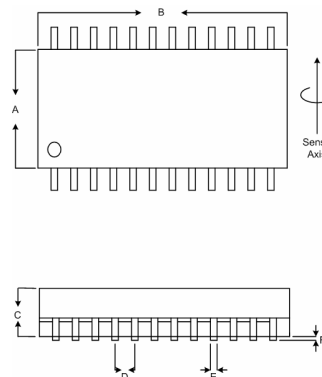
### Notes

- Custom sensitivities from 40mV/(°/sec) through 3.3mV/(°/sec) available.
- Bandwidth is factory programmed to 75Hz. A lower user-defined bandwidth adjustment is done with an external capacitor placed between CLP and GND.
- Output is non-ratiometric. A non-ratiometric 2.5 VDC reference is provided at pin #17 as a scale reference for, e.g., A/D conversions.
- Mechanical shock ratings based on survivability without permanent damage. Recovery time depends on characteristics of shock imparted to device.
- The packaged device weighs .6 grams.

## FUNCTIONAL DIAGRAM



## 24-PIN SOIC OPEN-CAVITY PACKAGE

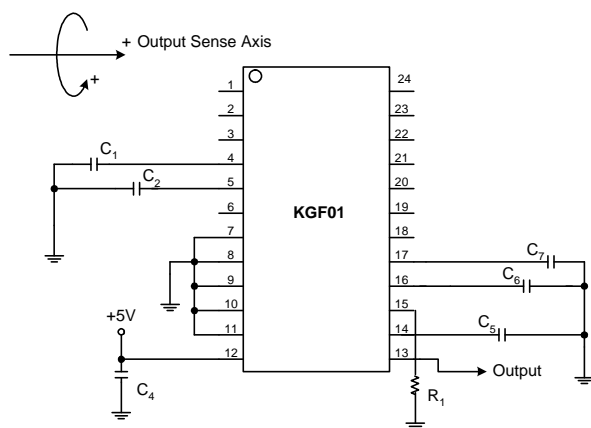


Dimension	Inches	Millimeters
A	.308 / .301	7.83 / 7.64
B	.614 / .599	15.60 / 15.20
C	.128 / .108	3.25 / 2.74
D	.060 / .040	1.52 / 1.02
E	.020 / .013	.51 / .33
F	.011 / .004	.27 / .10
G	.419 / .394	10.64 / 10.01
H	.131 / .119	3.32 / 3.01



# KGF01 Series

## APPLICATION SCHEMATIC & PIN FUNCTION TABLE



Pin	Function	Pin	Function
1	DNC	13	Output
2	DNC	14	CLP
3	DNC	15	CST
4	CAP Car	16	CompCap
5	CAP HD	17	2.5 Ref
6	DNC	18	DNC
7	Reserved	19	V_T
8	GND	20	DNC
9	Reserved	21	Self Test
10	Reserved	22	DNC
11	Reserved	23	DNC
12	Vdd	24	DNC

### Definitions

<b>2.5 Ref</b>	Fixed 2.5V reference. Allows scaling of sensor's non-ratiometric output. Tied to GND via C <sub>7</sub> .
<b>Cap Car</b>	Regulated ASIC reference voltage. Tied to GND via C <sub>1</sub> .
<b>Cap HD</b>	Regulated ASIC reference voltage. Tied to GND via C <sub>2</sub> .
<b>CLP</b>	Single-pole low-pass filter capacitor; customer selectable. See note 3 below.
<b>CompCap</b>	ASIC VCO control voltage. Tied to GND via C <sub>6</sub> .
<b>CST</b>	Continuous self-test digital output. 5V when sensor operational; ground when fault. See note 4 below.
<b>DNC</b>	Do not connect.
<b>GND</b>	Ground.
<b>Output</b>	Rate output with optional sensor fault indication.
<b>Reserved</b>	For factory use; recommend grounding.
<b>Self Test</b>	The output of a properly functioning part will increase by 50[d/s] (nom) when 5V is applied to the self-test pin #21.
<b>Vdd</b>	Sensor supply voltage.
<b>V_T</b>	Temperature reference voltage for customer use. $V_T = 2.46 + (0.0016 * T[C])$ [VDC].

### Notes

1. Recommend using 0.1µF for capacitors C<sub>1</sub>, C<sub>2</sub>, C<sub>6</sub>, & C<sub>7</sub>, 1.0 µF for decoupling capacitor C<sub>4</sub>, and 100 kΩ for R<sub>1</sub>.
2. External components must have same or greater operating temperature range as KGF01 sensor application. Recommended external component voltage and tolerance ratings are:

Component	Min Voltage	Tolerance	Type
C <sub>1</sub> , C <sub>2</sub>	16 V	± 25%	X7R or X5R*
C <sub>4</sub> , C <sub>6</sub> , C <sub>7</sub>	10 V	± 25%	X7R or X5R*
C <sub>5</sub>	10 V	± 10%	X7R or X5R*
R <sub>1</sub>	10 V	± 5%	= 1/16 W

\* Type X7R operating temperature range -55°C - +125°C. Type X5R operating temperature range -25°C - +85°C.

3. C<sub>5</sub> implements a 1-pole filter cascaded upon an internal 75 Hz low-pass 3-pole Bessel filter. Even if the 75 Hz cutoff of the internal 3-pole filter is desired, C<sub>5</sub> should still be populated to reduce digital switching spikes on the output.
4. Resistor R<sub>1</sub> is recommended only if CST (pin #15) is monitored for fault indication in addition to fault indication provided by sensor output (pin #13) going to Vdd rail.
5. Since Kionix gyros are high-precision moving structures, please avoid ultrasonic operations such as ultrasonic cleansing.
6. An evaluation board is available upon request.

## ORDERING GUIDE

Product	Axis of Sensitivity	Range	Sensitivity (mV/g)	Offset (V)	Operating Voltage (V)	Temperature	Package
<b>KGF01-1001</b>	X	75 deg/sec	26.7	2.5	5	-40 to +125 °C	24-pin SOIC Open Cavity
<b>KGF01-1002</b>	X	250 deg/sec	8.0	2.5	5	-40 to +125 °C	24-pin SOIC Open Cavity

