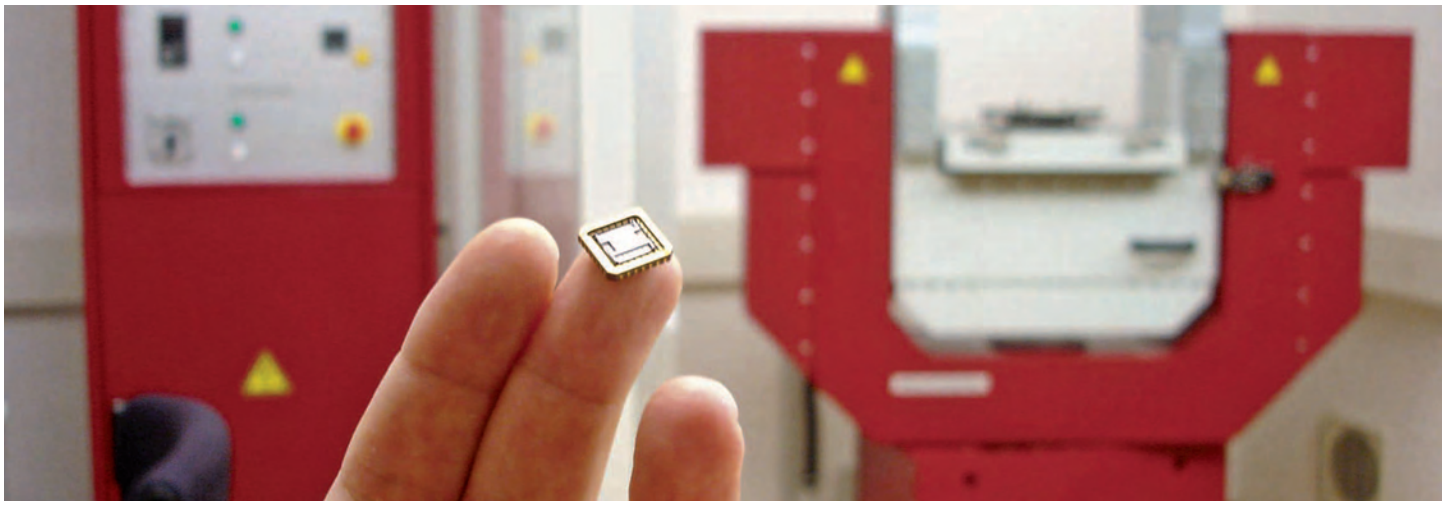
Issue 12_November 2007

Newsletter



Gyroscope chip tested on ACUTRONIC's Three-Axis MEMS Tester (Model AC3337-TCC)

Editorial

Dear reader

We have dedicated the second edition of our 2007 Newsletter to various aspects of MEMS and its growing importance to our market. MEMS technology has opened new markets and created novel applications. The ACUTRONIC Group covers the entire range of test products and also satisfies the needs of the MEMS community. Talking about MEMS is not only about products, as service also plays a crucial role. ACUTRONIC offers a wide range of services such as leasing solutions or renting out entire MEMS test stations at both our USA and Swiss facilities.

Enjoy reading our ACUTRONIC Newsletter.

Thomas W. Jung
Group CEO ACUTRONIC

Testing of MEMS based Inertial Sensors

Thomas Link, HSG-IMIT

The German Institute for Micromachining and Information Technology (HSG-IMIT) uses the new Three-Axis MEMS Tester of ACUTRONIC for characterization of MEMS gyroscopes and studies for medical applications such as walking analysis of patients in rehabilitation.

New technologies based on micro-technology, so called MEMS (Micro Electro-Mechanical Systems), have been enabling many new products over the last ten years such as inkjet printers, displays or pressure sensors. Focusing on measurement of motion, MEMS inertial sensors such as accelerometers and gyroscopes, open new application fields for three big branches: the automotive, consumer goods and aerospace industry. Their annual growth of products based on these sensors is more than 10 percent.

Although MEMS based gyroscopes often do not match the specifications of fiber optic gyroscopes in terms of stability they

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ACUTRONIC

AC1120S – Single-Axis MEMS Tester

Martin Hugi, Project Manager AC1120, ACUTRONIC Switzerland

The AC1120E – conceived at the beginning of this century in order to provide cost-effective test solutions for the MEMS (Micro Electro-Mechanical Systems) Industry – has been replaced with the AC1120S with enhanced features.

The Challenge of Testing MEMS Inertial Sensors

Since the first use of MEMS inertial sensors at the end of the last century, the sensors have become increasingly popular. MEMS sensors are mainly used in the automotive industry as critical elements of airbag systems, electronic stability control systems or roll-over sensors. Being mass produced, test equipment designed for high production volumes and low cost is required.

ACUTRONIC's answer to this challenge was the AC1120E single axis rate table. The motion table was typically enhanced with temperature chamber options and a number of add-ons which can be combined to several different configurations. Since the year 2000 over 100 units have been sold to a great number of customers. The rate tables are primarily used for MEMS testing but also customers outside the MEMS world are using the AC1120 – for testing of traditional inertial components.

AC1120S – The New Family

In 2005 a redesign was initiated to keep the concept up to date with developments in the drives industry. The result of the redesign is the new family AC1120S, with new or improved features such as:

- Maximum rate 3,000 °/s
- Maximum acceleration 40,000 °/s²
- More precise encoder – leading to positioning accuracy of 15 arc sec
- Easier installation
- Improved rate stability (0.0001% over 360°)
- Comprehensive and standardized technical documentation
- ACUTROL 3000-like GUI (General User Interface), running on a PC
- Short, ex-stock lead times

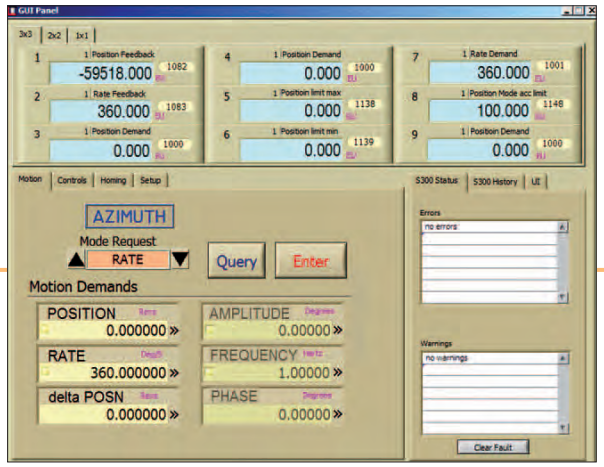
Since its introduction on the market about 30 systems have already been delivered to a number customers worldwide. Applications range from laboratory testing during development of new sensors to mass production. Often customers use sophisticated fixtures in order to test several sensors at the same time.

System Description

The drive assembly is equipped with a direct drive brushless motor providing high torque and smooth rates over a wide range of operation. It is mounted on a preci-

AC1120S, Basic System, System Prepared for Temperature Chamber with Standard Table Top and with Large Table Top (from left to right, all three with Axes in Vertical position)

AC1120S, Basic System and System Prepared for Temperature Chamber with Standard Table Top (from left to right, both with Axes in Horizontal Position)



ACUTROL 3000-like GUI
(Graphical User Interface), running on a PC

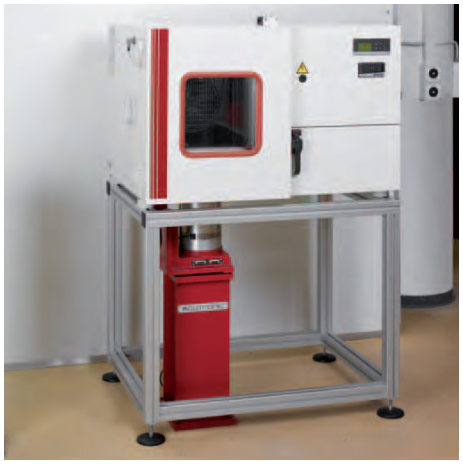
sion-ground, cast iron angle bracket for use in either horizontal or vertical orientation.

Support points are precision-machined perpendicular or parallel to the table axis within small angular tolerance. A 30-way slip-ring capsule, with rings rated at 1.7 Amps continuous current and 200 VDC or 110 VAC per circuit, connects the Unit Under Test (UUT) to the table base. The lines terminate in two D-SUB connectors on the table top with corresponding connectors on the table base.

Control of the rate table is done either via the ACUTRONIC GUI (Graphical User Interface) or via customer's own software using ASCII command strings, via RS232 communication interface. LabView®* Virtual Instrument (.vi) drivers are provided for easy implementation of customer's software. The GUI allows the user to select modes, command motion set points, monitor system variables and query status. The GUI is also used to customize the system configuration, initiate tuning/calibration procedures. Additional interfaces available are analog inputs, digital inputs/outputs and CanBus. Optionally, USB and Ethernet converters can be used.

Two sizes of temperature chamber are available. The axis of the turn table can be used either in vertical or horizontal position. The standard temperature range is –50 °C to +115 °C. Extended temperature ranges are available on request. Please download the AC1120S data sheet from our website www.acutronic.com for more details.]

*LabView® is a registered trademark of National Instruments Corporation.



AC1120S with Temperature Chamber, Axis Vertical

AC1120S with Temperature Chamber, Axis Horizontal

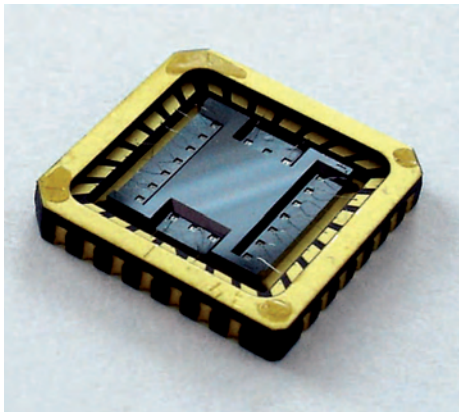
AC1120S with Temperature Chamber, Axes Vertical and Horizontal

Specifications

Rate Table		**Positioning accuracy**	± 15 arcsec	**Digital inputs**	4 digital inputs
Payload, nominal	10 kg	**Rate range**	± 3,000 °/s	**Digital outputs**	2 digital outputs
Payload, max.	20 kg	**Rate resolution**	0.001 °/s		
Table top diameter	250 mm	**Rate stability (over 360°)**	0.001 %	**Temperature Chamber** (Standard Size)	
30 way slip ring	1.7 Amps cont.	**Acceleration, no load**	40,000 °/s2	**Cooling**	mechanical
Wobble	< 10 arc sec	**Bandwidth (-3dB)**	>150 Hz for velocity loop	**Temperature range**	–50 °C to 115 °C
Angular freedom	Continuous			**Gradient**	4.7/5.3 °C/min.
Position range	0 to 359.999 deg	**Host computer interface**	RS-232 or USB	**Chamber size (mm)**	1,000 × 780 × 630
Position slew profiling	Rate, Acceleration	**Analog inputs**	2 analog inputs	**Chamber volume**	37 ltr

Continuation cover story

feature minimal cost, ultra light weight and small dimensions. Additionally their shock resistivity for harsh environment can be up



Gyroscope chip on a ceramic carrier

to 10,000 g. These features open the doors to new applications, e.g. for main stream applications with high volumes, such as mobile phones or digital camcorders and for specific applications focusing on ultra small overall dimensions and weight. Sensors based on MEMS technology satisfy the environmental requirements and those of low cost in an ideal way. As of winter 2005, ACUTRONIC Switzerland and the Institute for Micromachining and Information Technology (HSG-IMIT), located in the south-west of Germany, began collaboration. A first phase resulted in the purchase of the new Three-Axis Motion Simulator AC3337-TCC from ACUTRONIC which has been designed specifically for MEMS testing applications. In late 2006 the simulator was installed at HSG-IMIT for actual project activities. Compared to fiber optic or laser based gyroscopes, motion simulation system for MEMS based inertial sensors have to fulfill specific requirements. Simultaneous excitation of all three axes combined with temperatures between –40 °C and +85 °C is of significance for the new MEMS sensor generation. The focus lies on fast test cycles and testing opportunities for multiple sample set-ups to reduce testing cost during development and production phase.

New MEMS applications require multi-axis testing

New applications require more than one rotation axis on a single silicon chip. Actual research and development activities of HSG-IMIT focus on these future requirements. One of the projects is the development of a new medical device dedicated to analyze the walking of a patient in rehabilitation. Therefore several small and lightweight motion sensors have been fixed to arms and legs in order to measure the complex motion in six degrees of freedom. Characterization of these devices will be performed on the new Three-Axis Simulation System. In addition to scale factor and offset drift over temperature, a lot of attention is paid to axis misalignment and cross-axis sensitivities.]

The Institute for Micromachining and Information Technology (HSG-IMIT) is a leading R&D provider for micro technical components and systems in the field of **Sensors & Systems, Microfluidics and Prototyping & Production.** Since 1995 HSG-IMIT has strong activities focused on Inertial Sensors and Systems offering product oriented and innovative solutions for precise acquisition of rotations, translations and inclinations in space. Since 2007 Mr. Thomas Link is head of the new application center “Micro-Mountains Applications AG”, involving the competence of HSG-IMIT to bring innovative solutions to success with their customers—mainly small—and medium enterprises (SME).

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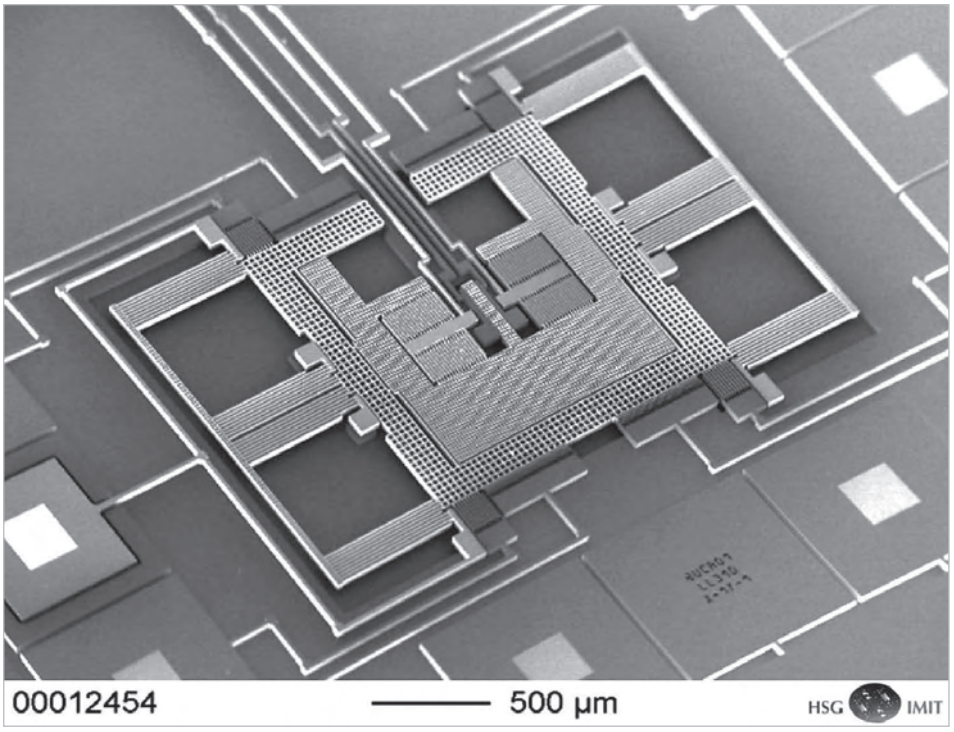

MEMS gyroscope for harsh environment (overall dimension of the micromachined silicon structure is 2.5 × 2.0 mm², minimal technological gap is about two thousands of a millimeter).