

# GyroSmart™

Directional surveying inside drill rods



Australia



Chile



USA



**Memory Miniature Gyro**  
Smallest there is ...





## **GyroSmart™ A Memory Gyro that's more than just a gyro. GyroSmart™ A complete downhole surveying package capable of surveying in all environments, magnetic and non magnetic, providing its own internal quality checks.**

### **Introduction.**

GyroSmart™ is the simplest to use, yet most technically advanced, miniature Digital Gyro survey system available. With the GyroSmart™, Claes Ericsson releases his latest precision survey instrument, the most revolutionary survey system since he launched the Fotobor to the mineral exploration industry in 1974. The GyroSmart™ represents decades of innovative development in borehole surveying systems.

The new GyroSmart™ uses 12 sensors to record its relative position from any given direction and utilizes for the first time. MEMS Gyro technology that is so small it fits on your index finger.

There is no need for expensive conductor wire line or cable heads, the power is provided by a rechargeable internal battery pack and data is downloaded from the 512 Mb onboard memory via Blue Tooth or WLAN.

### **Uses:**

Directional survey inside the following drill rods.

- Reverse circulation
- Conventional diamond core drilling
- Wireline drilling
- Raise bore
- Percussion
- Rotary
- Directional drilling
- Steered coredrilling

Providing directional data (azimuth and dip) at any interval from inside the drill string.

GyroSmart™ can also be used in open hole applications providing Azimuth data in disturbed zones by utilizing the Gyros. The magnetometers can be used to quality check the accuracy where the ground is not magnetically disturbed.

### **Key features:**

#### **Navigation Software**

- state-of-the-art Kalman filters

#### **Proven technology**

- Uses Imego digital Gyro Sensor, IBG10

#### **No moving parts**

- Utilizes MEMS Gyro

#### **Rugged**

- Solid state components

#### **Memory Gyro**

- 512MB onboard memory

#### **Small OD**

- 36mm and 38mm OD

#### **Fits standard running gear**

- Existing brass 36mm and 38mm barrels.

#### **No Cables**

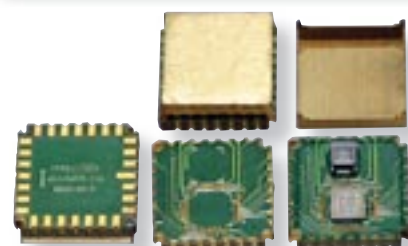
- Uses Blue Tooth or WLAN

#### **Battery powered**

- 3600 mAh NiMH (re-chargeable) for 9 hours

#### **Affordable**

- One of the least expensive Gyros on the market



## GyroSmart™ – Micro-Gyro Based Logging and Mapping of Drilled Holes

Flexit Navigation AB and Imego AB of Sweden have built GyroSmart™ - the new technology for logging and mapping of drilled holes. GyroSmart™ is built around digital micro gyroscopes, complementing traditional magnetometers and inclinometers, to form a small but precise instrument that will replace a host of competing technologies.

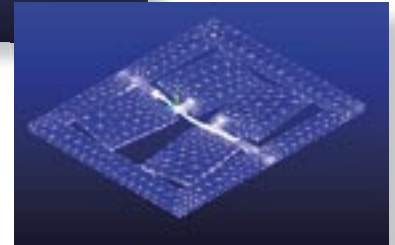
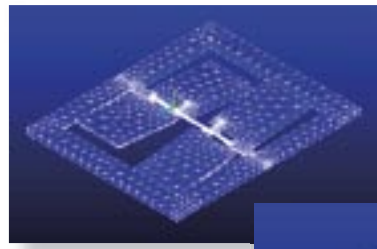
GyroSmart™ complements and expands Flexit's current line of products, enabling smart measurement in zones of magnetic anomalies, including both rock and casing or surface materials. In GyroSmart™, Flexit offers a survey tool with several hours internal data storage and fast wireless download of all data using Bluetooth or WLAN. A special feature will enable complete mapping of holes with a relative precision in the order of centimeters. Furthermore, GyroSmart™ will permit a direct comparison of angular information from gyro sensors versus magnetometers in magnetically anomalous rock.

### Imego's MEMS Gyro

GyroSmart™ is built around the Imego digital Butterfly Gyroscope, the IBG10. The gyro consists of a sensor chip and a mixed-signal ASIC assembled in a non-magnetic package. These two components work together to yield unparalleled flexibility; world-class digital micro-gyro performance in a standard LCC28 footprint. The GyroSmart™ Survey System is the first inertial sensor system built around the IBG10. This survey system is battery operated and completely based on shock tolerant MEMS sensors giving high performance in a micro sized system. The first field tests were performed in February 2006 and production is planned for the third quarter of 2006 by Flexit.

A gyroscope is a device that is used to measure angular rate. The rate detection principle of all micro-mechanic gyros is based on an effect first described by Coriolis. The easiest way to understand this effect is to think of a man who is standing on a merry-go-round. Imagine that the man starts to walk toward the centre of rotation. He will immediately experience a force pulling him to his right. This is the Coriolis force acting at right angles to the

### Detection Mode



### Excitation Mode

external rate and the velocity of the man. The Coriolis force is proportional to the mass of the man, his velocity and the rate of the merry-go-round:  $F = 2mv \times \Omega$ . The main part of the IBG10 sensor chip, consists of two wings interconnected to a solid frame by a set of elastic beams. Using a set of electrodes underneath, the wings are forced to vibrate in anti-phase motion in the plane of the frame. The ASIC is used to keep active control of this vibration.

Imagine that a rate is applied to make the gyro rotate about an axis perpendicular to the main interconnecting beam. Thanks to the Coriolis effect, the two wings will begin to vibrate out of the plane and they will do so in anti-phase. The amplitude of the out-of-plane vibration is directly proportional to the applied rate. A second set of electrodes underneath the wings is used to measure this amplitude and the ASIC transforms it into a digital output rate signal. The digital Butterfly gyro has an in-run stability of 1.0 deg/h, a white noise level of 0.003 deg/s/rtHz and the ability to survive shock levels of up to 10,000g.

- **ASIC - Application Specific Integrated Circuit**
- **MEMS - Micro Electro-Mechanical System**



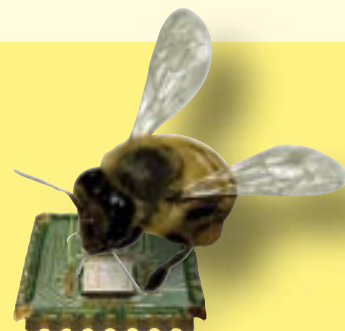
Hand units

# GyroSmart™ Data Sheet

## Instrument Accuracy

Parameter	Accuracy	
	Static Mode	Inertial Mode
Dip (Inclination)	± 0,2 °	± 0,2 °
Azimuth	± 0,3 °	± 0,5 °(*)
Roll	± 0,3 °	± 0,3 °

• verified to ± 0,1° covering 100m with 10m stations in max 8 min,  
estimated to ± 0,5° covering 800m with 10m stations in max 40 min.



Actual size compared to a bee

## Sensor Specifications

Parameter	Angular rate	Acceleration	Inclination	Magnetic Field
Dimensions	3 axes	3 axes	3 axes	3 axes
Range	± 600 °/s	± 50 g	± 2 g	± 6 G*
Linearity [% FS]	0,3 %	< 1,0 %	0,3 %	0,1 % [±1G]
Temp. stability	0.05 °/s/°C	80 mg/°C	800 µg/°C	200 µG/°C
Sensitivity	N/A	25 mV/g	1 V/g, 0.5V/g	1 V/G
Noise Density	0,002 °/s/√Hz	50 µg/√Hz	200 µg/√Hz	20 µG/√Hz
Alignment Error	± 1,0 °	± 1,0 °	± 0,5 °	± 6 °
Bandwidth	250 Hz	450 Hz	17 Hz	40 Hz
Max sample rate	1952 Hz	1952 Hz	122 Hz	122 Hz

\*1 G = 10<sup>5</sup> nT

## Physical specifications

<b>Digital interface</b>	RS-232 / Bluetooth 2.0
<b>Built in memory</b>	512 MB
<b>Operating voltage</b>	7,2V
<b>Power consumption</b>	400 mA
<b>Battery package</b>	3600 mAh NiMH (re-chargeable)
<b>Continuous operation</b>	9 hours
<b>Dimensions</b>	Diameter 31,7 mm , Length 750 mm
<b>Weight</b>	1,1 kg
<b>Temperature rating</b>	5-65 °C (0,1 °C resolution)

