Honeywell HG4930CA51
Tactical grade 6-axis IMU
System report by Philippe VANDAR & Sylvain Hallereau
January 2019 – version 1
# Table of Contents

## Overview / Introduction
- Executive Summary
- Main Chipset
- Reverse Costing Methodology
- Glossary

## Company Profile
- Honeywell International Inc.

## Teardown Analysis
- Characteristics IMU
- Views and Dimensions of the System
- System Opening
- CPU board
  - Top Side – Global view
  - Top Side – High definition photo
  - Top Side – Main Components & ICs Identification
  - Bottom Side – Global View
  - Bottom Side – Main Components Identification
- Accelerometer Board
- Gyroscope Board
- Sensor components
  - 1-axis accelerometer MEMS
  - 1-axis gyroscope MEMS
  - Movable Elements
  - MEMS Cross-Section
  - Process Flow
- Comparison with Sensonor STIM210 and HG1120CA50 IMUs

## Cost Analysis
- PCB Cost
- MEMs components costs
- Components Estimation costs
- Inertial MEMS - Wafer cost
- Inertial MEMS – Die Cost
- Inertial MEMS – Components Cost
- 4 ASIC Dies – Wafer Cost
- 4 ASIC Dies – Die Cost
- 4 ASIC Dies – Components Cost
- BOM Cost – CPU Board
- BOM Cost – Accelerometer Board
- BOM Cost – Gyroscope Board
- Housing Parts – Estimation
- Material Cost Breakdown by Sub-Assembly
- Accessing the Added Value (AV) cost
- Electronic Boards Manufacturing Flow
- Details of the CPU Board AV Cost
- Details of the IMU-Mechanical Parts
- Added-Value Cost Breakdown
- Manufacturing Cost Breakdown

## Estimated Price Analysis
- Estimation of the Selling Price

## Give us your Feedbacks!

## Company Services
Executive Summary

This full reverse costing study has been conducted to provide insight on technology data, manufacturing cost and selling price of the **HG4930 Inertial Measurement Unit** supplied by [Honeywell International Inc](https://www.honeywell.com) (website).

The System is a Micro-Electro-Mechanical System (MEMS) based Inertial Measurement Unit (IMU) used in the agriculture, Autonomous Underwater Vehicles, industrial equipment, robotics, survey/mapping, stabilized platforms, transportation, drone and aerospace.

The HG4930 includes MEMS gyroscopes, accelerometers from Honeywell.

With a gyroscope bias instability in run of 0.25°/h and accelerometer bias in run stability 0.025mg, the Honeywell HG4930CA51 is the highest performance silicon MEMS IMU not ITAR controlled IMU from Honeywell. The analyzed module is a complete system offering 3 axes MEMS gyros and 3 axes MEMS accelerometer.

The Honeywell MEMS technology are based on silicon and glass substrates bonded together to perform a high-reliability and high accurate inertial MEMS.

The HG1120CA50 is a 65 mm × 52 mm × 35 mm module targeted for applications such as platform control, navigation, robotics. Mixing the technologies developed for military and harsh environment and 6 high-grade inertial silicon MEMS sensor from Honeywell. The 6 MEMS are associated with 13 ASIC dies which provides flexibility in device configuration.

We estimate that the device is manufactured and tested by Honeywell in **USA** for a volume of 1,000 units per year. So, the production cost and the selling price are calculated for 1,000 units in 2018.

The **HG4930 MEMS Inertial Measurement Unit** is made with 3 electronic boards and **479** components and parts.
Characteristics IMU

- **HG4930 IMU TYPICAL KEY CHARACTERISTICS**
  - **Gyroscope Operating Range**: 200°/sec to +200°/sec
  - **Accelerometer Operating Range**: -20 g to +20 g
  - **Supply Voltage**: ±5 VDC ±5%
  - **Power Consumption**: < 2 Watts (Standard Series)
  - **Operating Temperature Range**: -54°C to +85°C
  - **Volume/Size**: 82 cm³ (6.5 x 51 x 35.5 mm)
  - **Weight**: 140 grams (0.3 lbs)
  - **Dual Navigation/Control Serial Asynchronous RS422 Output**: Fully Compensated Incremental/Delta Outputs are Ready for Integration into Position/Attitude Stabilization Configurations Optimize Latency & Bandwidth Without Sacrificing Accuracy

- **HG4930 IMU TYPICAL BANDWIDTH AND DATA RATE CHARACTERISTICS**
<table>
<thead>
<tr>
<th>Device Class</th>
<th>Gyro</th>
<th>Accel</th>
<th>Control</th>
<th>Incremental</th>
<th>Band Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>HG4930CA51</td>
<td>70/180</td>
<td>70/180</td>
<td>600 Hz</td>
<td>100 Hz</td>
<td>1 MBit</td>
</tr>
<tr>
<td>HG4930BA51</td>
<td>70/180</td>
<td>70/180</td>
<td>600 Hz</td>
<td>100 Hz</td>
<td>1 MBit</td>
</tr>
<tr>
<td>HG4930AA51</td>
<td>70/180</td>
<td>70/180</td>
<td>600 Hz</td>
<td>100 Hz</td>
<td>1 MBit</td>
</tr>
</tbody>
</table>

- **HG4930 IMU TYPICAL PERFORMANCE OVER FULL TEMPERATURE RANGE**
<table>
<thead>
<tr>
<th>Device Class</th>
<th>Gyro Bias</th>
<th>Gyro Bias In-run Stabilty</th>
<th>Accel Bias</th>
<th>Accel Bias In-run Stabilty</th>
<th>Accel V/K</th>
</tr>
</thead>
<tbody>
<tr>
<td>HG4930CS36</td>
<td>0.25</td>
<td>0.04</td>
<td>0.025</td>
<td>0.03</td>
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<tr>
<td>HG4930CA51</td>
<td>0.25</td>
<td>0.04</td>
<td>0.025</td>
<td>0.03</td>
<td></td>
</tr>
</tbody>
</table>

**Manufacturer Plant**

HG4930 Datasheet extract
System Opening

Overview / Introduction

Company Profile & Supply Chain

Physical Analysis
- Characteristics IMU
- System Views & Dimensions
- System Opening & Board
- MEMS
  - Accelerometer x-axis
  - Accelerometer z-axis
  - Gyroscope x-axis
  - Gyroscope z-axis
- Comparison

Cost Analysis

Selling Price Analysis

Related Reports

About System Plus
Overview / Introduction

Company Profile & Supply Chain

Physical Analysis
- Characteristics IMU
- System Views & Dimensions
  - System Opening & Board
    - MEMS
      - Accelerometer x-axis
      - Accelerometer z-axis
      - Gyroscope x-axis
      - Gyroscope z-axis
    - Comparison

Cost Analysis

Selling Price Analysis

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Package

Package type: CLCC 25-pin
Package dimensions: XXmm x XXmm XXmm
Pin Pitch: XXmm

HTCC ceramic,
Inertial sensor – Movable Elements

Physical Analysis
- Characteristics IMU
- System Views & Dimensions
- System Opening & Board
- MEMS
  - Accelerometer x-axis
  - Accelerometer z-axis
  - Gyroscope x-axis
  - Gyroscope z-axis
- Comparison

Cost Analysis

Selling Price Analysis

Related Reports

About System Plus
Inertial MEMS Cross-Section

Overview / Introduction

Company Profile & Supply Chain

Physical Analysis
- Characteristics IMU
- System Views & Dimensions
- System Opening & Board
- MEMS
  - Accelerometer x-axis
  - Accelerometer z-axis
  - Gyroscope x-axis
  - Gyroscope z-axis
- Comparison

Cost Analysis
Selling Price Analysis
Related Reports
About System Plus
## Glass Substrate – MEMS Front-End Cost

### Bottom Glass Wafer

<table>
<thead>
<tr>
<th>Raw Wafer (Glass 150mm)</th>
<th>Low Yield</th>
<th>Medium Yield</th>
<th>High Yield</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Cost</td>
<td>Breakdown</td>
<td>Cost</td>
</tr>
<tr>
<td>Clean Room</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
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<tr>
<td>Consumable</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Labor</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Yield Losses Cost</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

### MEMS Front-End Cost

### Cap Glass Wafer

<table>
<thead>
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<th>Raw Wafer (Holed glass 150mm)</th>
<th>Low Yield</th>
<th>Medium Yield</th>
<th>High Yield</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Cost</td>
<td>Breakdown</td>
<td>Cost</td>
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<td>Clean Room</td>
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<td></td>
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<tr>
<td>Labor</td>
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<td></td>
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</tr>
<tr>
<td>Yield Losses Cost</td>
<td></td>
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</tr>
</tbody>
</table>

### MEMS Front-End Cost
# BOM Cost – Gyroscope Board

## Cost Analysis
- Assessing the BOM
- PCB Cost
- MEMS costs
- IC costs
- BOM Cost
- Housing Parts Estimation
- Manufacturing Cost

## Selling Price Analysis

## Related Reports

## About System Plus

### GYROSCOPE BOARD

<table>
<thead>
<tr>
<th>Part reference</th>
<th>Article qty</th>
<th>Description</th>
<th>Package</th>
<th>Pin nb</th>
<th>Manufacturer</th>
<th>Datasheet</th>
<th>Side</th>
<th>Unit cost</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCB of GYROSCOPE BOARD</td>
<td>56006115</td>
<td>CAPACITOR MLCC 0402 5%</td>
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<td></td>
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</table>

**TOTAL PURCHASING COST PER ARTICLE: $ 574.49**
### Manufacturing Cost Breakdown

<table>
<thead>
<tr>
<th>Honeywell-IMU-HG4930CA51</th>
<th>ASSEMBLY COST</th>
<th>MATERIAL COST</th>
<th>MANUFACTURING COST without scrap &amp; supplying costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article Qty</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU BOARD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACCELEROMETER BOARD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GYROSCOPE BOARD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMU-Mechanical Parts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Honeywell-IMU-HG4930CA51</th>
<th>ASSEMBLY COST</th>
<th>MATERIAL COST</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU BOARD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACCELEROMETER BOARD</td>
<td></td>
<td></td>
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<tr>
<td>GYROSCOPE BOARD</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>IMU-Mechanical Parts</td>
<td></td>
<td></td>
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<tr>
<td>TOTAL</td>
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Estimation of the Selling Price

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Quantity</th>
<th>Manufacturing Location</th>
<th>Material Cost</th>
<th>Scrap</th>
<th>Supplying</th>
<th>Total Material Cost</th>
<th>Assembly Cost</th>
<th>Manufacturing Cost</th>
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</thead>
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<tr>
<td>2018</td>
<td>1,000</td>
<td>USA</td>
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<td>20.0%</td>
<td>5.0%</td>
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Honeywell, Inc

<table>
<thead>
<tr>
<th>R&amp;D</th>
<th>G&amp;A</th>
<th>Profit</th>
<th>Estimated Manufacturing Price</th>
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</thead>
<tbody>
<tr>
<td>5.0%</td>
<td>14.0%</td>
<td>18.0%</td>
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</table>

Related Reports
- Selling Price Analysis
  - Financial Ratios
  - Manufacturer Price

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Related Reports

REVERSE COSTING ANALYSES - SYSTEM PLUS CONSULTING

- SP14152 – Sensonor STIM210
- Analog Devices ADIS16460 6-axis MEMS Inertial Sensor
- Honeywell HG1120CA50 9-axis MEMS Inertial Sensor

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MEMS & SENSORS
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- Sensors for Robotic Vehicles 2018
- High-end Inertial Sensors for Defense, Aerospace, and Industrial Applications

Related Reports
MEMS inertial measurement units (IMUs) for tactical grade applications have made a lot of progress in the past few years in terms of performance, stability and reliability. They are now accepted in high-reliability environments and are even starting to replace Fiber Optic Gyros (FOGs) and other technologies in tactical applications. Today in new market opportunities, like robots, smart agriculture, autonomous cars and drones, highly accurate motion in a small space is mandatory, which could boost the IMU market. Already a leader in the military market, Honeywell has developed the HG4930CA51, a non-International Traffic in Arms Regulations (ITAR) tactical grade IMU for these applications they call the Internet of Moving Things.

With a gyroscope bias instability in-run of 0.25°/h and accelerometer bias in-run stability of 0.025mg, the HG4930CA51 is the highest performance non-ITAR silicon MEMS IMU from Honeywell. The analyzed module is a complete system utilizing three single-axis MEMS gyroscopes and three single-axis MEMS accelerometers.

The HG4930CA51 is a 65 mm × 52 mm × 35 mm compact module addressing platform control, navigation and robotics applications. It mixes technologies developed for military and harsh environments and six high-grade silicon MEMS sensors from Honeywell. The six MEMS sensors are associated with 13 ASIC dies, which provides flexibility in device configuration.

The report contains a detailed physical analysis with process description and manufacturing cost analysis. It also includes a full comparison with Sensonor STIM210 and the HG1120CA50.
TABLE OF CONTENTS

Overview/Introduction
• Executive Summary
• Main Chipset
• Reverse Costing Methodology
• Glossary
• Characteristics IMU

Company Profile
• Honeywell International Inc.

Physical Analysis
• Views and Dimensions of the System
• System Opening
• CPU Board
  ✓ External view
  ✓ Main and IC component markings
  ✓ Main component and IC identification
• MEMS Board
• Sensor Components
  ✓ 1-Axis accelerometer MEMS
  ✓ 1-Axis gyroscope MEMS
  ✓ Movable Elements
  ✓ MEMS Cross-Section
  ✓ Process Flow

Cost Analysis
• Accessing the BOM
• PCB Cost
• Component Costs
  ✓ Inertial MEMS - Wafer cost
  ✓ Inertial MEMS – Die Cost
  ✓ Inertial MEMS – Components Cost
  ✓ 4 ASIC Dies – Wafer Cost
  ✓ 4 ASIC Dies – Die Cost
  ✓ 4 ASIC Dies – Components Cost
• BOM Cost
• Housing Parts – Estimation
• BOM Cost - Mechanical Parts
• Accessing the Added Value (AV) Cost
• Electronic Boards Manufacturing Flow
• Details of the CPU Board AV Cost
• Details of the Accelerometer and Gyroscope Board AV Cost
• Added-Value Cost Breakdown
• Manufacturing Cost Breakdown

Selling Price

AUTHORS

Sylvain Hallereau is in charge of costing analyses for IC, power and MEMS. He has more than 10 years of experience in power device manufacturing cost analysis and has studied a wide range of technologies.

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Philippe Vandar has joined System Plus Consulting as a Costing Analyst in Electronic Systems in 2018. He is in charge of reverse costing, with a focus on electronic boards and systems. He previously worked for PSA Group, where he was in charge of costing.

RELATED REPORTS

Honeywell HG1120CA50 9-axis MEMS Inertial Sensor
The first high reliability and highly rugged 9-axis IMU for industrial applications from Honeywell.
January 2019 - Price: EUR 3,990*

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High precision 6-Axis Inertial Measurement Unit for industrial and harsh environments.
June 2018 - EUR 3,490*

Sensonor STIM210 – High-precision MEMS Gyro Module
World highest performance silicon MEMS gyro available without export control.
March 2014 - EUR 4,490*
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