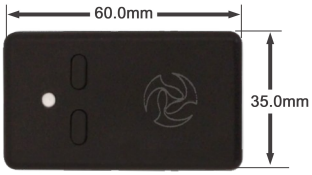
Technical Brief

# Yost Labs 3-Space Sensor™ Wireless 2.4GHz DSSS




Miniature High-Performance Attitude & Heading Reference Systems / Inertial Measurement Units

## Product Overview

The 3-Space Sensor™ Wireless integrates a miniature, high-precision, high-reliability, Attitude and Heading Reference System (AHRS) / Inertial Measurement Unit (IMU) with a 2.4GHz DSSS communication interface and a rechargeable lithium-polymer battery solution into a single low-cost end-use-ready unit. The Attitude and Heading Reference System (AHRS) uses triaxial gyroscope, accelerometer, and compass sensors in conjunction with advanced processing and on-board quaternion-based orientation filtering algorithms to determine orientation relative to an absolute reference in real-time.

Orientation can be returned in absolute terms or relative to a designated reference orientation. The gradient descent calibration process and high update rates increase accuracy and greatly reduce and compensate for sensor error. The 3-Space Sensor system also utilizes a dynamic sensor confidence algorithm that ensures optimal accuracy and precision across a wide range of operating conditions.

The 3-Space Sensor Wireless unit features are accessible via a well-documented open communication protocol that allows access to all available sensor data and configuration parameters using either 2.4GHz DSSS wireless or USB 2.0 interfaces. Versatile commands allow access to raw sensor data, normalized sensor data, and filtered absolute and relative orientation outputs in multiple formats including: quaternion, Euler angles (pitch/roll/yaw), rotation matrix, axis angle, two vector (forward/up).

## Applications

- Robotics
- Motion capture
- Positioning and stabilization
- Personnel / pedestrian navigation and tracking
- Unmanned air/land/water vehicle navigation
- Education and performing arts
- Healthcare monitoring
- Gaming and motion control
- Accessibility interfaces
- Virtual reality and immersive simulation

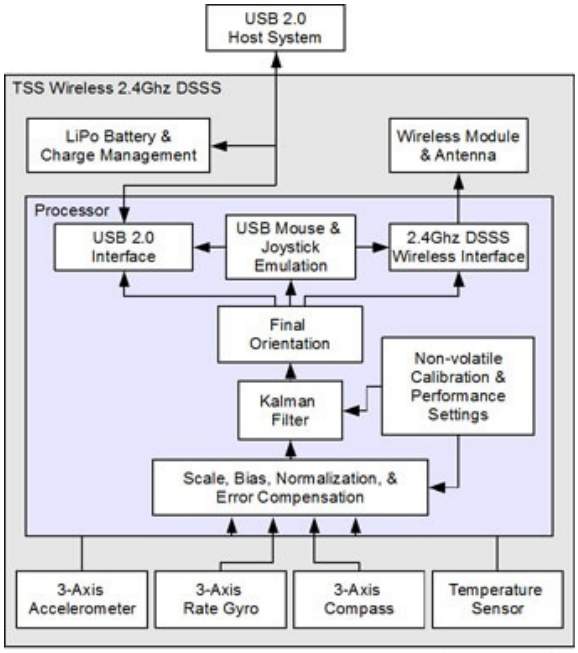
## Key Features

The 3-Space Sensor Wireless has many features that allow it to be a flexible all-in-one solution for your orientation sensing needs. Below are some of the key features:

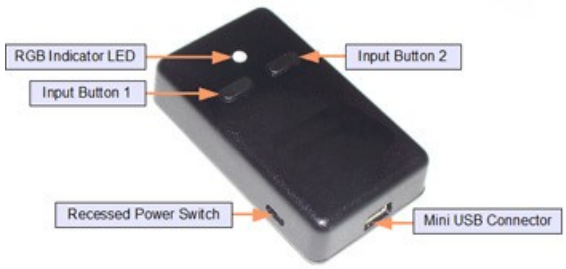
- Small self-contained high-performance wireless AHRS at 35mm x 60mm x 15mm and 28 grams
- Integrated 2.4GHz DSSS wireless communication interface allows high-performance at ranges up to 200'
- Integrated Lithium-Polymer battery and charge control allows battery life of 5+ hours at full performance
- Fast sensor update and filter rate allow use in real-time applications, including stabilization, virtual reality, real-time immersive simulation, and robotics
- Highly customizable orientation sensing with options such as tunable filtering, oversampling, and orientation error correction
- Advanced integrated Kalman filtering allows sensor to automatically reduce the effects of sensor noise and sensor error
- Robust open protocol allows commands to be sent in human readable form, or more quickly in machine readable form
- Orientation output format available in absolute or relative terms in multiple formats (quaternion, rotation matrix, axis angle, two-vector)
- Absolute or custom reference axes
- Access to raw sensor data
- Flexible communication options: USB 2.0 or wireless 2.4GHz DSSS (FCC Certified)
- Communication through a virtual COM port
- USB joystick/mouse emulation modes ease integration with existing applications
- Upgradeable firmware
- RGB status LED, two programmable input buttons
- Available in either hand-held or screw-down packaging
- Each communication dongle unit supports up to 15 independent sensor units

High-reliability MEMS technology combined with advanced processing and multiple quaternion-based filtering algorithms allows for accurate orientation outputs across a wide range of performance conditions.

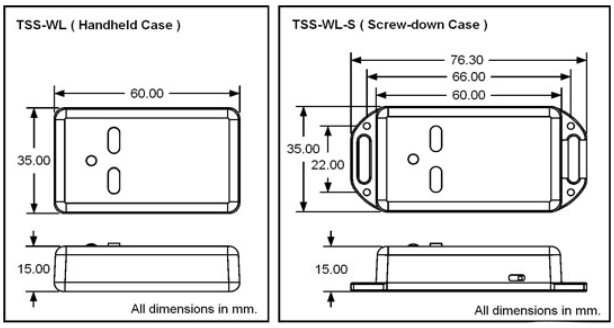
## Block Diagram




## Hardware Overview




## Case Dimensions




## Specifications

| General | |
|---|---|
| Part number | TSS-WL (Handheld Sensor Unit)<br>TSS-WL-S (Screw-down Sensor Unit)<br>TSS-DNG (Communication Dongle) |
| Dimensions | 35mm x 60mm x 15mm (1.38 x 2.36 x 0.59 in.) |
| Weight | 28 grams (0.98 oz) |
| Supply voltage | +5v USB |
| Battery technology | rechargeable Lithium-Polymer |
| Battery lifetime | 5+ hours continuous use at full performance |
| Communication interfaces | USB 2.0, 2.4GHz DSSS Wireless (FCC certified) |
| Wireless communication range | up to 200' |
| Filter update rate[1] | up to 250Hz with Kalman AHRS(higher with oversampling)<br>up to 850Hz with QCOMP AHRS(higher with oversampling)<br>up to 1350Hz in IMU mode |
| Orientation output | absolute & relative quaternion, Euler angles, axis angle, rotation matrix, two vector |
| Other output | raw sensor data, corrected sensor data, normalized sensor data, temperature |
| Shock survivability | 5000g |
| Temperature range | -40C ~ 85C (-40F ~ 185F) |
| **Sensor** | |
| Orientation range | 360º about all axes |
| Orientation accuracy[2] | ±1º for dynamic conditions & all orientations |
| Orientation resolution | <0.08º |
| Orientation repeatability | 0.085º for all orientations |
| Accelerometer scale | ±2g / ±4g / ±8g selectable for standard models<br>±6g / ±12g / ±24g selectable for HH models<br>±100g / ±200g / ±400g selectable for H3 models |
| Accelerometer resolution | 14 bit, 12 bit(HH), 12 bit(H3) |
| Accelerometer noise density | 99µg/√Hz, 650µg/√Hz(HH), 15mg/√Hz(H3) |
| Accelerometer sensitivity | 0.00024g/digit-0.00096g/digit<br>0.003g/digit-0.012/digit(HH)<br>0.049g/digit-0.195g/digit(H3) |
| Accelerometer temperature sensitivity | ±0.008%/°C, ±0.01%/°C(HH, H3) |
| Gyro scale | ±250/±500/±1000/±2000 º/sec selectable |
| Gyro resolution | 16 bit |
| Gyro noise density | 0.009º/sec/√Hz |
| Gyro bias stability @ 25°C | 2.5º/hr average for all axes |
| Gyro sensitivity | 0.00833º/sec/digit for ±250º/sec<br>0.06667º/sec/digit for ±2000º/sec |
| Gyro non-linearity | 0.2% full-scale |
| Gyro temperature sensitivity | ±0.03%/°C |
| Compass scale | ±0.88 Ga to ±8.1 Ga selectable (±1.3 Ga default) |
| Compass resolution | 12 bit |
| Compass sensitivity | 0.73 mGa/digit |
| Compass non-linearity | 0.1% full-scale |

1. Depends upon communication mode and filter mode.
2. Average value when calibrated.

Specifications are subject to change.
Version: 2.2.1

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