



Yost Labs 3-Space Sensor™ Mini Bluetooth Dual-Mode

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



Product Overview

The 3-Space Sensor™ Mini Bluetooth integrates a miniature, high-precision, high-reliability, Attitude and Heading Reference System (AHRS) / Inertial Measurement Unit (IMU) with a 2.4GHz Bluetooth v2.0+EDR Class 1 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, compass and barometric pressure 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 Mini Bluetooth 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 Bluetooth 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
- Research and instrumentation

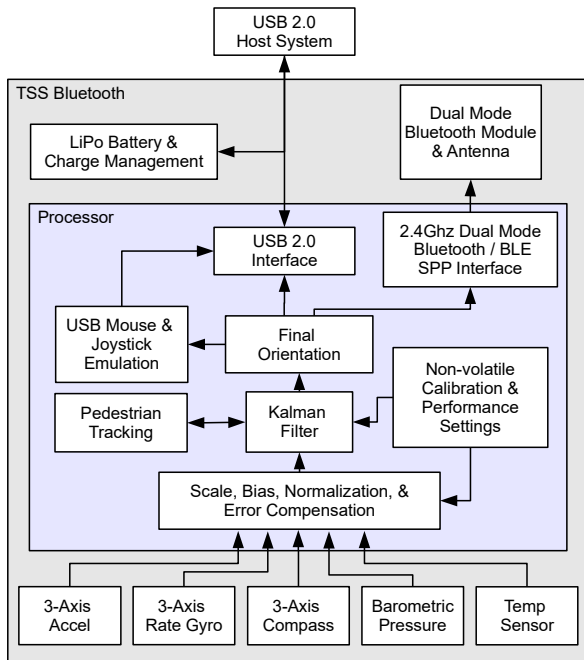
Key Features

The 3-Space Sensor Mini Bluetooth 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 37mm x 25mm x 9.1mm and 9 grams
- Integrated 2.4GHz Dual-Mode Bluetooth v2.0 EDR and BLE wireless interface allows high-performance at ranges up to 100'
- Integrated Lithium-Polymer battery and charge control allows battery life of 1 ½ + 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: Bluetooth 4.0, Bluetooth LE, and USB 2.0
- Bluetooth SPP and BLE requires no proprietary dongle hardware
- USB 2.0 and Bluetooth SPP and Bluetooth Low Energy communication via virtual COM port
- USB joystick/mouse emulation modes ease integration with existing applications
- Upgradeable firmware
- Available with integrated haptic sensor for an expanded sensory experience
- RGB LED for power and logging status.
- Fully compatible with existing 3-Space products.

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.

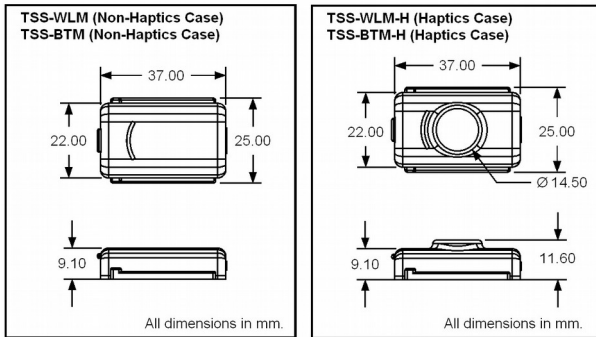
Block Diagram



Hardware Overview



Case Dimensions



Specifications

General	
Part number	TSS-BTM (Bluetooth Sensor Unit) TSS-BTM-H (Bluetooth Sensor Unit with Haptic Driver Included)
Dimensions	37.0 mm x 25.0 mm x 9.1 mm
Weight	9 grams (0.32 oz)
Supply voltage	+5v USB
Battery technology	Rechargeable Lithium-Polymer
Battery lifetime	1 ½+ hours continuous use at full performance
Communication interfaces	Bluetooth 2.0, Bluetooth 4.0 LE, and USB 2.0
Wireless communication range	up to 100' (Bluetooth v2.0+EDR + BLE v4.0)
Filter update rate ¹	up to 250Hz with Kalman AHRS (higher with oversampling) up to 850Hz with QGrad2 AHRS (higher with oversampling) 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, calibrated sensor data, temperature, date/time, relative pedestrian path, pressure / altitude
Shock survivability	5000g
Temperature range	-40C ~ 85C (-40F ~ 185F)
Sensor	
Orientation range	360° about all axes
Orientation accuracy ²	±1° for dynamic conditions & all orientations
Orientation resolution	<0.08°
Orientation repeatability	0.085° for all orientations
Accelerometer scale	±2g / ±4g / ±8g selectable for standard models
Accelerometer resolution	16-bit
Accelerometer noise density	105µg/√Hz
Accelerometer sensitivity	0.0000610352g/digit-0.00024414g/digit
Accelerometer temperature sensitivity	±0.002%/°C
Gyro scale	±250/±500/±1000/±2000 °/sec selectable
Gyro resolution	16 bit
Gyro noise density	0.009°/sec/√Hz
Gyro bias stability @ 25°C	1.5°/hr average for all axes
Gyro sensitivity	0.007629°/sec/digit for ±250°/sec 0.061035°/sec/digit for ±2000°/sec
Gyro non-linearity	0.05% full-scale
Gyro temperature sensitivity	±0.015°/sec/C
Compass scale	±49.152 Ga
Compass resolution	16 bit
Compass sensitivity	1.5 mGa/digit
Compass non-linearity	0.1% full-scale

1. Depends upon communication mode, filter mode, Bluetooth adapter
2. Average value when calibrated. Specifications are subject to change. Version: 1.0



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Patents Pending
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