Technical Brief

Yost Labs 3-Space Sensor™ Watertight USB/RS232

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

Product Overview

The 3-Space Sensor™ Watertight USB/RS232 is a miniature, high-precision, high-reliability, Attitude and Heading Reference System (AHRS) / Inertial Measurement Unit (IMU) offering USB 2.0 and RS232 communication interfaces in a single low-cost end-use-ready IP67 sealed case. 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 Watertight USB/RS232 unit's features are accessible via a well-documented open communication protocol that allows access to all available sensor data and configuration parameters using either USB 2.0 or RS232. 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

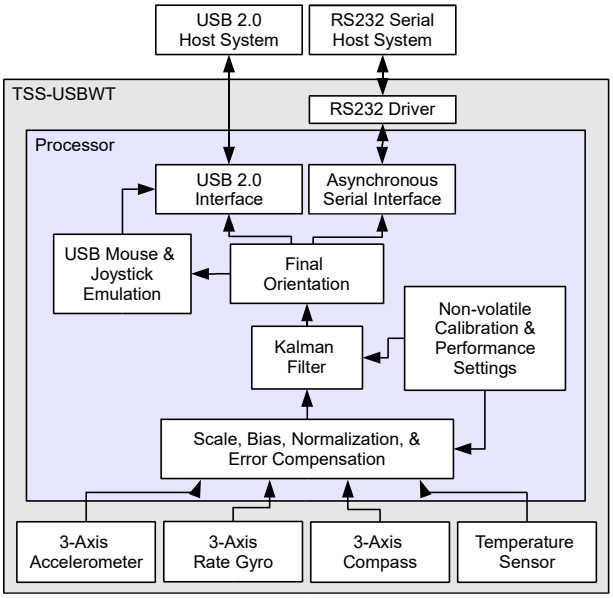
Key Features

The 3-Space Sensor Watertight USB / RS232 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 AHRS at 35mm x 67.6mm x 20mm and 21 grams
- 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 RS232 asynchronous serial
- USB communication via virtual COM port
- USB joystick/mouse emulation modes ease integration with existing applications
- Upgradeable firmware
- RGB status LED, two programmable input buttons
- IP67 rated connector provides power, USB, and RS232 connections
- Available in screw-down water-tight silicone-sealed IP67 rated enclosure

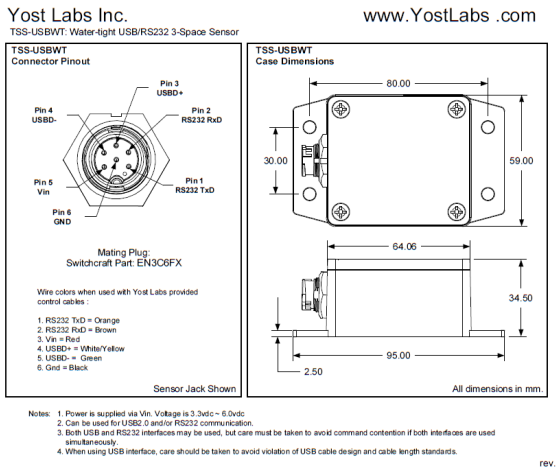
High-reliability MEMS technology combined with advanced processing and multiple quaternion-based filtering algorithms allows for accurate orientation outputs across a wide range of performance conditions.

Block Diagram



Hardware Overview

Case Dimensions



Specifications

General	
Part number	TSS-USBWT-S (Watertight Screw-down Sensor Unit)
Dimensions	35mm x 67.6mm x 20mm (1.38 x 2.66 x 0.79 in.)
Weight	21 grams (0.74 oz)
Supply voltage	+5v USB, +3.3v~+6.0v for RS232
Communication interfaces	USB 2.0, RS232 Asynchronous Serial
Serial baud rates	1,200~921,600 selectable, default: 115,200
Filter update rate[1]	up to 250Hz with Kalman AHRS(higher with oversampling) up to 850Hz with QCOMP 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, 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 ±6g / ±12g / ±24g selectable for HH models ±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 0.003g/digit-0.012/digit(HH) 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 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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