Technical Brief

Yost Labs 3-Space™ Sensor
Watertight WT3-HUx Series

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



Product Overview

The 3-Space™ Sensor Watertight WT3-HUx Series (Parts: TSS-WT3-HU1 and TSS-WT3-HU2) is a miniature, high-precision, high-reliability, 10-DOF SMT Attitude and Heading Reference System (AHRS) / Inertial Measurement Unit (IMU) offering USB 2.0 and 3.3v UART(TSS-WT3-HU1) or RS232(TSS-WT3-HU2) in an end-use-ready IP68-rated ruggedized cast aluminum case. The IMU/AHRS uses triaxial gyroscope, auto-selecting dual accelerometers, magnetometers, and barometric pressure sensors in conjunction with patented advanced processing and on-board quaternion-based orientation filtering algorithms to determine orientation relative to an absolute or relative 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.

All 3-Space™ Sensor WT3-HUx features are accessible via a well-documented open communication protocol that allows access to all available sensor data and configuration parameters. 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).

All 3-Space™ Sensor WT3-HUx modules also offer a range of communication interface options which include High-Speed USB 2.0 and either UART asynchronous serial or RS232 asynchronous serial.

Applications

- Robotics
- Positioning and stabilization
- Aeronautical and defense systems
- Maritime applications
- Unmanned air/land/water vehicle navigation
- Down-hole applications
- Equipment monitoring and preventative maintenance
- Industrial motion and vibration analysis
- Environmental monitoring
- Automotive and UGV monitoring and instrumentation
- Impact analysis

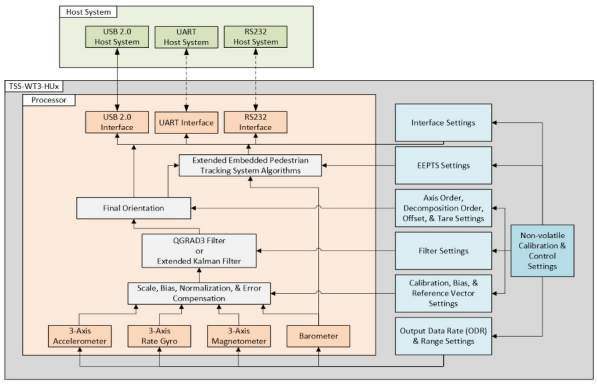
Key Features

The 3-Space™ Sensor Watertight WT3-HUx series 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:

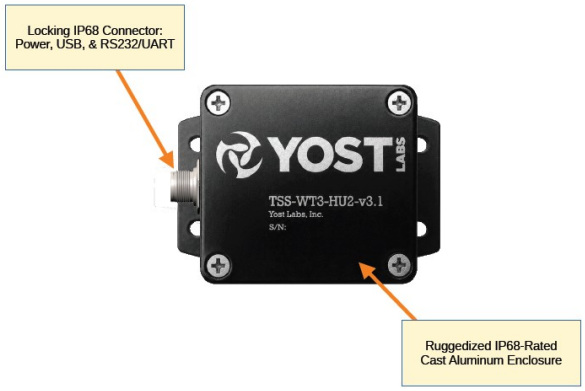
- High-performance ruggedized IP-68-rated USB and UART/RS232 AHRS at 59.0mm x 95.0mm x 35.0mm and 158.0 grams
- Ultra-fast sensor update and filter rate allow use in real-time applications, including stabilization, virtual reality, real-time immersive simulation, and robotics
- Highly customizable orientation sensing with options such as tunable filtering, oversampling, and orientation error correction
- Embedded World Magnetic Model(WMM) and tilt-compensated heading functionality allow for easy extraction of accurate true-north, magnetic-north, or grid-north headings.
- Selectable advanced integrated filtering modes, including high-performance QGRAD3, 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 binary
- 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 fully-calibrated or raw sensor data
- Flexible communication options: High-Speed USB 2.0 and UART asynchronous serial or RS232 asynchronous serial
- USB communication through a virtual COM port
- Upgradeable firmware
- RGB status LED
- Programmable interrupt capability
- 3-Space™ Sensor Suite application allows for quick experimentation and evaluation
- Python and C APIs available
- Easily mountable screw-down/strap-down watertight
- IP-68 rated form-factor

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.

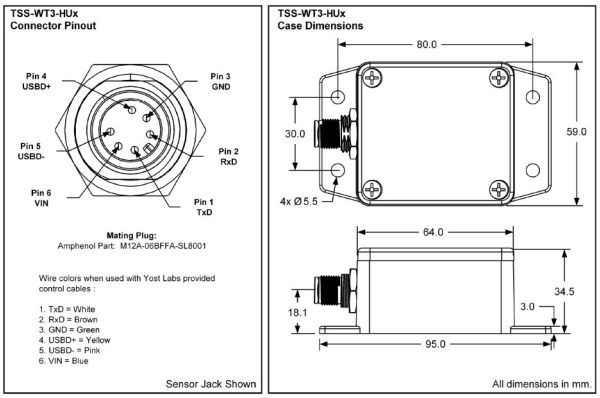
Block Diagram



Hardware Overview



Connector / Case Dimensions



Specifications

General	
Part numbers	TSS-WT3-HU1-v3.1 (3.3v UART serial option) TSS-WT3-HU2-v3.1 (RS232 serial option)
Dimensions	59.0 x 95.0 x 35.0mm (2.32 x 3.74 x 1.378 in.)
Weight	158.0 grams (5.573 oz)
Supply voltage	+3.3v ~ +6.0v
Power consumption	75mA @ 5v at Full-Performance
Communication interfaces	USB 2.0, 3.3v Async Serial UART (TSS-WT3-U1-v3.1) USB 2.0, Async Serial RS232 (TSS-WT3-U2-v3.1)
Filter update rate[1]	up to 2000Hz with Kalman AHRS up to 2000Hz with QGRAD3™ AHRS up to 2000Hz in IMU mode
Orientation output	absolute & relative quaternion, Euler angles, axis angle, rotation matrix, two vector
Other output	corrected sensor data, normalized sensor data, temperature, pedestrian motion-path (longitude / latitude) offsets
Serial baud rate	4,800~4,000,000 selectable, default: 115,200
Shock survivability	5000*g*
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	Dual Accelerometer - Auto-Selecting ±2*g* / ±4*g* / ±8*g* / ±16*g* selectable for Accel1 ±32*g* / ±64*g* / ±128*g* / ±256*g* / ±320*g* selectable for Accel2
Accelerometer resolution	16-bit(Accel1), 16-bit(Accel2)
Accelerometer noise density	60µg/√Hz(Accel1), 1000µg/√Hz(Accel2)
Accelerometer sensitivity	0.0000610352g/digit-0.00048828g/digit (Accel1) 0.00097656g/digit-0.010417g/digit(Accel2)
Accelerometer temperature sensitivity	±0.01%/°C (-40°C to +85°C) (Accel1) ±0.01%/°C (-40°C to +85°C) (Accel2)
Gyro scale	±250/±500/±1000/±2000/±4000 º/sec selectable
Gyro resolution	16-bit
Gyro noise density	0.005º/sec/√Hz
Gyro bias stability @ 25°C	1.5º/hr average for all axes
Gyro sensitivity	0.008750º/sec/digit for ±250º/sec 0.140016º/sec/digit for ±4000º/sec
Gyro non-linearity	0.01% full-scale
Gyro temperature sensitivity	±0.007%/°C (-40°C to +85°C)
Magnetometer scale	±8.0 Ga
Magnetometer resolution	18-bit
Magnetometer sensitivity	0.06 mGa/digit
Magnetometer 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: 3.1.0

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