

Yost Labs 3-Space™ Sensor with QGRAD™ Fusion

EMBEDDED

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



PRODUCT OVERVIEW

The Yost Labs 3-Space™ sensor is an ultra-miniature, high-precision, high-reliability, low-cost SMT Attitude and Heading Reference System (AHRS)/Inertial Measurement Unit (IMU) which uses triaxial gyroscope, accelerometer, and compass sensors in conjunction with QGRAD 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 Yost Labs 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 Yost Labs 3-Space embedded module 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).

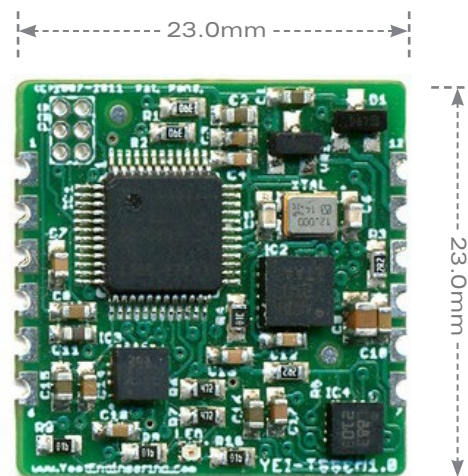
The 3-Space embedded module also offers a range of communication interface options which include SPI, USB 2.0, and asynchronous serial.

QGRAD™		10x more efficient
Kalman Filter		

Yost Labs' 3-Space sensors feature QGRAD™ fusion firmware designed to increase the speed with which AHRS/IMUs filter raw inputs to create fused motion data.

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
- Virtual reality and immersive simulation



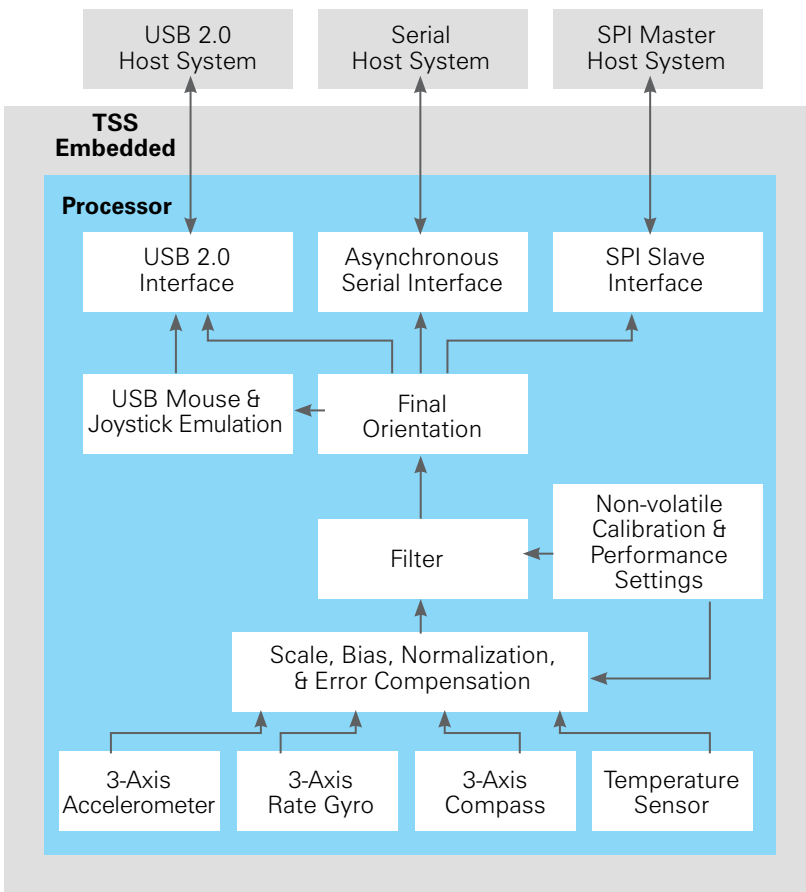
KEY FEATURES

The **Yost Labs 3-Space sensor** 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:

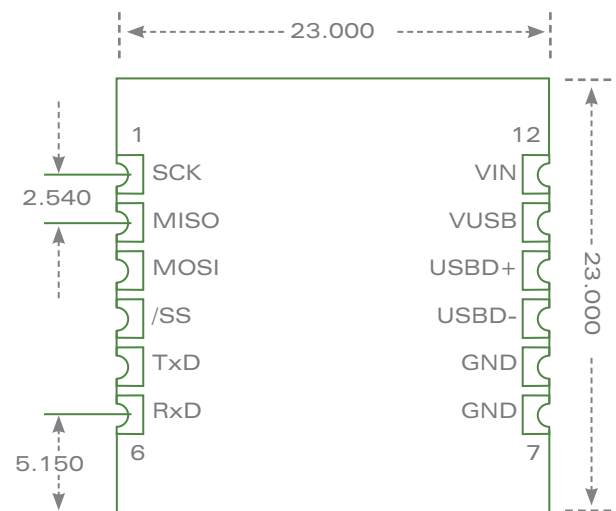
- Smallest and lightest high-performance AHRS available at 23mm x 23mm x 2mm and only 1.3 grams
- Fast sensor update and filter rate allow use in real-time applications, including stabilization, virtual reality, real-time immersive simulation, and robotics
- Highly customizable orientation sensing with 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: SPI, USB 2.0, or asynchronous serial
- USB communication through a virtual COM port
- When used as a USB device, USB joystick/mouse emulation modes ease integration with existing applications
- Castellated SMT edge pads provide secure SMT mounting and allow optional through-hole mounting
- Upgradeable firmware
- RGB status LED
- Programmable interrupt capability
- Development kit available

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



PINOUT



Top View. All dimensions in mm.

SPECIFICATIONS

General	
Part number	TSS-EM
Dimensions	23mm x 23mm x 2.2mm (0.9 x 0.9 x 0.086 in.)
Weight	1.3 grams (0.0458 oz)
Supply voltage	+3.3v ~ +6.0v
Power consumption	45mA @ 5v
Communication interfaces	USB 2.0, SPI, Asynchronous Serial
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
SPI clock rate	6 MHz max
Serial baud rate	1,200~921,600 selectable, default: 115,200
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 ±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 °/sec selectable
Gyro resolution	16 bit
Gyro noise density	0.009°/sec/√Hz
Gyro bias stability @ 25°C	2.5°/hr average for all axes
Gyro sensitivity	0.00833°/sec/digit for ±250°/sec 0.06667°/sec/digit for ±2000°/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. Specifications are subject to change.

2. Average value when calibrated. Version: 2.0.0



Made in USA. Patents: 8498827,
8682610, 9255799, 9354058.
Additional patents pending.