INERTIALSENSE
autonomous navigation solutions

Overview

The **µIMU™** is a miniature calibrated sensor module consisting of an Inertial Measurement Unit (IMU), magnetometer, barometer, and onboard L1 GNSS receiver. Data out includes angular rate, linear acceleration, magnetic field, barometric altitude, and GPS.

The **µAHRS™** is an Attitude Heading Reference System (AHRS) that includes all functionality of the µIMU™ and fuses IMU and magnetometer data to estimate roll, pitch, and heading.

The **µINS+RTK™** is a GNSS aided Inertial Navigation System (GPS-INS) module that includes all functionality of the µAHRS™ and provides orientation, velocity, and position. Sensor data from MEMs gyros, accelerometers, magnetometers, barometric pressure, and GNSS is fused to provide optimal estimation.
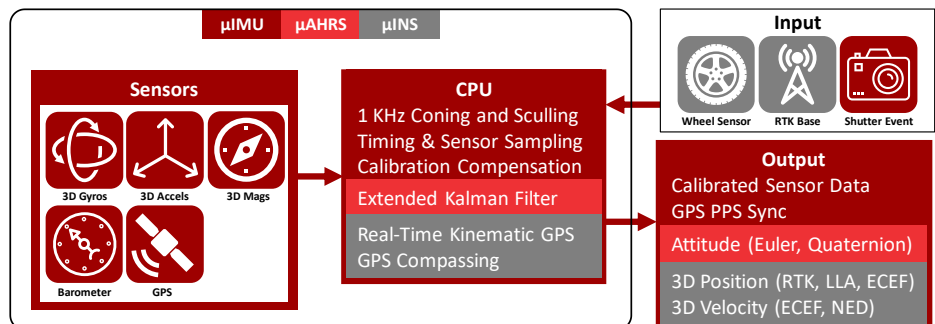
The **µINS Dual™** is a GNSS aided Inertial Navigation System (GPS-INS) module that includes all functionality of the µAHRS™ and provides orientation, velocity, and position. By utilizing Dual GPS antennas, accurate heading can be determined in environments that are challenging for a magnetometer.

Applications

- Drone Navigation
- Unmanned Vehicle Payloads
- Aerial Survey
- Stabilized Platforms
- Antenna and Camera Pointing
- First Responder and Personnel Tracking
- Health, Fitness, and Sport Monitors
- Robotics and Ground Vehicles
- Maritime

Features

- Up to 1KHz IMU and INS Output Data Rate
- Multi-frequency L1/L2 external GNSS Support
- CAN Bus Interface
- Attitude (Roll, Pitch, Yaw, Quaternions), Velocity, and Position UTC Time Synchronized
- Dual Redundant IMUs Calibrated for Bias, Scale Factor, and Cross-Axis Alignment
- -40°C to 85°C Sensor Temperature Calibration
- On-Board u-Blox L1 GNSS Receivers
- Binary and NMEA ASCII Protocol
- Barometric Pressure and Humidity
- Strobe In/Out Data Sync (Camera Shutter Event)
- Fast Integration with SDK and Example Software
- Data Logging (SDK and Application Software)

µIMU	µAHRS	µINS

Sensors
3D Gyros 3D Accels 3D Mags
Barometer GPS

CPU
1 KHz Coning and Sculling Timing & Sensor Sampling Calibration Compensation
Extended Kalman Filter
Real-Time Kinematic GPS GPS Compassing

Input
Wheel Sensor   RTK Base   Shutter Event

Output
Calibrated Sensor Data
GPS PPS Sync
Attitude (Euler, Quaternion)
3D Position (RTK, LLA, ECEF)
3D Velocity (ECEF, NED)

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Specifications

Performance (μINS, μAHRS)

	Typ
Roll/Pitch (RMS)	0.05°
Static Heading w/magnetometer (RMS)	2.0°
Static Heading w/Dual Compass (RMS)	0.4°
μINS Dynamic Heading** (RMS)	0.1°

*Position is stationary. **Requires GPS lock with periodic >0.8 m/s^2 acceleration and >2 m/s velocity.

Performance

	Typ	L1/L2 RTK-GPS
Horizontal Position (w/ SBAS)	1.5 m CEP	1 cm + 1 PPM CEP
Velocity (GPS and INS)	0.05 m/s	
Angular Resolution	0.05°	
Operation Limits		
Velocity	500 m/s	
Altitude (GPS)	50 Km	
Altitude (Barometric)	10 Km	
Startup Time	0.8 sec	
GNSS Receiver Type (4 Constellations)	u-blox M10 engine GPS L1 C/A, QZSS L1 C/A/S, GLONASS L10F, BeiDou B1I/B1C, Galileo E1B/C,SBAS L1 C/A: WAAS, EGNOS, MSAS, GAGAN	
GNSS Receiver Sensitivity	Tracking: -164 dBm, Hot: -156 dBm, Cold: -147 dBm	
GNSS Lock Time: Hot Start	1 sec	10 sec
GNSS Lock Time: Cold Start	30 sec	2-4 min
GNSS Update Rate	5 Hz	
GNSS_PPS Time Sync. Pulse (10% duty cycle)	1 Hz	
GNSS_PPS Time Sync. Accuracy (RMS, 99%)	30, 60 ns	
INS/AHRS Timestamp Accuracy (RMS)	1 us	
Max Output Data Rate (IMU and INS)	1 KHz	
IMU signal latency	4 ms	
Humidity Sensor Relative Accuracy	±3 %	

Absolute Maximum Ratings

	MAX	
Acceleration	10,000 g	
Storage Temperature (μINS)	-45 to 85 °C	Barometer limitation
Overpressure	600 kPa	
ESD rating	± 2 kV	Human body model
Soldering Temperature	Hand Solder ONLY. Do NOT solder reflow.	

Sensors

	IMU - Gyros	IMU - Accels	Mags	Pressure
Operating Range	±4000 °/sec	±16 g	±2500 μT	30–125 kPa
Bias Repeatability	< 0.1 °/sec	< TBD mg		
In-Run Bias Stability	< 1.8 °/hr	< TBD μg		
Random Walk	0.12 °/√hr	TBD m/s/√hr		
Non-linearity	0.07 % FS	TBD % FS		
Noise Density	0.003 °/s/√Hz	40 μg/√Hz		Pa/√Hz
Bias Error over -40C to 85C	0.6 °/s RMS	0.5 m/s^2 RMS		
Max Output Rate	1 KHz	1 KHz	100 Hz	50 Hz
Bandwidth	250 Hz	218 Hz	50 Hz	5 Hz
Alignment Error	0.05°	0.05°	0.05°	
Sampling Rate	8 KHz	4 KHz	300 Hz	200 Hz
Resolution	*0.0076 °/sec	*122 μg	0.3 μT	0.03 Pa (2 cm)

*1KHz resolution after oversampling

Data Output

	μIMU™	μAHRS™	μINS™
GPS, GPS Raw, UTC Time	•	•	•
IMU (Gyro & Accelerometer)	•	•	•
Magnetometer & Barometer	•	•	•
Attitude (Quaternions, Euler, DCM)		•	•
Inertial Velocity & Position			•

Electrical (μINS, μAHRS, μIMU)

Power Draw (w/o GPS ant.)	Min	Typ	Max	Units
μIMU @ 1KHz		TBD	350	mW
μINS, μAHRS @ 250Hz		TBD	400	mW
Supply Voltage (Vcc)	3.0	3.3	3.6	V
GPS VBAT Voltage	1.4	3.3	3.6	V
GPS VBAT Current @ 3.0V		15		μA
GPS Antenna Supply w/o load (2.8V w/ 10mA load)*		2.9		V
GPS Antenna Supply Current*			300	mA
I/O Pin MAX Voltage Range	-0.5		3.6	V
Total Output Current, All Pins			120	mA
I/O Pin Input low-level	0.99			V
I/O Pin Input high-level	2.31	3.3	3.6	V
I/O Pin Output high-level		3.3		V
STROBE input frequency			1	KHz
Rising Slope of VIN**	2.4			V/ms

*A 10 Ohm current limiting resistor sits in-line between voltage supply and antenna.
**The supply rising slope must be higher than minimum rating for proper function.

Electrical (μINS with Rugged/EVB)

	Min	Typ	Max	Units
Supply Voltage (VIN)	4.0		20	V
μINS with Rugged or EVB				
Current Draw @ 5V, 250Hz*		125		mA
Power Consumption @250Hz*		625		mW
Power Consumption @100Hz*		575		mW
Power Consumption – Dual		1100		mW

*Navigation filter update rate.

Mechanical (μINS, μAHRS, μIMU)

μINS		Units
Size	16.5 x 12.6 x 4.6	mm
Weight	1.3	grams

Mechanical (Rugged μINS)

		Units	Conditions
Size	25.4 x 25.4 x 20.0	mm	W/o mounting tabs
	35.9 x 25.4 x 20.0		W/ mounting tabs
IP Rating	40		No liquid protection
Mounting Tab Hole Spacing	30.836	mm	
Weight	14.0	grams	
Connectors	Main: Harwin# G125-MV11205L1P, GPS 1/2: MMCX		

Communications

Interface	TTL, SPI
Rugged Interface (IS-RUG-1.x)	USB, TTL, RS232, RS485, CAN
Max Baud Rate:	
TTL, RS422, RS485	3 Mbps
RS232	500 Kbps

Development Kits available on our website.