

LandMark™ 10 GPS/AHRS



- **Small, Light Weight and Low Power MEMS GPS-Aided AHRS**
- **Rugged Environmentally Sealed Packaging & MILSPEC Connector**
- **Low Noise Gyros** $0.012^\circ / \text{sec} / \sqrt{\text{Hz}}$
- **Low Noise Accels** $0.07 \text{mg} / \sqrt{\text{Hz}}$
- **In-Run Gyro Bias** $25^\circ / \text{hour } 1\sigma$
- **Heading** $\pm 0.5^\circ \text{ stationary}$
- **Pitch & Roll Angles** $\pm 0.25^\circ \text{ stationary}$
- **Redundant Altitude** $\pm 3 \text{ meter typical}$
- **Fully Compensated Bias, Scale Factor, Misalignment, g-Sensitivity, Heading & Altitude**
- **GPS-Aiding of Velocity & Altitude**
- **Single RS485 Data Rate** 100Hz
- **GPS Receiver – 50 Channel & 5 Hz Position Data Update Rate**
- **GPS Accuracy** $\pm 2.5 \text{m CEP}$
- **Supports WAAS, EGNOS and MSAS**
- **Low Power** $< 825 \text{ mW typical}$
- **Low Voltage** $+3.3 \text{V (single sided power)}$
- **Light Weight** $< 160 \text{ grams}$
- **Small Size** $< 108 \text{cm}^3 / 6.6 \text{in}^3$

**Light Weight & Low Power
GPS-Aided AHRS**

Export Classification: Commerce ECCN7A994

The newest version of our LandMark™ 10 GPS/AHRS is our economy class model of our standard LandMark™ GPS/AHRS. The unit features low noise gyros and accelerometers with exceptional bias in-run and bias over temperature performance with integrated GPS-Aiding in a small, light weight and low power ruggedized package at **very low cost**. The unit provides RS485 output of delta velocity, delta theta, heading, pitch and roll angles, altitude information, position, velocity and precision time. The inertial suite is integrated with a 50 channel C/A code GPS receiver with 5Hz position update rate. GPS aiding is included in all units **for turning error correction** as well as for continued output during short-term GPS dropouts. The signature feature is the low noise inertial sensors that provide **fully compensated bias, scale factor, misalignment, g-sensitivity, heading, pitch and roll angles and redundant altitude information**. The unit employs a Kalman Filter to integrate the GPS data and GPS-Aiding in a **ruggedized environmentally sealed package** that is EMI resistant and includes a **MILSPEC connector**. This GPS-Aided AHRS is highly durable and can withstand environmental vibration, shock and EMI typically associated with commercial aircraft requirements. The LandMark™ 10 GPS/AHRS is well suited for low cost applications including flight control, navigation, image stabilization, antenna stabilization and pointing, general aviation, automotive testing as well as laboratory use.

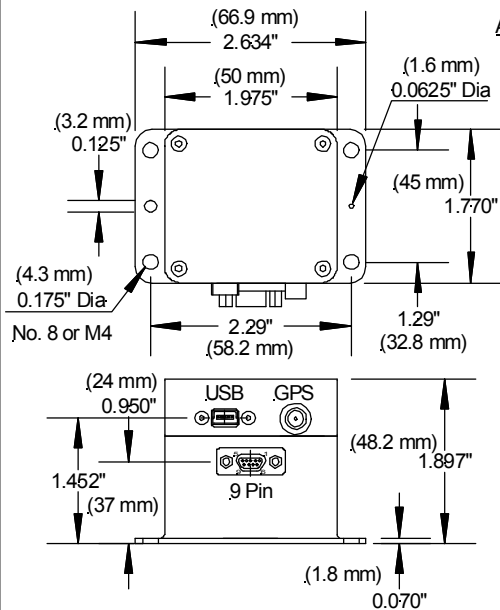


Gladiator Technologies
High Performance Inertial MEMS

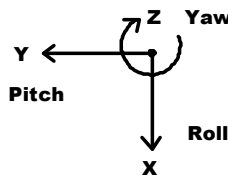
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Rev. 13July26
SN: 203

LandMark™ 10 GPS/AHRS



Axes (Top View) Right Hand Rule



LandMark™ 10 GPS/AHRS

LMRK10GP5A-075-02-**200**
 LMRK10GP5A-075-10-**200**
 LMRK10GP5A-150-02-**200**
 LMRK10GP5A-150-10-**200**
 LMRK10GP5A-300-02-**200**
 LMRK10GP5A-300-10-**200**

Specification

Pin No.	GPS/AHRS Pin Assignment
1	RS-485 A (+) AHRS
2	RS-485 B (-) AHRS
3	Power Ground
4	RS-485 A (+) Combined GPS/AHRS
5	+3.1V to +5.5V Input Power
6	RS-485 B (-) Combined GPS/AHRS
7	+5V Regulator Output
8	Signal Ground
9	Self Test

Outputs	Serial Sequence at 100Hz
1, 2, 3	Gyros: Roll (X), Pitch (Y), Yaw (Z)
4, 5, 6	Accelerometers: (X), (Y), (Z)
7	Temperature
8, 9, 10	Angles: Roll (X), Pitch (Y), Yaw (Z)
11, 12, 13	Airspeed, Longitude, Latitude
14, 15, 16	Time ms, Time Week, Baro Alt
17, 18, 19	GPS: Altitude, Velocity, Heading
20	No. of SV's
21, 22, 23	AHRS Status, Status, Checksum

PARAMETER	RATE AXES	ACCEL AXES
Power Requirements		
Input Voltage	+3.1V to +5.5VDC	
Power Typical (Max)	825mW (1100mW)	
Inertial Performance		
Standard Full Scale Ranges	±75°/sec	±150°/sec ±300°/sec ±2 g's ±10 g's
Scale Factor Error %	≤0.2% (over temperature) 1σ	
Bias In-Run Stability	25°/hour 1σ	0.1mg 1σ 0.25mg
Bias Over Temperature	<0.1°/sec 1σ	< 3mg 1σ < 5mg
Sensor Resolution	0.007°/sec	0.035mg 0.25mg
Angle Random Walk	0.012°/sec/√Hz 1σ	0.07mg /√Hz 1σ 0.15mg
Alignment	1mrad 1σ	
G-Sensitivity	≤0.03°/sec/g 1σ	
GPS/AHRS System Performance		
GPS Accuracy	±2.5m CEP stationary	
Heading (sole inertial)	± 0.5° stationary	
Pitch & Roll Angles	± 0.25° stationary	
Altitude (barometric)	± 3m 1σ	
Start-Up Time (inertial)	< 0.65 sec	
GPS Acquisition (Cold Start)	< 30 sec	
GPS Reacquisition (Warm Start)	< 1 sec	
Update Rate (inertial)	100 Hz	
Data Rate (GPS)	5 Hz Position Data typical	
Physical		
Weight	< 160 grams	
Size	U.S.:	1.770 x 1.975 x 1.882 = 6.58 in ³
	Metric:	4.5 x 5.0 x 4.78 = 107.6 cm ³
Operating Life	10 Years typical	
Environments		
Operating Temperature	-40°C to +85°C	
Storage Temperature	-55°C to +100°C	
Vibration Operating	6gRMS (20Hz to 2KHz ~ 10g accelerometers)	
Shock	500g's ½ sine 30 msec powered, any axis	

Specification subject to change without notice



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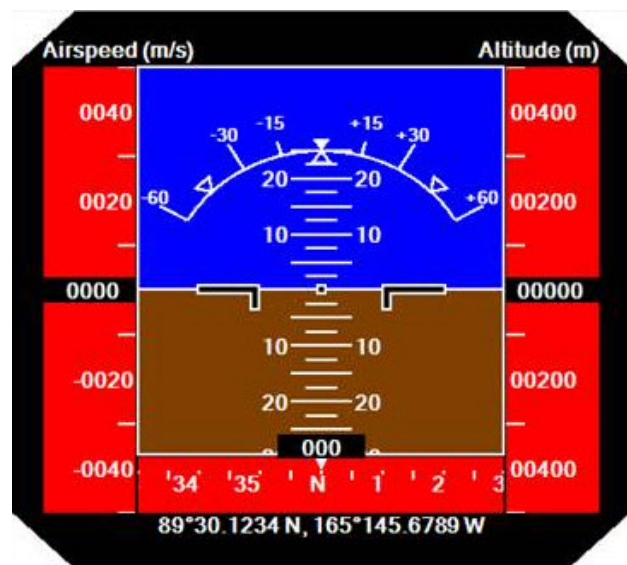
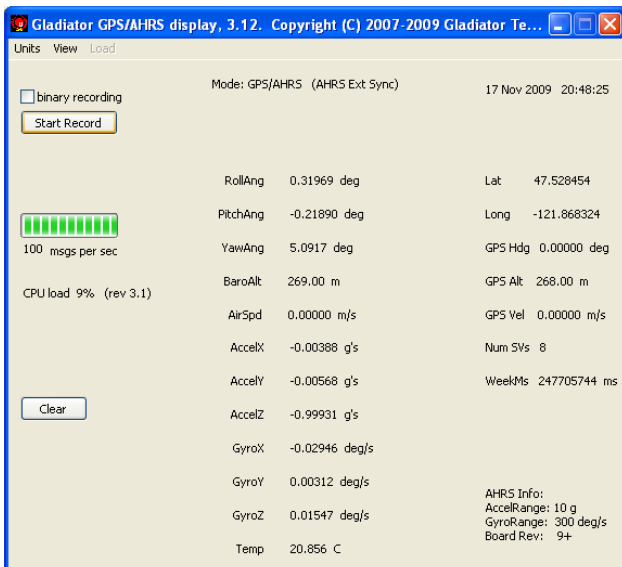
LandMark™ 10 GPS/AHRS Feature Guide

GPS/AHRS Feature Guide	GPS-Aided AHRS with Velocity Correction, Mags. & Barometric Pressure
Inertial	
Magnetic Heading	✓
Pitch, Roll & Yaw Angles - X, Y & Z	✓
Inertial Data Accels - X, Y & Z	✓
Inertial Data Gyros - X, Y & Z	✓
Redundant Altitude (Barometric Pressure)	✓
Temperature	✓
Magnetometer Data - X, Y & Z	✓
External Sync	✓
In-Field Calibration AHRS Capable	✓
Unit of Measure Selection	✓
Real-Time Display Software (in DEMO KIT)	✓
GPS	
Latitude	✓
Longitude	✓
GPS Altimeter	✓
GPS Velocity	✓
GPS Heading	✓
Number of Satellites	✓
GPS Week millisecond time (ms)	✓
GPS Week Number	✓
EGNOS, WAAS, MSAS Capable	✓
Kalman Filter CCA	
Single Synchronized (Time Correlated) Output	✓
GPS Turning Error Correction with Short-Term GPS Loss	✓
Barometric Aiding	✓

Description	Format	Source	LSB Weight
Start of message	U8	Fixed: 0x51	N/A
Message counter	U8	Mod 256 counter	N/A
Gyro - X axis	I16	AHRS	0.01 deg/sec
Gyro - Y axis	I16	AHRS	0.01 deg/sec
Gyro - Z axis	I16	AHRS	0.01 deg/sec
Accel - X axis	I16	AHRS	See note 6.
Accel - Y axis	I16	AHRS	See note 6.
Accel - Z axis	I16	AHRS	See note 6.
Temp - X axis	I16	AHRS	0.01 deg C
Roll Angle	I16	AHRS	0.01 deg
Pitch Angle	I16	AHRS	0.01 deg
Yaw Angle	U16	AHRS (magnetometer)	0.01 deg
Air Speed	I16	N/A	meters/sec
Latitude	I32	POSLLH - Latitude	1e-7 degrees
Longitude	I32	POSLLH - Longitude	1e-7 degrees
TimeMs	U32	SOL - ms since start of week	1
TimeWeek	U16	SOL - week number	1
Baro Altitude	I16	AHRS corrected with GPS	meters
Altitude	I16	POSLLH - height above sea level	meters
Velocity	U16	VELNED 3-D velocity	0.01m/s
Heading	U16	VELNED - 2D heading	0.01 deg
No. of SVs	U8	SOL - Number of SVs	1
AHRS status	U8	AHRS: See note 4.	n/a
Status	U8	See note 5.	n/a
Checksum	U8	See note 1.	n/a
Total size (bytes)	50		
Output Rate	100Hz		

Messaging Protocol Notes:

- The checksum byte is the two's complement of the sum of all bytes in the message excluding the checksum byte.
- All 16-bit data are transferred in little-endian format (LSB first).
- Total transport time per message packet is 4.8ms:
 $Full: (50 \text{ bytes} * 11 \text{ bits/byte}) / 115200 \text{ bps} = 4.8\text{ms}$
- Status byte format: The status byte contains 5 error bits and 3 status bits (see *User Guide*).



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