

LandMark™ 20 VG/GPS



- **Small, Light Weight and Low Power MEMS GPS-Aided VG**
- **Rugged Environmentally Sealed Packaging & MILSPEC Connector**
- **Low Noise Gyros**  $0.01^\circ/\text{sec}/\sqrt{\text{Hz}}$
- **Low Noise Accels**  $0.05\text{mg}/\sqrt{\text{Hz}}$
- **In-Run Gyro Bias**  $15^\circ/\text{hour } 1\sigma$
- **Pitch & Roll Angles**  $0.25^\circ \text{ stationary } 1\sigma$
- **Fully Compensated Bias, Scale Factor, Misalignment, g-Sensitivity & Altitude**
- **GPS-Aiding of Velocity**
- **Single RS485 Data Rate** 100Hz
- **GPS Receiver – 50 Channel & 5 Hz Position Data Update Rate**
- **GPS Accuracy**  $\pm 2.5\text{m CEP Stationary}$
- **Supports WAAS, EGNOS and MSAS**
- **Low Power**  $< 725 \text{ mW typical}$
- **Low Voltage**  $+3.3\text{V (single sided power)}$
- **Light Weight**  $< 147 \text{ grams}$
- **Small Size**  $< 108\text{cm}^3/6.6\text{in}^3$

**Light Weight & Low Power  
GPS-Aided Vertical Gyro**

The "LN Series" version of our LandMark™ 20 VG/GPS is a low noise GPS-aided vertical gyro. The unit features very 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. 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 altitude information**. The unit employs a Fixed Gain Kalman Filter to integrate the GPS data and IMU data in a **ruggedized environmentally sealed package** that is EMI resistant and includes a **MILSPEC connector**. This GPS-Aided VG is highly durable and can withstand environmental vibration, shock and EMI typically associated with commercial aircraft requirements. The LandMark™ 20 VG/GPS "LN Series" is well suited for low cost flight control, navigation, image stabilization, antenna stabilization and pointing, general aviation, automotive testing as well as laboratory use.



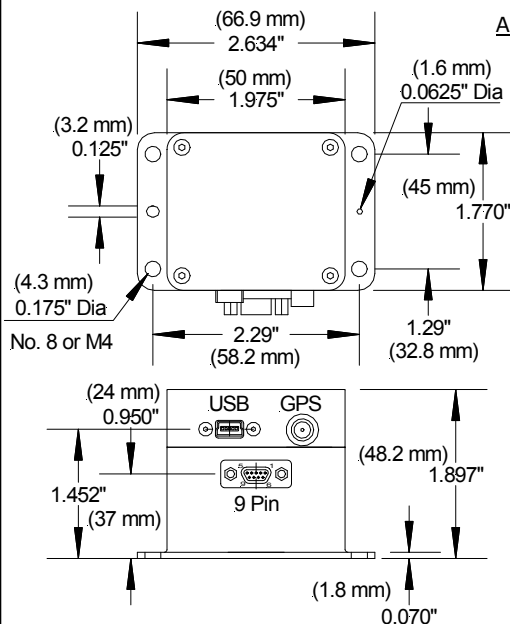
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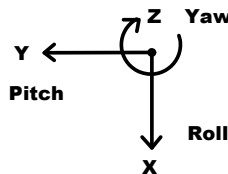
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## LandMark™ 20 VG/GPS



Axes (Top View) Right Hand Rule



LandMark™ 20 VG/GPS
LMRK20VGGPS-075-02- <b>200</b>
LMRK20VGGPS-075-10- <b>200</b>
LMRK20VGGPS-150-02- <b>200</b>
LMRK20VGGPS-150-10- <b>200</b>
LMRK20VGGPS-300-02- <b>200</b>
LMRK20VGGPS-300-10- <b>200</b>

### Specification

**Mating Connector: M83513/01-AN**

Pin No.	GPS/AHRS Assignment
1	RS-485 A (+) AHRS
2	RS-485 B (-) AHRS
3	Power Ground
4	RS-485 A (+) Combined GPS/AHRS
5	<b>+3.1V to +5.5V Input Power</b>
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	No Baro Altitude
12, 13, 14	Analog Airspeed Longitude, Latitude
15, 16	Time ms, Time Week
17, 18, 19	GPS: Altitude, Velocity, Heading
20	No. of SV's
21, 22, 23	IMU Status, Status, Checksum

Notes:

1. The connector case should be tied to a shield for wires and tied to ground at some point in the system.
2. The RS485 receiver should be referenced to local ground and tied to power ground at some point in the system.

PARAMETER	RATE AXES	ACCEL AXES
<b>Power Requirements</b>		
Input Voltage	<b>+3.1V to 5.5VDC</b>	
Power Typical (Max)	725mW (1000mW)	
<b>Inertial Performance</b>		
Standard Full Scale Ranges	±75°/sec	±150°/sec
Bias Over Temperature	±300°/sec	±2 g's
Bias In-Run Stability	±10 g's	±10 g's
Scale Factor Error %	<0.05°/sec	< 1.0mg
Sensor Resolution	1 σ	< 1.5mg
Angle Random Walk	15°/hour	0.02mg
Alignment	1 σ	0.1mg
G-Sensitivity	≤0.1% (over temperature)	1 σ
	0.005°/sec	0.025mg
	0.01°/sec/√Hz	0.05mg/√Hz
	1 σ	0.16mg/√Hz
	1 σ	1 σ
	1mrad 1 σ	
	<0.02°/sec/g 1 σ	
<b>VG/GPS System Performance</b>		
GPS Accuracy	±2.5m CEP stationary	
Pitch & Roll Angles	± 0.25° stationary	
Altitude (barometric)	± 3m 1 σ	
Start-Up Time (Inertial)	< 0.65 sec at 200 Hz	
GPS Acquisition (Cold Start)	< 30 sec	
GPS Reacquisition (Warm Start)	< 1 sec	
Update Rate (Inertial)	100 Hz or 10 Hz (user selectable)	
Data Rate (GPS)	5 Hz Position Data typical	
<b>Physical</b>		
Size	U.S.: 1.97 x 1.77 x 1.25 = 4.4 in <sup>3</sup>	Metric: 5 x 4.5 x 3.2 = 7.2 cm <sup>3</sup>
Weight	< 147 grams	
Operating Life	10 Years typical	
MTBF	19,787 hrs (per MIL-STD-217F, Notice 2 based on AIC environment with ambient temperature at 40°C)	
<b>Environments</b>		
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	

*Specification subject to change without notice*



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## LandMark™ 20 VG/GPS Feature Guide

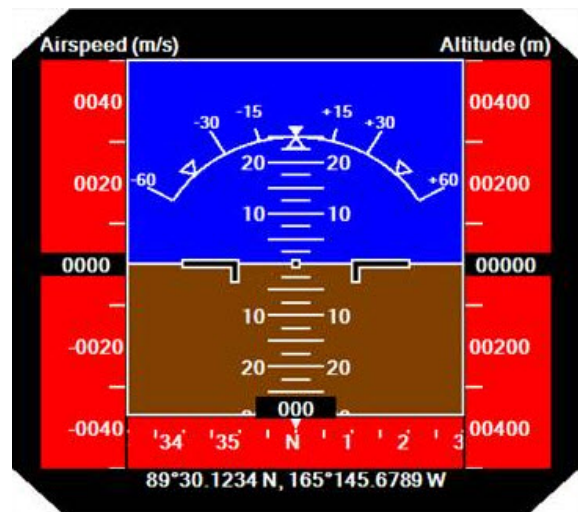
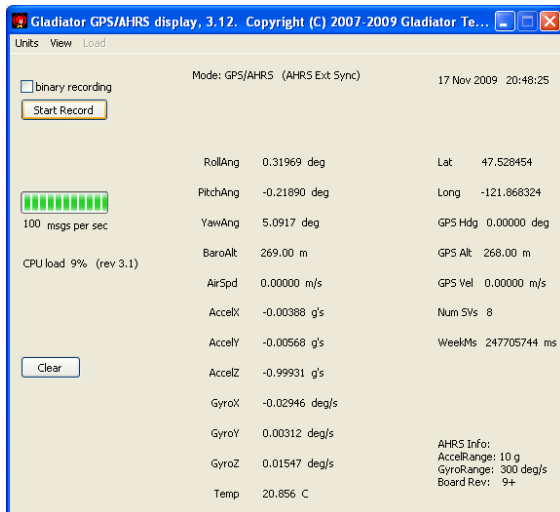
VG/GPS "LN Series" Feature Guide	-2XX GPS-Aided Vertical Gyro with Velocity Correction
<b>Inertial</b>	
Pitch & Roll Angles - X & Y	✓
Inertial Data Accels - X, Y & Z	✓
Inertial Data Gyros - X, Y & Z	✓
Temperature	✓
External Sync	✓
Unit of Measure Selection	✓
Real-Time Display Software (in DEMO KIT)	✓
<b>GPS</b>	
Latitude	✓
Longitude	✓
GPS Altimeter	✓
GPS Velocity	✓
GPS Heading	✓
Number of Satellites	✓
GPS Week millisecond time (ms)	✓
GPS Week Number	✓
EGNOS, WAAS, MSAS Capable	✓
<b>Kalman Filter CCA</b>	
Single Synchronized (Time Correlated) Output	✓
GPS Turning Error Correction with Short-Term GPS Loss	✓

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	IMU	0.01 deg/sec
Gyro - Y axis	I16	IMU	0.01 deg/sec
Gyro - Z axis	I16	IMU	0.01 deg/sec
Accel - X axis	I16	IMU See User's Guide for Scaling	See note 6.
Accel - Y axis	I16	IMU See User's Guide for Scaling	See note 6.
Accel - Z axis	I16	IMU See User's Guide for Scaling	See note 6.
Temp - X axis	I16	IMU	0.01 deg C
Roll Angle	I16	IMU	0.01 deg
Pitch Angle	I16	IMU	0.01 deg
Yaw Angle	U16	GPS Only (when moving & ≥ 4SV)	0.01 deg
Air Speed	I16	IMU - *Factory Option	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	Not Provided	meters
Altitude	I16	POSLLH - height above mean sea level (MSL)	meters
Velocity	U16	VELNED 3-D velocity blended with AHRs accels	meters/sec
Heading	U16	VELNED - 2D heading	0.01 deg
No. of SVs	U8	SOL - Number of SVs	1
IMU status	U8	IMU: See note 4.	n/a
Status	U8	See note 5 in User's Guide	n/a
Checksum	U8	See note 1.	n/a
<b>Total size (bytes)</b>	<b>50</b>		
<b>Output Rate</b>	<b>100Hz</b>		

\* **Factory Option - Requires special configuration & pitot tube of 1.45 differential pressure analog input 0-5V or linear 5V = 500 knots**

### 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 4.4ms:  
 $Full: (46 \text{ bytes} * 11 \text{ bits/byte}) / 115200 \text{ bps} = 4.4\text{ms}$
- Status byte format: The status byte contains 5 error bits and 3 status bits (see User Guide).



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