

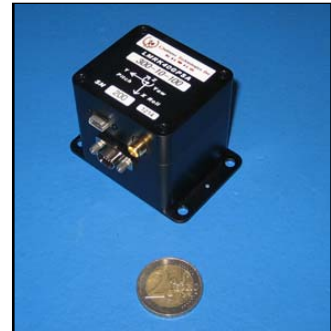
LandMark™ 40 VG/GPS



- **Small, Light Weight and Low Power MEMS GPS-Aided VG**
- **Rugged Environmentally Sealed Packaging & MILSPEC Connector**
- **Low Noise Gyros** $0.002^\circ/\text{sec}/\sqrt{\text{Hz}}$
- **Low Noise Accels** $0.04\text{mg}/\sqrt{\text{Hz}}$
- **In-Run Gyro Bias** $6^\circ/\text{hour } 1\sigma$
- **Pitch & Roll Angles** 0.25° typical
- **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** $< 825 \text{ mW typical}$
- **Low Voltage** $+3.3\text{V}$ (single sided power)
- **Light Weight** $< 150 \text{ grams}$
- **Small Size** $< 108\text{cm}^3/6.6\text{in}^3$

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

The LandMark™ 40 VG/GPS is an ultra low noise GPS-aided vertical gyro that also outputs inertial pitch & roll angles. The unit features very 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 that also. 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™ 40 VG/GPS is well suited for low cost flight control, navigation, image stabilization, antenna stabilization and pointing, general aviation, automotive testing as well as laboratory use.



Export Classification: Commerce ECCN7A994

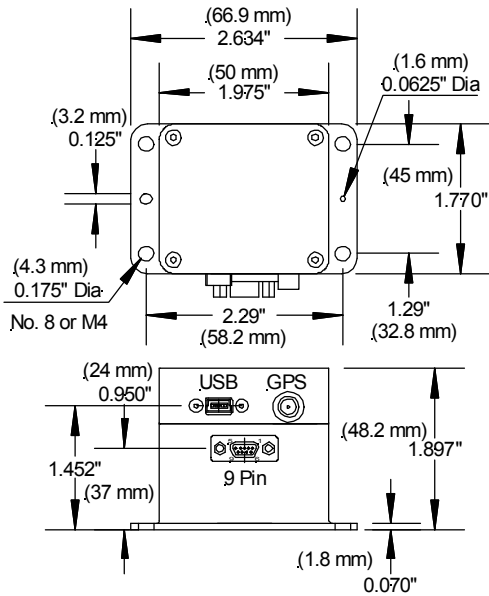


Gladiator Technologies
High Performance Inertial MEMS

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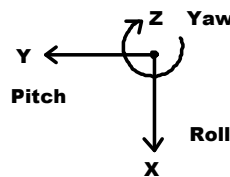
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LandMark™ 40 VG/GPS



Mating Connector: M83513/01-AN

Axes (Top View)
Right Hand Rule



LandMark™ 40 VG/GPS

LMRK40VGGPS-100-02-100
LMRK40VGGPS-100-10-100
LMRK40VGGPS-300-02-100
LMRK40VGGPS-300-10-100

Specification

| PARAMETER | RATE AXES | | ACCEL AXES | |
|----------------------------------|--|------------------------|--------------------|--------------------|
| Power Requirements | | | | |
| Input Voltage | +3.1V to 5.5V Max Input (single sided) | | | |
| Power Typical (Max) | 825mW (1100mW) | | | |
| Inertial Performance | | | | |
| Range | ±100°/sec | ±300°/sec | ±2 g's | ±10 g's |
| Bias (Over Temp.) | <0.1°/sec 1 σ | <0.15°/sec 1 σ | < 0.5mg 1 σ | < 1.5mg 1 σ |
| Bias (In Run Stability) | 6°/hour 1 σ | | 0.02mg 1 σ | 0.08mg 1 σ |
| Scale Factor Error % | ≤0.1% (over temperature) 1 σ | | | |
| Sensor Resolution | 0.001°/sec | | 0.02mg | 0.06mg |
| Angle Random Walk | 0.002° /sec/√Hz 1 σ | 0.004° /sec/√Hz 1 σ | 0.04mg /√Hz 1 σ | 0.12mg /√Hz 1 σ |
| Alignment | 1mrad 1 σ | | | |
| G-Sensitivity | <0.01°/sec/g 1 σ | | | |
| VG/GPS System Performance | | | | |
| GPS Accuracy | ±2.5m CEP stationary | | | |
| Pitch & Roll | ± 0.25° stationary | | | |
| Altitude | ± 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 | | | |
| Physical | | | | |
| Weight | ≤ 150 grams | | | |
| Size | U.S.: 1.97 x 1.77 x 1.25 = 4.4 in ³ Metric: 5 x 4.5 x 3.2 = 72 cm ³ | | | |
| Operating Life | 10 Years typical | | | |
| Environments | | | | |
| Operating Temperature | -40°C to +85°C | | | |
| Storage Temperature | -55°C to +85°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

| Pin No. | VG/GPS 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 | 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 |



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LandMark™ 40 VG/GPS Feature Guide

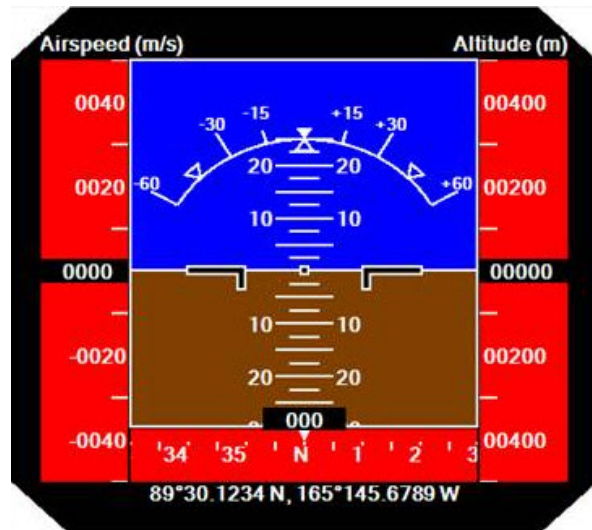
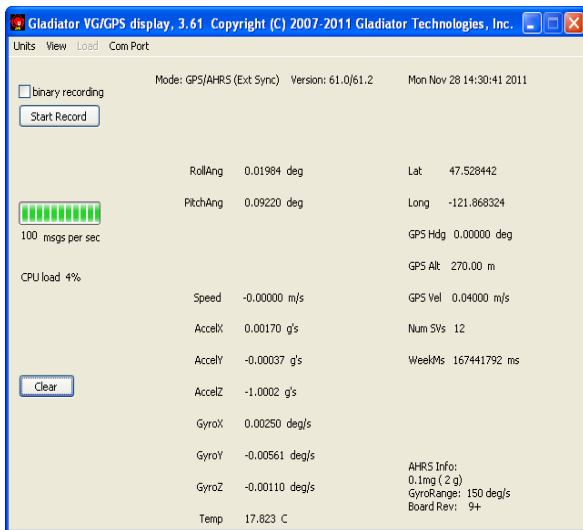
| LandMark™ 40 VG/GPS Feature Guide | -1XX |
|---|-------------|
| GPS-Aided Vertical Gyro with Velocity Correction | |
| Inertial | |
| Pitch & Roll Angles - X & Y | ✓ |
| Inertial Data Accels - X, Y & Z | ✓ |
| Inertial Data Gyros - X, Y & Z | ✓ |
| Temperature | ✓ |
| External Sync | ✓ |
| Unit of Measure Selection | ✓ |
| Real-Time Display Software (in DEMO KIT) | ✓ |
| 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 | ✓ |

| 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 | 0.01 m/s |
| 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 sea level | meters |
| Velocity | U16 | VELNED 3-D velocity | 0.01 m/s |
| 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 |
| 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 4.4ms:
 $Full: (46 \text{ bytes} * 11 \text{ bits/byte}) / 115200 \text{ bps} = 4.4 \text{ ms}$
- Status byte format: The status byte contains 5 error bits and 3 status bits (see User Guide).

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



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