

LandMark™ 20 GPS/AHRS



- **Small, Light Weight and Low Power MEMS GPS-Aided AHRS**
- **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** $15^\circ/\text{hour } 1\sigma$
- **Heading** $\pm 0.5^\circ$ stationary
- **Pitch & Roll Angles** $\pm 0.25^\circ$ stationary
- **Redundant Altitude** ± 3 meter 1σ
- **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** < 775 mW typical
- **Low Voltage** +3.3V (single sided power)
- **Light Weight** < 156 grams
- **Small Size** $< 108\text{cm}^3/6.6\text{in}^3$

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

Export Classification: Commerce ECCN7A994

The latest version of our LandMark™ 20 GPS/AHRS is the mid-performance version of our small size LandMark™ GPS/AHRS. The unit features ultra 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 redundant altitude information**. The unit employs a Kalman Filter to integrate the GPS data and GPS-Aiding with turning error correction 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™ 20 GPS/AHRS is well suited for low cost flight control, navigation, image stabilization, antenna stabilization and pointing, general aviation, automotive testing as well as laboratory use.



Gladiator Technologies



High Performance Inertial MEMS

Gladiator Technologies, Inc.

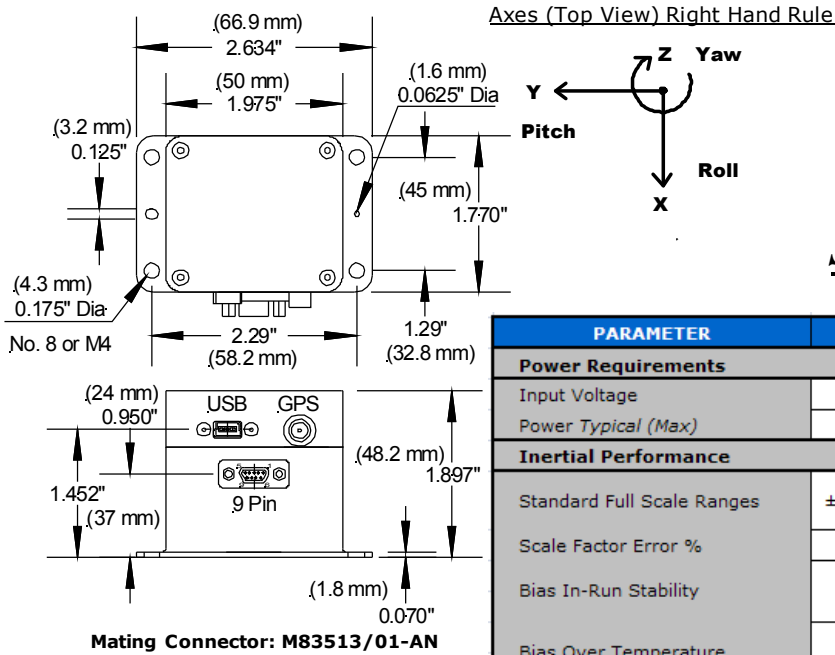
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LandMark™ 20 GPS/AHRS

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LMRK20GPSA-075-02-**300**
LMRK20GPSA-075-10-**300**
LMRK20GPSA-150-02-**300**
LMRK20GPSA-150-10-**300**
LMRK20GPSA-300-02-**300**
LMRK20GPSA-300-10-**300**



Specification

| 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 | +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) | 775mW (1050mW) | |
| Inertial Performance | | |
| Standard Full Scale Ranges | ±75°/sec ±150°/sec ±300°/sec | ±2 g's ±10 g's |
| Scale Factor Error % | ≤0.1% (over temperature) 1σ | |
| Bias In-Run Stability | 15°/hour 1σ | 0.02mg 0.1mg 1σ |
| Bias Over Temperature | <0.05°/sec 1σ | <1.0mg <1.5mg 1σ |
| Sensor Resolution | 0.005°/sec | 0.025mg 0.08mg |
| Angle Random Walk | 0.01° /sec/√Hz 1σ | 0.05mg 0.16mg /√Hz 1σ |
| Alignment | 1mrad 1σ | |
| G-Sensitivity | ≤0.02°/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 | < 156 grams | |
| Size | U.S.: Metric: | 1.770 x 1.975 x 1.882 = 6.58 in ³ 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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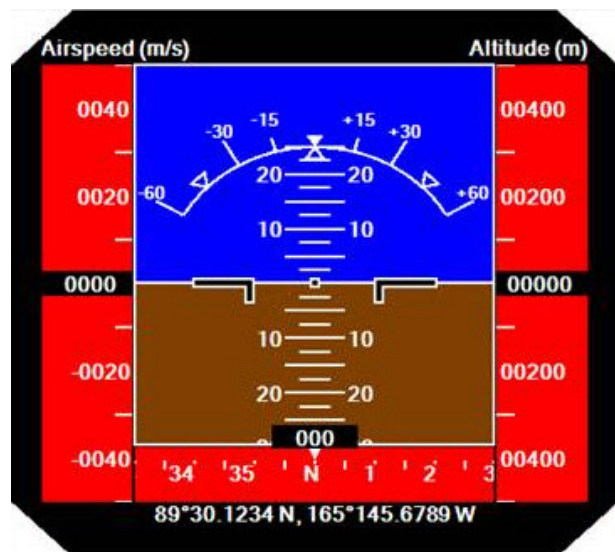
LandMark™ 20 GPS/AHRS Feature Guide

| 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 bytes * 11 bits/byte) / 115200 bps = 4.8ms*
- Status byte format: The status byte contains 5 error bits and 3 status bits (see User Guide).



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