![Inertial Labs logo](Attitude is Everything)

# OEM Version of the Professional GPS-Aided Inertial Navigation System
# "INS-P-OEM"

- **Tactical Grade IMU**
- **Competitively priced**
- **Small Size, light weight**
- **NovAtel/Septentrio/u-blox GNSS Receiver**
- **0.5 cm Position accuracy (PPK)**
- **0.03 deg Heading accuracy (PPK)**
- **0.006 deg Pitch & Roll accuracy (PPK)**
- **Ideal solution for accurate point clouds**
- **Compatible with LIDAR, Optical camera**
- **Applications: flight control, remote sensing**
- **Embedded gyro compensated Fluxgate compass**
- **Real time (RTK) & Post Processing (PPK) Kinematics**

The **Professional Inertial Labs GPS-Aided Inertial Navigation System (INS-P-OEM)** is the OEM version of Inertial Labs' new generation, fully-integrated, combined GPS, GLONASS, GALILEO, QZSS, NAVIC and BEIDOU GNSS and high-performance strapdown system, that determines position, velocity and absolute orientation (Heading, Pitch and Roll) for any device on which it is mounted. Horizontal and Vertical Position, Velocity and Orientation are determined with a high level of accuracy for both motionless and dynamic applications.
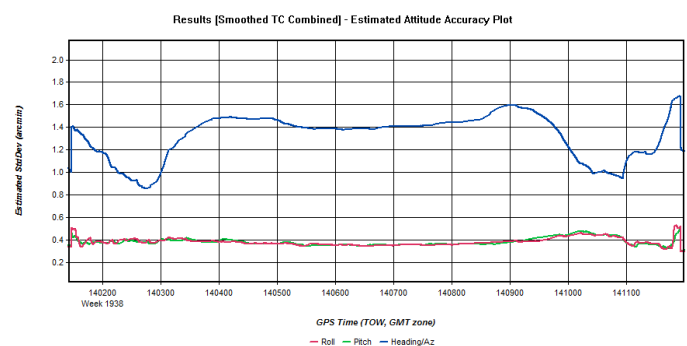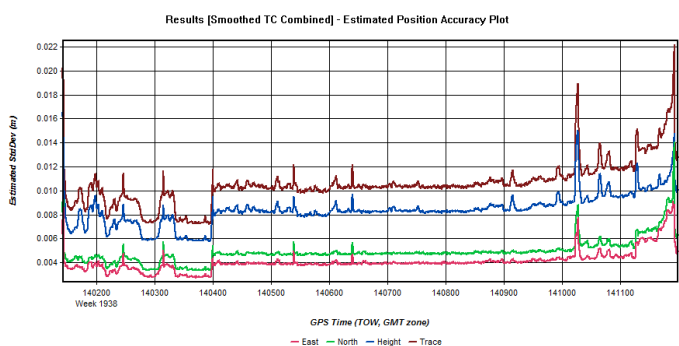
The Inertial Labs **INS-P-OEM** utilizes an advanced single antenna GNSS receiver, barometer, 3-axes each of calibrated in full operational temperature range precision Fluxgate magnetometers, Advanced MEMS Accelerometers and Gyroscopes to provide accurate Position, Velocity, Heading, Pitch and Roll of the device under measure. The **INS-P-OEM** contains Inertial Labs new on-board sensors fusion filter, state of the art navigation and guidance algorithms, and calibration software.

## KEY FEATURES, BENEFITS & FUNCTIONALITY

- Commercially exportable GPS-Aided Inertial Navigation System
- Small size & light weight: 85.5 x 47.7 x 46.9 mm size and 174-gram weight
- High-precision IMU (1 deg/hr gyroscopes and 5 micro g accelerometers Bias in-run stability)
- GPS, GLONASS, GALILEO, BEIDOU, QZSS, NAVIC, SBAS, DGPS, RTK supported signals
- Compatibility with LiDARs (Velodyne, RIEGL, FARO, Ouster, Hesai, Livox)
- Trigger for optical camera
- Up to 2000 Hz IMU; 200 Hz INS and 100 Hz GNSS data rate
- GNSS measurements and IMU raw data for post processing
- Sensor fusion algorithms with advanced extended Kalman Filter
- State-of-the-art algorithms for different dynamic motions of Vessels, Ships, Helicopters, UAV, UUV, UGV, AGV, ROV, Gimbals and Land Vehicles
- Implemented ZUPT, ZARUPT, Tunnel Guide, and GNSS tracking angle features
- Full temperature calibration of all sensing elements
- Full integration with ArduPilot platform

## INS performance

| Outage duration | Positioning mode | Position accuracy (meters, RMS) | | Velocity accuracy (meters/sec, RMS) | | Attitude accuracy (degree, RMS) | |
|---|---|---|---|---|---|---|---|
| | | Horizontal | Vertical | Horizontal | Vertical | Pitch, Roll | Heading |
| 0 sec | RTK | 0.01 + 1ppm | 0.02 + 1ppm | 0.02 | 0.01 | 0.015 | 0.08 |
| | SP | 1.2 | 1.0 | 0.03 | 0.02 | 0.08 | 0.1 |
| | PP | 0.005 | 0.01 | 0.02 | 0.01 | 0.006 | 0.03 |
| 60 sec | RTK | 7 | 2 | 0.3 | 0.1 | 0.05 | 0.15 |
| | SP | 8 | 3 | 0.3 | 0.1 | 0.1 | 0.5 |
| | PP | 0.3 | 0.2 | 0.03 | 0.05 | 0.01 | 0.1 |



Results [Smoothed TC Combined] - Estimated Position Accuracy Plot



Results [Smoothed TC Combined] - Estimated Attitude Accuracy Plot

**Inertial Labs** Address: 39959 Catoctin Ridge Street, Paeonian Springs, VA 20129 U.S.A.
Tel: +1 (703) 880-4222, Website: www.inertiallabs.com

2

## INS-P-OEM specifications

| | Parameter | Units | INS-P-OEM |
|---|---|---|---|
| **Inputs & Outputs** | Input signals | | • Marine application: DVL (Doppler Velocity Log) <br> • Land application: Odometer, Wheel sensor, Encoder, DMI <br> • Aerial application: Wind sensor, Air Speed Sensor, Doppler shift from locator (for long-term GPS denied) |
| | Output signals | | • Positions, Heading, Pitch & Roll, Velocity, Accelerations, Angular rates, Barometric data, 1PPS <br> • Direct AT_ITINS message with Position, Heading, Pitch & Roll to COBHAM AVIATOR UAV 200 <br> • Direct Navigation Support for Pixhawk Flight Controllers as NMEA messages |
| | Main feature | | Ideal solution for flight control and remote sensing (mapping, survey and inspection with LiDAR, Optical Camera) |
| | Update rate (INS data) | Hz | 1 … 200 (user settable) |
| | Update rate (IMU data) | Hz | 1 … 2000 (user settable) |
| | Start-up time | sec | <1 |

| | Positions, Velocity and Timestamps | Units | INS-P-OEM |
|---|---|---|---|
| **Navigation** | Horizontal position accuracy (GPS L1), RMS | meters | 1.5 |
| | Horizontal position accuracy (GPS L1/L2), RMS | meters | 1.2 |
| | Horizontal position accuracy (SBAS), RMS [1] | meters | 0.6 |
| | Horizontal position accuracy (DGPS), RMS | meters | 0.4 |
| | Horizontal position accuracy (post processing) [2] | meters | <0.005 |
| | Horizontal position accuracy (RTK), RMS | meters | 0.01 + 1 ppm |
| | Vertical position accuracy, RMS | meters | <1 |
| | Velocity accuracy, RMS | meters/sec | 0.03 |
| | Position accuracy (free inertial, land vehicles) | %, DT | 0.2 (w/o odometer input), 0.05 (w/ odometer input) |
| | PPS timestamps accuracy | nano sec | 20 |

| | Heading | Units | INS-P-OEM |
|---|---|---|---|
| **Orientation** | Range | deg | 0 to 360 |
| | Static Accuracy [3] | deg | 1 |
| | Gyromagnetic accuracy | deg | 0.4 |
| | Dynamic accuracy (GNSS) [6] | deg RMS | 0.1 |
| | Post processing accuracy [2] | deg RMS | 0.03 |
| | **Pitch and Roll** | **Units** | **INS-P-OEM** |
| | Range: Pitch, Roll | deg | ±90, ±180 |
| | Angular Resolution | deg | 0.01 |
| | Static Accuracy in whole Temperature Range | deg | 0.05 |
| | Dynamic Accuracy [6] | deg RMS | 0.03 |
| | Post processing accuracy [2] | deg RMS | 0.006 |

| | Gyroscopes | Units | INS-P-OEM | | |
|---|---|---|---|---|---|
| **IMU** | Measurement range | deg/sec | ±450, ±950, ±2000 | | |
| | Bias in-run stability (RMS, Allan Variance) | deg/hr | 1 | | |
| | Bias error over temperature range (RMS) | deg/hr | <30 | | |
| | Angular Random Walk (ARW) | deg/√hr | <0.2 | | |
| | **Accelerometers** | **Units** | **INS-P-OEM** | | |
| | Measurement range | g | ±8 | ±15 | ±40 |
| | Bias in-run stability (RMS, Allan Variance) | mg | 0.005 | 0.02 | 0.03 |
| | Bias error over temperature range (RMS) | mg | 0.5 | 0.7 | 1.2 |
| | Bias one-year repeatability | mg | 1.0 | 1.3 | 1.5 |
| | Velocity Random Walk (VRW) | m/sec/√hr | 0.015 | 0.035 | 0.045 |
| | **Magnetometers** | **Units** | **INS-P-OEM** | | |
| | Measurement range | Gauss | ±1.6 | | |
| | Bias in-run stability, RMS | nT | 0.2 | | |
| | Noise density, PSD | nT√Hz | 0.3 | | |

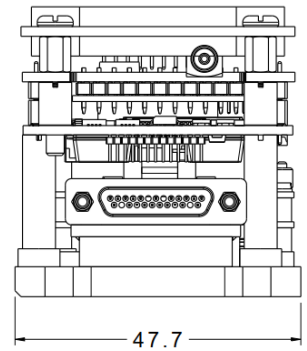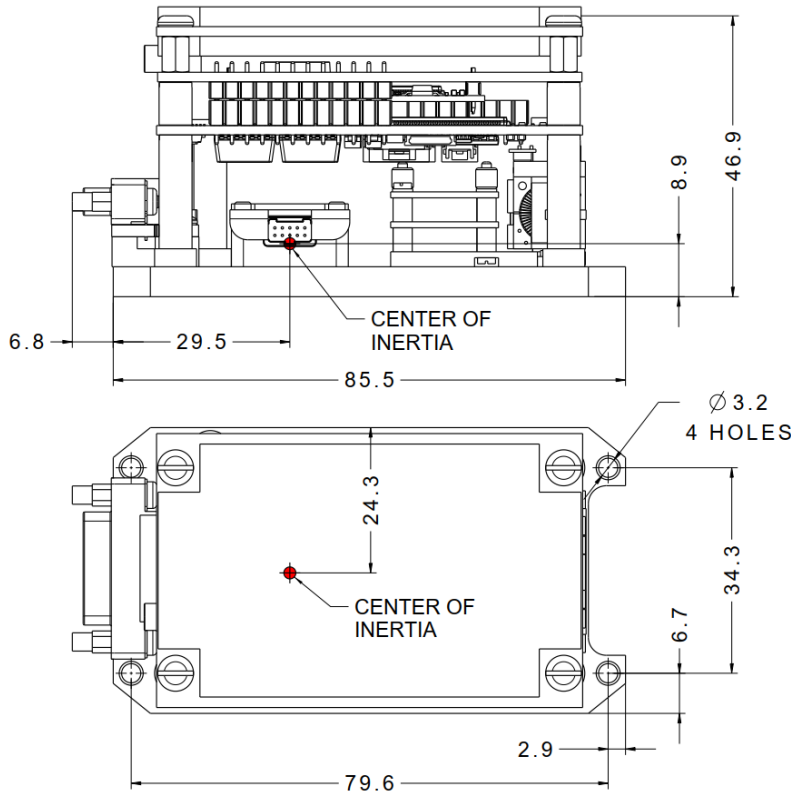| | Environment | Units | INS-P-OEM |
|---|---|---|---|
| **General** | Operating temperature | deg C | -40 to +70 |
| | Storage temperature | deg C | -50 to +85 |
| | Vibration & Shock | | MIL-STD-810G |
| | MTBF | hours | 100,000 |
| | **Electrical** | **Units** | **INS-P-OEM** |
| | Supply voltage | V DC | 9 - 36 |
| | Power consumption | Watts | 2.5 (3.5 with data logger) |
| | Output Interface (options) | - | RS-232, RS-422, Ethernet, CAN |
| | Output data format | - | Binary, NMEA 0183 ASCII characters |
| | **Physical** | **Units** | **INS-P-OEM** |
| | Size | mm | 85,5 x 47,7 x 46,9 |
| | Weight | gram | 174 |

[1] GPS only; [2] RMS, incremental error growth from steady state accuracy. Post-processing results using third party software; [3] calibrated in whole operational temperature range, in homogeneous magnetic environment, for latitude up to ±65 deg; [4] tracks up to 60 L1/L2 satellites; [5] 50 Hz while tracking up to 20 satellites. 20 Hz position update rate for Basic model of INS ; [6] dynamic accuracy may depend on type of motion ; [7] time accuracy does not include biases due to RF or antenna delay

| | Receiver Options Available | Units | NovAtel | Septentrio | u-blox |
|---|---|---|---|---|---|
| **GNSS Specifications** | Model | - | OEM719 | mosaic-X5 | ZED-F9P |
| | Number of GNSS Antennas | - | Single | Single | Single |
| | GNSS Constellations | - | GPS L1 C/A, L1C, L2C, L2P, L5; GLONASS L1 C/A, L2 C/A, L2P, L3, L5 (OEM719); BeiDou B1I, B1C, B2I, B2a, B2b, B3I (OEM719); Galileo E1, E5 AltBOC, E5a, E5b, E6 (OEM719); QZSS L1 C/A, L1C, L1S, L2C, L5, L6 (OEM719); NavIC (IRNSS) L5; L-Band | GPS L1C/A, L1C, L1PY, L2C, L2P, L5; GLONASS L1CA, L2CA, L2P, L3 CDMA; Beidou B1I, B1C, B2a, B2I, B3; Galileo E1, E5a, E5b, E5 AltBoc, E6; QZSS L1C/A, L1C, L2C, L5, L6; Navic L5; L-band | GPS L1C/A, L2C; GLONASS L1OF, L2OF; Galileo E1B/C, E5b; BeiDou B1I, B2I; QZSS L1C/A, L2C |
| | GNSS Corrections | - | WAAS; EGNOS; MSAS; GAGAN; SBAS L1, L5; DGPS; RTK; TerraStar PPP, Oceanix PPP | WAAS; EGNOS; MSAS; GAGAN; SBAS L1, L5; DGPS; RTK | WAAS; EGNOS; MSAS; GAGAN; SBAS L1C/A; DGPS; RTK |
| | Channel Configuration [1] | - | 555 | 448 | 184 |
| | GNSS Data Rate [1] | Hz | 5 / 20 / 100 | 100 (max) | 10, 20 [2] |
| | RTK Corrections | - | RTCM 2, RTCM 3 | RTCM 2, RTCM 3 | RTCM 3 |
| | Velocity Accuracy | m/s | 0.03 | 0.03 | 0.05 |
| | Initialization Time | s | <39 (cold start), <20 (hot start) | <45 (cold start), <20 (hot start) | <30 (cold start), <10 (hot start) |
| | Time Accuracy (clock drift) [3] | Nano sec | 20 | 20 | 30 |

[1] tracks up to 60 L1/L2 satellites; [2] If tracking GPS only; [3] time accuracy does not include biases due to RF or antenna delay

**Inertial Labs** Address: 39959 Catoctin Ridge Street, Paeonian Springs, VA 20129 U.S.A.
Tel: +1 (703) 880-4222, Website: www.inertiallabs.com

3

## INS mechanical interface drawing (standard configuration)



CENTER OF INERTIA

Ø 3.2 4 HOLES

CENTER OF INERTIA

Device side: 25-pin connector
MDSM-25PE-Z10-VR17

Notes:
- All dimensions are in millimeters.
- All dimensions within this drawing are subject to change without notice.
- Weight and size are PN dependent. Customers should obtain the most recent 2D/3D files before designing any interface hardware.
- Please contact Inertial Labs, Inc. if you need the INS unit to be delivered in a custom configuration with customized connector and output data.

## INS product code structure

| Model | Gyroscope | Accel | Calibration | Connector | Encoder support | Data Logger | GNSS receiver | Version | Interface |
|-------|-----------|-------|-------------|-----------|-----------------|-------------|---------------|---------|-----------|
| INS-P-OEM | G450 | A8 | TMGA | C8 | E (option) | S64 (option) | O719 | V0 | 1 |
| | G950 | A15 | | | | | ZF9P | V1 | 2 |
| | G2000 | A40 | | | | | SMX5 | V2 | 4 |
| | | | | | | | | V3 | 5 |
| | | | | | | | | V4 | 11 |
| | | | | | | | | VR43 | 22 |
| | | | | | | | | VR5 | 145 |
| | | | | | | | | V9 | 245 |
| | | | | | | | | V91 | 1245 |

Example: INS-P-OEM-G450-A15-TMGA-C8-O719-V0.1

**Product code details:**
- INS-P-OEM: OEM Version of Professional Model of GPS-Aided Inertial Navigation System
- G450: Gyroscopes measurement range ±450 deg/sec
- G950: Gyroscopes measurement range ±950 deg/sec
- G2000: Gyroscopes measurement range ±2000 deg/sec
- A8: Accelerometers measurement range ±8 g –> recommended for applications with low level of operational vibrations
- A15: Accelerometers measurement range ±15 g –> recommended for applications with medium level of operational vibrations
- A40: Accelerometers measurement range ±40 g –> recommended for high dynamic applications or/and with high level of operational vibration
- TMGA: Magnetometers, Gyroscopes and Accelerometers
- C8: Aluminum base plate with 25-pin micro D-SUB connector with screw lock (MDSM-25PE-Z10-VR17 by ITT Cannon) (with available interfaces of: RS-232, RS-422, Ethernet and CAN)
- E: encoder support
- S64: 64GB embedded Data Logger (optional)
- O719: NovAtel OEM719 single antenna GNSS receiver
- ZF9P: u-blox ZED-F9P single antenna GNSS receiver
- SMX5: Septentrio mosaic-X5 single antenna GNSS receiver
- V0: GPS L1, SBAS, DGPS, 20 Hz positions (NovAtel Single Antenna GNSS Receiver only)
- V1: GPS L1, SBAS, DGPS, 50 Hz positions (NovAtel Single Antenna GNSS Receiver only)
- V2: GPS L1, GLONASS, SBAS, DGPS, 20 Hz positions (NovAtel Single Antenna GNSS Receiver only)
- V3: GPS L1/L2, SBAS, DGPS, 20 Hz positions (NovAtel Single Antenna GNSS Receiver only)
- V4: GPS L1/L2, GLONASS L1/L2, SBAS, DGPS, 20 Hz positions (NovAtel Single Antenna GNSS Receiver only)
- VR43: GPS L1/L2, GLONASS L1/L2, SBAS, DGPS, 20 Hz positions, 20 Hz measurements (NovAtel Single Antenna GNSS Receiver only)
- VR5: GPS L1/L2, GLONASS L1/L2, SBAS, DGPS, RTK, 20 Hz positions, 20 Hz measurements (NovAtel Single Antenna GNSS Receiver only)
- V9: GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2, GALILEO E1/E5, QZSS L1/L5, DGPS, RTK, 20 Hz measurements, 20 Hz positions (Single Antenna GNSS Receiver only)
- V91: GPS L1/L2/L5, GLONASS L1/L2/L3, GALILEO E1/E5/E6, BEIDOU B1/B2/B3, QZSS L1/L2/L5, NavIC L5, SBAS, RTK, GNSS measurements, GNSS positions (Single Antenna Septentrio mosaic-X5 Receiver only)
- VX.1: RS-232 interface
- VX.2: RS-422 interface
- VX.4: CAN interface
- VX.5: Ethernet interface
- VX.11: two RS-232 interfaces
- VX.22: two RS-422 interfaces
- VX.145: RS-232, CAN and Ethernet interface (with optional Encoder support)
- VX.245: RS-422, CAN and Ethernet interface (without Encoder support)
- VX.1245: RS-232, RS-422, CAN and Ethernet interface

Inertial Labs Address: 39959 Catoctin Ridge Street, Paeonian Springs, VA 20129 U.S.A.
Tel: +1 (703) 880-4222, Website: www.inertiallabs.com

4