

STANDARD
MIL-STD
810G



Inertial Labs Single and Dual Antenna GPS-Aided Inertial Navigation Systems INS



The **Inertial Labs Single and Dual Antenna GPS-Aided Inertial Navigation System – INS** is new generation of fully-integrated, combined GPS, GLONASS, GALILEO, QZSS, BEIDOU and L-Band navigation 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 high accuracy for both motionless and dynamic applications.

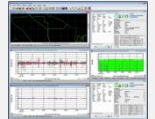


The Inertial Labs **INS** utilizes advanced single and dual antenna GNSS receiver, barometer, 3-axes each of calibrated in full operational temperature range precision Fluxgate magnetometers, Accelerometers and Gyroscopes to provide accurate Position, Velocity, Heading, Pitch and Roll of the device under measure. **INS** contains Inertial Labs new on-board sensors fusion filter, state of the art navigation and guidance algorithms and calibration software.

KEY FEATURES AND FUNCTIONALITY

- Affordable price
- Excellent accuracy in GPS-Denied environments (up to 0.05 % DT)
- Tactical-grade IMU + Fluxgate compass + Aiding data
- Support: ROS, LabVIEW, Waypoint Inertial Explorer, QINSy
- GPS, GLONASS, GALILEO, BEIDOU, SBAS, DGPS, RTK supported signals
- Tactical-grade IMU (1 deg/hr gyroscopes and 5 micro g accelerometers Bias in-run stability)
- Fluxgate gyro-compensated compass to maintain free-inertial Heading (INS-P model)
- Single and Dual antenna GNSS receivers
- Compatibility with LiDARs (Velodyne, RIEGL, FARO) and optical cameras
- Odometer, Wheel sensor, Airspeed sensor, Wind sensor, Doppler shift from locator aiding data
- 1 cm + 1 ppm RTK Horizontal Position Accuracy or 2.5 cm TerraStar-C PRO Horizontal Position Accuracy
- 0.05 deg GNSS Heading and <0.4 deg Free-inertial Heading accuracy (3 sigma)
- Advanced, extendable, embedded Kalman Filter based sensor fusion algorithms
- State-of-the-art algorithms for different dynamic motions of Vessels, Ships, Helicopters, UAV, UUV, UGV, AGV, ROV, Gimbals and Land Vehicles
- Implemented ZUPT, GNSS tracking angle features
- Full temperature calibration, Environmentally sealed (IP67), compact design, MIL-STD-810G/DO-160E

WAYPOINT
PRODUCTS GROUP



ROS



LabVIEW

Models & features

INS-B



Basic

Ideal solution for remote sensing (UAV, LiDAR, Optical Camera, Point Clouds)

INS-P



Professional

High performance in long-term GPS-Denied environment

INS-D



Dual Antenna

High precision Heading Tactical-grade IMU SP/SBAS/DGPS/RTK

INS-DL



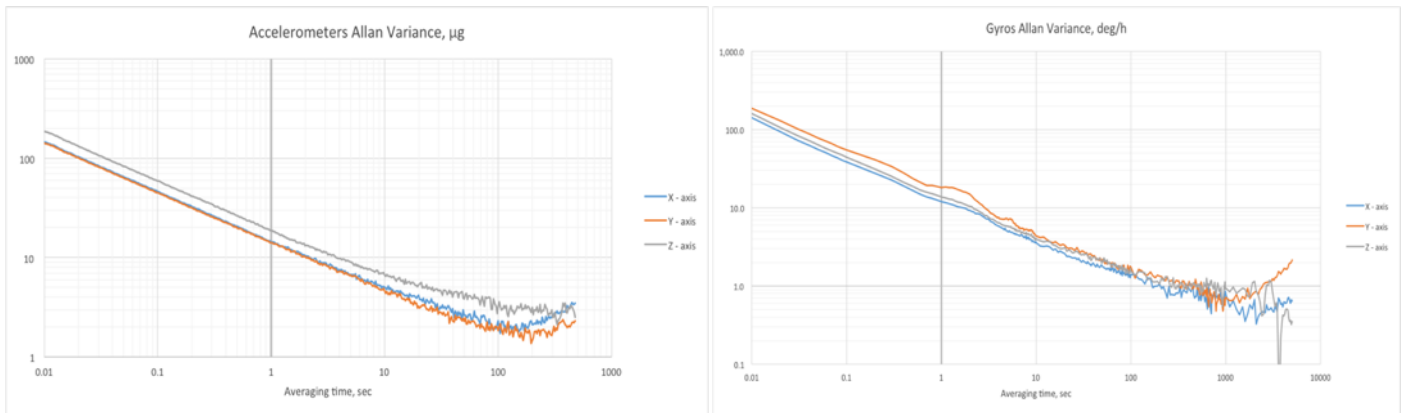
Dual Antenna

High precision Heading Industrial-grade IMU 1 cm RTK position

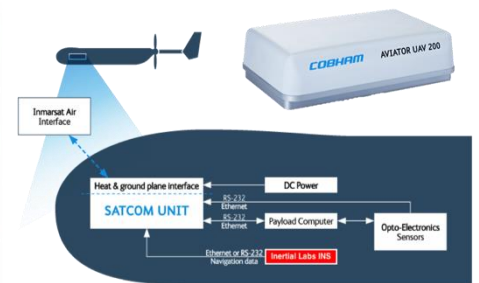
	Parameter	Units	INS-B	INS-P	INS-D	INS-DL	
GENERAL	Output signals		<ul style="list-style-type: none"> Positions, Heading, Dual antenna Heading (D/DL), Pitch, Roll, Velocity, Accelerations, Angular rates, Barometer, PPS Direct AT_ITINS message with Position, Heading, Pitch & Roll to COBHAM AVIATOR UAV 200 				
	Input signals		<ul style="list-style-type: none"> Marine application: DVL (Doppler Velocity Log) Land application: Odometer, Wheel sensor, Encoder, DMI Aerial application: Wind sensor, Air Speed Sensor, Doppler shift from locator (for long-term GPS denied) All: External Stand Alone Magnetic Compass (SAM/AHRS) 				
	Main features		Ideal solution for remote sensing (with LiDAR, Optical Camera)	High performance in long-term GPS-Denied environment	High precision Heading Tactical-grade IMU	Affordable price High precision Heading 1 cm RTK position	
	Compatible with		Pixhawk Autopilot; Embention Autopilot; COBHAM AVIATOR UAV 200				
	Available colors of enclosure		Black (default), Desert Tan or Green				
	Data rate	Hz	Up to 200 (INS data); Up to 2000 (IMU data)			Up to 200 (INS) & 2000 (IMU)	
	Internal Data Logger (storage) - optional		8 GB or 64 GB (optional)			8 GB or 64 GB (optional)	
Start-up time	sec		<1		<1		
Navigation	Positions, Velocity and Timestamps	Units	INS-B	INS-P	INS-D	INS-DL	
	Horizontal position accuracy (GPS L1)	meters, RMS		1.5		1.5	
	Vertical position accuracy (GPS L1)	meters, RMS		<1		<2	
	Horizontal position accuracy (GPS L1/L2)	meters, RMS		1.2		1.2	
	Horizontal position accuracy (SBAS) ⁽¹⁾	meters, RMS		0.6		n/a	
	Horizontal position accuracy (DGPS)	meters, RMS		0.4		0.4	
	Horizontal position accuracy (TerraStar-L) ⁽²⁾	meters, RMS		0.4		n/a	
	Horizontal position accuracy (TerraStar-C PRO) ⁽²⁾	meters, RMS		0.025		n/a	
	Horizontal position accuracy (post processing) ⁽³⁾	meters, RMS		0.005		0.005	
	Horizontal position accuracy (RTK)	meters, RMS		0.01 + 1 ppm		0.01 + 1 ppm	
	Vertical position accuracy (RTK)	meters, RMS		0.02		0.02	
	Position accuracy (free inertial, land vehicles)	%, DT		0.2% DT (w/o odometer input) 0.05 % DT (w/ odometer input)		0.5% DT (w/o odometer input) 0.1 % DT (w/ odometer input)	
	Velocity accuracy, RMS	meters/sec		0.03		0.03	
PPS timestamps accuracy	nano sec		20		20		
Orientation	Heading	Units	INS-B	INS-P	INS-D	INS-DL	
	Range	deg	0 to 360	0 to 360	0 to 360	0 to 360	
	Static Accuracy ⁽⁴⁾	deg RMS	1	0.4	0.15 (1 meter base line)	0.2 (1 meter base line)	
	Dynamic accuracy (GNSS) ⁽⁷⁾	deg RMS	0.1	0.1	0.08 (2 meters baseline)	0.08 (2 meters baseline)	
	Post processing accuracy ⁽³⁾	deg RMS	0.03	0.03	0.03	0.03	
	Pitch and Roll	Units	INS-B	INS-P	INS-D	INS-DL	
	Range: Pitch, Roll	deg		±90, ±180		±90, ±180	
	Angular Resolution	deg		0.01		0.01	
	Static Accuracy in whole Temperature Range	deg RMS		0.05		0.05	
	Dynamic Accuracy ⁽⁷⁾	deg RMS		0.08		0.1	
Post processing accuracy ⁽³⁾	deg RMS		0.006		0.01		
GNSS	GNSS	Units	INS-B	INS-P	INS-D	INS-DL	
	Number of GNSS Antennas		Single	Single	Dual	Dual	
	Supported navigation signals		GPS L1 C/A, L1C, L2C, L2P, L5; GLONASS L1 C/A, L2 C/A, L2P, L3, L5; BeiDou B1, B2; Galileo E1, E5 AltBOC, E5a, E5b; NavIC (IRNSS) L5; SBAS L1, L5 QZSS L1 C/A, L1C, L2C, L5; L-Band up to 5 channels; DGPS; RTK			GPS L1/L2; GLO L1/L2; BDS B1/B2, GAL E1/E5, QZSS L1/L2, DGPS, RTK	
	Channel configuration ⁽⁵⁾		555 Channels			432 Channels	
	RTK corrections		RTCM 2, RTCM 3			RTCM 2, RTCM 3	
	GNSS Positions data rate ⁽⁶⁾	Hz	20, 50			20	
	GNSS Measurements (raw) data rate	Hz	20			5	
	Velocity accuracy, RMS	meters/sec	<0.03			<0.03	
	Initialization time	Sec	<50 (cold start), <30 (hot start)			<50 (cold start), <30 (hot start)	
	Time accuracy (clock drift) ⁽⁸⁾	nano sec	20			20	
IMU	Gyroscopes	Units	INS-B	INS-P	INS-D	INS-DL	
	Type			Tactical-grade		Industrial-grade	
	Measurement range	deg/sec		±450 / ±950		±450 / ±950	
	Bias in-run stability (RMS, Allan Variance)	deg/hr		1		3	
	Bias error over temperature range (RMS)	deg/hr		<30		<50	
	Angular Random Walk	deg/√hr		<0.2 (0.08 optional)		<0.3	
	Accelerometers	Units	INS-B	INS-P	INS-D	INS-DL	
	Type			Tactical-grade		Industrial-grade	
	Measurement range	g		±8 g / ±15 g / ±40 g		±8 g / ±15 g / ±40 g	
	Bias in-run stability (RMS, Allan Variance)	mg		0.005 (±8 g) / 0.02 (±15 g) / 0.03 (±40 g)		0.01 / 0.03 / 0.05	
Bias error over temperature range (RMS)	mg		0.5 (±8 g) / 0.7 (±15 g) / 1.2 (±40 g)		0.7 / 1.1 / 1.5		
Bias one-year repeatability	mg		1.0 (±8 g) / 1.3 (±15 g) / 1.5 (±40 g)		1.5 / 2.0 / 2.5		
Velocity Random Walk	m/s/√hr		0.015 (±8 g) / 0.035 (±15 g) / 0.045 (±40 g)		0.02 / 0.045 / 0.06		
Magnetometers	Units	INS-B	INS-P (Fluxgate)	INS-D	INS-DL		
Measurement range	Gauss		±1.6				
Bias in-run stability, RMS	nT	Optional	0.2		Optional		
Noise density, PSD	nT/√Hz		0.3				
Pressure	Units	INS-B	INS-P	INS-D	INS-DL		
Measurement range	hPa		300 – 1100		300 – 1100		
Bias in-run stability (RMS, Allan Variance)	Pa		2		2		
Noise density	Pa/√Hz		0.8		0.8		
General	Environment	Units	INS-B	INS-P	INS-D	INS-DL	
	Operating temperature	deg C		-40 to +75		-40 to +70	
	Storage temperature	deg C		-50 to +85		-50 to +85	
	MTBF (G _M @ +65degC)	hours		100,000		100,000	
	Shock and Vibration			MIL-STD-810G		MIL-STD-810G	
	EMC/EMI			MIL-STD-461F		MIL-STD-461F	
	Electrical	Units	INS-B	INS-P	INS-D	INS-DL	
	Supply voltage	V DC	9 to 36	9 to 36	9 to 36	9 to 36	
	Power consumption	Watts	1	1.4	2.6	2.6	
	Output Interface (options)	-	RS-232 / RS-422 / CAN / Ethernet / 2 x RS-232 / 2 x RS-422 / RS-232 + CAN + Ethernet / RS-422 + CAN + Ethernet				
Output data format		Binary, NMEA 0183 ASCII characters					
Physical	Units	INS-B	INS-P	INS-D	INS-DL		
Size	mm	120 x 50 x 53	120 x 50 x 53	120 x 50 x 53	120 x 50 x 53		
Weight	gram	220	280	320	320		

⁽¹⁾ GPS only; ⁽²⁾ Requires a subscription to a TerraStar data service ⁽³⁾ RMS, incremental error growth from steady state accuracy. Post-processing results using third party software; ⁽⁴⁾ calibrated in whole operational temperature range, in homogeneous magnetic environment, for latitude up to +65 deg; ⁽⁵⁾ tracks up to 60 L1/L2 satellites; ⁽⁶⁾ 50 Hz while tracking up to 20 satellites. 20 Hz position update rate for Basic mode of INS; ⁽⁷⁾ dynamic accuracy may depend on type of motion; ⁽⁸⁾ time accuracy does not include biases due to RF or antenna delay

Inertial Labs GPS-Aided INS key sensors (IMU) performance



Inertial Labs GPS-Aided INS key applications



INS part numbers structure

Model	Gyro	Accel	Calibration	Connector	Color	Data Logger	GNSS receiver	Version	Interface
INS-B	G450	A8	TGA	C1	D	S8 (option)	O615	V0	1
INS-P	G950	A15	TMGA	C3	B	S64 (option)	O617D	V1	2
INS-D		A40		C31	G		O718	V2	3
INS-DL				C32	W		O719	V3	4
							O7720	V4	5
							P327	VR43	11
							B482	VR5	22
								V8	145
								VD4	245
								VD42	
								VD43	
								VD9	

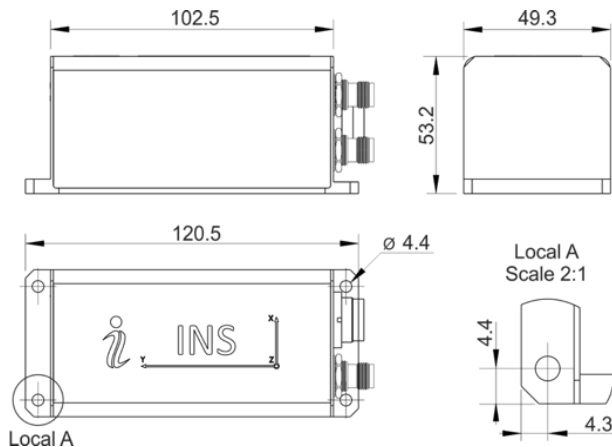


Example: INS-B-G450-A8-TGA-C3-D-S8-O719-V0.1

- INS-B: Basic Model of GPS-Aided Inertial Navigation System
- INS-P: Professional Model of GPS-Aided Inertial Navigation System
- INS-D: Dual Antenna GPS-Aided Inertial Navigation System
- INS-DL: Dual Antenna GPS-Aided Inertial Navigation System
- G450: Gyroscopes measurement range = ± 450 deg/sec
- G950: Gyroscopes measurement range = ± 950 deg/sec
- A8: Accelerometers measurement range = ± 8 g
- A15: Accelerometers measurement range ± 15 g
- A40: Accelerometers measurement range ± 40 g
- TGA: Gyroscopes and Accelerometers
- TMGA: Magnetometers, Gyroscopes and Accelerometers (INS-P and INS-D only)
- C1: 12 pins connector (RS-232) - OBSOLETE
- C3: 24 pins connector (RS-232, RS-422, CAN, Ethernet interfaces)
- C31: 24 pins connector (RS-232, 2 x RS-422, CAN interfaces)
- C32: 24 pins connector (RS-232, RS-422, CAN, Ethernet interfaces) with modified PPS (preserve PPS configurable polarity): Active high - 5v (1'). Active low - 0v (0')
- D - Desert Color (Desert tan, color code 33446 (tan 686A) per FED-STD-595, Change Notice 1.)
- B - Black Color (default)
- G - Green
- W - White
- S8: 8GB embedded Data Logger (optional)
- S64: 64GB embedded Data Logger (optional)
- O615: Novatel OEM615 single antenna GNSS receiver (INS-B and INS-P only) - OBSOLETE
- O617D: Novatel OEM617D dual antenna GNSS receiver (INS-D only) - OBSOLETE
- O718: Novatel OEM718D dual antenna GNSS receiver (INS-D, for China only)
- O719: Novatel OEM719 single antenna GNSS receiver (INS-B and INS-P only)
- O7720: Novatel OEM7720 dual antenna GNSS receiver (INS-D only)
- P327: Hemisphere P327 single antenna GNSS receiver (INS-B and INS-P only)
- B482: Inertial Labs B482 dual antenna GNSS receiver (INS-DL only)
- V0: GPS L1, SBAS, DGPS, 20 Hz positions (INS-B and INS-P only)
- V1: GPS L1, SBAS, DGPS, 50 Hz positions (INS-B and INS-P only)
- V2: GPS L1, GLONASS, SBAS, DGPS, 20 Hz positions (INS-B and INS-P only)
- V3: GPS L1/L2, SBAS, DGPS, 20 Hz positions (INS-B and INS-P only)
- V4: GPS L1/L2, GLONASS L1/L2, SBAS, DGPS, 20 Hz positions (INS-B and INS-P only)
- VR43: GPS L1/L2, GLONASS L1/L2, SBAS, DGPS, 20 Hz positions, 20 Hz measurements (INS-B and INS-P only)
- VR5: GPS L1/L2, GLONASS L1/L2, SBAS, DGPS, RTK, 20 Hz positions, 20 Hz measurements (INS-B and INS-P only)
- V8: GPS L1/L2/L5; GLONASS L1/L2; BeiDou B1/B2/B3; GALILEO E1/E5; SBAS; DGPS; 20 Hz measurements; 20 Hz positions RTK (INS-B and INS-P only)
- VD4: GPS L1/L2, Dual antenna Heading, SBAS, DGPS, 20 Hz positions (INS-D only)
- VD42: GPS L1/L2, GLONASS L1/L2, Dual antenna Heading, SBAS, DGPS, RTK, 20 Hz measurements, 20 Hz positions (INS-D only)
- VD43: GPS L1/L2, GLONASS L1/L2, Dual antenna Heading, SBAS, DGPS, 20 Hz positions (INS-D only)
- VD9: GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2, GALILEO E1/E5, QZSS L1/L5, DGPS, RTK, Dual antenna Heading, DGPS, RTK, 20 Hz measurements, 20 Hz positions (INS-DL only)
- VX.1: RS-232 interface
- VX.2: RS-422 interface
- VX.3: RS-485 interface (temporary is not available)
- 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 interfaces
- VX.245: RS-422, CAN and Ethernet interfaces

Notes:
 1. All dimensions are in millimeters.
 2. All dimensions within this drawing are subject to change without notice. Customers should obtain final drawings before designing any interface hardware.
 3. Interface connector type: Binder. Male receptacle, shielded, rear-mounting
 4. GNSS antenna connector type: TNC - Female

INS-D and INS-DL mechanical interface drawing



INS-B and INS-P mechanical interface drawing

