

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, heave and absolute orientation (Heading, Pitch and Roll) for any device on which it is mounted. Horizontal and Vertical Position, Velocity, Heave 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 (Tactical-grade IMU + Fluxgate compass + Aiding data)
- 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
- 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 of all sensing elements
- Environmentally sealed (IP67), compact design, MIL-STD-810G/DO-160E



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

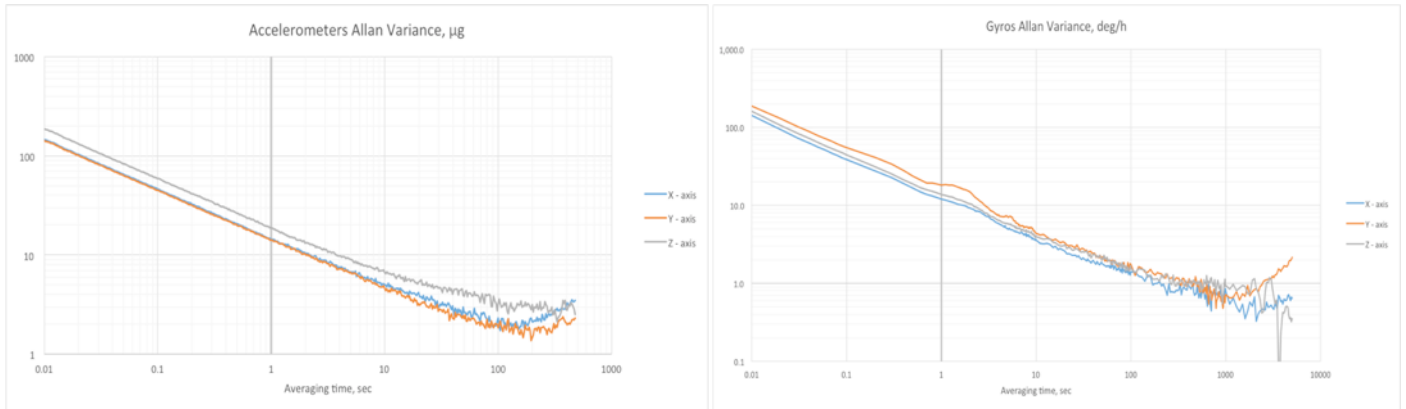
High precision Heading Industrial-grade IMU 1 cm RTK position

Single and Dual Antenna GPS-Aided INS Specifications

Parameter		Units	INS-B (Basic)			INS-P (Professional)			INS-D (Dual Antenna)			INS-DL (Low-cost Dual Antenna)		
	Output signals		Positions, Heading, Dual antenna Heading (D/DL), Pitch, Roll, Velocity, Accelerations, Angular rates, Barometric data, PPS											
	Input signals		Marine application: DVL (Doppler Velocity Log) Land application: Odometer, Wheel sensor, Encoder, DMI											
	Main features		Aerial application: Wind sensor, Air Speed Sensor, Doppler shift from locator (for long-term GPS denied)											
	Update rate	Hz	200 (INS data) 2000 (IMU data)			200 (INS data) 2000 (IMU data)			200 (INS data) 2000 (IMU data)			200 (INS data) 2000 (IMU data)		
	Start-up time	sec	<1											
Navigation	Positions, Velocity and Timestamps		INS-B			INS-P			INS-D			INS-DL		
	Horizontal position accuracy (GPS L1)	meters, RMS	1.5			1.5			1.5			1.5		
	Vertical position accuracy (GPS L1)	meters, RMS	<1			<1			<1			<2		
	Horizontal position accuracy (GPS L1/L2)	meters, RMS	1.2			1.2			1.2			1.2		
	Horizontal position accuracy (SBAS) ⁽¹⁾	meters, RMS	0.6			0.6			0.6			0.6		
	Horizontal position accuracy (DGPS)	meters, RMS	0.4			0.4			0.4			0.4		
	Horizontal position accuracy (TerraStar-L) ⁽²⁾	meters, RMS	0.4			0.4			0.4			n/a		
	Horizontal position accuracy (TerraStar-C PRO) ⁽²⁾	meters, RMS	0.25			0.25			0.25			n/a		
	Horizontal position accuracy (post processing) ⁽³⁾	meters, RMS	0.005			0.005			0.005			0.005		
	Horizontal position accuracy (RTK)	meters, RMS	0.01 + 1 ppm			0.01 + 1 ppm			0.01 + 1 ppm			0.01 + 1 ppm		
	Vertical position accuracy (RTK)	meters, RMS	0.02			0.02			0.02			0.02		
	Velocity accuracy, RMS	meters/sec	0.03			0.03			0.03			0.03		
	PPS timestamps accuracy	nano sec	20			20			20			20		
Orientation	Heading		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) 0.08 (2 meters baseline)			0.2 (1 meter base line) 0.08 (2 meters baseline)		
	Dynamic accuracy (GNSS) ⁽⁷⁾	deg RMS	0.1			0.1								
	Post processing accuracy ⁽³⁾	deg RMS	0.03			0.03			0.03			0.03		
	Pitch and Roll		INS-B			INS-P			INS-D			INS-DL		
	Range: Pitch, Roll	deg	±90, ±180			±90, ±180			±90, ±180			±90, ±180		
	Angular Resolution	deg	0.01			0.01			0.01			0.01		
	Static Accuracy in whole Temperature Range	deg RMS	0.05			0.05			0.05			0.08		
	Dynamic Accuracy ⁽⁷⁾	deg RMS	0.08			0.08			0.08			0.1		
Post processing accuracy ⁽³⁾	deg RMS	0.006			0.006			0.006			0.006			
GNSS	GNSS		INS-B			INS-P			INS-D			INS-DL		
	Number of Antennas		Single			Single			Dual			Dual		
	Supported navigation signals		GPS L1/L2/L5; GLONASS L1/L2; BeiDou B1/B2/B3, QZSS L1/L2/L5; GALILEO E1/E5; SBAS; DGPS; RTK			GPS L1/L2, GLONASS L1/L2, BeiDou B1/B2/B3, SBAS, DGPS, RTK			GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2, GALILEO E1/E5, QZSS L1/L5, SBAS, DGPS, RTK			GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2, GALILEO E1/E5, QZSS L1/L5, SBAS, DGPS, RTK		
	Channel configuration ⁽⁵⁾					555 Channels			435 Channels			435 Channels		
	RTK corrections					RTCM 2.1/2.3/3.0/3.1			RTCM 2.3/3.0/3.2			RTCM 2.3/3.0/3.2		
	GNSS Positions data rate ⁽⁶⁾	Hz	20, 50			20, 50			20			20		
	GNSS Measurements (raw) data rate	Hz	20			20			20			20		
	Velocity accuracy, RMS	meters/sec	<0.03			<0.03			<0.03			<0.03		
	Initialization time	Sec	<50 (cold start), <30 (hot start)			<50 (cold start), <30 (hot start)			<50 (cold start), <30 (hot start)			<50 (cold start), <30 (hot start)		
	Time accuracy (clock drift) ⁽⁸⁾	nano sec	20			20			20			20		
IMU	Gyroscopes		INS-B			INS-P			INS-D			INS-DL		
	Type		Tactical-grade			Tactical-grade			Tactical-grade			Industrial-grade		
	Measurement range	deg/sec	±450 / ±950			±450 / ±950			±450 / ±950			±450 / ±950		
	Bias in-run stability (RMS, Allan Variance)	deg/hr	1			1			3			3		
	Bias error over temperature range (RMS)	deg/hr	<30			<30			<50			<50		
	Angular Random Walk	deg/√hr	<0.2			<0.2			<0.3			<0.3		
	Accelerometers		INS-B			INS-P			INS-D			INS-DL		
	Type		Tactical-grade			Tactical-grade			Tactical-grade			Industrial-grade		
	Measurement range	g	±8 g	±15 g	±40 g	±8 g	±15 g	±40 g	±8 g	±15 g	±40 g	±8 g	±15 g	±40 g
	Bias in-run stability (RMS, Allan Variance)	mg	0.005	0.02	0.03	0.005	0.02	0.03	0.005	0.02	0.03	0.01	0.03	0.05
	Bias error over temperature range (RMS)	mg	0.5	0.7	1.2	0.5	0.7	1.2	0.5	0.7	1.2	0.7	1.1	1.5
	Bias one-year repeatability	mg	1.0	1.3	1.5	1.0	1.3	1.5	1.0	1.3	1.5	1.5	2.0	2.5
	Velocity Random Walk	m/s/√hr	0.015	0.035	0.045	0.015	0.035	0.045	0.015	0.035	0.045	0.02	0.045	0.06
Magnetometers		INS-B			INS-P (Fluxgate)			INS-D			INS-DL			
Measurement range	Gauss	Optional			±1.6			Optional			Optional			
Bias in-run stability, RMS	nT	Optional			0.2			Optional			Optional			
Noise density, PSD	nT/√Hz	Optional			0.3			Optional			Optional			
Pressure		INS-B			INS-P			INS-D			INS-DL			
Measurement range	hPa	300 – 1100			300 – 1100			300 – 1100			300 – 1100			
Bias in-run stability (RMS, Allan Variance)	Pa	2			2			2			2			
Noise density	Pa/√Hz	0.8			0.8			0.8			0.8			
Environment		INS-B			INS-P			INS-D			INS-DL			
Operating temperature	deg C	-40 to +70			-40 to +70			-40 to +70			-40 to +70			
Storage temperature	deg C	-50 to +85			-50 to +85			-50 to +85			-50 to +85			
MTBF (G _M @ +65degC)	hours	100,000			100,000			100,000			100,000			
Shock and Vibration		MIL-STD-810G			MIL-STD-810G			MIL-STD-810G			MIL-STD-810G			
EMC/EMI		MIL-STD-461			MIL-STD-461			MIL-STD-461			MIL-STD-461			
Electrical		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, Ethernet, CAN												
Output data format		Binary, TSS-1, NMEA 0183 ASCII characters												
Physical		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 model 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



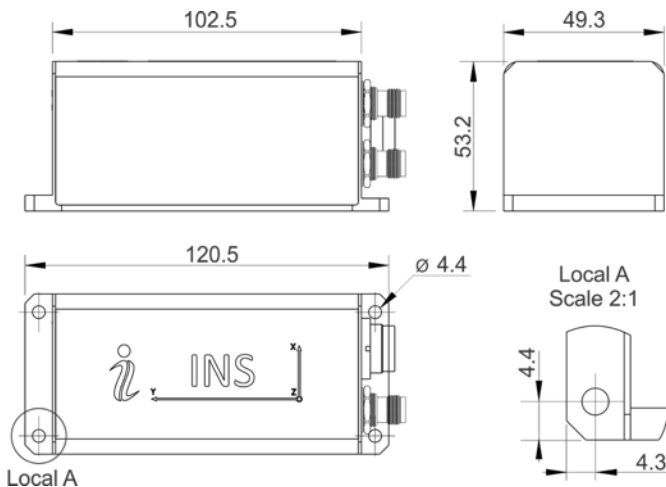
INS part numbers structure

Model	Gyro	Accel	Calibration	Connector	GNSS receiver	Version	Interface
INS-B	G450	A8	TGA	C1	O615	V0	1
INS-P	G950	A15	TMGA	C3	O617D	V1	2
INS-D		A40			O718	V2	
INS-DL					O719	V3	
					O7720	V4	
					P327	VR43	
					B482	VR5	
						V8	
						VD4	
						VD42	
						VD9	

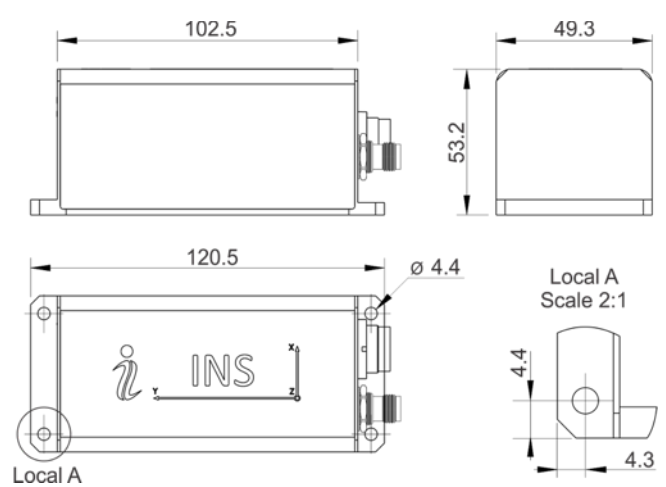
Example: INS-B-G450-A8-TGA-C1-O615-V0.1

- 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)
- C3: 24 pins connector (RS-232, RS-422, CAN, Ethernet interfaces)
- O615: Novatel OEM615 single antenna GNSS receiver (INS-B and INS-P only)
- O617D: Novatel OEM617D dual antenna GNSS receiver (INS-D only)
- O718: Novatel OEM718D dual antenna GNSS receiver (INS-D 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, CAN, Ethernet interface
- VX.2: RS-422, CAN, Ethernet interface

INS-D and INS-DL mechanical interface drawing



INS-B and INS-P mechanical interface drawing



Notes:

- All dimensions are in millimeters.
- All dimensions within this drawing are subject to change without notice. Customers should obtain final drawings before designing any interface hardware.

Interface connector type: Binder. Male receptacle, shielded, rear-mounting
GNSS antenna connector type: TNC - Female