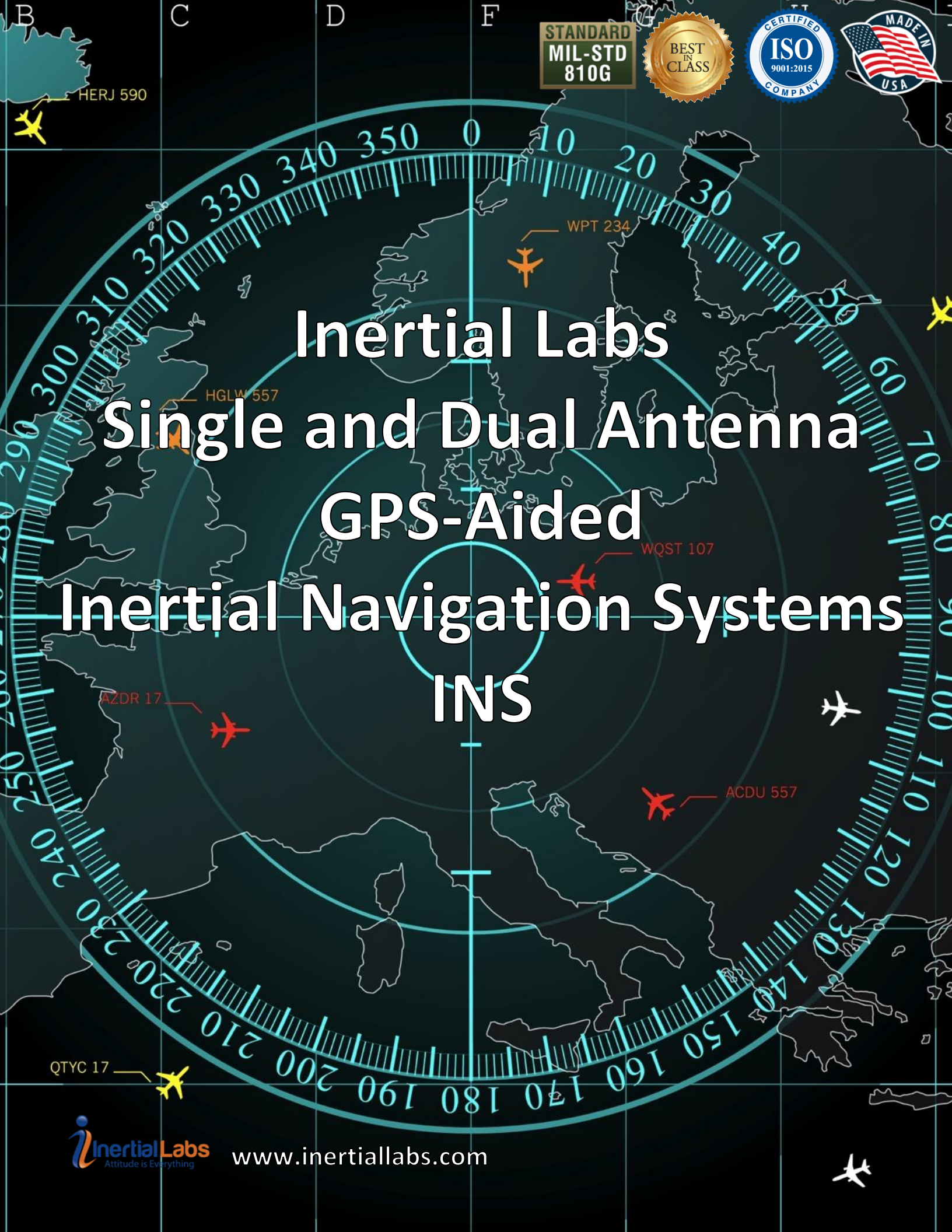




Inertial Labs Single and Dual Antenna GPS-Aided Inertial Navigation Systems INS

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.

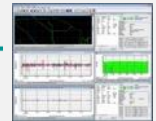


The Inertial Labs **INS** utilizes advanced single and dual antenna GNSS receiver, barometer, 3-axes each of calibrated in full operational temperature range precision Fluxgate magnetometers, Accelerometers and Gyroscopes to provide accurate Position, Velocity, Heading, Pitch and Roll of the device under 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



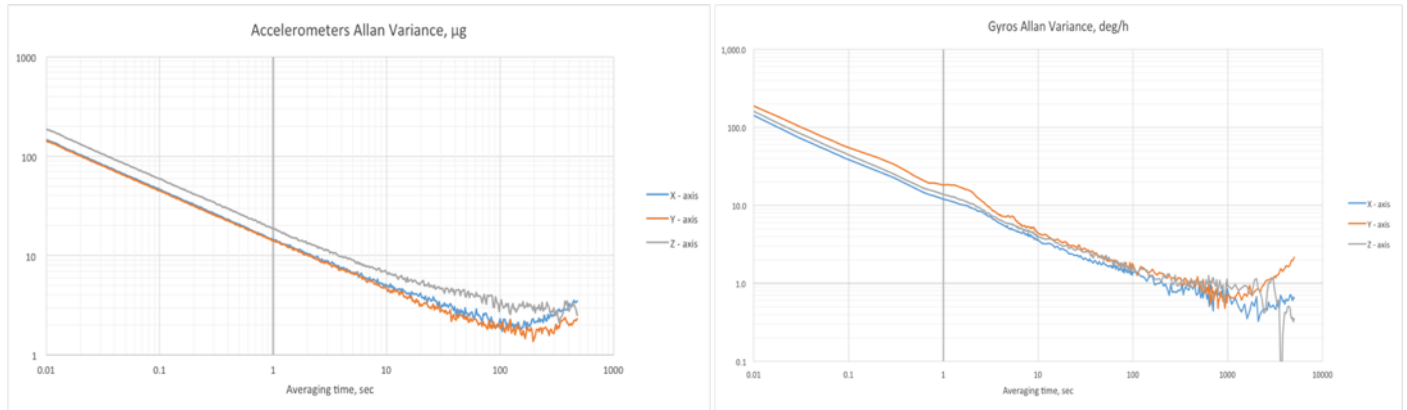
Dual Antenna

High precision Heading
Industrial-grade IMU
1 cm RTK position

	Parameter	Units	INS-B	INS-P	INS-D	INS-DL
GENERAL	Output signals		- 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 - Direct Navigation Support for Pixhawk Flight Controllers as NMEA messages			
	Input signals		- 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 (SAMC/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			
	Data rate	Hz	Up to 200 (INS data); Up to 2000 (IMU data)			
	Internal Data Logger (storage) - optional		64 GB			
GENERAL	Start-up time	sec	<1			
	Positions and Velocity	Units	INS-B	INS-P	INS-D	INS-DL
	Horizontal position accuracy (GPS L1)	meters, RMS	1.5			
	Vertical position accuracy (GPS L1)	meters, RMS	<1			
	Horizontal position accuracy (GPS L1/L2)	meters, RMS	1.2			
	Horizontal position accuracy (SBAS) ⁽¹⁾	meters, RMS	0.6			
Navigation	Horizontal position accuracy (DGPS)	meters, RMS	0.4			
	Horizontal position accuracy (TerraStar-L) ⁽²⁾	meters, RMS	0.4			
	Horizontal position accuracy (TerraStar-C PRO) ⁽²⁾	meters, RMS	0.025			
	Horizontal position accuracy (TerraStar-X) ⁽²⁾	meters, RMS	0.02			
	Horizontal position accuracy (post-processing) ⁽³⁾	meters, RMS	0.005			
	Horizontal position accuracy (RTK)	meters, RMS	0.01 + 1 ppm			
	Vertical position accuracy (RTK)	meters, RMS	0.02			
	Position accuracy (free inertial, land vehicles)	% , DT	0.2% DT (w/o odometer input) 0.05 % DT (w/ odometer input)			
	Velocity accuracy, RMS	m/s RMS	0.03			
	Heading	Units	INS-B	INS-P	INS-D	INS-DL
	Range	deg	0 to 360			
	Static Accuracy ⁽⁴⁾	deg RMS	1			
Orientation	Dynamic accuracy (GNSS) ⁽⁷⁾	deg RMS	0.1			
	Post processing accuracy ⁽³⁾	deg RMS	0.03			
	Pitch and Roll	Units	INS-B	INS-P	INS-D	INS-DL
	Range: Pitch, Roll	deg	±90, ±180			
	Angular Resolution	deg	0.01			
	Static Accuracy in whole Temperature Range	deg RMS	0.05			
	Dynamic Accuracy ⁽⁷⁾	deg RMS	0.08			
	Post processing accuracy ⁽³⁾	deg RMS	0.006			
	GNSS Receiver	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 B1I, B1C, B2I, B2a, B3I; Galileo E1, E5 AltBOC, E5a, E5b, E6; NavIC (IRNSS) L5; SBAS L1, L5; QZSS L1 C/A, L1C, L2C, L5, L6; L-Band up to 5 channels; DGPS; RTK			
GNSS	Channel configuration ⁽⁵⁾		555 Channels			
	RTK corrections		RTCM 2, RTCM 3			
	GNSS Positions data rate ⁽⁶⁾ , GNSS Raw Data Rate	Hz	Up to 100 (Positions), Up to 100 (Raw Data)			
	Initialization time	Sec	<39 (cold start), <20 (hot start)			
	PPS Timestamp accuracy (clock drift) ⁽⁸⁾	nano sec	<50 (cold start), <30 (hot start)			
			20			
IMU	Gyroscopes	Units	INS-B	INS-P	INS-D	INS-DL
	Type		Tactical-grade			
	Measurement range	deg/sec	±450 / ±950			
	Bias in-run stability (RMS, Allan Variance)	deg/hr	1			
	Bias error over temperature range (RMS)	deg/hr	<30			
	Angular Random Walk	deg/√hr	<0.2 (0.08 optional)			
	Accelerometers	Units	INS-B	INS-P	INS-D	INS-DL
	Type		Tactical-grade			
	Measurement range	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)			
	Bias error over temperature range (RMS)	mg	0.5 (±8 g) / 0.7 (±15 g) / 1.2 (±40 g)			
	Bias one-year repeatability	mg	1.0 (±8 g) / 1.3 (±15 g) / 1.5 (±40 g)			
	Velocity Random Walk	m/s/√hr	0.015 (±8 g) / 0.035 (±15 g) / 0.045 (±40 g)			
	Magnetometers	Units	INS-B	INS-P (Fluxgate)	INS-D	INS-DL
	Measurement range	Gauss	Optional	±1.6	Optional	Optional
	Bias in-run stability, RMS	nT		0.2		
	Noise density, PSD	nT/√Hz		0.3		
Pressure	Units		INS-B	INS-P	INS-D	INS-DL
	Measurement range	hPa	300 – 1100			
	Bias in-run stability (RMS, Allan Variance)	Pa	2			
	Noise density	Pa/√Hz	0.8			
General	Environment	Units	INS-B	INS-P	INS-D	INS-DL
	Operating temperature	deg C	-40 to +75			
	Storage temperature	deg C	-50 to +85			
	MTBF (Gm @ +65degC)	hours	100,000			
	Shock and Vibration		MIL-STD-810G			
	EMC/EMI		MIL-STD-461F			
	Electrical	Units	INS-B	INS-P	INS-D	INS-DL
	Supply voltage	V DC	9 to 36			
	Power consumption	Watts	2.5			
	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			
	Protection (optional)		MIL-STD-1275			
	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			
	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



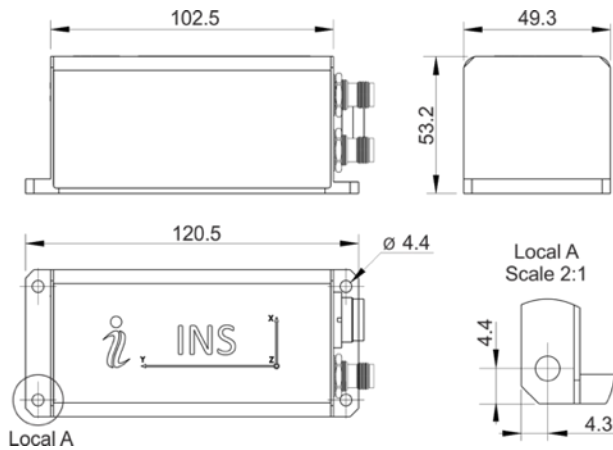
INS part numbers structure

Model	Gyro	Accel	Calibration	Connector & Enclosure	Encoder support	Color	Data Logger	GNSS receiver	Version	Interface
INS-B	G450	A8	TGA	C1 (obsolete)	E (option)	B (default)	S64 (default)	O615 (obsolete)	V0	1
INS-P	G950	A15	TMGA	C3 (default)		D	S8 (option)	O617D (obsolete)	V1	2
INS-D	G2000	A40		C31		G		O718D (China only)	V2	3
INS-DL				C32		W		O719	V3	4
				C35				O7720	V4	5
				C5				P327	VR43	11
				C7				B482 (obsolete)	VR5	22
				C71					V8	145
									VD4	245
									VD42	
									VD43	
									VD49	
									VD9	

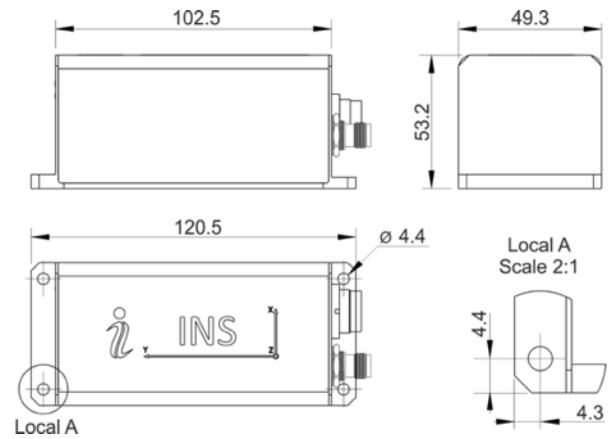
Example: INS-B-G450-A8-TGA-C3E-B-S64-O719-V0.1

- 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
- G2000: Gyroscopes measurement range = ± 2000 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')
- C35: 24 pins connector (RS-232, RS-422, CAN, Ethernet interfaces, Differential PPS via RS-422)
- C5: 24 pins connector, flanges and alignment pins
- C7: two 19 pins connectors
- C71: two 19 pins connectors, MIL-STD1275 protection
- E: encoder support
- B - Black Color (default)
- D - Desert Color (Desert tan, color code 33446 (tan 686A) per FED-STD-595, Change Notice 1.)
- 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 **OBSOLETE**
- 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)
- VD49: GPS L1/L2, GLONASS L1/L2, NavIC (IRNSS), Dual antenna Heading, SBAS, DGPS, 20 Hz positions; 20 Hz GNSS measurements (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 (with optional encoder support)
- VX.245: RS-422, CAN and Ethernet interfaces (w/o Encoder support)

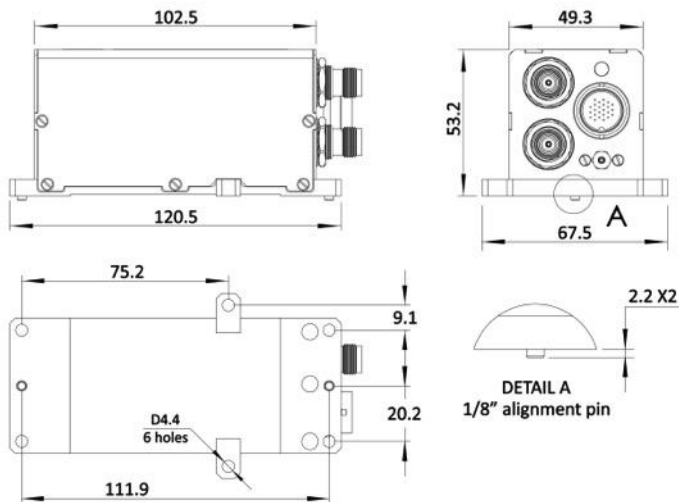
Default: INS-D / INS-DL mechanical interface drawing



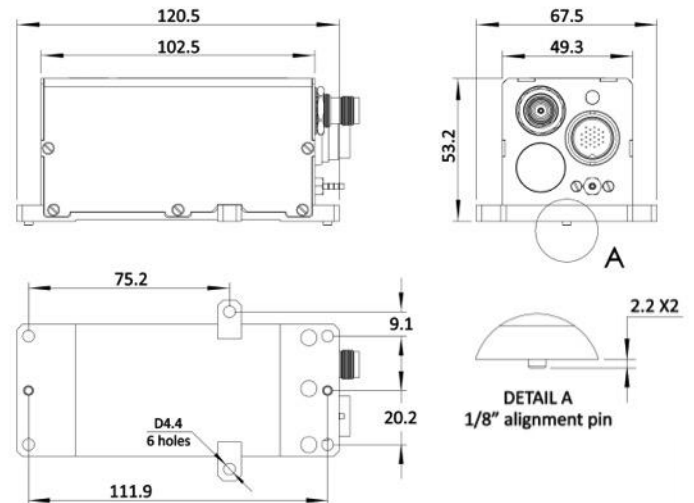
Default: INS-B / INS-P mechanical interface drawing



Optional: INS-D / INS-DL with alignment pins



Optional: INS-B / INS-P with alignment pins



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