STANDARD
MIL-STD
810G

BEST IN CLASS

CERTIFIED
ISO
9001:2015
COMPANY

MADE IN USA

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

WPT 234

HGLW 557

WQST 107

AZDR 17

ACDU 557

QTYC 17

HERJ 590

i Inertial Labs
Attitude is Everything

www.inertiallabs.com

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
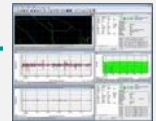
Models & Features

INS-B	INS-P	INS-D	INS-DL
Basic	Professional	Dual Antenna	Dual Antenna
Ideal solution for remote sensing (UAV, LiDAR, Optical Camera, Point Clouds)	High performance in long-term GPS-Denied environment	High precision Heading Tactical-grade IMU SP/SBAS/DGPS/RTK	High precision Heading Industrial-grade IMU 1 cm RTK position

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

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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)			Up to 200 (INS) & 2000 (IMU)
Internal Data Logger (storage) - optional		64 GB			64 GB
Start-up time	sec	<1			<1
Positions and Velocity	**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			0.6
Horizontal position accuracy (DGPS)	meters, RMS	0.4			n/a
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 (TerraStar-X)[2]	meters, RMS	0.02			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 CEP
Vertical position accuracy (RTK)	meters, RMS	0.02			0.02 + 1ppm CEP
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	m/s RMS	0.03			0.05
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)	0.4 (1 meter base line)
Dynamic accuracy (GNSS) [7]	deg RMS	0.1	0.1	0.08 (2 meters baseline)	0.02 (2 meters baseline)
Post processing accuracy [3]	deg RMS	0.03	0.03	0.03	0.1
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	0.03			0.1
Post processing accuracy [3]	deg RMS	0.006			0.01
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			GPS L1C/A L2C, GLO L1OF L2OF, GAL E1B/C E5b, BDS B1I B2I, QZSS L1C/A L2C SBAS L1C/A: WAAS, EGNOS, MSAS, GAGAN
Channel configuration [5]		555 Channels			184 channels-F9 engine
RTK corrections		RTCM 2, RTCM 3			RTCM 3
GNSS Positions data rate [6], GNSS Raw Data Rate	Hz	Up to 100 (Positions), Up to 100 (Raw Data)			20 (Optional 25)
Initialization time	Sec	<39 (cold start), <20 (hot start)			<29 (cold start), <1 (hot start)
PPS Timestamp accuracy (clock drift) [8]	nano sec	20			30
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	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			300 – 1100
Bias in-run stability (RMS, Allan Variance)	Pa	2			2
Noise density	Pa/√Hz	0.8			0.8
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 (Gм @ +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	2.5 (3.5 with datalogger)	3.5 (4.5 with data logger)	5 (6 with datalogger)	5 (6 with datalogger)
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	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

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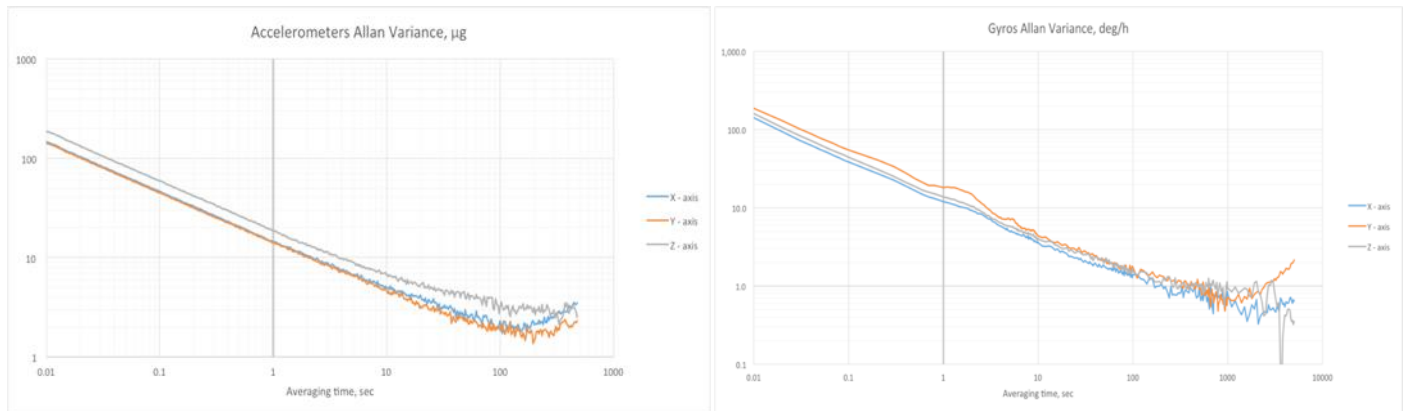
Inertial Labs GPS-Aided INS key applications

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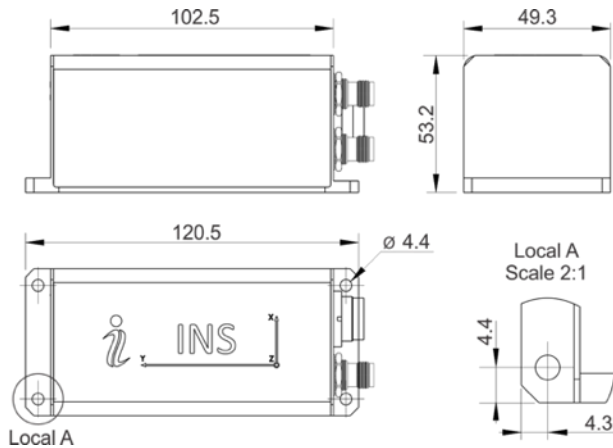Tel: +1 (703) 880-4222, Website: www.inertiallabs.com

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INS part numbers structure

| Model	Gyro	Accel	Calibration	Connector & Enclosure	Encoder support	Color	Stand Alone Magnetic Compass	Data Logger	GNSS receiver	Version	Interface
INS-B	G450	A8	TGA	C1 (obsolete)	E (option)	B (default)	SAMC	S64	O615 (obsolete)	V0	1
INS-P	G950	A15	TMGA	C3 (default)		D			O617D (obsolete)	V1	2
INS-D	G2000	A40		C31		G			O718D (China only)	V2	4
INS-DL				C32		W			O719	V3	5
				C35					O7720	V4	11
				C37					P327	V49	22
				C5					B482 (obsolete)	VR43	145
				C7					ER	VR5	245
				C71						V8	135
										VD4	235
										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), MIL-STD-1275 protection
- C37: 24 pins connector (RS-232, RS-422, CAN, Ethernet interfaces) and MIL-STD-1275 Protection
- C5: 24 pins connector, flanges and alignment pins
- C7: two 19 pins connectors
- C71: two 19 pins connectors, MIL-STD-1275 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
- SAMC – Support external Stand-Alone Magnetic Compass (optional) (can only be used with VX.135 or VX.235)
- 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
- ZD9P: Dual UBlox ZED-F9P GNSS Receivers
- ER: Support External GNSS receiver. External GNSS receiver must provide GGA and RMC messages (optionally HDT)
- 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)
- V49: GPS L1/L2, GLONASS L1/L2, NavIC (IRNSS), SBAS, DGPS, 20 Hz GNSS 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, 20 Hz measurements, 20 Hz positions (INS-D and INS-DL 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.15: RS-232 and Ethernet 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)
- VX.135: RS-232, RS-485 (to be used when connecting to a Stand-alone Magnetic Compass), and Ethernet interfaces (unit will not be able to communicate with the receiver)
- VX.235: RS-422, RS-485 (to be used when connecting to a Stand-alone Magnetic Compass), and Ethernet interfaces (unit will not be able to communicate with the receiver)

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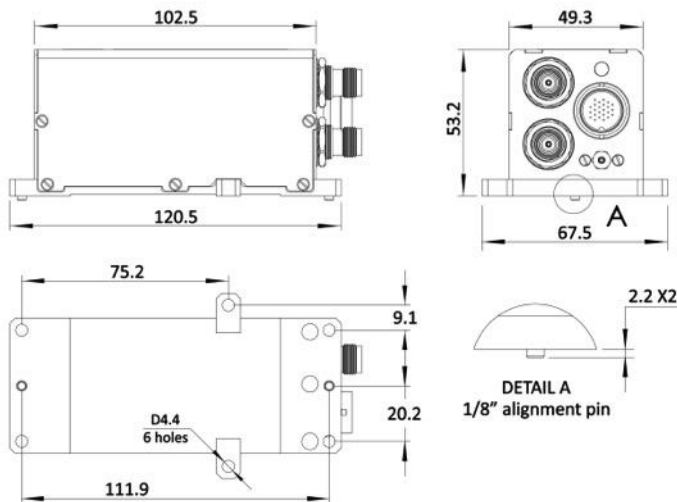Tel: +1 (703) 880-4222, Website: www.inertiallabs.com

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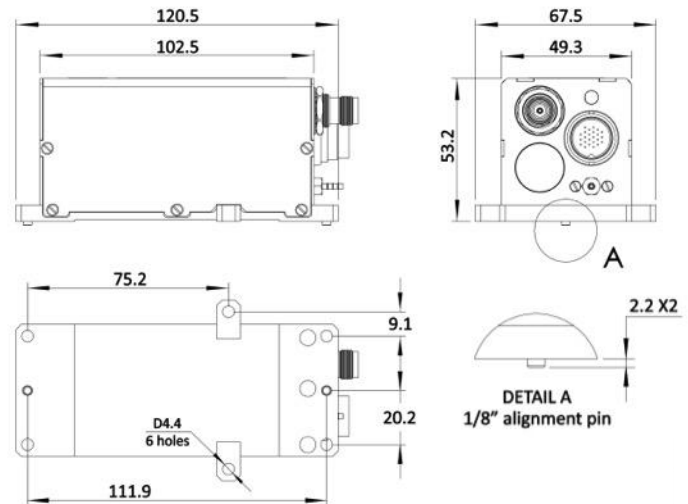**Default: INS-D / INS-DL mechanical interface drawing**

Default: INS-B / INS-P mechanical interface drawing
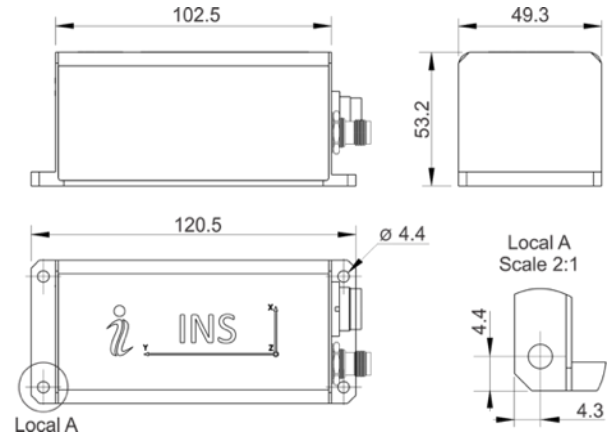
Optional: INS-D / INS-DL with alignment pins

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

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