Inertial Labs
a VIAVI Solutions company

GPS-Aided Inertial Navigation Systems

INS-U

INS-U-OEM

Datasheet

CERTIFIED ISO 9001:2015 COMPANY

MADE IN THE USA

The **Inertial Labs GPS-Aided Inertial Navigation System (INS-U, INS-U-OEM)** is the new generation, fully integrated, combined Inertial Navigation System (INS) + Attitude & Heading Reference System (AHRS) + Air Data Computer (ADC) 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.

INS-U

INS-U-OEM

The Inertial Labs **INS-U** utilizes advanced single antenna multi constellation (GPS, GLONASS, GALILEO, QZSS and BEIDOU GNSS) receiver; two Honeywell TruStability® Board Mount Pressure Sensors; a miniature gyro-compensated Fluxgate compass; 3-axes each of calibrated in full operational temperature range Advanced MEMS Accelerometers and Gyroscopes to provide accurate Position, Velocity, Heading, Pitch and Roll of the device under measure.

INS-U contains Inertial Labs new on-board sensor fusion filter, state of the art navigation and guidance algorithms and calibration software.

KEY FEATURES, BENEFITS & FUNCTIONALITY

- Commercially exportable GPS-Aided Inertial Navigation System
- 3-in-1 strapdown system: INS + AHRS + ADC (Air Data Computer)
- Embedded in-flight calibration
- Designed for UAV application
- Small size, lightweight & low power
- GPS, GLONASS, GALILEO, BEIDOU, QZSS, RTK supported signals
- Total and Static Pressure Sensors for calculating Indicated Airspeed
- Embedded or External Inertial Labs Magneto-Inductive and Mini-Fluxgate magnetometers (compass)
- GNSS measurements and IMU raw data for post processing
- Advanced, extendable, embedded Kalman Filter based sensor fusion algorithms
- State-of-the-art algorithms for different dynamic motions of Helicopters, and UAV
- Full temperature calibration of all sensing elements
- Aiding data: Wind sensor, Airspeed sensor, External position and External heading

SPECIFICATIONS

	Parameter	Units			
Inputs & Outputs	Input signals		• External Magnetometer, Wind sensor, Air Speed Sensor, Doppler shift from locator (for long-term GPS denied), External position and External Heading aiding data		
	Output signals		• **IMU** data: Accelerations, Angular rates; • **AHRS** data: Magnetic Field, Heading, Pitch & Roll • **INS data**: Positions, Velocity, Delta Theta and Delta Velocity, GNSS data, Time • **Air Data Computer** data: Static Pressure (calibrated), Dynamic Pressure (calibrated), Baro-Corrected Pressure Altitude, Pressure Altitude, Calibrated Airspeed, True Airspeed, Mach-Number, Static Pressure Over Total Pressure, True Angle of Attack, Rate of Climb		
	Update rate	Hz	1 … 200 (user settable)		
	Start-up time	sec	<1		
	Positions, Velocity, and Timestamps				
Navigation	Horizontal position accuracy (SP), CEP	meters	1.5 CEP		
	Horizontal position accuracy (RTK), CEP [1]	meters	0.01 + 1 ppm CEP		
	Vertical position accuracy (RTK) [1], CEP	meters	0.01 + 1 ppm CEP		
	Velocity accuracy, CEP	meters/sec	0.05		
	Heading				
Orientation	Range	deg	0 to 360		
	Angular Resolution	deg	0.01		
	Static Accuracy [2]	deg RMS, 1σ	0.6		
	Dynamic accuracy (GNSS) [3]	deg RMS, 1σ	0.3		
	Pitch and Roll				
	Range: Pitch, Roll	deg	±90, ±180		
	Angular Resolution	deg	0.01		
	Static Accuracy in Temperature Range	deg, 1σ	0.08		
	Dynamic Accuracy [3]	deg RMS, 1σ	0.05		
	Gyroscopes				
IMU	Measurement range	deg/sec	±2000		
	Bias in-run stability (RMS, Allan Variance)	deg/hr, 1σ	2		
	Angular Random Walk (ARW)	deg/√hr, 1σ	0.38		
	Accelerometers				
	Measurement range	g	±8	±15	±40
	Bias in-run stability (RMS, Allan Variance)	mg, 1σ	0.01	0.03	0.05
	Velocity Random Walk (VRW)	m/sec/√hr, 1σ	0.02	0.045	0.06
	Magnetometers (embedded)				
	Measurement range	Gauss	±8.0		
	Bias in-run stability (Allan Variance)	μGauss, 1σ	8		
	Power Spectral Density	μGauss/√Hz, 1σ	15		
	SF Accuracy	%, 1σ	0.05		
	Air Data Computer				
Air Data Computer	Aiding Data Input		External GNSS receiver data, ambient air data		
	Pressure Sensor Measurement Range	mbar	±25	±600	±4000
	Static Pressure (calibrated)	hPa, % FS	300 to 1100 hPa, from -2000 ft to 30000 ft; Accuracy: ±0.1% FSS		
	Dynamic Pressure (calibrated)	hPa, % FS	0.15 to 25 hPa / 10 to 124 KCAS, Accuracy: ±0.25% FSS	0.15 to 600 hPa / 10 to 600 KCAS, Accuracy: ±0.25% FSS	0.15 to 4000 hPa / 10 to 1570 KCAS, Accuracy: ±0.25% FSS
	Pressure Altitude	meters	-500 to 9000 meters; Accuracy: 1 meter		
	Airspeed	meters/sec	5 to 64 meters/sec; Accuracy: 0.5 meters/sec	5 to 310 meters/sec; Accuracy: 0.5 meters/sec	5 to 800 meters/sec; Accuracy: 0.5 meters/sec
	Mach-Number	M	0.01 to 0.2 M; Accuracy: 0.001 M	0.01 to 0.99 M; Accuracy: 0.002 M	0.01 to 2.5 M; Accuracy: 0.002 M
	Static Pressure Over Total Pressure		0.97 to 1; Resolution 1 ppm	0.63 to 1; Resolution 1 ppm	0.20 to 1; Resolution 1 ppm
	Air Density	kg/m3	0.3 to 1.6 kg/m3; Accuracy 0.002 kg/m3		
	Outside Air Temperature (OAT)	deg C	-40 to +85 degC; Resolution 0.01 degC		
	Environment				
General	Operating Altitude	meters	Up to 10000 meters (32800 ft)		
	Operating temperature	deg C	-40 to +85		
	Storage temperature	deg C	-50 to +90		
	Environmental protection [4]	-	IP-67, MIL-STD-810G		
	MTBF (GM)	hours	100000		
	Electrical				
	Supply voltage	V DC	5-32		
	Power consumption	Watts	<2		
	Output Interface	-	RS-232 or RS-422		
	Output data format	-	Binary, NMEA 0183 ASCII characters		
	1 PPS Level	V DC	5		
	Physical		**INS-U**	**INS-U-OEM**	
	Nominal Size [5]	mm	82 x 40 x 25.8	65 x 37.2 x 20.3	
	Weight [5]	gram	< 200	< 100	

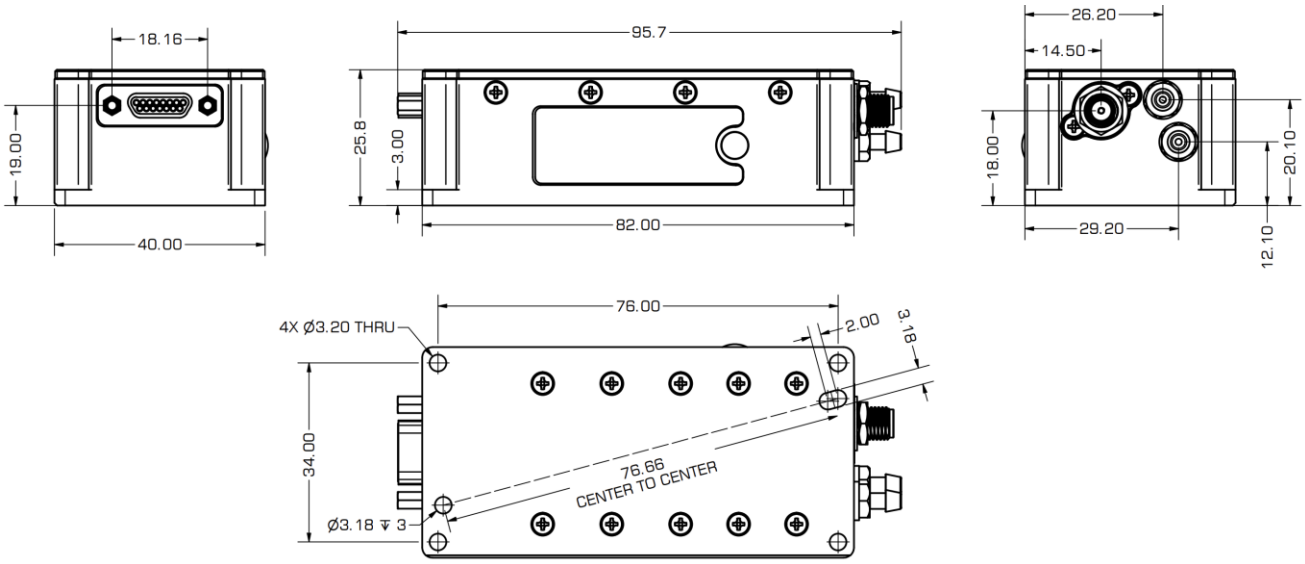
Specifications subject to change without notice

[1] Measured using 1 km baseline and patch antennas with good ground planes. Does not account for possible antenna phase center offset errors. ppm limited to baselines up to 20 km. [2] In homogeneous magnetic environment, for latitude up to ±65 deg; calibrated in whole operational temperature range. [3] With aiding GNSS data. 50% @ 30 m/s dynamic operation, accuracy may depend on type of motion. [4] The environmental protection ratings apply only to the device in its protective case. The OEM version may not meet these standards. [5] Weight and size are PN dependent. Customers should obtain the most recent 2D/3D files before designing any interface hardware.

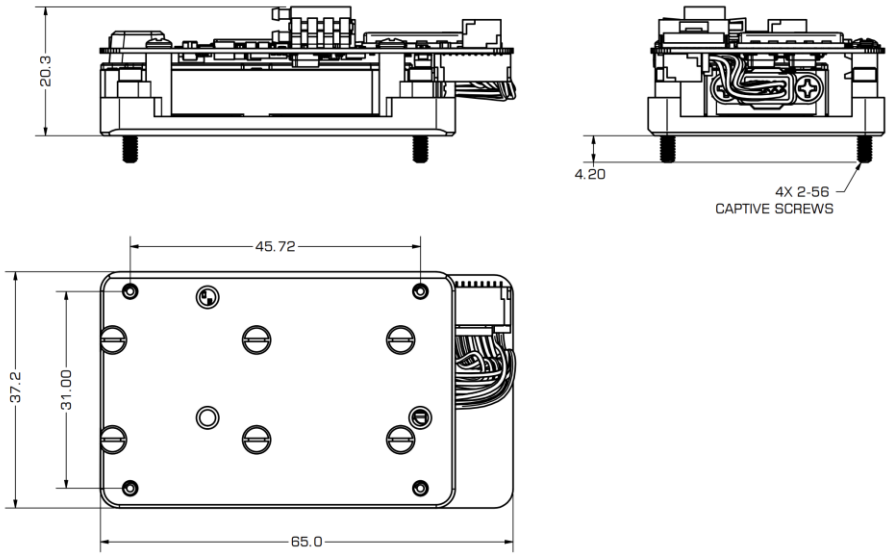
	GNSS Receiver	Units	Septentrio	u-blox	
GNSS Specifications	Model	-	mosaic-X5	ZED-F9P	ZED-F9P L1/L5
	Number of GNSS Antennas	-	Single	Single	Single
	GNSS Constellations	-	GPS L1C/A, L1C, L1PY, L2C, L2P, L5; GLONASS L1CA, L2CA, L2P, L3 CDMA; Beidou B1I, B1C, B2a, B2I, B3; Galileo E1, E5a, E5b, E5 AltBoc, 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	GPS L1C/A, L5; GLONASS L1OF; Galileo E1B/C, E5a; BeiDou B1I, B2a; QZSS L1C/A L1S L5; NavIC L5
	GNSS Corrections	-	WAAS; EGNOS; MSAS; GAGAN; SBAS L1, L5; DGPS; RTK	WAAS; EGNOS; MSAS; GAGAN; SBAS L1C/A; DGPS; RTK	
	Channel Configuration [1]	-	448	184	
	GNSS Data Rate [1]	Hz	20	10	
	RTK Corrections	-	RTCM 2, RTCM 3	RTCM 3	
	Velocity Accuracy	m/s	0.03	0.05	
	Initialization Time	s	<45 (cold start), <20 (hot start)	<30 (cold start), <10 (hot start)	
	Time Accuracy (clock drift) [2]	Nano sec	20	30	

[1] Tracks up to 60 L1/L2 satellites. [2] Time accuracy does not include biases due to RF or antenna delay.

INS-U MECHANICAL INTERFACE



INS-U-OEM MECHANICAL INTERFACE



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

PRODUCT CODE STRUCTURE

Model	Gyro	Accelerometers	Calibration	Connector and Enclosure	Pressure Ports	Color	Stand Alone Magnetic Compass	GNSS receiver	Version	Interface
INS-U	G2000	A8	TMGA	C15	2P	B	SAMC (optional)	ZF9P	V9	.13
INS-U-OEM		A15		C9	2PEXT			ZF9P-L5	V95	.23
		A40		C6W	2PMAX			SMX5		

Examples:
INS-U-G2000-A15-TMGA-C15-2P-B-SMX5-V9.13
INS-U-OEM-G2000-A15-TMGA-C9-2PEXT-B-SAMC-ZF9P-V9.13

Product code details:

- INS-U: Enclosed IP67 rated version of the GPS-aided Inertial Navigation System
- INS-U-OEM: OEM version of the GPS-aided Inertial Navigation System
- 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
- TMGA: Calibration of IMU (Gyroscopes, Accelerometers, and Magnetometers) in operational temperature range
- C15: Aluminum Enclosure with 15 pin micro-D-SUB plug MM-212-015-11 (by Airborn) (INS-U only)
- C9: Aluminum Base Plate with 9 pin SM09B-NSHSS (JST) latch-lock connector (INS-U-OEM only)
- C6W: Wing profile-based Aluminum Base Plate with 9 pin SM09B-NSHSS (JST) latch-lock connector (INS-U-OEM only)
- 2P: Two Airspeed Pressure Ports Standard Range (Total/Static)
- 2PEXT: Two Airspeed Pressure Ports with Extended Range (Total/Static, Honeywell 600MD)
- 2PMAX: Two Airspeed Pressure Ports with Extended Range (Total/Static, Honeywell 004BD)
- B: Black color
- SAMC: Support External Stand-Alone Magnetic Compass (optional)
- ZF9P: u-blox ZED-F9P: GPS+GLO+GAL+BDS+QZSS, L1C/A/L2C/L1OF/L2OF/E1B/C/E5b/B1I/B2I/L1C/A/L1S/L2C/L5, SBAS, RTK, Active CW detection and removal, Onboard bandpass filter, Advanced anti-spoofing algorithms
- ZF9P-L5: u-blox ZED-F9P L1/L5: GPS+GLO+GAL+BDS+QZSS, L1C/A/L5/L1OF/E1B/C/E5a/B1I/B2a/L1C/A/L1S/L5/, NavIC L5, SBAS, RTK, Active CW detection and removal, Onboard bandpass filter, Advanced anti-spoofing algorithms
- SMX5: Septentrio mosaic-X5: GPS+GLO+BDS+GAL+QZSS, L1C/A/L1PY/L2C/L2P(Y)/L5/L1CA/L2CA/L2P/L3 CDMA/B1I/B1C/B2a/B2I/B2b/B3I/E1/E5a/E5b/E5 AltBoc/E6, SBAS, L-band, RTK, AIM+ anti-jamming, anti-spoofing Advanced Interference Monitoring and Mitigation
- V9: Single antenna GNSS receiver
- V95: SMX5 with COCOM limits removed
- .13: RS-232/485 (RS-485 for stand-alone magnetic compass only)
- .23: RS-422/485 (RS-485 for stand-alone magnetic compass only) (such configuration does not support RTK GNSS correction and available only with enclosed INS-U)

DISCLAIMER:
The document is subject to change without notice. Inertial Labs reserves the right to make changes to any product or technology herein. Inertial Labs does not assume any liability arising out of the application or use of the product.
TRADEMARK LEGAL NOTICE:
All product names, logos, and brands are property of their respective owners. All company, product and service names used in this document are for identification purposes only. Use of these names, logos, and brands does not imply endorsement.