



GPS-Aided Inertial Navigation System **INS-U**



- INS, AHRS and ADC (Air Data Computer) output data
- Multi frequency and Multi constellations GNSS Receiver
- GPS, GLONASS, GALILEO, QZSS and BEIDOU GNSS
- Designed for fixed-wing and multi-rotor Aerial Platforms
- Two Barometers for Indicated Airspeed
- Position accuracy = 1 cm (RTK)
- Heading accuracy = 0.3 deg (RTK, Dynamic)
- Pitch & Roll accuracy = 0.08 deg (RTK, Dynamic)
- Gyro-compensated, embedded Fluxgate magnetic compass
- Optional external Stand-Alone Magnetic Compass
- Small Size, light weight, low power
- Affordable price



The **Inertial Labs GPS-Aided Inertial Navigation System (INS-U)** is an IP67 rated version of 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.



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

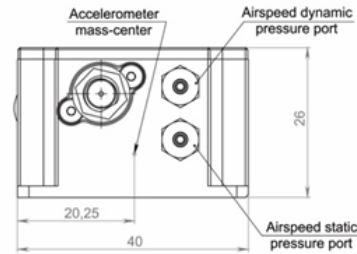
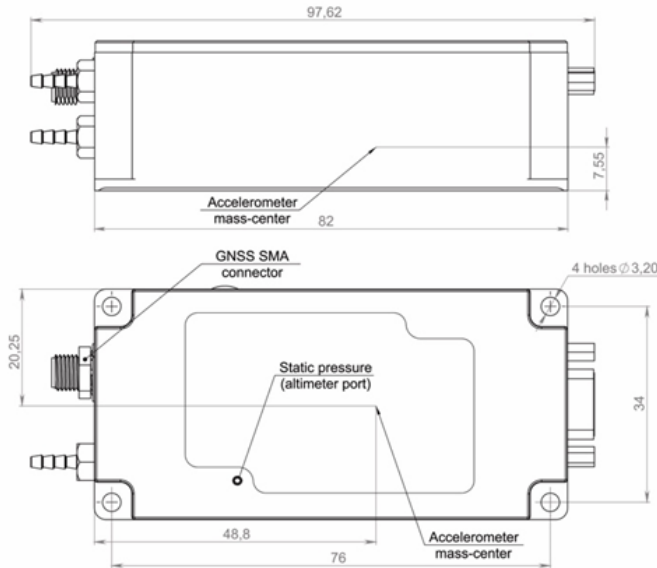
- Commercially exportable GPS-Aided Inertial Navigation System
- 3-in-1 strapdown system: INS + AHRS + ADC (Air Data Computer)
- Embedded in-flight calibration
- Designed for UAV application algorithm
- Ublox ZED-F9P F9 High Precision GNSS Module
- Small size, lightweight & low power: 82 x 40.0 x 26.0 mm, <200-grams, <1 watt
- GPS, GLONASS, GALILEO, BEIDOU, QZSS, RTK supported signals
- Total and Static Pressure Sensors for calculating Indicated Airspeed
- Embedded Gyro-compensated 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
- Environmentally sealed (IP67)
- Aiding data: Wind sensor, Air Speed Sensor, Doppler shift from locator (for long-term GPS denied), External position and External Heading

INS-U Specifications

	Parameter	Units	INS-U
Inputs & Outputs	Input signals		<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> 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
Navigation	Positions, Velocity, and Timestamps		INS-U
	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
Orientation	Heading		INS-U
	Range	deg	0 to 360
	Angular Resolution	deg	0.01
	Static Accuracy ⁽²⁾	deg RMS, 1 σ	0.6
	Dynamic accuracy (GNSS) ⁽³⁾	deg RMS, 1 σ	0.3
	Pitch and Roll		INS-U
	Range: Pitch, Roll	deg	$\pm 90, \pm 180$
	Angular Resolution	deg	0.01
GNSS	GNSS receiver		INS-U
	Type		Single GNSS Antenna
	Supported GNSS signals & corrections		GPS L1C/A L2C, GLO L10F L20F, GAL E1B/C E5b, BDS B1I B2I, QZSS L1C/A L2C SBAS L1C/A: WAAS, EGNOS, MSAS, GAGAN, NAVIC L5
	Channel configuration		184 Channels – F9 Engine
	Raw GNSS data rate	Hz	10, 20 ⁽⁶⁾
	Accuracy of Time Pulse Signal	Ns	30 (RMS), 60 (99%)
	Frequency of Time Pulse Signal	Hz	0.25 – 10,000 (configurable)
	GNSS Convergence time ⁽⁴⁾	Sec	< 10 (GPS+GLO/GAL/BDS); < 30 (GPS)
	Acquisition time ⁽⁵⁾	Sec	<30 (cold start), <2 (warm start), <1 (hot start)
	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: $\pm 0.1\%$ FSS
Dynamic Pressure (calibrated)		hPa, % FS	0.15 to 25 hPa / 10 to 124 KCAS, Accuracy: $\pm 0.25\%$ FSS 0.15 to 600 hPa / 10 to 600 KCAS, Accuracy: $\pm 0.25\%$ FSS 0.15 to 4000 hPa / 10 to 1570 KCAS, Accuracy: $\pm 0.25\%$ FSS
Baro-Corrected Pressure Altitude		meters	-500 to 9000 meters; Accuracy: 1 meter
Pressure Altitude		meters	-500 to 9000 meters; Accuracy: 1 meter
Calibrated 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
True 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 0.000001 0.63 to 1; Resolution 0.000001 0.20 to 1; Resolution 0.000001
Air Density		kg/m ³	0.3 to 1.6 kg/m ³ ; Accuracy 0.002 kg/m ³
Outside Air Temperature (OAT)	deg C	-40 to +85 degC; Resolution 0.01 degC	
IMU	Gyroscopes		INS-U
	Measurement range	deg/sec	± 2000
	Bias in-run stability (RMS, Allan Variance)	deg/hr, 1 σ	2
	Angular Random Walk (ARW)	deg/ $\sqrt{\text{hr}}$, 1 σ	0.38
	Accelerometers		INS-U
	Measurement range	g	$\pm 8, \pm 15, \pm 40$
	Bias in-run stability (RMS, Allan Variance)	mg, 1 σ	0.01, 0.03, 0.05
	Velocity Random Walk (VRW)	m/sec/ $\sqrt{\text{hr}}$, 1 σ	0.02, 0.045, 0.06
	Magnetometers (embedded)		INS-U
	Measurement range	Gauss, 1 σ	± 8.0
Bias in-run stability (Allan Variance)	μGauss , 1 σ	8	
Power Spectral Density	$\mu\text{Gauss}/\sqrt{\text{Hz}}$, 1 σ	15	
SF Accuracy	%, 1 σ	0.05	
General	Environment		INS-U
	Operating Altitude	meters	Up to 10000 meters / 32800 ft
	Humidity	%	<95
	Operating temperature	deg C	-40 to +85
	Storage temperature	deg C	-50 to +90
	Type of Sealing		IP-67
	Sand, Dust, Water, Humidity, Shock, Vibration		MIL-STD-810G
	MTBF (GM)	hours	100,000
	Electrical		INS-U
	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	
Nominal Size ⁽⁷⁾	mm	82.0 x 40 x 26	
Weight ⁽⁷⁾	gram	< 200	

⁽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⁾ depends on atmospheric conditions, baseline length, GNSS antenna, multipath conditions, satellite visibility and geometry. ⁽⁵⁾ Commanded start. All satellites at -130 dBm; 1 σ specifications are manufactured to a controlled 3 σ standard; ⁽⁶⁾ If tracking GPS only. ⁽⁷⁾ Weight and size are PN dependent. Customers should obtain the most recent 2D/3D files before designing any interface hardware.

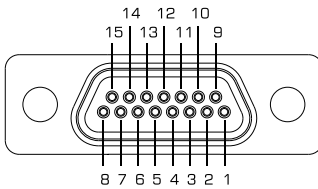
INS-U Mechanical & Electrical Interfaces Description (standard configuration)



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.

Connector



RS-232 & RS-485 interfaces

PIN	FUNCTION	PIN	FUNCTION
1	POWER IN	9	POWER RTRN
2	POWER RTRN	10	5VOUT
3	RS485-B	11	NC
4	POWER RTRN	12	NC
5	RS485-A	13	1PPS OUT
6	RS232-TX2	14	RS232-RX2
7	RS232-RX1	15	CHASSIS
8	RS232-TX1	SHELL	CHASSIS

RS-422 & RS-485 interfaces

POWER IN	1	POWER RETURN	9
POWER RETURN	2	5V OUT	10
RS485-B	3	BOOT	11
POWER RETURN	4	NC	12
RS485-A	5	1PPS OUT	13
RS422-TX-	6	RS422-TX+	14
RS422-RX+	7	POWER RETURN	15
RS422-RX-	8	CHASSIS	SHELL

INS-U Product Code Structure

Model	Gyro	Accelerometers	Calibration	Connector	Pressure Ports	Color	Stand Alone Magnetic Compass	GNSS receiver	Version	Interface
INS-U	G2000	A8	TMGA	C15	2P	B	SAMC	ZF9P	V9	.13
		A15		C16	2PEXT				V93	.23
		A40		2PMAX	V1 (OBSOLETE)					

Example: INS-U-G2000-A15-TMGA-C15-2P-B-ZF9P-V9.13

Product code details:

- INS-U: Enclosed IP67 Rated Version of the Single Antenna 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: 15 pin micro-D-SUB plug MM-212-015-11 (by Airborn)
- C16: 15 pin micro-D-SUB plug MM-212-015-11 (by Airborn), special PIN dedicated to Firmware update
- 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 (default)
- SAMC: Support external, Stand-Alone Magnetic Compass (optional)
- ZF9P: Single ZED-F9P, Dual-Frequency, Multi-Constellation, RTK Capable GNSS Receiver
- V9: GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2, GALILEO E1/E5, QZSS L1/L5, DGPS, RTK, GNSS measurements, GNSS positions (Single Antenna GNSS Receiver only)
- V93: GPS L1C/A, L5 GLO L1OF GAL E1B/C, E5a BDS B1I, B2a QZSS L1C/A, L1S, L5; NavIC L5
- .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)