



GPS-Aided Inertial Navigation Systems

INS-FI



Datasheet



The **Inertial Labs GPS-Aided Inertial Navigation System (INS-FI)** is the newest Inertial Navigation System (INS) developed by Inertial Labs using Tactical-grade Fiber Optic Gyroscope technology. The INS-FI is the result of over 20 years of experience in developing and supplying INS solutions to land, marine and aerial platforms around the world.

The fully integrated INS-FI contains an Inertial Measurement Unit (IMU) combining Fiber Optic Gyroscopes and MEMS Accelerometers, along with all constellations (GPS, GLONASS, GALILEO, QZSS, BEIDOU and NAVIC) and multiple bands GNSS receiver. It determines horizontal and vertical positions, 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.



Due to its high-performing FOG IMU, the **INS-FI** can measure GNSS-free Heading (True North) with less than 0.5 deg error, Horizontal & Vertical Positions with approximately 0.1% error of Distance Traveled for land applications, and 5 nautical miles per hour drift for aerospace (Unmanned Aerial Vehicles) applications without GNSS signal.

INS-FI is fully compatible with the Inertial Labs developed VINS (Visual Inertial Navigation Systems) and SAMC (Stand-Alone Magnetic Compass).

The **INS-FI** contains Inertial Labs' latest version of the 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 (ECCN 7A994)
- 3-in-1 strapdown system: IMU + AHRS + INS
- Fiber Optic Gyroscopes (FOG) & MEMS accelerometers Inertial Measurement Unit (IMU)
- NovAtel OEM7, u-blox ZED-F9P, or Septentrio mosaic-H High Precision GNSS receiver
- Embedded Anti-Jamming and Spoofing mitigation features
- L1/L2/L5 GPS, GLONASS, GALILEO, BEIDOU, QZSS, IRNSS
- SP, SBAS, DGPS, RTK and PPP for real time operation
- Sensor fusion algorithms with advanced extended Kalman Filter
- State-of-the-art algorithms for Land, Aerospace and Maritime applications
- Full temperature calibration of all sensing elements according to MIL-STD-810 standard
- MIL-STD-461 standard based EMC, EMI, and ERD protection
- Aiding data: Wind sensor, Air Speed Sensor, Doppler shift from locator (for long-term GPS denied), External position and External Heading
- Internal/External Air Data Computer (ADC) and External Stand-Alone Magnetic Compass (SAMC)
- Full integration with ArduPilot platform

SPECIFICATIONS

	Parameter	Units	
Inputs & Outputs	Input signals		External Magnetometer, Embedded/External Air Data Computer (ADC), 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, Magnetic field; AHRS data: Heading, Pitch & Roll MRU data: Heave, Surge, Sway INS data: Positions, Velocity, Delta Theta and Delta Velocity, GNSS data, Time External 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 (INS & AHRS data); up to 1000 (IMU data)
	Start-up time	sec	<1
Navigation	Positions, Velocity, and Timestamps		
	Horizontal position accuracy (SP)	meters	1.2
	Horizontal position accuracy (SBAS) ⁽¹⁾	meters	0.6
	Horizontal position accuracy (DGPS)	meters	0.4
	Horizontal position accuracy (PPP TerraStar-C PRO) ⁽²⁾	meters	0.025
	Horizontal position accuracy (RTK)	meters	0.01
	Vertical position accuracy (RTK)	meters	0.02
	Velocity accuracy (OEM7720, Mosaic H), RMS	m/sec	0.03
	Velocity accuracy (uBlox F9P), RMS	m/sec	0.05
	Horizontal Position accuracy (free inertial, land vehicles)	% DT	0.1
Orientation	Horizontal Position accuracy (free inertial, aerial)	meters	3
	Heading		
	Range	deg	0 to 360
	Angular Resolution	deg	0.01
	Static & Dynamic Accuracy ⁽⁴⁾ (Dual antenna, 1 meter baseline)	deg	0.15
	Static & Dynamic Accuracy ⁽⁴⁾ (Dual antenna, 2 meters baseline)	deg	0.08
	Dynamic Accuracy ⁽⁴⁾ (Single antenna)	deg	0.15
	Post processing accuracy ⁽³⁾	deg	0.01
	Free inertial	deg	0.5
	With External Stand-Alone Magnetic Compass (after calibration)	deg	1
IMU	Pitch and Roll		
	Range	deg	±90, ±180
	Angular Resolution	deg	0.01
	Static Accuracy	deg	0.01
	Dynamic Accuracy	deg	0.01
	Post processing accuracy ⁽³⁾	deg	0.005
	Gyroscopes		
	Technology		Closed-loop FOG
	Measurement range	deg/sec	±490
	Bandwidth (~3dB)	Hz	200
GNSS	Data update rate	Hz	1000
	Bias in-run stability (Allan Variance)	deg/hr	0.025
	Bias repeatability (over temperature range)	deg/hr	0.5
	SF accuracy (over temperature range)	ppm	100
	Noise, Angular Random Walk (ARW) ⁽⁵⁾	deg/√hr	0.025
	Non-linearity	ppm	50
	Accelerometers		
	Technology		MEMS
	Measurement range	g	±8
	Bandwidth (~3dB)	Hz	260
Air Data Computer	Data update rate	Hz	1000
	Bias in-run stability (RMS, Allan Variance)	mg	0.005
	Bias repeatability (over temperature range)	mg	0.5
	SF accuracy (over temperature range)	ppm	150
	Noise, Velocity Random Walk (VRW) ⁽⁶⁾	m/sec/√hr	0.015
	Non-linearity	ppm	150
	Receiver		
	Number of GNSS Antennas	-	Dual
	GNSS Constellations	-	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; QZSS L1 C/A, L1C, L2C, L5, L6; L-Band
	GNSS Corrections	-	WAAS; EGNOS; MSAS; GAGAN; SBAS L1, L5; DGPS; RTK; PPP Terrastar
Environment	Channel Configuration ⁽⁵⁾	Channels	555
	GNSS Data Rate ⁽⁶⁾	Hz	5 / 20 / 100
	RTK Corrections	-	RTCM 2, RTCM 3
	Velocity Accuracy	m/s	0.03
	Initialization Time	s	<39 (cold start), <20 (hot start)
	Time Accuracy (clock drift) ⁽⁷⁾	Nano sec	20
	Air Data Computer		
	Pressure Sensor Range	mbar	±25
	Static Pressure Range	hPa, % FS	±600
	Static Pressure Accuracy	% FSS	300 to 1100
Air Data Computer	Dynamic Pressure Range	hPa	±0.1
	Dynamic Pressure Accuracy	% FSS	0.15 to 600
	Pressure Altitude Range	m	±0.25
	Pressure Altitude Accuracy	m	-500 to 9000
	Airspeed Range	m/sec	1
	Airspeed Accuracy	m/sec	5 to 64
	Mach Number Range	M	5 to 310
	Mach Number Accuracy	M	0.5
	Static Pressure Over Total Pressure Range		0.01 to 0.99
	Static Pressure Over Total Pressure Resolution	ppm	0.001
Air Data Computer	Air Density Range	kg/m3	0.63 to 1
	Air Density Accuracy	kg/m3	0.3 to 1.6
	Outside Air Temperature (OAT) Range	deg C	0.002
	Outside Air Temperature (OAT) Resolution	deg C	-40 to +85
	Environment		
	Operational and Storage Temperature	deg C	0.01
	EMC/EMI		-40 to +65
	Altitude	meters	MIL-STD-461F
	Acoustic noise	dB	Up to 15000
	MTBF (GM @ +65degC)	hours	185
Air Data Computer	Air Data Computer		
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	Static Pressure Range	hPa, % FS	±600
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General	Electrical		
	Input power protection	-	Standard
	Supply voltage	V DC	9 to 36 (27±10 for MIL-STD-1275 protection)
	Output data format	-	Binary, NMEA 0183 ASCII characters
	1 PPS level	V DC TTL	3.3 / 5 / differential
	Physical		
	Size	mm	D88.9 x H129
	Weight	gram	950

Specifications subject to change without notice

⁽¹⁾ GPS only. ⁽²⁾ For Novatel OEM7720 GNSS receiver only. 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⁾ Dynamic accuracy may depend on the type of motion. ⁽⁵⁾ Tracks up to 60 L1/L2 satellites. ⁽⁶⁾ If tracking GPS Only. ⁽⁷⁾ Time accuracy does not include biases due to RF or antenna delay. ⁽⁸⁾ Typical result value.

Product Code Structure

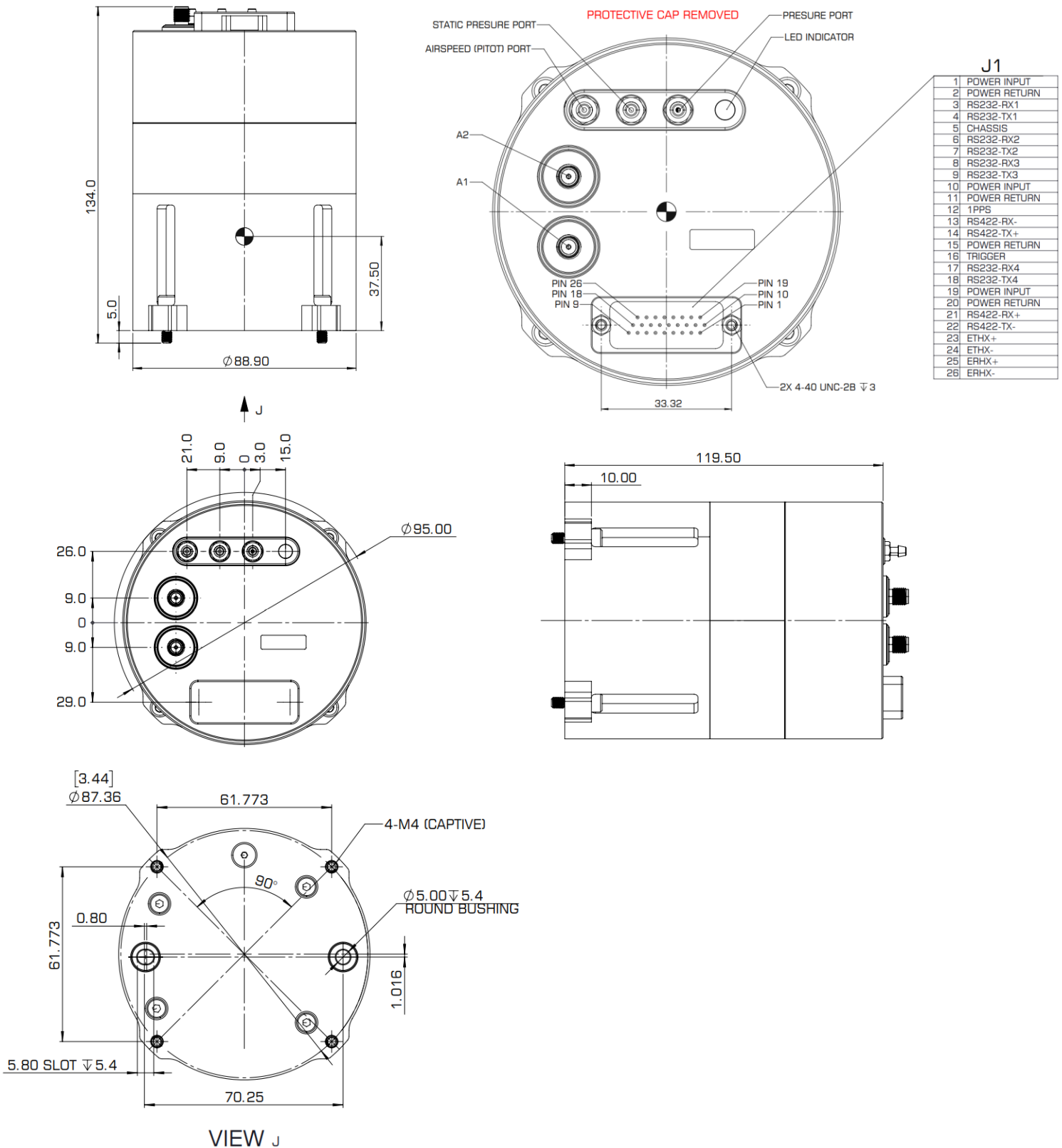
Model	Gyro	Accel	Calibration	Connector	Encoder	Pressure Ports	Color	External Compass	Data Logger	GNSS receiver	Version	Interface
INS-FI	G490	A8	TGA	C18	E	0P	S	SAMC	S64	O719	V9	124
		A40				2P				O7720	VD9	145
						2PEXT				DMH		1234
						2PMAX				SMX5		1245
										ZF9P		
										ZD9P		
										ZF9P-L5		

Example: INS-FI-G490-A40-TGA-C18-2P-S-SAMC-S64-ZD9P-VD9.12345

Product code details:

- INS-FI: Dual Antenna GPS-Aided Inertial Navigation System
- FI: FOG IMU-FI-200T
- G490: Gyroscopes measurement range = ±490 deg/sec
- A8: Accelerometers measurement range ±8 g
- A40: Accelerometers measurement range ±40 g
- TGA: Calibration of IMU (Gyroscopes and Accelerometers) in operational temperature range
- C18: 26-pin male, D-sub connector
- E: Encoder support (optional)
- 0P: Zero Airspeed Pressure Ports (Total/Static)
- 2P: Two Airspeed Pressure Ports with Standard Range (Total/Static, Honeywell 025MD)
- 2PEXT: Two Airspeed Pressure Ports with Extended Range (Total/Static, Honeywell 600MD)
- 2PMAX: Two Airspeed Pressure Ports with Extended Range (Total/Static, Honeywell 004BD)
- S: Silver Color of enclosure (default)
- SAMC: External Stand-Alone Magnetic Compass (optional)
- S64: 64GB embedded Data Logger (optional)
- O719: NovAtel OEM719: GPS+GLO+GAL+BDS+QZSS, L1/L2/L5/L6/E1/E5a/E5b/AltBOC/E6/B1/B2I/B2b/B2a/B3, NavIC L5, SBAS L1/L5, RTK+PPP+Single Point+DGPS PNT, 20 Hz Data Output Rate, Base Station Corrections + Measurements, GRIT Interference Mitigation and Spoofing Detection Includes GLIDE & RAIM
- O7720: NovAtel OEM7720: GPS+GAL+BDS+QZSS, L1/L2/L5/E1/E5a/E5b/AltBOC/B1/B2I/B2a/B2b, NavIC L5, SBAS L1/L5 Dual Antenna Activation, RTK+PPP+Single Point+DGPS PNT, ALIGN Heading, 20 Hz Data Output Rate, Base Station Corrections + Measurements, GRIT Interference Mitigation and Spoofing Detection Includes GLIDE & RAIM
- 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
- DMH: Septentrio mosaic-H: GPS+GLO+BDS+GAL+QZSS, L1C/A/L2P(Y)/L2C/L1CA/L2CA/B1I/B2I/B3I/E1/E5b/L1C/A/L1C/B/L2C, SBAS, RTK, Dual Antenna GNSS Heading, AIM+ anti-jamming, anti-spoofing Advanced Interference Monitoring and Mitigation
- ZF9P: u-blox ZED-F9P-02B: 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-15B: 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
- ZD9P: Dual u-blox ZED-F9P-02B: GPS+GLO+GAL+BDS+QZSS, L1C/A/L2C/L1OF/L2OF/E1B/C/E5b/B1I/B2I/L1C/A/L1S/L2C/L5, SBAS, RTK, Dual Antenna GNSS Heading, Active CW detection and removal, Onboard bandpass filter, Advanced anti-spoofing algorithms
- V9: Single Antenna GNSS Receiver
- VD9: Dual Antenna GNSS Receiver
- .124: RS-232, RS-422 and CAN interface
- .145: RS-232, CAN and Ethernet interface (w/ Encoder support)
- .1234: RS-232, RS-422, RS-485 (to be used when connecting to a Stand-alone Magnetic Compass), and CAN interface
- .1245: RS-232, RS-422, CAN and Ethernet interface

INS-FI Mechanical Interfaces Description



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