Inertial Labs
a VIAVI Solutions company

GPS-Aided Inertial Navigation System

INS-DM

INS-BM

STANDARD MIL-STD 810G

CERTIFIED ISO 9001:2015 COMPANY

MADE IN THE USA

Datasheet

The **Inertial Labs GPS-Aided Inertial Navigation System (INS-DM, INS-BM)** is the latest version of Inertial Navigation System, developed by Inertial Labs. The INS is the result of over 20 years of our experience in developing and supplying INS solutions to land, marine and aerial platforms around the world.

This system, is an IP67 rated version of an all-new generation of super ruggedized, shielded from the EMC/EMI, 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-DM/INS-BM** can support multiple types of MEMS Inertial Measurement Units (IMUs) developed by Inertial Labs and also utilize multi-constellation (GPS, GLONASS, GALILEO, QZSS, and BEIDOU) GNSS receivers from NovAtel, Septentrio, and u-blox.

The design of the **INS-DM/INS-BM** also includes an optional Air Data Computer (ADC), supported by two barometers, and the ability to support an external Stand-Alone Magnetic Compass (SAMC). The **INS-DM/INS-BM** 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 Honeywell or Inertial Labs MEMS Inertial Measurement Unit (IMU)
- NovAtel OEM7, u-blox ZED-F9P, or Septentrio mosaic-H High Precision GNSS receiver
- GPS, GLONASS, GALILEO, BEIDOU, QZSS, RTK supported signals
- Total and Static Pressure Sensors for calculating Indicated Airspeed
- SP, SBAS, DGPS, RTK and PPP for real time operation
- 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
- EMC, EMI, and ERD protection
- Environmentally sealed (IP67)
- Aiding data: Wind sensor, Air Speed Sensor, Doppler shift from locator (for long-term GPS denied), 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, Magnetic field; **AHRS** data: 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 (INS, MRU & AHRS data); up to 2000 (IMU data)							
	Start-up time	sec	<1							
	Positions, Velocity, and Timestamps		**M1 (miniAHRS)**		**E1 (KERNEL-110)**		**A1 (KERNEL-210)**		**N11 (IMU-NAV-200)**	
Navigation	Horizontal position accuracy (SP)	m	1.2							
	Horizontal position accuracy (SBAS) [1]	m	0.6							
	Horizontal position accuracy (DGPS)	m	0.4							
	Horizontal position accuracy (PPP TerraStar-C PRO) [2]	m	0.025							
	Horizontal position accuracy (PPK) [3]	-	0.005							
	Horizontal position accuracy (RTK)	m	0.01							
	Vertical position accuracy (RTK)	m	0.02							
	Velocity accuracy (OEM7720), RMS	m/sec	0.03							
	Horizontal Position accuracy (free inertial, land vehicles)	% DT	1				0.2		0.1	
	Horizontal Position accuracy (free inertial, aerial)	NMPH	<10				<7		<5	
	Heading									
Orientation	Range	deg	0 to 360							
	Angular Resolution	deg	0.1							
	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	0.05				0.03		0.015	
	Free inertial	deg/hr	10				2		1	
	Pitch and Roll									
	Range	deg	±90, ±180							
	Angular Resolution	deg	0.1							
	Static Accuracy	deg	0.08				0.05		0.03	
	Dynamic Accuracy (with GNSS correction)	deg	0.05				0.03		0.02	
	Post processing accuracy [3]	deg	0.05				0.006		0.003	
	Gyroscopes									
IMU	Measurement range	deg/sec	±450, ±950, ±2000							
	Bias in-run stability, RMS	deg/hr	2				1		0.5	
	Bias residual error, RMS	deg/hr	72				25		15	
	SF error	ppm	1000							
	Noise (ARW)	deg/√hr	0.38				0.2		0.1	
	Accelerometers									
	Measurement range	g	±8	±15	±40	±8	±15	±40	±8	±15	±40
	Bias in-run stability, RMS	mg	0.01	0.03	0.05	0.005	0.01	0.02	0.003	0.005	0.007
	Bias residual error, RMS	mg	0.7	1.1	1.5	0.5	0.7	1.2	0.4	0.5	0.6
	SF error	ppm	500	700	850	150	300	500	150	300	500
	Noise (VRW)	m/s/√hr	0.02	0.045	0.06	0.015	0.035	0.045	0.008	0.018	0.025
	Magnetometers									
	Measurement range	Gauss	±8		-	±1.6				
	Bias in-run stability, RMS	µGauss, 1σ	8		-	0.2				
	Noise density, PSD	µGauss/√Hz, 1σ	15		-	3				
	SF Accuracy	ppm, 1σ	500		-	50				
	Receiver		**NovAtel OEM7720**	**NovAtel OEM719**	**Septentrio mosaic-H**	**Septentrio mosaic-X5**		**u-blox ZED-F9P**		**u-blox ZED-F9P L5**
	Number of GNSS Antennas	-	Dual	Single	Dual	Dual	Single	Dual	Single	Single
GNSS	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		GPS (L1C/A, L2P(Y), L2C) GLONASS (L1C/A, L2C/A) Beidou (B1I, B2I, B3I) Galileo (E1, E5b) QZSS (L1C/A, L1C/B, L2C) NavIC (L5)	GPS (L1C/A, L1PY, L2C, L2P(Y), L5) GLONASS (L1CA, L2CA, L2P, L3 CDMA) Beidou (B1I, B1C, B2a, B2I, B2b, B3I) Galileo (E1, E5a, E5b, E5 AltBoc, E6) NavIC (L5)		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; PPP Terrastar		WAAS; EGNOS; MSAS; GAGAN; SBAS; DGPS; RTK			WAAS; EGNOS; MSAS; GAGAN; SBAS L1C/A; DGPS; RTK		
	Channel Configuration [5]	channels	555		448			184		
	GNSS Data Rate [6]	Hz	5 / 20 / 100		100 (max)			10, 20		
	RTK Corrections	-	RTCM 2, RTCM 3					RTCM 3		
	Velocity Accuracy	m/sec	0.03					0.05		
	Initialization Time	sec	<39 (cold start), <20 (hot start)		<45 (cold start); <20 (hot start)			<30 (cold start), <10 (hot start)		
	Time Accuracy (clock drift) [7]	nano sec	20					30		
	Air Data Computer		**2P**		**2PEXT**			**2PMAX**		
Air Data Computer	Pressure Sensor Range	mbar	±25		±600			±4000		
	Static Pressure Range	hPa, % FS	300 to 1100							
	Static Pressure Accuracy	% FSS	±0.1							
	Dynamic Pressure Range	hPa	0.15 to 25		0.15 to 600			0.15 to 4000		
	Dynamic Pressure Accuracy	% FSS	±0.25							
	Pressure Altitude Range	m	-500 to 9000							
	Pressure Altitude Accuracy	m	1							
	Airspeed Range	m/sec	5 to 64		5 to 310			5 to 800		
	Airspeed Accuracy	m/sec	0.5							
	Mach Number Range	M	0.01 to 0.2		0.01 to 0.99			0.01 to 2.5		
	Mach Number Accuracy	M	0.001		0.002					
	Static Pressure Over Total Pressure Range	-	0.97 to 1		0.63 to 1			0.20 to 1		
	Static Pressure Over Total Pressure Resolution	ppm	1							
	Air Density Range	kg/m3	0.3 to 1.6							
	Air Density Accuracy	kg/m3	0.002							
	Outside Air Temperature (OAT) Range	deg C	-40 to +85							
	Outside Air Temperature (OAT) Resolution	deg C	0.01							
	Environment									
	Operational and Storage Temperature	deg C	-40 to +80							
	EMC/EMI	-	MIL-STD-461F							
	Altitude	m	Up to 15000							
	Acoustic noise	dB	185							
	Environmental protection	-	IP67							
	MTBF (GM @ +65degC)	hr	100000							

General	**Electrical**		
	Input power protection	-	MIL-STD-1275 (optional)
	Supply voltage	V DC	9 to 36 (26±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	160.4 x 141.2 x 61.1
	Weight [8]	gram	1345

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] Depends on configuration.

PRODUCT CODE STRUCTURE

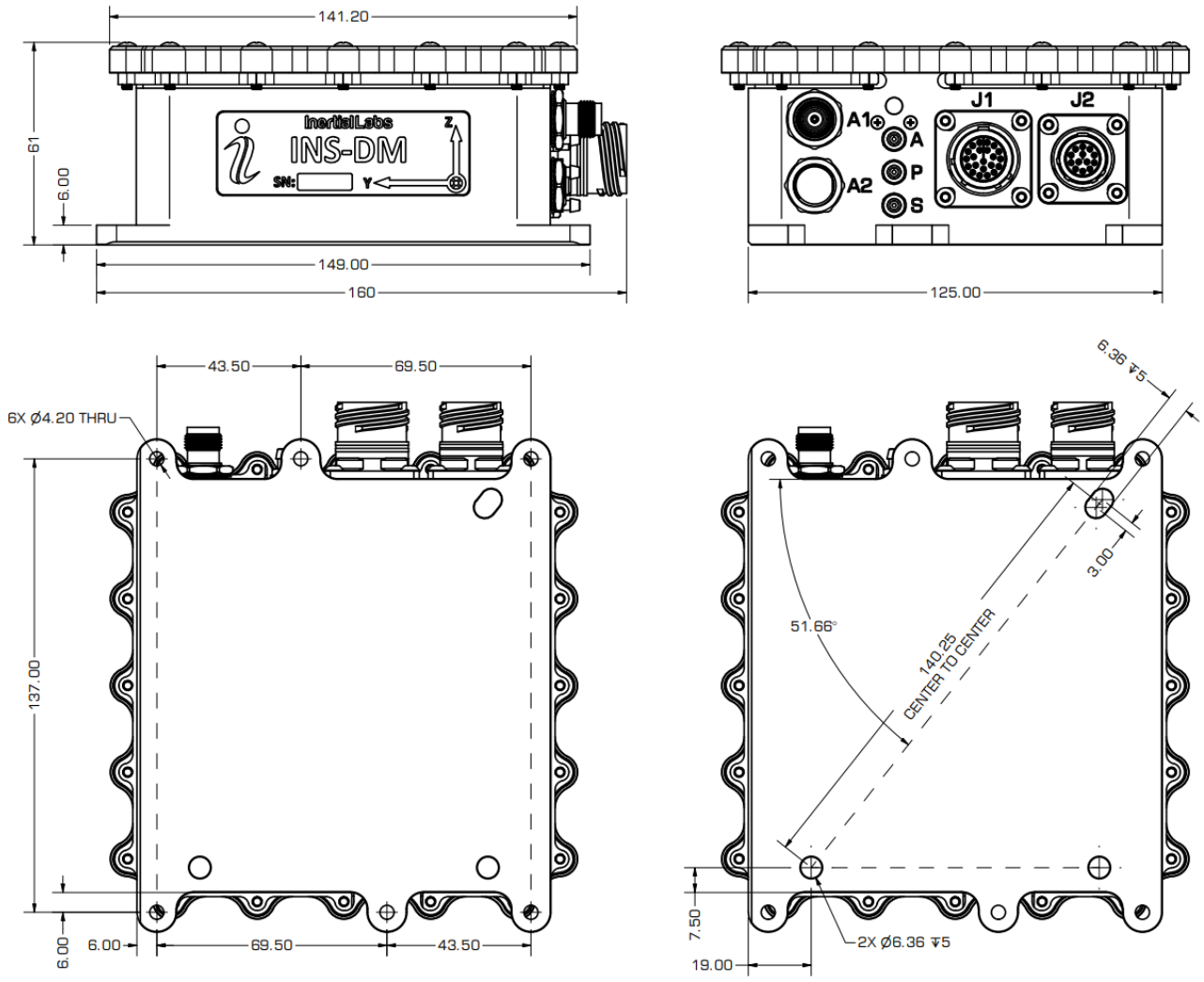
Model	IMU type	Gyro	Acc	Calibration	Connector	Encoder support	Pressure Ports	Color	External Compass	Data Logger	GNSS receiver	Version	Interface
INS-DM	M1	G450	A8	TGA	C71	E	0P	B	SAMC	S64	O719	V9	12345
INS-BM	E1	G950	A15	TMGA	C73		2P				O7720	VD9	123457
	A1	G2000	A40				2PEXT				SMX5		123458
	N11						2PMAX				DMX5		
											DMH		
											ZF9P		
											ZF9P-L5		
											ZD9P		

Example:
INS-DM-A1-G2000-A8-TGA-C71E-2P-B-SAMC-O7720-VD9.12345
INS-BM-N11-G450-A40-TMGA-C73E-2PEXT-B-SAMC-S64-SMX5-V9.12345

Product code details:

- INS-DM: Dual Antenna GPS-Aided Inertial Navigation System
- INS-BM: Single Antenna GPS-Aided Inertial Navigation System
- M1: Inertial Labs miniAHRS Attitude & Heading Reference System
- E1: Inertial Labs KERNEL-110 IMU
- A1: Inertial Labs KERNEL-210 IMU
- N11: Inertial Labs IMU-NAV-200 (available with the G450 gyro range option only)
- 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: Calibration of IMU (Gyroscopes and Accelerometers) in operational temperature range
- TMGA: Calibration of IMU (Magnetometers, Gyroscopes and Accelerometers) in operational temperature range
- C71: two connectors (22 – main; 13 – auxiliary), enclosure with asymmetrical alignment mounting holes
- C73: C71 with MIL-STD-1275 protection
- E: Encoder support (default)
- 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)
- B: Black Color of enclosure (default)
- SAMC: External Stand-Alone Magnetic Compass (default)
- 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, NavIC L5, SBAS, L-band, RTK, AIM+ anti-jamming, anti-spoofing Advanced Interference Monitoring and Mitigation
- DMX5: Dual 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, NavIC L5, SBAS, L-band, RTK, Dual Antenna GNSS Heading, 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, NavIC L5, 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
- .12345: RS-232, RS-422, RS-485 (for stand-alone magnetic compass only), CAN, Ethernet
- .123457: RS-232, RS-422, RS-485 (for stand-alone magnetic compass only), CAN, Ethernet, ARINC-429
- .123458: RS-232, RS-422, RS-485 (for stand-alone magnetic compass only), CAN, Ethernet, RS-422 interface of COM4

MECHANICAL INTERFACES DESCRIPTION



Notes:
1. All dimensions are in millimeters.
2. All dimensions within these drawings are subject to change without notice. Customers should obtain final drawings before designing any interface hardware.