



Dual Antenna, GPS-Aided Inertial Navigation Systems

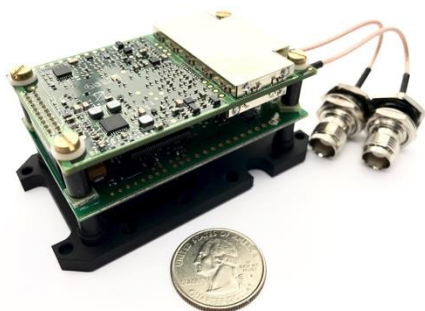
INS-D-OEM

INS-DL-OEM

- Real time (RTK) & Post Processing (PPK)
- Position accuracy = 0.5 cm (PPK) / 1 cm (RTK)
- Heading accuracy = 0.03 deg (PPK) / 0.05 deg (RTK)
- Pitch & Roll accuracy = 0.006 deg (PPK) / 0.08 deg (RTK)
- High precision dual antenna GNSS receiver
- Ideal solution for accurate point clouds
- Small Size, light weight
- Affordable price
- Compatible with LIDAR, Optical camera
- Applications: flight control, remote sensing, photogrammetry



The **Inertial Labs GPS-Aided Inertial Navigation System (INS-D/DL-OEM)** is OEM version of new generation, dual GNSS antenna, fully-integrated, combined GPS, GLONASS, GALILEO and BEIDOU GNSS 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, Dual Antenna Heading, Pitch & Roll are determined with high accuracy for both motionless and dynamic applications.



The Inertial Labs **INS-D/DL-OEM** utilizes advanced dual antenna GNSS receiver, 3-axes each of calibrated in full operational temperature range Advanced MEMS Accelerometers and new generation of tactical grade MEMS Gyroscopes to provide accurate Position, Velocity, Heading, Pitch and Roll of the device under measure.

INS-D/DL-OEM contains Inertial Labs new on-board sensors fusion filter, state of the art navigation and guidance algorithms and calibration software.

KEY FEATURES, BENEFITS & FUNCTIONALITY

- Commercially exportable Dual Antenna GPS-Aided Inertial Navigation System
- Small size & light weight: 85.5 x 47.7 x 40 mm size and 174 (or 184) grams weight
- Industrial & Tactical-grade IMU (1 – 3 deg/hr gyroscopes Bias in-run stability)
- GPS, GLONASS, BEIDOU, SBAS, DGPS, RTK supported signals
- Up to 0.05 deg Heading and 0.08 deg Pitch & Roll accuracy
- Compatibility with LiDARs (Velodyne, RIEGL, FARO, Ouster, Hesai, Livox) and Optical Cameras for remote sensing applications
- Up to 200 Hz INS, up to 2000 Hz IMU, up to 100 Hz GNSS positions and GNSS measurements data rate
- Sensor fusion algorithms with advanced extended Kalman Filter
- State-of-the-art algorithms for different dynamic motions of Vessels, Ships, Helicopters, UAV, UUV, UGV, AGV, ROV, Gimbals and Land Vehicles
- Implemented ZUPT, ZARUPT, Tunnel Guide, GNSS tracking angle features
- Full temperature calibration of all sensing elements
- Full integration with ArduPilot platform

INS-D-OEM and INS-DL-OEM performance during GNSS outages

Model	Outage duration	Mode	Position accuracy (meters, RMS)		Velocity accuracy (meters/sec, RMS)		Attitude accuracy (degree, RMS)	
			Horizontal	Vertical	Horizontal	Vertical	Pitch, Roll	Heading*
INS-D-OEM	0 sec	RTK	0.01 + 1ppm	0.02 + 1ppm	0.02	0.01	0.015	0.05
		SP	1.2	1.0	0.03	0.02	0.08	0.08
		PP	0.005	0.01	0.02	0.01	0.006	0.03
	60 sec	RTK	7	2	0.3	0.1	0.05	0.08
		SP	8	3	0.3	0.1	0.1	0.1
		PP	0.3	0.2	0.03	0.05	0.01	0.05
INS-DL-OEM	0 sec	RTK	0.01 + 1ppm	0.02 + 1ppm	0.05	0.05	0.09	0.2
		SP	1.2	1.0	0.06	0.06	0.1	0.3
	60 sec	RTK	8	3	0.5	0.4	0.06	0.3
		SP	9	4	0.6	0.5	0.15	0.4

* 2 meters baseline

Specifications

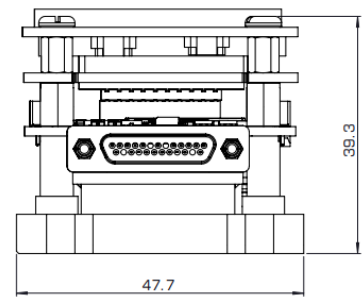
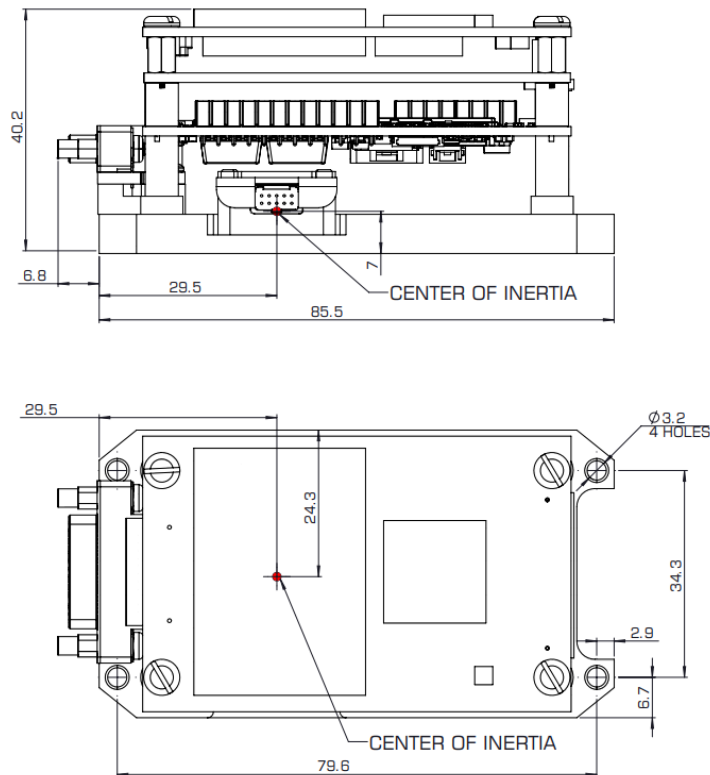
	Parameter	Units	INS-DL-OEM Low cost dual antenna			INS-D-OEM High precision dual antenna		
General	Input signals		- Marine application: DVL (Doppler Velocity Log) - Land application: Odometer, Wheel sensor, Encoder, DMI - Aerial application: Wind sensor, Air Speed Sensor, Doppler shift from locator (for long-term GPS denied) - All: External Stand-Alone Magnetic Compass (SAMC/AHRS)					
	Output signals		- Horizontal and Vertical Positions, Heading, Pitch & Roll, Velocity, Accelerations, Angular rates, Barometric data, 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					
	Main features		Affordable price Dual antenna Heading 1 cm RTK position			High precision dual antenna Heading, 1 cm RTK position, Tactical-grade IMU		
	Data rate (INS)	Hz	Up to 200 (user settable)			Up to 200 (user settable)		
	Data rate (IMU)	Hz	Up to 2000 (user settable)			Up to 2000 (user settable)		
Navigation	Start-up time	sec	<1			<1		
	Positions, Velocity and Timestamps	Units	INS-DL-OEM			INS-D-OEM		
	Horizontal position accuracy (SP, L1), RMS	meters	1.5			1.5		
	Horizontal position accuracy (SP, L1/L2), RMS	meters	1.2			1.2		
	Horizontal position accuracy (SBAS), RMS ⁽¹⁾	meters	0.6			0.6		
Orientation	Horizontal position accuracy (DGPS), RMS	meters	n/a			0.4		
	Horizontal position accuracy (TerraStar-L) ⁽²⁾	meters	n/a			0.4		
	Horizontal position accuracy (TerraStar-C PRO) ⁽²⁾	meters	n/a			0.025		
	Horizontal position accuracy (TerraStar-X) ⁽²⁾	meters	n/a			0.02		
	Horizontal position accuracy (post processing) ⁽³⁾	meters	0.005			0.005		
	Horizontal position accuracy (RTK), RMS	meters	0.01 + 1 ppm CEP			0.01 + 1 ppm		
	Vertical position accuracy (SP), RMS	meters	<2			<1		
	Vertical position accuracy (RTK), RMS	meters	0.02 + 1 ppm CEP			0.02 + 1 ppm		
	Velocity accuracy, RMS	meters/sec	0.05			0.02		
	PPS timestamps accuracy	nano sec	20			20		
	Heading	Units	INS-DL-OEM			INS-D-OEM		
	Range	deg	0 to 360			0 to 360		
	Static Accuracy ⁽⁴⁾	deg RMS, 1σ	0.4 (1 meter base line)			0.15 (1 meter base line)		
	Dynamic accuracy (GNSS) ⁽⁵⁾	deg RMS, 1σ	0.2 (2 meters baseline)			0.08 (2 meters baseline)		
	Post processing accuracy ⁽³⁾	deg RMS, 1σ	0.1			0.03		
IMU	Pitch and Roll	Units	INS-DL-OEM			INS-D-OEM		
	Range: Pitch, Roll	deg	±90, ±180			±90, ±180		
	Angular Resolution	deg	0.01			0.01		
	Static Accuracy in whole Temperature Range	deg	0.08			0.05		
	Dynamic Accuracy ⁽⁵⁾	deg RMS	0.04			0.03		
	Post processing accuracy ⁽³⁾	deg RMS	0.01			0.006		
	Gyroscopes	Units	INS-DL-OEM			INS-D-OEM		
	Type		Industrial-grade			Tactical-grade		
	Measurement range	deg/sec	±450 / ±950 / ±2000			±450 / ±950 / ±2000		
	Bias in-run stability (RMS, Allan Variance)	deg/hr	3			1		
	Bias error over temperature range (RMS)	deg/hr	<50			<30		
	Angular Random Walk	deg/√hr	<0.3			<0.2		
	Accelerometers	Units	INS-DL-OEM			INS-D-OEM		
	Type		Industrial-grade			Tactical-grade		
	Measurement range	g	±8 g	±15 g	±40 g	±8 g	±15 g	±40 g
Electrical and Physical	Bias in-run stability (RMS, Allan Variance)	mg	0.01	0.03	0.05	0.005	0.02	0.03
	Bias error over temperature range (RMS)	mg	0.7	1.1	1.5	0.5	0.7	1.2
	Bias one-year repeatability	mg	1.5	2.0	2.5	1.0	1.3	1.5
	Velocity Random Walk	m/s/√hr	0.02	0.045	0.06	0.015	0.035	0.045
	Environment	Units	INS-DL-OEM			INS-D-OEM		
	Operating temperature	deg C	-40 to +75			-40 to +75		
	Storage temperature	deg C	-50 to +85			-50 to +85		
	MTBF	hours	55,500			55,500		
	Electrical	Units	INS-DL-OEM			INS-D-OEM		
	Supply voltage	V DC	9 - 36			9 - 36		
	Power consumption	Watts	5 (6 with data logger)			5 (6 with data logger)		
	Output Interface (options)	-	RS-232 or RS-422, CAN Ethernet (optional)			RS-232 or RS-422, CAN Ethernet (optional)		
	Output data format	-	Binary, NMEA 0183 ASCII			Binary, NMEA 0183 ASCII		
	Physical	Units	INS-DL-OEM			INS-D-OEM		
	Size ⁽⁶⁾	mm	85.5 x 47.7 x 40			85.5 x 47.7 x 40.2		
	Weight ⁽⁶⁾	gram	174 (184)			174 (184)		

⁽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⁾ 2 meters base line between two GNSS antennas. ⁽⁵⁾ dynamic accuracy may depend on type of motion. ⁽⁶⁾ Weight and size are PN dependent. Customers should obtain the most recent 2D/3D files before designing any interface hardware. In bracket shown weight for a device in standard configuration with internal datalogger.

GNSS Specifications	Receiver Options Available		NovAtel		Septentrio		u-blox	
	Model	-	OEM7720		mosaic-H		Dual ZED-F9P	
	Number of GNSS Antennas	-	Dual		Dual		Dual	
	GNSS Constellations	-	GPS L1 C/A, L1C, L2C, L2P, L5; GLONASS L1 C/A, L2 C/A, L2P, L3, L5 (OEM719); BeiDou B1I, B1C, B2I, B2a, B2b, B3I (OEM719); Galileo E1, E5 AltBOC, E5a, E5b, E6 (OEM719); QZSS L1 C/A, L1C, L1S, L2C, L5, L6 (OEM719); NavIC (IRNSS) L5; L-Band		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	
	GNSS Corrections	-	WAAS; EGNOS; MSAS; GAGAN; SBAS L1, L5; DGPS; RTK; TerraStar PPP, Oceanix PPP		WAAS; EGNOS; MSAS; GAGAN; SBAS L1, L5; DGPS; RTK		WAAS; EGNOS; MSAS; GAGAN; SBAS L1C/A; DGPS; RTK	
	Channel Configuration ⁽¹⁾	-	555		448		184	
	GNSS Data Rate ⁽¹⁾	Hz	5 / 20 / 100		100 (max)		10, 20 ⁽²⁾	
	RTK Corrections	-	RTCM 2, RTCM 3		RTCM 2, RTCM 3		RTCM 3	
	Velocity Accuracy	m/s	0.03		0.03		0.05	
	Initialization Time	s	<39 (cold start), <20 (hot start)		<45 (cold start), <20 (hot start)		<30 (cold start), <10 (hot start)	
	Time Accuracy (clock drift) ⁽³⁾	Nano sec	20		20		30	

⁽¹⁾ tracks up to 60 L1/L2 satellites. ⁽²⁾ If tracking GPS only. ⁽³⁾ time accuracy does not include biases due to RF or antenna delay.

INS-D-OEM mechanical interface drawing (standard configuration)

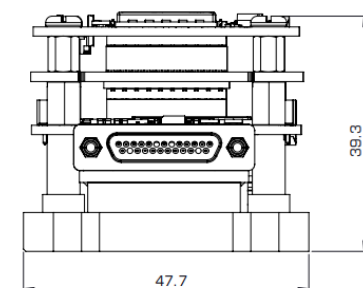
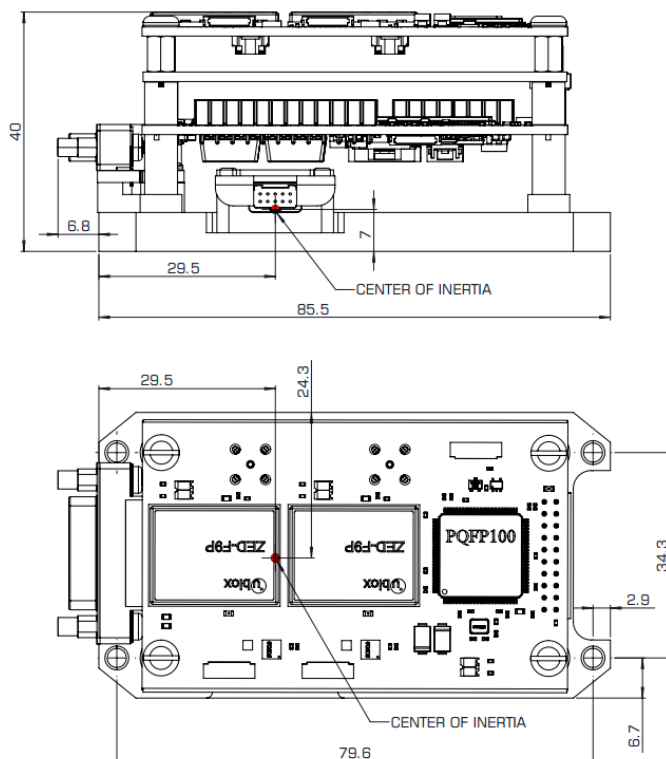


Device side: 25-pin connector
MDSM-25PE-Z10-VR17

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.

INS-DL-OEM mechanical interface drawing (standard configuration)



Device side: 25-pin connector
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Product Code Structure:

Model	Gyroscope	Accel	Calibration	Connector	SAMC	Encoder	Data Logger	GNSS receiver	Version	Interface
INS-D-OEM	G450	A8	TGA	C4	SAMC (option)	E (option)	S64	O7720	VD4	1
	G950	A15	TMGA (Option)	C6				ZD9P	VD42	2
	G2000	A40		C8				DMH	VD43	3
								WOR	VD44	4
									VD49	5
								VD9	11	
								VD91	22	
									145	
									125	
									245	

Model	Gyroscope	Accel	Calibration	Connector	SAMC	Encoder	Data Logger	GNSS receiver	Version	Interface
INS-DL-OEM	G450	A8	TGA	C4	SAMC (option)	E (option)	S64	B482 (Obsolete)	VD9	1
	G950	A15	TMGA (Option)	C6				ZD9P	VD91	2
	G2000	A40		C8				DMH		3
								WOR		4
										5
										11
										22
		145								
		125								
		245								

Product code details:

- INS-D-OEM: Dual Antenna GPS-Aided Inertial Navigation System
- INS-DL-OEM: Low cost 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 $\rightarrow$ recommended for applications with low level of operational vibrations
- A15: Accelerometers measurement range ± 15 g $\rightarrow$ recommended for applications with medium level of operational vibrations
- A40: Accelerometers measurement range ± 40 g $\rightarrow$ recommended for high dynamic applications or/and with high level of vibration
- TGA: Gyroscopes and Accelerometers
- TMGA: Magnetometers, Gyroscopes and Accelerometers
- C4: Aluminum Base Plate - 26 pin header and ribbon cable (20021121-00026T4LF by Amphenol) (with available interfaces of: RS-232, RS-422, Ethernet and CAN)
- C6: Aluminum Base Plate - 14 pin screw-lock connector (M80-5401442 by Harwin) (with available interfaces of: RS-232 and CAN, RS-422 and CAN, or Ethernet and CAN)
- C8: Aluminum Base Plate - 25-pin micro D-SUB connector with screw lock (MDSM-25PE-Z10-VR17 by ITT Cannon) (with available interfaces of: RS-232, RS-422, Ethernet and CAN)
- SAMC: support of external Stand Alone Magnetic Compass (for RS-232; or RS-422; or RS-232 & RS-422 interfaces)
- E: Encoder support
- S64: 64GB embedded Data Logger (optional)
- O7720: NovAtel OEM7720 dual antenna GNSS receiver (INS-D-OEM only)
- B482: Inertial Labs B482 dual antenna GNSS receiver (INS-DL-OEM only) **OBSOLETE**
- ZD9P: u-blox ZED-F9P dual antenna GNSS receiver
- DMH: Septentrio mosaic-H dual antenna GNSS receiver
- WOR: without GNSS receiver
- VD4: GPS L1/L2, Dual antenna Heading, SBAS, DGPS, 20 Hz positions (NovAtel Dual Antenna GNSS Receiver only)
- VD42: GPS L1/L2, GLONASS L1/L2, Dual GNSS Heading, SBAS, DGPS, RTK, 20 Hz measurements, 20 Hz positions (NovAtel Dual Antenna GNSS Receiver only)
- VD43: GPS L1/L2, GLONASS L1/L2, Dual antenna Heading, SBAS, DGPS, 20 Hz positions (NovAtel Dual Antenna GNSS Receiver only)
- VD44: GPS L1/L2, GLONASS L1/L2, GALILEO E1B/C E5b Dual antenna Heading, SBAS, DGPS, 20 Hz positions (NovAtel Dual Antenna GNSS Receiver only)
- VD49: GPS L1/L2, GLONASS L1/L2, NavIC (IRNSS), Dual antenna Heading, SBAS, DGPS, 20 Hz positions; 20 Hz GNSS measurements (NovAtel Dual Antenna GNSS Receiver only)
- VD9: GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2, GALILEO E1/E5, QZSS L1/L5, DGPS, RTK, Dual GNSS Heading, GNSS measurements, GNSS positions (Dual Antenna GNSS Receiver only)
- VD91: GPS L1/L2, GLO L1/L2, GALILEO E1/E5b, BEIDOU B1/B2/B3, QZSS L1/L5, SBAS, RTK, Dual Antenna Heading, GNSS measurements, GNSS positions (Dual Antenna Septentrio Mosaic-H Receiver only)
- .1: RS-232 interface
- .2: RS-422 interface
- .3: RS-485 interface (temporary is not available)
- .4: CAN interface
- .5: Ethernet interface
- .11: two RS-232 interfaces (only available for C4 and C8 connectors)
- .22: two RS-422 interfaces (only available for C4 and C8 connectors)
- .145: RS-232, CAN and Ethernet interfaces (with optional Encoder support) (only available for C4 and C8 connectors)
- .125: RS-232, RS-422 and Ethernet interfaces (without optional Encoder support) (only available for C8 connectors)
- .245: RS-422, CAN and Ethernet interfaces (without Encoder support) (only available for C4 and C8 connectors)