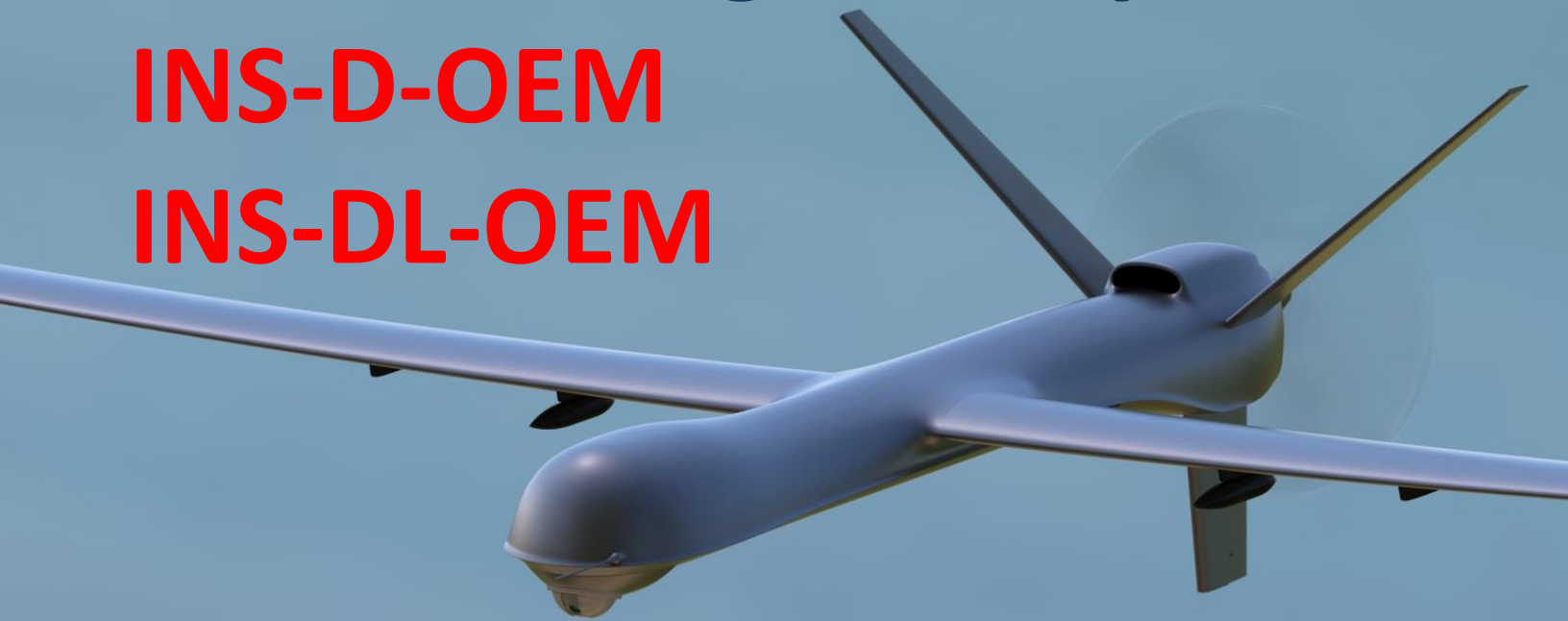




# Dual Antenna, GPS-Aided Inertial Navigation Systems

**INS-D-OEM**

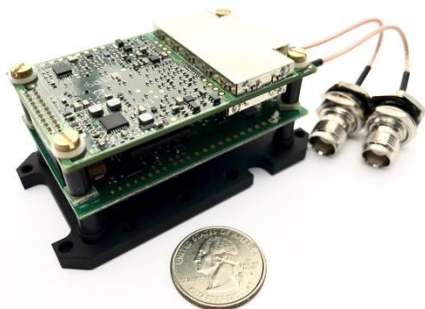
**INS-DL-OEM**



- 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
- 85 x 47 x 36 mm size and 115 gram weight. Full temperature calibration of all sensing elements
- 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 and Optical Cameras for remote sensing applications
- Up to 200 Hz INS, up to 2000 Hz IMU, 50 Hz GNSS positions, 20 Hz GNSS measurements data rate
- Advanced, extendable, embedded Kalman Filter based sensor fusion algorithms
- State-of-the-art algorithms for different dynamic motions of Vessels, Ships, Helicopters, UAV, UUV, UGV, AGV, ROV, Gimbals and Land Vehicles
- Implemented ZUPT, GNSS tracking angle features

### 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	0.03	0.02	0.09	0.06
		SP	1.2	1.0	0.04	0.03	0.1	0.09
		PP	0.009	0.015	0.025	0.02	0.009	0.035
	60 sec	RTK	8	3	0.4	0.3	0.06	0.09
		SP	9	4	0.45	0.5	0.15	0.15
		PP	0.45	0.35	0.04	0.065	0.025	0.07

\* 2 meters baseline

**INS-D-OEM & INS-DL-OEM Specifications**

	Parameter	Units	INS-DL-OEM			INS-D-OEM		
			Low cost dual antenna			High precision dual antenna		
<b>General</b>	Input signals		<ul style="list-style-type: none"> <li>Marine application: DVL (Doppler Velocity Log)</li> <li>Land application: Odometer, Wheel sensor, Encoder, DMI</li> <li>Aerial application: Wind sensor, Air Speed Sensor, Doppler shift from locator (for long-term GPS denied)</li> <li>All: External Stand Alone Magnetic Compass (SAMC/AHRS)</li> </ul>					
	Output signals		<ul style="list-style-type: none"> <li>Horizontal and Vertical Positions, Heading, Pitch &amp; Roll, Velocity, Accelerations, Angular rates, Barometric data, PPS</li> <li>Direct AT ITINS message with Position, Heading, Pitch &amp; Roll to COBHAM AVIATOR UAV 200</li> </ul>					
	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)		
	Start-up time	sec	<1			<1		
	<b>Positions, Velocity and Timestamps</b>	<b>Units</b>	<b>INS-DL-OEM</b>			<b>INS-D-OEM</b>		
<b>Navigation</b>	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 <sup>(1)</sup>	meters	0.6			0.6		
	Horizontal position accuracy (DGPS), RMS	meters	0.4			0.4		
	Horizontal position accuracy (post processing) <sup>(2)</sup>	meters	0.005			0.005		
	Horizontal position accuracy (RTK), RMS	meters	0.01 + 1 ppm			0.01 + 1 ppm		
	Vertical position accuracy (SP), RMS	meters	<2			<1		
	Vertical position accuracy (RTK), RMS	meters	0.02 + 1 ppm			0.02 + 1 ppm		
	Velocity accuracy, RMS	meters/sec	0.03			0.02		
PPS timestamps accuracy	nano sec	20			20			
	<b>Heading</b>	<b>Units</b>	<b>INS-DL-OEM</b>			<b>INS-D-OEM</b>		
<b>Orientation</b>	Range	deg	0 to 360			0 to 360		
	Static Accuracy <sup>(3)</sup>	deg RMS	0.15 (1 meter base line)			0.15 (1 meter base line)		
	Dynamic accuracy (GNSS) <sup>(6)</sup>	deg RMS	0.08 (2 meters baseline)			0.08 (2 meters baseline)		
	Post processing accuracy <sup>(2)</sup>	deg RMS	0.03			0.03		
	<b>Pitch and Roll</b>	<b>Units</b>	<b>INS-DL-OEM</b>			<b>INS-D-OEM</b>		
	Range: Pitch, Roll	deg	±90, ±180			±90, ±180		
	Angular Resolution	deg	0.01			0.01		
	Static Accuracy in whole Temperature Range	deg	0.05			0.03		
	Dynamic Accuracy <sup>(6)</sup>	deg RMS	0.1			0.08		
Post processing accuracy <sup>(2)</sup>	deg RMS	0.01			0.006			
	<b>GNSS receiver</b>	<b>Units</b>	<b>INS-DL-OEM</b>			<b>INS-D-OEM</b>		
<b>GNSS</b>	Number of GNSS Antennas		Dual			Dual		
	Supported GNSS signals & corrections (optional)		GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2, GALILEO E1/E5, QZSS L1/L5, SBAS, DGPS, RTK			GPS L1/L2; GLONASS L1/L2; BeiDou B1/B2; SBAS; DGPS; RTK		
	Channel configuration <sup>(4)</sup>		435 Channels			555 Channels		
	GNSS Positions data rate <sup>(5)</sup>	Hz	20			20, 50		
	RTK corrections		RTCM 2.3/3.0/3.2			RTCM 2.1/2.3/3.0/3.1		
	GNSS Measurements (raw) data rate	Hz	20			20		
	Velocity accuracy, RMS	meters/sec	<0.04			<0.03		
	Initialization time	Sec	<50 (cold start), <30 (hot start)			<50 (cold start), <30 (hot start)		
	Time accuracy (clock drift) <sup>(7)</sup>	nano sec	20			20		
	<b>Gyroscopes</b>	<b>Units</b>	<b>INS-DL-OEM</b>			<b>INS-D-OEM</b>		
<b>IMU</b>	Type		Industrial-grade			Tactical-grade		
	Measurement range	deg/sec	±450 / ±950			±450 / ±950		
	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		
	<b>Accelerometers</b>	<b>Units</b>	<b>INS-DL-OEM</b>			<b>INS-D-OEM</b>		
	Type		Industrial-grade			Tactical-grade		
	Measurement range	g	±8 g	±15 g	±40 g	±8 g	±15 g	±40 g
	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	
	<b>Environment</b>	<b>Units</b>	<b>INS-DL-OEM</b>			<b>INS-D-OEM</b>		
<b>Electrical and Physical</b>	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		
	<b>Electrical</b>	<b>Units</b>	<b>INS-DL-OEM</b>			<b>INS-D-OEM</b>		
	Supply voltage	V DC	9 - 36			9 - 36		
	Power consumption	Watts	3			3		
	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		
	<b>Physical</b>	<b>Units</b>	<b>INS-DL-OEM</b>			<b>INS-D-OEM</b>		
Size	mm	85 x 47 x 36			85 x 47 x 36			
Weight	gram	115			115			

<sup>(1)</sup> GPS only; <sup>(2)</sup> RMS, incremental error growth from steady state accuracy. Post-processing results using third party software; <sup>(3)</sup> 2 meters base line between two GNSS antennas; <sup>(4)</sup> tracks up to 60 L1/L2 satellites;

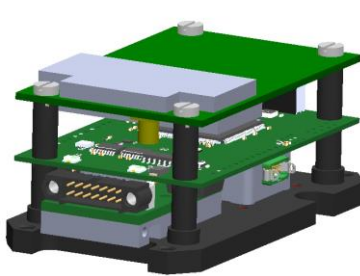
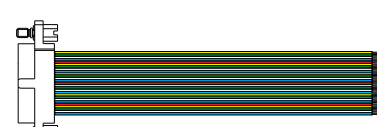
<sup>(5)</sup> 50 Hz while tracking up to 20 satellites. 20 Hz position update rate for Basic model of INS; <sup>(6)</sup> dynamic accuracy may depend on type of motion; <sup>(7)</sup> time accuracy does not include biases due to RF or antenna delay

**INS-D/DL-OEM electrical and mechanical interface drawing**

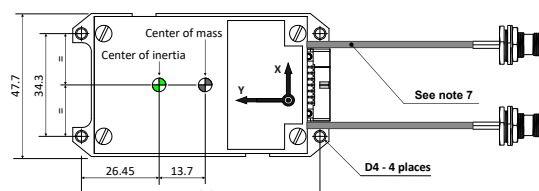
Main harness (RS232 option)			Main harness (RS422 option)		
1	POWER IN	RED	1	POWER IN	RED
2	GROUND	BLACK	2	GROUND	BLACK
12	RS232-TX1	WHITE	12	RS422-A	WHITE
13	RS232-RX1	BLUE	13	RS422-B	BLUE
11	NC	WHITE	11	RS422-Y	WHITE
14	NC	ORANGE	14	RS422-Z	ORANGE
5	RS232-RX2	GREY	5	RS232-RX2	GREY
6	RS232-TX2	BROWN	6	RS232-TX2	BROWN
9	RS232-RX3	PURPLE	9	RS232-RX3	PURPLE
10	RS232-TX3	GREEN	10	RS232-TX3	GREEN
7	RS232-RX4 (Alt: CAN_L)	YELLOW	7	RS232-RX4 (Alt: CAN_L)	YELLOW
8	RS232-TX4 (Alt: CAN_H)	WHITE	8	RS232-TX4 (Alt: CAN_H)	WHITE
4	GNSS PPS	GREY	4	GNSS PPS	GREY
3	GNSS EV2	PURPLE	3	GNSS EV2	PURPLE

**Note 1:** PPS and EV2 conductors are twisted  
**Note 2:** RS232-RX1 and RS232-TX1 conductors are twisted  
**Note 3:** NC and NC conductors are twisted  
 The names of the signals are given relative to the device. I.e. the Rx pin is the input pin of the INS, Tx is the output one.

**Note 4:** PPS and EV2 conductors are twisted  
**Note 5:** RS422-A and RS422-B conductors are twisted  
**Note 6:** RS422-Y and RS422-Z conductors are twisted  
 RS422-A and RS422-B pair is used by device for data receive  
 RS422-Y and RS422-Z pair is used by device for data transmit

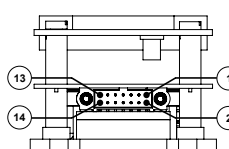
Cable side: 14-pin connector M80-4601405 by Harwin (Length is configurable)




Center of mass  
Center of inertia  
See note 7  
D4 - 4 places

Main electrical parameters	
Supply voltage	9 to 34 VDC
Power consumption	1000 mW
Output interface	3 x RS-232 (optional RS422)
Output data format	Binary, TSS-1, NMEA 0183 ASCII characters

**Note 7:** TNC Female Bulkhead, 150mm length RG178 Coax  
**Note 8:** Weight 145g



Device side: 14-pin connector M80-5401442 by Harwin (Ethernet is not available in this configuration)



INS-D-OEM assembly drawings  
 REV3.2 21-MAY-2019 TECHNICAL DRAWING 1 OF 1

**INS-D-OEM part numbers structure (Example: INS-D-OEM-G450-A15-TGA-C6-O7720-VD4.1)**

Model	Gyroscope	Accel	Calibration	Connector	GNSS receiver	Version	Interface
INS-D-OEM	G450	A8	TGA	C4	O7720	VD4	1
	G950	A15		C6		VD42	2
				C8		VD43	11

**INS-DL-OEM part numbers structure (Example: INS-DL-OEM-G450-A15-TGA-C6-B482-VD9.1)**

Model	Gyroscope	Accel	Calibration	Connector	GNSS receiver	Version	Interface
INS-DL-OEM	G450	A8	TGA	C4	B482	VD9	1
	G950	A15		C6			2
				C8			11

**Part number structure:**

- 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
- A8: Accelerometers measurement range = ±8 g → recommended for applications with low level of operational vibrations
- A15: Accelerometers measurement range ±15 g → recommended for applications with medium level of operational vibrations
- A40: Accelerometers measurement range ±40 g → recommended for high dynamic applications or/and with high level of operational vibration
- TGA: Gyroscopes and Accelerometers
- C4: Aluminum Base Plate - 26 pin header and ribbon cable (20021121-00026T4LF by Amphenol)
- C6: Aluminum Base Plate - 14 pin screw-lock connector (M80-5401442 by Harwin)
- C8: Aluminum Base Plate - 25 pin enclosed cable with screw lock connector (CCA-025-136R152 by NorComp)
- O7720: Novatel OEM7720 dual antenna GNSS receiver (INS-D only)
- B482: Inertial Labs B482 dual antenna GNSS receiver (INS-DL only)
- VD4: GPS L1/L2, Dual antenna Heading, SBAS, DGPS, 20 Hz positions (INS-D only)
- VD42: GPS L1/L2, GLONASS L1/L2, Dual antenna Heading, SBAS, DGPS, RTK, 20 Hz measurements, 20 Hz positions (INS-D-OEM only)
- VD43: GPS L1/L2, GLONASS L1/L2, Dual antenna Heading, SBAS, DGPS, 20 Hz positions (INS-D-OEM only)
- VD9: GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2, GALILEO E1/E5, QZSS L1/L5, DGPS, RTK, Dual antenna Heading, DGPS, RTK, 20 Hz measurements, 20 Hz positions (INS-DL-OEM only)
- VX.1: RS-232, CAN, Ethernet interface
- VX.2: RS-422, CAN, Ethernet interface
- VX.11: two RS-232 interfaces
- VX.22: two RS-422 interfaces