



**Low cost  
Dual Antenna GPS-Aided  
Inertial Navigation Systems**

# **INS-DU**



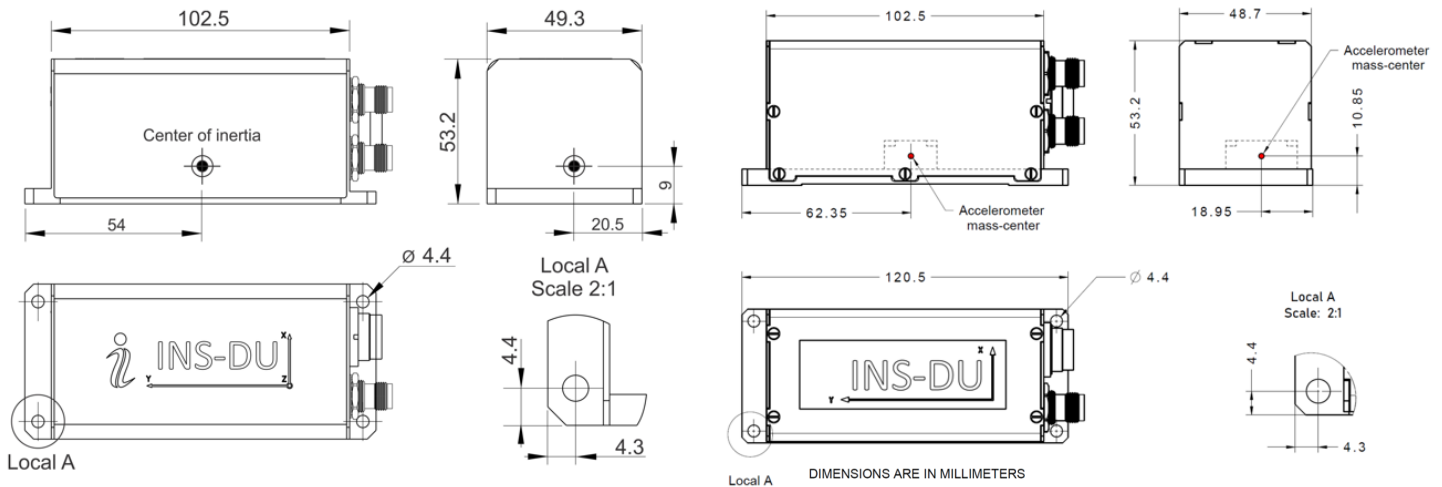
**INS-DU Specifications**

	Parameter	Units	INS-DU		
<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, 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> <li>Direct Navigation Support for Pixhawk Flight Controllers as NMEA messages</li> </ul>		
	Main features		Low Cost, Dual antenna Heading, 1 cm RTK position		
	Data rate (INS)	Hz	Up to 200 (user settable)		
	Data rate (IMU)	Hz	Up to 2000 (user settable)		
	Start-up time	sec	<1		
<b>Positions, Velocity and Timestamps</b>		<b>Units</b>	<b>INS-DU</b>		
<b>Navigation</b>	Horizontal position accuracy (SP, L1), RMS	meters	1.5		
	Horizontal position accuracy (SP, L1/L2), RMS	meters	1.2		
	Horizontal position accuracy (post processing) <sup>(1)</sup>	meters	0.005		
	Horizontal position accuracy (RTK), RMS	meters	0.01 + 1 ppm CEP		
	Vertical position accuracy (SP), RMS	meters	<2		
	Vertical position accuracy (RTK), RMS	meters	0.02 + 1 ppm CEP		
	Position Accuracy (Free Inertial Land Vehicle) <sup>(2)</sup>	% , DT	1 (Tunnel Guide positional aiding references)		
Velocity accuracy, RMS	meters/sec	0.05			
PPS timestamps accuracy	nano sec	20			
<b>Dual antenna GNSS Heading</b>		<b>Units</b>	<b>INS-DU</b>		
<b>Orientation</b>	Range	deg	0 to 360		
	Static / Dynamic Accuracy (INS-DU with NovAtel OEM7720 or Septentrio mosaik-H receiver) <sup>(3)(6)</sup>	deg RMS	0.08 (2m baseline); 0.15 (1m baseline)		
	Static / Dynamic Accuracy (INS-DU with u-blox ZD9P receiver) <sup>(3)(6)</sup>	deg RMS	0.2 (2m baseline); 0.4 (1m baseline)		
	Post processing accuracy (INS-DU with NovAtel OEM7720 or Septentrio mosaik-H receiver) <sup>(1)</sup>	deg RMS	0.05		
	Post processing accuracy (INS-DU with u-blox ZD9P receiver) <sup>(1)</sup>	deg RMS	0.1		
	<b>Pitch and Roll</b>		<b>Units</b>	<b>INS-DU</b>	
	Range: Pitch, Roll	deg	±90, ±180		
Angular Resolution	deg	0.01			
Static Accuracy in whole Temperature Range	deg	0.08			
Dynamic Accuracy <sup>(6)</sup>	deg RMS	0.05			
Post processing accuracy <sup>(1)</sup>	deg RMS	0.03			
<b>Gyroscopes</b>		<b>Units</b>	<b>INS-DU</b>		
<b>IMU</b>	Type		Industrial-grade		
	Measurement range	deg/sec	±2000		
	Bias in-run stability (RMS, Allan Variance)	deg/hr	2		
	Bias instability after INS initialization (RMS)	deg/hr	10		
	Bias instability over temperature range (RMS)	deg/hr	72		
	Angular Random Walk	deg/√hr	0.38		
	<b>Accelerometers</b>		<b>Units</b>	<b>INS-DU</b>	
Type		Tactical-grade			
Measurement range	g	±8 g	±15 g	±40 g	
Bias in-run stability (RMS, Allan Variance)	mg	0.01	0.03	0.05	
Bias instability over temperature range (RMS)	mg	0.7	1.1	1.5	
Bias one-year repeatability	mg	1.5	2	2.5	
Velocity Random Walk	m/s/√hr	0.02	0.045	0.06	
<b>Magnetometers</b>		<b>Units</b>	<b>INS-DU</b>		
Measurement Rate	Gauss	±8.0			
Bias in-run stability (Allan Variance)	μGauss	8			
Power Spectral Density	μGauss/√Hz	15			
SF Accuracy	%	0.05			
<b>Pressure</b>		<b>Units</b>	<b>INS-DU</b>		
Measurement Rate	hPa	300 – 1100			
Bias in-run stability (RMS, Allan Variance)	Pa	2			
Noise Density	Pa/√Hz	0.8			
<b>Environment</b>		<b>Units</b>	<b>INS-DU</b>		
<b>Electrical and Physical</b>	Operating temperature	deg C	-40 to +85		
	Storage temperature	deg C	-50 to +90		
	Type of Sealing		IP-67		
	MTBF	hours	55,500		
	<b>Electrical</b>		<b>Units</b>	<b>INS-DU</b>	
	Supply voltage	V DC	9 - 34		
	Power consumption	Watts	5 (6 with data logger)		
	Output Interface (options)	-	RS-232 or RS-422, CAN, Ethernet (optional)		
	Output data format	-	Binary, NMEA 0183 ASCII		
	<b>Physical</b>		<b>Units</b>	<b>INS-DU</b>	
Size <sup>(9)</sup>	mm	120 x 50 x 53			
Weight <sup>(9)</sup>	gram	320			

<sup>(1)</sup> RMS, incremental error growth from steady state accuracy. Post-processing results using third party software; <sup>(2)</sup> Under ideal conditions that include proper static alignment and in-field dynamic motions during loss of GNSS signal; <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; <sup>(8)</sup> If tracking GPS only; <sup>(9)</sup> Weight and size are PN dependent. Customers should obtain the most recent 2D/3D files before designing any interface hardware;

<b>Specifications</b>	Receiver Options Available	Units	NovAtel OEM7720	Septentrio mosaik-H	u-blox ZED-F9P
	Available For	-	INS-DU (optional)	INS-DU (optional)	INS-DU (default)
	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; 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, 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; PPP TerraStar	WAAS; EGNOS; MSAS; GAGAN; SBAS L1, L5; DGPS; RTK	WAAS; EGNOS; MSAS; GAGAN; SBAS L1C/A; DGPS; RTK
	Channel Configuration <sup>(1)</sup>	-	555	448	184
	GNSS Data Rate <sup>(1)</sup>	Hz	5 / 20 / 100	100 (max)	10, 20 <sup>(2)</sup>
	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) <sup>(3)</sup>	Nano sec	20	20	30

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



**Product Code Structure:**

Model	Gyroscope	Accel	Calibration	Connector	Encoder	Color	Datalogger	GNSS receiver	Version	Interface
INS-DU	G450	A8	TMGA	C3	E (option)	B (default)	S64 (option)	ZD9P (default)	VD4	1
	G950	A15	TGA	C36		D		O7720 (option)	VD42	2
	G2000	A40				G		DMH (option)	VD43	4
						W			VD44	5
									VD49	11
									VD9	22
									VD91	245
										135
										235
										1245

Example: INS-DU-G450-A15-TMGA-C3E-B-ZD9P-VD9.1

**Product code details:**

- INS-DU: Low cost GPS-aided inertial navigation system utilizing miniAHRS
- G450: Gyroscopes measurement range =  $\pm 450$  deg/sec
- G950: Gyroscopes measurement range =  $\pm 950$  deg/sec
- G2000: Gyroscopes measurement range =  $\pm 2000$  deg/sec
- A8: Accelerometers measurement range =  $\pm 8$  g  $\rightarrow$  recommended for applications with low level of operational vibrations
- A15: Accelerometers measurement range  $\pm 15$  g  $\rightarrow$  recommended for applications with medium level of operational vibrations
- A40: Accelerometers measurement range  $\pm 40$  g  $\rightarrow$  recommended for high dynamic applications or/and with high level of vibration
- TMGA: Magnetometers, Gyroscopes and Accelerometers (miniAHRS)
- TGA: Gyroscopes and Accelerometers (KERNEL-100 IMU)
- C3: 24 pins connector (RS-232, RS-422, CAN, Ethernet interfaces)
- C36: 24 pins connector (RS-232, RS-422, CAN, Ethernet interfaces), Trigger (Event) pin #4 of the INS for entering the FW update mode
- E: Encoder support
- B: Black Color (default)
- D: Desert Color (Desert tan, color code 33446 (tan 686A) per FED-STD-595, Change Notice 1.)
- G: Green
- W: White
- S64: 64GB embedded Data Logger (optional)
- ZD9P: Dual ZED-F9P, Dual-Frequency, Multi-Constellation, RTK Capable GNSS Receiver (default)
- O7720: Dual antenna NovAtel OEM7720 GNSS receiver
- DMH: Dual antenna Septentrio mosaic-H 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 antenna 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 E1/E5, 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, GLO L1/L2, BDS B1/B2, GAL E1/E5, QZSS L1/L5, SBAS, RTK, GNSS measurements, GNSS positions (Dual Antenna GNSS Receiver only)
- VD91: GPS L1/L2, GLONASS L1/L2, GALILEO E1/E5b, BEIDOU B1/B2/B3, QZSS L1/L5, SBAS, RTK, dual antenna heading, GNSS measurements, GNSS positions (Septentrio mosaic-H Dual Antenna Receiver only)
- .1: RS-232 interface
- .2: RS-422 interface
- .3: RS-485 interface (to be used when connecting to a Stand-alone Magnetic Compass)
- .4: CAN interface
- .5: Ethernet interface
- .11: two RS-232 interfaces
- .22: two RS-422 interfaces
- .245: RS-422, CAN and Ethernet interfaces (without Encoder support)
- .135: RS-232, RS-485 (to be used when connecting to a Stand-alone Magnetic Compass), and Ethernet interfaces (user will not be able to communicate with the receiver) - OBSOLETE
- .235: RS-422 (RS-485 interface (to be used when connecting to a Stand-alone Magnetic Compass) and Ethernet interfaces (user will not be able to communicate with the receiver) - OBSOLETE
- .1245: RS-232, RS-422, CAN and Ethernet interfaces