



SENSORSAN

Sensing Technologies

SENS-INS SERIES

DATASHEET

The SENSORSAN Single and Dual Antenna GPS-Aided Inertial Navigation System (INS), SENS-INS, determines velocity, position and absolute orientation (Heading, Pitch, Roll) of the device it is mounted. It is a fully-integrated solution of GPS, GLONASS, QZSS ,GALILEO, BEIDOU and L-Band navigation system. For both static and dynamic applications, high-accuracy measurements are achieved in determining horizontal and vertical position, velocity, and orientation.

The Sensorsan SENS-INS consists of single and dual antenna GNSS receiver, barometers, three-axes temperature calibrated fluxgate magnetometers, accelerometers and gyroscopes. It provides Position, Velocity, Heading, Pitch and Roll measurements of the unit. The INS is designed with SOTA navigation & guidance and sensor fusion algorithms along with its calibration software.

The primary applications that SENS-INS is designed for are listed below:



Figure 1: Land Vehicles Navigation Systems



Figure 2: Autonomous Vehicles



Figure 3: Unmanned Aerial Vehicle (UAV)



Figure 4: Precision Agriculture

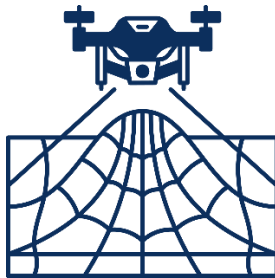


Figure 5: Remote Sensing (Mapping)

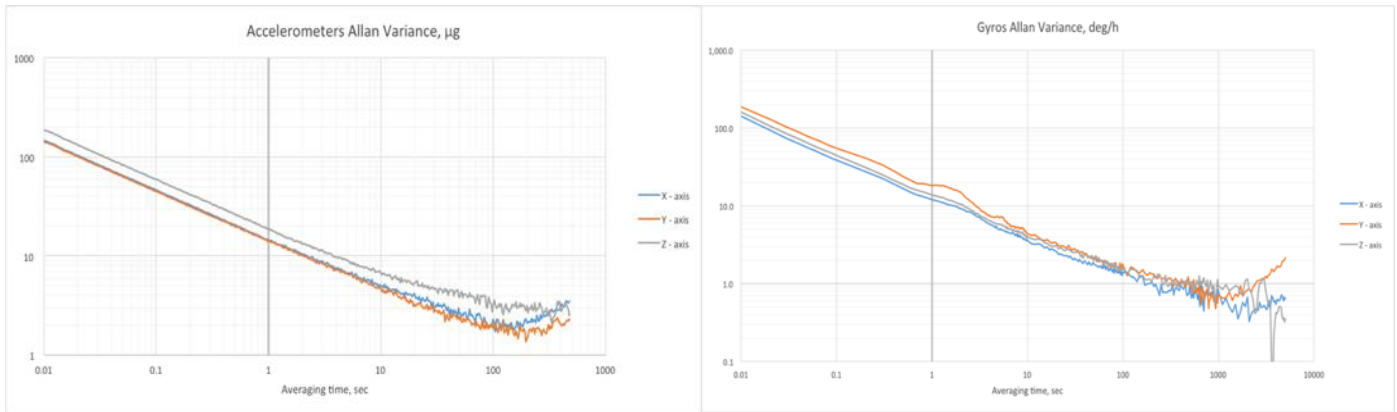


Figure 6: Aerospace

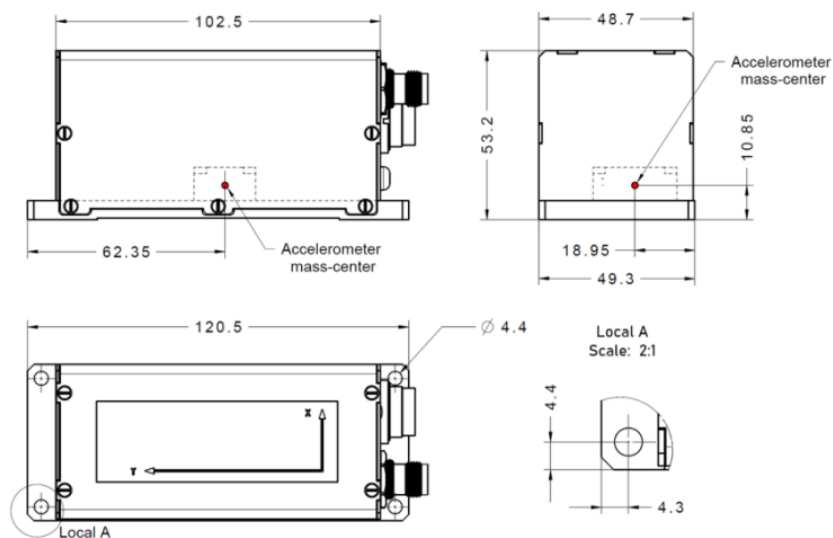
Parameter	Units	SENS-INS-S	SENS-INS-D
Output signals		Positions, Heading, Pitch, Roll, Velocity, Accelerations, Angular rates, Barometer, PPS Direct AT_ITINS message with Position, Heading, Pitch & Roll to COBHAM AVIATOR UAV 200	
		Direct Navigation Support for Pixhawk Flight Controllers as NMEA messages	
Input signals		Marine application: DVL (Doppler Velocity Log)	
		Land application: Odometer, Wheel sensor, Encoder, DMI	
Main features		Aerial application: Wind sensor, Air Speed Sensor, Doppler shift from locator (for long-term GPS denied) All: External Stand-Alone Magnetic Compass (SAMC/AHRS)	
		High performance in long-term GPS-Denied environment	
Compatible with		Pixhawk Autopilot; Embention Autopilot; COBHAM AVIATOR UAV 200	
Data rate	Hz	Up to 200 (INS data); Up to 2000 (IMU data)	
Internal data logger (storage) - optional		64 GB	
Start-up time	s	<1	
Positions and Velocity	Units	SENS-INS-S	SENS-INS-D
Horizontal position accuracy (Gps L1)	mt, RMS	1.5	
Vertical position accuracy (GPS L1)	mt, RMS	<1	
Horizontal position accuracy (GPS L1/L2)	mt, RMS	1.2	
Horizontal position accuracy (SBAS)	mt, RMS	0.6	
Horizontal position accuracy (DGPS)	mt, RMS	0.4	
Horizontal position accuracy (Terrastar-L)	mt, RMS	0.4	
Horizontal position accuracy (Terrastar-C Pro)	mt, RMS	0.025	
Horizontal position accuracy (Terrastar-X)	mt, RMS	0.02	
Horizontal position accuracy (post-processing)	mt, RMS	0.005	
Horizontal position accuracy (RTK)	mt, RMS	0.01	
Vertical position accuracy (RTK)	mt, RMS	0.02	
Position accuracy (free inertial, land vehicles)	%, DT	0.2% DT (using Tunnel Guide positional aiding references)	
Velocity accuracy, RMS	m/s RMS	0.03	
Heading	Units	SENS-INS-S	SENS-INS-D
Range	deg	0 to 360	
Static accuracy	deg RMS	0.3	
Dynamic accuracy (GNSS)	deg RMS	0.1	
Post processing accuracy	deg RMS	0.03	
Pitch and Roll	Units	SENS-INS-S	SENS-INS-D
Range: pitch, roll	deg	±90, ±180	
Angular resolution	deg	0.01	
Static accuracy in whole temperature range	deg RMS	0.05	
Dynamic accuracy	deg RMS	0.03	
Post processing accuracy	deg RMS	0.006	
Gyroscopes	Units	SENS-INS-S	SENS-INS-D
Type		T-grade	
Measurement range	deg/sec	±450 / ±950	
Bias instability (RMS, Allan Variance)	deg/hr	1	
Bias error over temperature range (RMS)	deg/hr	<30	
Angular random walk	deg/Vhr	<0.2 (0.08 optional)	
Accelerometers	Units	SENS-INS-S	SENS-INS-D
Type		T-grade	
Measurement range	g	±8 g / ±15 g / ±40 g	
Bias instability (RMS, Allan Variance)	mg	0.005 (±8 g) / 0.02 (±15 g) / 0.03 (±40 g)	
Bias error over temperature range (RMS)	mg	0.5 (±8 g) / 0.7 (±15 g) / 1.2 (±40 g)	
Bias one-year repeatability	mg	1.0 (±8 g) / 1.3 (±15 g) / 1.5 (±40 g)	
Velocity random walk	m/s/Vhr	0.015 (±8 g) / 0.035 (±15 g) / 0.045 (±40 g)	
Magnetometers	Units	SENS-INS-S (Fluxgate)	SENS-INS-D
Measurement range	Gauss	±1.6	
Bias instability, RMS	nT	0.2	
Noise density, PSD	nTVHz	0.3	
Pressure	Units	SENS-INS-S	SENS-INS-D
Measurement range	hPa	300 – 1100	
Bias instability (RMS, Allan Variance)	Pa	2	
Noise density	Pa/VHz	0.8	
Environment	Units	SENS-INS-S	SENS-INS-D
Operating temperature	deg C	-40 to +75	
Storage temperature	deg C	-50 to +85	
Mtbf (gm @ +65degC)	hours	100,000	
Shock and vibration		MIL-STD-810G	
EMC/EMI		MIL-STD-461F	
Electrical	Units	SENS-INS-S	SENS-INS-D
Supply voltage	V DC	9 to 36 (26±10 for MIL-1275 protection)	
Power consumption	Watts	3.5 (4.5 with data logger)	
Output interface (options)	-	RS-232 / RS-422 / CAN / Ethernet / 2 x RS-232 / 2 x RS-422 / RS-232 + CAN + Ethernet / RS-422 + CAN + Ethernet	
Protection (optional)		MIL-STD-1275	
Output data format		Binary, NMEA 0183 ASCII characters	
Physical	Units	SENS-INS-S	SENS-INS-D
Size	mm	120.5 x 53.2 x 49.3	
Weight	gr	280	

Receiver Options Available	Units	NovAtel		u-blox	
Model	-	OEM719	OEM7720	Single ZED-F9P	Dual ZED-F9P
Available for	-	SENS-INS-S	SENS-INS-D	SENS-INS-S	SENS-INS-D
Number of GNSS antennas	-	Single	Dual	Single	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; QZSS L1 C/A, L1C, L2C, L5, L6; NavIC (IRNSS) 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 L1C/A; DGPS; RTK	
Channel configuration	-	555		184	
GNSS data rate	Hz	5 / 20 / 100		10, 20	
RTK corrections	-	RTCM 2, RTCM 3		RTCM 3	
Velocity accuracy	m/s	0.03		0.05	
Initialization time	s	<39 (cold start), <20 (hot start)		<30 (cold start), <10 (hot start)	
Time accuracy (clock drift)	ns	20		30	

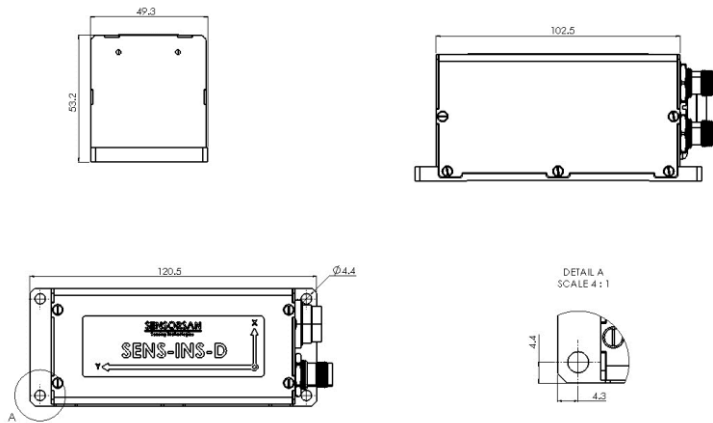
SENS-INS Gyroscopes and Accelerometers Allan Variance Plots



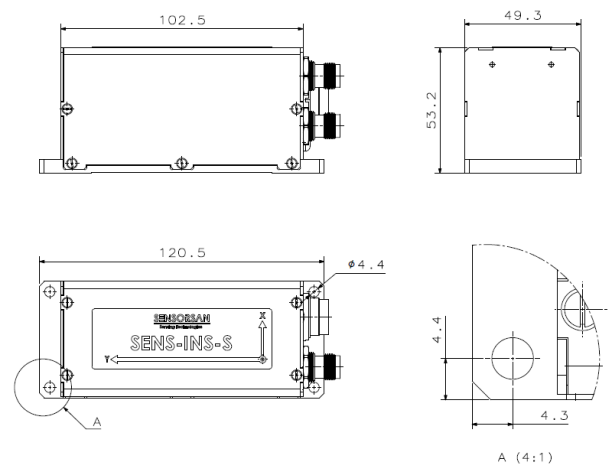
SENS-INS Mechanical Interface



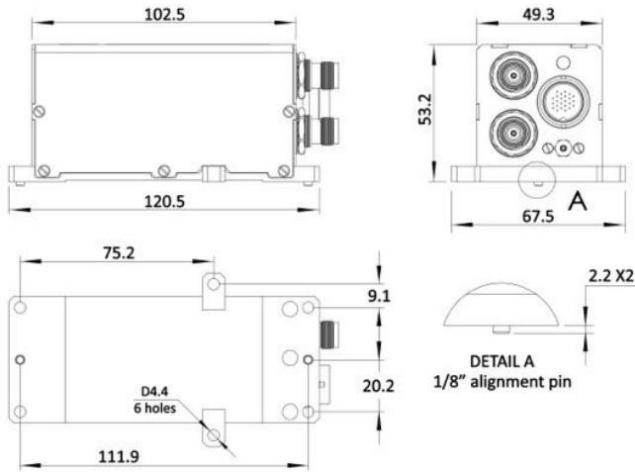
SENS-INS-D Mechanical Interface



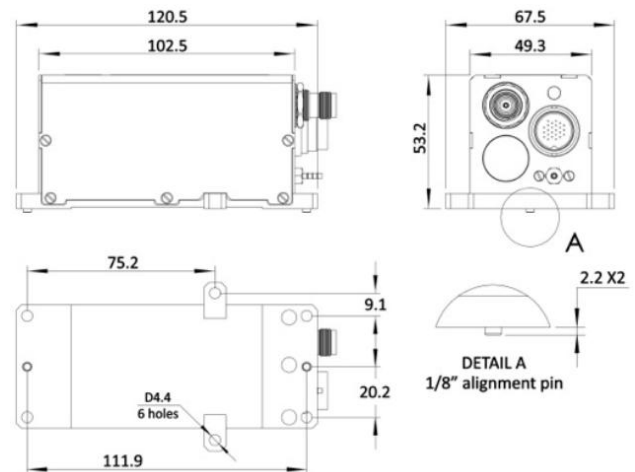
SENS-INS-S Mechanical Interface



SENS-INS-D with Alignment Pins



SENS-INS-S with Alignment Pins



SENS-INS Part Number Description

Model	Gyroscope Dynamic Range	Accelerometer Dynamic Range	Sensor Kit	Encoder Support	Color Of Enclosure	Stand Alone Magnetic Compass	Data Logger	GNSS Receiver	Version	Interface Type
SENS-INS-D-	GR450-	AR8-	GA-	EA-/EN -(option)	B- (default)	SAMC-	S64-	O719-	V1.	11
SENS-INS-S-	GR950-	AR15-	MGA-		D-			O7720-	V2.	15
	GR2000-	AR40-			G-			ZD9P-	V3.	22
					SG-			ZF9P-	V4.	23
									VR43.	245
									VR5.	124
									V8.	1234
									V9.	1245
									VD4.	
									VD42.	
									VD44.	

Example : SENS-INS-S-GR450-AR8-GA-EA-B-SAMC-S64-O719-V1.11

Product Code Details :

- SENS-INS-S: Single Antenna GPS-Aided Inertial Navigation System
- SENS-INS-D: Dual Antenna GPS-Aided Inertial Navigation System
- GR450: Gyroscopes measurement range = ± 450 deg/sec
- GR950: Gyroscopes measurement range = ± 950 deg/sec
- GR2000: Gyroscopes measurement range = ± 2000 deg/sec
- AR8: Accelerometers measurement range = ± 8 g
- AR15: Accelerometers measurement range ± 15 g
- AR40: Accelerometers measurement range ± 40 g
- GA: Gyroscopes and Accelerometers
- MGA: Magnetometers, Gyroscopes and Accelerometers (SENS-INS-S and SENS-INS-D only)
- EA-/EN- : optional 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
- SG – Silver Grey
- SAMC – Support external Stand-Alone Magnetic Compass (optional) (can only be used with VX.1234)
- S64: 64GB embedded Data Logger (optional)
- O719: NovAtel OEM719 Single Antenna GNSS Receiver (SENS-INS-S only)
- O7720: NovAtel OEM7720 Dual Antenna GNSS Receiver (SENS-INS-D only)
- ZD9P: u-blox ZED-F9P Dual Antenna GNSS Receiver (SENS-INS-D only)
- ZF9P: u-blox ZED-F9P Single Antenna GNSS Receiver (SENS-INS-S only)
- V1: GPS L1, SBAS, DGPS, 50 Hz positions (NovAtel Single Antenna GNSS Receiver only)
- V2: GPS L1, GLONASS, SBAS, DGPS, 20 Hz positions (NovAtel Single Antenna GNSS Receiver only)
- V3: GPS L1/L2, SBAS, DGPS, 20 Hz positions (NovAtel Single Antenna GNSS Receiver only)
- V4: GPS L1/L2, GLONASS L1/L2, SBAS, DGPS, 20 Hz positions (NovAtel Single Antenna GNSS Receiver only)
- VR43: GPS L1/L2, GLONASS L1/L2, SBAS, DGPS, 20 Hz positions, 20 Hz measurements (NovAtel Single Antenna GNSS Receiver only)

- VR5: GPS L1/L2, GLONASS L1/L2, SBAS, DGPS, RTK, 20 Hz positions, 20 Hz measurements (NovAtel Single Antenna GNSS Receiver only)
- V8: GPS L1/L2/L5; GLONASS L1/L2; BeiDou B1/B2/B3; GALILEO E1/E5; SBAS; DGPS; 20 Hz measurements; 20 Hz positions RTK (NovAtel Single Antenna GNSS Receiver only)
- V9: GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2, GALILEO E1/E5, QZSS L1/L5, DGPS, RTK, GNSS measurements, GNSS positions (Single Antenna GNSS Receiver only)
- 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)
- VD44: GPS L1/L2, GLONASS L1/L2, GALILEO E1/E5, Dual Antenna Heading, SBAS, DGPS, 20 Hz positions (NovAtel Dual Antenna GNSS Receiver only)
- Vx.11: two RS-232 interfaces
- Vx.15: RS-232 and Ethernet interfaces
- Vx.22: two RS-422 interfaces
- Vx.23: RS-422, RS-485 (to be used when connecting to a Stand-alone Magnetic Compass)
- Vx.245: RS-422, CAN and Ethernet interfaces (w/o Encoder support)
- Vx.124: RS-232, RS-422 and CAN interface.
- Vx.1234: RS-232, RS-422, RS-485 (to be used when connecting to a Stand-alone Magnetic Compass), and CAN interface.
- Vx.1245: RS-232, RS-422, CAN and Ethernet interface.