

# WAVE Sensors

WS-E  
WS-PD

- 0.5 cm Wave Height Accuracy
- 0.1 sec Wave Period Accuracy
- 0.05° Wave Direction Accuracy
- 0.02° Pitch & Roll accuracy
- 5 cm / 5% Heave accuracy
- IP67 or Subsea Enclosure
- Optional Internal Data Logger
- Compatible with Buoy's Controllers



WS - Enhanced  
WS - Professional Dual

Datasheet  
Revision 1.11



 **Inertial Labs**  
Attitude is Everything

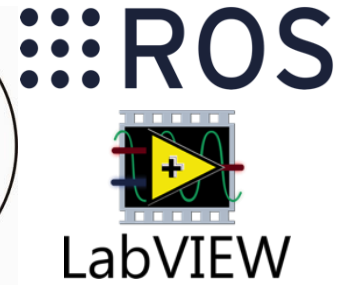
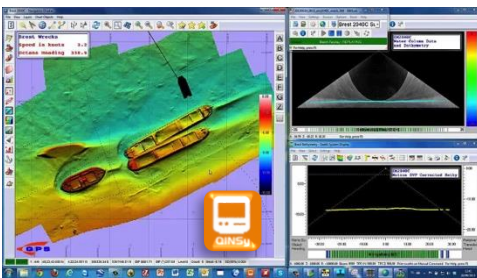
Inertial Labs has developed **Wave Sensors (WS)** to meet industry wave statistics requirements and also generates the spectral data as a complete set of Fourier coefficients and energies. **Wave Sensors (WS)** are an enhanced, high-performance strapdown Wave, Direction & Motion Sensors, that determines Significant Wave Height, Max Wave Height, Wave Period, Wave Direction, Wave Energy, Directional Width, Fourier Coefficients, Mean Spread Angle, Heading, Pitch, Angular Rates, Accelerations, Magnetometer Data, Temperature, Heave, Heave Velocity and Position for any device on which it is mounted.



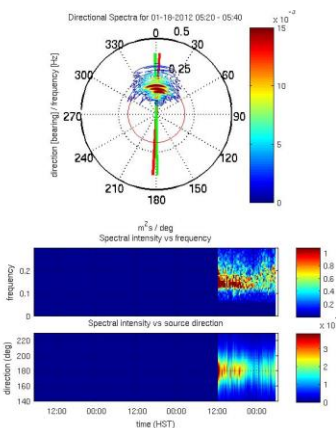
The Inertial Labs **Wave Sensors (WS)** Units utilizes solid state 3-axes each of precision accelerometers, magnetometers, gyroscopes and barometric sensors to provide accurate Wave Characteristics as well as Heave, Sway, Surge, Pitch and Roll of the device under measure.

The **Wave Sensors (WS)** can easily be integrated with a buoy or floating platform controller to transmit data in real time.

Through a combination of proven sector expertise and a continued investment in technological innovation, Inertial Labs delivers the optimum balance of price and performance ratio solutions for its customers.



Our **Wave Sensors** featuring developed few micro g Bias in-run stability Advanced Micro Electro Mechanical System (AMEMS)-based accelerometers. New generation of Inertial Labs 1 deg/hr Bias in-run stability MEMS-based gyroscopes are an ideal solution for demanding marine applications, with their electronic nature negating the problems associated with expensive mechanical gyro solutions, as well as those based on fiber optic (FOG) technology. Inertial Labs MEMS gyroscopes set the standard for the industry, with our high-end **Wave Sensors** featuring gyros that enable sector-leading accuracy and reliability standards.



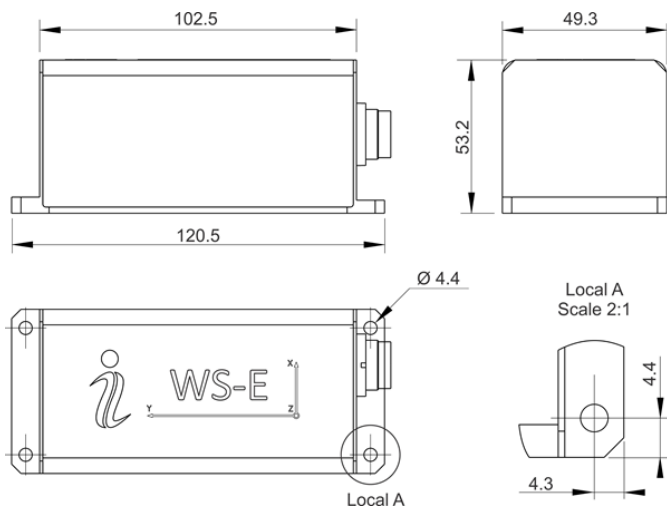
Measured Parameters	WS-E	WS-PD
	Enhanced	Professional Dual
Wave Height (meters)	✓	✓
Wave Period (sec)	✓	✓
Wave Direction (deg)	✓	✓
Heave, Surge, Sway (% / meters)	✓	✓
Pitch & Roll (deg)	✓	✓
Gyro-magnetic Heading (deg)	✓	✓
High Precision GNSS Heading (HDT) (deg)	✓	✓
DGPS/RTK Position (meters)	✓	✓

**Specifications**

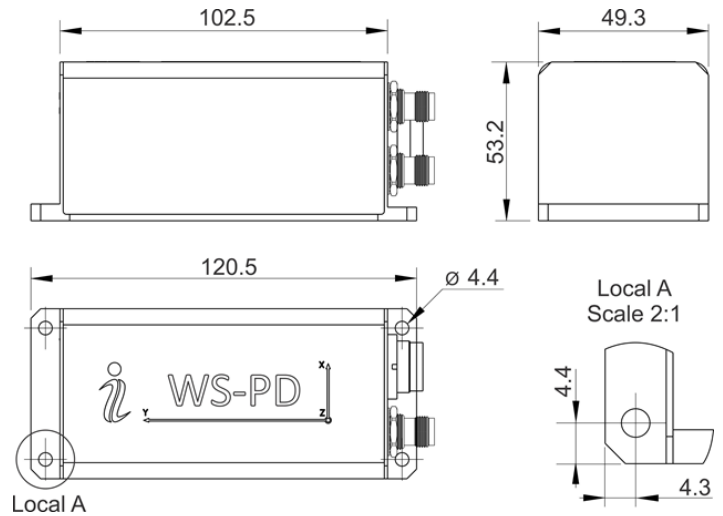
Parameter	Units	WS-E (Enhanced)	WS-PD (Professional Dual)
Certification	-	ABS	
Basic Output Signals	-	<ul style="list-style-type: none"> <li>• Significant Wave Height; Max Wave Height; Wave Period; Wave Direction; Wave Energy; Fourier Coefficient; Directional Width; Mean Spread Angle; Heading; Pitch; Angular Rates (X,Y,Z), Accelerations (X,Y,Z); Magnetometer Data; Temperature; Heave; Heave Velocity</li> </ul>	
Input Signals	-	<ul style="list-style-type: none"> <li>• Doppler Velocity Log; Gyro Compass; External Heading; External Position; External GNSS</li> </ul>	
Output Data Formats	-	<ul style="list-style-type: none"> <li>• Binary; TSS-1, NMEA 0183 ASCII; Kongsberg /Seatex; SMC; Teledyne TSS*</li> </ul>	
Compatibility	-	<ul style="list-style-type: none"> <li>• Buoy; SBES/MBES; Doppler Velocity Logger (DVL); Helideck Monitoring System (HMS)</li> <li>• HYPACK; QINSY; Novatel Inertial Explorer software*</li> <li>• DP-1; DP-2; DP-3; AHC; Survey systems</li> </ul>	
Internal Data Logger	-	Optional (64 GB)	Optional (64 GB)
Update Rate	Hz	1-200 (User Settable)	1-200 (User Settable)
IP Grade	-	IP67	IP67
<b>Wave Period</b>			
Range	seconds	1 to 30	1 to 30
Resolution	seconds	0.001	0.001
Accuracy	% (seconds)	1 (0.1)	1 (0.1)
Wave Mean Period	seconds	Yes	Yes
Wave Peak Period	seconds	Yes	Yes
<b>Wave Height</b>			
Range	meters	±300	±300
Resolution	meters	0.001	0.001
Accuracy	meters	0.05	0.05
<b>Wave Direction</b>			
Range	deg	0 to 360	0 to 360
Resolution	deg	0.01	0.001
Accuracy	deg	0.5	0.08 (2 meters baseline)
Wave Mean Direction	deg	Yes	Yes
Wave Peak Direction	deg	Yes	Yes
<b>Wave Characteristics</b>			
	-	Fourier Coefficient Spectrum; Mean Spreading Angle; Directional Width; Long Crestedness Parameter; Mean Wave Direction Spectrum; Principal Wave Direction Spectrum; Average Wave Power; Number of Zero Crossings	
<b>Pitch and Roll</b>			
Range	deg	±90, ±180	±90, ±180
Angular Resolution	deg	0.01	0.005
Accuracy	deg	0.02	0.02
<b>Heading</b>			
Range	deg	0 to 360	0 to 360
Angular Resolution	deg	0.01	0.001
Accuracy	deg	0.6	0.08 (2 meters baseline)
<b>Heave, Surge and Sway</b>			
Measurement Range	meters	±300	±300
Resolution	meters	0.01	0.01
Real Time Accuracy, RMS	% / (meters)	5 / (0.05)	5 (0.05)
<b>Positions and Velocity</b>			
Horizontal position accuracy (DGPS), RMS	meters	External Source	0.4
Horizontal position accuracy (RTK), RMS	meters	External Source	0.01 + 1 ppm
Horizontal position accuracy (Oceanix Nearshore), RMS <sup>(1)</sup>	meters	External Source	0.03
Horizontal position accuracy (VERIPOS), RMS <sup>(1)</sup>	meters	External Source	1-0.05
Velocity Accuracy, RMS	meters/sec	External Source	0.03
<b>GNSS Receiver</b>			
Number of GNSS Antennas	-	External Source	Dual
Supported navigation signal	-	External Source	GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2, GALILEO E1/ES, QZSS L1/L5, SBAS, DGPS, RTK
Velocity accuracy, RMS	meters/sec	External Source	<0.03
Initialization time	seconds	External Source	<50 (cold start), <30 (hot start)
<b>Environment</b>			
Operating temperature	deg C	-40 to +70	-40 to +70
Storage temperature	deg C	-50 to +85	-50 to +85
MTBF	hours	250,000	250,000
Vibration	-	IEC 60945/EN 60945	IEC 60945/EN 60945
<b>Electrical</b>			
Supply voltage	V DC	9 to 36	9 to 36
Power consumption	Watts	1.4 (2.4 with data logger)	2.6 (3.6 with data logger)
Compliance to EMC/EMI, immunity/emission	-	IEC 60945/EN 60945	IEC 60945/EN 60945
Output Data Formats	-	Binary; TSS-1; NMEA 0183 ASCII; Kongsberg/Seatex; SMC; Teledyne TSS*	
Interface	-	RS-232; RS-422; Ethernet	RS-232; RS-422; Ethernet
<b>Physical</b>			
Size	mm	IP-67 120 x 50 x 53	Subsea 245 x 140 x 115
Weight	kg	0.320	6.5

\* **Trademark Legal Notice:** All product names, logos, and brands are property of their respective owners. All company, product and service names used in this document are for identification purposes only. Use of these names, logos, and brands does not imply endorsement. Kongsberg/Seatex, Ship Motion Control SMC, Teledyne TSS, R2Sonic, WAASP, EdgeTech, NORBIT, IMAGENEX, HYPACK, QINSY, Novatel Inertial Explorer are trademarks of Kongsberg/Seatex, Ship Motion Control SMC, Teledyne TSS, R2Sonic, WAASP, EdgeTech, NORBIT, IMAGENEX, HYPACK, QINSY, Novatel its affiliates or its respective owners, registered or used in many jurisdictions worldwide.

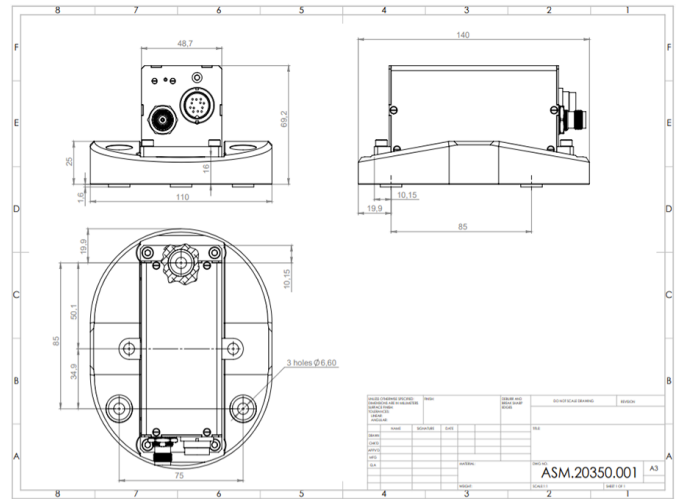
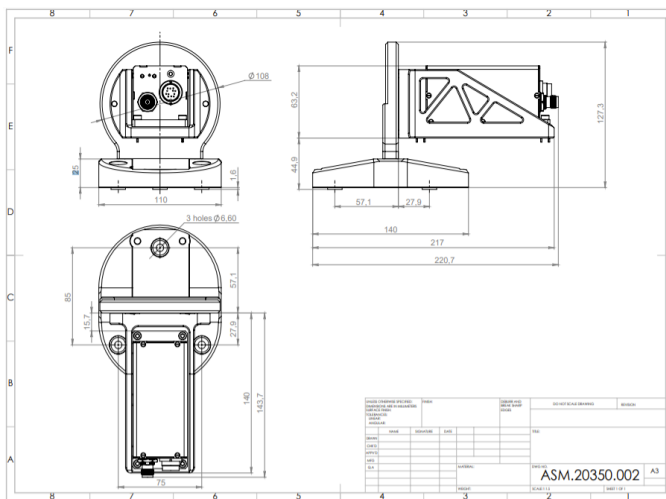
**Wave Sensor (WS-E) Mechanical Interface Drawings**



**Wave Sensor (WS-PD) Mechanical Interface Drawings**



Inertial Labs IP67 sealed Wave Sensors (WS-E, WS-PD) can be easily integrated into existing systems using the following bracket.

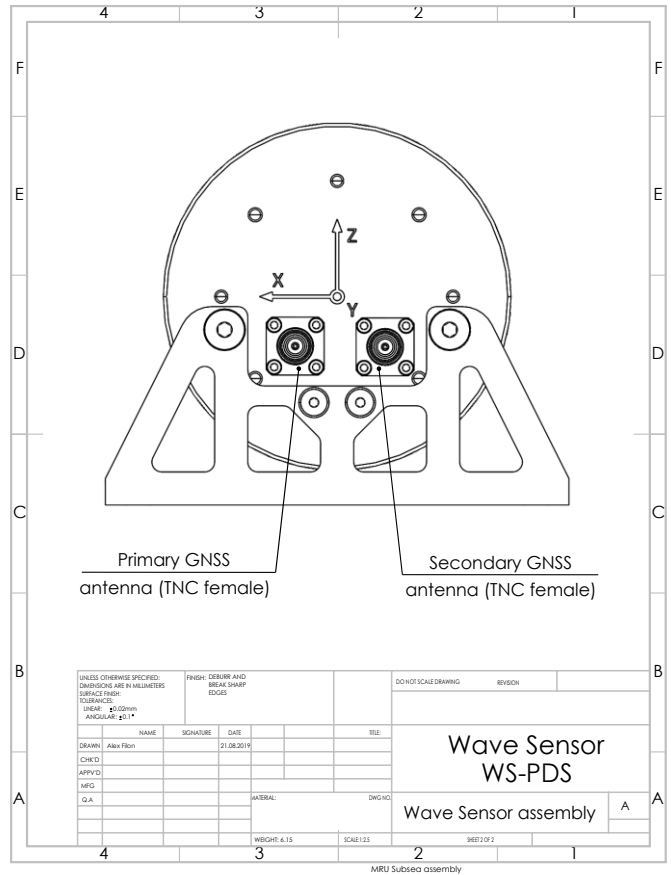
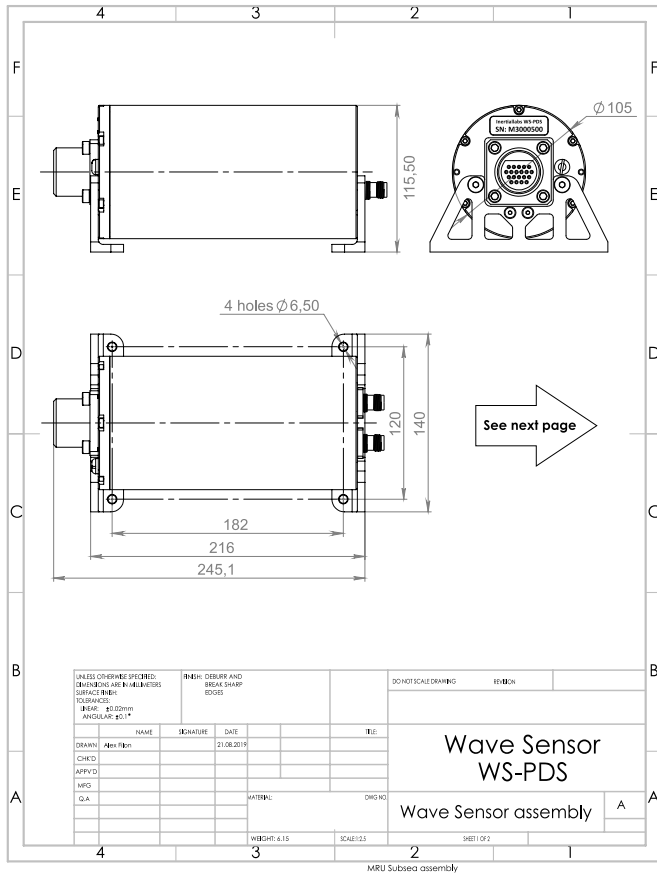


**Notes:**

1. All dimensions are in millimeters.
2. All dimensions within this drawing are subject to change without notice. Customers should obtain final drawings before designing any interface hardware.
3. Data connector type: Binder Series 723. Male receptacle, shielded, rear-mounting.
4. GNSS connector type (WS-PD): TNC-Female.

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**WS-PDS mechanical interface drawing (Subsea enclosure)**



**WS-E Product Code Structure (IP-67)**

Model	Gyro	Accel	Calibration	Connector	Color	Storage	Version	Interface
WS-E	G450	A8	TMGA	C3	B	S64	V0	1245

**WS-PD Product Code Structure (IP-67)**

Model	Gyro	Accel	Calibration	Connector	Color	Storage	GNSS Receiver	Version	Interface
WS-PD	G450	A8	TGA TMGA (optional)	C3	B	S64 (optional)	O7720	VD4 VD42 VD43 VD49 VD9	1245

**WS-PDS Product Code Structure (Subsea)**

Model	Gyro	Accel	Calibration	Connector	Color	Storage	GNSS Receiver	Version	Interface
WS-PDS	G450	A8	TGA	C13	S	S64 (optional)	O7720	VD4 VD42 VD43 VD49 VD9	1245

Example: WS-PD-G450-A8-TGA-C3-B-S64-O7720-VD4.1245

**Product code details:**

- WS-E: Heading, Heave, Surge, Sway, Pitch and Roll + Wave Direction, Fourier Coefficients, Wave Spectrum (IP-67)
- WS-PD/WS-PDS: Heave, Surge, Sway, Pitch, Roll, Heading, Position, Velocity + Wave Direction, Wave Position, Fourier Coefficients, Wave Spectrum
- G450: Gyroscopes measurement range =  $\pm 450$  deg/sec
- A8: Accelerometers measurement range =  $\pm 8$  g
- TGA: Gyroscopes and Accelerometers
- TMGA: Magnetometers (optional), Gyroscopes and Accelerometers
- C3: 24 pins connector (IP67)
- C13: 20 pins connector (subsea)
- B: Black color of enclosure (IP67)
- S: Silver color of enclosure (Subsea)
- S64: 64GB of internal storage (optional)
- WS-PD/WS-PDS-----
- OEM7720: Novatel OEM O7720: Dual Antenna GNSS receiver
- VD4: GPS L1/L2, SBAS, Dual antenna Heading, DGPS, (40 cm position accuracy)
- VD42: GPS L1/L2, GLONASS L1/L2, SBAS, DGPS, Dual antenna Heading RTK (1 cm position accuracy)
- VD43: GPS L1/L2, GLONASS L1/L2, Dual antenna Heading, SBAS, DGPS, 20 Hz positions
- VD49: GPS L1/L2, GLONASS L1/L2, NavIC (IRNSS), Dual antenna Heading, SBAS, DGPS, 20 Hz positions; 20 Hz GNSS measurements
- VD9: GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2, GALILEO E1/E5, QZSS L1/L5, DGPS, RTK, Dual antenna Heading, 20 Hz measurements, 20 Hz positions
- WS-E/WS-PD/WS-PDS-----
- .1245: RS-232, RS-422, CAN, Ethernet