

# Motion Reference Units



- IP-67 sealed
- 5% / 5 cm Heave accuracy
- 0.03 m/sec Velocity accuracy
- 0.03 deg Pitch and Roll accuracy
- 0.005 m/sec<sup>2</sup> Acceleration accuracy
- 0.0002 deg/sec Angular rate accuracy
- NMEA 0183 and TSS1 output data format
- 1 cm RTK horizontal position accuracy



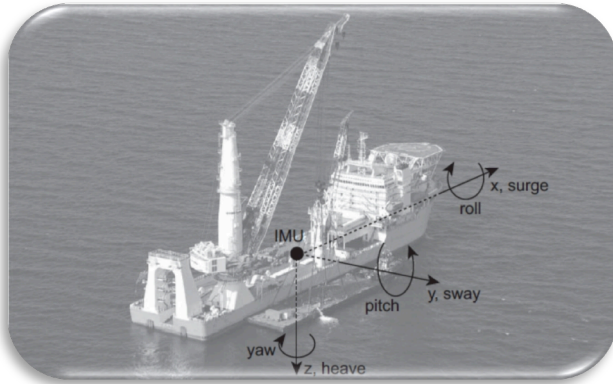
MRU-B (Basic)  
MRU-E (Enhanced)  
MRU-P (Professional)



Datasheet  
Revision 1.5



Inertial Labs has developed **Motion Reference Units (MRU)** to meet requirements from marine and hydrographic applications. **MRU** is enhanced, high-performance strapdown Motion Sensor, that determines Pitch & Roll, Heave, Sway, Surge, Accelerations, Angular rates, Heading, Velocity and Positions for any device on which it is mounted.



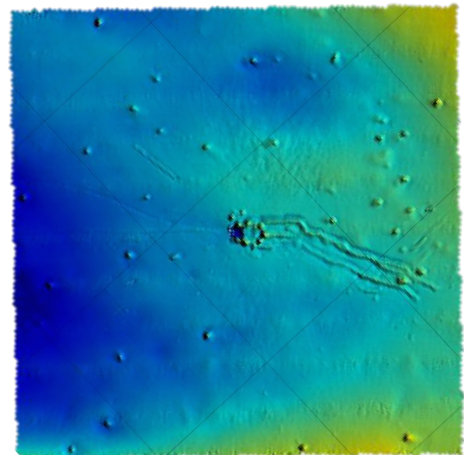
The Inertial Labs **Motion Reference Units** utilizes solid state 3-axes each of precision accelerometers, magnetometers, gyroscopes and barometric sensors to provide accurate Heave, Sway, Surge, Pitch and Roll of the device under measure.

Integration of very low noise gyroscopes output provides high frequency, real-time measurement of the Vessel, Ships, Helidecks, ROV, Marine antennas, Cranes rotation about all three rotational axes.

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.

## KEY FEATURES AND FUNCTIONALITY

- State-of-the-art algorithms for Survey, Vessels, Ships, Active Heave Compensators, Cranes, Helideck, ROV, AUV, DPS, Buoys, Echo Sounders, Offshore Platforms
- 0.03 deg RMS Pitch & Roll dynamic accuracy
- 5% or 5 cm RMS (whichever is greater) Heave accuracy
- 0.005 m/sec<sup>2</sup> linear acceleration accuracy
- NMEA 0183, TSS1 output data formats
- HYPACK software compatibility
- Velocity and Horizontal positions output
- Environmentally sealed (IP67), compact design



Our **MRUs** featuring developed few micro g Bias in-run stability Micro Electro Mechanical System (MEMS)-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 **MRUs** featuring gyros that enable sector-leading accuracy and reliability standards.

| Measured Parameters         | MRU-B *<br>Basic | MRU-E<br>Enhanced | MRU-P<br>Professional |
|-----------------------------|------------------|-------------------|-----------------------|
| Heave, Surge, Sway (% / cm) | +                | +                 | +                     |
| Pitch & Roll (deg)          | +                | +                 | +                     |
| Heading/Yaw (deg)           |                  | +                 | +                     |
| Velocity (meters/sec)       |                  |                   | +                     |
| DGPS/RTK Positions (meters) |                  |                   | +                     |

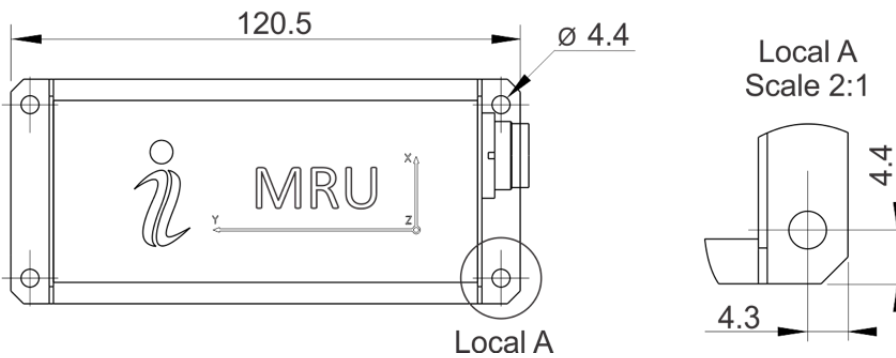
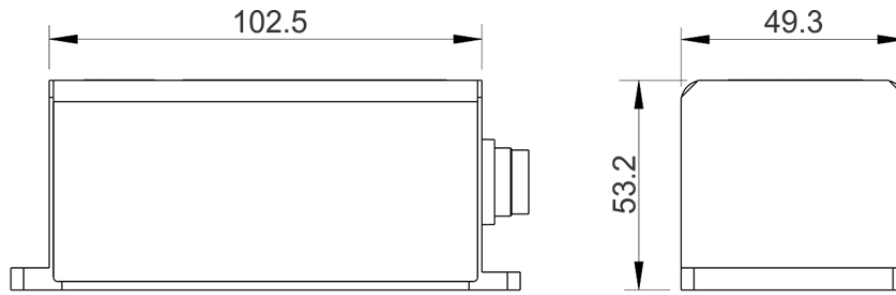
\* MRU-B1 (Heave or Pitch & Roll measurement) and MRU-B2 (Heave, Pitch & Roll measurements) are available

## MRU Specifications

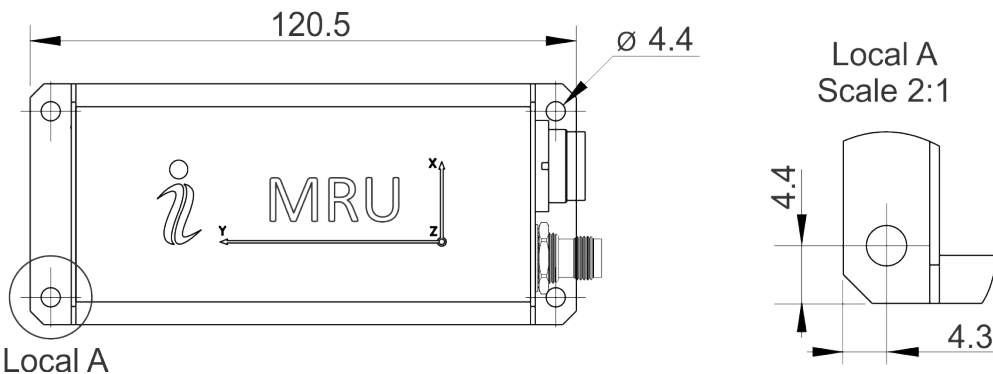
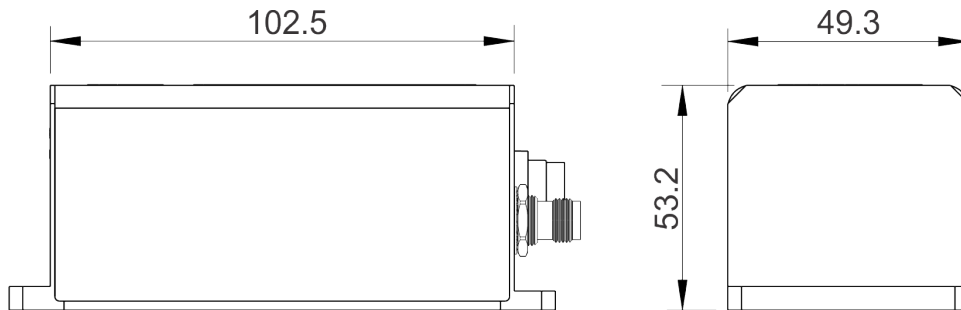
| Parameter   | Units        | MRU-B (Basic)   | MRU-E (Enhanced)                             | MRU-P (Professional)   |
|---|--------------|---|--|--|
| Basic Output signals  |              | Heave, Heave Velocity, Heave Acceleration, Surge, Sway, Pitch & Roll, Pitch & Roll Rate, Pitch & Roll Velocity, Accelerations, Angular rates, Significant Wave Height, Temperature, Barometric data, Pulse Per Second (PPS) |  |  |
| Additional output signals                                     |              |   | Heading/ Yaw                                 | Heading/Yaw<br>GPS/GLONASS/GALIELO/<br>BeiDou/DGPS/RTK Positions<br>Velocity |
| Update rate   | Hz           | 1 ... 200 (user settable)   | 1 ... 200 (user settable)                    | 1 ... 200 (user settable)  |
| Start-up time   | sec          | <1  | <1   | <1   |
| <b>Heave</b>  | <b>Units</b> | <b>MRU-B</b>  | <b>MRU-E</b>                                 | <b>MRU-P</b>   |
| Measurement range   | meters       | ±300  | ±300   | ±300   |
| Resolution  | meters       | 0.01  | 0.01   | 0.01   |
| Accuracy, RMS   | % (meters)   | 5 (0.05)  | 5 (0.05)                                     | 5 (0.05)   |
| <b>Pitch and Roll</b>   | <b>Units</b> | <b>MRU-B</b>  | <b>MRU-E</b>                                 | <b>MRU-P</b>   |
| Range: Pitch, Roll  | deg          | ±90, ±180   | ±90, ±180                                    | ±90, ±180  |
| Angular Resolution  | deg          | 0.01  | 0.01   | 0.01   |
| Static Accuracy in whole Temperature Range                    | deg          | 0.02  | 0.02   | 0.02   |
| Dynamic Accuracy  | deg RMS      | 0.03  | 0.03   | 0.03   |
| <b>Heading</b>  | <b>Units</b> | <b>MRU-B</b>  | <b>MRU-E</b>                                 | <b>MRU-P</b>   |
| Range   | deg          | -   | 0 to 360                                     | 0 to 360   |
| Angular Resolution  | deg          | -   | 0.01   | 0.01   |
| Static Accuracy in whole Temperature Range                    | deg          | -   | 0.3  | 0.2  |
| Dynamic Accuracy  | deg RMS      | -   | 0.6  | 0.4  |
| Post processing accuracy <sup>(1)</sup>                       | deg RMS      | -   | 0.1  | 0.1  |
| <b>Positions, Velocity and Timestamps</b>                     | <b>Units</b> | <b>MRU-B</b>  | <b>MRU-E</b>                                 | <b>MRU-P</b>   |
| Horizontal position accuracy (GPS L1), RMS                    | meters       | -   | -  | 1.5  |
| Horizontal position accuracy (SBAS), RMS                      | meters       | -   | -  | 0.6  |
| Horizontal position accuracy (DGPS), RMS                      | meters       | -   | -  | 0.4  |
| Horizontal position accuracy (RTK), RMS                       | meters       | -   | -  | 0.01 + 1 ppm   |
| Horizontal position accuracy (post processing) <sup>(1)</sup> | meters       | -   | -  | 0.005  |
| Velocity accuracy, RMS  | meters/sec   | -   | -  | 0.03   |
| GNSS raw data rate  | Hz           | -   | -  | 20   |
| Timestamps accuracy   | nano seconds | 20  | 20   | 20   |
| <b>Gyroscopes</b>   | <b>Units</b> | <b>MRU-B</b>  | <b>MRU-E</b>                                 | <b>MRU-P</b>   |
| Measurement range   | deg/sec      | ±450  | ±450   | ±450   |
| Bias in-run stability (RMS, Allan Variance)                   | deg/hr       | 1   | 1  | 1  |
| Noise density   | deg/sec/√Hz  | 0.004   | 0.004  | 0.004  |
| <b>Accelerometers</b>   | <b>Units</b> | <b>MRU-B</b>  | <b>MRU-E</b>                                 | <b>MRU-P</b>   |
| Measurement range   | g            | ±8  | ±8   | ±8   |
| Bias in-run stability (RMS, Allan Variance)                   | mg           | 0.005   | 0.005  | 0.005  |
| Noise density   | mq/√Hz       | 0.025   | 0.025  | 0.025  |
| <b>Magnetometers</b>  | <b>Units</b> | <b>MRU-B</b>  | <b>MRU-E</b>                                 | <b>MRU-P</b>   |
| Measurement range   | Gauss        | -   | ±1.6   | ±1.6   |
| Bias in-run stability, RMS                                    | nT           | -   | 0.2  | 0.2  |
| Noise density, PSD  | nT/√Hz       | -   | 0.3  | 0.3  |
| <b>Pressure</b>   | <b>Units</b> | <b>MRU-B</b>  | <b>MRU-E</b>                                 | <b>MRU-P</b>   |
| Measurement range   | hPa          | 300 – 1100  | 300 – 1100                                   | 300 – 1100   |
| Bias in-run stability (RMS, Allan Variance)                   | Pa           | 2   | 2  | 2  |
| Noise density   | Pa/√Hz       | 0.8   | 0.8  | 0.8  |
| <b>Environment</b>  | <b>Units</b> | <b>MRU-B</b>  | <b>MRU-E</b>                                 | <b>MRU-P</b>   |
| Operating temperature   | deg C        | -40 to +70  | -40 to +70                                   | -40 to +70   |
| Storage temperature   | deg C        | -50 to +85  | -50 to +85                                   | -50 to +85   |
| MTBF  | hours        | 55,500  | 55,500                                       | 55,500   |
| Vibration   |              | IEC 60945/EN 60945  | IEC 60945/EN 60945                           | IEC 60945/EN 60945   |
| <b>Electrical</b>   | <b>Units</b> | <b>MRU-B</b>  | <b>MRU-E</b>                                 | <b>MRU-P</b>   |
| Supply voltage  | V DC         | 9 to 36   | 9 to 36                                      | 9 to 36  |
| Power consumption   | Watts        | 1   | 1.4  | 2.6  |
| Output Interface  | -            | Ethernet, RS-232, RS-422  | Ethernet, RS-232, RS-422                     | Ethernet, RS-232, RS-422   |
| Output data format  | -            | Binary, TSS-1, NMEA<br>0183 ASCII characters  | Binary, TSS-1, NMEA<br>0183 ASCII characters | Binary, TSS-1, NMEA 0183<br>ASCII characters                                 |
| Compliance to EMC/immunity/emission                           |              | IEC 60945/EN 60945  | IEC 60945/EN 60945                           | IEC 60945/EN 60945   |
| Connector <sup>(2)</sup>                                      |              | Binder Series 723   | Binder Series 723                            | Binder Series 723 & TNC  |
| <b>Physical</b>   | <b>Units</b> |   |  |  |
| Size  | mm           | 120 x 50 x 53   | 120 x 50 x 53                                | 120 x 50 x 53  |
| Weight  | gram         | 220   | 280  | 320  |
| Enclosure material  |              | Anodized Aluminum   | Anodized Aluminum                            | Anodized Aluminum  |

<sup>(1)</sup> Post-processing results using third party software. <sup>(2)</sup> Cable with pigtail wires or with Souriau 851-36RG 16-26s50 connector are the options

## MRU-B and MRU-E mechanical interface drawing



## MRU-P mechanical interface drawing



### 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 (MRU-P): TNC-Female