Motion Reference Units

MRU

- ABS Certification, affordable price
- IP-67 sealed or Subsea version
- 5% / 5 cm Heave accuracy
- 0.02 deg Pitch and Roll accuracy
- 40 cm DGPS or 1 cm RTK position
- 0.03 m/sec Velocity accuracy
- 0.005 m/sec² Acceleration accuracy
- 0.0002 deg/sec Angular rate accuracy
- NMEA 0183 and TSS1 output data format
- Kongsberg/Seatex, SMC & Teledyne data formats*

Datasheet
Revision 2.0
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**

- Kongsberg/Seatex, Teledyne and SMC data formats
- State-of-the-art algorithms for Survey, Vessels, Ships, Active Heave Compensators, Cranes, Helideck, ROV, AUV, DPS, Buoys, Echo Sounders, Offshore Platforms
- 0.02 deg RMS Pitch & Roll dynamic accuracy
- 5% or 5 cm RMS (whichever is greater) Heave accuracy
- 0.005 m/sec² linear acceleration accuracy
- NMEA 0183, TSS1 output data formats
- HYPACK software compatibility
- Environmentally sealed (IP67) or Subsea Enclosure (200 meters depth)
- Affordable price

Our **MRU**’s 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 **MRU**s featuring gyro that enable sector-leading accuracy and reliability standards.

<table>
<thead>
<tr>
<th>Measured Parameters</th>
<th>MRU-B *</th>
<th>MRU-E</th>
<th>MRU-P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heave, Surge, Sway (% / cm)</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Pitch &amp; Roll (deg)</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heading/Yaw (deg)</td>
<td>+</td>
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<td></td>
</tr>
<tr>
<td>Velocity (meters/sec)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>DGPS/RTK Positions (meters)</td>
<td></td>
<td></td>
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</table>

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>MRU-B (Basic)</th>
<th>MRU-E (Enhanced)</th>
<th>MRU-P (Professional)</th>
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<tbody>
<tr>
<td>Basic Output signals</td>
<td></td>
<td>Heave, Heave Velocity, Heave Acceleration, Surge, Sway, Pitch &amp; Roll, Pitch &amp; Roll Rate, Pitch &amp; Roll Velocity, Accelerations, Angular rates, Significant Wave Height, Temperature, Barometric data, Pulse Per Second (PPS)</td>
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<tr>
<td>Output data formats</td>
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<td>Kongsberg/Seateax, Ship Motion Control SMC, Teledyne TSS*</td>
<td>Heading/Yaw GPS/GLONASS/GALILEO/BeiDou/SBAS/DGPS/RTK Positions, Velocity</td>
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<tr>
<td>Additional output signals</td>
<td></td>
<td></td>
<td>Heading/ Yaw</td>
<td></td>
</tr>
<tr>
<td>Compatibility</td>
<td></td>
<td>SBES/MBES: Teledyne; R2Sonic: WAASP; Kongsberg; EdgeTech; NORBIT; IMAGENEX HYPACK; QINSY and Navitel Inertial Explorer software*</td>
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<tr>
<td>Update rate</td>
<td>Hz</td>
<td>1 ... 200 (user settable)</td>
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<td>1 ... 200 (user settable)</td>
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<td>Start-up time</td>
<td>sec</td>
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<tr>
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<td>±300</td>
<td>±300</td>
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<td>Resolution</td>
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<td>Accuracy, RMS</td>
<td>% (meters)</td>
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<td>5 (0.05)</td>
<td>5 (0.05)</td>
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<td>Pitch and Roll</td>
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<tr>
<td>Range: Pitch, Roll</td>
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<td>+90, +180</td>
<td>+90, +180</td>
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<tr>
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<td>Static Accuracy in whole Temperature Range</td>
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<tr>
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<td>0.1</td>
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<td>Positions, Velocity and Timesteps</td>
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<td>Horizontal position accuracy (SBAS), RMS</td>
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<tr>
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<td>-</td>
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<td>Horizontal position accuracy (RTK), RMS</td>
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<tr>
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<td>Velocity accuracy, RMS</td>
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<td>Gyroscopes</td>
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<td>Measurement range</td>
<td>deg/sec</td>
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<td>±450</td>
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<td>deg/hr</td>
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<tr>
<td>Noise density</td>
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<td>Accelerometers</td>
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<td>Measurement range</td>
<td>g</td>
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<td>±8</td>
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<td>Bias in-run stability (RMS, Allan Variance)</td>
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<td>Noise density</td>
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<td>Bias in-run stability, RMS</td>
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<td>Noise density, PSD</td>
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<td>Bias in-run stability (RMS, Allan Variance)</td>
<td>Pa</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Noise density</td>
<td>Pa/√Hz</td>
<td>0.8</td>
<td>0.8</td>
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<td>Environment</td>
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<tr>
<td>Operating temperature</td>
<td>deg C</td>
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<td>-40 to +70</td>
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<td>Storage temperature</td>
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<td>-50 to +85</td>
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<tr>
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<td>100,000</td>
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<td>IEC 60945/EN 60945</td>
<td>IEC 60945/EN 60945</td>
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<td>Supply voltage</td>
<td>V DC</td>
<td>9 to 36</td>
<td>9 to 36</td>
<td>9 to 36</td>
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<td>Power consumption</td>
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<td>1</td>
<td>1.4</td>
<td>2.6</td>
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<tr>
<td>Output Interface</td>
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<td>Ethernet, RS-232, RS-422</td>
<td>Ethernet, RS-232, RS-422</td>
<td>Ethernet, RS-232, RS-422</td>
</tr>
<tr>
<td>Output data format</td>
<td></td>
<td>Binary, TSS-1, NMEA 0183 ASCII, Kongsberg/Seateax, SMC, Teledyne</td>
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<td></td>
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<tr>
<td>Compliance to EMCD, immunity/emission</td>
<td>IEC 60945/EN 60945</td>
<td>IEC 60945/EN 60945</td>
<td>IEC 60945/EN 60945</td>
<td>IEC 60945/EN 60945</td>
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<tr>
<td>Connector (2)</td>
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<td>Binder Series 723</td>
<td>Binder Series 723</td>
<td>Binder Series 723 &amp; TNC</td>
</tr>
<tr>
<td>Physical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>mm</td>
<td>120 x 50 x 53</td>
<td>120 x 50 x 53</td>
<td>120 x 50 x 53</td>
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<tr>
<td>Weight</td>
<td>gram</td>
<td>220</td>
<td>280</td>
<td>320</td>
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<tr>
<td>Enclosure</td>
<td></td>
<td>IP-67 or Subsea (200 m)</td>
<td>IP-67 or Subsea (200 m)</td>
<td>IP-67 or Subsea (200 m)</td>
</tr>
</tbody>
</table>

(1) Post-processing results using third party software. (2) Cable with pigtail wires or with Souriau 851-36RG 16-26x50 connector are the options.
MRU-B / MRU-E mechanical interface drawing (IP-67 version)

MRU-P mechanical interface drawing
MRU-BS / MRU-ES mechanical interface drawing (Subsea enclosure)

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: please check ICD
4. GNSS connector type (MRU-P): TNC-Female
## MRU-B Part numbers structure (IP-67)

<table>
<thead>
<tr>
<th>Model</th>
<th>Gyro</th>
<th>Accel</th>
<th>Calibration</th>
<th>Connector</th>
<th>Color</th>
<th>Version</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRU-B1</td>
<td>G450</td>
<td>A8</td>
<td>TGA</td>
<td>C3</td>
<td>B</td>
<td>V1</td>
<td>12</td>
</tr>
<tr>
<td>MRU-B1.1</td>
<td></td>
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<td>MRU-B2</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Example: MRU-B1-G450-A8-TGA-C3-B-V1.12

## MRU-BS Part numbers structure (Subsea)

<table>
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<tr>
<th>Model</th>
<th>Gyro</th>
<th>Accel</th>
<th>Calibration</th>
<th>Connector</th>
<th>Color</th>
<th>Version</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRU-B1S</td>
<td>G450</td>
<td>A8</td>
<td>TGA</td>
<td>C3</td>
<td>B</td>
<td>V1</td>
<td>12</td>
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<tr>
<td>MRU-B2S</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Example: MRU-B1S-G450-A8-TGA-C3-B-V1.12

## MRU-E Part numbers structure (IP-67)

<table>
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<th>Accel</th>
<th>Calibration</th>
<th>Connector</th>
<th>Color</th>
<th>Version</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRU-E</td>
<td>G450</td>
<td>A8</td>
<td>TGA</td>
<td>C3</td>
<td>B</td>
<td>V1</td>
<td>12</td>
</tr>
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</table>

Example: MRU-E-G450-A8-TMGA-C3-B-V1.12

## MRU-ES Part numbers structure (Subsea)

<table>
<thead>
<tr>
<th>Model</th>
<th>Gyro</th>
<th>Accel</th>
<th>Calibration</th>
<th>Connector</th>
<th>Color</th>
<th>Version</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRU-ES</td>
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<td>A8</td>
<td>TGA</td>
<td>C3</td>
<td>B</td>
<td>V1</td>
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</tr>
</tbody>
</table>

Example: MRU-ES-G450-A8-TMGA-C3-B-V1.12

## MRU-P Part numbers structure (IP-67)

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<th>Model</th>
<th>Gyro</th>
<th>Accel</th>
<th>Calibration</th>
<th>Connector</th>
<th>Color</th>
<th>GNSS Receiver</th>
<th>Version</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRU-P</td>
<td>G450</td>
<td>A8</td>
<td>TGA</td>
<td>C3</td>
<td>B</td>
<td>O719</td>
<td>V0</td>
<td>12</td>
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</tbody>
</table>

Example: MRU-P-G450-A8-TMGA-C3-B-O719-V0.12

**Description:**
- MRU-B1: Heave Sensor (IP-67)
- MRU-B1S: Heave Sensor (Subsea)
- MRU-B1.1: Pitch & Roll Sensor (IP-67)
- MRU-B1.1S: Pitch & Roll Sensor (Subsea)
- MRU-B2: Heave, Surge, Sway, Pitch and Roll Sensor (IP-67)
- MRU-B2S: Heave, Surge, Sway, Pitch and Roll Sensor (Subsea)
- MRU-E: Heading, Heave, Surge, Sway, Pitch and Roll Sensor (IP-67)
- MRU-E: Heading, Heave, Surge, Sway, Pitch and Roll Sensor (Subsea)
- MRU-F: Heading, Heave, Surge, Sway, Pitch, Roll, Heading, Position and Velocity Sensor
- G450: Gyroscope measurement range ± 450 deg/sec
- A8: Accelerometers measurement range ± 8 g
- TGA: Gyrosopes and Accelerometers
- TMGA: Magnetometers, Gyrosopes and Accelerometers (MRU-E/MRU-ES only)
- C3: 24 pins connector
- B: Black color of enclosure
- O719: GNSS receiver
- V0: DGPS (40 cm position accuracy) – for MRU-P only
- V1: Default version (w/o modifications) – MRU-B and MRU-E
- VRS: RTK (1 cm position accuracy) – for MRU-P only
- V1.12: RS-232, RS-422 and Ethernet

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