Honeywell's 6DF (six degrees of freedom) Inertial Measurement Unit (IMU), 6-D Motion Variant, is designed to provide six dimensional motion sensing from a single device over six degrees of freedom by sensing translational movement in three perpendicular axes (surge, heave, sway) and rotational movement about three perpendicular axes (roll, pitch, yaw).

Because the movement and rotation along the three axes are independent of each other, such motion is said to have "six degrees of freedom" or 6DF, as shown below:
Application Note
6DF Series, 6 Degrees of Freedom Inertial Measurement Unit, 6-D Motion Variant

PRODUCT VERSIONS
The 6DF Series is available in two versions, one with a 2 g accelerometer and the other with a 6 g accelerometer, as shown in the order guide below:

<table>
<thead>
<tr>
<th>Catalog Listing</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6DF-1N2-C2-HWL</td>
<td>6DF Series Inertial Measurement Unit, 6-D Motion Variant, 2 g accelerometer</td>
</tr>
<tr>
<td>6DF-1N6-C2-HWL</td>
<td>6DF Series Inertial Measurement Unit, 6-D Motion Variant, 6 g accelerometer</td>
</tr>
</tbody>
</table>

6DF-1N2-C2-HWL is slightly more accurate than the 6DF-1N6-C2-HWL, but less tolerant of vibration. It is designed for “cleaner” environments, where the higher accuracy can be realized due to the reduced environmental interference with respect to the signals.

6DF-1N6-C2-HWL is much more tolerant of vibration and rugged environments than the 6DF-1N2-C2-HWL. This allows for optimum performance in harsh environments, with a small reduction in accuracy.

POTENTIAL APPLICATIONS
Transportation (tractors, harvesters, loaders, graders, bulldozers):
- Stability
- Rollover Prevention/Detection
- Grading/Harvesting

Industrial (mining conveyors, robotics, shaker tables):
- Stability
- Rollover Prevention/Detection

Aerospace/Military (non ITAR) (ground vehicles UAVs, unmanned aerial vehicles):
- Stability
- Rollover Prevention/Detection

These benefits may be extended to heavy duty equipment such as shaker tables and mining conveyors.

The 6DF Series IMU helps customers to:
- Provide vehicle traction
- Prevent mechanical arm overextension
- Provide safe equipment operation
- Extend vehicle product life due to reduction in vibration and other mechanical stresses
- Reduce operator error

2. Rollover Prevention/Detection
Preventing vehicle rollover is critically important for both safe operation and equipment longevity.

Honeywell’s 6DF IMU unit can be used to prevent vehicle rollover in a wide variety of environments. Whether it’s a vehicle traveling over rugged terrain, or a front loader with a fully extended load, the IMU can be used to provide the operator a warning when the vehicle is approaching an angle of tilt or inclination that could lead to a vehicle rollover, preventing potential catastrophic damages to the vehicle or operator.

The 6DF Series IMU helps customers to:
- Prevent equipment damage
- Provide operator safety
- Extend vehicle product life due to reduction in vibration and other mechanical stresses
- Reduce operator error
- Withstand harsh outdoor conditions

3. Grading/Harvesting
Accurate grading and harvesting are imperative to constructing quality roadways and to maximizing crop yields.

The 6DF IMU data may be used to ensure a flat, smooth roadway or field for road grading or planting purposes. It may also be used to optimize harvester blade levels to maximize crop yield in uneven fields.

The 6DF Series IMU helps customers to:
- Save time by reducing the number of steps in processes requiring heavy machinery
- Maximize crop yields
- Withstand harsh outdoor conditions
Application Note
6DF Series, 6 Degrees of Freedom Inertial Measurement Unit, 6-D Motion Variant

VALUE TO CUSTOMER (★ = competitive differentiator)

★ Designed to Six Sigma standards: Six Sigma standards provide the highest level of product quality, performance, and consistency. Six Sigma provides confidence that the IMU will perform to specification. Some competitive products may be produced to much lower Sigma tolerances, which may result in some products not performing to the specification in some conditions

★ Industry-leading durability:
- Aluminum housing protects device from damage due to stones, dust, dirt, pressure washing, and humidity, allowing for use in harsh and outdoor environments
- Corrosion-resistance minimizes susceptibility to deterioration often experienced in salt water environments
- Compatible to chemicals such as diesel fuel, hydraulic oil, gas/ethylene glycol, brake fluids, urea, liquid lime, NPK fertilizer, ammonia hydroxide, and alkaline degreasers
- IP67 and IP69k ratings provide resistance to weather
- Wide operating temperature range withstands most thermal extremes, preventing package breakage
- EMI (electromagnetic interference) and EMC (electromagnetic compatibility) rating protects device from environmental radio frequencies
- Reduces replacement and downtime due to broken parts, temperature incompatibilities, EMC and EMI, and exposure to chemicals

★ Industry-leading accuracy: Provides highly accurate 6-dimensional rotation and acceleration outputs due to the IMU’s industry-leading durable packaging, industry-leading stability, temperature compensation, software filtering and design, and automotive-grade Six Sigma testing requirements

★ Eases integration:
- SAEJ1939 CAN 29 bit identifier communication output—the standard for the Transportation segment—allows more data to be transmitted than RS-485 output
- IP67 and IP69k ratings minimize the customer having to design a weather resistant packaging around the IMU, allowing for a wide range of use in the application
- Wide voltage range (7 V to 32 V) minimizes the need for a voltage converter
- Deutsch connector, common in Transportation applications, simplifies the customer’s supply chain and reduces design complexity
- Chemical compatibility minimizes the OEM having to expose the device to the substances

★ 6-dimensional motion sensing: Senses 3-D motion in the forward/backward, up/down, and left/right accelerations combined with rotation about three perpendicular axes (pitch, yaw, roll):
- Provides key equipment operating data for automated steering and control
- Frees the operator to focus on equipment functions
- Enables precise control which otherwise cannot be achieved with the human eye alone
- Increase accuracy, safety, stability, and operator productivity

★ Industry-leading voltage input flexibility (7 V to 32 V):
- Allows customers with multiple product lines the ability to purchase only one catalog listing instead of multiple listings
- Allows the IMU to accommodate voltage fluctuation within the vehicle/device
- Provides reverse polarity protection in case the end customer accidentally reverses the red and black battery voltage wires

★ Industry-leading application expertise: Honeywell's application engineers are available to provide assistance to customers to help troubleshoot unforeseen communication protocol data, helping to optimize the customers’ system performance; additionally, Honeywell’s application engineers are available to answer design questions during the development, launch, and production of the customer’s product

★ Industry-leading customization: For Transportation-applications with high volumes over 500 units per year, Honeywell will consider offering customers a choice of any CAN protocol, acceleration range up to ±6 g, rotation rates up to ±75 °/s, inclination angles up to ±50° and a sensor update rate from 1 Hz to 100 Hz:
- Allows customers to customize the IMU so that it readily fits into existing vehicle protocol architecture
- Allows customers the ability to make custom protocol inclusions into the IMU quickly and easily
- Allows fast customer development turnaround with expert engineering support
- No customization for Aerospace and Military ITAR-applicable applications
Application Note
6DF Series, 6 Degrees of Freedom Inertial Measurement Unit, 6-D Motion Variant

- **Automotive-grade qualified**: Certified to operate in automotive-grade environments due to:
  - Temperature compensated to operate from -40 °C to 85 °C [-40 °F to 185 °F]
  - Meets EMC (electromagnetic compatibility) and EMI (electromagnetic interference) requirements
  - Meets ESD (electrostatic discharge) requirements
  - Chemical compatibility (e.g., diesel, hydraulic oil, gas/ethylene glycol, brake fluid, urea, liquid lime, NPK fertilizer, ammonia hydroxide, and alkaline degreaser)

- **Industry-leading temperature performance**: A temperature sensor is placed within each rotation rate sensor within the IMU:
  - Provides a temperature value to the processing module where the data samples are filtered and compensated
  - Allows the customer's system to perform over a wide temperature range

- **Long-term stability**: Even after long-term use and thermal extremes, these sensors offer customers enhanced long-term stability:
  - Minimizes system calibration needs
  - Maximizes system performance
  - Helps support system uptime by eliminating the need to service or replace the sensor during its application life

- **No calibration needed**: Large batches of the IMU are calibrated to a flat surface, providing calibration consistency between units, and eliminating the customer's need to calibrate the IMU

### Features and Benefits

<table>
<thead>
<tr>
<th>6DF Series</th>
<th>Features and Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• <strong>Industry-standard CAN SAEJ1939</strong>: Provides easy-to-integrate, cost-effective, high-integrity serial data communications bus for real-time control applications, allowing enhanced error detection</td>
</tr>
<tr>
<td></td>
<td>• <strong>Test to mechanical shock, thermal shock, and random vibration</strong>: Provides the customer with durability in tough environments</td>
</tr>
</tbody>
</table>

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Find out more
To learn more about Honeywell’s sensing and control products, call 1-800-537-6945, visit sensing.honeywell.com, or e-mail inquiries to info.sc@honeywell.com

Warranty. Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell’s standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items it finds defective. The foregoing is buyer’s sole remedy and is in lieu of all warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.

While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

Sensing and Control
Honeywell
1985 Douglas Drive North
Golden Valley, MN 55422
sensing.honeywell.com

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