

Honeywell

THE POWER OF **CONNECTED**

TRANSPORTATION ATTITUDE REFERENCE SENSOR IN A SKID STEER LOADER

An Application Note





Background Skid steers loaders are small, engine-powered machines that allow users to attach a variety of labor-saving tools and attachments. They are capable of zero-radius turns which makes them extremely maneuverable and valuable in situations that require compact, agile loading capability. These loaders are a staple of many small and large contractors worldwide. One drawback to these small loaders, unlike larger more conventional loaders, is that these small machines have less capability when finishing grading and ground leveling. Larger, more expensive machines are equipped with standard technologies and devices to allow operators to precisely grade and level the work site.

Recently, a large manufacturer of skid steer loaders contacted Honeywell for a solution to address the small loaders' lack in grading and ground leveling ability. They were seeking a way to add more capability. The system had to be robust, reliable, and accurate enough to be useful, and priced competitively to not put this technology out of reach for these lower-cost loaders.



TARS-IMU: Transportation Attitude Reference Sensor (TARS) Ruggedized Inertial Measurement Unit (IMU)

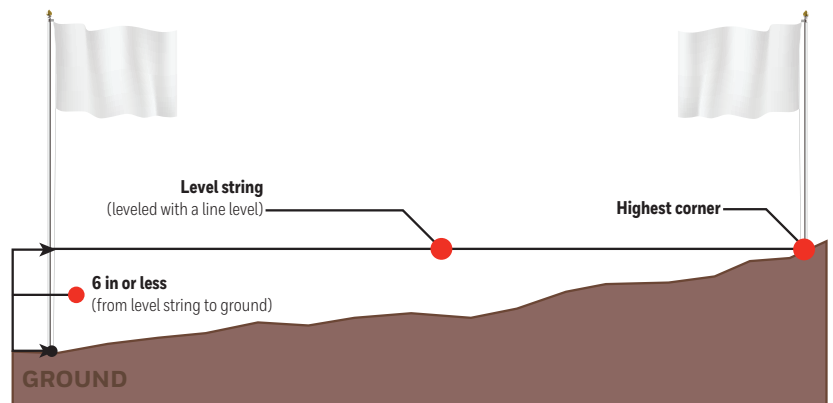
TARS Key Features

- High performance IMU, reports vehicle angular rate, acceleration, and inclination (6 degrees of freedom)
- Ruggedized design for most demanding applications and environments (IP67 & IP69K certified)
- Advanced fusion filtering to minimize unwanted noise and vibrations, improves positioning accuracy
- Optional metal guard for added protection
- Supports 5 V and 9 V to 36 V vehicle power systems
- Operating temperature of -40°C to 85°C [-40°F to 185°F]
- Reduced power consumption
- Small form-factor

The Solution

Honeywell engineers spent months working in collaboration with this customer to develop and deliver a Transportation Attitude Reference Sensor (TARS) Inertial Measurement Unit (IMU) that was specifically programmed with this customer's parameters. By integrating with Honeywell's TARS-IMU, customers know in real-time the vehicle's position in respect to inclination. The machine's ECU (Equipment Control Unit) processes this information and provides feedback to the operator where the machine is sitting in respect to inclination. Such indicators allow the operator to make real-time adjustments to grade as the loader is in motion.

Figure 1. Work-Site Ground Preparation



This feature allows an operator to prepare the work site more accurately and quickly. Previously, customers would need to stake out the site using a laser transit to mark the stakes to properly prepare the ground site. This can be time consuming and is only as precise and accurate as the number of stakes placed in the ground and measured. Another method to measuring grade is with a Zip level; this is also a slow process that requires the operator to exit the skid steer in order to check the grade.

The Honeywell TARS-IMU has grade measurement capability engineered into its design. Internal machine systems provide real-time grade data to the operator who has the ability to adjust the terrain as needed. This

feature adds value to the end user as he/she is now able to prepare a work site quicker – saving time and money with no need for additional expensive ground surveying equipment. Operators can use the TARS-IMU equipped loader to achieve a level of 0.6° equivalent to a 1 % of grade for proper water run-off.

The TARS-IMU excels in flexibility as customers can simply download new programs to add even more features to the equipment. This increases value not only to Honeywell’s direct customer, but also to the end user who is now a software upgrade away from getting even more capability from their skid steer loader.

Other Potential Applications

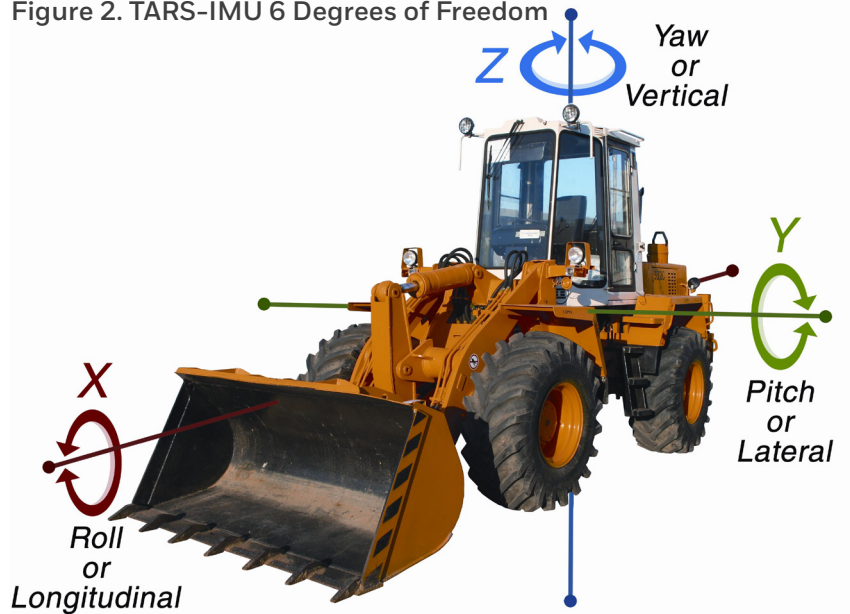
Construction equipment

- Excavators, mining trucks, forestry equipment, telescopic handlers, loaders, cranes, graders
 - Improves operator awareness relative to equipment loading/extension arms in cranes, material/telescopic handlers
 - Provides real-time stability control in most rugged/steep terrain (Inclination outputs to prevent vehicle roll over)
 - Provides active control of graders/ bulldozers (depth/angle)

Agricultural equipment

- Combines, harvesters, tractors, balers
 - Provides motion control feedback (attitude/acceleration) for stability and the leveling cutting blades, planters, tillers, and other equipment when on slopes/hills
 - Inclination outputs to prevent vehicle roll over
 - Improves automated steering capabilities by providing rotational rate change data to vehicle controls

Figure 2. TARS-IMU 6 Degrees of Freedom



Value to OEM Customers

Durability for the environment

- Corrosion-resistant housing/case minimizes the susceptibility to deterioration often experienced in salt-water environments
- UV-resistant plastic housing
- IP67 and IP69K ratings provide resistance to weather, harsh conditions and cleaning environments, reducing risk and cost associated with lower-rated products
- Wide operating temperature range withstands most thermal extremes, preventing package breakage
- Electromagnetic Interference (EMI) and Electromagnetic Compatibility (EMC) rating ensures device compatibility with the radio frequency environment

Ease of integration

- One high voltage (9 V to 36 V) model is designed for operation from heavy-duty vehicle battery power with immunity to load dump and electrical transients
- The second low voltage (5 V) model is designed for operation from a regulated 5 V power source
- SAE J1939 CAN output – allows more data to be transmitted than a RS-485 output
- AMPSEAL 16 connector, common in transportation applications, simplifies the customer’s supply chain and reduces design complexity
- The TARS-IMU employs a boot-loader feature to facilitate program updates and integration with new functional requirements. New features can thereby be upgraded without opening the unit, keeping the calibration parameters and sensor performance intact

Performance in a wide variety of environmental conditions

- Calibration with 2-axis rate table with verification over temp. range
- Tested to mechanical shock, thermal shock, and random vibration

Warranty/Remedy

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship during the applicable warranty period. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgment 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 that Honeywell, in its sole discretion, finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other 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.**

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DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.

Failure to comply with these instructions could result in death or serious injury.

WARNING **MISUSE OF DOCUMENTATION**

- The information presented in this product sheet is for reference only. Do not use this document as a product installation guide.
- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

Failure to comply with these instructions could result in death or serious injury.

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