

# Correct Orientation of Container Spreaders on Port Cranes

F99 Inertial Measurement Unit  
Provides Dynamic Inclination Data  
for Precise Control

## At a Glance

- Noncontact measurement of inclination, acceleration, and rotation rate along three axes
- Reliable, dynamic inclination values through intelligent compensation of external acceleration
- Rugged design for outdoor use in harsh conditions
- Resistant to weather conditions, extreme temperatures, and salt water
- Adjustable compensation range for adjusting angular accuracy



## The Application

Every minute spent in port costs money, so container ships must be loaded and unloaded as quickly as possible. This requires precise control of the spreaders that the port cranes use to pick up the containers. Naturally, port facilities—especially in seaports—are exposed to severe weather conditions, sometimes facing extreme temperatures, precipitation, and ice formation. In addition, the salt water has a corrosive effect and strong wind can cause mobile components such as spreaders to vibrate.

## The Goal

The smooth running of the partially or fully automated loading processes must be ensured for each crane type at all times and in all weather conditions. The spreader should be level during pick-up, unloading, and transport. Leveling must happen automatically, since it is intended to compensate for deviations from the horizontal position as quickly as possible—for example, due to mechanical influences or wind load. For this purpose, the dynamic inclination value of the spreader must be reliably recorded.



## The Solution

The F99 inertial measuring unit is mounted on the spreader. It measures the horizontal inclination in two axes and the rotation of the spreader along the x, y, and z axes. The angle values are recorded as reliably during movement as they are when stationary. The device measures acceleration and rotation rate, and uses these values to calculate the dynamic angle of the moving component. By intelligently linking the acceleration sensor and gyroscope, the sensor fusion algorithm reliably compensates for external acceleration and ensures highly precise inclination measurement. Since the sensor always provides clear data regardless of its position and orientation, it can be installed virtually anywhere on the spreader.

## The Benefits

The output data can be freely selected according to requirements, and specific filters can be parameterized. The controller has access to both the raw data from the individual sensor elements and various merged data. The latter is calculated in real time and can be used immediately. As the only sensor of its kind, the IMU F99 offers configurable acceleration compensation with eight compensation ranges. This allows the function to be optimally adapted to the type of movement and angular accuracy of the application. The device has been specially developed for outdoor use and is housed in a highly rugged enclosure with IP68/69 degree of protection. Unlike camera-based systems, the device works in all weather conditions, including strong sunlight. Furthermore, in terms of price, the IMU F99 offers great advantages compared to similar systems.

### Technical Features

- Inclination, acceleration, and rotation rate measurement along three axes
- Adjustable compensation range
- IP68/IP69 degree of protection
- Temperature range of  $-40\text{ °C}$  to  $+85\text{ °C}$
- Housing withstands mechanical impact up to 100 g
- Interface for parameterization
- Output formats and values can be selected
- Suitable for dynamic applications
- E1 approval

