Diagnostic solutions for mobile machines

Use of diagnostic tools allows for a product testing and targeted monitoring over the mobile machine's life cycle. Failures can be detected before actual faults in the communication occur. This helps to avoid costly downtimes.

Today, communication between several mobile machines makes work more comfortable, but it also increases the demands for sensors, electronics, and networking. Unplanned disruptions can occur due to system errors and cause costly downtimes.

Gemac (Germany) offers different solutions for diagnostic of the physical layer parameters and the logical data traffic in the CAN-based in-vehicle-networks of mobile machines. The battery-operated handheld CANtouch diagnostic device is the further development of the CAN-Bus Tester 2 and inherits and exceeds its features. It connects to the CAN network via a cable and is user-friendly with a touchscreen similar to smartphones. Measuring functions are operated interactively via applications ("apps"). The evaluation system uses a combination of traffic light colors and smileys to show the user the measurements' condition. The 4,3-inch color display allows a graphical representation of the measured results. Service technicians can use the device for commissioning, analysis, monitoring, and maintenance works. CAN networks that are diagnosed by the CANtouch, use proprietary and standardized higher-layer protocols such as CANopen, Devicenet, and J1939.

The user can monitor the network for individual physical limits, determine problems over time, and make errors visible in an oscillogram. The measurement results can be archived for documentation or later analysis and processing on a PC. The physical layer measurements include the direct determination of potential differences between the participants (common-mode/ground shift). With this, it measures the absolute signal levels of all CAN nodes relative to its position and determines the widest spread among all nodes, i.e., the "absolute maximum common-mode voltage." Even though the CAN transceivers permit higher values than those specified in the datasheet, higher common-mode voltages can result in communication errors and eventually destroy the CAN transceivers. Sporadic bus interference, such as external EMC (electromagnetic interference) or a slowly deteriorating signal quality attributable to worn out plug connections or cables, can be detected. Thus, the diagnostic devices allow to reveal error sources in the physical network characteristics early and catch errors before actual communication faults occur. "Gemac is the only provider in the world of such diagnostic systems that physically measure and enable comparable statements about the signal quality and interference reserve in the mobile machine," said Ralf Meischner from Technical Support Fieldbus. Users can

Figure 1: Fieldbus diagnostic system CANtouch (Source: Gemac)

diagnose and repair loaders, bulldozers, excavators, and other commercial vehicles and equipment. The tools are also used in mining and other off-highway applications.

In September, the company introduced the Gemac Motus series of inertial measurement units (IMUs) dedicated to mobile machines. Motus comes from Latin and means movement. Gemac Motus provides a high-precision recording and digitalization of movement up to an inclination resolution of 0,01 ° combined with a static accuracy up to 0,1 ° and a dynamic accuracy up to 0,25 °, with an acceleration resolution up to 0,244 mg and a gyroscope resolution up to 0,00875 °/s. This precision guarantees safety when using the IMU in mobile machines.

Gemac realizes this mentioned new level of functionality based on the six-axis motion detection. It measures the 3-axis acceleration and the 3-axis

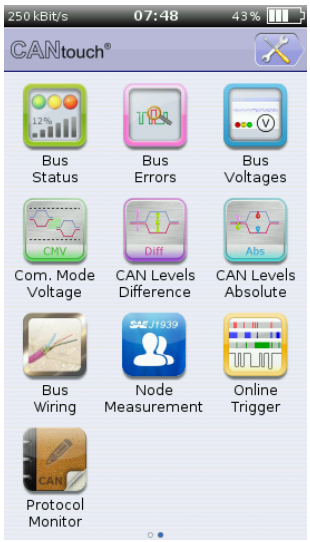

Figure 2: CANtouch user interface uses "apps" (Source: Gemac)

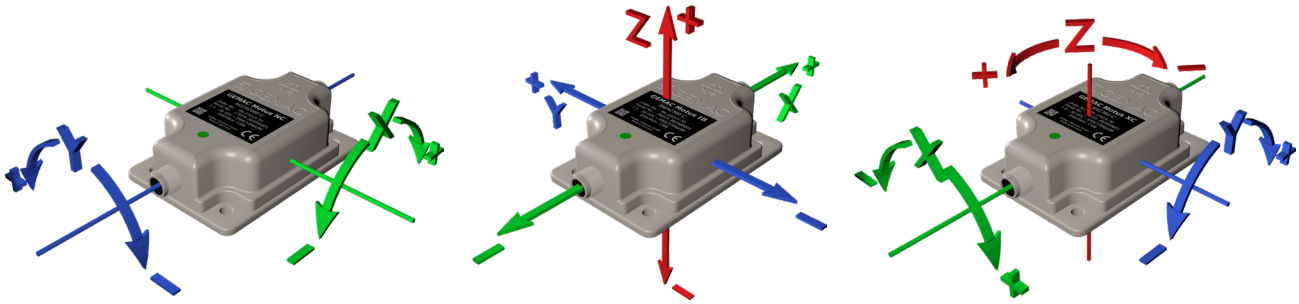

Figure 3: The Gemac Motus IMU measures 2-axis inclination, 3-axis acceleration, and 3-axis rotation rate (Source: Gemac)

rotational rate. Variants with an additional inclinometer are available. Data processing occurs in the measuring unit using a sensor fusion algorithm developed from Gemac. This new algorithm combines and extends the well-known Kalman filter and the Complementary filter, exploiting their advantages and suppressing their disadvantages at the same time. Integrated sensor fusion filters support the user in calculating the vehicle orientation by suppressing external accelerations. Because of the combination of hardware, parameters, and the invited sensor fusion algorithm, the company names the Gemac Motus as the worldwide first Power-IMU for mobile machines.

The IMU is available in 29 different application-related configuration options. It supports CANopen and J1939 higher-layer protocols. The CANopen version implements the CiA 301 (version 4.2.0) CANopen application layer and communication profile. For the inclinometer function, the CANopen device profile for inclinometers (CiA 410 v. 2.0.0) is supported. The ISD-Control software for the IMU parameterization is available for a free download. It works with CAN adapters from various manufacturers. The units are dedicated for use in construction machinery, agricultural machinery, forest machines, cranes, lifting technology, ships, etc.

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