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Data Security and Communications

The Electronic Bubble Level

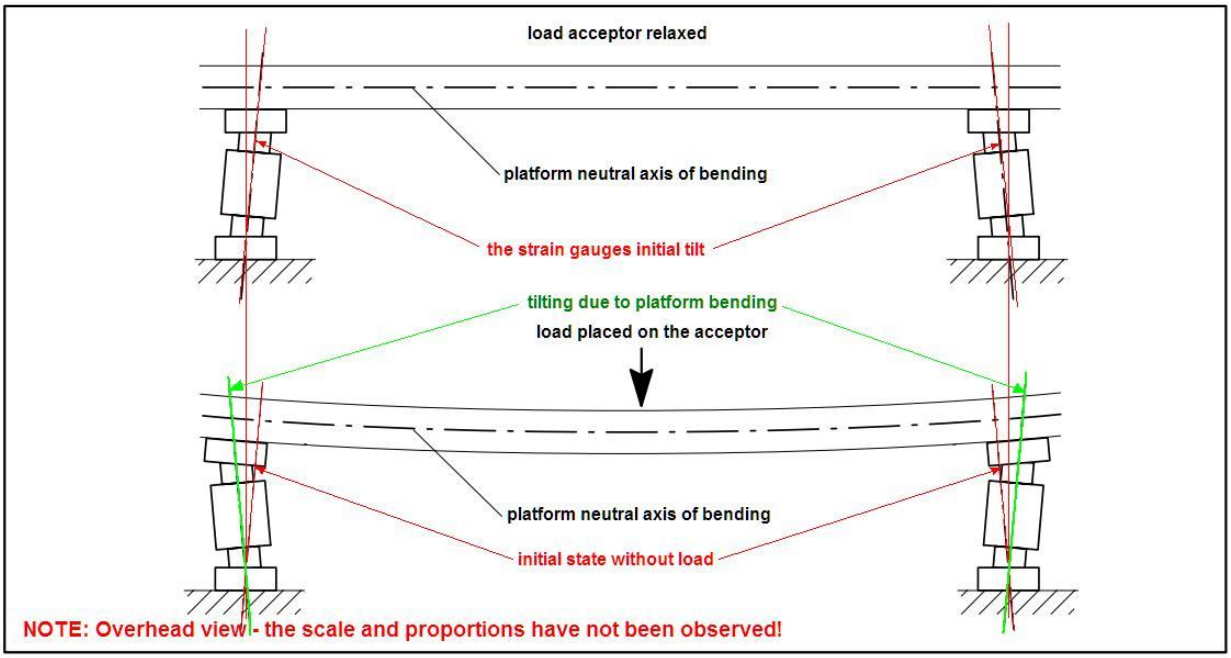
The problem and the solution

It's common knowledge that companies installing and servicing multi-sensor platform scales and tanks scales often meet a problem of precise adjustment of the load cells. An inclination of the load cell working axis from the vertical results in various problems with weighing. Most common are: a weight indication decrease, an increased amount of errors due to the non-symmetric loading of the load receptor or an unacceptable instability of indications. These symptoms are often a cause of the consumer's complaint, which results in a service call and the Contractor's or the Servicing Company's visit to the place where the scale was installed. Such situation is troublesome for both sides.

Such phenomenon, as an effect of the long-term exploitation of the scale, worries nobody but its Owner, but if it occurs at the very beginning of the new scale's operation or after servicing it can cause inconvenience to the Weigh Specialist. It often results in additional costs necessary to achieve the desired effect, which are: the stable weight indication, the repeatability of indications and the resistance to the typical conditions in which the scale is used.

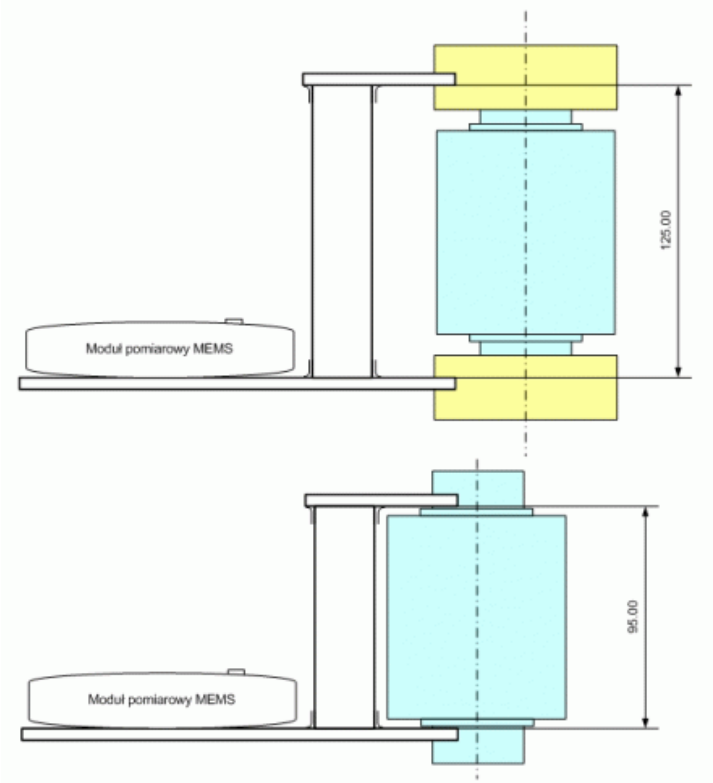
My solution – the Electronic Bubble Level– naturally doesn't eliminate the load cells' setting errors, but it allows judging quickly and precisely whether the sensor is correctly set. The setting errors in both perpendicular axes are clearly indicated, which is invaluably helpful in a size and direction adjustment of the sensor's setting, needed to achieve the correct position.

There are manufacturers who claim their load cells are resistant to the inclination of the sensor working axis from the vertical even up to 5°. This is true on condition that the sensor has a constant setting for the whole time of working. In that case the load cell himself is working properly and only its output sensitivity decreases (proportionally to the cosine of inclination angle). We all know that this state is unreachable in practice, even if the load cell is located under the tank. Dynamic load changes naturally cause “swaying” of the sensor. Also the mutual setting is changed always when the ground (foundation), the load receptor and sensors altogether don’t create a perfect parallelogram – the most common situation in practice. Preventive tilt of the sensors (into upside-down “V” position) while assembling, recommended by some manufacturers, is also not a solution. It immediately raises a problem of achieving the symmetry of the settings, which can’t be solved only with measuring the distance between load cells’ supports.



The range of applying the Electronic Bubble Level is wider than only to the commissioning and service of truck and tank scales. Any kind of industry scale that uses analog or digital compression load cells, cylindrical in shape, can be efficiently assembled, commissioned and maintained thanks to the proposed device.

The concept of the level and load cell cooperation



"Moduł pomiarowy MEMS" means: MEMS measuring module

The idea of measuring with the Electronic Bubble Level

The Electronic Bubble Level uses a triaxial acceleration sensor. It is made with MEMS technology (micro machine produced as silicon integrated circuits), and it responds to the gravity vector (vertical) position in three dimensional space. Signal from the accelerometer is converted into a digital value and then processed in an embedded microcontroller. Thanks to that, results can be presented in the form of displacement of the level "bubble" in two axes: longitudinal and transversal in relation to the foundation of the sensor. The design of the position sensor support (an innovatory swan shape) enables putting the Level to the load cell core or supports. Precisely crafted triangular measuring prisms with the angle of 120° provide a correct cooperation between the level and any cylindrical load cell with diameter of the circular core or supports ranging from 30mm to 90mm.

Variants of the device

The Electronic Bubble Level is available in three variants:

- Level with a built-in graphic display with a touch panel,
- ZigBee wireless Level (2.4GHz),
- Level with an external LED display.

All mentioned variants share following features:

Sensor type: triaxial accelerometer with measuring range ± 2g,
Attitude sensor: LIS3LV02DL,
Resolution of the acceleration measurement: 16 bits (2^{14} LSB/g),
Resolution of tilt measurement: better than 0.06°,

Level setting error: 0.056° (16 LSB),
Tilt measurement range: ± 3.2° in both axes,
Frequency of measurements: 40/s
Power supply: Li-Poly 3.7V 1000mAh / Charger Built-in
Charging conditions: 5V / 500mA max,
Indication: tilt in degrees and mm/m referenced to the 200mm base (typical height of the load cell with supports),

Attitude sensor handlers are made of polished stainless steel. Triangular measuring prisms have opening angles of 120° and distance of 95mm or 125mm.

The Level with a built-in graphic display with a touch panel

This version has following unique features:

- 32-bits ARM microcontroller STM32,
- internal battery charge via USB port,
- minimum 10h of continuous working without recharging,
- on/off turning by five-direction joystick,
- 128x160 pixels graphics color display with a touch panel,
- four-color range of tilt indicator,
- tilt can be presented in following forms:
  - graphic (as a moving red dot),
  - digital (in degrees and mm/m),
    - for both axes longitudinal (Y) and transversal (X),
    - total inclination (W),
- display reading angle: 60°,
- battery charge level indicator,
- automatically turn off when the battery is drained,
- USB cable and user's guide are enclosed,
- actual software version 1.3H/2010.

The Electronic Level display- the graphics mode, lateral inclination (X) and longitudinal inclination (Y) together with total tilt (W)

The price of the Level with a built-in graphic display **537 €** per pcs
The price of the Level over five items **509 €** per pcs

The Wireless Level (ZigBee)

working with the visualization software via USB dongle

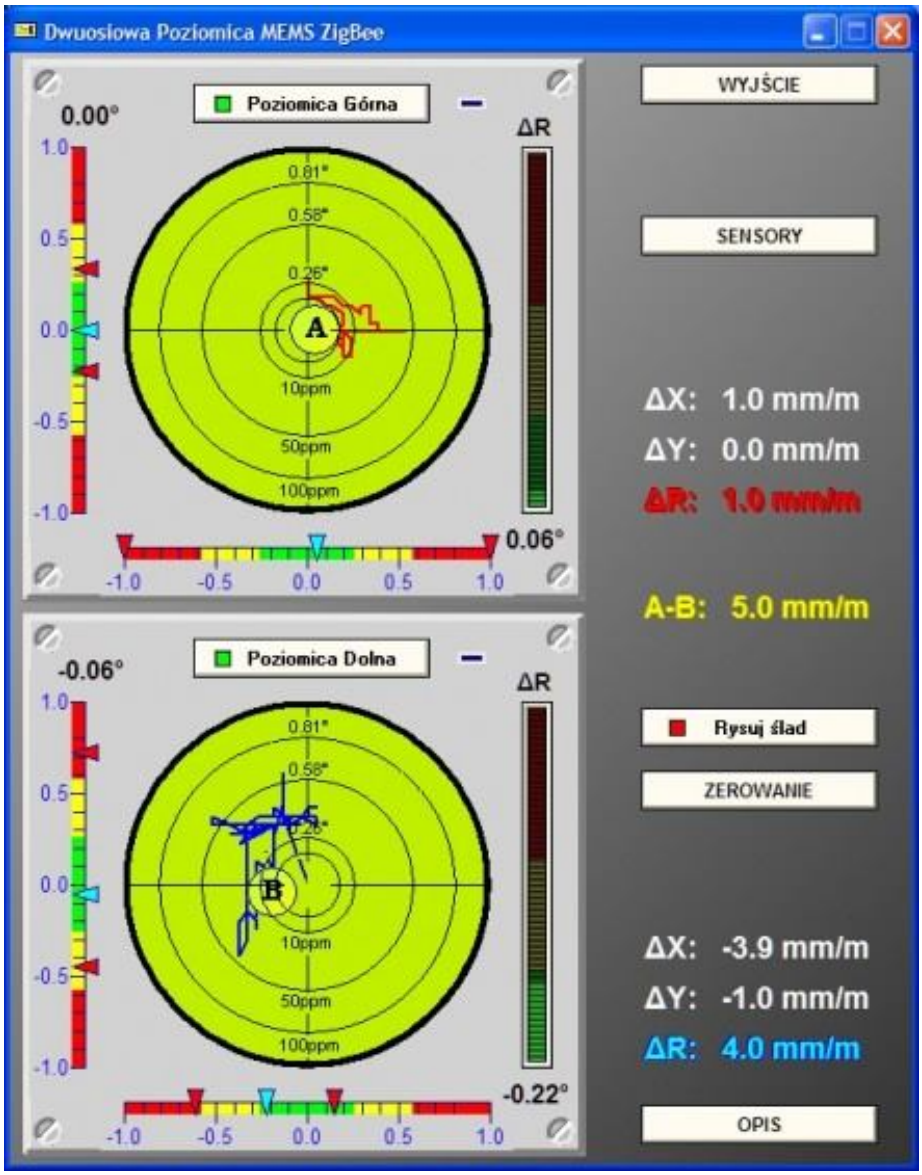
This version of the Electronic Level can cooperate with the second level sensor. The software shows a difference of inclination between two level sensors. You can also visualize a trace of tilt position of the load cell(s) for example during a car's going onto the load receptor.

ZigBee wireless Electronic Level

This version has the following unique features:

- radio interface working in license-less band 2.4GHz (ZigBee),
- range in open space up to 150m,
- range in buildings circ. 20m, depending on the obstacles,
- USB dongle to the PC with LED indicator of transmission,
- visualization program working on Windows™ PC, version XP or later,
- the possibility of the load cell's tilt trajectory visualization (trace) e.g. during car's moving on the scale platform,
- graphic presentation of the tilt ("bull eye" bubble level),

- digital readout of the tilt in ±2.57° range, with resolution of 0.06° and the possibility of memorizing boundary values,
- total inclination presented in a colorful bar-graph form,
- optical indicators (LED) of power, on-line connection and data transfer,
- built-in battery charger, 5V/500mA power supply enclosed,
- minimum 10h of continuous working without battery recharging,
- battery over-draining protection,
- car charger as an option,
- up to four such levels can work as a set (requires a special software).



Double biaxis MEMS ZigBee Level – the GUI

The price of the Wireless Level with software and charger	**845 €** per set
The price of the set of two Levels with software and charger	**1543 €** per set
The price of the set of four Levels with software and charger	**2790 €** per set

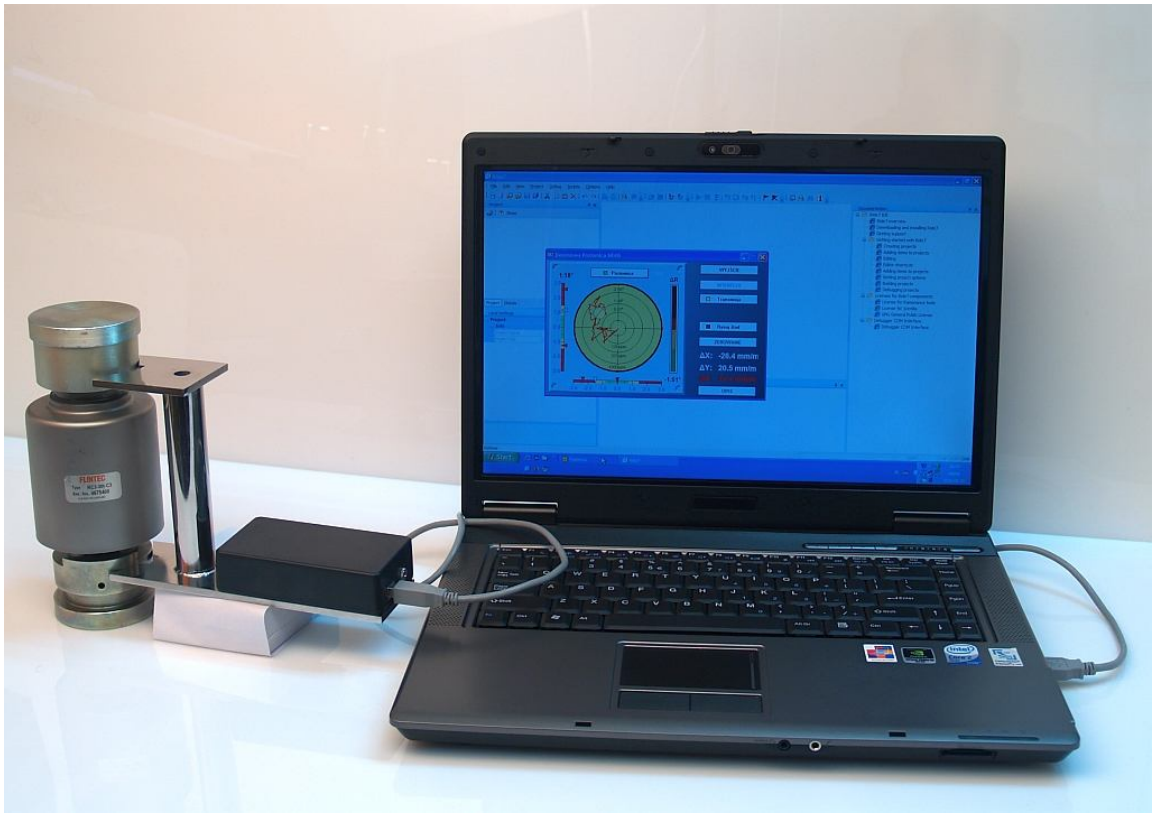
The Level wired with a detached LED visualization panel,
working with the PC via USB port

Level with a detached visualization panel

Level wired with an external desktop visualization has the following individual characteristics:

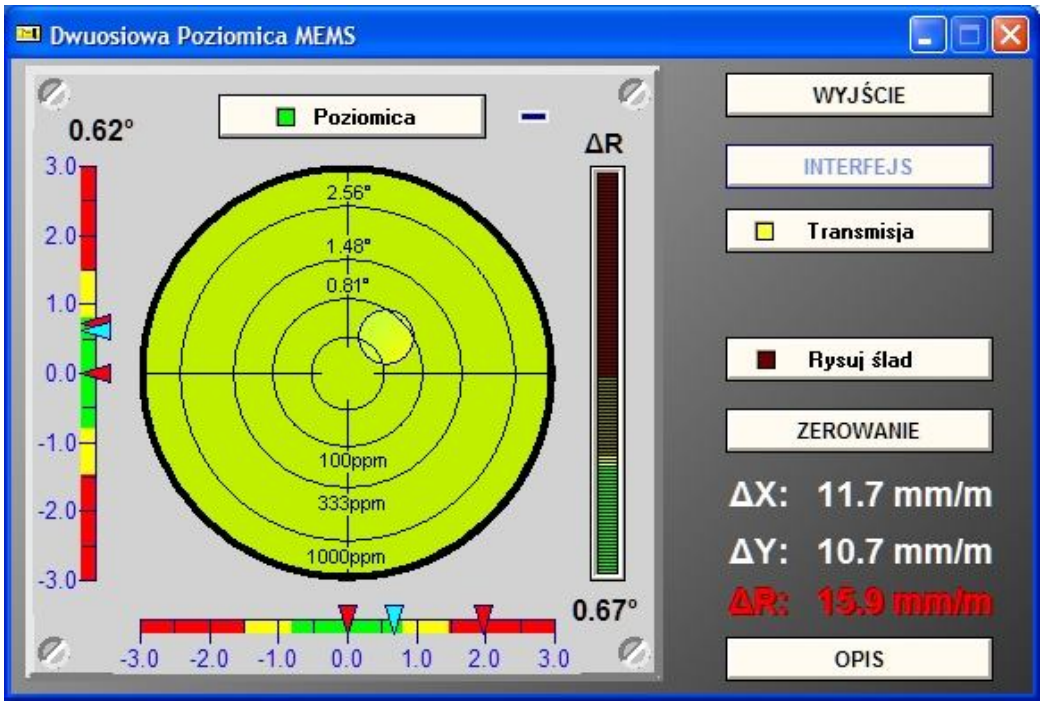
- improved resolution of the inclination measurement from 0.056° to 0.025°,
- external visualization desktop, connected to the level by a cable with stereo mini-jack connector:
  - the length of the included cable: 3m,
  - the maximum length of the interface cable: 100m,
- indication of the level position and range of the inclination in a form of LED lights arranged in a cross with a built-in autotest,
- the central light color indicates the inclination in the following ranges:
  - <0.25° - green,
  - <0.50° - orange,
  - <0.75° - red,
  - transmission fault - blue,
- the direction and size of the inclination presented in a form of the direction light activity:
  - flicker with a 2.5Hz frequency - deviation less than 0.75°,
  - flicker with a 5Hz frequency - deviation less than 1.5°,
  - flicker with a 10Hz frequency - deviation less than 3.0°,
  - steady light - deviation of 3.0° or greater,
- built-in battery charging system with AC 5V/500mA power supply e.g. a charger for Nokia cell phone (supplied in a kit),
- car charger is optionally available (from a cigarette lighter socket),
- USB interface to the PC,
- visualization software running on a PC with the Windows ™ XP version or later, with the following characteristics (optionally available):
  - a graphic readout in a form of the spirit bubble level with the indication of the error zones inducted by inclination (100ppm, 333ppm and 1000ppm),

        - a digital readout of the tilt in range of ± 3.0°, with a resolution of 0.025° and memorizing the limits of the deviations in the whole range of measurement,
        - total inclination presented in a colorful bar-graph form,
        - a digital readout of the tilt in mm/m referred to the base of 1m or 200mm (optional),
        - the possibility of the load cell's tilt trajectory visualization (trace) e.g. during car's moving on the scale platform,
    - USB cable is included with the software,
    - The software is serialized, each program works only with one particular Electronic Level as a set. Open-licensed software working with any level is available on request.
    - The software can be used in multiple copies simultaneously on one PC. Limitation of the number of program instances is due to the number of available USB ports.



The Electronic Level - cooperation with the PC via USB port

The price of the Level with detached LED panel, 3m cable and charger	**604 €** per set
The price of the Level over four sets	**577 €** per set
The price of the Level with software, 3m cable, USB cable and charger	**751 €** per set
The price of the five Levels with the open-licensed software, cables and chargers	**3555 €** per set



The window of the program - biaxial MEMS Level

Purchasing software in the open version is viable when you buy more than four sets of the Level with PC software!

All the versions of the Electronic Level are available in two sizes:

Level with 95mm opening width of measuring prisms, adapted to cooperate with load cells of the families:

- ASC / DSC (Vishay / Revere),
- ASL / SCL (Precia),
- BM14G / BM14K (Zemic),
- C16A / C16i (HBM),
- CA40X (Scaime),
- RCP (Dini Argeo),
- SPA / SPD (Sensocar),
- ZSFA / ZSFY (KELI).

Level with 125mm opening width of measuring prisms, adapted to cooperate with load cells of the families:

- ASC / DSC (Vishay / Revere) – applied to the LC supports,
- ASL / SCL (Precia) – applied to the LC supports,
- BM14C / BM14G / BM14K (Zemic) – applied to the LC supports,
- C16A/C16i (HBM) – applied to the LC supports,
- CA40X / CB50X (Scaime) – applied to the LC supports,
- RC3 (Flintec),
- RCK (Dini Argeo),
- ZSFA / ZSFY (KELI).

The presented Electronic Bubble Level can also set-up other, so far not mentioned, load cells of similar size and way of fixing in the supports.
With the help of the Level, you can check vertical position of any round object with a diameter of 30mm – 90mm and traditionally you can level any surface.

On Customer's request it is possible to prepare a Level's support of any desired aperture of the measuring prisms, e.g. for Pfister - Bilanciai load cell families STI, CPD, CPR and CPR-M.

All mentioned prices are net prices stated in Euros. Customers outside EU have to add the 23% VAT. For prices in other currency please contact us.

The Electronic Level and the visualization software is designed and produced by the **DSC Andrzej Józef Majewski** company from Gdańsk, Poland.
In case of any technical and commercial matters, please **contact us**.

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