

Precision Digital Level Accuracy and Reliability - Digi-Pas® 2-Axis Technology

In any precision measuring instruments and metrology, **accuracy** and **reliability** are very important aspects to users. Readings from an inaccurate measuring instrument/tool would result in making a faulty decision and in many cases could have unintended consequences.

Digi-Pas® 2-axis digital leveling instruments are built with advanced **MEMS Sensor Technology** and precisely calibrated for non-linearity for its entire measurement range using high precision computer numerical controlled equipment with resolution of 0.0001° (< 1 arcsecond). The accuracy and repeatability conformance of these highly specialized calibration equipment are further tested and periodically verified with ultra-high precision angular rotary systems (<0.01 arcsecond), as well as laterally compared against measuring data from world-leading accredited test and certification bodies in Japan, USA, UK and Germany, traceable to **NIST, JIS, UKAS & DIN**. Series of Calibration Certificates obtained from these certification bodies are obvious evidences of our product conformance to specification. This has demonstrated Digi-Pas® capability and its leading-edge technology to develop and manufacture world-first dual-axis high precision angular measuring instruments.



SelfA47 Precision Rotary Table System for Angular Standard (Japan) - Source: National Metrology Institute of Japan (NMIJ)



Moore Nano technology System – NanoTech 350FG (USA)

The digital technology adopted has enabled **Digi-Pas®** angular measuring instruments to be compensated for wide operating temperature variation utilizing Digi-Pas® patented advanced calibration processes (US Pat. No. 9,459,121 B2). Programmable precision temperature and humidity chambers are also utilized to calibrate various Digi-Pas® product lines for a range of -20°C to +60°C. This has enabled these products to reliably withstand stringent operating environment in many harsh terrains ranging from building skyscrapers in the desert of Middle-East to the constructing of oil pipes, tunnels and bridges in the freezing cold countries such as Canada, the Nordic and Russia.

1. Characterizing Digi-Pas® 2-Axis High Precision Digital Level

It is well known that a typical characteristic of MEMS tilt sensor inherently contains nonlinearity within its angular measuring range at any fixed operating temperature as well as when temperature changes. These nonlinearities affect angular instrument accuracy becomes even more significant when dealing with ultra-precision angular measuring system. **Digi-Pas®** employs our proprietary calibration processes utilizing advanced calibration technologies to stabilize multiple variables contributed by material properties, components and electronic system. Hysteretic nonlinearity and cross-axis error have been controlled and managed to a level negligible or within product's specification.

2. Calibration and Testing of 2-Axis Precision Digital Level – Digi-Pas® U.S. Patented

Calibration and testing of precision angular measuring instrument become very challenging at higher precision, wider measuring range and multi-axis. Test equipment's linearity compounding error within entire measuring range and testing processes such as Swash errors become major impediments for establishing a responsible budget on measuring system uncertainties of no less than 95% confidence level at a coverage factory of $k=2$.

Over the years, **Digi-Pas®** has relentlessly made continuous improvements and closely collaborated with global leading 3rd party accredited test laboratories in USA, Japan, UK & Germany and world-leading National Metrology Institutes under Bureau International des Poids et Mesures (**CIPM MRA**) to successfully test and verify with rigor our products performances to specification traceable to NIST, JIS, UKAS & DIN for international conformity assessments. These collaboration and cooperation have benefited many of our users in USA, EU and Asia to conveniently sending their instruments for annual

calibration and test at a nearby laboratory for shorter lead-time and lower cost as these labs are in a close proximity to their respective geographical location.



Digi-Pas® Calibration equipment – Micrometer Sine Bar

Digi-Pas® patent (US Pat. No. 9,459,121 B2) on methods and apparatus for calibrating ultra-precision 2-axis simultaneous angular instrument (of < 1.0 arcsec accuracy) utilizing Nano-technology equipment addresses and resolves critical limitations and shortcomings inherent when using conventional **single-axis** rotary table or laser interferometer to calibrate and test dual-axis precision digital angular measuring instrument by taking **one axis at a time**.

3. Utilizing the "Absolute Level Setting" to Set Reference Level Point to Earth Datum

In leveling applications, the primary aim is to align the surface plane of a physical object such as a machine, equipment or engineering structure to a **reference leveling point**, commonly known by tradesmen as '**zero level**'. This 'reference level point' is a planar position tangent to the center gravity of earth i.e. refers as Earth Datum. This 'reference level point' can then be transferred into a leveling instrument. Subsequently, this leveling instrument is used by industrial engineers to set a particular machine/object surface to a required leveling position. The process of transferring Earth Datum to a Digi-Pas® digital leveling instrument is referred as performing "**Absolute Leveling Setting**". By performing Absolute Level Setting on Digi-Pas® digital levels, it also effectively removes any offset resides in the instrument and thus resetting the instrument's reference leveling point to coincide with earth datum.

Similarly, "**User Self-Calibration**" is another alternative process to transfer Earth Datum and automatically store the reference leveling point into a Digi-Pas® digital leveling instrument.

For further information on earth datum, please also refer to web-link: **Geodetic Datum**.

http://en.wikipedia.org/wiki/World_Geodetic_System

4. What happen to the accuracy of Digi-Pas® leveling instrument/tool if it drops?

Likewise to any precision measurement instrument/tool, mishandling such as dropping a digital level to the floor or storing it outside the specified temperature range, could affect its accuracy. This is due to structural deformation resulted from mechanical shock on impact when dropped and physical micro-dimensional changes (e.g. non-linearity) resulted from thermal expansion or contractions when storage temperature exceeded maximum specified range.

However, unlike traditional 'bubble' spirit levels and many other digital levels in the market, all Digi-Pas® digital level is built with User's Self-Calibration feature. This feature empowers users to perform their own calibration without the need to sending to 3rd party testing laboratory for inspection when minor mishandling the device. At user's convenient work site or field work, User's Self-Calibration can reliably reset the Digi-Pas® digital level back to factory preset accuracy whenever in doubt with the accuracy.

For further information on Digi-Pas® digital level, please refer to **FAQ** at the following web-link:
<http://www.digipas.com/faq.php>.