

LiPAD[®]-100

Portable Alignment Device

Technical Description & Application Paper



Compact and flexible handheld gyro compassing system
Providing heading, roll and pitch angular information
Suitable for alignment, positioning, survey and monitoring

Fast

- Real-time data display
- Permanent data acquisition
- Ready to use in 5 minutes

Efficient

- Easy to use, no special skills required
- Single person operation
- No additional alignment equipment necessary
- Eliminates expensive and time consuming surveys
- Rechargeable & exchangeable battery
- Operation time up to 6 hours (fully charged)
- Short battery charging time
- Compatible with Android handheld devices
- Data import / export possible
- Ideal quality control measurement device

Reliable

- Inertial measurement technology
- Calibrated over a wide temperature range
- GPS independent
- Internal system test monitoring
- Shock / vibration resistant
- Simple measurement procedure to avoid errors

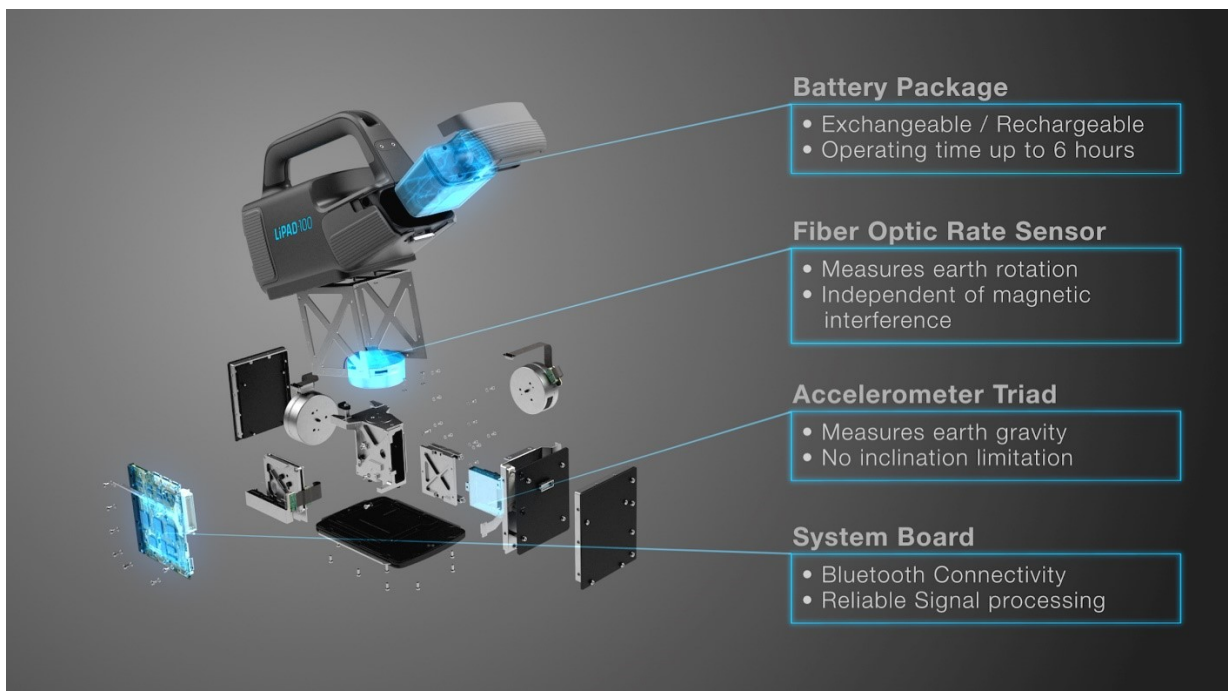


Technical Description

LiPAD[®]-100 is designed as a battery driven stand-alone system. The core of the LiPAD[®]-100 system is the LCI-100N north seeker, a fibre-optic survey-grade gyrocompass and inertial measurement unit. It provides the three angles true north heading, roll and pitch with respect to its x-, y-, and z-axis.

The measured sensor data are processed within an analytical platform algorithm by a digital computer, which also performs sensor data compensation, operational mode control, built-in tests and communication via the system interfaces.

The LiPAD[®]-100 handheld system comprises the following main modules:



- Three orthogonally mounted fiber optical rate gyroscopes measuring the angular increments (delta-angles) without any inclinometer limitation;
- A MEMS-based accelerometer triad with three orthogonal sensing axes measuring linear accelerations (velocity increments) along the three axes;
- A rechargeable battery power module with the capacity to operate the system for a minimum of 6 hours. The battery can be exchanged and charged with an external charging device in approximately 2 hours. Meanwhile, a second battery allows continuous operation.

- A digital computer controlling the interfaces and the modes of operation of the north seeker, providing the sensor data compensation and the built-in test results;
- A Bluetooth® module transmitting the measurement data to a handheld device such as tablet or mobile phone, and allowing the control of the LiPAD®-100 modes and status through the operator.
- An internal interface for tests, debugging and other purposes.

LiPAD®-100 offers Bluetooth® Version 4.2 connectivity to communicate with your handheld device. An Android based software App (provided at no cost in Google Play online store) enables the operator to control the device and display the measurement data in real-time. All data can be stored and forwarded together with the GPS information of your current position, operator, project name and date/time.

The baseplate is designed to be attachable to alignment fixtures, placed repeatedly on measurement spots or used for any other reference position survey. The compact design lets the operator handle it in an easy way wherever needed, even in small space applications. Besides sparkling water and dust resistance, it operates independent of magnetic surrounding, and meets the gyrocompass performance within the specified temperature range of -20°C ... +60°C (stationary conditions).

Two exchangeable batteries, a battery charging device, a storage/transportation case and a technical manual are provided with the system.

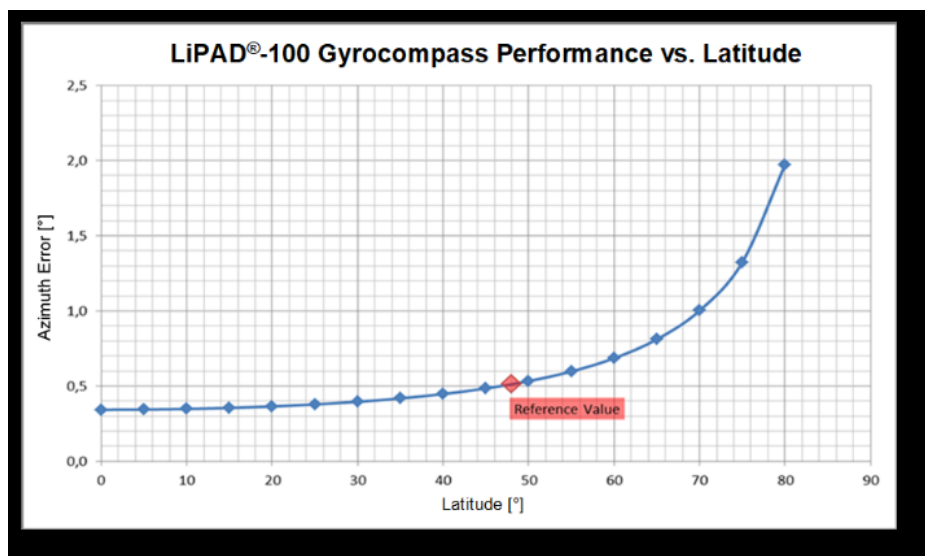


Performance Characteristics

LiPAD[®]-100 provides absolute orientation (true heading) as well as pitch and roll angle with accuracies as shown below:

Parameter	Unit	Accuracy LiPAD [®] -100
True-Heading Accuracy (1 σ)	degree	$\leq 0.35^\circ$ secant latitude (alignment proceeding time ≥ 5 min)
Pitch & Roll Accuracy (1 σ)	degree	$\leq 0.05^\circ$

The achieved gyrocompass performance is depending of the actual latitude position. The reference value marked in the graph represents the heading error expected for measurements performed at LITEF location in Freiburg, Germany.



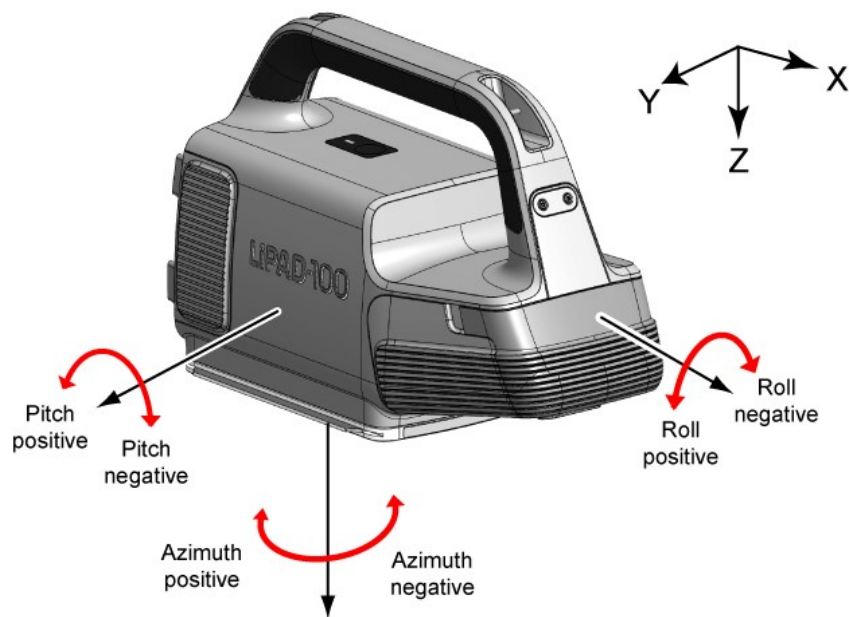
Inertial rate sensors, as used in LiPAD[®]-100, have a systematic, time related drift. This drift causes a slight change of the measured angles even when the system is not moving. Due to advanced methods, this drift is limited to 0,1° per hour at LiPAD[®]-100.

After five minutes alignment time, LiPAD[®]-100 is ready for use and provides permanent valid data. No time consuming alignment setup or additional equipment are required which makes it easy to use for anyone who needs to perform reliable and repeatable alignment or measurement tasks.

LiPAD[®]-100 is suitable to measure the absolute direction of one or multiple objects relative to the earth's rotation axis or the relative direction of multiple objects to each other (e.g. parallelism, orthogonality).

Two selectable measurement modes are available

- Display of pitch and heading in 2D
- Display of roll, pitch and heading in 3D



The following pages show some typical measurement and survey applications where true-heading and attitude (pitch and roll) data are required but GPS or a magnetic compass are not usable.

These are only examples – the applications are almost unlimited.

Drill Alignment



At directional drilling tasks, the initial azimuth and tilt angle of the drill-head is needed to ensure the required direction of the borehole, which is given by construction engineering. LiPAD[®]-100 can be used to provide the direction information without expensive and time-consuming geodesy alignment process. Since LiPAD[®]-100 provides roll, pitch and heading angles, the measurement is insensitive to roll angle deviations and still obtains the correct drill rod tilt and azimuth angles.

Data is transmitted to an optional handheld device in real-time and displayed graphically with the supplied app. This makes it easy for any operators to align the drill accurately.

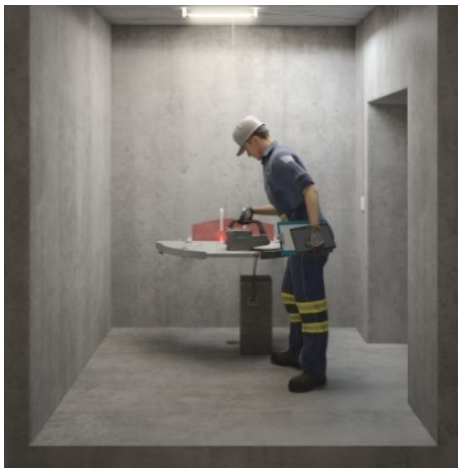
The measurement results can be stored for later quality control purposes, e.g. as documentation for civil regulation requirements.

Handling a multiplicity of boreholes safely has never been that easy.

Geological Surveying / Condition Monitoring

Measuring distances and directions in survey tasks requires accurate heading, pitch and roll information. Traditionally, this data is created by accurate triangulation between known reference points. These arrays of measurements typically accumulate errors.

Since LiPAD[®]-100 provides heading, pitch and roll independent from previous survey point measurements, less measurement errors accumulate during the test series. This is especially of great advantage in ragged environments or environments where no GPS signal is available.



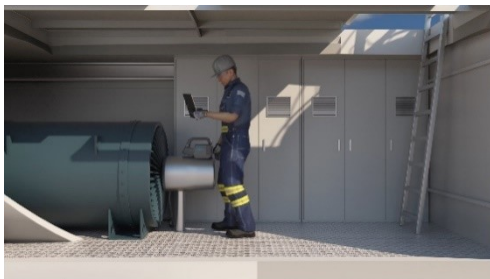
Large buildings or plants are frequently monitored to detect possible damages early. Parameters like vibration, change of position and attitude are measured to determine whether maximum permissible values have been exceeded.

LiPAD[®]-100 is used for periodic measurements at fixed survey points inside a building, mine or tunnel. It is installed with a precisely machined mechanical adapter to ensure a high repeatability of the measurements.



LiPAD[®]-100 significantly enhances the efficiency of these measurements. Series of measurements, which normally take days using a tachymeter or optical theodolite, are made in a few hours using LiPAD[®]-100.

Adjusting a Wind Sensor on a Wind Energy Generator



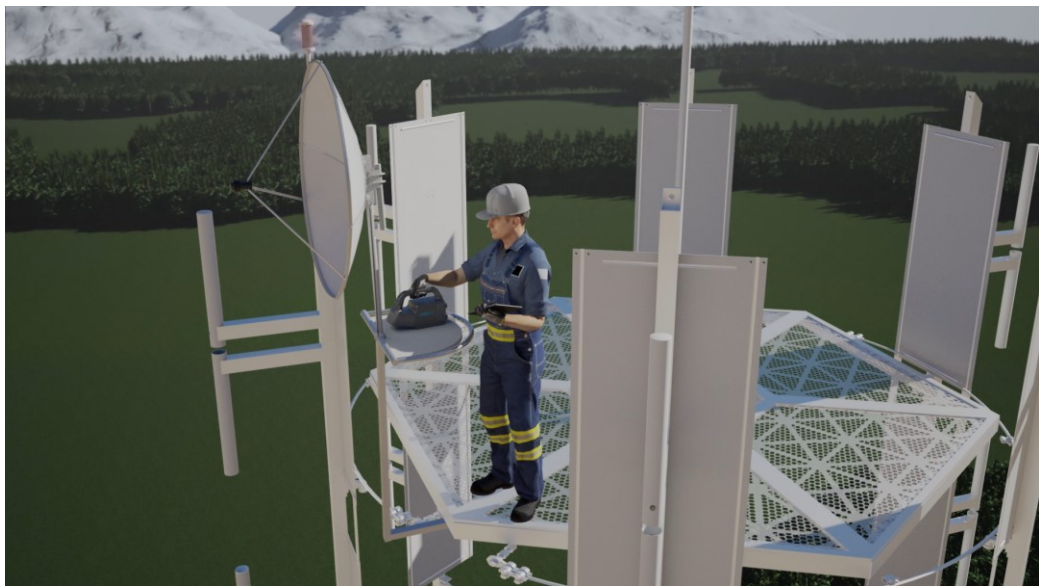
The handheld device can also be used to relatively adjust different parts to each other. This example shows the alignment of the roof top wind sensor to the generator axis, which is essential for the generator's efficiency. LiPAD[®]-100 can record the shaft direction and keep it as a reference independent of workmanship movements. The device is then carried to the wind measurement sensor, which is located on top of the turbine housing in order to align it parallel to the generator axis.

LiPAD[®]-100 enables accurate alignment possibilities even in small space conditions, and can be used by any operator without external special survey team.

Antenna Adjustment

If your task takes place in heights where bulky equipment cannot be used, you will appreciate the LiPAD[®]-100 possibilities. This example shows the installation and adjustment of radio / telecommunication antennas on high masts.

Based on its compact design and high robustness against shocks and electromagnetic fields, LiPAD[®]-100 is the best option for this task.



LiPAD[®]-100 is designed that it can be used anywhere by any operator without the need of external survey specialists. After a short alignment, you will be able to perform adjustments with an accuracy of half a degree secant latitude –

Accuracies that are second to none for handheld devices.



Industry Machine Alignment



Another application task is the installation and adjustment of several axis of a machine where the axis need to be aligned with high precision.

The small size of the temperature calibrated device makes it an ideal tool to enhance installations and periodical maintenance control. Even small spaces are accessible with LiPAD[®]-100 and extreme temperature conditions will not affect the calibrated measurement device. LiPAD[®]-100 also forgives handling bumps which can always happen in these conditions.

Thinking of a larger amount of part adjustment like in printing machines and frequent re-adjustment / monitoring of the parts to prevent production downtimes, this small measurement device will be economical reliable after a short time.

Plus, the cost of expensive survey teams are saved as well!

Summary

LiPAD[®]-100 is a compact, easy to handle gyro compassing device which delivers accurate north direction, roll and pitch angle to your handheld device in real-time.

LiPAD[®]-100 is suitable for alignment, positioning, survey and monitoring applications independent of harsh environmental conditions.

The measurement device can be used conveniently by any operator without time-consuming survey setup in the field.

The battery driven system operates safely independent of magnetic influence, shock/vibration impact, temperature variation or harsh conditions like dust and rain – a solid companion for various tasks.

***Series of measurements, which normally take days,
are made in a few hours using LiPAD[®]-100.***

Fast. Efficient. Reliable.



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