AutoHeight Feature
White Paper

FlexLine

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Leica Geosystems

AutoHeight Feature –
A new way to measure instrument height

Measuring a total station's instrument height to ground has always been a time-consuming and cumbersome task. Considering the ongoing digitalisation of collecting, sharing and processing geospatial information in all dimensions, the conventional method of using an analogue tape has become an even bigger weakness in terms of traceable and error-free data acquisition.

With the release of the Leica FlexLine Series TS03, TS07 and TS10, Leica Geosystems provides not only a new range of reliable, long-lasting and high-quality manual total stations but also introduces AutoHeight – an innovative functionality for getting the instrument height with a simple button press. The AutoHeight functionality is available in the Leica TS07 and TS10.

Figure 1 – Leica Flexline TS07 and TS10. World's first total stations with integrated instrument height measurement.

Figure 2 – Illustrating the downsizing challenge. Leica Geosystems' smallest DISTO D110 (left), AutoHeight module (middle), TS10 (right).

Problems of the past

Nowadays, total stations represent extremely precise and powerful measurement systems. Highly complex in mechanical and electro-optical design and supplied with efficient and easy-to-use onboard software, total stations support the operator during daily measurement and stakeout tasks.

Despite these valuable and versatile characteristics, there is an initial well-known procedure typically required before the actual data acquisition starts, namely the Station Setup. Levelling and centring the instrument above a given point on ground delivers the 2D link to a common and higher ranked coordinate system, while taking the instrument height finally delivers the full 3D reference of your further collected data.

Until now, this step of measuring the instrument height was under the responsibility of the operator and the particular analogue tape being used. This led to a missing traceability, affected all further measurements from this station, and could cause several hassles and sources of errors:

- A forgotten or lost tape can limit the field work on 2D point collection only
- A damaged tape can cause inconspicuous height errors in the final point measurements
- Inconvenient handling can cause errors e.g. due to an oblique tape alignment or a sagging tape
- Unnoticed reading or typing errors when entering heights by hand can cause gross errors
- A manual height measurement takes time and interrupts the workflow inside the user interface

In the past, technological approaches of solving this problem were facing a challenge considering the given space limitations. See Figure 2.

How does it work?

By replacing the traditional downward-facing laser plummet with an electro-optical distance measurement (EDM) system, two functionalities are now provided by one sensor:

- Using the pointer mode for centering above ground
- Using the EDM mode for taking heights above ground

The pointer mode works the same way as it is known from the traditional laser plummet. It is switched on when the Level & Compensator Panel is entered. The intensity can be adjusted to adapt to surrounding light conditions.

The EDM is based on a time-of-flight principle and realized by a biaxial optical design. As can be seen in Figure 3, the small lens centrical to the standing axis represents the transmitter (Tx) while the eccentric bigger lens (Rx) receives the reflected light from the ground. Its characteristics can be seen in Table 1. AutoHeight can measure any surface and does not require a specific target. The specified accuracy refers to 18% reflectance which is a realistic value according to the reflectance of most common ground points such as surveying nails, markers or concrete. The instrument height can directly be measured and applied inside the Setup app. When entering the appropriate panel (Figure 4), the pointer switches on automatically and the operator can see where the height will be measured to. The height will always be measured where the visible laser hits the ground. In addition, a height offset can optionally be entered. This can be useful, if the laser is e.g. centered to the inner notch of a surveying nail, but the height from the upper edge is desired. In this case the notch depth can be entered as negative height offset.

AutoHeight can be used with all existing Leica tripods and tribrachs without plummet. In case of extremely unbalanced tribrach foot screws, a warning message might appear to turn the instrument by Hz = 180° to escape a possible shadow area of the receiver (Figure 5) and to try again.

Benefits of AutoHeight

With AutoHeight one of the last analogue & cumbersome measurement procedures is replaced by a simple button press which delivers the following key benefits:

- No more time lost during cumbersome tape handling
- Accurate and reliable instrument heights
- No more mistakes in manual height reading and typing
- No more additional equipment to take care of

This enables the operator to finish the Station Setup in an efficient and reliable way so that the user can quickly focus on the actual working task.

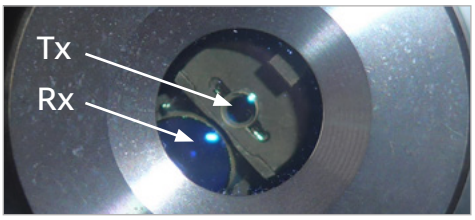

Figure 3 – Visible transmitter (Tx) and receiver (Rx) lens of the AutoHeight module, bottom view.

Table 1 – AutoHeight characteristics.

Laser class	2
Height accuracy	1 mm (1 σ over range, Kodak Gray Card 18% reflectance)
Working range	0.7 m to 2.7 m (Instrument height from tilting axis)
Meas. time, typically	< 3 s

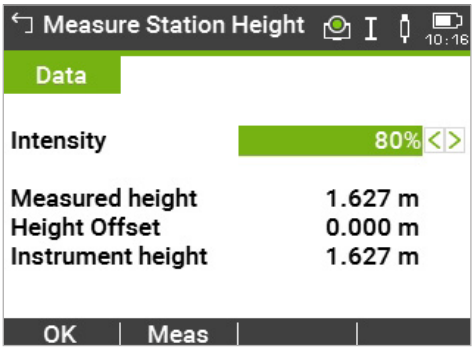

Figure 4 – Example of the FlexField panel for measuring the height on the Leica FlexLine TS07.

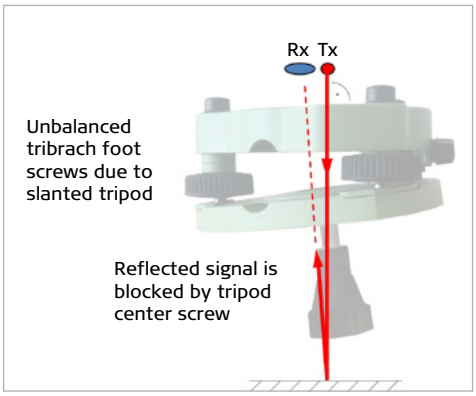

Figure 5 – In such an unlikely event, turning the instrument by Hz = 180° will move the receiver outside the shadow area and enable a new try.

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Swiss Technology
by Leica Geosystems

Leica FlexLine Series
Data Sheet

Leica FlexLine TS03/TS07
Data Sheet

Leica FlexLine TS10
Data Sheet

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