

System 1200 Newsletter – No. 23

Copying a SmartStation

SMARTSTATION – A WORLD'S FIRST

On 31st January 2005, Leica Geosystems proudly announced the world's very first total station with integrated GPS – the **System1200 SmartStation**.

Newsletter no.19 explained why Leica created the SmartStation, what it can do and how it will change the way surveyors think and work. Initial feedback from the market is very positive...

And clearly other manufactures also recognise the benefits of the SmartStation and are now in a hurry to copy our innovation – we have already received these pictures of “SmartStation” look-a-likes.



But how easy is to create a SmartStation? Is it as simple as the pictures above may suggest? Is it only needed to drill a hole in the handle of a total station and bolt on a GPS antenna?

TRUE INTEGRATION

Perhaps it is first useful to recall what is the purpose of the SmartStation – it is the ability to easily and quickly determine the coordinates of the total station using GPS.

Of course, this was already possible before SmartStation. Mount the antenna of an RTK rover on a tripod, obtain the RTK coordinates, remove the GPS antenna and then place the total station on the tripod. It is now possible to enter the coordinates of the known point as the known for the total station.

So surely to create a SmartStation is as simple as bolting a GPS antenna to the total station? But consider the following - what about streamlining the work flow by combining the ability to

measure a GPS point within the setup routine of the total station instrument? What about the combining and handling of total station and GPS data within the instrument database? What about hardware compatibility? What about the cost?

STREAMLINING THE WORK-FLOW

A great deal of thought went into the streamlining of the workflow when using a SmartStation – most of it is not immediately apparent by looking at the hardware alone.

THE BASICS

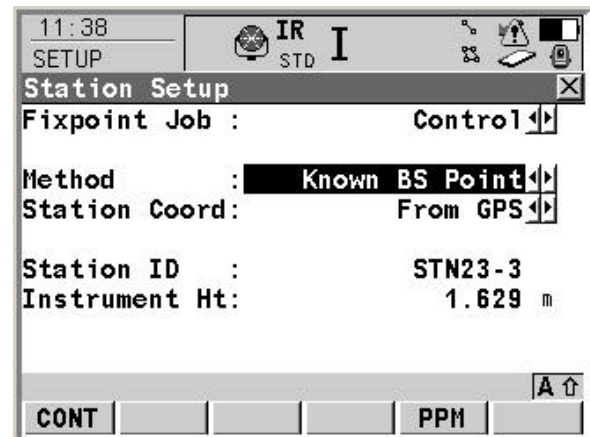
With the Leica SmartStation, once the SmartAntenna is mounted onto the total station and the total station is turned on then the SmartAntenna is automatically and immediately powered up – the user does not need to remember to do this.

It automatically starts to track satellites, receive RTK corrections and to resolve ambiguities and so by the time the user has levelled the instrument and needs a GPS position then a cm accurate position will be available. No delay.

SETTING UP THE TOTAL STATION

After levelling the instrument, the user now needs to “setup” the instrument – that is, the instrument needs to be positioned and orientated. To do this with the TPS1200 instrument the **Setup** application program is used.

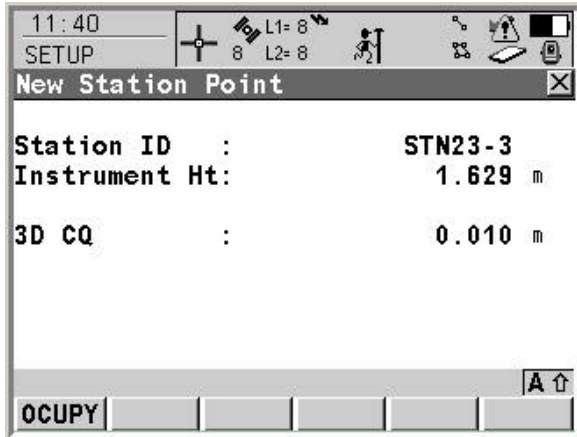
With a SmartStation instrument, the **Setup** application is extended such that in order to obtain the RTK GPS coordinates from the SmartAntenna it is only necessary to choose the **From GPS** option in the **Station Coord** list box. (The last used method is remembered, so it probably is not even necessary to do that).



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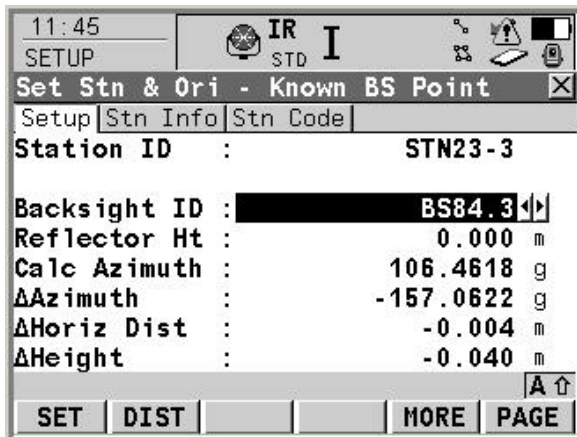
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F1(CONT) now accesses the panel where the GPS point can be measured. This panel is the same as found on the GPS1200 instrument – so already familiar and very easy to use.



The first 5 icons have automatically changed to GPS related icons showing all necessary GPS RTK related information – how many satellites are being tracked, the position solution type currently being computed, the RTK data link status etc. GPS related information instantly available when needed - if more GPS status information is needed, then simply touch the icons!

After pressing **F1(OCUPY)** to measure and store the GPS point, the orientation of the total station can be made and the setup routine is complete. Simple.



The SmartAntenna can now be removed from the total station, or can be left on the instrument. If it is left on the instrument, then after a certain period of time (as defined by the user) the SmartAntenna will automatically power down to save battery power.

The point here is that the use of the SmartStation has been fully integrated into the work-flow of the user. There is no need to press buttons to switch between using a GPS instrument and a

total station. There is no need to change the configuration of the instrument. There is no need to store the GPS measured point and then later retrieve this point in order to use it as the total station position. This is all fully integrated into the setup routine. Simple.

IMPROVING THE HEIGHT

The nature of GPS is such that the height component of a GPS measured point is approximately twice as bad as the horizontal component.

What if you want to use the easting and northing coordinates from the GPS but want to transfer the height to the total station from a known point measured with the total station? This is possible with a SmartStation instrument – simply choose the **Ori & Ht Transfer** setup method in the **Setup** application – the height of the total station can then be determined by measuring to one or more known points.

OTHER SMALL DETAILS...

The complete work flow of using a SmartStation has been considered – including small details – for example, if you try to measure the GPS point before the total station is levelled, a warning message is shown.

Another example is that if you try to measure the GPS point before having chosen a coordinate system then a warning message is shown - obviously you cannot use a GPS position (stored as WGS84 coordinates) as the total station coordinates (needed as local grid) unless a coordinate system is being used. If you don't know the coordinate system, then simply enter arbitrary coordinates – subsequent SmartStation setups in the same area will fit together.

The whole process of obtaining and using the GPS RTK position is seamless and simple – even surveyors who have never used GPS before can use a SmartStation.

THE DATABASE – DBX

The DBX database was already used within the GPS1200 and TPS1200 instruments when System1200 was released over a year ago. It was designed to be able to store all information relevant to both total station and GPS measurements – not as trivial a task as may first appear.

RTK GPS measurements are stored as WGS84 coordinates with associated information such as baseline components, quality information and so

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on. Total station measurements on the other hand are stored as grid coordinates along with raw observation measurements (Hz, V, slope distances), ppm values (both atmospheric and geometric) and so on. In addition to this “instrument specific” information there is data common to both instrument types such as coding, attribute, annotations, lines and areas.

Thus, the design of the database also plays a major role when combining a total station and GPS – this is perhaps not always so obvious when simply bolting a GPS antenna to a total station.

RTK DATA LINKS AND DEVICES

Which RTK data link (or device) do you use with your RTK system? Sateline 3AS or 2ASX radio? Pacific Crest RFM or PDL radio? Siemens MC45 or TC35 GSM modem or some other GSM modem? CDMA? Is it in a housing (the same as the housings used for GPS1200) or is it a Bluetooth enabled device?

With SmartStation it does not matter – all devices are supported. Even if you currently use a radio today, but may switch to use GSM or CDMA in the future then you only need to obtain the additional device – no hardware or firmware upgrades are needed – simply plug it in and use it.

Do you use your own single reference station, or do you use a reference network or even NTRIP? RTCM or Leica or QMR or CMR+ data formats? Again, with SmartStation it does not matter – all are supported.

And of course, it is easy to configure a SmartStation to handle all the RTK data link and device options – the necessary functionality and panels have simply been copy and pasted from the GPS instrument to the SmartStation.

HARDWARE COMPATIBILITY

There are also many things to consider with regards to the compatibility of the hardware before simply bolting a GPS antenna to a total station.

SUPPORT OF FULL INSTRUMENT RANGE

The SmartAntenna can be used with any System1200 total station – from the “entry-level” TC1205 (non-motorised, non-reflectorless) to the “high-end” TCRP1201 (motorised, reflectorless, robotic) instruments.

This means that it is possible to create a SmartStation instrument for most budgets – a surveyor is not forced to buy a top-of-the-line total station and pay for functionality which may not be used. With other manufacturer’s instruments, it is only possible to bolt a GPS antenna to certain total stations – the most expensive top of the range instruments.

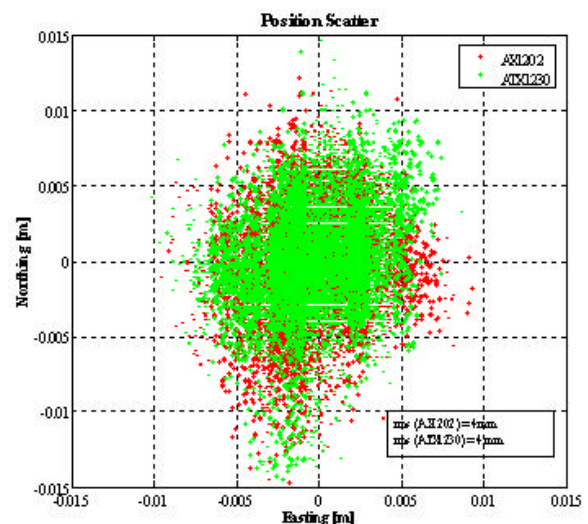
Additionally, the SmartStation can be operated from the total station keyboard – it is not needed to use the RX1200 controller. With other manufacturer’s “SmartStations” it may be necessary to use an external controller or data logger in order to measure the GPS point – even if that data logger is then no longer used to complete the survey.

EFFECT OF THE TOTAL STATION ON THE GPS

In the crudest terms, a total station could be considered a lump of metal with a lot of electronics built in – possibly not the best environment in which to use a GPS antenna near to.

The Leica SmartStation has been specifically designed and has undergone extensive tests to ensure that there is no influence of the total station on the GPS performance.

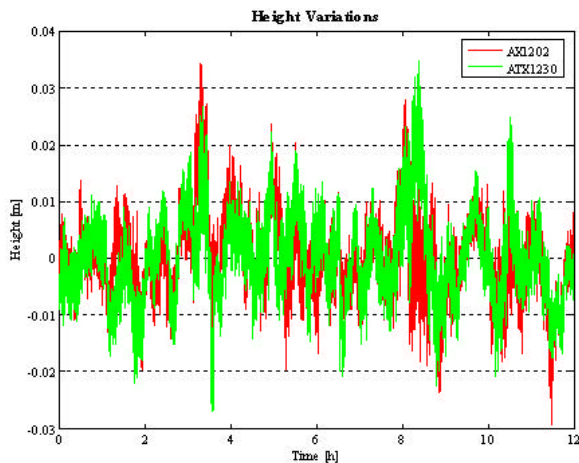
For example, the plots below are position scatters in horizontal and vertical components. The green dots relate to the ATX1230 antenna and the red dots relate to the AX1202 antenna as used with a normal GPS1200 RTK rover.



The plot above shows the easting and northing components and the plot below shows the height component.

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It can be seen that the RTK performance is identical. And remember that newsletters 01 and 18 already showed the superior RTK performance of GPS1200 to competitor's RTK units – this RTK performance is also available with SmartStation.

EFFECT OF THE GPS ON THE TOTAL STATION

What could be the effect of placing of a GPS antenna on a total station? The GPS antenna has weight - especially if it includes a battery and RTK device. If the GPS antenna therefore remains mounted on the total station during the survey, then what effect could this additional weight have on the motors and/or gears which turn the instrument?

The Leica SmartStation has undergone extensive tests to ensure that there are no detrimental effects on the total station from the SmartAntenna.

OFFSETS

In order to determine the coordinates of the point on the ground when using a SmartStation then the height of the GPS antenna above the ground needs to be known.

With the SmartStation, simply measure to the same point on the total station as with non-SmartStation instruments. The offset from this point to the "centre" of the GPS antenna is fixed and known by the instrument and is automatically applied. Nothing for the user to worry about here.

If you simply bolt a GPS antenna to the total station, then do make sure you know and apply the correct offset!

COSTS

And now to the bottom line.

The Leica SmartStation consists of a TPS1200 total station instrument and a ATX1230 SmartAntenna. The ATX1230 SmartAntenna fits to any TPS1200 total station all the way from a 5" non-motorised instrument to the top of the range 1 " motorised, reflectorless, robotic instrument. This makes the price of the "entry level" SmartStation extremely low.

Bolting an RTK GPS antenna onto a total station on the other hand means that you had to purchase a complete total station and RTK rover system – this price can never compete with the SmartStation.

Of course, with a Leica SmartStation you can then choose later to buy a GTX1230 receiver and RX1200 controller and then also use the ATX1230 SmartAntenna as an RTK rover. But only if you choose.

Bolting an RTK rover antenna onto a total station system will always mean that a lot of money is tied up in a piece of equipment which for most of the time is not being used – one surveyor can only use either the total station or GPS instrument at one time.

The flexibility of the Leica SmartStation approach means that the user is free to purchase what is needed when it is needed. And of course, all existing TPS1200 instruments can be upgraded to be used as a SmartStation

SUMMARY

It may initially appear trivial to create a SmartStation by bolting an RTK GPS antenna to the handle of a total station, but as this newsletter has explained, there are many things to consider

If you can recognise the benefits of a SmartStation and are thinking to buy a total station with integrated GPS then maybe you should consider the following...

Do you want to invest in an instrument where the integration of the total station and GPS technologies has been fully investigated and evaluated or do you want to invest in a total station which has a hole drilled in the handle with a GPS antenna bolted on top?