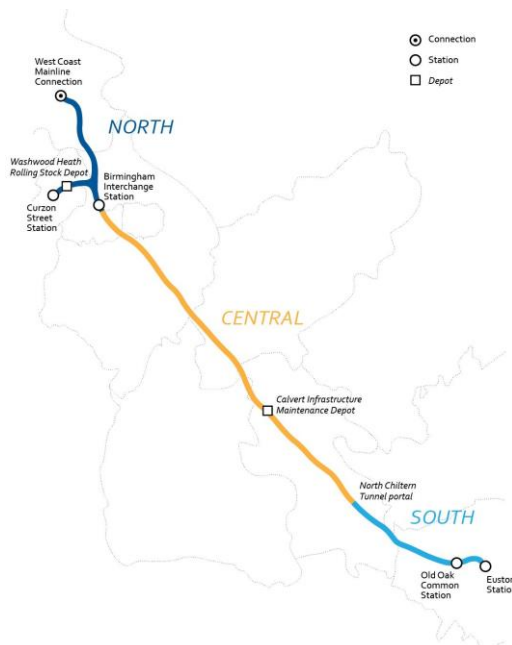# Leica Geosystems – Captivate Quick Guide
Using HS2 co-ordinate systems with Leica Captivate and Hxgn Smartnet

This Guide will take you through the process to upload the <u>HS2 Survey Grid 2015</u> Coordinate System to your Captivate Instrument, and to check that you are receiving suitable corrections from the Hxgn Smartnet service.

1. Why should you use the HS2 Survey Grid 2015? The story so far…
2. Downloading and installing the files to the instrument.
3. Activating the Coordinate System on your instrument.
4. Checking the Smartnet port number and Mountpoint.
5. Configure Leica Captivate For HS2 Survey Grid_2015 with Hxgn Smartnet.

1. Why should you use the HS2 Survey Grid 2015? The story so far...

Phase 1 of the HS2 engineering project originally started out with a unique **SnakeGrid** transformation called **HS2P1_14** and used **OSGM02** as the height datum.

A **SnakeGrid** transformation is designed such that for very long projects such as railways, roads or pipelines a single coordinate system can be used over the entire length of the project without introducing distortions and scale issues when converting from grid to ground distances. (See http://snakegrid.org/technical-zone **for more information on SnakeGrids.**)

The HS2P1_14 snakegrid was based upon the Ordnance Survey CORS (Continuously Operating Reference Station) network called **OSNet** which forms the reference frame for accurate engineering survey in the UK. These reference stations are also used by **Hxgn Smartnet** for RTK corrections and raw data for GNSS post processing.
Recently, the co-ordinates of **OSNet** were updated to account for an improvement in the underlying reference system, called ETRS89. This was applied by the Ordnance Survey in **August 2016** and the new realisation of the reference frame was called **OSNet v2009**. Ordnance Survey released their new transformation file called **OSTN15** to produce correct OSGB36 positions when using **OSNet v2009.**
(See https://www.ordnancesurvey.co.uk/legacy/docs/gps/updated-transformations-uk-ireland-geoid-model.pdf **for more information on the Ordnance Survey update.**)

BUT.... the **HS2P1_14** SnakeGrid had been calculated using the previous realisation (called **OSNet v2001**) and was not able to allow for this change.
If **HS2P1_14** is used with **OSNet v2009** then differences at the cm level can be observed.

Therefore **HS2P1_14** has been superseded by **HS2 Survey Grid 2015.**

HS2 Survey Grid 2015 is not a SnakeGrid system. Instead it uses a **Transverse Mercator** projection (called **HS2_Snake**), combined with an **NTv2 type transformation** (standard binary grid shift) which when used correctly with **Hxgn Smartnet** on **OSNet v2009** will yield correct plan positions in HS2 Survey Grid co-ordinates. The transformation is called **HS2TN15_NTv2.** (See https://en.wikipedia.org/wiki/NTv2 **for more information on NTv2 formats**)

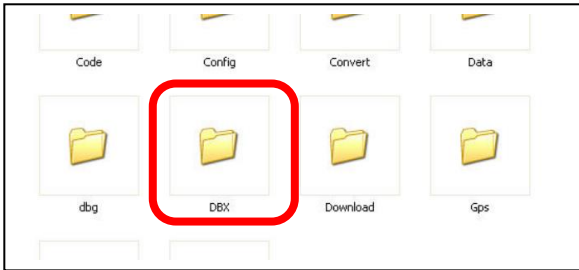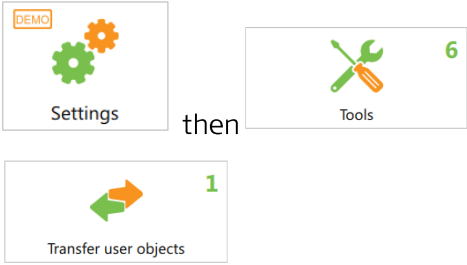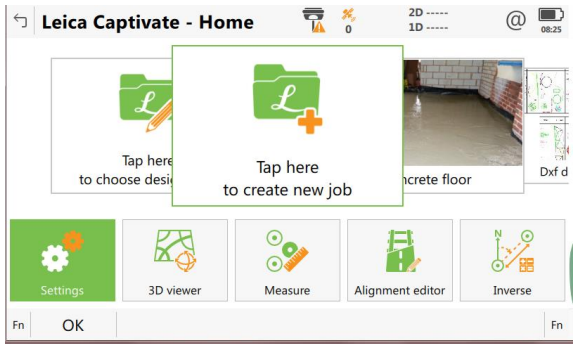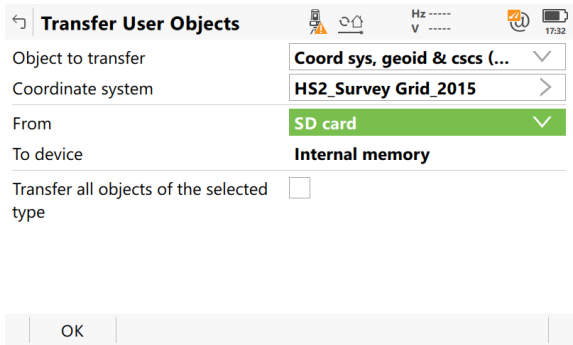**Height Measurements**
At the same time as the CORS network was updated, the national height datum model was also updated from **OSGM02** to **OSGM15**. This introduced an average +20-30mm shift in measured heights related to ODN (Ordnance Datum Newlyn) across the UK, which can cause major issues for large engineering projects such as HS2.
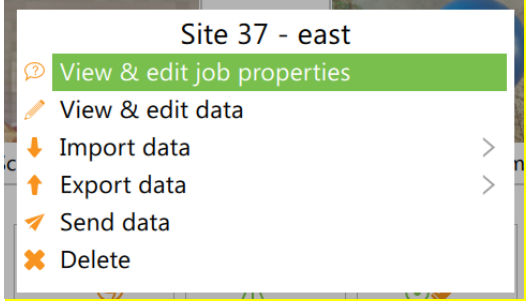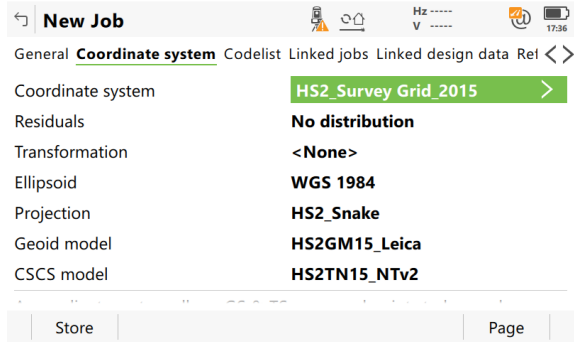
Therefore for consistency in heights, HS2 took the decision to still refer back to **OSGM02** as a height datum, and have created their own vertical reference model, which when used correctly with Hxgn Smartnet will yield height values which match the original **OSGM02** used. This is called **HS2GM15.**

So, to produce up to date HS2 Survey Grid Co-ordinates when using Hxgn SmartNet, Leica geosystems equipment uses (**HS2_snake**)+(**HS2TH15_NTv2.csc**)+(**HS2GM15.gem**)
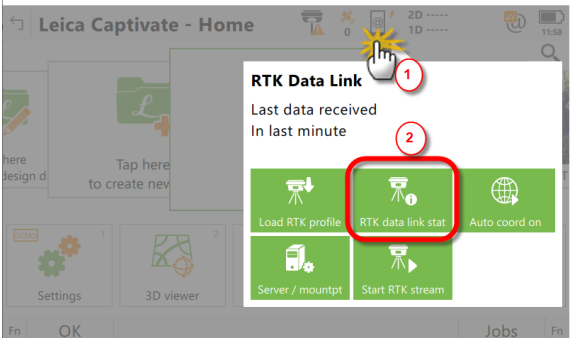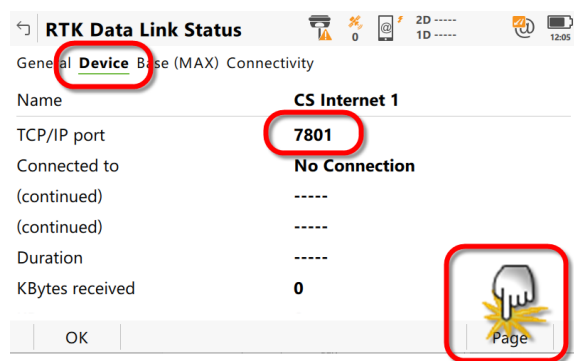
2. **Downloading and installing HS2 Survey Grid 2015 to Leica Captivate**

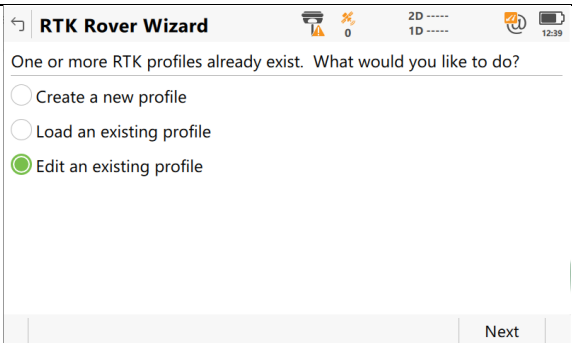| Step	Instruction	Screenshots
	Included with this guide is a zipfile, TRFSET.zip which can be loaded directly to the Leica Captivate hardware. This zipfile holds all the files required.	
1	Save the **TRFSET.zip** file to the DBX Folder on your SD Card or USB stick. This zipfile contains all the files and parameters necessary for HS2 Survey Grid 2015. **Do not unzip the file.**	
2	From the Home screen, select; Settings **then** Tools 6 Transfer user objects 1 From here one can transfer different objects from & to different memory devices.	
3	To load the Coordinate System; Select the following Object to Transfer as **Coord Sys, geoid & cscs (zip)** From : SD card or USB To : Internal Memory Ensure the Coordinate System is shown as **HS2 Survey Grid_2015** and press **F1 OK** **OK** any messages that appear Once the transfer is completed press **No** when asked to load more Files.	

3. **Activating the Coordinate System on your instrument**
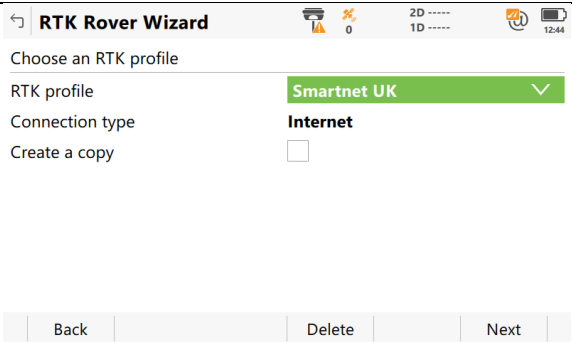
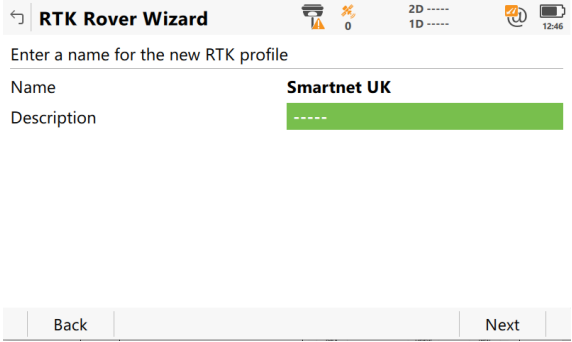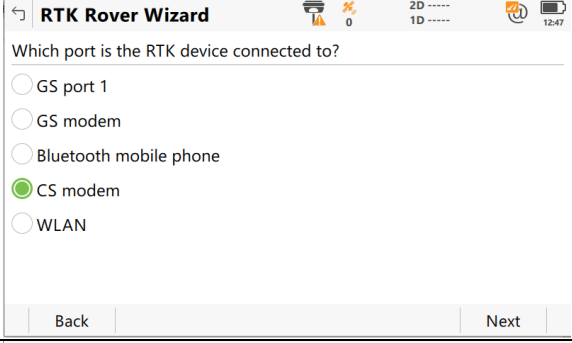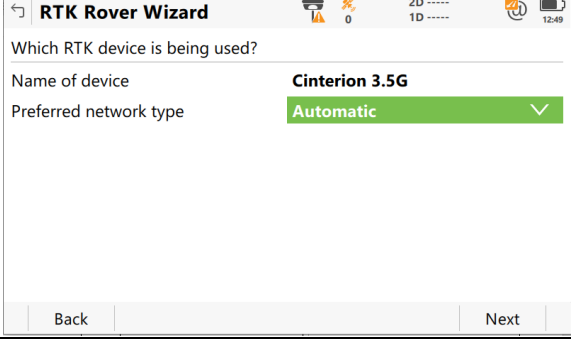| Step	Instruction	Screenshots
4	On the Job carousel on the Home screen, tap on the job you which to apply the coordinate system to and select the View & edit job properties, or create a new job. Select the Coordinate system Tab and use the › to select the **HS2 Survey Grid_2015** coordinate system, Select store. Your instrument is now using **HS2 Survey Grid_2015**.	

- when it has to be **right**
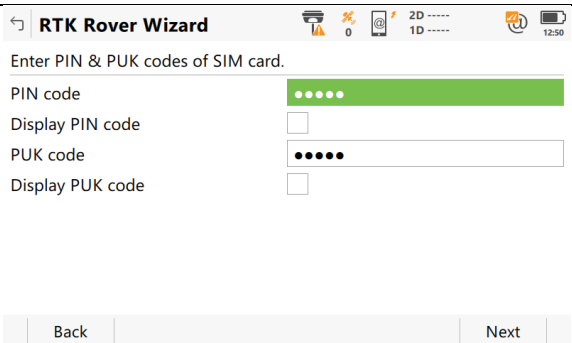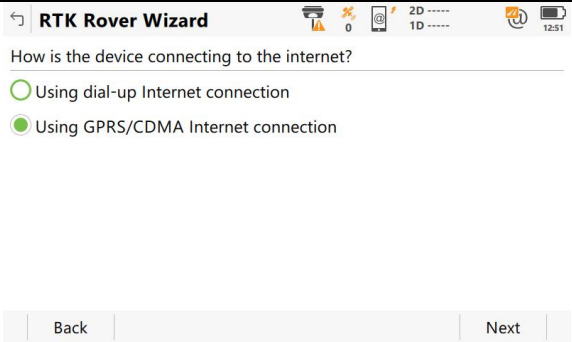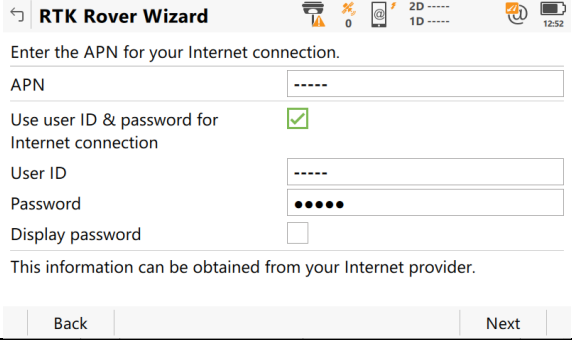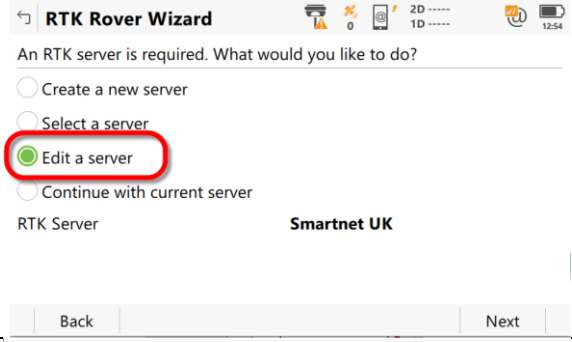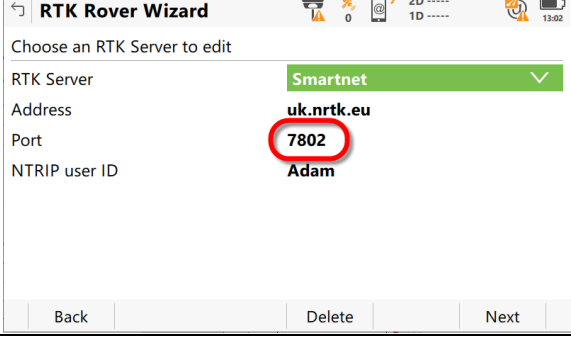
4. **Checking the Smartnet port number**

Step	Instruction	Screenshots
	When using HS2 Survey Grid_2015 with Hxgn Smartnet, the correct port MUST be used. This is an easy way to check the port number.	
1	1. When on the Home screen, tap the [@] icon on the status bar. 2. Tap the ‚RTK Data Link Status' option	
2	The RTK Data Link Status Screen: Tap **F6** or **Page** to highlight the **Device** page. If the **TCP/IP port** is set to **7801** or **9301:** simply press OK and continue to work as normal. Either of these is the correct port number. If the **TCP/IP port** is set to **7802:** Please follow the rest of this section to apply the correct configuration	
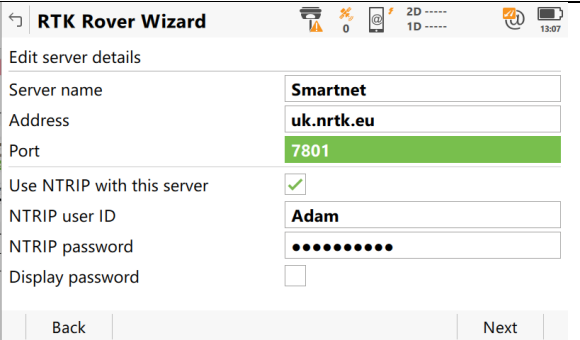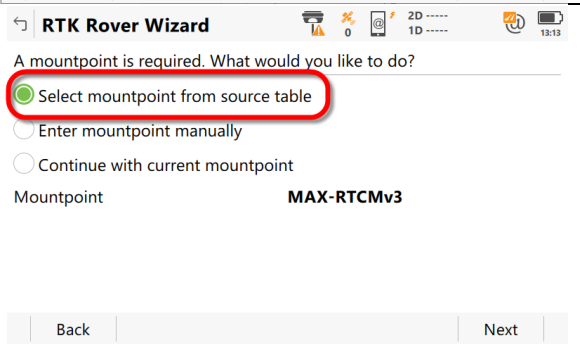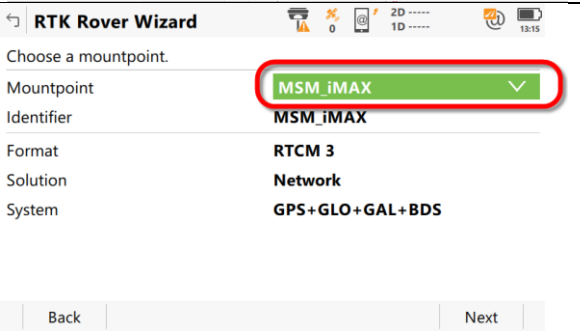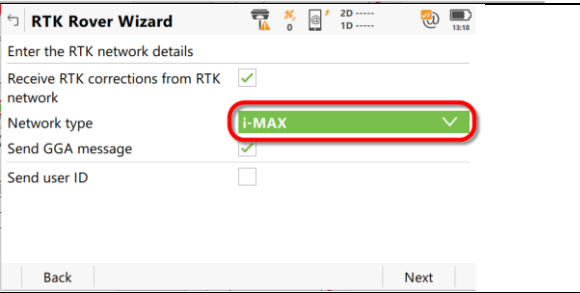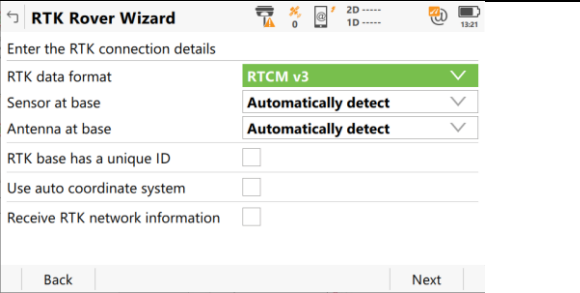
5. **Configure Leica Captivate For HS2 Survey Grid_2015 with Hxgn Smartnet**

Step	Instruction	Screenshots
	This lists the process of editing an existing RTK profile to work with HS2 Survey Grid_2015. It is identical to the settings used for OSGB36(15). **Some existing settings on your equipment may vary from those shown in this guide, depending on such factors as the type of GS antenna being used and the location of the sim card (in the CS or in the GS).** **Please only change the settings where prompted in this guide! Otherwise you may find you are no longer receiving RTK corrections.**	
1	From the Main Menu select **Settings** from the far left of the app list	
2	Then Connections	
3	Followed by **RTK Rover Wizard**	

- when it has to be **right**

4	Select **Edit and Existing profile.** Press **F6 Next**	**RTK Rover Wizard** One or more RTK profiles already exist. What would you like to do? ○ Create a new profile ○ Load an existing profile ◉ Edit an existing profile Next
	For the following pages you may see some different settings to those shown in this guide. Please do not change any settings on these pages.	
5	**Choose an RTK Profile.** This will show the profile currently in use. Typically this is the correct profile to edit. Press **F6 Next**	**RTK Rover Wizard** Choose an RTK profile RTK profile **Smartnet UK** Connection type **Internet** Create a copy Back Delete Next
6	**Enter a name for the new RTK profile.** Press **F6 Next.**	**RTK Rover Wizard** Enter a name for the new RTK profile Name **Smartnet UK** Description ----- Back Next
7	**Which port is the RTK device connected to?** Press **F6 Next**	**RTK Rover Wizard** Which port is the RTK device connected to? ○ GS port 1 ○ GS modem ○ Bluetooth mobile phone ◉ CS modem ○ WLAN Back Next
8	**Which RTK device is being used?** Press **F6 Next**	**RTK Rover Wizard** Which RTK device is being used? Name of device **Cinterion 3.5G** Preferred network type **Automatic** Back Next

9	Enter PIN and PUK of SIM card Press **F6 Next**	
10	How is the device connecting to the internet? Press **F6 Next**	
11	Enter the APN for your internet connection Press **F6 Next**	
	For the following pages please only make the changes listed	
12	Move the focus to **Edit a Server** Press **F6 Next**	
13	Remember! If the port number here is 7801 or 9301 you should not be following this part of the guide! Do not change anything on this page. Press **F6 Next**	

14	**Highlight the Port** Type in **7801** and press enter. Press **F6 Next**	**RTK Rover Wizard** Edit server details Server name — **Smartnet** Address — **uk.nrtk.eu** Port — **7801** Use NTRIP with this server — ✓ NTRIP user ID — **Adam** NTRIP password — ●●●●●●●●●● Display password — ☐ Back — Next
15	Move the focus to **Select Mountpoint from source table** Press **F6 Next**	**RTK Rover Wizard** A mountpoint is required. What would you like to do? ◉ Select mountpoint from source table ○ Enter mountpoint manually ○ Continue with current mountpoint Mountpoint — **MAX-RTCMv3** Back — Next
16	Tap the Mountpoint list and scroll down to select **MSM_iMAX.** This will use multi constellation GNSS if your antenna supports it, but also GPS and GLONASS if that is all your antenna will support Press **F6 Next**	**RTK Rover Wizard** Choose a mountpoint. Mountpoint — **MSM_iMAX** Identifier — **MSM_iMAX** Format — **RTCM 3** Solution — **Network** System — **GPS+GLO+GAL+BDS** Back — Next
17	Tap the network type and select **i-MAX** Press **F6 Next**	**RTK Rover Wizard** Enter the RTK network details Receive RTK corrections from RTK network — ✓ Network type — **i-MAX** Send GGA message — ✓ Send user ID — ☐ Back — Next
18	Nothing should need changing on this page. Press **F6 Next**	**RTK Rover Wizard** Enter the RTK connection details RTK data format — **RTCM v3** Sensor at base — **Automatically detect** Antenna at base — **Automatically detect** RTK base has a unique ID — ☐ Use auto coordinate system — ☐ Receive RTK network information — ☐ Back — Next
	If you are outside and are showing a position, the connection to SmartNet will now be tested. When ready, press OK to return to the home screen. The setup is now complete.	