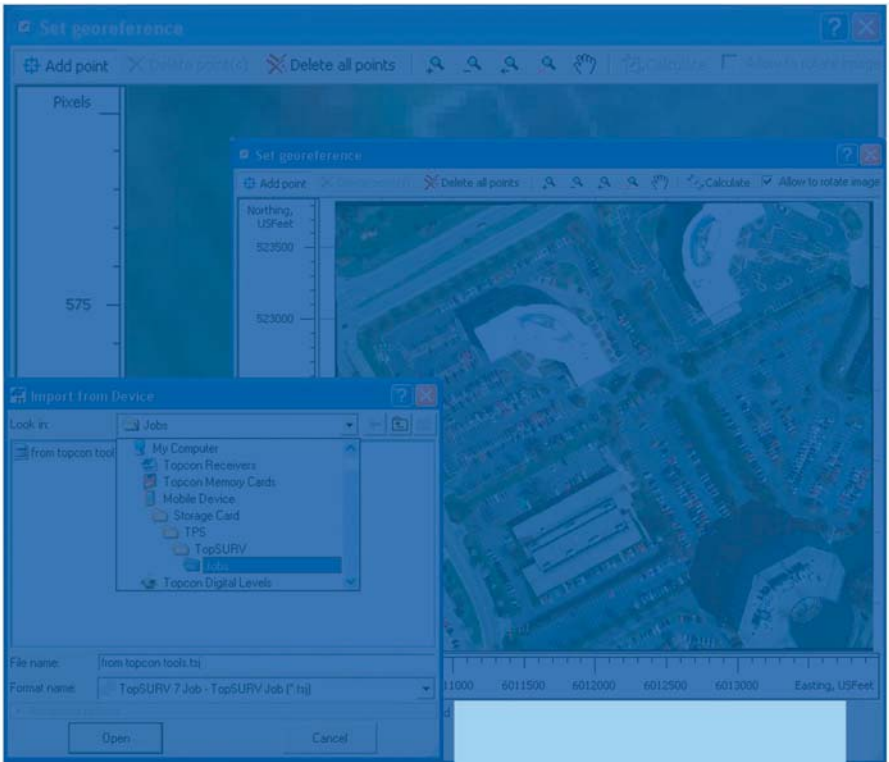


Topcon Tools

Processing RTK Data



Application Guide



Topcon Tools Processing RTK Data Application Guide

Part Number 7010-0928

Rev A

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Notes:

How to Process RTK Data

TopSURV software allows a user to collect and save Real Time Kinematic (RTK) data to a job on Topcon Controllers with Windows CE and/or Controllers with Windows Mobile OS. TopSURV jobs have 'tsj' extension. ActiveSync® software running on a computer is needed to transfer jobs between the controllers and the computer. ActiveSync® is a free software from Microsoft® that establishes a connection between a computer (with operating system Windows XP) and an external device. If the user's computer operates under Windows Vista, ActiveSync is not needed. A connection between the computer and an external device with Windows CE/Windows Mobile will be automatically established after connecting your device to your computer via USB or COM ports.

Working with RTK data in Topcon Tools can be divided into two stages:

- creating a job in Topcon Tools and exporting this job to a Controller
- importing the job with field data from a controller to a computer, viewing and editing data, exporting to any desired file format.

To import/export, view and edit RTK data in Topcon Tools, only

RTK module has to be activated:

Enabled modules:	
Module	Status
<input checked="" type="checkbox"/> RTK	Enabled

Creating TopSURV Job in Topcon Tools

There are two ways to create a TopSURV job:

- directly in Controller
- using Topcon Tools

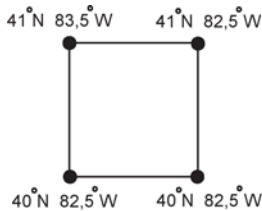
If a user uses Topcon Tools for creating a TopSURV job, he can prepare a job to collect field data in TopSURV. This tsj job will contain:

- set of control points,
 - code library,
 - set of layers,
- and the following separate files for this job:
- a georeferenced background image for work area,
 - the desired geoid file for work area.

It is good to use Topcon Tools for selecting the coordinate system, preparing the geoid of minimal size, georeferencing the background image and importing the necessary set of points. Generally, for preparing a TopSURV job, Topcon Tools is used only once when creating the initial job for a local region.

How to Create a Geoid for Local Area

To save the internal memory of the Topcon Controller, we recommend creating the geoid file for the local region. For this procedure the user has to know the coordinates of boundary points of the work area and to have the original geoid file which is used for this area. As an example, let us create the geoid for the following area,

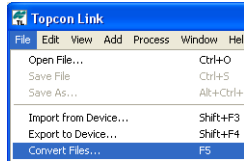


using g2003u07.bin as the base geoid model.

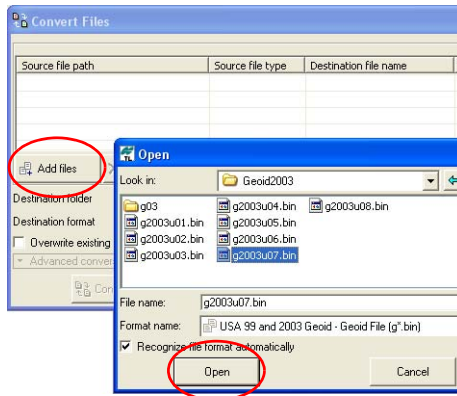
To create the geoid file for local work area, do the following:

1. Run Topcon Link (this is a free Topcon software),

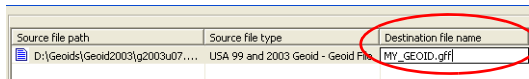
2. Click *File -> Convert Files*



3. Click the *Add files* button in the *Convert Files* window, select the file format 'USA 99 and 2003 Geoid', navigate to the location of "g2003u07.bin" file, select this file and click the *Open* button:



4. In the *Destination file name* field, enter the name of created geoid file (for example: MY_GEOID.gff):



5. Specify positions for the points limiting the use of this geoid model:

Minimum Latitude	40°00'00.00000N
Maximum Latitude	41°00'00.00000N
Minimum Longitude	82°30'00.00000W
Maximum Longitude	83°30'00.00000W

6. Press the button  **Convert** to start creating the local geoid

- If the file was created successfully, the *File Status* field will display:

Source file path	Source file type	Destination file name	File status
D:\Geoids\Geoid2003\g2003u07.bin	USA 99 and 2003 Geoid - Geoid File	MY_GEOID.gff	File is successfully converted

- Click *OK*.

This geoid file is ready for use in TopSURV. Copy the file into the Controller with TopSURV.

How to Import Control Points to the Job

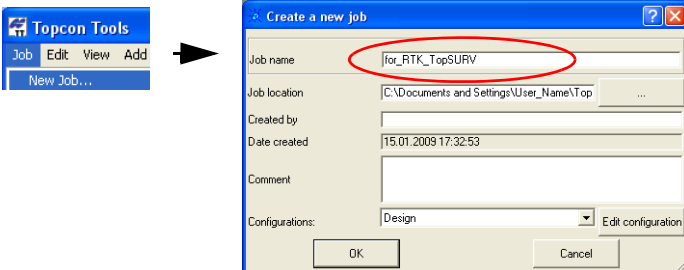
It is useful to have in the TopSURV job true coordinates of the base station in the given coordinate system, and also coordinates of the control points in a local coordinate system to perform localization directly in TopSURV job.

Topcon Tools allows importing a text coordinate file that does not contain information about the coordinate system. These files contain **ONLY** the values of coordinates. To import the point coordinates in the corresponding coordinate system, the user has to:

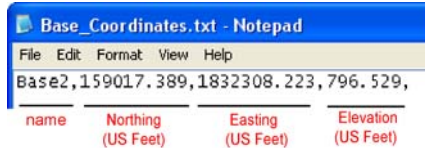
- know this coordinate system or projection,
- set this coordinate system / projection as current (in the *Job Configuration* window) before importing.

To import control points to the job, do the following:

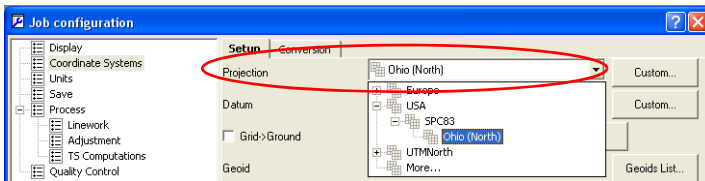
- Run Topcon Tools
- Create a new Topcon Tools job: Click *Job->New Job* and type in a job name:



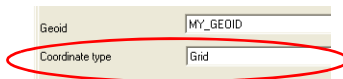
- For example, let us create the coordinate file for the base RTK station in SPC-83 grid system, zone Ohio (North) using the text editor *Microsoft Notepad*, and then import this file to the Topcon Tools job:



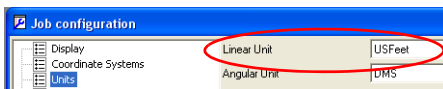
- Click *Job->Job Configuration->Coordinate System*, select *Ohio (North)* projection in the *Projection* field,



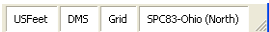
select *Grid* coordinate system in the *Coordinate Type* field,



click *Job->Job Configuration->Units* and select *US Feet* in the field:

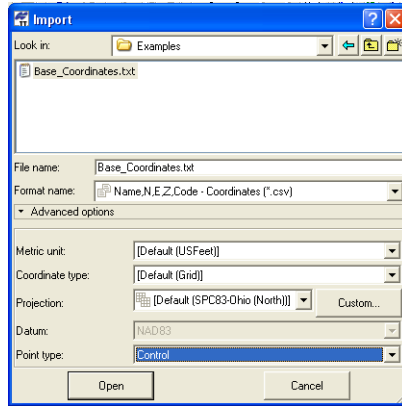


Click **OK** in the *Job Configuration* window to save this configuration of the Topcon Tools job. The *Status Bar* will display the selected

projection and linear unit: 

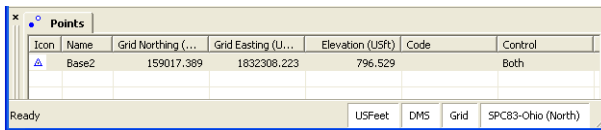
- To import this file, click *Job->Import*, select the file format '*Name,N,E,Z,Code*', navigate to the location of the desired text

file ('Base_Coordinates.txt') and click *Open* on the *Open* dialog box:

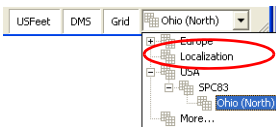


The *Points* tab displays the coordinates in the desired projection and

linear units :



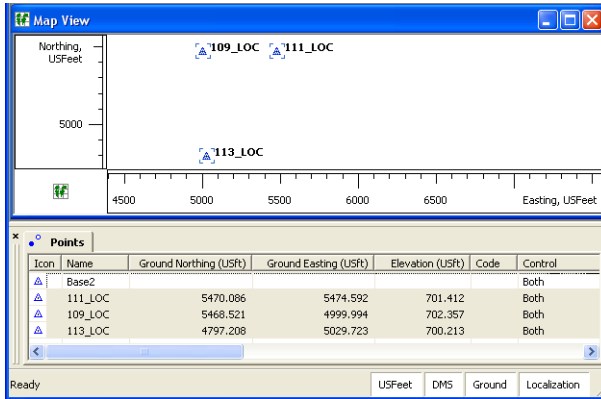
Before importing a text coordinate file with local coordinate points, set the *Ground* coordinate system in the *Status Bar*



and perform the steps which described on

page 1-5.

After importing the local points, the *Map View* and the *Tab View* will display these points:



How to See Imported Points on Google Earth

To see and check where imported points (in Grid coordinate system) is located, click *View->Google Earth*:



How to Create Background Map for Work Area

If the user has a digital image in one of the following formats: JPEG (*.jpg), Bitmap (*.bmp) or TIFF (*.tif), the user has to georeference the image to use it as background. To calculate relationship between the image and real coordinate system, the user needs to know minimum three of picture points in the desired coordinate system.

Let us create the georeferenced image for the JPG file which covers



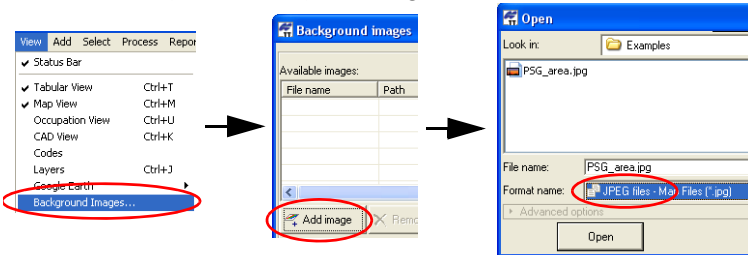
the work area:


To georeference the image using Topcon Tools, do the following:

1. The image georeferencing parameters (the coordinate system, the coordinate type, and metric unit) are defined by the same parameters selected in the Status bar. Set the coordinate system and linear unit which will be used in the TopSURV job:

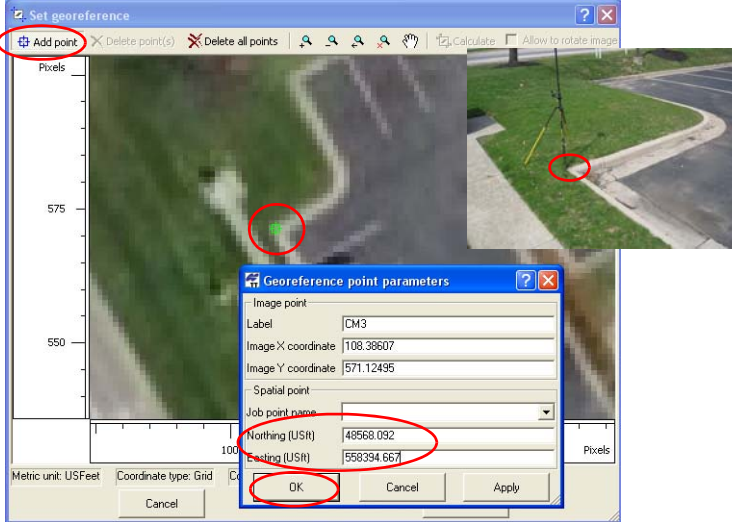



2. Click *View->Background images* and click the *Add Image* button in the *Background images* dialog box.

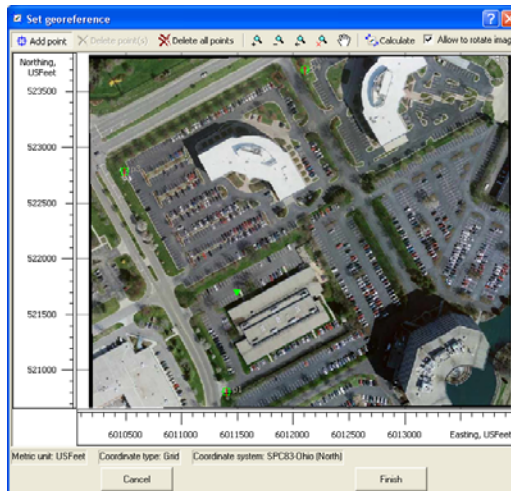


3. If the image is not georeferenced, Topcon Tools automatically opens the *Set Georeference* dialog box. This dialog box allows the user to mark the photo points on the image:
 - Click *Add point* in the Toolbar of this window. The cursor changes into  (add point cursor).
 - Using the 'add point' cursor, identify and left-click the desired point on the image using a photographic sketch of ground point.

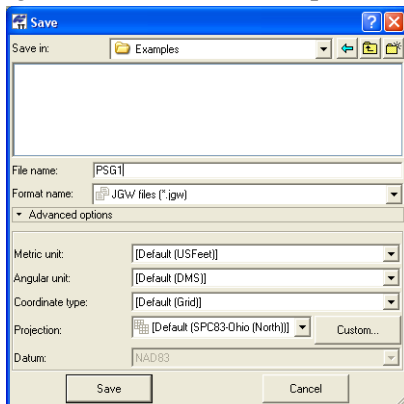
Type in the point name in the *Label* field, the point coordinates in the current coordinate system and click **OK** to mark this point:



- Using this technique, mark other photo points.
- Click  **Calculate** button to georeference the image. After transforming, the *Set Georeference* dialog box will display the image in the current coordinate system:

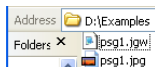


- To save the transformed image, click the **Finish** button in the *Set Georeference* dialog box. Navigate to the location in which to save the file and type in the file name in the corresponding field of the *Save* dialog box. Click **Save** to complete:



Topcon Tools creates and saves two file types in the selected folder:

- The transformed image in the same format which was selected for the image that was not georeferenced
- ESRI World File Format



These both files are ready to be used in TopSURV. Copy the files into the Controller with TopSURV installed.

How to Create a User's Layer

To create a new layer in the current job, click **Add->Layers**



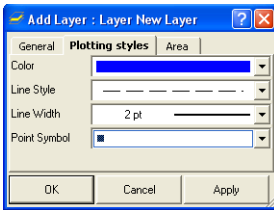
1. On the *General* tab of the *Layer* dialog box, enter the following general parameters for the layer:



- *Name* – the name of the layer.
- *Note* – enter desired comments.
- *Breakline Type*- select Auto.

2. On the *Plotting Styles* tab, select the following parameters for the

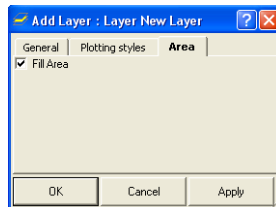
layer:



- *Line Style* – select the type of line to display line information in the layer.
- *Line Width* – select a width for lines in the layer.
- *Color* – select a color for all data (point and line) in the layer.
- *Point Symbol* – select a symbol to represent all points in the

layer.

3. On the *Area* tab, check the *Fill Area* field to fill the areas in this layer:



Topcon Tools allows you to create and save unlimited number of the different layers in the current job.

To view all job's layers, click *View->Layers*:

Name	Visible	Line Style	Line Width	Color	Point Symbol	Breakline Type
0	Yes		1 pt		▼	Auto
L1	Yes		4 pt		•	Auto
L2	Yes		6 pt		◇	Auto

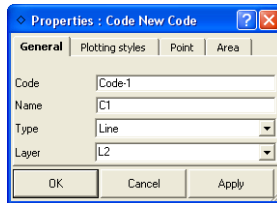
This tab also allows one to edit the layer's parameters.

How to Create User's Codes

To create a new code in the current job, click *Add->Code*



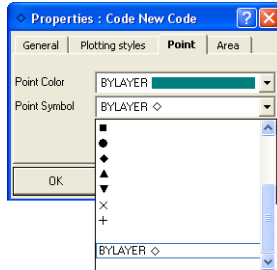
1. On the *General* tab, edit the code's name and select the desired type (*Point*, *Line*, *Area*, *Auto*) and the layer



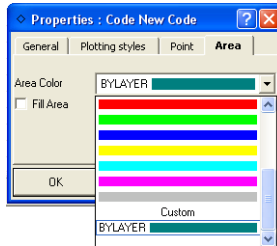
2. On the *Plotting styles* tab, select the line color, line style and line width. The line's plotting style can be edited for any code with or without a layer:



- On the *Point* tab, select the point color, point symbol. The points plotting style can be edited for any code with or without a layer

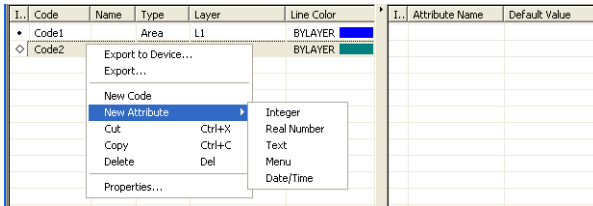


- On the *Area* tab, select the area color. Check the *Fill Area* field, to fill the areas of this code.



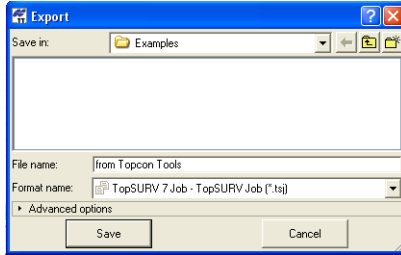
Topcon Tools allows you to create and save unlimited number of the different codes in the current job.

To view all job's layers, click *View->Codes*. This tab also allows one to edit the code's parameters and to add desired attributes for the corresponding code.



How to Export a Topcon Tools Job to TopSURV Job


To export the current Topcon Tools job to a Topcon job, click *Job->Export*, select the file format ‘TopSURV 7 Job’ and type in the name of the TopSURV job.



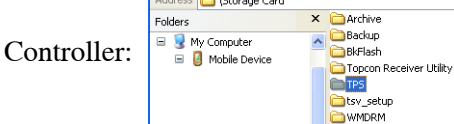
Click **OK** to start creating the TopSURV job.

How to Export a TopSURV Job to Controller

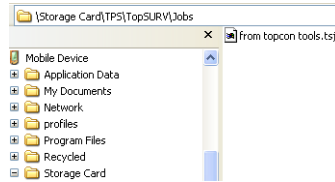
We have created the TopSURV job from the Topcon Tools job, which contains the control points in the different coordinate systems and the set of layers and codes. Also we created the local geoid and the georeferenced image for the work area. All these files were saved in the same folder on the computer.

If you have Windows XP operation system, make sure that *Microsoft ActiveSync* is installed on the computer and a successful computer-to-device connection is established. In this case the system tray displays a green ActiveSync circle .

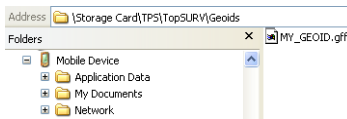
To export the created files into the Controller, close the Topcon Tools job and open Windows Explorer. Click the *Mobile Device* folder. The right-hand panel of the window displays the contents of the Topcon



To export the tsj job, open the folder *\TPS\TopSURV\Jobs* on the Controller and copy this job to the selected folder:



To export the created geoid file, open the folder *\TPS\TopSURV\Geoids* on the Controller and copy this file to the selected folder:



To export the created georeferenced image, open the folder *\TPS\TopSURV* on the Controller and copy these file to the selected folder.

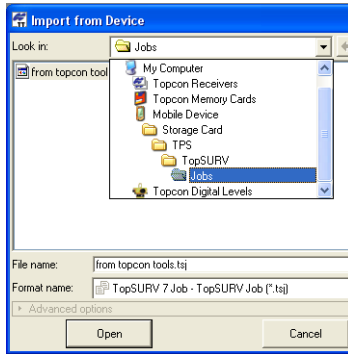
Importing, Viewing and Editing TopSURV Job in Topcon Tools

This chapter describes how the user can use the Topcon Tools software for importing, viewing, editing a TopSURV job, and creating reports for this TopSURV job.

How to Import a TopSURV Job to Computer

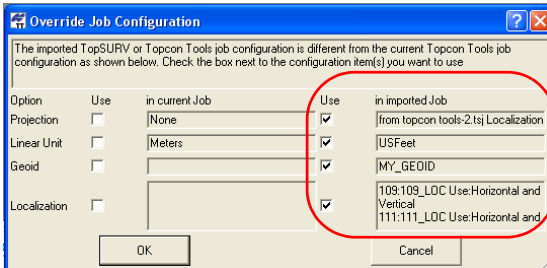
After collecting field data and performing localization using control points, the closed TopSURV job is ready for import to Topcon Tools for viewing and editing.

Run Topcon Tools and create a new job. Click *Job-> Import from Device*, select mobile device and navigate to the location of "from topcon tools.tsj" file (*Storage Card/TPS/TopSURV/Jobs*).

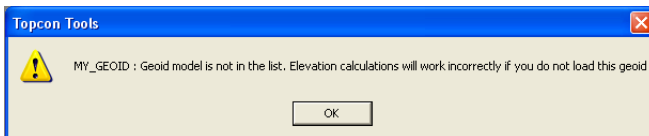


Click **Open** in this dialog box to start import the TopSURV job to the current Topcon Tools job.

The created Topcon Tools job and the imported TopSURV job have different configurations. In process of import of the TopSURV job, Topcon Tools offers to set the desired configuration in the *Override Job Configuration* dialog box. In this case we recommend setting the configuration used in the TopSURV job:



If the geoid used in TopSURV is not presented in the current Topcon Tools job, the following message will appear:

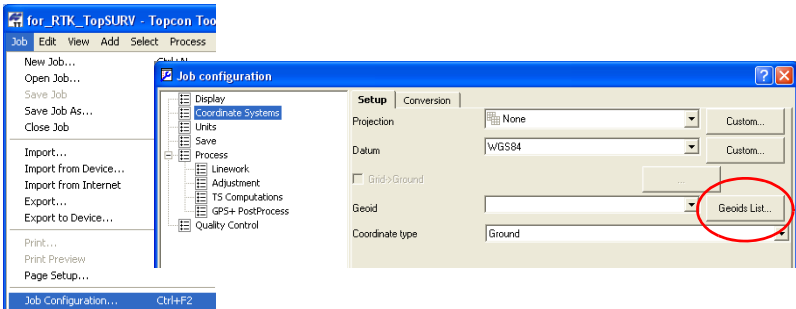


To continue import of the TopSURV job to the Topcon Tools job, click OK.

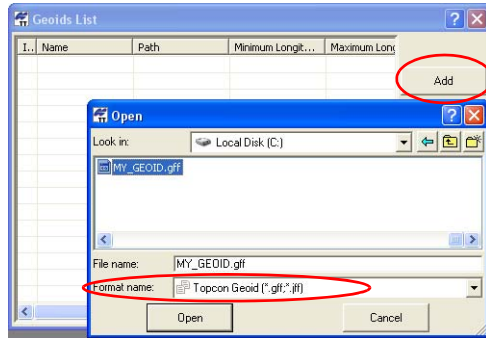
How to Add a Geoid File to Topcon Tools Job

For correct calculation of points elevations, add the geoid to the current job:

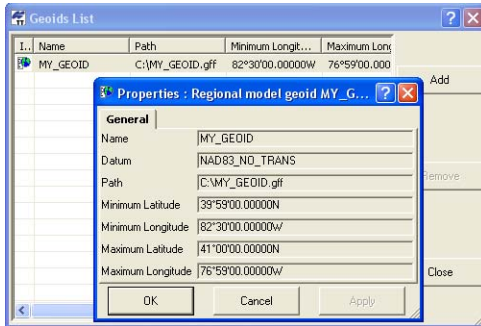
1. Click *Job->Job Configuration->Coordinate System* and click the *Geoid List* button



2. Click the *Add* button on the *Geoid List* dialog box, select the file format '*Topcon Geoid*', navigate to the location of the local geoid ('*MY_GEOID.jff*') and click *Open* on the *Open* dialog box:



3. The *Geoid List* dialog box displays the area covered by the geoid:



To add this local geoid to the current Topcon Tools job, click the *Close* button on the *Geoid List* dialog box and select this geoid from the *Geoid* list on the *Job Configuration* window:



After setting the desired geoid, Topcon Tools automatically recalculate the orthometric heights of the imported job.

Note, that orthometric heights will be displayed if either *Ground*, *Grid*, or *Datum Elevation* is selected in the *Status Bar*. In this case, the orthometric heights are displayed in the ‘*Elevation*’ column of the *Points* tab.

Viewing Collected Data

After importing the TopSURV job to the Topcon Tools job, all collected data can be displayed in the *Tab View*, *Map View*, *Cad View* and *Google Earth View*:

The *Points* tab displays the coordinates of the points measured from the base station in the selected coordinate system, standard

deviations for each component of RTK observations, codes and layers in use:

Icon	Name	Grid Northing...	Grid Easting (U...	Elevati...	Std Dev n (USft)	Std Dev e (USft)	Std Dev u (USft)	Std Dev Hz (USft)
📍	100	159135.875	1832325.253	792.171	0.009	0.006	0.010	0.011
📍	101	159215.137	1832470.546	792.457	0.014	0.009	0.018	0.016
📍	102	159105.281	1832361.732	790.344	0.009	0.016	0.011	0.019
📍	103	159028.391	1832273.795	789.908	0.006	0.004	0.008	0.007
📍	104	158956.033	1832220.924	791.343	0.008	0.008	0.012	0.011
📍	105	159047.804	1832203.630	793.490	0.013	0.008	0.013	0.015
📍	106	159154.759	1832084.745	797.905	0.014	0.016	0.021	0.022
📍	107	159221.878	1832025.243	795.160	0.010	0.011	0.017	0.022

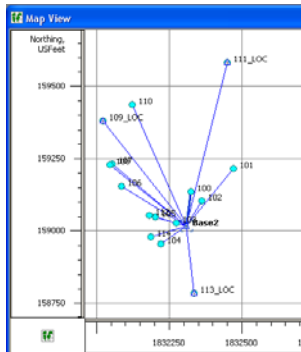
The *GPS Occupations* tab displays information about collected occupations (used antenna type, antenna height, duration, method of measurements, recording interval):

I...	Point Name	Original ...	Antenna Type	Antenna H...	Ant Heig...	Start Time	Stop Time	Duration	Method	Interval
📍	Base2	Base2	CR-4 with C...		7.000	05.05.20...	05.05.200...	0:52:10	Base	
📍	100	100	TPSGR-3		6.004	05.05.20...	05.05.200...	0:00:24	Topo	1000
📍	101	101	TPSGR-3		6.004	05.05.20...	05.05.200...	0:00:20	Topo	1000
📍	102	102	TPSGR-3		6.004	05.05.20...	05.05.200...	0:00:20	Topo	1000
📍	103	103	TPSGR-3		6.004	05.05.20...	05.05.200...	0:00:20	Topo	1000
📍	104	104	TPSGR-3		6.004	05.05.20...	05.05.200...	0:00:25	Topo	1000
📍	105	105	TPSGR-3		6.004	05.05.20...	05.05.200...	0:00:20	Topo	1000
📍	106	106	TPSGR-3		6.004	05.05.20...	05.05.200...	0:00:23	Topo	1000

The *GPS Observations* tab displays the name of point “from” and point “to”, horizontal/vertical precision of the vector, components of computed vector, and information about solution type.

I...	Point F...	Point To	Duration	Horizontal Pre...	Vertical Pre...	dN (USft)	dE (USft)	dH (USft)	Method	Solution Type
📍	Base2	100	0:00:24	0.011	0.010	118.486	17.030	2.394	RTK Topo	Fixed,Phase Diff
📍	Base2	101	0:00:20	0.016	0.018	197.748	162.323	2.680	RTK Topo	Fixed,Phase Diff
📍	Base2	102	0:00:20	0.019	0.011	87.892	53.509	0.567	RTK Topo	Fixed,Phase Diff
📍	Base2	103	0:00:20	0.007	0.008	11.002	-34.428	0.132	RTK Topo	Fixed,Phase Diff
📍	Base2	104	0:00:25	0.011	0.012	-61.356	-87.299	1.566	RTK Topo	Fixed,Phase Diff
📍	Base2	105	0:00:20	0.015	0.013	30.415	-104.593	3.714	RTK Topo	Fixed,Phase Diff
📍	Base2	106	0:00:23	0.021	0.024	137.370	-223.478	8.170	RTK Topo	Fixed,Phase Diff

The *Map View* is a graphical view of latitude/longitude or northing/easting of points, observations and background map



The *CAD View* is a graphical view of linework, roads, and surfaces with the associated points:



The *Google Earth* is a client application to work with a 3D map of the Earth created using live satellite imagery (a connection with the Internet is needed):

MAP View



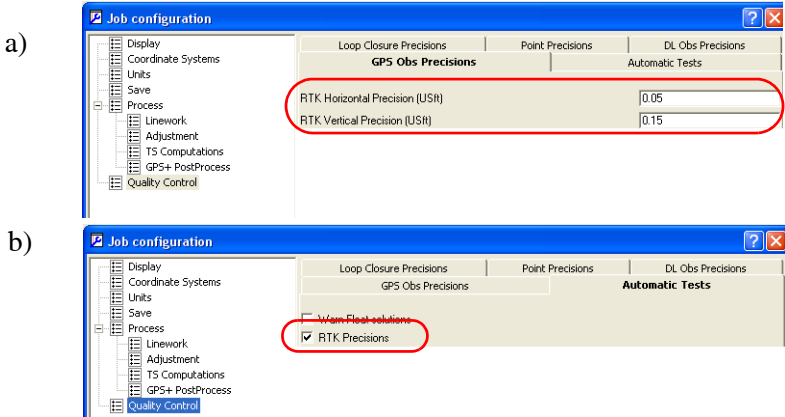
CAD View



How to Estimate Precision of Data

To estimate the precision of each GPS observation of the job, it is useful to automatically mark those vectors, which have the precision worse than the values set in this job by the user. The user can set

threshold values in the *GPS Obs Precisions* tab (*Job Configuration -> Quality Control*) and activate this test in the *Automatic Tests* tab:

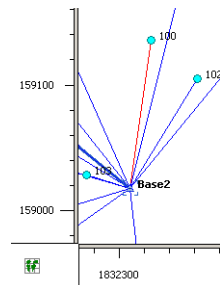


After that Topcon Tools will automatically highlight in red the ‘bad’ GPS observation(s):

in the *GPS Observations* tab

GPS Obs				
I.	Point From	Point To	Horizontal Precision ...	Vertical Precision (USRT)
1	Base2	100	0.264	0.243

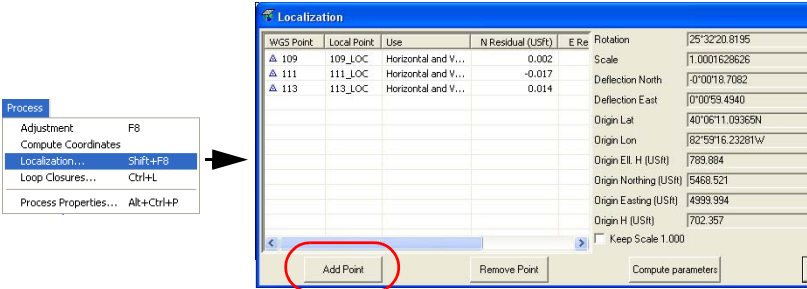
in *Map View*




Viewing and Editing Localization

If localization was performed in TopSURV, the user can see (in the current Topcon Tools job) the localization parameters and pair points

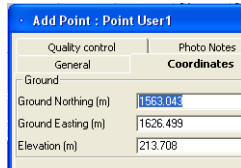
which were used in localization. To open the *Localization dialog box*, click *Process->Localization*:



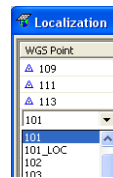
The *Localization window* allows one to add the pair points for calculating the localization parameters:

- before adding a new pair, be sure that the *Points* tab contains the desired point(s) with coordinates in the both coordinate systems (*Ground/Localization* and *Grid/Datum*). If needed, to create such a point, you can use the option *Add -> Point* () and type in the desired coordinates in the corresponding

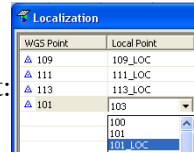
coordinate system:



- Click *Add Point* in the *Localization* window.
- Select the desired point from the *WGS Point* list:



- Select the desired point from the *Local Point* list:



- Click to calculate localization parameters using new pair points.

Editing Antenna Height

Topcon Tools allows one to edit the *Antenna Height* and/or *Antenna Height Method* and/or *Antenna Type* columns as needed. For multiple points:

- in the *GPS Occupations* tab press *Shift* (and/or *Ctrl*) and highlight the desired

points:

I...	▲ P...	Original ...	Antenna T...	Antenna Hei...
101	101	TP5GR-3	6.004	
102	102	TP5GR-3	6.004	
103	103	TP5GR-3	6.004	
104	104	TP5GR-3	6.004	
105	105	TP5GR-3	6.004	
106	106	TP5GR-3	6.004	
107	107	TP5GR-3	6.004	

- click a point:

I...	▲ P...	Original ...	Antenna T...	Antenna Hei...
101	101	TP5GR-3	6.004	
102	102	TP5GR-3	6.00393	
103	103	TP5GR-3	6.004	
104	104	TP5GR-3	6.004	
105	105	TP5GR-3	6.004	
106	106	TP5GR-3	6.004	
107	107	TP5GR-3	6.004	

- type in a new height:

I...	▲ P...	Original ...	Antenna T...	Antenna Hei...
101	101	TP5GR-3	6.004	
102	102	TP5GR-3	7.7777	
103	103	TP5GR-3	6.004	
104	104	TP5GR-3	6.004	
105	105	TP5GR-3	6.004	
106	106	TP5GR-3	6.004	
107	107	TP5GR-3	6.004	

- press *Enter*:

GPS Occupations					
I...	▲	P...	Original ...	Antenna T...	Antenna Hei...
101			101	TP5GR-3	6.004
102			102	TP5GR-3	7.778
103			103	TP5GR-3	7.778
104			104	TP5GR-3	6.004
105			105	TP5GR-3	6.004
106			106	TP5GR-3	7.778
107			107	TP5GR-3	7.778

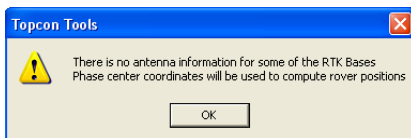
After this updating, you need to recalculate the coordinates of the network.

How to Recalculate the Coordinates

To recalculate the coordinates of the given RTK network with any modification, click the *Process -> Compute coordinates*.

Note that if the base station antenna does not have information about antenna type, antenna height and antenna height method, the phase center coordinates of this antenna will be used to compute the coordinates of all points in this network.

GPS Occupations					
I...	Point Name	Original Name	Antenna Type	Antenna Height (USft)	Ant Height Method
Base2	Base2				Vertical



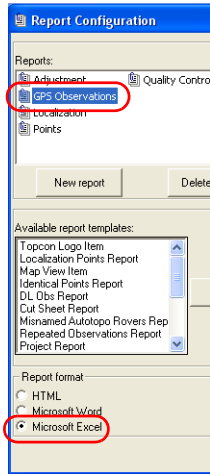
Reporting Data

To create a report in *Microsoft Excel* for all GPS observations of the given job, take the following steps:

- Click *Report-> Report Configuration*

Report	
Quality Control	Ctrl+5
Points	Ctrl+4
Localization	Ctrl+3
GPS Observations	Ctrl+2
Adjustment	Ctrl+1
Report Configuration...	F9

- Select the *GPS observations* report in the *Report* list and *Microsoft Excel* in the *Report format* field:



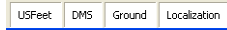
- Click **OK** to save that report configuration.
- To create the corresponding report, click *Report-> GPS Observations*. The following report displays

	A	B	C	D	E	F	G
1							
2							
3							
4	Project Summary						
5							
6	Project name: from topcon tools.ttp						
7	Surveyor:						
8	Comment						
9	Linear unit: USFeet						
10							
11	GPS Observations						
12	Name	dN (USft)	dE (USft)	dH (USft)	Horizontal Precision (USft)	Vertical Precision (USft)	
13	Base2-100	118.575	16.368	2.394	0.011	0.01	
14	Base2-101	198.643	161.21	2.679	0.016	0.018	
15	Base2-102	88.185	53.015	0.567	0.019	0.011	
16	Base2-103	10.809	-34.487	0.132	0.007	0.008	
17	Base2-104	-61.84	-86.952	1.566	0.011	0.012	
18	Base2-105	29.829	-104.757	3.713	0.015	0.013	
19	Base2-106	136.115	-224.232	8.127	0.021	0.021	
20	Base2-107	213.053	-256.163	5.381	0.022	0.017	
21	Base2-108	210.047	-262.988	8.39	0.016	0.015	
22	Base2-109	360.835	-288.895	4.037	0.024	0.019	
23	Base2-110	417.103	-188.324	3.271	0.014	0.011	
24	Base2-111	566.824	138.55	2.984	0.018	0.011	
25	Base2-112	35.926	-127.379	3.853	0.012	0.011	
26	Base2-113	-232.026	27.271	1.752	0.011	0.011	
27	Base2-114	-37.491	-122.118	2.942	0.017	0.021	
28							

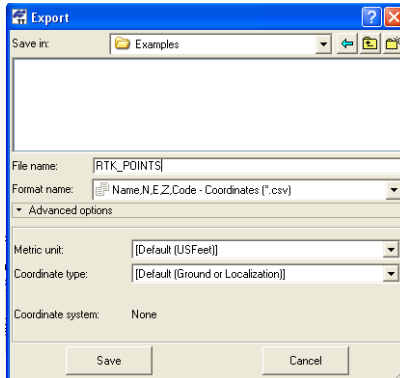
Export to Coordinate File

To export the coordinates of the measured RTK points to a text file format, do the following:

- Select the desired linear unit (*US Feet*) and coordinate system (*Ground/Localization*) in the *Status Bar*



- Click *Job-> Export*, select the file format '*Name,N,E,Z,Code*', type in the name of the created file and click OK:



The created file will have the following type:

```
File Edit Options Help
100,5118.280,5171.041,700.819,
101,5128.082,5336.271,701.140,NAIL
102,5075.055,5191.009,699.005,00R
103,5042.959,5078.684,698.552,NAIL
104,5000.020,5000.016,699.978,NAIL
105,5090.421,5023.473,702.112,NAIL
106,5237.847,4961.485,706.483,NAIL
107,5321.045,4965.844,703.777,NAIL
```




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