TRUKK SOFT

Nigra
Special Software for Levellings

Reference Manual

Version 6.2 © 1988-2021
Nigra for Windows

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Nigra is the Windows version of the DOS software Delta.

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https://www.trukksoft.de
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1 Introduction

1.1 Manuals and Help

The following sources of information help you learn Nigra, your software for the evaluation of levellings.

**Getting Started Guide.** The *Getting Started Guide* contains a general overview, system requirements, installation instructions and first steps to use Nigra.

**Reference Manual.** The book you are reading now. The reference manual is available as .PDF file to read or print with Acrobat Reader. The manual contains detailed technical information for all Nigra items.

**Online Help.** To access the Nigra help, press the F1 key in Nigra.

If you are updating from Nigra/DOS, the chapter from *Nigra/DOS to Nigrawin* is very important.

**Getting Product Support**

If you can't find an answer in the section *Questions and Answers* in the online reference or on our website [http://www.trukksoft.de](http://www.trukksoft.de), write an e-mail with your question to mail@trukksoft.de or send a fax to 49 (0) 2241 9237290. We can only answer if your question is in English or German language.

1.2 General Overview

Nigra is a special software for the registration and evaluation of all kinds of levellings. With the additional software Nivnet, it covers almost the complete user spectrum for levellings.

Nigra since version 6.0 runs under the operating systems Windows 7/8/8.1 and 10.

Nigra is an international program: Menus and help can be displayed in either English or German. Independent of this the texts for all printouts are stored in separate data files and may be adapted by the user. Files for the languages English and German are included. Evaluations may be performed in meters, feet or inches.

The core of the program is the calculation of levellings performed with digital levelling instruments (Leica, Trimble/Zeiss, Topcon, SOKKIA). Manual data entry can be done with the text editor in the measurement data file.
The standard way of working in connection with a digital level:

- Execute the levelling
- Transfer raw data to the PC
- Formatting of raw data into Nigra format
- Compute the data (height calculation, profiles, levelling diagrams, and movement lists, etc.)

Nigra computes different kinds of levellings: levelling with side shots, line levelling, line adjustment and instrument testing.

The Nigra **Height Database** in the Microsoft Access format is able to store approximately 10 mio. points per job. There is an interface for the import of heights from any text files and for the export of heights in the ASCII format.

**Movement measurements** may be computed automatically in list form or as movement diagrams.

**Profiles** can be established either from levelling data or from tachymeter data in the Y,X,Z format.

### 1.3 Installing Nigra

Make sure that Windows 7, 8/8.1 or 10 is installed on your computer.

Close all open applications. Insert the Nigra CD-ROM into the appropriate drive. If the Nigra setup does not start automatically, follow these steps:

Select the **Run** button in the **Start** menu.

Then enter the command line `x:\setup.exe` (where x is the letter of the CD-ROM) and click **OK** to start the installation. Follow the setup instructions on the screen. In case you have already installed Delta/DOS or Nigrawin up to version 4.31, it is important to select a different installation folder for Nigrawin from version 5.0 than for Delta/DOS or an older Nigrawin. This allows you to work simultaneously with both versions for some time and gradually change over to Nigrawin.

When updating from a Windows version since 5.0 install Nigra in the same folder as the previous version.

To run Nigra the .Net Framework 4.5 or higher is needed. If this not already on your PC, the .Net Framework will be preinstalled from the Nigra Setup.
After installation is completed, a new item will be added to the Start menu and to the desktop. Double-click the Nigra icon to start Nigra.

The Nigra template folder is installed under c:\program files\nigra\templates. If Windows Vista or higher is installed on your computer, then copy the complete folder to another place (drive, folder), where you have the full access. Then change in Nigra under Options, Program Configuration, Misc. the entry for the Folder for templates to the new place.

c:\program files\nigra = Nigra installation folder

**Uninstalling Nigra**

To uninstall Nigra proceed as follows:
Click on the item **Settings** in the **Start** menu, then on **Control Panel**. Make a double-click on the icon **Add/Remove Programs**. In the box below select the line which contains the name of the Nigra software and click on the button **Add/Remove**. In the dialog box **Select Uninstall Mode** select **Automatic** and click the **Next** button. Then follow the description in the following dialog boxes.

All files installed by Nigra will be removed. Files which are created after installation of Nigra will not be deleted. Therefore the Nigra folder will not be deleted. You can remove this folder manually after the uninstall procedure has finished.

**1.4 Starting Nigra**

Start Nigra by double-clicking on the Nigra icon.

If you are already familiar with the use of Windows software, you can now continue with Section 2, First Steps.

**1.5 Quitting Nigra**

You quit Nigra by clicking on **Exit** in the **File** menu. Alternatively, you may quit Nigra by pressing the keys [Ctrl]+[F4] if all Nigra windows are closed.
1.6 Nigra Screen

Nigra is equipped with a menu system and a menu bar with symbols:

Nigra Screen

You may select frequently used functions directly in the menu bar with the left mouse button. Using the right mouse button a context menu with the most important functions is called. The last line (above, Trimble) depends on the last selected menu or toolbar digital level.
From the toolbar frequently used functions can be directly selected with the left mouse button. If the mouse is over an icon appears briefly a help text.

Symbols or menu items that cannot be used at present are shown in gray. They are automatically activated when the conditions for their use are given. After starting Nigra, almost all symbols and menu items are deactivated until a job is opened.

**1.7 Nigra Menus**

Menus can be opened with the left mouse button or with the short cuts [Alt]+[underlined character]. The respective menu items may then be called up by entering the underlined character or with a mouse click. Some menu items can be invoked directly by pressing F-keys or [Ctrl] + [character].
## File Menu

<table>
<thead>
<tr>
<th>Command</th>
<th>Shortcut</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open/New Job...</td>
<td>Ctrl+O</td>
<td>Select existing or new job</td>
</tr>
<tr>
<td>Edit Measurements</td>
<td>F4</td>
<td>Editing measurements in current job</td>
</tr>
<tr>
<td>Reorganize Calculation No.</td>
<td>Ctrl+R</td>
<td>Numbering of levellings in the batch file</td>
</tr>
<tr>
<td>Print Measurement...</td>
<td></td>
<td>Measurement report from calc. no. to calc. no.</td>
</tr>
<tr>
<td>Edit Files...</td>
<td>Ctrl+L</td>
<td>Edit any ASCII file</td>
</tr>
<tr>
<td>Delete Files...</td>
<td></td>
<td>Delete project files in current folder</td>
</tr>
<tr>
<td>Convert ASCII → ANSI</td>
<td>Ctrl+L</td>
<td>Convert files from ASCII into ANSI</td>
</tr>
<tr>
<td>Print...</td>
<td>Ctrl+P</td>
<td>Print any ASCII file</td>
</tr>
<tr>
<td>Printer Setup...</td>
<td></td>
<td>Select default printer</td>
</tr>
<tr>
<td>Printer Font...</td>
<td></td>
<td>Select printer font</td>
</tr>
<tr>
<td>Exit</td>
<td>Ctrl+E</td>
<td>Quit Nigra</td>
</tr>
</tbody>
</table>

1 D:\Nigra\GUT\MAR.NIG 2 D:\Nigra\GUT\KD.NIG

This lists the last six jobs executed

## Calculate Menu

<table>
<thead>
<tr>
<th>Command</th>
<th>Shortcut</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batch...</td>
<td>F5</td>
<td>Batch processing from calc. no. to calc. no.</td>
</tr>
<tr>
<td>View Calculation</td>
<td>F6</td>
<td>View the calculations of the current job</td>
</tr>
<tr>
<td>Print Calculation...</td>
<td></td>
<td>Print the calculations of the current job</td>
</tr>
<tr>
<td>Delete Calculation</td>
<td></td>
<td>Delete the calculations of the current job</td>
</tr>
</tbody>
</table>

## Heights Menu

<table>
<thead>
<tr>
<th>Command</th>
<th>Shortcut</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter Heights...</td>
<td>F7</td>
<td>Enter, view, edit, and delete heights</td>
</tr>
<tr>
<td>Delete Points...</td>
<td>Ctrl+U</td>
<td>Deletes points from number to number</td>
</tr>
<tr>
<td>Renumber Points...</td>
<td>Ctrl+U</td>
<td>Renumbering of points</td>
</tr>
<tr>
<td>Heights Output...</td>
<td>Ctrl+V</td>
<td>Screen, ASCII file and printer</td>
</tr>
<tr>
<td>Edit ASCII File</td>
<td></td>
<td>Edit ASCII file of the current job</td>
</tr>
<tr>
<td>Import Nigra Heights...</td>
<td></td>
<td>Import heights from other Nigra jobs</td>
</tr>
<tr>
<td>Import ASCII Heights...</td>
<td></td>
<td>Import heights from any ASCII file</td>
</tr>
</tbody>
</table>

## Digital Level Menu

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leica</td>
<td>Functions for Leica digital level</td>
</tr>
<tr>
<td>Trimble</td>
<td>Functions for Trimble digital level</td>
</tr>
<tr>
<td>Topcon</td>
<td>Functions for Topcon digital level</td>
</tr>
<tr>
<td>SOKKIA</td>
<td>Functions for SOKKIA digital level</td>
</tr>
<tr>
<td>Terminal Data Transfer...</td>
<td>Data transfer for standard devices</td>
</tr>
</tbody>
</table>


### Leica Submenu

<table>
<thead>
<tr>
<th>Action Sequence</th>
<th>Key/Shortcut</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIF 10 ↔ PC...</td>
<td>F8</td>
<td>Data transfer GIF 10 ↔ PC</td>
</tr>
<tr>
<td>NA/DNA/Sprinter Raw Data ↔ PC...</td>
<td>Ctrl+</td>
<td>Edit Leica raw data</td>
</tr>
<tr>
<td>Edit Raw Data...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Format NA-GSI → Nigra...</td>
<td>Ctrl+</td>
<td>Reformat Leica NA-GSI raw data</td>
</tr>
<tr>
<td>Format DNA/LS → Nigra...</td>
<td>Ctrl+</td>
<td>Reformat Leica DNA/LS raw data</td>
</tr>
<tr>
<td>Format Sprinter-GSI → Nigra...</td>
<td></td>
<td>Reformat Leica Sprinter-GSI raw data</td>
</tr>
<tr>
<td>Format Heights → Leica GSI...</td>
<td></td>
<td>Create GSI format from the height database</td>
</tr>
</tbody>
</table>

### Trimble Submenu

<table>
<thead>
<tr>
<th>Action Sequence</th>
<th>Key/Shortcut</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DiNi Raw Data ↔ PC...</td>
<td>F9</td>
<td>Data transfer DiNi raw data</td>
</tr>
<tr>
<td>Edit DiNi Raw Data...</td>
<td>Ctrl+Z</td>
<td>Edit DiNi DiNi raw data</td>
</tr>
<tr>
<td>Format DiNi Rec E → Nigra...</td>
<td>Ctrl+Z</td>
<td>Reformat DiNi DiNi raw data</td>
</tr>
<tr>
<td>Format Heights → DiNi Rec E...</td>
<td></td>
<td>Create Rec E format from the height database</td>
</tr>
</tbody>
</table>

### Topcon Submenu

<table>
<thead>
<tr>
<th>Action Sequence</th>
<th>Key/Shortcut</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DL-100 Raw Data → PC...</td>
<td>Ctrl+B</td>
<td>Data transfer DL-100 raw data</td>
</tr>
<tr>
<td>Edit DL-100 Raw Data...</td>
<td>Ctrl+T</td>
<td>Edit DL-100 raw data</td>
</tr>
<tr>
<td>Format DL-100 → Nigra...</td>
<td>Ctrl+T</td>
<td>Reformat DL-100 raw data</td>
</tr>
<tr>
<td>Format Heights → Topcon Raw Data...</td>
<td></td>
<td>Create Topcon raw data format from the height database</td>
</tr>
</tbody>
</table>

### SOKKIA Submenu

<table>
<thead>
<tr>
<th>Action Sequence</th>
<th>Key/Shortcut</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDL Raw Data → PC...</td>
<td>Ctrl+B</td>
<td>Data transfer SDL raw data</td>
</tr>
<tr>
<td>Edit SDL Raw Data...</td>
<td>Ctrl+T</td>
<td>Edit SDL raw data</td>
</tr>
<tr>
<td>Format SDL → Nigra...</td>
<td>Ctrl+T</td>
<td>Reformat SDL raw data</td>
</tr>
<tr>
<td>Format Heights → SOKKIA Raw Data...</td>
<td></td>
<td>Create SOKKIA raw data format from the height database</td>
</tr>
</tbody>
</table>

### Options Menu

<table>
<thead>
<tr>
<th>Action Sequence</th>
<th>Key/Shortcut</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job Configuration...</td>
<td>F2</td>
<td>Header data, parameters, indiv. program config.</td>
</tr>
<tr>
<td>Program Configuration...</td>
<td>F3</td>
<td>Enter company name, error limits, etc.</td>
</tr>
</tbody>
</table>
## Movements Menu

<table>
<thead>
<tr>
<th>Menu Item</th>
<th>Hotkey</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create List…</td>
<td>Ctrl+S</td>
<td>Movement list from points of current height database</td>
</tr>
<tr>
<td>View List</td>
<td></td>
<td>View movement list of current job</td>
</tr>
<tr>
<td>Print List…</td>
<td></td>
<td>Print movement list of current job</td>
</tr>
<tr>
<td>Delete List</td>
<td></td>
<td>Delete movement list of current job</td>
</tr>
<tr>
<td>Create Movement Plot…</td>
<td>Ctrl+G</td>
<td>Movement plots in HP-GL and DXF format</td>
</tr>
<tr>
<td>View/print Movement Plot…</td>
<td></td>
<td>View and print movement plots</td>
</tr>
<tr>
<td>View Error List</td>
<td></td>
<td>View errors</td>
</tr>
</tbody>
</table>

## Profile Menu

<table>
<thead>
<tr>
<th>Menu Item</th>
<th>Hotkey</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create Profile File…</td>
<td>Ctrl+F</td>
<td>Based on data of current job</td>
</tr>
<tr>
<td>Edit Profile File</td>
<td></td>
<td>Edit profile file of current job</td>
</tr>
<tr>
<td>Create Profile…</td>
<td></td>
<td>Create plot file in HP-GL and DXF format</td>
</tr>
<tr>
<td>View/print Profiles…</td>
<td></td>
<td>View and print profiles</td>
</tr>
<tr>
<td>Print Profiles…</td>
<td></td>
<td>Print profiles</td>
</tr>
<tr>
<td>View Error List</td>
<td></td>
<td>View errors</td>
</tr>
</tbody>
</table>

## Nivnet Menu (=Network Adjustment Nivnet)

<table>
<thead>
<tr>
<th>Menu Item</th>
<th>Hotkey</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create Network File…</td>
<td>Ctrl+N</td>
<td>Based on data of current job</td>
</tr>
<tr>
<td>Edit Network File</td>
<td></td>
<td>Edit network file in current job</td>
</tr>
<tr>
<td>Calculate Standard Deviation</td>
<td></td>
<td>Calculate standard deviation for 1 km double levelling</td>
</tr>
<tr>
<td>Run Network Adjustment…</td>
<td>Ctrl+A</td>
<td>Run Nivnet</td>
</tr>
<tr>
<td>View Network Adjustment</td>
<td></td>
<td>View results of network adjustment</td>
</tr>
<tr>
<td>Print Network Adjustment…</td>
<td></td>
<td>Print results of network adjustment</td>
</tr>
<tr>
<td>Network Heights → Height Database…</td>
<td></td>
<td>Transfer heights into height database of current job or other height databases</td>
</tr>
</tbody>
</table>

## ? Menu (Help)

<table>
<thead>
<tr>
<th>Menu Item</th>
<th>Hotkey</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigra-Help</td>
<td>F1</td>
<td>Shows Nigra help file</td>
</tr>
<tr>
<td>About</td>
<td></td>
<td>Show information on program (version, etc.)</td>
</tr>
<tr>
<td>Nigra on the web</td>
<td></td>
<td>Connecting to the Nigra website</td>
</tr>
<tr>
<td>E-mail…</td>
<td></td>
<td>Calling the default e-mail program</td>
</tr>
</tbody>
</table>
1.8 Windows and Dialog Boxes

Dialog boxes are presented in special windows. They are used for the entry or selection of values or texts. In addition, they contain buttons. As with all Windows applications, you may skip to the next field with the TAB key.

![Dialog Box for Header Data](image)

**Dialog Box for Header Data**

You can directly connect to various functions with [Alt]+[underlined character]. An entry is concluded by a click on the **OK** button. In the above dialog box, the previous state is reestablished by clicking **Undo**. Clicking the **Exit** button closes the dialog box.

Normally one of the buttons has a bold frame. This command is executed by pressing the Enter key.

With the F1 key or clicking the question mark above right of the dialog box, you get special help for this dialog box.

The window for entering header data and parameters is designed as a ‘register card’. By clicking the **Parameters** tab you switch to the entry of levelling parameters.

You may close a dialog box by either pressing the [Esc] key, or [Alt]+[F4], or by clicking the **Exit** button. In case there is no **Exit** button, click **Cancel** or **Quit**. You may also close a dialog box by clicking the symbol in the upper left corner, opening a menu. Then click the menu item **Exit**.
1.9 From Delta/DOS or Nigra/DOS to Nigrawin

This section is intended for users who have already worked with Delta/DOS and want to transfer their data and files into Nigrawin. You will quickly feel at home in Nigrawin if you have previously worked with Delta/DOS, since the basic application structure is similar.

**Differences between Nigrawin and Delta/DOS**

Many differences between Delta/DOS and Nigrawin are based on differences between DOS and Windows. Windows, for example, uses a different font than DOS. Consequently, all DOS fonts with an ASCII value > 127 are presented differently in Windows. This also applies to the German 'umlauts', or vowel changes. You may transfer DOS text files into Windows format with the Nigra function **Convert ASCII → ANSI** (File menu). Unfortunately, there is a small problem: The Windows font does not include all DOS symbols.

The special user administration for Delta/DOS has been given up. You may now work in any folder with Nigrawin.

The job file with the measurement data ('job'.DAT) from Delta/DOS is compatible with 'job'.NIG from Windows. You should, however, use the ASCII → ANSI conversion once in order to make sure that the German 'umlauts' are correctly presented. To convert the file extension .DAT to .NIG, use the function **Program Configuration** in the **Options** menu.

The Nigra height database is not compatible. This file has a different database format and an extended data structure in Nigrawin.

You may transfer your old heights into Nigrawin without any problem: Export the heights as an ASCII file in Delta/DOS and import them into Nigrawin via the ASCII interface. The table below shows the differences in the data structure:
<table>
<thead>
<tr>
<th>Data Field</th>
<th>Nigrawin</th>
<th>Delta/DOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>10 characters, e.g., 10-15-2010</td>
<td>8 characters, e.g., 10-15-10</td>
</tr>
<tr>
<td>Remarks/</td>
<td>max. 30 characters</td>
<td>max. 19 characters</td>
</tr>
<tr>
<td>Comments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y-coordinate</td>
<td>Y-coordinate</td>
<td>not available</td>
</tr>
<tr>
<td>X-coordinate</td>
<td>X-coordinate</td>
<td>not available</td>
</tr>
</tbody>
</table>

All remaining data fields have the same data format as in Delta/DOS. The coordinates are not computed at this time, but are only recorded and stored. Thus you may import available 3D data without loss to Nigra and subsequently re-export them.

The **Nigrawin height database** (file extension .MDB) is compatible with the **Microsoft Access** database. You can access the Nigra database with MS Access, for example, in order to create special database reports. In this case, you should always work with a copy and not with the original database!

All texts for printouts, for example, headers for calculations and height database, are not an integral part of the program. They are located in an external file with the file extension .LAG and may be adapted by the user according to his own requirements. They serve mainly for the adaptation into various languages.

The files **ENGLISH.LAG** for English texts and **DEUTSCH.LAG** for German texts are included.

All calculations may be performed in meters, feet or inches, as desired.

An editor for editing the measurement data and other ASCII files is an integral part of Nigrawin. You may, however, use your own editor.

When **Nigra** is used in the following, **Nigrawin** is always meant.
1.10 Update from Nigrawin < 5.0

While earlier versions of Nigrawin are developed with MS Visual Basic 6, the MS Visual Studio development environment is used from version 5.0. The new Nigra from Version 6.0 can be installed only on the Windows 7 operating system or higher. After the installation from an earlier version, all program and project parameters must be redefined.

Many parts of the program had to be developed completely new. This concerns primarily the Nigra height file, the editor and printing. The proven menu design was retained, so you can find your way in the new Nigra quickly.

Since the first version of Nigrawin the height database had the MS Access database format 97. From Nigra-Version 5 the Access format 2000 – 2007 is used. Existing height files must not be converted, new projects will be created in the new file format. The display of the height file on the screen is only possible in the unit of meters.

The functions for the Manual Calculation and the REC500 are no longer available, also the menu bars Repair Height File and Pack Height File.

Project and application settings are now stored in .XML files. The definition of the serial interface for data transfer is now in the dialog box of each data transfer.
1.11 Nigra Working Files

After installation, the following files can be found in the folder c:\Nigra\TEMPLATES:

- NACODE.TXT - reference table for Leica raw data coding
- DINICODE.TXT - reference table for DiNi raw data coding
- DLCODE.TXT - reference table for Topcon raw data coding
- LATTE.CAL - calibration data for levelling staff
- DEUTSCH.LAG - German text file for printouts
- ENGLISH.LAG - English text file for printouts

Also stored in this folder are the format files for ASCII import/export (*.IMF, *.EXF) and the profile files for data transfer (*.PRF).

c:\Nigra = Nigra installation folder

In case examples are also installed in the folder c:\Nigra\SAMPLE:

- SAMPLE.NIG contains the measurement data for calculations examples from the manual
- SAMPLE.MDB contains the associated fixed Heights
- SAMPLE.LEV contains a network file required for Nivnet
- SAMPLE.JOK profile file
- SAMPLE_Profil.XML contains plot parameters for creating a profile
- SAMPLE_SET.XML contains parameters for creating a movement plot. The corresponding heights are located in the SAMPLE.MDB file. Enter for the example: distance of the running number =6, point range from number 1000146 to 20000146

During an application, further job-specific files are created in the related folder:

- 'job'.GSI = heights in the Leica GSI format
- " .ASC = ASCII heights file
- " .AUS = network adjustment report
- " .BER = calculations report
- " .DAT = heights in the DiNi Rec E format
- " .NIG = measurement data (batch file)
- " .MDB = height database
- " .JOK = profile start file
- " .LEV = network adjustment start file
- " .NET = heights of network adjustment for
transfer into the height database
* " .PER = plot file errors
" _PROFIL.XML = plot parameters for profiles
* nnn.PLT = plot files for profiles (HP-GL)
* nnn.DXF = plot files for profiles (DXF)
nnn= running plot number
* " .SDR = heights in the SOKKIA raw data format
* " .SER = movement plot errors
* " .SET = movement list
* " .TOP = heights in the Topcon raw format
* nnnnnnnn.HPG = plot files for movement plots (HP-GL)
* nnnnnnnn.DXF = plot files for movement plots (DXF)
nnnnnnnn= running point number
" _SET.XML = plot parameters for movement plots

Files marked with an asterisk (*) are text files that can be viewed with the editor. All other files should in no case be loaded into the editor. If you load, for example, the height database 'job'.MDB into the editor and edit it by mistake, it cannot be used anymore afterwards.

When running Nigra for the first time, the file PROJEKT.XML is created in the job folder. This file contains job parameters. The program parameters are stored separated for each user.

The following files are for temporary use only and are normally automatically deleted:

'job'.MIT
'job'.LIS
'job'.LI1
'job'.LI2
'job'.DRU
'job'.TMP
'job'.FEH
1.12 Error Handling

The majority of errors is intercepted (for example, printer not ready). How to handle errors is indicated in a window.

In case an error occurs during calculations (for example, error in the header data), an error report is written directly into the report file.

With some system errors, it may not be possible to continue with the program. In this case, just restart Nigra.

Power/System Failure

In case of a damaged height database, an error message is displayed for all operations with the height database.

1.13 Backups

Nigra does not make automatic backups. Make sure to backup your measurement data regularly (‘job’.NIG), the height database (‘job’.MDB) and, as far as available, profile (plot) files (‘job’.JOK), and network files (‘job’.LEV or ’job’.NIV) on an external data medium.

If you have to store heights for a longer period or for other computer systems, create an ASCII file from the height database (Heights menu, menu item Heights Output, item ASCII) and store that file.
2 First Steps

2.1 Setting Program Parameters

When first starting Nigra, it is advisable to make some program customizations and alter the standard parameters. Select the **Program Configuration** item in the **Options** menu. The parameters are stored separately for each user.

The individual input fields have the following functions:

**Company:**
- **Name of Company** defines a header for all printouts (for example, company name and address).

**Header graphics** allows defining a graphics to be printed in the head of a printout (calculation, movement list, etc.) in addition to the company name. **Graphics name** defines the complete file name of the graphics (including drive and folder). Alternatively you can double-click on the input field or click on the button on the right side to open a selection dialog box.

In the field **Graphics dimension** you can define the size of the graphic (width and height). If these values differ from the original graphic size, the graphic will be resized in the printout.
The graphic will be printed with right justification. If you print from the editor, the graphics will not be printed.

**Error Limits:**

Error limits defines the boundary values according to the most used formula:
(example of unit of measurement "meters")

\[
\text{Misclosure } E \text{ (in mm)} = a + b \times \sqrt{D} \text{ (in km)}
\]

\(a = \text{constant error part in mm}, \ b = \text{systematic error part in mm}, \ D = \text{levelling distance in km}\)

The error limits for the four error classes can be defined in free formula style as a function of the levelling distance \(D\), for example, \(2 + 3\times\sqrt{D}\). "\(\sqrt{\text{ }}\)" means square root and \(D\) the levelling distance in km. In modification of this standard formula, you can also calculate, for example, the term \(2 + 3\times\sqrt{D/2}\).

When reformatting the digital level raw data you may choose the error class as required.

**Admissible difference between forward and back levelling**

When creating a network file with double levellings measured, the difference is calculated and compared with the permissible difference.

If you have chosen the unit of measurement "feet" or "inches", error limits will also be entered in these units.
Programs:

Transfer programs for digital levels: Here an entry is only required if you do not want to use the integrated Nigra data transfer. Enter the name of the transfer program supplied by your manufacturer, including file extensions.

Editor name: An entry is only required if you do not want to use the text editor integrated in Nigra. In any case, the editor has to be a Windows program, for example, the word processor WRITE. The editor must be entered completely with drive and path, for example, c:\winnt\system32\write.exe.

A click on the buttons on the right will display a dialog box for selecting a program.

In addition to these program parameters, special parameters can be defined for each job. To do this, however, a particular job must be opened. How to open and start jobs is described in section 2.2.

Miscellaneous (Misc.)

Program Language: The language of Nigra (for menus, dialog boxes, and Help) can be switched between English and German. The texts for printings will not be hereby changed automatically.
Nigra Background Color: Defining the individual color for the Nigra background.

.DAT → .NIG: Changes all file extension in the current folder from .DAT to .NIG. From Nigrawin Rev. 2.0, .NIG is the file extension for Nigra job files with measurement data.

Folder for Templates: With this function you choose a folder for the template files (english.lag, dinicode.txt etc.). The default folder created during the Nigra installation is c:\program files\Nigra\TEMPLATES.

Before using this option, create the new folder and copy all files from c:\program files\Nigra\TEMPLATES to this folder.

c:\program files\Nigra = Nigra installation folder

Job folder: With this entry you can choose a folder which will be shown while opening a project.

When all data have been entered, click OK.

2.2 Opening/New Job

Nigra works job-oriented. This greatly facilitates the subsequent handling of the program, as all operations, for example, calculations, refer to this job, and the required parameters and data files are created and selected automatically.

After starting Nigra, first create a new job or open an existing one. Choose from the File menu Open/New Job .... You may start a new job in any given folder by entering a job name or choosing an existing job (with the file extension .NIG).

The job name will be shown, complete with the full path name, in the header of the Nigra window.
Opening Job

The last 6 jobs opened appear in the bottom item of the File menu. If you want to use one of these jobs, click on the desired item.

Several jobs may be processed within one folder. Larger jobs, however, should always be processed in a separate folder.

When setting up a new job, a file is opened with the chosen job name and the file extension .NIG with the following contents:

```
<table>
<thead>
<tr>
<th>x</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>xDistance</td>
<td>Back</td>
<td>Side</td>
<td>Fore</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

In this file your measurement data will be stored and it is the basis for batch processing. The first four lines are for a better orientation, in case measurement data have to be edited. Accidental deletion of this lines is of no importance for further processing.

A complete list of all possible data files for a job can be found in section 1.11, *Nigra Working Files*.

Apart from these job files there are also job-unconnected files, for example, the raw data after transfer to the PC. They will be allocated to a job only after being reformatted into the Nigra format.
2.3 Individual Configuration

The individual configuration (in the Option menu, item Job Configuration) enables the user to adapt the program configuration to his special job.

The individual configuration is valid for the job in use and all further jobs to be processed in the same folder. With this configuration you may, for example, define the units of measurement (meters, feet, inches), the country-specific file for the printouts or other preset parameters.

If you create a job in a new folder, the last used job parameters are transferred to the new folder.

![Defining Individual Configuration](image)

**Defining Individual Configuration**

**Reorganize calculations numbers automatically**

Check box activated: The running levelling calculation numbers are automatically renumbered after each reformatting of raw data.

**Show point number extension for digital levels**

Check box activated: Shows the input field for point number extension when reformatting raw data.
Print header graphics

Check box activated: Header graphics chosen in the program configuration will be used in all Nigra printouts.

Lines per page for calculations, height lists, etc.

Fixes the number of lines per printed page before Nigra performs a form feed.

Text file for printouts

All texts to be printed are taken from an ASCII file with the file extension .LAG. Standard files supplied with Nigra are DEUTSCH.LAG and ENGLISH.LAG. The files use the following format:

*  Point Number    Height  Calc.No. Diff. NC  Date        Comments
69,Point Number    Height  Calc.No. Diff. NC  Date        Comments

The syntax is: running number, Text. Lines starting with the asterisk (*) contain comments and are skipped. In the example, the text (header for a height report) separated by a comma is allocated to the number 69.

If you want to alter texts, do not alter the supplied files DEUTSCH.LAG or ENGLISH.LAG, but copy them, for example, in the file ENGLISH1.LAG and alter the newly created file. In this way you will avoid that your texts will be overwritten by future Nigra updates. It is possible to create more language files using the same method and to select them in this dialog box.

Nigra does not work directly with the selected file *.LAG, but with an automatically created file TEXT.XML. After a text modification, this file has to be created new by clicking on the button Update Text Database.

Note:
Self-created text files may have to be updated after the installation of a Nigra update. Compare your own file with the file ENGLISH.LAG or DEUTSCH.LAG.

Units of measurement

Nigra operates with meters, feet, and inches. After program installation, the standard preset unit of measurement is always meters. In case you want to work with another unit, it can be defined in the dialog box Units of measurement.

When reformatting the raw data of the digital level, all measurement data are automatically converted into the chosen unit of measurement, in case measurements were taken in another unit of measurement by mistake.
Although the height database originally uses meters as the unit of measurement, the input and output of heights can alternatively be made in feet or inches at any time (except height output on the screen).

Conversion factors for units of measurement:

\[
\begin{align*}
\text{Meter} &= \text{Feet} \times \frac{1200}{3937} \\
\text{Feet} &= \text{Meter} \times \frac{3937}{1200} \\
\text{Inch} &= \text{Meter} \times \frac{39.37}{1200} \\
\text{Feet} &= \text{Inch} \times \frac{12}{3937} \\
\text{Inch} &= \text{Feet} \times 12 \\
\end{align*}
\]

The unit of measurement feet above means 'US feet' (also known as U.S. Survey Feet). The Leica DNA and LS levels and the Sokkia SDL1X/Topcon DL-501 knows also the unit of measurement 'international feet' (conversion factor meter in feet = 1/0.3048). When using this unit of measurement with a DNA level and choosing meters in Nigra, the results will be wrong. When using 'international feet' with a level, choose feet in Nigra every time and don't change the unit of measurement.

2.4 First Calculations

2.4.1 Levelling with Digital Levels

If you want to calculate with levelling data obtained from a digital level and registered in a data storage, the following steps have to be taken:

- Transfer the data to the computer
- Reformat the raw data into the special Nigra format
- Enter the heights of the fix points.
- Start calculation.

Click the Leica, Trimble, Topcon or SOKKIA icon or select the item Leica, Trimble, Topcon or SOKKIA from the Digital Level menu.

From the following submenu select first the item GIF 10 ↔ PC, NA/DNA/Sprinter-Level ↔ PC, DiNi Raw Data ↔ PC, DL-100 Raw Data → PC or SDL Raw Data → PC to transfer the raw data to the PC via the serial interface. Follow the instructions on the monitor screen. Add the file extension .NA2, .GSI or .DNA to the raw data file for Leica data, .DIN for Trimble data, .TOP for Topcon data and .SOK for SOKKIA format.

With some newer versions of digital levels, the data can also be stored on a USB flash drive or other storage medium. This eliminates the error-prone transmission via the serial interface and the raw data can be copied directly into the project folder.
Subsequently, the data transmitted to the PC are reformatted into the Nigra format with the menu item **Format NA/DNA/LS/Sprinter → Nigra, Format Sprinter-GSI → Nigra, Format DiNi Rec E → Nigra, Format DL-100 → Nigra** or **Format SDL → Nigra**. A dialog box for the selection of the file name for the raw data file appears on the screen.

In the following dialog box for reformatting use the **Measurements** option to transfer the raw in the Nigra measurement file. Then select or enter parameters or header data by clicking **Parameters** and **Header data**.

**Reformatting Raw Data**

**Entry of Parameters:**
Take your time and select the appropriate parameters carefully. A detailed description of the parameters is given in section 8.1.

**Entry of Header Data**

When all entries are completed, click on **OK** or **Exit**.

Reformatting is started by clicking **Run** in the dialog box for **Reformatting Raw Data**. The lines of your raw data as read by Nigra will be displayed on the screen. After reformatting, the individual levellings are automatically numbered with consecutive calculation numbers.

There may still be some point numbers to be corrected or lines to be deleted. Click the editor icon to edit your measurement data file. Alternatively, corrections can also be made in advance in the raw data file.
Enter the heights of the reference bench marks in the menu item **Enter Heights** in the **Heights** menu, then click the button for batch calculation. The following dialog box will appear:

![Batch File Calculations dialog box](image)

**Starting Batch Calculation**

Enter the first and last calculation number and start batch calculation by clicking **Run**. After completion of the calculations, click the button for edit calculations to display the calculations on the screen.

You can print the calculation from the editor or close the editor and print with the print button.
3 Data Entry and Data Format

3.1 Data Entry

Nigra is able to process virtually all levelling data. There are also several alternative ways of entering measurements.

Measurements become especially efficient if levellings are performed with digital levels from Leica, Trimble, Topcon, or SOKKIA. After the transfer to the PC, the data have to be converted to the Nigra format. Choose **Format Leica NA-GSI → Nigra, Format Leica DNA/LS → Nigra, Format Sprinter-GSI → Nigra, Format DiNi Rec E → Nigra, Format DL-100 → Nigra or Format SDL → Nigra** in the Digital Level menu.

You may also enter the data directly in the batch file. It is advisable to copy header data and parameters from previous levellings and to modify them, if necessary.

When reformatting the raw data a Nigra measurement file in the ASCII format (batch file) is always created, which comprises a section of control data and a section of measurement data for each levelling. Both sections have an "E" in the first column as termination character.

The control data includes a calculation number, the header data (observer, date, comments, etc.), and the parameters (levelling method, error limits, etc.). Although the header data (any text) has no influence on the calculations, the parameters control the batch file calculation.

**Note:**

*Beforehand, the heights of the reference bench marks must be entered (Heights menu). If the calculation numbers were not renumbered automatically, click Reorganize Calculation No. in the File menu.*
3.2 Batch File Data Format

A single levelling job has no limit to the data records. A measurement file may contain any number of levellings of any kind.

Example for a Nigra measurement file:

```
RTest file for manual
x23456789012345678901234567890123456789012345678901234567890123456789012345678901
x 1 2 3 4 5 6 7
xDistance<--- Back Side Fore ---><--- Point Number --->
C1
HSan Augustin  Location
H Location
HMovement Levelling  Order
H Order
H123/97  Line
H05-22-2008  Date
Hmost sunny  Weather
HJohnson, M.  Observer
HLeica NA3003  Level
H3 m  Staff
HFirst Measurement  Comments
H Comments
H00  2.Col.:0=Side,1=no Side,4=Line, 5=Level test
*  3.Col.:0=BF,BBFF,2=BFFB,4=BFBF,5=FBBF,4.Col.:a=altern.
H1  Number of staff scales or readings
H0  Scale constant for 2 staff graduations
H2  Difference tolerance for two readings
H1  Staff graduation 1=cm,feet,inches, 0.5=1/2cm
H1  With distances, 1=yes, 0=no
H4  Decimal places for heights in calculations
H4  Decimal places for readings in calculations
E13m  E/Mean value/Error class/Unit of measurement
D  25.26 b1.4235    1503
D  15.47  s2.9007    1503,5
D  15.47  s2.9017    1503,5
D  26.15 f.0279       1504
D  31.59 b1.2622    1504
D  30.99 f.0011       1505
D  18.54 b1.5197     1505
D  12.43 s-.1052      1506
D  18.44 f2.6         1560
E
```
The basic structure of a measurement file:

<table>
<thead>
<tr>
<th>Characters</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st line</td>
<td>Raaa</td>
</tr>
<tr>
<td>2nd line</td>
<td>x23456.</td>
</tr>
<tr>
<td>3rd line</td>
<td>x</td>
</tr>
<tr>
<td>4th line</td>
<td>x</td>
</tr>
</tbody>
</table>

1st levelling -->

- Cn: Code for calculation number
- Hxx..: Header/parameters (20 lines), x=Text or parameters
- Enmu: E=Control data end code, n=mean value mode, m=error class, u=unit, with m=meters, f=feet, i=inches
- D: Measurement
- 0: Measurement
- 1: Measurement
- 2: Measurement
- 3: Measurement
- E: Measurement and levelling end code

2nd levelling -->

- Cn: Code for next calculation number
- Hx: Hx

3rd levelling -->

- Cn

The first column of a data set contains a code (R, C, H, D, E, 0, 1, 2, 3). The reference benchmarks for network adjustment are given in the code A (see section on Network Adjustment).

Other characters are also permissible, but then these lines of data have no influence on the processing. Such characters can be used, for example, to suppress the measured values:

xD  12.34     z1.234 ..........

Both upper and lower case letters may be chosen. The codes are explained in the following sections.

Note:

Levelling codes are defined in the language file *.LAG by the numbers 230-238. In the previous and following text, the designators used are the standard values from the file ENGLISH.LAG. If you use another file, the codes may be different.
3.2.1 Remarks/Comments
Code: R

The first line should include a detailed description of the job (max. 72 characters). This information is part of the header on all pages printed. It is not printed, however, if the line only contains the character "R".

Other comment lines are printed together with the calculations regardless of position.

3.2.2 Calculation Number
Code: C

Calculation numbers serve to select a range to be calculated by the current batch file or to be printed by the printing function.

When reformatting digital level raw data only a C is inserted between the various levellings. When formatting is finished, calculations will be renumbered automatically.

Alternatively, if automatic numbering is disabled, the menu item Reorganize Calculation No. in the File menu (see this section) numbers all the levellings consecutively starting from a number assigned to the first levelling (max. 6 digits).

Special calculation number: 999999 = fixed points not overwritten by calculations

3.2.3 Header Data
Code: H

The header data and the parameters form the control block comprising 21 data records (=lines), which precedes all measurement data.
The header data (alphanumeric data records 1-12) describe or explain a levelling job and the parameters (data records 13-21) control the calculations.

When converting digital level raw data special input masks are provided for entering the header and for defining the parameters. With the digital levels, both header and parameters can already be added in the field at the levelling stage (see sections 7.1 Leica, 7.2 Trimble, 7.3 Topcon).

Refer to section 8.1 for further details on parameters and header.

**Header data:**

<table>
<thead>
<tr>
<th>Record</th>
<th>Description</th>
<th>Permissible Char.</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rec.  1</td>
<td>Location (char. 1-19)</td>
<td>alphanumeric</td>
<td></td>
</tr>
<tr>
<td>Rec.  2</td>
<td>Location (char. 20-38)</td>
<td>alphanumeric</td>
<td></td>
</tr>
<tr>
<td>Rec.  3</td>
<td>Order (char. 1-19)</td>
<td>alphanumeric</td>
<td></td>
</tr>
<tr>
<td>Rec.  4</td>
<td>Order (char. 20-38)</td>
<td>alphanumeric</td>
<td></td>
</tr>
<tr>
<td>Rec.  5</td>
<td>Line</td>
<td>alphanumeric</td>
<td></td>
</tr>
<tr>
<td>Rec.  6</td>
<td>Date</td>
<td>alphanumeric</td>
<td></td>
</tr>
<tr>
<td>Rec.  7</td>
<td>Weather</td>
<td>alphanumeric</td>
<td></td>
</tr>
<tr>
<td>Rec.  8</td>
<td>Observer</td>
<td>alphanumeric</td>
<td></td>
</tr>
<tr>
<td>Rec.  9</td>
<td>Level</td>
<td>alphanumeric</td>
<td></td>
</tr>
<tr>
<td>Rec. 10</td>
<td>Staff</td>
<td>alphanumeric</td>
<td></td>
</tr>
<tr>
<td>Rec. 11</td>
<td>Comment (Char. 1-19)</td>
<td>alphanumeric</td>
<td></td>
</tr>
<tr>
<td>Rec. 12</td>
<td>Comment (Char. 20-38)</td>
<td>alphanumeric</td>
<td></td>
</tr>
</tbody>
</table>

**Control data:**

Rec. 13 levelling method

1st character, type of evaluation:
- 0 = heights calculation of side shots and turning points
- 1 = evaluation as line levelling
- 4 = line adjustment (only for manual data entry)

2nd character, series of observation:
- 0 = BF BF or BBFF BBFF
- 2 = BFFB BFFB
- 4 = BF BF
- 5 = FBBF FBBF

3rd character
- a = alternate series of observation

**Examples:**
- H00a or H10a BF FB or BBFF FFBB, respectively
- H02a or H12a BFFB BFFB
- H04a or H14a BF BF
- H05a or H15a FBBF FBBF

In addition, the following older codes will be supported:
- H0 equivalent H00
- H1 equivalent H10
- H03 equivalent H00a
- H13 equivalent H10a
| Rec. 14 | Number of staff scales | 1, 2 | 1 |
| Rec. 15 | Scale constant | numeric |
| Rec. 16 | Diff. tolerance between scales | numeric |
| | in mm/20 or mm/10 for meters | |
| | 0.0001 ft for feet | |
| | 0.01 for inches | |
| Rec. 17 | Staff graduation/units | 1 = cm | 1 |
| | .5 = 1/2 cm | |
| Rec. 18 | Calculation with distances | 1 = yes | 1 |
| | 0 = no | |
| Rec. 19 | Decimal places for heights | 2, 3, 4, 5 | 3 |
| Rec. 20 | Decimal places for readings | 2, 3, 4, 5 | 4 |
| Rec. 21 | End code | E13m |

Default data will replace the entered data in case they are outside the admissible range.

**Identification code:** E, first end identification (after the header/parameters data)

**2nd Column:** Contains the code for averaging the following levelling.

0 = Any multiple calculations of points are averaged and the resulting mean value is stored.

The mean value mode considers all previous determinations of a point, also those from previous calculations.

(see data field NC in Section 6).

1 = The heights calculated with 1 are always stored, already existing heights will be overwritten.

NC (=Number of Calculations) is set to 1, Diff to 0.

2 = Twice-determined points calculated with calculation mode 2 are only compared. Points not stored so far will, however, then be stored.

3 = No storage, no comparison

In the cases 0 and 2, the height database includes the averaging difference for multiple determination of points. For the mean value calculation mode also see Section 3.2.4.
Note:
The height database stores only the mean difference between the current height and the previous height (this height may already be a mean).

The protocol of mean value calculations issued at the end of a calculation contains all averaging differences in the sequence of the calculations.

3rd Column: Error Class

Error Class 1 - 4 for misclosure E of new measurements and the specified height difference of two reference bench marks for levelling by side shots, and for line adjustments.

Error Limits can be defined for 4 classes in the Options menu with the menu item Program Configuration.

Example of error limits:

<table>
<thead>
<tr>
<th></th>
<th>1st Class</th>
<th>2nd Class</th>
<th>3rd Class</th>
<th>4th Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+ (2 + 2 * √D) mm</td>
<td>+ (2 + 3 * √D) mm</td>
<td>+ (2 + 5 * √D) mm</td>
<td>+ (2 + 7 * √D) mm</td>
</tr>
<tr>
<td></td>
<td>for D in km</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4th Column: Unit of measurement

Unit of measurement of the measurement data: m = meters, f = feet, i = inches. No indication means meters (for example, from Delta/DOS files).

3.2.4 Measurement Data

Identification codes: D, 0, 1, 2, 3

Identification codes define the mean value calculation mode:

Column 1:  D  mean value mode as determined in the control data block

0 - 3 point-specific mean value mode, i.e., this point has a mean value mode differing from the header mean data. (Further information: see below)

Columns 2 - 9:  distance in meters, feet, or inches
Columns 10 - 39:  staff readings for back, side, and fore sightings, abbreviated b, s, f, respectively. Also + and - using line adjustment.
Columns 40 - 60:  Point number, max. 14 alphanumeric characters.
Data may be placed at any location within each column range.

Examples of measurement data:

\[
\begin{array}{c|c|c}
D & 20.5 & b12.5678 \\
0 & 15.0 & s2.345 \\
\end{array}
\quad \begin{array}{c}
CD123456789 \\
CD123456790 \\
\end{array}
\]

Examples of the different levelling modes: See section 13.

Concerning **point-specific mean value mode:**

It is possible to alter the mean value mode fixed in a batch file by replacing the character "D" in the first column by the numbers 0, 1, 2, or 3 (for example, after reformatting the raw data).

Before starting a batch calculation, it should be carefully considered which mean value mode is to be applied. It is advisable to determine the first definition of a point with 1 (=new).

If points with several determinations have to be averaged, there are alternative procedures:

**Method 1:**

All fixed points are entered with the calculation number 999999. For all points the mean value mode 0 (=mean value) is entered. If the batch calculations must be repeated, activate the check box **Delete new points.**

**Method 2:**

The initial definition of a point is performed with mean value mode 1 (=new), all further definitions of the point with 0 (=mean value). Here you usually have to work with the point-specific mean value mode.

**Note:**

If a point has been defined with the point-specific mean value mode, the mean value mode (o,n,m,w/old, new, mean, without) is indicated on the right side of the point number in the calculation report.

To keep track of the mean value modes, the respective mean value mode is indicated in the mean value report for each point. You may also control the mean value mode with the NC field (=number of calculations) of the height database. You will find a 1 entered there for points with the mean value mode set to 1 (=new).
3.2.5 Special Features of Nigra

Use of decimal point or comma?

In the Windows Regional Settings (under Control Panel) you can select a point (.) or comma (,) for the decimal character, corresponding to the regional settings. Nigra works correctly with both, point or comma. If a comma is entered as decimal character in the system control, all inputs must also be made with a comma. If you enter a point, it will be automatically changed into a comma.

Note:
All outputs have a decimal point!

Rounding numbers

The rounding is done "surveyed". Is a value exactly halfway between two values is always rounded to the nearest even value. Because of the accuracy loss that could arise from the nature of internal representation of decimal floating-point arithmetic operations, Nigra rounds in some cases may not be the nearest even value.

The probability that a value is exactly between two numbers, however, is extremely low, as measured and calculated values are always stored with the greatest possible number of digits and are only rounded for output.

Measurement Data Control

During batch calculations, the logical sequence of the measurement data (marked b, s or f) is controlled during levelling with side shots and during line levelling. The numerical correctness of the measurement data is also checked, for example, the measurement data bl..456 or t3.2451 are recognized as incorrect.
4 File Menu

4.1 Open/New Job
This menu item sets up a new job or opens an existing one for working. A Nigra job must contain at least the measurement data file with the job name and the file extension .NIG.

Example: The job name Test results in measurement data file TEST.NIG.

More information on this subject is to be found in section 2.2, Open/New Job.

4.2 Edit Measurement Data
Editing measurement data generated from the digital level raw data format. The current job file is displayed with the file extension .NIG.

You may also enter the data directly in the batch file with this menu item. It is advisable to copy header data and parameters from previous levellings and to modify them, if necessary.

4.3 Reorganize Calculation No.
When reformatting digital level raw data the character 'C' (for calculation number) is automatically entered between individual levellings.

Starting from the first levelling, all following levellings are numbered in sequence with Reorganize Calculation No.

Example:
C in the first levelling = C1
                          C2
                          C3

C100 in the first levelling = C100
                               C101
                               C102

.
The calculation number must be <= 999999. C999999 in the first levelling =

\[ C999999 \\
C999999 \\
C999999 \]

Note:

*Points with the calculation number 999999 are fixed points that are not changed in the height database when calculated, independent of the averaging.*

if at the start of a line the text SPLIT (or split) will be found.

Example:

```
D  25.26 b1.4235       1503
D  15.47         s2.9007     1503.5
0  15.47         s2.9017     1503.5
1  15.47         s2.        200
D  26.15         f0.0279     1504
split
D  31.59 b1.2622     1504
0  30.99         f0.0011     1505
E
```

At the point 1504 the previous levelling will be closed with E and with the same header will be created a new levelling from point 1504 to point 1505.

Simultaneously it is possible to split levellings with this function, if the text SPLIT (or split) precedes the line.

Example:

```
D  25.26 b1.4235       1503
D  15.47         s2.9007     1503.5
0  15.47         s2.9017     1503.5
1  15.47         s2.        200
D  26.15         f0.0279     1504
split
D  31.59 b1.2622     1504
0  30.99         f0.0011     1505
E
```

At point 1504 the previous levelling is closed with E and a new levelling is created from point 1504 to point 1505 with the same header.
4.4 Print Measurement Data Protocol

After defining the area (From calculation no. - To calculation no.) and the start page number a data file is created and sent to the printer. A further protocol of the current job may be created only after the running printout is finished.

![Image of Measurement Report dialog box]

Printing Measurement Data Protocol

4.5 Edit Files

A dialog box is opened for selecting any text file. Do not choose any program files with the file extensions EXE, COM, DLL, etc.

4.6 Delete Files

This opens a dialog box for deleting Nigra files no longer needed in the current job folder.

![Image of Delete files dialog box]
By clicking on a certain file type, the selection can be limited. Multiple choice is possible in the **File Type** field as well as in **File List**: Press the control key [Ctrl] and simultaneously click on the desired line. With the command **Select all**, all files will be marked. A second click on **Select all** will cancel the selection.

Click on **Delete file** if the selected files are to be erased. Selecting **Exit** quits the dialog box without deleting a file.

**Measurements** deletes only the measurement data file of the selected job (file extension .NIG). In case you still want to use the old height database and other files of this job, create a new job under the old name.

### 4.7 Convert ASCII → ANSI

The conversion of ASCII→ANSI is advisable, if old DOS files, for example, a *.DAT file from Delta/DOS, are to be used with Windows. This ensures the correct display of the German 'umlauts'.

**Note:**

*Not for every DOS character is there a corresponding ANSI character.*

The menu item **Convert ASCII → ANSI** opens a dialog box for selecting an ASCII file. Selecting of multiple files is also possible. After the selection is confirmed, the conversion is started. The new file bears the same name as the ASCII file and is stored in the current job folder.
4.8 Print

This menu item opens a dialog box for selecting a text file. After confirmation of the file name by clicking **OK**, a dialog box opens:

The above dialog box is for printing text files. It is also used when printing calculations, movement lists and results of the result of network adjustment.

**From page** – **To page** defines the printing area. In case there is no margin, the needed margin can be determined with **Left margin**. (All Nigra files have a sufficient margin.) Activate check box **Print header graphics**, to print out the header graphics (see also **Program Configuration**). By activating the button **Print header graphics in header line**, the upper edge of the graphic is placed right-justified in the first line. The size of the header graphic must not exceed approx. 2.5 cm x 2.5 cm.

Activating the **Print preview** button only generates a print preview instead of a direct printout. Storage space problems may occur with very large files.

After activating the check box **PDF Format**, a file in the Adobe Acrobat PDF format will also be generated. The file name will be created from the present file name and the file extension PDF, changing SAMPEL.BER to SAMPLE_BER.PDF.

After activating the check box **HTML Format**, a file in the HTML format will also be generated. The file name will be created from the present file name and the file extension HTM, changing SAMPEL.BER to SAMPLE_BER.HTM.
Click on the **Run** button to start the printout, print preview or create the PDF and HTML format. Click on the **Cancel** button to stop the printout.

If you want partial printout, load the file into the editor. You will be instructed how to arrange printouts with the help of the editor in the appendix *Nigra Editor*.

### 4.9 Printer Setup

Any printer suitable for Windows may be used for printing lists created by Nigra. This menu item opens a dialog box for selecting and setting up a printer.

When you have made changes, you finally press the **Accept** button.

### 4.10 Printer Fonts

This opens a dialog box for selecting a font. You may select the font, style, color, and size. Only the non-proportional fonts available in your computer are shown, i.e. fonts with an equal width for all characters (for example, Courier New). Arial, for instance, is a proportional font and cannot be chosen. When using A4 portrait, select a 10 or 11 point font.

![Selecting a Font](image)

For printing movement lists, Nigra automatically selects a suitable font size to fit of paper format.

### 4.11 Exit

Closes Nigra.
5 Calculate Menu
The heights will be calculated with the data of an already existing measurement data file (batch file calculation).

Calculation reports are written in the file 'job'.BER.

5.1 Batch File Calculations

![Start of Batch Calculations](image)

By entering **From calculation no.** - **To calculation no.**, either a complete job or part of a job may be processed. With **Page no.**, any page number may be set as starting point.

All fixed point heights are always searched in the height database of the current job. All newly calculated heights are also stored in this database.

Alternatively, for bigger jobs you can work with an external height database:

By selecting **External height file**, the selected one will be used for all height operations instead of the current one: Connecting points will be searched for there, newly calculated points will be stored there.

If you want to use an external height database, click on the button at the right of the text field: It opens a dialog box for selecting a height database. The name of that height database will then be written in this field.
The option **External height file** is active only if the check box at the left side is also activated. This application is meant for large jobs with a lot of measurement data, where it seems advisable to divide one job into several part jobs. With the option **External height file**, various jobs have access to a joint height database.

**Note:**
*Measurement data are taken from the current job. All following file operations refer only to the current job.*

In addition, you can choose a **Central height file**, which will be used to search for connecting points. Newly calculated points are stored in the current job height database or in the external height file (if chosen).

In the central height file may be stored, for example, all points of your town or the country. Then it is not necessary to load the connecting points in the current job file. If the check box **Central height file** is activated, and a file is selected, Nigra searches for connecting points in this file first. If the connecting point cannot be found there (for example if a point was newly calculated), the searching will be continued in the current job height file (or the external file). If the point is also missing there, an error message will be written in the calculation output.

Comparisons (mean value 2 - old) will not be executed with the central height file, but with points in the current job or in the external height file.

The **Central height file** is selected in the same way as the **External height file**.

Activate the check box **Delete old calculations** in case a previously existing calculation file is to be deleted in advance.

Activate the check box **Delete new points** if you want to delete all new points (points with calculation number <> 999999) before starting the calculation. In this way you can avoid the explicit deleting of new points, if you are using mean value '0 - mean'.

**Note:** All fixed points must be stored in the height database with calculation number 999999.

Activate the check box **Stop if error limit is exceeded** if calculations are to be stopped if the limit for the closure error is exceeded.
Missing heights for connecting points when calculating levelling with side shots or line adjustment will cause the stoppage of calculations only if **Stop if error limit is exceeded** is activated. If at least one connecting point is known, alternatively a calculation without error distribution will be performed ("backward calculation"). If both connecting points are missing, the calculation is performed with a starting height = 0.000.

The check box **Error limit (in mm) for multiple measurements** permits control of points with multiple measurements. If the error limits are exceeded, the averaging protocol will make a note of it.

The check box **Threshold factor for error messages** serves to ensure a decreased error limit, for example, with the entry of 0.5 a warning is placed in the calculation list when half of the error limit is exceeded. Entering 1 eliminates this check.

Press the **Run** button to start the calculation.

Errors, for example, missing header data, exceeding the error limit, or connecting points not found are marked with ***.

The sum of all errors is shown at the end of the calculation file.

The sum of all levelling distances is displayed at the end of the calculation. Distances to side shots and levelling distances for instrument testing are not taken into account. In case some points were determined several times, the protocol also contains an averaging protocol.

**Note:**

*The current parameters from the dialog box Parameters and Header Data is not taken into account for batch calculation as these parameters are contained in the header data of the batch file. Should you want to change the decimal places of the heights, for example, you have to alter them in the batch file.*
5.2 **View Calculations**
For viewing or editing of the calculation file. It is advisable to check whether the calculation has been performed correctly before printing.

5.3 **Print Calculations**
For printing the calculation file on the printer and output of PDF or HTML format. A new calculation may be started only after the printout is finished.

5.4 **Delete Calculations**
For deleting a calculation file. Alternatively, an existing calculation may be deleted by activating the respective check box before starting a batch calculation.
6 Heights Menu

Nigra offers various possibilities of inputting, altering and displaying heights.

Heights calculated or recorded with Nigra are stored in the Nigra height database. The height database (file extension .MDB) is compatible to Microsoft Access Database. Since the first version of Windows Nigra had the MS Access database format 97th. From Nigra 5.0 is Access 2000 to 2007 used.

It is possible to access the Nigra height database with MS Access, for example, to produce special data output formats. In this case, always be sure to work with a copy of the original height database!

The following data are stored under an alphanumerical point number with maximum 14 characters:

<table>
<thead>
<tr>
<th>Data</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>-10000 to +10000 m, numeric</td>
</tr>
<tr>
<td>Date</td>
<td>measurement date, max. 10 characters, alpha-numeric, e.g. 05-15-2010</td>
</tr>
<tr>
<td>Calculation no.</td>
<td>&lt;= 999999, numeric</td>
</tr>
<tr>
<td>NC</td>
<td>1-99, number of determinations, simultaneously mean weight, numeric</td>
</tr>
<tr>
<td>Difference</td>
<td>mean difference in mm, -9999.9 to +9999.9, numeric</td>
</tr>
<tr>
<td>Comment</td>
<td>max. 30 characters, alphanumeric</td>
</tr>
<tr>
<td>Y-coordinate</td>
<td>-9999999 to +9999999 m, numeric</td>
</tr>
<tr>
<td>X-coordinate</td>
<td>-9999999 to +9999999 m, numeric</td>
</tr>
</tbody>
</table>

Heights recorded in either feet or inches are always stored in meters in the height database. The switch to the chosen unit of measurement is only made upon calculation or the output of a heights list.

Date and comments for calculations are taken from the headers of the measurement data file.

In the case of multiple calculations, the last calculation number is stored. Fixed points are defined by calculation number 999999 and are not modified by a calculation.
Point numbers are in ascending sequence for all height lists from the database according to the numerical values of the ASCII codes of the individual characters of a point number. Numbers range before letters in the case of an equal number of digits. Example of sorted heights:

1
A
a
22
111
zzz
KD12
00001
50001

Note:
*The digit 0 is also a valid character in the point number. Therefore, the point numbers 1 and 01 are not identical. However, when reformatting digital level raw data, preceding zeros are eliminated.*

In general, purely numerical point numbers are easier to handle than alphanumerical point numbers. For determining profiles, only a maximum of 8-digit numeric point numbers are allowed.

Per project can be stored approximately 10 million points in the height file.
6.1 Enter Heights

Functions for entering new points, modifying and deleting heights already recorded.

**Enter Heights**

**Explanation of buttons:**

**Automat. increment:** Increments the right-hand numerical part of the point number by the value entered.

**Save:** Saves the point in the height database. The contents of the fields for date, calculation number and comments remain unchanged for entering the next point.

**Search:** Searches for the point number entered in the field **Point no.** and displays all data of the point.

**New Mask:** Provides an empty mask for entering data.

**Delete:** Deletes the presently displayed point from the height database. After deleting the last point an empty mask will be displayed.

**Exit:** Closes the dialog box.

**Scrolling:** Clicking on the button ‘<<’ displays the first point, clicking on the button ‘>>’ displays the last point of the height database. Clicking on the arrows ‘<’ and ‘>’ moves one point backward and forward respectively.

Double-click on the input field for **Date** enters the present system date.
Moving the cursor in the data entry mask

Pressing the **TAB** key moves the cursor to the next entry field.

**How can points be modified?**

Enter the point number and click on **Search**. The displayed point data may be modified. Furthermore they can be stored in the height database by clicking on **Save**.

You may also enter, alter or delete heights with the menu item **Heights Output**, output device **Screen**.

**Modifying many heights** (for example, to change to another height system)

Nigra provides a function to alter heights and coordinates of a complete job or point area by a fixed amount. Independent of this or simultaneously, other data fields of the height database can be modified with this command.

**Usage:**

In the entry field of a point number, enter the string **#add#** and then enter the desired amount in the entry field **Height/Y-coordinate/X-coordinate** in meters, feet, or inches. Text in other entry fields also modifies the height database (except the field **No. of Calculations**). To keep a data field unchanged, the entry line must be empty.

Particularity in the **Comment** field: **#add#** adds "new text" to the old text. Without **#add#**, the old text will be overwritten by the new text.
In the example above, the amount 0.15 is subtracted from the stored heights. Also, the text ", (1999)" is added to the database field Comment.

After a click on the Save button, a new dialog box for the point number area entry will be displayed in which the changes can be made.

The data fields for No. of calculation and Difference should not be changed.

6.2 Delete Points

For deleting point groups (enter From point no. and To point no.) or single points (empty field To point no.).

Deleting points

Deleting fixed points (points with the calculation number 999999) can be excluded. Activate the check box Delete points with calculation no. 999999, if also points with the calculation number 999999 are to be deleted.

Clicking the Run button starts the deletion of the selected points.

6.3 Renumber Points

Renumbering of individual points or area of points. There are different methods available.
Renumbering of points

**Single points:** Renumbering of individual points by entering of the old and new point number.

**Extend area:** Renumbering of an area of points, by extending the point number. Input of point number area by **From point no.** and **To point number.** The characters for the extension (first string) of the point numbers and the position (starting at the right) of the entry must be inputted under **Extend point number.** The original point numbers can be extended by any two alphanumerical character strings, i.e. insert numbers or letters, add or set before.

The position from the right in the second string refers to the point number changed by the first character string. Example:

1\textsuperscript{st} string: GAS,  
*Position from right:* 5

The point number 1000 will be changed to GAS1000.

**Replace area:** Renumbering an area of points by replacing a part of the point number. Input of point number area at **From point no.** and **To point number.** Under **Replace parts of point number** input the replacement text and the position from the right, where the replacing starts. Example:

*Replace text:* WAS  
*Position from right:* 7
The point number GAS1000 changes to WAS1000.

**List:** First it is necessary to create a list (ASCII file), which contains the old and new point number separate by a single space character. The list can be chosen with the icon on the right.

**Example for list:**

```
1000  GAS1000
200012 Wasser0001
```

The point number 1000 will be changed to GAS1000 and the point number 200012 will be changed to Wasser0001. The lines of the file will be worked off line by line like the renumbering of individual points.

A report of the renumbering and errors by Nigra recognized (e.g. new point number already exists) will be written to a LOG file, which can be shown after the end of renumbering.

### 6.4 Heights Output

With the menu item **Heights Output** you may generate three different height outputs:

- **Screen**
- **ASCII** and
- **Printer**

The output **ASCII** includes the Nigra standard format and a lot of user defined formats.
Create Heights Output

The output of the height database can be limited by indicating the point numbers. For the output types ASCII and Printer, several point number areas may be outputted in one file: Enter a point number area and then click on OK. Enter a second point number area and click on OK again. The Exit button stops the output and starts the printout or the creation of the ASCII file.

For the Screen output, only one entry in the field From point no. is necessary. If a specified point cannot be found, the output is starting with the next higher number.

If the ASCII output (only standard format) is used, a character can be optionally used as separator between the data fields. This is probably useful if data are to be exported to different software.

You may set the desired decimal points for heights and coordinates in the field Decimal places. Negative decimal places result in an output using the indicated digits without displaying the decimal point.

Example: Decimal places = -4, Height = 104.56493 results in 1045649

Activate the check box Output of X, Y-coordinates, if coordinates are also to be entered into the heights list.
Screen heights output:

![Screen heights output](image)

**Note:**

The output of the heights on the screen is always in the unit of meters.

**Moving:** With the scroll bars, the buttons **First point**, **Last point**, the keys [Pos1] (first point), [End] (last point), the arrow keys (up or down one line) and the keys PgUp and PgDn (previous or next screen). With the **Search** button a specified point number can be located.

Points can not only be displayed but also altered and new points may also be entered.

**To modify points:** Put the cursor in the field that is to be altered. The existing value is deleted by the new entry. If only certain data in the field are to be altered, double-click the respective field and put the cursor in the position where alterations are to be made. You may also alter point numbers. The alterations are effective when you leave the data record.

The present system date is entered by double-clicking the **Date** field.

**To copy cell contents** with Drag & Drop: Click the cell you want to copy with the left mouse key. Keep the key depressed and release it on the cell into which the contents are to be copied.
To enter new points: Click the Last point button to go to the end of the height database. The cursor is placed in the first empty field with the arrow down key or mouse click. Enter the point data there. The point data are written into the height database when you leave the data record. A sorted file will appear only in a repeat display.

To delete points: Click on the left margin of a data record that is to be deleted. A hook will appear and the data record is marked. If required, mark further data records by keeping down the Ctrl-key. Areas can be selected by pressing the Shift key. By clicking the Delete button or pressing the Del key all marked data records will be deleted.

ASCII List

The Nigra height database is kept as a MS Access Database. It is written into an ASCII file (file name 'job'. ASC) with this function, either completely or in parts. This file may then be transferred into other programs for further modification, for example, into a spread sheet or a text editor.

Example of an ASCII list (Standard format):

Company xyz
NigraWin - Levelling, Version 4.00 02-26-2008
Job: Sample
Road Construction L 269

<table>
<thead>
<tr>
<th>Point Number</th>
<th>Height</th>
<th>Calc.No.</th>
<th>Diff.</th>
<th>NC</th>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>002+1250</td>
<td>50.500</td>
<td>777777</td>
<td>0.0</td>
<td>1</td>
<td>07-07-2007</td>
<td>000</td>
</tr>
<tr>
<td>102+1250</td>
<td>48.513</td>
<td>777777</td>
<td>0.0</td>
<td>1</td>
<td>07-07-2007</td>
<td>130</td>
</tr>
<tr>
<td>102+1275</td>
<td>48.498</td>
<td>777777</td>
<td>0.0</td>
<td>1</td>
<td>07-07-2007</td>
<td>980</td>
</tr>
<tr>
<td>102+1300</td>
<td>48.516</td>
<td>777777</td>
<td>0.0</td>
<td>1</td>
<td>07-07-2007</td>
<td>160</td>
</tr>
<tr>
<td>102+1325</td>
<td>48.520</td>
<td>777777</td>
<td>0.0</td>
<td>1</td>
<td>07-07-2007</td>
<td>200</td>
</tr>
<tr>
<td>102+1350</td>
<td>48.520</td>
<td>777777</td>
<td>0.0</td>
<td>1</td>
<td>07-07-2007</td>
<td>200</td>
</tr>
<tr>
<td>102+1400</td>
<td>48.510</td>
<td>777777</td>
<td>0.0</td>
<td>1</td>
<td>07-07-2007</td>
<td>100</td>
</tr>
<tr>
<td>102+1450</td>
<td>48.480</td>
<td>777777</td>
<td>0.0</td>
<td>1</td>
<td>07-07-2007</td>
<td>800</td>
</tr>
<tr>
<td>102+1551</td>
<td>48.513</td>
<td>777777</td>
<td>0.0</td>
<td>1</td>
<td>07-07-2007</td>
<td>130</td>
</tr>
<tr>
<td>102+1552</td>
<td>48.498</td>
<td>777777</td>
<td>0.0</td>
<td>1</td>
<td>07-07-2007</td>
<td>980</td>
</tr>
<tr>
<td>102+1553</td>
<td>48.516</td>
<td>777777</td>
<td>0.0</td>
<td>1</td>
<td>07-07-2007</td>
<td>160</td>
</tr>
</tbody>
</table>

User defined ASCII List

In addition to the Nigra standard format, users can define their own output format. All data fields can be outputted. Invariable text can be inserted.

The format definitions will be stored in files with the file extension EXF in the Nigra templates folder.
The output format is line-oriented. For each line there is a maximum of 500 columns. All user defined formats get no header line like the Nigra standard format.

**How to create user defined formats**

If there are no user defined formats stored, the list box under the caption **ASCII Formats ....** will only show the item **Standard** to create the Nigra standard format output. Execute a double click on the caption of the list box, if you want to create or alter your own output format.

**Defining your own heights output format:**

![Image of the Define Format for Height Output dialog box]

Look at the dialog box above. First, you have the choice of loading a sample file containing the desired format: Execute a double click on the top green field. Use the keys PgUp and PgDn to browse in the file.

In the middle part of the dialog box you must enter the column range of the output format for each data field you want to write in the ASCII file. The right entry is **first column, space, last column.** For the data fields Height, X-coordinate and Difference you can also define the decimal places of the output. The entry for the X-coordinate is also valid for the Y-coordinate. If you want to create the output with decimal places but **without the decimal point,** the entry must contain a negative number, for example, -3.

Except for the data field **Comment,** all other data fields will be right justified.
As soon as you leave an input field, the output format will be shown with x-characters in the fourth line of the pink section on the bottom of the dialog box. Intersections will be marked with an exclamation mark (!).

In the third line of the pink section on the bottom of the dialog box you can enter fixed text. Intersections with the above defined columns will be marked with asterisk (*). The fourth line will only be updated, if you the leave this section.

When all entries are made, click on the **Save Format** button to store the defined format in a file with the extension .EXF.

By clicking on the **Load Format** button you can load a present format into the dialog box to make changes.

If the format definition is OK and the format is stored successful, click the **OK** button to return to the dialog box **Heights Output**. Then choose the desired format in the list box and click **OK** for ASCII output.

If you find the asterisk (*) in the ASCII output, there are intersections, or it may result if the defined length of a data field is not long enough to hold all characters.

**Printer List**

Printing is performed immediately after clicking **OK** on the standard printer registered under Windows. In contrast to the ASCII list, each page will be printed with a header indicating the page numbers.

### 6.5 Edit ASCII File

For editing the previously created ASCII file.
6.6 Import Nigra Heights

Imports heights from other Nigra jobs into the height database of the present job. First choose the height database to be imported (file extension .MDB).

Import of Nigra Heights

After selecting the point range, a constant calculation number may be defined in the field Calculation no. for all points to be imported. Clicking OK starts the import.

Perhaps in the height file already stored points with the same number will be overwritten.

6.7 Import ASCII Heights

Imports heights from ASCII files in any format into the height database of the present job. The individual ASCII file must have a uniform format and may not contain any lines without heights (except blank lines).

If only parts of the data are to be imported, the ASCII file has to be cut beforehand, using the editor. After the selection of the ASCII file, the following dialog box is displayed:
The first line of the ASCII file is displayed in the upper part. The first 50 lines of the ASCII file can be displayed with the PgUp/PgDn keys.

Point number, height, date, comment, Y-coordinate, X-coordinate, number of calculations (NC), difference and calculation number are defined by specifying columns in the ASCII file like F L (F=first column, space, L=last column).

An entry in the text field for **Add century** adds the century for dates which have only two digits for the century.

**Example:**
Date = 2-15-65  
Century entry = 19 or 1900  
Results in date 2-15-1965

With no entry for **Add century**, the century for correct dates will be added automatically.

**Please note:** There must be selected four characters for year in the Windows control panel.

**Date, Comment** and **Calculation no.** can be defined alternatively free; inputs to the Comment field must begin with the # character.
If there are no fixed column ranges for **Number of calculations**, NC is set to 1. If there are no fixed column ranges for **Difference**, the difference is set to 0.0.

ASCII codes < 32 (printer control codes) are eliminated. The height value may also contain a comma as decimal point (it will be converted into a point).

In ASCII files without a comma/point, the position of the decimal point can be defined by entering a value in the field **Number of decimal places**.

Another function of **Import ASCII Heights** is to complete the stored data with further data, for example, coordinates.

**Example:** In the height database are stored the height and date of a point. From an ASCII file you want to add data with Y, X-coordinates and comments. To do this, you must enter the column values only in the fields **Y, X-coordinate** and **Comment** and run the ASCII import. The height values and dates already existing in the height file will remain intact.

The previously defined format can be stored (**Save Format** button) as a template and loaded in the future (**Load Format** button). The templates have the file extension .IMF and are stored in the Nigra templates folder.
7 Digital Level Menu

7.1 Leica NA- and DNA/LS-Levels

For the evaluation of data measured with the Leica digital level NA2000, NA2002, NA3000, NA3003, DNA03, DNA10, LS10 and LS15 carry out the following steps:

- Transfer raw data to a computer
- Reformat raw data to Nigra format
- Enter heights of connecting points
- Start calculations

The point heights of the raw data file can also be transformed directly in the Nigra height file. Additionally, it is possible to create a profile file from raw data.

7.1.1 Leica GSI Data ↔ PC

This activates the program for the transfer of raw data to a PC or for the transfer of real heights to the digital level.

The method of data transfer depends on the level used:

NA2002, NA3003 (since software version 3.2), DNA03, DNA10, Sprinter 100M, 150M, 200M, 250M: Direct transfer by the built-in serial com interface.


With the levels DNA03 and DNA10 it is possible to transfer the data to a PCMCIA or CF card and copy it to the PC with a corresponding adapter.

With the Levels LS 10 and LS 15, it is recommended to transfer the data to a USB stick and then copy them for further processing on the PC.

Data Transfer GIF 10 ↔ PC

This invokes the program module to transfer raw data from the GIF 10 to the PC or set-out heights to GIF 10. If there is no program defined in the Program Configuration, Transfer programs for digital levels, the Nigra built-in data transfer is activated.
If you want to use another program for the data transfer, define the name of the transfer program in **Program Configuration** (Options menu). Clicking on the menu item **GIF 10 ↔ PC** opens your program (instead of the Nigra built-in data transfer). In the latter case, please refer to the manual supplied with the program.

![Data Transfer GIF 10 ↔ PC](image)

**Data Transfer GIF 10 ↔ PC**

**Transfer of Data with the Nigra built-in Interface**

First define the serial interface to which the GIF 10 is connected to the PC. Nigra shows only the available serial ports on your PC.

Then check the transfer parameters baud rate and parity: The same values must be set on the PC and on GIF 10. Furthermore, the following settings must be performed on the GIF 10:

- **CONNECTION AS DCE**
- **PROTOC** ACK/NAK
- **ENDMARK** CR
Data Transfer GIF 10 → PC:

If this not yet the case, activate the option **GIF 10 → PC**. Use the default file name for raw data (current date and file extension .NA2) or enter any file name with the file extension .NA2 for the transfer in the current job folder. Alternatively click on the **File name** button to get a dialog box for file selection.

If there already exists a file with the same name, a dialog box appears and asks: "File exists, overwrite?". Click the **Yes** button to overwrite, or **No** to add data.

Do not define any file extensions which are in use by Nigra (.NIG, .MDB, .BER etc.)! It is recommended to use the file extension .NA2, .GSI or .DNA.

Follow the orders in the dialog box, then click on **Run**.

Another dialog box will appear:

![Data Transfer GIF 10 → PC dialog box](image)

Take the default or change the settings for **REC module file no.**, **Start block no.**, **End block no.**, and start data transfer by clicking **OK**. The transfer can be interrupted by pressing the key [Esc] on the PC or [CE] on the GIF.

Data transfer PC → GIF 10:

Initiates the transfer of the file 'job'_FixPt.GSI (including the heights of the current job) to the GIF 10. This file is in the GSI format and must be created first with the menu item **Format Heights → Leica GSI**. Alternatively, you can choose every file in the GSI format by clicking on the button **File name**.

Activate the option **PC → GIF 10** and click on **Run**. Enter the REC module file number in the next dialog box and click on **OK**.

The transfer can be interrupted by pressing the key [Esc] on the PC or [CE] on the GIF 10.
Note:  
In the case of a breakdown of the data transfer, please use a special transfer program from Leica.

Data Transfer NA/DNA/Sprinter Raw Data ↔ PC

This starts the Nigra terminal data transfer. Detailed explanations are in the section 7.5.

7.1.2 Edit Leica Raw Data

For editing Leica raw data before reformatting into the Nigra format. A dialog box to select a Leica raw data file appears.

7.1.3 Format Leica Raw Data → Nigra

The Leica raw data format cannot be computed directly by Nigra. By activating this menu item, raw data will be reformatted to the Nigra format:

Format NA-GSI → Nigra   for NA-levels
Format DNA/LS → Nigra   for DNA- and LS-levels (GSI- und XML-format)
Format Sprinter-GSI → Nigra  only for Leica Sprinter

In case you want to reformat your raw data in parts, limit the reformatting with the letters x and e in the first column of a data record of the raw data file:

x  All data records will be ignored until the next x.
e  End of reformatting, the following data will be ignored.

Single data can be ignored by using an asterisk (*) in the first column. Because all data lines in the GSI-16 format normally starts with * a second asterisk is required here.

Depending on the level used, there is a different raw data format available:

NA2000/2002/3000/3003 creates a special GSI-8 format.
DNA03/DNA10 creates a standard GSI-8 and GSI-16 and the LeicaXml format.
LS10/LS15 creates a standard GSI-8 and GSI-16 and the HexagonLandXML format.

16-digit point numbers in the formats GSI-16 and XML are cut to 14 digits.

Nigra supports all the aforementioned data formats.

Example for GSI-8:

| Point no. | Distance | Staff reading |
The following WI are used for levellings:

<table>
<thead>
<tr>
<th>WI</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Point number</td>
</tr>
<tr>
<td>330</td>
<td>Staff reading (MEASURE ONLY)</td>
</tr>
<tr>
<td>331</td>
<td>Staff reading backsight</td>
</tr>
<tr>
<td>332</td>
<td>Staff reading foresight</td>
</tr>
<tr>
<td>333</td>
<td>Staff reading side shot</td>
</tr>
<tr>
<td>334</td>
<td>Staff reading set-out</td>
</tr>
<tr>
<td>335</td>
<td>Staff reading backsight 2</td>
</tr>
<tr>
<td>336</td>
<td>Staff reading foresight 2</td>
</tr>
<tr>
<td>32</td>
<td>Distance to staff</td>
</tr>
<tr>
<td>52</td>
<td>Number and standard deviation of staff reading in the case of multiple measurements</td>
</tr>
<tr>
<td>83</td>
<td>Height of a point</td>
</tr>
</tbody>
</table>

After the start of a levelling and the input of a starting-point number, a line with a code block of the type 410001+?....1 is registered (NA levels since Leica software version 3.0), where the digit after the points (in example 1) defines the method of the line levelling.

A data record follows with WI 11 in columns 1 and 2, and 83..1 in columns 17 – 21 (GSI-8 format). By older versions the code block 410001+?....1 is missing.

All data will be ignored during the reformatting until these codes appear (except code blocks with WI 41). It is important always to transfer these two lines to the PC!

In addition to measurement data, infos can be added by the user after the input of a code number (WI = 41), which are used by Nigra for the control of the evaluation of levellings.

Structure of a code block (GSI-8 format):

<table>
<thead>
<tr>
<th>Code no.</th>
<th>Info 1</th>
<th>Info 2</th>
<th>Info 3</th>
<th>Info 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>410001+00000001</td>
<td>42....+04262008</td>
<td>43....+00001234</td>
<td>44....+00000003</td>
<td>45....+00000000</td>
</tr>
</tbody>
</table>

In this example, the date 04-26-2008 is entered in info 1 using the characters 04262008. Infos are registered right-justified. Not all four infos must contain values. The complete data record can be registered just after the entry of a code number and a single info.
Nigra Formats

After the selection of a raw data file, raw data can be transformed into three different Nigra formats:

- **Measurements**
  Transfer of measurement data in a batch file for calculations

- **Height file**
  Transfer of levelled raw heights in the Nigra height file

- **Profile**
  Creation of an ASCII file (file extension .JOK) for profile plots

**Reformatting of Raw Data**

Select one of the following described data formats.

**Measurement Data Format**

Raw data, supplemented with header data and parameters, are transferred in the Nigra batch file. To reformat raw data measured with the levels NA2000, NA3000, NA2002, and NA3003 choose the menu item **Format NA-GSI → Nigra**.

Raw data in GSI- and XML-format measured with the levels DNA03, DNA10, LS10 and LS15 will be reformatted with the menu item **Format DNA/LS → Nigra**. With this menu item the GSI format for NA3003 (device software from version 3.0) levels can also be reformatted. For DNA and LS-levels use advantageously the GSI-16 or XML format.
After selection of a raw data file click on the **Header data** button, if you want to change header data. Explanations to header data are given in the sections 3.2.3 and 8.1.1 of this manual.

Press the **Parameters** button, if you want to make some changes for parameters. Comprehensive explanations of parameters are given in the section 8.1.2.

### Defining Parameters

Header data and parameters can be registered not only manually using the screen masks, but also directly during levelling by using code blocks. The use of code blocks will be explained later on in this section.

### Methods of Levelling

The method of levelling is consists of the **Observation sequence** and the parameter **Evaluation of side shots/turning points**. All Leica levels permit the observation sequence BF, the levels NA3003, DNA03, DNA10, LS10 and LS15 in addition the sequence BFFB and DNA03, DNA10, LS10 and LS15 also the alternate observation sequence to BF and BFFB. The sequence of characters B (backsight) and F (foresight) describes the sequence of possible measurements. In addition, side shots can be measured.

The levels LS10 and LS15 know by default the observation sequences BBFF, BFBF, aFBBF, SimBF and SimBFFB. All are supported by Nigra.

With the software for the older NA2000 and NA3000 levels, Nigra permits additional observation sequences, which are realized by using those Leica levels
only with 'tricks'; for example the observation sequence BF FB (named Leica aBF).

When reformatting raw data from the DNA and LS levels, some buttons are deactivated, because Nigra automatically recognizes the right parameter from the raw data.

If the button Evaluation of side shots/turning points is activated, the heights of side shots and turning points will be evaluated by batch file calculation. If not, a so-called line levelling will be defined.

**With distances** check box is activated: Distribution of misclosure is proportional to the distance.

**With distances** check box is **not** activated: Distribution of misclosure depends on the number of back- and foresights.

**Explanation of the Methods of Levelling**

**Observation sequence BF (all Leica levels)**

Standard levelling with or without side shots. Side shots are possible before or after the measurement of the foresight.

**Including evaluation of side shots/turning points:**

Stores value H00 for method of levelling in the batch file: method of levelling = 0 - levelling with side shots, measured in the sequence BF.

Reading sequence: B S S F S S.

**No evaluation of side shots/turning points:**

Defines a line levelling, i.e. in batch processing only the height differences and the distance sum from the starting- to the end-point will be calculated. As method of levelling, value H10 is stored in the batch file: Method of levelling = 1 - line levelling, measured in the sequence BF.

Reading sequence: B F, no side shots.

**Measurement mode BFFB (NA3003, DNA03, DNA10, LS10, LS15)**

**With evaluation of side shots/turning points:**

Stores the value H02 for method of levelling in the batch file: Method of levelling = 0 - levelling with side shots, measured in the sequence BFFB.

Reading sequence: BFFB SS
Side shots must be performed after completion of the station measurement BFFB. Since this is a levelling mode with two staff readings, two readings are necessary also for the side shots. If only one measurement was performed, Nigra adds a second automatically and labels it in the batch file with '*'.

**No evaluation of side shots/turning points:**

Stores the value H12 for the method of levelling in the batch file: Method of levelling = 1 - line levelling, measured in the sequence BFFB.

Reading sequence: BFFB, no side shots.

The measurement data will be transformed in the batch file in the following sequence:

```
B1
B2
F1
F2
```

**Example of raw data, GSI-8:**

```
410001+?.?....2
110002+00000143 83..16+01002900
110003+00000143 32..00+00030120 331108+00100160
110004+00000144 32..00+00032360 332108+00167388
110005+00000144 32..00+00032360 336108+00167386
110006+00000143 32..00+00030120 335108+00100163
110007+00000144 571..8-00000005 572..8-00000005 573..0+0002240 574..0+00062480 83..06+00996177
110008+00002736 32..00+00015170 333108+00154142
110009+00002736 32..00+00015170 333108+00154144
110010+00002736 83..06+00980763
```
Nigra batch file:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGSI-8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HSan Augustin</td>
<td>Location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMovement</td>
<td>Order</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Order</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H123/97</td>
<td>Line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H04-01-2008</td>
<td>Date</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hsunny</td>
<td>Weather</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HJohnson, C.</td>
<td>Observer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HNA3003</td>
<td>Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H123124</td>
<td>Staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Comments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Comments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H02</td>
<td>2.Col.:0=Side,1=no Side,4=Line, 5=Level test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*</td>
<td>3.Col.:0=BF,BBFF,2=BFFB,4=BFBB,5=FBBF,4.Col.:a=altern.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2</td>
<td>Number of staff scales or readings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H0</td>
<td>Scale constant for 2 staff graduations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2</td>
<td>Difference tolerance for two readings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1</td>
<td>Staff graduation 1=cm, feet, inches, 0.5=1/2cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1</td>
<td>With distances, 1=yes, 0=no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H3</td>
<td>Decimal places for heights in calculations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H3</td>
<td>Decimal places for readings in calculations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E13m</td>
<td>E/Mean value/Error class/Unit of measurement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>D 30.12</td>
<td>b1.00160</td>
<td>143</td>
<td></td>
</tr>
<tr>
<td>D 30.12</td>
<td>b1.00163</td>
<td>143</td>
<td></td>
</tr>
<tr>
<td>D 32.36</td>
<td>f1.67388</td>
<td>144</td>
<td></td>
</tr>
<tr>
<td>D 32.36</td>
<td>f1.67386</td>
<td>144</td>
<td></td>
</tr>
<tr>
<td>D 15.17</td>
<td>s1.54142</td>
<td>2736</td>
<td></td>
</tr>
<tr>
<td>D 15.17</td>
<td>s1.54144</td>
<td>2736</td>
<td></td>
</tr>
</tbody>
</table>

The additional information's with labels 571 (station difference), 572 (cumulated station difference), 573 (distance comparison), and 574 (distance sum) are not kept in the batch file. They will be calculated in a similar manner during the later batch calculations.

The evaluation in the given example is performed as levelling with side shots. Point numbers must be entered correctly at readings B1 and F1. They are used automatically for the readings F2 and B2.

**Alternating observation sequence BF and BFFB (DNA03/DNA10/LS10/LS15)**

On every even station number the foresight staff is measured first: BF FB or BFFB FBBF.

The Levels LS10/LS15 additionally know the alternating observation method FBBF.
**Observation sequence BBFF (only NA2000, NA3000, NA2002, NA2003)**

This observation sequence cannot be used directly with Leica levels. If you want to perform your levelling in that sequence, please select the observation sequence **BF** on the level and perform two measurements for every point (including side shots). A repeat of the back- and foresights is possible by pressing **REP**. REP labels in the raw data will be ignored.

For reformatting, select **Observation sequence BF** and choose the option **2 Staff scales**.

**Observation sequence Leica BFFB** (not for NA2002/NA3003 with Leica software version 3.0 or higher, not for DNA03/DNA10, LS10, LS15).

With this option you can perform the reading sequence BFFB, necessary for precise levellings, also with older Leica digital levels. The second foresight (reading 3) and the second backsight (reading 4) are registered here as backsight and foresight, respectively.

If you start with the first backsight of a new levelling at height 0.000, you will obtain the station difference after the last reading at ground height. At the next stations, the station differences are added. At the end of the levelling, the sum of all station differences is calculated.

After reformatting to the Nigra format, reading 3 and reading 4 are changed to foresight and backsight, respectively.

The measurement data are transformed in the batch file in the following sequence:

\[
\begin{align*}
B1 & \ldots. \\
B2 & \ldots. \\
F1 & \ldots. \\
F2 & \ldots. \\
S1 & \ldots. \\
S2 & \ldots.
\end{align*}
\]

For **Leica BFFB** without evaluation of side shots the value H12 is stored in the batch file as method of levelling: Method of levelling 1, observation sequence BFFB (=2). The evaluation is performed as line levelling. Side shots are not allowed.

For **Leica BFFB** with evaluation side shots/turning points, value H02 is stored in the batch file as method of levelling: method of levelling 0, observation sequence BFFB (=2). The evaluation is performed as levelling with side shots. Side shots are only allowed after the measurement of BFFB. Since this is a levelling with two
staff readings, two readings are necessary also for the side shots. If only one measurement was performed, Nigra automatically adds a second and labels it in the batch file with '*'.

The numbers of turning points and the number of end-point must be entered at the last measurement of a station, i.e. the second backsight. For free turning points, enter point number 0.

Example of Data Records for Leica BFFB (including side shots)

Leica raw data format:

<table>
<thead>
<tr>
<th>Station</th>
<th>Measurement 1</th>
<th>Measurement 2</th>
<th>Measurement 3</th>
<th>Measurement 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>110018</td>
<td>00616270</td>
<td>83..16</td>
<td>00000000</td>
<td>110019</td>
</tr>
<tr>
<td>110019</td>
<td>00616270</td>
<td>32..00</td>
<td>00017560</td>
<td>331106</td>
</tr>
<tr>
<td>110020</td>
<td>00000000</td>
<td>32..00</td>
<td>0020960</td>
<td>332106</td>
</tr>
<tr>
<td>110021</td>
<td>00000000</td>
<td>32..00</td>
<td>0020960</td>
<td>331106</td>
</tr>
<tr>
<td>110022</td>
<td>00416290</td>
<td>32..00</td>
<td>00017560</td>
<td>332106</td>
</tr>
<tr>
<td>110023</td>
<td>00000001</td>
<td>32..00</td>
<td>0015560</td>
<td>333106</td>
</tr>
<tr>
<td>110024</td>
<td>00000001</td>
<td>32..00</td>
<td>0015560</td>
<td>333106</td>
</tr>
</tbody>
</table>
Nigra batch file:

RTest measurement BFFB
\(x2345678901234567890123456789012345678901234567890123456789012345678901\)
\(x\) distance<--- back inter fore<---<--- point number --->

C1
HSan Augustin Location
H Location
HMovement Order
H Order
H123/97 Line
H05-11-2008 Date
Hsunny Weather
HJohnson, C. Observer
HNA3003 Level
H123124 Staff
H Comments
H Comments
H02 2.Col.:0=Side,1=no Side,4=Line, 5=Level test
* 3.Col.:0=BF,BBFF,2=BFFB,4=BFBF,5=FBBF,4.Col.:a=altern.
H2 Number of staff scales or readings
H0 Scale constant for 2 staff graduations
H2 Difference tolerance for two readings
H1 Staff graduation 1=cm,feet,inches, 0.5=1/2cm
H1 With distances, 1=yes, 0=no
H3 Decimal places for heights in calculations
H3 Decimal places for readings in calculations
E13m E/Mean value/Error class/Unit of measurement
D 17.56 b0.58980 616270
D 17.56 b0.58970 616270
D 20.96 f2.81040 416290
D 20.96 f2.81020 416290
D 15.56 s0.58970 1
D 15.56 s0.58950 1
E

Observation sequence Leica aBF (not for DNA03, DNA10, LS10, LS15)

Observation sequence BF in the alternate mode: Here, the same staff is measured first from all stations. At the odd station numbers, first measure the backsight staff; at the even station numbers, first measure the foresight staff.

When reformatting into the Nigra format, the readings from the even station numbers are changed accordingly.
Note:
The level-calculated heights are not correct starting from the second station.

Measurement data are transformed in the batch file in the following sequence:

\[ B1 \ldots \quad F1 \ldots \quad S1 \ldots \quad S2 \ldots \]

For **Leica aBF** with no evaluation side shots/turning points value H10a is stored in the batch file as method of levelling: method of levelling 1, observation sequence BF alternate (=0a). The evaluation is performed as distance levelling.

For **Leica aBF** with evaluation side shots/turning points value H00a is stored in the batch file as method of levelling: method of levelling 0, observation sequence BF alternate (=0a). Evaluation is performed as levelling with side shots. Side shots are allowed after the station point measurement BF respectively FB.

The numbers of turning points and the number of the end-point must be entered at the **last measurement** of a station backsight respectively foresight. For free turning points enter the point number 0.

**Sample Data Records for Leica aBF (including side shots)**

**Leica raw data format:**

```
110018+00616270 83..16+00000000
110019+00616270 32..00+00017560 331106+00005898
110020+00416290 32..00+00020960 332106+00028104 83..06-00022206
110022+00000001 32..00+00017560 333106+00015895 83..06-00009997
110002+00416290 32..00+00007980 333106+00016530
110003+00010001 32..00+00009410 332106+00015528 83..00-00025204
110004+00000003 32..00+00009410 333106+00015529 83..00-00025205
110005+00000004 32..00+00007980 333106+00016530 83..06-00026206
```
**Nigra batch file:**

RLeica aBF  
HSan Augustin Location  
H Location  
HMovement Order  
H Order  
H 123/97 Line  
H 05-11-2008 Date  
Hsunny Weather  
HJohnson, C. Observer  
HNA3003 Level  
H123124 Staff  
H Comments  
H Comments  
H00a  
2.Col.:0=Side, 1=no Side, 4=Line, 5=Level test  
*  
3.Col.:0=BF, BBFF, 2=BFFB, 4=BFBF, 5=FBBF, 4.Col.:a=altern.  
H1 Number of staff scales or readings  
H0 Scale constant for 2 staff graduations  
H2 Difference tolerance for two readings  
H1 Staff graduation 1=cm, feet, inches, 0.5=1/2cm  
H1 With distances, 1=yes, 0=no  
H3 Decimal places for heights in calculations  
H3 Decimal places for readings in calculations  
E13m E/Mean value/Error class/Unit of measurement  

<table>
<thead>
<tr>
<th>D</th>
<th>17.56</th>
<th>b0.58980</th>
<th>616270</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>20.96</td>
<td>f2.81040</td>
<td>416290</td>
</tr>
<tr>
<td>D</td>
<td>17.56</td>
<td>s1.58950</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>9.41</td>
<td>b1.55280</td>
<td>416290</td>
</tr>
<tr>
<td>D</td>
<td>7.98</td>
<td>f1.25300</td>
<td>10001</td>
</tr>
<tr>
<td>D</td>
<td>9.41</td>
<td>s1.55290</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>7.98</td>
<td>s1.65300</td>
<td>4</td>
</tr>
</tbody>
</table>

For observation sequences named **Leica (Leica BFFB, Leica aBF)**, the parameters unit of staff graduation (cm, feet, or inch), number of staff scales (1 or 2), and scale constant (0) are set automatically to the right values, independent of the screen settings.
Observation sequence Test = instrument test (with line measurement BF, BBFF)

Example, procedure according to Näbauer: The level stations are lying outside of the staff stations. The distance $a$ is about 15 m.

Distances and readings 1 - 4 must be determined according to the figures above in the sequence 1-2-3-4.

When using a DNA level (XML format), Nigra recognizes the instrument test from the raw data automatically. Because Nigra expects the measurement data in the sequence BFBF, but the test procedure of the DNA level creates the sequence BFFB, the third measurement will be changed into a backsight and the fourth measurement into a foresight.

By using GSI data a line containing the following data must be preceded:

410005+?.....10

For further explanations refer to section 8.1.2.

Selection of the Appropriate Method of Levelling.

For short levellings with simple precision perform the observation sequence BF. For high precision levellings only use the levellings BFFB or aBFFB to avoid systematic errors.

For all levellings, the multiple measurements mode is recommended.

Use with DNA and LS levels only the formats GSI-16 or XML.

Parameters in the Frame Staff

The default setting for digital levels is 1 cm staff graduation (or feet or inch) and scale constant = 0. Scale constant and difference tolerance between scales ($1^{st}$ measurement minus $2^{nd}$ measurement) are only used for levellings with two staff readings (BFFB or BBFF).
Furthermore the mean value, error class, and decimal places for staff readings and heights can be defined.

**Decimal places**

The parameters **Dec. readings** and **Dec. heights** have no influence on the reformatting of raw data, but on the calculation output.

**Start of Reformatting**

If all parameters are set correctly and header data are entered, start reformatting by clicking the **Run** button. Data are added to an existing measurement data file (file extension .NIG) of the current job.

Staff readings are kept with all digits. Distances are rounded to 2 digits. If the measurement was performed in units different from the current Nigra unit of measurement, the measurement data will be converted automatically.

Before starting batch file calculations, enter the heights of connecting points (**Heights** menu) and start **Reorganize Calculation No.** (**Files** menu), if this has not been done automatically.

**Special Functions**

**Free turning points** (turning points without numbers)

Free turning points can be registered with the point number 0. Furthermore it is possible to eliminate free turning points like 1, 2, 3, etc. by inputting a higher number in the field **Remove turning point numbers** during reformatting (only effective for format **Measurements**).

**Note:** All measurement points must have a higher number!

Also available: Enter a negative number for the running point number, for example -99 and select the character "*" for the first point number extension during the reformatting of raw data. Now, all negative point numbers will be erased and the second point number extension of Nigra can still be used.

If you use the point number extension with code block 5, info 1, the asterisk (*) has no effect.

**Levelling with MEASURE ONLY:** During this mode of measurement readings are not marked as backsight, side shot, or foresight. These data are not suitable for a calculation. They will be ignored during reformatting. If you want to reformat these data, proceed as described here:
Change the word identification from 330 to 331, 332, 333, 334, 335, or 336 and add a line with WI '11' and '83..1' in front of the measurement data in the columns 1-2, and 17-21 (GSI-8 format), respectively. This changed file can be transformed into the Nigra format.

**Repeated measurements with the REP button:** These measurements are marked in the raw data from Leica software version 3.0 (NA2002 and NA3003). Nigra recognizes REP measurements during the reformatting of raw data and deletes the respective lines automatically.

**Note:** The raw data of the DNA and LS levels don't contain repeated measurements.

For older levels, enter a code block with a code number before a repeated measurement. This number corresponds to the word identification without additional infos of the repeated measurement (see explanations of levelling codes).

**Multiple measurements:** The number of measurements and the standard deviation of staff readings (WI52) or the band width (WI521) and the integration time (WI57) are stored in the measurement data file from column 62 on:

Standard deviation $s_R$ of staff reading and integration time $I_t$:

\[
D \quad 10.00 \quad s0.94235 \quad 120 \quad n=5/sR=0.30 \text{ mm}/I_t=4 \text{ sec}
\]

In the GSI data Leica documents the standard deviation of a single staff reading. Using for reformatting the XML format, Nigra documented the standard deviation of the mean.

In the measuring mode median is the scatter/band width output (= maximum - minimum value) $B_w$ instead of the standard deviation:

Band width $B_w$:

\[
D \quad 30.00 \quad f1.29742 \quad 121 \quad n=5/Bw=0.20 \text{ mm}
\]

**Remarks on the point measured:** With DNA/LS levels a remark can be entered on every point measured. Nigra writes the remark beginning in column 62 or right beside the standard derivation in the measurement data file.

**Format Height File**

The heights of all points in raw data, including starting- and end-points, are transferred into the height file. The date (max. 10 characters) and comments (max. 30 characters) from header data are added. In contrast to the import of ASCII files, the
set parameters **mean value** and **stop, if error limit is exceeded** are active here. Other parameters, for example method of levelling, are meaningless.

With the LS Levels also adjusted heights from the GSI file (M_..... GSI) can be outputted.

The default setting of the calculation number is 777777. If the mean value of points was calculated, a mean value calculation protocol is generated in the calculation file (**Calculate** menu, item **View Calculations**).

**Format Profile**

Creates an ASCII file (file extension .JOK) from point number, distance, and raw height of raw data, which is the starting file for the profile creation. This file can be edited in the **Profile** menu (item **Edit Profile File**). For the profile creation, the length of point numbers is limited to 8 characters. All points with heights are transferred, except the respective starting- and endpoint of a levelling. The levelling must be performed in the BF mode including side shots.

If an older profile file already exists, the question "Profile file exists, overwrite?" appears. Clicking on the NO button adds new data to the old file, YES deletes the file and creates a new one.

As an alternative, a profile file can also be created from measurement data. Please refer to section 10.1, **Create Profile File**, also for the format of a profile file.

**Point Number Extension**

During measurements with NA2000, NA2002, NA3000, and NA3003 only 8-digit numerical point numbers can be registered. Because often more than 8 digits are necessary, Nigra allows point number extensions, which are performed during the reformatting of Leica raw data → Nigra. Sometimes, point numbers like 12.01, 12.02 etc. may be needed. These numbers can also be generated by the Nigra point number extension function from the numerically stored point number in the raw data format.

The functions for point number extensions are only displayed if they are activated in the menu item **Job Configuration** (**Options** menu).

This method of point number extension is useful, if all point numbers of a file to be reformatted are to be extended with the same character, for example when adding the movement period.

After the entry of a character for the extension of the point numbers and the position (starting at the right) of entry, the original point numbers can be extended by
any two alphanumerical character strings, i.e. insert numbers or letters, add or set before.

The position from the right in the second string refers to the point number changed by the first character string.

Point numbers, which should not be changed, have to be entered with a negative sign, for example -1248. If no point number extension is selected, the negative sign is stored together with the point number.

Examples:
Registered point number= ..-00000230  
1st string= KD, position from the right = 0 or no entry

New point number: 230  
123KD

Registered point number= ...+00000056005  
1st string= . (point), position from the right = 3  
2nd string= 25, position from the right = 7

New point number: 25560.05

Registered point number= ...+00000001  
1st string= Channel, position from the right = 4

New point number: Channel001

The negative sign (for points not to be changed) and also leading zeros will be removed from the point number. Point numbers with more than 14 digits due to point number extensions are cut off from the left.

Use of Code Blocks for the Definition of Levellings

If you have measured several different kinds of levellings or different jobs in a raw data file or measured at different days, the allocation of header and control data is not the same. If you proceed as described here, all levellings of a raw data file will have the same control data.

With the codes, header data and levelling parameters can already be acquired in the field. For more extensive jobs, if data cannot be transferred every day, code blocks should not be omitted.

The entry of code blocks is very simple. They can be entered whenever the measurement prompt is displayed: Just press the CODE button.
Code blocks must be registered before the start of the first levelling (NA levels) or directly after the start of levelling and before registration of the first reading (DNA/LS levels), if they are to become active. They can be repeated any time with new entries.

With the DNA/LS levels some header data (i.e. observer) can be entered directly. This data is exported only with the XML format.

Note:
If no code blocks are registered, parameters defined on the screen mask are active.

The corrections of staff readings with mean staff meter and linear coefficient of extension is also controlled by the code blocks.

The setting of parameters with codes depends on the level used. Because of this, please note the type of level in the following description.

Input of a code:
NA levels: Press the CODE key, DNA levels: Keys Shift + User, choose Code in the menu, enter code no=1 and info 1=04122008:

GSI-8:  410012+00000001 42....+04122008
GSI-16:  *410012+0000000000000001 42....+0000000004122008

Code information can also be stored in part, because control data defined in the screen mask are active until they are substituted by suitable code blocks. If a code block consists of fields without an entry, the existing control data are kept active.

Code block 331, 332, 333, 335, 336 (only for older levels)

410012+00000331  any or no entries in the infos

In this way you can delete sets of data acquired with older levels, which do not mark REP measurements automatically. The code block must be registered immediately after a faulty measurement. The codes are identical to the word identification of the repeated measurement:

enter code 331: repeat from backsight 1
enter code 332: repeat from foresight 1
enter code 335: repeat from backsight 2
enter code 336: repeat from foresight 2
enter code 333: repeat from last side shot

For levels NA2002 and NA3003 this mark is not required, because REP measurements are deleted automatically. The raw data of DNA/LS levels contains no REP measurements.
Code block 0 (all Levels)

410012+00000000      Any or no entries in the infos

All control data are reset to the values defined in the screen masks.

The following code blocks 1 – 3 may be used both for NA and DNA/LS levels. For DNA/LS levels however it is recommended to use the code blocks 10 and 11.

The examples for the following code blocks 1 – 8 are given in the GSI-8 format. In the GSI-16 format, another 8 leading zeros are included.

Code block 1 (all levels)

**Info 1**

410012+00000001 42....+04122002    Date in format MMDDYYYY, in example 04-12-2002

**Note:**

*Date separators are set according to the Windows Regional Settings in the Control Panel. The sequence of day, month, and year is not changed.*

**Info 2**

410027+00000001 43....+00aabcde    levelling parameters

The characters a – e in info 2 correspond to the following explanations:

a=levelling method (00-03, 05-09)
b=mean value calculation mode (0-3)
c=error class (1-4)
d=decimal places for heights (2-5)
e=decimal places for staff readings (2-5)
Levelling methods:

00 - BF(S), BFFB(S)* (including side shots)
01 - BF, BFFB* (no side shots)
02 - BBFF (SS) (including side shots)
03 - BBFF (no side shots)
05 - Test
06 - Leica BFFB (SS) (including side shots)
07 - Leica BFFB (no side shots)
08 - Leica aBF (S) (including side shots)
09 - Leica aBF (no side shots)

* For NA 2002, NA3003 since software release 3.2, DNA levels aBF, aBFFB, also for LS levels with BBFF, BF, BF, aBBF, SimBF, SimBFF. Nigra automatically detects the leveling mode BF.

Registration 00001144 means: levelling method BF S, mean value calculation mode 1=new, error class 1, decimal places heights and staff reading for the calculation output each 4.

The following registrations (xxxxxxxxx) are replaced by characters from the table of reference file NACODE.TXT during reformatting into the Nigra format:

Info 3
410027+00000001 44....+xxxxxxxxx Observer

Info 4 not used

Code block 2 (all levels)

Info 1
410028+00000002 42....+xxxxxxxxx Level

Info 2
43....+xxxxxxxxx Staff

Info 3
44....+xxxxxxxxx Line

Info 4
45....+xxxxxxxxx Weather

Code block 3 (all levels)

Info 1
410029+00000003 42....+xxxxxxxxx Location

Info 2
43....+xxxxxxxxx Order
Table of references is an ASCII file in the folder c:\Nigra\TEMPLATES (c:\Nigra = Nigra installation folder) named NACODE.TXT. You can create table of references according to the following format, or change the provided file with your text editor. A maximum of 500 entries is allowed.

The first section of the table of references has the same format as the code block:

410000+00000001 44....+00000001 = Text, which replaces the code
Reference value from registration
of levelling
Code number

The text after the equal sign is kept in the control data block of the measurement data file instead of the code. Entries for location, order, and comment have a maximum length of 38 characters, the other entries of 19 characters.

Example:

Data record in the raw data file:

410000+00000001 ........ 44....+00000001

Data record in the table of references NACODE.TXT:

410000+00000001 44....+00000001=Johnson

results in name of observer Johnson.

Code block 4 (all levels)

In code block 4, the correction of staff readings with mean staff meter, linear coefficient of extension and staff offset are defined. Calibration data of staffs must be stored in a calibration file named LATTE.CAL (see below).

Info 1
410030+00000004 42....+00000156 Temperature for backsight
staff in °C*10,
in example 15.6 °C

Info 2
43....+00000158 Temperature for foresight
staff in °C*10,
Info 3

44....+00009019 Running number 9019 of backsight staff

Info 4

45....+00009020 Running number 9020 of foresight staff

Info 1 and 2: The temperature can also be entered with decimal point, for example 15.6. Since the decimal point cannot be entered at all leveling, also inputs are in °C*10, as explained above, possible.

Note:

Staff corrections are performed only in the unit "meter".

Corrections have to be entered before the first measurement to be effective. For the first registration of a code block, all entries are necessary. For changing the temperature, a repetition of the staff numbers is not necessary. A re-enter of the staff numbers defined also new the staffs for the sequence B and F.

A temperature value 0.0 is permitted. Entries of running staff numbers must be identical with entries in the file LATTE.CAL. If the staff number is not found in the file LATTE.CAL, an error message is displayed.

The staff numbers must always be entered in pairs. If now and then another staff with other corrections is to be used, it is possible to define a current staff for the next and the following measurements (see code block 7). The sequence B, F of the staff pair will not be influenced by this.

At stations with even numbers (2, 4, 6 etc.), the backsight staff is changed to foresight staff, and the foresight staff to backsight staff. This change is taken into consideration in the program. For this reason, it is not allowed to change the staffs during a leveling. If a leveling ends with a staff different from the starting staff and the new leveling starts with that staff, no change of staffs is required.

The reading sequences for Leica BFFB, Leica aBF, and BFFB (NA3003) and the alternate observation sequences aBF and aBFFB of the DNA levels and aFBBF of the LS levels are handled correctly. For the Leica aBF method of levelling an even number of instrument stations must be observed for each levelling.

For side shots and set-out values, always use the foresight staff for all methods of levelling.

Note:
For all precision levellings with staff correction, an even number of instrument stations should be observed. This eliminates a staff zero error. Additionally, distance sums should be virtually the same for back- and foresights.

Do not delete a complete levelling in the raw data file. First reformat the data, then delete the levelling from the batch file.

Corrections are active until they are changed. Code block 0 resets all values, i.e. no corrections will be performed after this.

For measurements with an inverse staff (for example ceiling points), the sign of the staff reading becomes negative. Nigra take this into account while calculating the correct reading. Negative readings with a normal staff below the zero point must be avoided, because the calculation in combination with the staff offset will produce wrong results.

If values for temperature, mean staff meter, and coefficient of extension are improbable, for example they have an illegal decimal point, a warning is displayed. Improbable means:

- \( T \) (measurement Temperature): \(< -20 \) or \( > 40 \) °C
- \( m_0 \) (Mean staff meter): \(< -20 \) or \( > 20 \) ppm
- \( \alpha_T \) (Linear coefficient of extension): \(< 0 \) or \( > 1 \) ppm/°C

Formula for correction:

\[
L = l_0 + L' \cdot [1 + (m_0 + \alpha_T \cdot (T - T_0)) \cdot 10^{-6}] + v_G
\]

- \( L \) = corrected staff reading [m]
- \( L' \) = staff reading [m]
- \( l_0 \) = index correction (zero correction) [mm]
- \( v_G \) = graduation correction [mm]
- \( m_0 \) = mean staff meter [ppm]
- \( \alpha_T \) = linear coefficient of extension [ppm/°C]
- \( T_0 \) = reference temperature [°C]
- \( T \) = temperature during the measurement [°C]

The values for \( l_0, m_0, \alpha_T, v_G \) and \( T_0 \) can be taken directly from a current calibration protocol of the testing institutions.

To ensure that the corrections of staff readings are taken into consideration, Nigra transfers the readings into the batch file with 6 digits. Independent of this, calculation output has 2 - 5 digits, dependent on the parameter of the **Decimal places staff readings (Dec. readings)**.
Values used for the staff correction are documented in the batch file.

Calibration data from the check protocol (for example produced by the Technical University of Munich) have to be stored with an text editor in the ASCII file LAT-TE.CAL in the folder c:\Nigra\TEMPLATES.

c:\Nigra = Nigra installation folder

Format of calibration of file LATTE.CAL:

Columns 1-8 running number of staff
10-19 $\alpha_T$ = Linear coefficient of extension in ppm/°C
20-29 $m_0$ = mean staff meter in ppm at reference temperature
30-39 $T_0$ = reference temperature for mean staff meter in °C
40-58 any staff description, is not evaluated. Entry is optional.
60-69 $v_G$, graduation correction in mm
70-79 $l_0$, index correction (zero correction) in mm

All values are numerical, except the staff description. The first three lines are only for orientation. Their content may vary but must not be missing. Invalid calibration data can be faded out with an asterisk (*) without deletion from the file. The file can contain a maximum of 500 lines. Example of the file LATTE.CAL:

<table>
<thead>
<tr>
<th>Run.no.</th>
<th>aT[ppm/°C]</th>
<th>mo [ppm]</th>
<th>To [°C]</th>
<th>Staff description</th>
<th>vG [mm]</th>
<th>l0 [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>9019</td>
<td>0.59</td>
<td>5.45</td>
<td>24.6</td>
<td>GPCL3 - Nedo 9019</td>
<td>2.0</td>
<td>0.0001</td>
</tr>
<tr>
<td>9020</td>
<td>0.49</td>
<td>-3.45</td>
<td>20.0</td>
<td>GPCL3 - Nedo 9020</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>*9021</td>
<td>0.34</td>
<td>3.45</td>
<td>21.8</td>
<td>GPCL3 - Nedo 9021</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Code block 5 (all levels)**

Info 1
410012+00000005 42....+00nnnnnnn Point number extension

This point number extension is useful, if characters to be defined are not constant within the Leica raw data file (this can be several levellings). This code block can be saved repeatedly during a levelling. Enter the new point number extension in info 1 and save the code block.
Definition of the point number extension is entered in the following syntax:

42....+apnnnnnn

- \( n \) = numerical character, for the extension of point number, max. 6 characters
- \( p \) = position from the right, where to insert the characters
- \( a \) = number of characters, for the extension of point number

The declaration of **number of characters** and **position** is necessary so that leading zeros in the point number are taken into account. This allows a very flexible form of numerical point number extension.

**Example:**

410027+00000005 42....+00470308  
\( \text{number}=4, \text{position}=7, \text{extension}=0308 \)

110028+00950002 32..00+00002230 331116+00016810  
\( \text{registered point number} \)

This results in the following point number:

0308950002

If you want to extend the point number with a second constant character string, use the second point number extension in the screen mask for reformatting raw data.

Entry 0 in Info 1 resets the point numbers extension.

**Code block 6 (all levels)**

With code block 6 you can define a staff offset directly (without using LAT-TE.CAL).

**Info 1**

410012+00000006 42....+00000025  Staff offset, e.g. 2.5  
\( \text{(in combination with info 2)} \)

**Info 2**

43....+00000001  Decimal places, e.g. 1

Code block 6 with input 0 for info 1 sets the staff offset to 0. The staff offset is printed in the Nigra measurement file near the right margin.

**Code block 7 (all levels)**

With code block 7 you can define, in extension to code block 4, a staff for the next and the following readings.
Info 1
410012+00000007 42....+00000200 Temperature in °C*10,
e.g. 20,0 °C

Info 2
43....+00000023 Staff number 23 (corrections from file LATTE.CAL)

Code block 7 with input 0 for info 2 switches off the staff correction for the current staff. Afterwards, the staff correction with code block 4 is valid.

Code block 8 – Immediate input of a levelling line number (all levels)

Info 1
410012+00000008 42....+00001275 Line number = 1275

The line number is written directly into the header of the measurement file and not translated from the file NACODE.TXT (like code block 2, info 3).

Code block 10 (only for DNA/LS levels with GSI format)

Info 1 – Levelling parameters
*410027+0000000000000000 42....+000000000000000000000bcde

The characters a – e in info 1 correspond to the following explanations:

a = levelling method, 0 = evaluation of side shots, 1 = no eval. of side shots
b=mean value calculation mode (0-3)
c=error class (1-4)
d=decimal places for heights (2-5)
e=decimal places for staff readings (2-5)

In infos 2 – 8 you can enter in alphanumeric characters:

Info 2: Line
Info 3: Date
Info 4: Weather
Info 5: Order
Info 6: Observer
Info 7: Level
Info 8: Staff(s) – not staffs used for staff correction!

For staff correction use the code blocks 4, 6, and 7.

Code block 11 (only for DNA/LS levels with GSI format)

Info 1: Location
Info 2: Remark
Example

To conclude this section, a complete protocol of measurement data and the use of code blocks including a point number extension is presented.

Leica GSI format with levelling codes (GSI-8 format):

```plaintext
410001+00000001  42....+04122002  43....+00001234  44....+00000003
410002+00000002  42....+00000014  43....+00000012  44....+00000022  45....+00000001
410003+00000003  42....+00000001  43....+00000002  44....+11111111  45....+00000001
410001+00000005  42....+00473617
410004+?......1
110005+00900111  83..16+00915670
110006+00900111  32..00+00014570  331106+00014960
110007+00000001  32..00+00017500  332106+0012503  83..06+00918127
110008+00000001  32..00+00018770  331106+00019233
110009+00416260  32..00+00016470  332106+0006153  83..06+00931207
110010+00416260  32..00+00016470  333106+0006153  83..06+00931207
110011+00416260  32..00+00019740  331106+00028574
110012+00616270  32..00+00020100  332106+0006424  83..06+00953357
110013+00616270  32..00+00020650  331106+00025638
110014+000000152 32..00+00025440  332106+0000996  83..06+00977999
110015+000000152 32..00+00021980  331106+00027352
110016+00416280  32..00+00018220  332106+0005885  83..06+00999466
110017+00416280  32..00+00015570  331106+00016414
110018+000000151 32..00+00014500  332106+00022930  83..06+00992950
110019+000000151 32..00+00017750  331106+00005661
110020+00900112  32..00+00011300  332106+0006017  83..06+00992594
```

Corresponding table of references NACODE.TXT:

```plaintext
410000+00000001  44....+00000001=Johnson
410000+00000001  44....+00000002=Bush
410000+00000001  44....+00000003=Lincoln
410000+00000002  42....+00000014=NA2000, Nr. 14235
410000+00000002  42....+000000015=NA3000, Nr. 25345
410000+00000002  43....+000000002=Nedo 5432, 5433
410000+00000002  43....+000000012=Nedo 5445, 5446
410000+00000002  44....+000000022=Line 2a
410000+00000002  44....+0000000122=Line 46
410000+00000002  45....+00000001=sunny
410000+00000002  45....+00000002=cloudy
410000+00000002  45....+000000011=overcast
410000+00000003  42....+000000001=Sankt Augustin
410000+00000003  42....+000000021=Chicago
410000+00000003  43....+000000011=1st movement measurement february 2008
410000+00000003  43....+00000002=2008-123/4
410000+00000003  44....+11111111=2nd movement measurement march 2008
410000+00000003  44....+00011112=Test comment
```
### Nigra batch file:

RNA2000-measurement data

<table>
<thead>
<tr>
<th>x</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>Back</td>
<td>Side</td>
<td>Fore</td>
<td>---</td>
<td>Point Number</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HSankt Augustin</td>
<td>Location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2008-123/4</td>
<td>Order</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Order</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HLine 2a</td>
<td>Line</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H04-12-2008</td>
<td>Date</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hsunny</td>
<td>Weather</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HLincoln</td>
<td>Observer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HNA2000, Nr. 14235</td>
<td>Level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HNedo 5445, 5446</td>
<td>Staff</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2nd movement measur</td>
<td>Comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hement march 2008</td>
<td>Comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.Col.:0=Side,1=no Side,4=Line, 5=Level test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.Col.:0=BF,BBFF,2=BFFB,4=BFBF,5=FBBF,4.Col.:a=altern.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1</td>
<td>Number of staff scales or readings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H0</td>
<td>Scale constant for 2 staff graduations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2</td>
<td>Difference tolerance for two readings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1</td>
<td>Staff graduation l=cm,feet,inches, 0.5=1/2cm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1</td>
<td>With distances, l=yes, 0=no</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H3</td>
<td>Decimal places for heights in calculations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H4</td>
<td>Decimal places for readings in calculations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E12m</td>
<td>E/Mean value/Error class/Unit of measurement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>14.57  b1.49600</td>
<td>3617900111</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>17.50  f1.25030</td>
<td>3617416260</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>18.77  b1.92330</td>
<td>3617416260</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>16.47  f0.61530</td>
<td>3617416260</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>16.47  s0.61530</td>
<td>3617416260</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>19.74  b2.85740</td>
<td>3617416260</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>20.10  f0.64240</td>
<td>3617616270</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>20.65  b2.56380</td>
<td>3617616270</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>25.44  f0.09960</td>
<td>3617616270</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>21.98  b2.73520</td>
<td>3617616270</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>18.22  f0.58850</td>
<td>3617416280</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>15.57  b1.64140</td>
<td>3617416280</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>14.50  f2.29300</td>
<td>3617416280</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>17.75  b0.56610</td>
<td>3617416280</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>11.30  f0.60170</td>
<td>3617900112</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Calculation output:

Company xyz
NigraWin - Levelling, Version 4.00 05-12-2008 Page: 1
Job: test1

NA2000 Measure Data
Calculation No.: 1
Location Sankt Augustin
Order 2008-123/4
Line Line 2a Date 04-12-2008
Weather sunny Observer Lincoln
Level NA2000, Nr. 14235 Staff Nedo 5445, 5446
Staff graduation 1 cm Reading sequence BF BF(S)
Comments 2nd movement measurement march 2008
Calculation of Mean Values: new - calculated height is inserted

Misclosure = -1.4 mm Max. error E (2) = 3.5 mm

<table>
<thead>
<tr>
<th>Distance</th>
<th>Back</th>
<th>Side</th>
<th>Fore</th>
<th>Height</th>
<th>Point No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.57</td>
<td>1.4960</td>
<td></td>
<td></td>
<td>91.567</td>
<td>3617900111</td>
</tr>
<tr>
<td>17.50</td>
<td></td>
<td>1.2503</td>
<td>91.813</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>18.77</td>
<td>1.9233</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.47</td>
<td></td>
<td>0.6153</td>
<td>93.120</td>
<td>3617416260</td>
<td></td>
</tr>
<tr>
<td>16.47</td>
<td></td>
<td>0.6153</td>
<td>93.120</td>
<td>3617416260</td>
<td></td>
</tr>
<tr>
<td>19.74</td>
<td>2.8574</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.10</td>
<td></td>
<td>0.6424</td>
<td>95.335</td>
<td>3617616270</td>
<td></td>
</tr>
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<td>20.65</td>
<td>2.5638</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td>0.0996</td>
<td>97.799</td>
<td>152</td>
<td></td>
</tr>
<tr>
<td>21.98</td>
<td>2.7352</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>18.22</td>
<td></td>
<td>0.5885</td>
<td>99.946</td>
<td>3617416280</td>
<td></td>
</tr>
<tr>
<td>15.57</td>
<td>1.6414</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>14.50</td>
<td></td>
<td>2.2930</td>
<td>99.294</td>
<td>151</td>
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</tr>
<tr>
<td>17.75</td>
<td>0.5661</td>
<td></td>
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</tr>
<tr>
<td>11.30</td>
<td></td>
<td>0.6017</td>
<td>99.258</td>
<td>3617900112</td>
<td></td>
</tr>
</tbody>
</table>

Sum total distances = 252.56 m Delta-H= 7.69240 m
Sum backsight distances = 129.03 m
Sum foresight distances = 123.53 m

Sum of all distances (without side shots) = 252.56 m
Max. misclosure = -1.4 mm (calcul. no. 1)

XML format (only DNA/LS levels)

With the DNA/LS levels it is possible, in contrast to the NA levels, to enter additional information. If the raw data is outputted in the GSI-8 format the information will be lost. For the evaluation of this information in Nigra use the-XML format.
Because the allocation of values between the DNA/LS levels and Nigra is not identical, the following rules of conversion apply:

<table>
<thead>
<tr>
<th>Level input</th>
<th>Assignment to Nigra header data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job name</td>
<td>Order</td>
</tr>
<tr>
<td>Observer name</td>
<td>Observer</td>
</tr>
<tr>
<td>Line name</td>
<td>Line</td>
</tr>
<tr>
<td>Date</td>
<td>Date</td>
</tr>
<tr>
<td>Comment 1</td>
<td>Weather</td>
</tr>
<tr>
<td>Comment 2</td>
<td>DNA: Level, LS: Location</td>
</tr>
<tr>
<td>Staff 1 + Staff 2</td>
<td>Staff</td>
</tr>
</tbody>
</table>

The reformatting of XML format is executed with the menu item **Format DNA/LS → Nigra**. Nigra distinguishes the GSI and XML format automatically. Error messages during reformatting refer to the file …XML_.GSI, which Nigra creates as an intermediate format from the Leica XML raw data.

Data of the measurement programs **Check & Adjust** and **Measure & Rec** are reformatted only from the DNA XML format to the Nigra format.
7.1.4 Format Heights → Leica GSI

Creates a GSI format from the points in the height file. This format can be transferred to the REC module or directly to the PC card/USB stick (DNA/LS levels), for example fixed heights for connecting points or set-out heights. The file is named 'job'_FixPt.GSI.

job = current job

Creation of a GSI file

With the opening of the dialog box, an existing GSI file will be overwritten.

Activate the option GSI-8 NA-Level to create GSI format for the NA levels or activate the option GSI-16 DNA/LS Level to create GSI format for the DNA/LS levels.

Heights are rounded in the current unit of measurement (meters, feet, or inches), depending on the parameter Decimal places, and written into the GSI file.

Activate the option Output of X,Y-coordinates, if the GSI format must contain coordinates.

A GSI file is created after the entry of a point number from and a point number to, and clicking on OK. This can be repeated with additional point numbers. Click on the Exit button, after all points are written into the GSI file.

A maximum of 9999 data records can be stored in one file.

GSI-8 format for Na levels:

Only points are stored in the file with a numeric point number and a height value <> 0. If point numbers comprise more than 8 digits, only the right 8 digits are stored.
Example (GSI-8 format):

110019+00000025 83..06+04001234

Meaning: data block 19, point number 25, height 400.1234 m
7.2 Leica Sprinter

For the evaluation of data measured with the Leica digital level Sprinter 100M, 150M, 200M, and 250M carry out the following steps:

- Transfer raw data to a computer
- Reformat raw data to Nigra format
- Enter heights of connecting points
- Start calculations

The point heights of the raw data file can also be transformed directly in the Nigra height file.

Identical in construction to the Leica Sprinter are the levels Geozone Geomax ZDL 700 and Stonex D2.

7.2.1 Line Levellings with Sprinter since Firmware Version P01.01.03

The Leica Sprinter since firmware version P01.01.03 (distributed from April 2006) supports line levellings with the observation sequences BF, BIF and BFFB.

Nigra recognizes automatically during reformatting to the Nigra format which observation sequence was selected. If you have measured more than one levelling, carry out the following:

Measurement to the last connection point and then an additional (fictitious) measurement to a point with the number A. After them you can started a new line levelling. The last levelling must not be finished with the point number A.

Free turning points

These points can be measured with the point number 0 or 1, 2, 3, etc. (in case these numbers are not real point numbers). The point numbers 1, 2 ,3, ... can be eliminated during reformatting to the Nigra format.

7.2.2 Line Levellings with Sprinter (Firmware older than version P01.01.03)

Each single measurement with the Leica Sprinter is stored in the GSI format with the code number 330 = single measurement. No code for back-/foresight reading or side shot is stored.

To realize an evaluation as line levelling (also with side shots) certain conventions must be agreed on.
On the condition that no heights will be required in the field, line levellings can be made easy and quickly with the Leica Sprinter in connection with Nigra.

- Power on Sprinter – it can be measured with or without entering of a reference height.

- Continue by pressing the **MENU** key, select **1. Enter PtNo**, enter point number for the first connecting point and confirm with the **MENU** key.

- Perform a measurement to the first connecting point (for Nigra this becomes a backside) by pressing the red button on the right side of Sprinter.

  If a reference point was first entered (with the **ΔH** key), the Sprinter shows

  **Meas. Target!**

  after the measurement to the first connecting point. Before the measurement of the next point first press the **MENU** key, enter the point number of the first measuring point (or foresight), confirm with the **MENU** key and then press the red button on the right side.

The next point is normally a foresight for Nigra. To measure a point as side shot, it is first necessary to measure a fictitious point with the point number **Z**, and then the side shot (also multiple side shots). To confirm the measurement of side shots, measure again a fictitious point with the point number **Z** and then the next foresight.

**Changing the station:**
Press the **MENU** key to confirm the displayed point number of the last measurement. Afterwards measure the backside and continue the levelling as described before.

**Concluding a line levelling:**
Measure to the last connecting point and make another fictitious measurement to the point number **A**.

Afterwards a new line levelling can be started by entering a point number (new first connecting point). The last levelling need not be concluded with the point number **A**.
Free turning points
These points can be measured with the point number 0 or 1, 2, 3, etc. (in case these numbers are not real point numbers). The point numbers 1, 2, 3, ... can be eliminated during reformatting to the Nigra format.

Skipping data records
If data records are already stored which you don't want to erase, register a fictitious point A0 before beginning a line levelling. All data records until the point A0 will be skipped when reformatting to the Nigra format. In the next chapter you will learn another method of how to skip data records.

Summary:
1st point measurement = backside to first connecting point
2nd point measurement = foresight
3rd point measurement = backside
..... etc.

n.- point measurement = last foresight

Then perform a point measurement to point A and go on with the next levelling.

With side shots:
1st point measurement = backside to first connecting point
2nd point measurement to point Z = then following side shots
3rd measurements of side shots
4th point measurement to point Z = end of side shots
5th point measurement = foresight
etc.

7.2.3 Sprinter Raw Data → PC
Data transfer with the built-in serial com interface

First connect Sprinter and the computer with the serial data cable.

In Nigra: Menu Digital Level → Leica → NA/DNA/Sprinter Raw Data ↔ PC ...
In the Nigra dialog box:

Transfer direction:
Activate **Receive data** to receive data from the Leica Sprinter.

**Filename:** Enter file name for data you will receive (the file is stored in the job folder) or choose folder and file name by clicking the button on the right.

As a default, the date of the day without file extension is used.

**Do not define any file extensions which are in use by Nigra (.NIG, .MDB, .BER etc.)! Always use the standard file extensions .GSI, .NA2 or .DNA for receiving data.**

**Serial interface:** Selection of the serial interfaces Com1, Com2,... Com16. If a non-existing interface is selected, an error message is given out.

The other parameters can be loaded with the button **Load parameters.** Choose the file sprinter.prf from the Nigra template folder.

If all parameter are set correctly, click the **OK** button. In the field below of **Reading data records**, the command **Start data transfer at peripheral device – Waiting for data** appears.
On the Sprinter press MENU → Settings → RS232 (and 12. RS232 respectively for elderly Sprinters) and set the Sprinter parameters Baudrate, Parity, Stop Bit and Data Bit to the same values as in the Nigra dialog box.

Now start the data transfer at the Sprinter: Choose DataManager → Download Data → GSI and start the data transfer with the MENU key.

The data transfer starts and finishes automatically after the last record set is transferred. The data transfer can be aborted by pressing the Esc key or clicking on the Cancel button.

The transferred data records will be shown in Nigra in the field Reading data records.

The Sprinter raw data can be transferred alternatively with the Leica software Geo Office Tools. In this case choose the format GSI2.

7.2.4 Edit Raw Data

For editing Sprinter raw data before reformatting into the Nigra format. A dialog box to select a Leica raw data file appears.

7.2.5 Format Sprinter-GSI → Nigra

The Sprinter raw data format cannot be computed directly by Nigra. By activating this menu item, raw data will be reformatted to the Nigra format.

In case you want to reformat your raw data in parts (if not signed with A0 during levelling), limit the reformatting with the letters x and e in the first column of a data record of the raw data file:

x  All data records will be ignored until the next x.

e  End of reformatting, the following data will be ignored.

Single data can be ignored by using an asterisk (*) in the first column.

Example for a data record in format GSI-8:

<table>
<thead>
<tr>
<th>Point no.</th>
<th>Distance</th>
<th>staff reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 .... +00900111 32 .00 +00014570</td>
<td>330.06 +00014960</td>
<td></td>
</tr>
</tbody>
</table>
The following word identification (WI) are used for levellings with Sprinter:

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Point number</td>
</tr>
<tr>
<td>330</td>
<td>Staff reading (Measure Only)</td>
</tr>
<tr>
<td>331</td>
<td>Staff reading, backside (since firmware P01.01.03)</td>
</tr>
<tr>
<td>332</td>
<td>Staff reading, foreside (since firmware P01.01.03)</td>
</tr>
<tr>
<td>32</td>
<td>Distance to staff</td>
</tr>
<tr>
<td>83</td>
<td>Height of a point</td>
</tr>
</tbody>
</table>

Nigra processed also data who are created with the Leica DataLoader with the function **ASCII Data Listing** (file extension .txt). However, the GSI format should be preferred.

**Nigra Formats**

After the selection of a raw data file, raw data can be transformed into two different Nigra formats:

- **Measurements**
  - Transfer of measurement data in a batch file for calculations

- **Height file**
  - Transfer of levelled raw heights in the Nigra height file

**Reformatting of Raw Data**

Select one of the following described data formats.
Measurement Data Format

Raw data, supplemented with header data and parameters, are transferred in the Nigra batch file.

Only for Sprinter from firmware P01.01.03: standard staff reading (Measure Only) with the word identification 330 are not transformed to the Nigra-format.

After selection of a raw data file click on the Header data button, if you want to change header data. Explanations to header data are given in the sections 3.2.3 and 8.1.1 of this manual.

Press the Parameters button, if you want to make some changes for parameters. Comprehensive explanations of parameters are given in the section 8.1.2 and in the following description.

Point Number Extension

During measurements with Sprinter only 8-digit numerical point numbers can be registered. Because often more than 8 digits are necessary, Nigra allows point number extensions, which are performed during the reformatting of Sprinter Raw Data → Nigra. Sometimes, point numbers like 12.01, 12.02 etc. may be needed. These numbers can also be generated by the Nigra point number extension function from the numerically stored point number in the raw data format.

The functions for point number extensions are only displayed if they are activated in the menu item Job Configuration (Options menu).

This method of point number extension is useful, if all point numbers of a file to be reformatted are to be extended with the same character, for example when adding the movement period.

After the entry of a character for the extension of the point numbers and the position (starting at the right) of entry, the original point numbers can be extended by any two alphanumerical character strings, i.e. insert numbers or letters, add or set before.

The position from the right in the second string refers to the point number changed by the first character string.

Point numbers, which should not be changed, have to be entered with a negative sign, for example -1248. If no point number extension is selected, the negative sign is stored together with the point number.
Examples:

Registered point number= -0000230
            +0000123
1\textsuperscript{st} string= KD, position from the right = 0 or no entry

\textbf{New point number:} \hspace{1cm} 230
\hspace{1cm} 123KD

Registered point number= +00056005
1\textsuperscript{st} string= . (point), position from the right = 3
2\textsuperscript{nd} string= 25, position from the right = 7

\textbf{New point number:} \hspace{1cm} 25560.05

Registered point number= +00000001
1\textsuperscript{st} string= Channel, position from the right = 4

\textbf{New point number:} \hspace{1cm} Channel001

The negative sign (for points not to be changed) and also leading zeros will be removed from the point number. Point numbers with more than 14 digits due to point number extensions are cut off from the left.

\textbf{Removing of free turning points} (turning points without numbers)

Free turning points can be registered with the number 0. Furthermore it is possible to eliminate free turning points like 1, 2, 3, etc. by inputting a higher number in the field \textbf{Remove turning point numbers} during reformatting (only effective for format \textbf{Measurements}).

\textbf{Note:} All measurement points must have a higher number!
Defining Parameters

**Levelling Method**

The method of levelling consists of the Observation sequence and the parameter Evaluation of side shots/turning points. Leica Sprinter supports line levellings with the observation sequence BF and BFFB. Nigra recognizes automatically with the help of GSI-data which observation sequence was selected.

If the button Evaluation of side shots/turning points is activated, the heights of side shots and turning points will be evaluated by batch file calculation. If not, a so-called line levelling will be defined. That is also valid, if line levelling BIF was selected.

**With distances** check box is activated: Distribution of misclosure is proportional to the distance.

**With distances** check box is not activated: Distribution of misclosure depends on the number of back- and foresights.

Stores value H00 for method of levelling in the batch file: method of levelling = 0 - levelling with side shots, measured in the sequence BF.

Reading sequence: B S S  F S S .
No evaluation of side shots/turning points:

Defines a line levelling, i.e. in batch processing only the height differences and the distance sum from the starting- to the end-point will be calculated. As method of levelling, value H10 is stored in the batch file: Method of levelling = 1 - line levelling, measured in the sequence BF

Reading sequence: B F, no side shots.

Decimal places

The parameters Dec. readings and Dec. heights have no influence on the reformatting of raw data, but on the calculation output.

Start of Reformatting

If all parameters are set correctly and header data are entered, start reformatting by clicking the Run button. Data are added to an existing measurement data file (file extension .NIG) of the current job.

Into the Nigra format can be transformed: point number, distance and staff reading (marked as backsight, side shot or foresight).

Staff readings are kept with all digits. Distances are rounded to 2 digits. If the measurement was performed in units different from the current Nigra unit of measurement, the measurement data will be converted automatically.

Before starting batch file calculations, enter the heights of connecting points (Heights menu) and start Reorganize Calculation No. (Files menu), if this has not been done automatically.

Format Height File

The heights of all points in raw data, including starting- and end-points, are transferred into the height file. The date (maximum of 10 characters) and comments (maximum of 30 characters) from header data are added. In contrast to the import of ASCII files, the set parameters mean value and stop, if error limit is exceeded are active here. Other parameters, for example method of levelling, are meaningless.
The default setting of the calculation number is 777777. If the mean value of points was calculated, a mean value calculation protocol is generated in the calculation file (Calculate menu, item View Calculations).

Example

To conclude this section, a complete protocol of measurement data is presented. (Measurement with Leica Sprinter from firmware P01.01.03.)

Sprinter GSI format:

```
11....+00000200 32...6+00018619 331.06+00011283 ..... 
11....+00002110 32...6+00038622 333.06+00003281 ..... 
11....+00002111 32...6+00048622 333.06+00004282 ..... 
11....+00002112 32...6+00058617 333.06+00005281 ..... 
11....+00002113 32...6+00068616 333.06+00006281 ..... 
11....+00000000 32...6+00078617 332.06+00008281 ..... 
11....+00000400 32...6+00098621 332.06+00010281 ..... 
```

Nigra batch file:

```
RTest measurement with Leica Sprinter
\*2345678901234567890123456789012345678901234567890123456789012
x 1 2 3 4 5 6 7
x Strecke<---- Rück Mitte Vor ----> Punktnummer ---->
C1
HSankt Augustin Location
H Location
HTest Order
H Order
H12a Line
H05/09/2010 Date
Hsunny Weather
HMeyer Observer
HLeica-Sprinter Level
H4m Staff
H Comments
H Comments
H00 2.Col.:0=Side,1=no Side,4=Line, 5=Level test
\* 3.Col.:0=BF,BBFF,2=BFFB,4=BFBF,5=FBBF,4.Col.:a=altern.
H1 Number of staff scales or readings
H0 Scale constant for 2 staff graduations
H7 Difference tolerance for two readings
H1 Staff graduation 1=cm,feet,inches, 0.5=1/2cm
H1 With distances, 1=yes, 0=no
H4 Decimal places for heights in calculations
H4 Decimal places for readings in calculations
E03m E/Mean value/Error class/Unit of measurement
D 1.86 b1.128300 200
D 3.86 s0.328100 2110
D 4.86 s0.428200 2111
D 5.86 s-0.528100 2112
D 6.86 s0.628100 2113
```
Calculation:

Company  XYZ
NigraWin - Levelling, Version 5.00       05-26-2010  Page: 1
Job: Sprinter_english

Calculation No.: 1
Location    Sankt Augustin
Order       Test
Line        12a             Date       05/09/2010
Weather     sunny           Observer    Meyer
Level       Leica-Sprinter  Staff       4 m
Staff graduation 1 cm     Reading sequence BF BF(S)

Comments
Calculation of Mean Values: mean value - mean of old and new

Misclosure =  1.3 mm
Max. error E (3) =  2.7 mm

<table>
<thead>
<tr>
<th>Distance</th>
<th>Back</th>
<th>Side</th>
<th>Fore</th>
<th>Height</th>
<th>Point No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.86</td>
<td>1.1283</td>
<td></td>
<td></td>
<td>57.1560</td>
<td>200</td>
</tr>
<tr>
<td>3.86</td>
<td>0.3281</td>
<td></td>
<td></td>
<td>57.9563</td>
<td>2110</td>
</tr>
<tr>
<td>4.86</td>
<td>0.4282</td>
<td></td>
<td></td>
<td>57.8562</td>
<td>2111</td>
</tr>
<tr>
<td>5.86</td>
<td>-0.5281</td>
<td></td>
<td></td>
<td>58.8125</td>
<td>2112</td>
</tr>
<tr>
<td>6.86</td>
<td>0.6281</td>
<td></td>
<td></td>
<td>57.6563</td>
<td>2113</td>
</tr>
<tr>
<td>7.86</td>
<td>0.8281</td>
<td></td>
<td></td>
<td>57.4566</td>
<td></td>
</tr>
<tr>
<td>8.86</td>
<td>0.9280</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.86</td>
<td>1.0281</td>
<td></td>
<td></td>
<td>57.3574</td>
<td>400</td>
</tr>
</tbody>
</table>

Sum total distances =  28.44 m
Delta-H=  0.20010 m
Sum backsight distances =  10.72 m
Sum foresight distances =  17.72 m

Sum of all distances (without side shots) =  28.44 m
Max. misclosure =  1.3 mm  (calcul. no. 1)
7.3 Trimble

For the evaluation of data measured with the Trimble digital levels DiNi 10, 11, 12, 20, 21, 22, 0.3 mm¹), 0.7 mm and 10-22 T in levelling mode, carry out the following steps:

- Transfer raw data to the computer
- Reformat raw data to Nigra format
- Enter heights of connecting points
- Start calculations

The point heights of the raw data file can also be transformed directly into the Nigra height file. It is also possible to create a profile file from raw data.

¹) Measuring method FBBF will not be supported.

7.3.1 DiNi Raw Data ↔ PC

7.3.1.1 DiNi 10-22 (T), 0.3 mm, 0.7 mm, Dac E, Dac 10

This activates the program for the transfer of raw data to a PC or for the transfer of real heights to DiNi/Dac E and Dac 10, respectively. If there is no program defined in the Program Configuration, Transfer programs for digital levels, the Nigra built-in data transfer is activated. The data transfer from DiNi/Dac E/Dac 10 to PC or vice versa with the serial interface is now possible.

If not the DiNi/Dac E/Dac 10 is utilized for data transfer, please define the name for a respective transfer program in Program Configuration (Options menu). Clicking on the menu item DiNi raw data ↔ PC opens your program (instead of the Nigra built-in data transfer). In the latter case, please refer to the appropriate program manual.

With some DiNis, the data can be stored on a PCMCIA card, or externally. Use in this case an appropriate reader. With the DiNis 0.3 and 0.7 the data transfer is easy via an USB adapter.
Data Transfer DiNi ↔ PC with the Internal Nigra Interface

First activate at the transfer direction the DiNi. Then define the serial interface to which the DiNi is connected to the PC. Nigra shows only the available serial ports on your PC.

Check the transfer parameters **Baud rate** and **Parity**: The same values must be set on the PC and DiNi. Furthermore, the following settings are required on the DiNi:

```
FORMAT    = REC E
PROTOK.   = REC500
STOPBITS  = 1
LINEFEED = YES
```

Transfer parameters must be set on the DiNi in the menu "DATA TRANSFER", submenu "INTERFACE 1" or "INTERFACE 2".
Note:
In the case of a break down of the data transfer, please use a special transfer program from Trimble.

Data Transfer DiNi → PC:

Activate the option DiNi → PERIPHERY. Enter any file name in the field File name with the file extension .DIN for the transfer into the current job folder or click on the button File name to get a dialog box for choosing a file name. It is useful to enter a file name with the date of measurement, for example 10102008.DIN: measurement on 10-10-2008.

If a file with the same name already exists, you will be asked: "File exists, overwrite?". Click the "Yes" button to overwrite, or "No" to add data.

Do not define any file extensions which are in use by Nigra (.NIG, .MDB, .BER etc.)! Always use the file extension .DIN.

Follow the instructions in the dialog box, then click on Run. The transferred data will be shown on the screen window. The data transfer can be stopped by pressing the Esc key or clicking the Cancel button.

Data Transfer PC → DiNi:

For the transfer of connecting or fixed heights to the DiNi. First create an ASCII file (name: 'job'\_FixPt.DAT) with the heights of the current job in the Rec E format with the menu item Format Heights → DiNi Rec E (see section 7.3.4). Alternatively, you can choose every file in the Rec E format by clicking on the button File name.

Activate the option transfer direction PERIPHERY → DiNi. Follow the instructions on the PC screen and on the DiNi.

Data Transfer with Dac 10

Activate the device option Dac 10, if you want to use the Dac 10 for data transfer. The number of the Com interface you can define in the Options menu, item Program Configuration.

Because the Dac 10 has no power switch on and no possibility of entering transfer parameters, the device will be fully controlled by Nigra. For technical information, the transfer parameters used are: Baud rate 9600, parity None, data bits 7, stop bits 2.
Note:
If the control lamp on the Dac 10 is still burning after the data transfer has finished, you must pull out the power plug to switch off the device.

Data Transfer Dac 10 → PC

Activate the option **Dac 10 → PC**. The entering of a file name is the same as for the data transfer with the DiNi. Click on the **Run** button to start the data transfer.

Then enter the starting (First) und finishing (Last) address or accept the default **1 – Last address** and click on the **OK** button.

The data transfer starts and finishes automatically after the last record set is transferred. The data transfer can be aborted by pressing the **Esc** key or clicking on the **Cancel** button.

Note:
If Nigra shows the message 'Mem is empty' although the mem contains data, there is a communication problem. Please pull out the power plug of the Dac 10 for a moment and restart the data transfer.

Data Transfer PC → Dac 10

Activate the option PC → Dac 10. After entering or choosing a file name (refer to the description for the DiNi data transfer) click on the Run button. The data transfer can be aborted by pressing the Esc key or clicking the Cancel button.

7.3.1.2 DiNi 0.3 mm, 0.7 mm

These DiNis supports the data transfer via the USB-interface. There are two ways possible: Data communication with the short data cable directly to a USB-stick or with the long data cable above the USB-interface of the PC with the Trimble-software Data Transfer. Copy the measuring file (.DAT) to any folder you like or directly to a Nigra job folder.

7.3.2 Edit DiNi Raw Data

To edit Trimble raw data before the reformatting into the Nigra format, for example correction of point numbers. A dialog box for the selection of a DiNi raw data file appears.

7.3.3 Format DiNi Rec E → Nigra

By activating this menu item, existing DiNi raw data will be reformatted into Nigra formats. First, a dialog box for the selection of a DiNi raw data file is displayed. Measurement data must be in the Rec E format.

Were transferred inadvertently data in Rec500 format, they are automatically converted to Rec E. However, the Rec500 format contains no units and type identifiers for the numeric keypad. It is always assumed that measurement unit is meter.

In case you want to reformat the raw data only in part, limit reformating with the characters x and e in the first column of a data record of the raw data file:

x  All sets of data will be ignored until the next x.

e  End of reformatting, the following data will be ignored.

Single data can be ignored by using an asterisk (*) in the first column.

Data records in the Rec E format always start with the characters 'For M5'. A line of measurement data has the following format (the first two lines are not part of the raw data, but serve for orientation):
Staff readings are marked with Lr (backsight), Lz (side shot), Lv (foresight), or just L (single measurement). Distances are marked with E and heights with Z. The point number has a maximum of 8 digits and is stored in columns 22-29. Columns 30-48 are reserved for point codes, measuring time, number of line, and number of instrument positions. They will be transferred from column 62 into the measurement file during the reformatting of raw data into the Nigra format (format measurement data), but are not evaluated further.

At the start of a line levelling and after the input of the starting-point number, first a text line 'Start-line' and the observation method (BF, BFFB, BFBF, BBFF, FBBF) are stored.

All data will be ignored during reformatting until this line appears (except remarks with codes). It is important always to transfer this line to the PC!

**Start of levelling:**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>For MS</td>
<td>Adr</td>
<td>4</td>
<td>TO</td>
<td>Start-Line</td>
<td>BF</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For MS</td>
<td>Adr</td>
<td>5</td>
<td>KD1</td>
<td>1000</td>
<td>2</td>
<td>5</td>
<td></td>
<td></td>
<td>Z</td>
<td>123.4567 m</td>
</tr>
<tr>
<td>For MS</td>
<td>Adr</td>
<td>6</td>
<td>KD1</td>
<td>1000</td>
<td>2</td>
<td>5</td>
<td>Lr</td>
<td>0.9446 m</td>
<td>E</td>
<td>3.53 m</td>
</tr>
</tbody>
</table>

**Meanings:**

Start-Line BF = line measurement with observation sequence BF
1000 = starting-point number
123.4567 = ground height

Since a finished levelling line can always be continued, the end of a line is not determined by the remark "**End-line**", but by the start of a new line or the end of the file.

In addition to measurement data, individual remarks can be entered manual on the DiNi. Special remarks in Nigra can be used to control the evaluation of your levellings.

**DiNi 10-22 (T):** On the DiNi press the [REM] key and then the key under the line 'Text'.

**DiNi 0.3 mm, 0.7 mm:** Press the Trimble function key, 8 or field **Comments**, select **Input further informations**.

Individual remarks line:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>For MS</td>
<td>Adr</td>
<td>10</td>
<td>TO</td>
<td>.0210-10-2008</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the preceding example, the date 10-10-2008 is entered by the code .02. For explanations of the codes, see below in this section.
Nigra Formats

After the selection of a raw data file, raw data can be transformed into three different Nigra formats:

- **Measurements**  
  Transfer of measurement data in the batch file for the execution of calculations.

- **Height file**  
  Transfer of raw or adjusted heights of all points into the Nigra height file. Y-,X-coordinates are also transferred (if available)

- **Profile**  
  Creation of an ASCII file (file extension .JOK) for profile plots.

Reformatting of Raw Data

Select one of the following described data formats.

**Measurement Data Format**

Raw data, supplemented with header data and parameters, are transferred into the Nigra batch file. If you want to change these data, click the button **Header data**. Some explanations to header data are given in sections 3.2.3 and 8.1.1 of this manual.

Press the **Parameters** button, if you want to make changes in the parameters. Comprehensive explanations of parameters are provided in section 8.1.2.
Definition of Parameters

Header data and parameters not only can be inputted manually using the screen masks, but also directly during levelling by using code blocks. The use of code blocks will be explained later on in this section.

Methods of Levelling

**BF:** Normal levelling with side shots or distance levelling. Nigra recognized the levelling sequence from the characterization in the DiNi raw data.

**TEST:** Instrument test

**DiNi aBF:** Alternative measuring method BF. This observation method is only used by older levels, which do not use software version 2.0 or higher. For comprehensive information see below in this section.

DiNi levels recognize the observation sequences BF, BBFF, BFFB, BFBF, and the respective alternate observation sequences (from DiNi software version 2.0), DiNi 0.3 also FBBF and aFBBF. Additionally, side shots can be measured. This also determines whether one or two staff readings are used. In contrast, it is not defined whether the evaluation will be performed as line levelling with side shots or distance levelling (for example for network adjustment).

Activate the check box **Evaluation of side shots/turning points** if the heights of side shots and turning points should be calculated. For the definition of the evaluation method, the parameter **Levelling method**, combined from **Observation sequence** and **Evaluation of side shots/turning points**, is used by Nigra.
Select the item **BF** in the list box **Observation sequence**, if you have performed a normal levelling.

For observation sequences with 2 staff readings at one station (BBFF, BFBF, and BFFB), the parameter **Staff scale** is automatically set to the value 2, for BF to the value 1. For levellings with 2 staff readings, two readings must be performed also for side shots. If only one measurement exists, a second is added automatically. This measurement will be marked in the batch file with '*' at the right side.

Side shots are permitted for the observation sequence BF (or BBFF) before or after the foresight measurement; for BFFB, FBBF, BFBF, and all alternating observation sequences, only after the completed station measurement.

In addition, the following parameters are set to default values:

- **Staff graduation**: 1 (cm, i.e. ft or in)
- **Distances**: 1 (=yes)
- **Scale constant**: 0

For levellings with **two** staff readings, the **Diff. tolerance between scales** must be defined (difference 1<sup>st</sup> measurement – 2<sup>nd</sup> measurement). For all levellings with only **one** staff reading, the parameters **Scale constant** and **Diff. tolerance between scales** are meaningless.

Levellings with the observation sequence BFFB, FBBF or BFBF are transferred into the Nigra batch file in the following format:

```
B1
B2
F1
F2
```

**Observation Sequence DiNi aBF (with line BF)**

Is used to realize the observation sequence BF FB on older DiNi levels (DiNi software version < 2.0). At **all stations**, first measure the same staff: At the odd station numbers, first measure the backsight staff; at the even station numbers, the foresight staff. On the DiNi, select line measurement **BF**.
Note:
The point heights calculated from the DiNi are not correct from the second station on.

Measurements at the even stations are registered in the reverse sequence: first a foresight, registered as backsight; then a backsight, registered as foresight. Point numbers of turning points and the point number of the end-point must be entered, if the DiNi expects a foresight input. During reformatting into the Nigra format, the readings of the even station numbers are changed appropriately.

Measurement data are transferred into the batch file in the following sequence:

B1...... F1......
S1......
S2......

For DiNi aBF without evaluation side shots/turning points, the value H10a is stored in the batch file for levelling method: levelling method 1, observed in sequence BF alternate (=0a). The evaluation is performed as distance levelling.

For DiNi aBF and evaluation side shots/turning points, the value H00a is stored in the batch file for levelling method: levelling method 0, observed in sequence BF alternate (=0a). Side shots are permitted after the first station measuring BF or FB.

Recommended measuring mode: multiple measurements.

Sample Data Records for DiNi aBF (including side shots)

DiNi Raw Data Format:

| For M5|Adr 1|TO Start-Line | BF | 9| | | |
| * 1st station |
| For M5|Adr 2|KD1 11123 11 9| | | |Z| 123.45600 m | |
| For M5|Adr 3|KD1 11123 11 14:33:21 9|Lr| 0.94246 m |E| 13.577 m | |
| For M5|Adr 4|KD1 1 11 14:33:32 9|Lv| 0.30990 m |E| 13.592 m | |
| For M5|Adr 5|KD1 1 11 14:33:32 9| | | |Z| 124.08956 m | |
| * 2nd station |
| For M5|Adr 7|KD1 1 11 14:33:56 9|Lr| 1.40988 m |E| 13.482 m | |
| For M5|Adr 10|KD1 2 11 14:34:16 9|Lv| 1.03344 m |E| 13.142 m | |
| For M5|Adr 11|KD1 2 11 14:34:16 9| | | |Z| 124.46600 m | |
| * 3rd. station |
| For M5|Adr 12|KD1 2 11 14:34:28 9|Lr| 0.74346 m |E| 13.477 m | |
| For M5|Adr 13|KD1 3 11 14:34:35 9|Lv| 0.50990 m |E| 13.192 m | |
| For M5|Adr 14|KD1 3 11 14:34:35 9| | | |Z| 124.69956 m | |
| For M5|Adr 24|KD1 11160002 11 14:36:41 9|Lz| 1.42990 m |E| 23.332 m |Z| 123.77956 m |
| * 4th. station |
| For M5|Adr 31|KD1 3 11 14:39:29 9|Lr| 1.40781 m |E| 12.442 m | |
| For M5|Adr 31|KD1 3 11 14:39:29 9|Lv| 1.60990 m |E| 13.232 m | |
| For M5|Adr 14|KD1 3 11 14:39:39 9| | | |Z| 124.49747 m | |
| For M5|Adr 23|TO intcal. sightings 9| | | | |
| For M5|Adr 26|KD1 1160003 11 14:39:53 9|Lz| 1.43993 m |E| 14.392 m |Z| 124.66744 m |
| For M5|Adr 26|KD1 1160004 11 14:40:33 9|Lz| 1.44563 m |E| 14.692 m |Z| 124.66174 m |
| For M5|Adr 26|KD1 1160005 11 14:40:58 9|Lz| 1.43221 m |E| 12.392 m |Z| 124.65416 m |
| For M5|Adr 30|TO End of intcal. sight. 9| | | | |
| For M5|Adr 32|KD1 4 11 14:40:58 9| | | |Z| 124.49747 m | |
| For M5|Adr 33|KD2 4 11 4 9Sr| 52.980 m |Sr| 53.150 m |Z| 124.49747 m | }

For M5|Adr 34|TO End-Line 9| | | | | | |
Nigra Batch File:

R Test DiNi aBF S
x234567890123456789012345678901234567890123456789012345678901234567890
x 1 2 3 4 5 6 7
x Distance<--- Back Side Fore<---<--- Point Number --->

C1
H Bonn Location
H Location
H Test Order
H Order
H 12 Line
H 09-17-2010 Date
H Sunny Weather
H Meier Observer
H DiNi 10 Level
H Nedo 2345, 2346 Staff
H Test DiNi-aBF Z Comments
H Comments
H 00a 2.column:0=Side,1=no side,4=Line, 5=Level Check
* 3.column:0=BF,BBFF,2=BFFB,4=BFBF,5=FBBF,4.Col._a=altern.
H 1 Number of staff scales for readings
H 0 Scale constant for 2 staff graduations
H 0 Difference tolerance for two readings
H 1 Staff graduation 1=cm,feet,inches, 0.5=1/2cm
H 1 With distances 1=yes, 2=no
H 5 Decimal places for heights in calculations
H 5 Decimal places for readings in calculations
E 13m E/Mean value/Error class/Unit of measurement

D 13.58 b0.94346 11123 11 14:33:21 9
D 13.59 f0.30990 1 11 14:33:32 9
D 13.14 b1.03344 1 11 14:33:56 9
D 13.48 f1.40988 2 11 14:34:16 9
D 13.48 b0.74346 2 11 14:34:28 9
D 13.19 f0.50990 3 11 14:34:35 9
D 23.33 sl.42990 11160002 11 14:36:41 9
D 13.23 b1.60990 3 11 14:39:29 9
D 12.44 f1.40781 4 11 14:39:39 9
D 14.69 sl.44563 1160004 11 14:40:33 9
D 12.39 sl.45321 1160005 11 14:40:58 9
E
Observation Sequence TEST = Instrument Test (with line measurement BF, BFFB, BFBF, BBFF)

Explanations to the measurement methods are given in section 8.1.2.

Summary of Labels of all Levelling Methods in the Batch File

Calculation of heights of side shots and turning points

H00  observation sequence BF BF respectively BBFF BBFF
H00a observation sequence BF FB (aBF) respectively BBFF FFBB aBBFF) and DiNi aBF
H02  observation sequence BFFB BFFB
H02a observation sequence BFFB FBBF (aBFFB)
H04  observation sequence BFBF BFBF
H04a observation sequence BFBF FBFB (aBFBF)
H05  observation sequence FBBF FBBF
H05a observation sequence FBBF BFFB (aFBBF)

Evaluation as distance levelling

H10  observation sequence BF BF or BBFF BBFF
H10a observation sequence BF FB (aBF) respectively BBFF FFBB aBBFF) and DiNi aBF
H12  observation sequence BFFB BFFB
H12a observation sequence BFFB FBBF (aBFFB)
H14  observation sequence BFBF BFBF
H14a observation sequence BFBF FBFB (aBFBF)
H15  observation sequence FBBF FBBF
H15a observation sequence FBBF BFFB (aFBBF)

For all alternating measurement methods, an even number of instrument stations must be observed for the consideration of a staff correction for each levelling.

Selection of the Appropriate Levelling Method

For short levellings with simple precision perform the observation sequence BF. For high precision levellings, only use the levellings BFFB or alternating observation sequences to avoid systematic errors.

Decimal Places

The parameters Decimal places for heights and Decimal places for staff readings have no influence on the reformatting of raw data, but do so on the later calculation output.
If all parameters are set correctly and the header data are entered, start reformatting by clicking the Run button. Data are added to an existing measurement data file (file extension .NIG) of the current job.

Into the Nigra format can be transformed: point number, distance and staff reading (marked as backsight, side shot, foresight). Set-outs are kept as side shots.

Staff readings are kept with all digits. Distances are rounded to 2 decimal places. If the measurement was performed in units different from the Nigra current unit of measurement, measurement data will be converted automatically.

Before starting a batch file calculation, enter the heights for connecting points (Heights menu) and start Reorganize Calculation No. (Files menu), if this has not been done automatically.

**Special Functions**

**Free turning points** (turning points without numbers): Free turning points can be registered with the point number 0.

Furthermore it is possible to eliminate free turning points like 1, 2, 3, etc. by inputting a higher number in the field Remove turning point numbers during reformatting (only effective for format Measurements).

**Note:** All measurement points must have a higher number.

**Single staff readings** (test measurements): During this measuring mode readings are not marked as backsight, side shot, or foresight. However, these data are not suitable for calculations. They will be ignored during the reformatting. If you want to perform calculations with these data, perform the following steps:

Change the label from L to Lr, Lz, and Lv, respectively, and enter the text line 'Start-Line' in the Rec E format and the observation sequence BF in front of the measurement data. A so modified file can be transformed into the Nigra format.

**Staff offset, adjustment, refraction coefficient** are documented in the batch file.

**Multiple measurements:** If the standard deviation sL of staff readings was set, then the number of measurements and standard deviation are displayed in the batch file at the right of the point number. If not, point code, measuring time, number of line, and number of stations are displayed at this location.
Repeat measurement: The repeated measurement will be not transferred into the Nigra format.

Repeat station: The repeated station measurement will be not transferred into the Nigra format.

From DiNi software version 2.0 and up, deleted raw data are marked in the point code with ######.

Height File Format

Heights and if available, also Y-,X-coordinates of all points in the raw data, including starting- and end-points, are transferred into the height file. Date (max. 10 characters) and comments (max. 30 characters) are added from the header data. In contrast to the import of ASCII files, the mean value calculation is activated. Other parameters, for example levelling method, have no influence.

The default setting of the calculation number is 777777. If the mean value of points was calculated, a protocol of mean value calculation is generated in the calculation file (Calculate menu, View Calculation).

Remarks on the DiNi Line Adjustment

Not only measurements to turning points, also measurements to side shots are corrected proportional to distance by the DiNi. Nigra calculates side shots from the last turning point without correction. Side shot heights levelled out by the DiNi can differ slightly from heights calculated by Nigra, depending on the value of the final error.

Nigra uses the following formulas:

\[ H_i = H_a + [h_i] + v_i \]
\[ H_{zi} = H_i + [h_{zi}] \]

With:
- \( H_a \) = Fixed point height
- \( H_i \) = Turning point height i
- \( H_z \) = Side point height
- \([h_i]\) = Sum of measured height differences b-f till point i
- \([h_{zi}]\) = Height difference b-s
- \( w \) = Misclosure
- \([S_i]\) = Sum of distances b and f to point i
- \([S_n]\) = Sum of all distances b and f of a levelling
Profile Format

Creates an ASCII file (file extension .JOK) from point number, distance, and raw height of raw data, as start file for the profile creation. This file can be edited in the Profile menu (menu item Edit Profile File). For the profile creation, the length of point numbers is limited to 8 characters. All points including heights, are transferred, except the related starting- and end-point of a levelling. The levelling must be performed in the BF mode including side shots.

If an older profile file already exists, the question "Profile file exist, overwrite?" appears. Clicking on the "No" button adds new data to the old file, clicking on "Yes" deletes the file and creates a new one.

As an alternative, a profile file can be created from the calculations. Please also refer to section 10.1, Create Profile File, for the format of a profile file.

Point Number Extension

During measurement with DiNi, only 8-digit numerical point numbers are registered. Because often more than 8 digits are necessary, Nigra handles point number extensions, which are made when reformatting Format DiNi Rec E → Nigra. In addition, point numbers of the kind 12.01, 12.02 etc. may be needed. These numbers can also be generated by the Nigra point number extension from the numerically stored point number in the raw data format.

Point number extensions are only displayed if they are activated in the Options menu (menu item Job Configuration).

Point number extension by entry in the screen mask

This kind of point number extension is useful, if all point numbers of a file, which must be reformatted, are to be extended with the same characters, for example adding of a movement period. After this, point numbers, which are not to be changed, must be set to the original value by editing the batch file.

By entering of a character to extend the point numbers and the position (start at the right), the original point numbers can be extended by any two alphanumeric character strings, i.e. insert numbers or letters, add or set in front.

Note:
The position from the right in the second string is referred to the point number changed by the first string.
Examples:

Registered point number = 230
1st string= KD, position from the right = 0 or no input
New point number: 230KD

Registered point number = 56005
1st string= . (point), position from the right = 3
2nd string= 25, position from the right = 7
New point number: 25560.05

Registered point number = 1
1st string= channel, position from the right = 9
New point number: channel00000001

Point numbers with more than 14 digits created by point number extensions, are cut off from the left.

**Point number extension by point code**

With this point number extension, the final point number is generated from the registered point number and point code. Enter the string pc+ or pc- in the input box 1st string for point number extension during the reformatting of raw data (Format DiNi Rec E → Nigra). The input box Position from the right is empty.

pc+: point number is generated from registered point number + point code
pc-: point number is generated from point code + registered point number

After the string pc+, i.e. pc-, separators can be entered between registered point number and point code.

Examples:

Registered point number = 700128
Registered point code = 4001
Input at 1st String = pc+. Results in new point number = 700128.4001

Registered point number = 700128
Registered point code = 4001
Input at 1st string = pc-** Results in new point number = 4001**700128

In addition, the point number can be extended by the second string (see below). The newly generated point number has an allowed maximum number of 14 characters.
During the creation of a file in the Rec E format with the menu item **Format Heights → DiNi Rec E** (see there), the point number can be restored again into point number and point code.

**Use of Codes for Header Data and Parameters**

If you have measured several different kinds of levellings or different jobs in a raw data file or measured on different days, the header and control data is not the same. Proceed as described before, all levellings of a raw data file have the same control data.

Using Nigra specific codes, header data and levelling parameters can be registered already in the field. Entering of codes:

**DiNi 10-22 (T):** On the DiNi press the [REM] button and then the button under the line 'Text'.

**DiNi 0.3 mm, 0.7 mm:** Press the Trimble function key, 8 or field **Comments**, select **Input further informations**.

Subsequently, enter a point (.) followed by a two digit code number and the remark, for example .0210.10.2008 = code .02, date 10-10-2008.

The code must be inputted before the first levelling, if they are to become active. They can be repeated any time with new entries.

**Note:**
If no codes are registered, parameters defined on the screen mask are active.

The correction of staff readings with intermediate staff meter, linear coefficient of extension and staff offset is also controlled by the codes.

Nigra uses the codes .00 - .19. The code number including the remark is stored from column 22 in the raw data file. The sequence of the codes is optional. Code information can also be stored in part, because control data defined in the screen dialog boxes are active until they are substituted by code blocks.

A warning is written by Nigra into the batch file, if codes are used which are not defined by Nigra.
Code .00

Resets all control data to values defined in the screen masks. This code is activated with the start of the following levelling.

Code .01 - Levelling parameters

.01aaabced:

aa  = Levelling method (00, 01, 05, 06, 07)
b  = Mean value calculation (0-3)
c  = Error class (1-4)
d  = Decimal places for heights (2-5)
e  = Decimal places for staff readings (2-5)

Levelling methods:

00 - BF S  Evaluation of side shots and turning points, all observation sequences are possible
01 - BF    Only distance levelling, all observation sequences are possible
05 - TEST  Instrument test
06 - DiNi  aBF with side shots, line measurement BF
07 - DiNi  aBF without side shots, line measurement BF

Entry .01001144 means: Code .01, levelling method 00=BF S, mean value calculation 1=new, error class 1, decimal places for heights and staff readings for the calculation output each 4.

Code .02 - Date

.0210-10-2008 = date 10-10-2008

Note:

Date separators are set according to the Windows Regional Settings in the Control Panel. The sequence of day, month, and year is not changed.

Code .03 - Point number extension

This point number extension is an alternative to point number extension by the registered point number and point code. The point number extension can be specified for each point separately and is active until it is changed or turned off.
The definition of the point number extension must be entered in the following format:

```
.03ssnnnnnn
```

- **n**=numeric character for the extension of point number, max. 6 characters
- **ss**=position from the right, where to insert the characters

Example:

```
.03070308
```

position=7, extension=0308

950002

registered point number

Results in the following point number:

0308950002

If you want to extend the point number by a second constant string, use the second point number extension in the screen mask.

With the input '.03' the point number extension is reset.

The following codes .04 - .11 are replaced during the reformatting into the Nigra format by characters of the table of references DINICODE.TXT:

- Code .04  - Observer
- Code .05  - Level
- Code .06  - Staff
- Code .07  - Line
- Code .08  - Weather
- Code .09  - Location
- Code .10  - Order
- Code .11  - Remark

Table of references is an ASCII file named DINICODE.TXT in the folder c:\Nigra\TEMPLATES (c:\Nigra= Nigra installation folder). You can create table of references according to the following format, or change the provided file with a text editor. A maximum of 500 entries is allowed.
The table of references first contains the code number with the remark and second, separated by an equal sign, the text substituting the remark:

```
.0402 = Johnson (optional text, which replaces the code)
```

The optional text after the equal sign is kept in the control data block of the measurement data file, instead of the code. Entries for location, order, and remark have a maximum length of 38 characters; the other entries, of 19 characters.

Example of data record in the raw data file:

```
For M5|Adr 15|TO .0402                     |
```

Data record in the table of references DINICODE.TXT:

```
.0402 = Johnson
```

results in the name of the observer Johnson.

**Code .12 -.15 - Staff correction**

With the codes .12-.15, the correction of staff readings with mean staff meter, linear coefficient of extension and staff offset is defined. Calibration data of staffs must be stored into a calibration file named LATTE.CAL (see below).

**Code .12 - Temperature backsight staff**

```
.1215.6 Temperature for backsight staff in °C, in example 15.6 °C
```

**Code .13 - Temperature foresight staff, see code .12**

**Code .14 - Running number backsight staff**

```
.149019 Running number 9019 of backsight staff
```

**Code .15 - Running number foresight staff, see code .14**
Note:
Staff corrections are performed only in the unit of measurement "meters".

Corrections have to be entered before the first measurement to be effective. For the first registration of a code block all entries are necessary. For changing the temperature, the repetition of the staff numbers is not necessary. A re-enter of the staff numbers defined also new the staffs for the sequence B and F.

A temperature value of 0.0 is permitted. Entries of running staff numbers must be identical with entries in the file LATTE.CAL. If the staff number is not found in the file LATTE.CAL, an error message is displayed.

The staff numbers must always be entered in pairs. If another staff is needed in between, it is possible to define a staff for the next and further measurements (see code 16 and 17). The sequence B, F of the staff pair will not be influenced by this.

At stations with even numbers (2, 4, 6 etc.), the backsight staff is changed to foresight staff and the foresight staff to backsight staff. This change is taken into consideration by the program. For this reason, it is not allowed to change staffs during a line levelling. If a levelling ends with a staff different from the starting staff and new levelling starts at that staff, no change of staffs is required.

Reading sequences of the kind DiNi BF FB and the alternating observation sequences of DiNi are processed correctly. For this levelling method, an even number of instrument stations must be observed for each levelling.

For side shots and set-outs, always use the foresight staff for all levelling methods.

Note:
For all precision levellings, an even number of instrument stations should be observed. This eliminates any staff zero error. Additionally, distance sums should be virtually the same for back- and foresights.

Do not delete a complete levelling in the raw data file. First reformat the data, then delete the levelling from the batch file.

Corrections are effective until they are changed. Code block 0 resets all values, i.e. no corrections will be performed after this.

Nigra recognizes the change of sign for measurements with inverse staff. Negative staff readings below the zero point of the staff must be avoided, because the result will be wrong in combination with staff offset.
If the values of temperature, mean staff meter, and coefficient of extension are improbable, for example they have an illegal decimal point, a warning is displayed. Improbable means:

- \( T \) (measurement Temperature): \(< -20 \) or \( > 40 \) °C
- \( m_0 \) (Mean staff meter): \(< -20 \) or \( > 20 \) ppm
- \( \alpha_T \) (Linear coefficient of extension): \(< 0 \) or \( > 1 \) ppm/°C

Formula for correction:

\[
L = l_0 + L' \times [1 + (m_0 + \alpha_T \times (T - T_0)) \times 10^{-6}] + v_G
\]

- \( L \) = corrected staff reading [m]
- \( L' \) = staff reading [m]
- \( l_0 \) = index correction (zero correction) [mm]
- \( v_G \) = graduation correction [mm]
- \( m_0 \) = mean staff meter [ppm]
- \( \alpha_T \) = linear coefficient of extension [ppm/°C]
- \( T_0 \) = reference temperature [°C]
- \( T \) = temperature during the measurement [°C]

The values for \( l_0, m_0, \alpha_T, v_G \) and \( T_0 \) can be taken directly from a current calibration protocol of the testing institutions.

To ensure that the correction of staff readings becomes effective, Nigra transfers the readings into the batch file with 6 decimal places. Independently of this, calculation output is performed with 2 - 5 decimal places, dependent on the parameter of **Decimal places of staff readings**

Values used for the correction are documented in the batch file.

Calibration data from the test report (for example produced by the Technical University of Munich) have to be stored with a text editor in the ASCII file LATTET.CAL in the folder c:\Nigra\TEMPLATES.

c:\Nigra = Nigra installation folder
Format of calibration file LATTE.CAL:

Columns 1-8 running number of staff
10-19 \( \alpha_T \) = Linear coefficient of extension in ppm/°C
20-29 \( m_0 \) = mean staff meter in ppm at reference temperature
30-39 \( T_0 \) = reference temperature for mean staff meter in °C
40-58 any staff description, is not evaluated. Entry is optional.
60-69 \( v_G \), graduation correction in mm
70-79 \( l_0 \), index correction (zero correction) in mm

All values are numerical, except the staff description. The first three lines are only for orientation. Their content may vary but must not be missing. Invalid calibration data can be faded out with an asterisk (*) without deletion from the file. The file can contain a maximum of 500 lines. Example of the file LATTE.CAL:

<table>
<thead>
<tr>
<th>Run.no.</th>
<th>aT[ppm/C]</th>
<th>mo [ppm]</th>
<th>To [°C]</th>
<th>Staff description</th>
<th>vG [mm]</th>
<th>l0 [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>123456789012345678901234567890123456789012345678901234567890</td>
<td>0.59</td>
<td>5.45</td>
<td>24.6</td>
<td>GPCL3 - Nedo</td>
<td>2.0</td>
<td>0.0001</td>
</tr>
<tr>
<td>9019</td>
<td>0.49</td>
<td>-3.45</td>
<td>20.0</td>
<td>GPCL3 - Nedo</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>*9021</td>
<td>0.34</td>
<td>3.45</td>
<td>21.8</td>
<td>GPCL3 - Nedo</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In addition to defining a staff pair with code .12 -.15, it is possible to define a staff for the next and further readings with code .16 and .17.

**Code .16 – Temperature for current staff**

.1623.5 Temperature = 23.5 °C

**Code .17 – Staff number for current staff**

.1733 Staff number = 33 (reading staff correction from file LATTE.CAL)

Code .17 with value 0 switches off the staff correction for the current staff. Afterwards the defined correction with Codes .12 -.15 is valid.

**Code .18 – Direct entry of a staff offset**

.182.5 Staff offset = 2.5

Code .18 with value 0 gives a staff offset of 0 meter. The staff offset will be documented on the right side of the Nigra measurement file.

**Code .19 – Direct entry of a line number**
.191275   Line number = 1275

Code .20 = Direct entry observer

Code .21 = Direct entry level

Code .22 = Direct entry staff

Code .23 = Direct entry weather

Code .24 = Direct entry location

Code .25 = Direct entry location, 2\textsuperscript{nd} part

Code .26 = Direct entry order

Code .27 = Direct entry order, 2\textsuperscript{nd} part

Code .28 = Direct entry comments

Code .29 = Direct entry comments, 2\textsuperscript{nd} part

For all direct entries you can enter a maximum of 18 characters.

The entries for code 19 – 29 will be transferred directly into the measurement file and will not be translated with the help of the file DINICODE.TXT.
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Digital Level Trimble Menu - Section 7

Sample
To conclude this section, a complete protocol of measurement data, including
codes, is presented.
DiNi data in the Rec E-format:
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr
For M5|Adr

1|TO .01001355
|
|
|
|
1|TO .0209-10-2008
|
|
|
|
1|TO Start-Line
BF 9|
|
|
|
2|KD1 123 22
9|
|
|Z
123.45600 m |
3|KD1 123 22 14:33:21 9|Lr
0.94346 m |E
23.577 m |
|
4|KD1
1 22 14:33:32 9|Lv
0.30990 m |E
23.592 m |
|
5|KD1
1 22 14:33:32 9|
|
|Z
124.08956 m |
6|KD1
1 22 14:33:48 9|Lr
1.04343 m |E
21.677 m |
|
7|KD1
2 22 14:33:56 9|Lv
2.14900 m |E
22.492 m |
|
8|KD1
2 22 14:33:56 9|
|
|Z
122.98399 m |
9|TO Repeat measurement
9|
|
|
|
10|KD1
2 22 14:34:16 9|Lv
2.14988 m |E
22.492 m |
|
11|KD1
2 22 14:34:16 9|
|
|Z
122.98311 m |
12|KD1
2 22 14:34:28 9|Lr
0.94346 m |E
33.287 m |
|
13|TO Intcal. Sightings
9|
|
|
|
14|KD1 4401 22 14:34:48 9|Lz
1.60890 m |E
4.592 m |Z
122.31767 m |
15|KD1 4402 22 14:35:01 9|Lz
1.55990 m |E
4.894 m |Z
122.36667 m |
16|TO End of intcal. sight. 9|
|
|
|
17|KD1
3 22 14:35:22 9|Lv
0.30990 m |E
34.592 m |
|
18|KD1
3 22 14:35:22 9|
|
|Z
123.61667 m |
19|KD1
3 22
9|
|dz
0.00133 m |Z
123.61800 m |
20|KD2
3 22 3
9|Sr
78.550 m |Sv
80.670 m |Z
123.61667 m |
21|TO End-Line
9|
|
|
|

Nigra batch file (measurement data):
RMeasurement with DiNi 10
x23456789012345678901234567890123456789012345678901234567890123456789012
x
1
2
3
4
5
6
7
x Distance<--- Back Side
Fore---><--- Point Number --->
HBonn
Location
H
Location
HTest DiNi data
Order
H
Order
H12
Line
H09-10-2008
Date
Hsunny
Weather
HMeyer
Observer
HDiNi 10
Level
HNedo 2345
Staff
H
Comments
H
Comments
H00
2.Col.:0=Side,1=no Side,4=Line, 5=Level Check
*
3.Col.:0=BF,BBFF,2=BFFB,4=BFBF,5=FBBF,4.Col.:a=altern.
H1
Number off staff scales or readings
H0
Scale constant for 2 staff graduations
H2
Difference tolerance for two readings
H1
Staff graduation 1=cm,feet,inches, 0.5=1/2cm
H1
With distances, 1=yes, 0=no
H5
Decimal places for heights in calculations
H5
Decimal places for readings in calculations
E13m
E/Mean value/Error class/Unit of measurement
D
23.58 b0.94346
123
22 14:33:21
D
23.59
f0.30990
1
22 14:33:32
D
21.68 b1.04343
1
22 14:33:48
D
22.49
f2.14988
2
22 14:34:16
D
33.29 b0.94346
2
22 14:34:28
D
4.59
s1.60890
4401
22 14:34:48
D
4.89
s1.55990
4402
22 14:35:01
D
34.59
f0.30990
3
22 14:35:22
E

9
9
9
9
9
9
9
9


Nigra calculation output:

Company xyz
NigraWin - Levelling, Version 5.00 10-10-2010 Page: 1
Job: Sample

Measurement with DiNi 10
Calculation No.: 1
Location Bonn
Order Test DiNi data
Line 12 Date 09-10-2010
Weather sunny Observer Meyer
Level DiNi 10 Staff Nedo 2345
Staff graduation 1 cm Reading sequence BF BF(S)
Comments
Calculation of Mean Values: new - calculated height is inserted

Misclosure = 1.3 mm Max. error E (3) = 3.6 mm

<table>
<thead>
<tr>
<th>Distance</th>
<th>Back</th>
<th>Side</th>
<th>Fore</th>
<th>Height</th>
<th>Point No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.58</td>
<td>0.94346</td>
<td></td>
<td></td>
<td>123.45600</td>
<td>123</td>
</tr>
<tr>
<td>23.59</td>
<td></td>
<td>0.30990</td>
<td></td>
<td>124.08995</td>
<td>1</td>
</tr>
<tr>
<td>21.68</td>
<td>1.04343</td>
<td></td>
<td></td>
<td>124.08995</td>
<td>1</td>
</tr>
<tr>
<td>22.49</td>
<td></td>
<td>2.14988</td>
<td></td>
<td>122.98387</td>
<td>2</td>
</tr>
<tr>
<td>33.29</td>
<td>0.94346</td>
<td></td>
<td></td>
<td>123.61800</td>
<td>3</td>
</tr>
<tr>
<td>4.59</td>
<td>1.60890</td>
<td></td>
<td></td>
<td>122.31871</td>
<td>4401</td>
</tr>
<tr>
<td>4.89</td>
<td>1.55990</td>
<td></td>
<td></td>
<td>122.36771</td>
<td>4402</td>
</tr>
<tr>
<td>34.59</td>
<td></td>
<td>0.30990</td>
<td></td>
<td>123.61800</td>
<td>3</td>
</tr>
</tbody>
</table>

Sum total distances = 159.22 m Delta-H= 0.16067 m
Sum backsight distances = 78.55 m
Sum foresight distances = 80.67 m

Sum of all distances (without side shots) = 159.22 m
Max. misclosure = 1.3 mm (calcul. no. 1)

7.3.4 Format Heights → DiNi Rec E

Creates a file in the Rec E format from points stored in the Nigra height file. This file can be transferred to the DiNi by data transfer (for example fixed heights for connecting points or set-out). The file is named 'job'_FixPt.DAT.

Creation of a Rec E File
At the opening of the dialog box, an existing 'job'_FixPt.DAT file will be overwrit-
ten.

A file is created after the entry of a number From point and a number To point and clicking on OK. This can be repeated with additional point numbers. Click on the Exit button, after all points are written into the .DAT file.

Older DiNi versions (< V 2.0) can not read Y-,X-coordinates. In this case deacti-
vate the Output of X,Y-coordinates check box.

A maximum number of 9999 data records can be stored in one file. Only points with a height value of <> 0 are written into the file. If point numbers comprise more than 8 digits, only the right 8 digits are written. Alphanumeric characters are not deleted from the point number, because the newer DiNi levels also work with alphanumeric point numbers.

Heights are rounded to 5 digits in the current unit of measurement (meters or feet) in the .DAT file.

Example:

For MS|Adr 2|KD1 12399999 | | Z 123.45600 m |

Meaning: data record 2, point number 123, height 123.45600 m, point code 99999.
Default setting for the point code is 99999.

Decomposition of a point number in a point number and a point code

Enter the number of digits for the point code to be generate, for example 5 or -3 (valid values: -5 to 5) at Places for point code. If the point number is to be written unmodified into the Rec file, enter 0.

Places Pcode > 0: Point number is separated into point number + point code
Places Pcode < 0: Point number is separated into point code + point number

All non-numeric characters are removed from the point number beforehand.

Examples:

Nigra point number = 700128.4001
Places point code = 4
generates in Rec E file: point number = 700128
point code = 4001

Nigra point number = 4001*700128
Places point code = -4
generates in Rec E file: point number = 700128
point code = 4001
Ctl$$$xx.cfg-file if using a PCMCIA card

Data transferred to the PCMCIA card needs a corresponding *.cfg file. If the PCMCIA card is in the DiNi and the DiNi is connected directly to the Com interface, the DiNi automatically creates a *.cfg file. If a PCMCIA adapter is used on the PC, the *.cfg file will be missing. For this reason, Nigra automatically creates a ctl$$$50.cfg file, when creating DiNi heights (job'_FixPt.DAT). Copy this *.cfg file in addition to the *.DAT file to the PCMCIA card.

The number 50 in the cfg file is created as default value. It can be changed, if a cfg file with this number already exists on the PCMCIA card.

*Use no signs in the file name, which DiNi doesn't support.*
7.4 Topcon

For the evaluation of data measured with the Topcon series DL-100 digital levels (DL-101, DL-101C, DL-102, DL-102C, in the following named DL-100), follow these steps:

• Transfer raw data to a computer
• Reformat raw data to Nigra format
• Enter heights of connecting points
• Start calculations

The point heights of the raw data file can also be transferred directly into the Nigra height file. It is also possible to create a profile file from raw data.

For the description to the Topcon levels DL-501 (identical with Sokkia SDL1X), DL-502 and DL-503 (identical with Sokkia SDL30 and SDL50) see section for Sokkia.

7.4.1 Topcon DL-100 Raw Data → PC

This activates the program for the transfer of raw data to a PC. If there is no program defined in the Program Configuration, Transfer programs for digital levels, the Nigra implemented data transfer is activated. This enables the data transfer from DL-100 to a PC. Data transfer from PC to the digital level, for example for the transfer of heights, is currently not possible with the DL-101 and DL-102.

The DL-101C und DL-102C levels use a PCMCIA card for data storage. Therefore you need no special data transfer program. The data files will be transferred by the PCMCIA adapter.

Please define the name of the Topcon transfer program in Program Configuration (Options menu), if you want to transfer data utilizing a program from Topcon. Open the program in the Digital Level, Topcon, DL-100 Raw Data → PC menus (instead of the Nigra implemented data transfer). In the latter case, please refer to the manufacturer's program manual.
Data Transfer with the Nigra Interface

Data Transfer DL-100 → PC

First define the serial interface to which the DL-level is connected to the PC. Nigra shows only the available serial ports on your PC.

Then, check the transfer parameters baud rate and parity: The same values must be set on the PC and the DL-100. Furthermore, set Term on the DL-100 to CR/LF On. The transfer parameters on the DL-100 can be adjusted after pressing the SET button in the Set Comm menu.

Note:
In the case of a breakdown of the data transfer, please utilize a special Topcon transfer program.

Data Transfer DL-100 → PC:

Enter any file name with file the extension .TOP for the transfer into the current job folder in the text box below the File name button or choose a file name by clicking on the File name button. It is useful to choose a file name with the current date of measurement, for example 10052008.TOP: measurement on 10-05-2008. If a file with the same name already exists, a dialog box appears and asks: "File exist, overwrite?". Click the "Yes" button to overwrite, or "No" to add data.

Do not define any file extensions which are used by Nigra (.NIG, .MDB, .BER etc.)! It's recommended to use the file extension .TOP.
Follow the instructions in the dialog box, then click on Run. The transferred data are displayed in a screen window. The data transfer can be interrupted on the PC by pressing the [Esc] key or by clicking the Cancel button (do not interrupt on the DL-100!).

7.4.2 Edit Topcon Raw Data

For editing Topcon raw data before reformatting into the Nigra format, for example for the correction of point numbers. A dialog box to select a Topcon raw data file appears.

For editing Topcon raw data a special editor is available from the TOPCOMM program (distributed by Topcon). This is an advantage, because the data are processed here into "readable" form.

7.4.3 Format Topcon DL-100 → Nigra

By activating this menu item, existing DL-100 raw data will be reformatted into special Nigra formats. First, a dialog box for the selection of a Topcon raw data file is displayed.

In case you want to reformat your raw data only in part, perform the reformatting with the characters x and e in the first column of a data record of the raw data file:

x  All data records will be ignored until the next x.
e  End of reformatting, the following data will be ignored.

Single data can be ignored by inserting an asterisk (*) in the first column.

Examples of raw data records in the DL-100 format:

```
b,28,128,7518,+11514500,0808091058,,,,[,
g,28,+145693,+7193,+11660193,3,1,7518,7518,1059,P,
i,28,+143180,+9837,+11517013,3,0,7519,7518,1101,],
```

All data records start with a letter. B and c mark the start of a line levelling, g marks a backsight and i a foresight. Data fields are divided by commas.

Point numbers have a maximum of 8 digits. The date at the start of a line levelling is written automatically into the Nigra measurement file.
The date, registered in the format YYMMDD, is transformed into a format according to the Windows Regional Settings in the Control Panel. The date separators are also inserted into the date correctly.

The number of each measurement and standard deviation of staff readings (in measuring mode multiple measurement) and the time are transferred into the Nigra format from column 62 in the batch file during reformatting, but they are not evaluated further.

**Note:**

*Only the data of a line measurement are transferred. So, always start your levelings with the "Menu Start L". All data until the first appearance of the marks b (observation sequence BF) or c (observation sequence BBFF or BFFB) are ignored during the reformatting process.*

**Start of a levelling:**

\[ b, 28, 128, 7518, +11514500, 0808091058, , , [, \]

**Meanings:**

- **b** = Line measurement with observation sequence BF
- **7518** = Starting-point number
- **+11514500** = Ground height 115.14500

The label t, which marks the end of a levelling, is not evaluated. The end of a levelling is recognized automatically by the start of a new levelling or the end of the file.

**Nigra Formats**

After selection of a raw data file, raw data can be transformed into three different Nigra formats:

- **Measurements**
  
  Transfer of measurement data in the batch file for the execution of calculations.

- **Height file**
  
  Transfer of levelled raw heights of all points in the Nigra height file.

- **Profile**
  
  Creation of an ASCII file (file extension .JOK) for profile plots.
Reformatting of Raw Data

Select one of the described formats for data transfer.

**Format Measurements**

Raw data, supplemented with header data and parameters, are transferred into the Nigra batch file (=measurement file). If you want to change header data, click on the button **Header Data**. Explanations to header data are given in sections 3.2.3 and 8.1.1 of this manual.

Click on the **Parameters** button, if you want to make some changes for parameters. Comprehensive explanations of parameters are given in section 8.1.2.
Definition of Parameters

Header data and parameters can be entered not only manually using the screen masks, but also directly in the field by using code blocks. The use of code blocks will be explained later on in this section.

Observation sequences

**BF:** Normal levelling with side shots or distance levelling. Nigra recognizes the levelling sequence from the characterization in the Topcon raw data.

**CHECK:** Instrument check

**DL-100 aBF:** Alternate measuring method. The characters B (backsight) and F (foresight) give the sequence of permitted measurements.

Topcon levels recognize the observation sequences BF, BBFF, and BFFB. Additionally, side shots can be measured. This also determines whether one or two staff readings are used. However, it is not defined whether the evaluation will be performed as a line or distance levelling (for example for network adjustment).

Activate the button **Evaluation of side shots/turning points** if the heights of side shots and turning points is to be calculated. For the definition of the evaluation method Nigra uses the parameter **Levelling Method**, combined from **Observation sequence** and **Evaluation of side shots/turning points**.

Select the item **BF** in the list box **Observation sequence**, if you have performed a normal levelling.
For observation sequences with 2 staff readings at one station (BBFF and BFFB), the parameter **Staff scale** is set automatically to the value 2, for BF to the value 1. For levellings with 2 staff readings, two readings also must be performed for side shots. If only one measurement exists, a second is added automatically by Nigra. This measurement will be marked in the batch file with "*" at the right.

Side shots are permitted for the observation sequence BF and BBFF only after the backsight or second backsight, for BFFB only after the completed station measurement.

Levellings with the observation sequence BFFB are transferred into the Nigra batch file in the following format:

```
B1
B2
F1
F2
```

For levellings with two staff readings, the **Difference tolerance between scales** must be defined (difference 1\textsuperscript{st} measurement minus 2\textsuperscript{nd} measurement). For all levellings with only one staff reading, the parameters **Scale constant** and **Difference tolerance between scales** are without meaning.

In addition, the following parameters are set to default values:

- **Staff graduation:** 1 (cm)
- **Distances:** yes
- **Scale constant:** 0

**Observation sequence DL-100 aBF (with line levelling BF)**

Is used to realize the observation sequence BF FB on Topcon levels. At all stations, first measure the same staff: At the odd station numbers, first measure the backsight staff; at the even station numbers the foresight staff, respectively. On the DL-100 select line measurement BF.

**Note:**

*The point heights calculated by the DL-100 are not correct from the beginning of the second station.*

Measurements at the even stations are registered in the reverse sequence: first a foresight, registered as backsight, then a backsight, registered as foresight. The point numbers of turning points and the point number of the end-point must be entered, while the DL-100 expects a foresight input. When reformatting into the Nigra format, the readings of the even station numbers are changed as needed.
Measurement data will be transferred into the batch file in the following sequence:

B....
  
F.....

Side shots are not permitted with this levelling method.

For DL-100 aBF, the value K10a is stored in the batch file for levelling method: levelling method 1, observed in sequence BF alternating (=0a). Evaluation is performed as distance levelling.

Recommended measuring mode: multiple measurement

**Example of Data Records for DL-100 aBF**

**DL-100 raw data format:**

```plaintext
b,17,J01,1505,+1000006,0808241952,62255,0204030511061208,,5,
* 1st station
g,17,+11069,+1296,+1001066,,,1505,1505,1954,",
i,17,+21070,+1306,+999999,,,1,1505,1954,C,
* 2nd station
g,17,+31075,+1366,+1000001,,,1,1505,1954,,%
i,17,+31071,+1316,+1000006,,,2,1505,1954,A,
* 3rd station
g,17,+31076,+1376,+1001066,,,2,1505,2000,,$
i,17,+31077,+1386,+1000002,,,3,1505,2001,[],
* 4th station
g,17,+21177,+1386,+1000002,,,3,1505,2002,[],
i,17,+11176,+1376,+1001066,,,4,1505,2003,,$,
* 5th station
g,17,+21276,+1376,+1000002,,,4,1505,2004,,$
i,17,+21277,+1386,+1000002,,,5,1505,2005,[],
* 6th station
g,17,+31277,+1386,+1000002,,,5,1505,2006,[],
i,17,+31276,+1376,+1001066,,,1510,1505,2007,,$,
w,17,J01,101,0808241959,+1,+1,+1596,+1596,+1000001,10,20,X,
t,00,J01,101,0808242007,,,,,,,,,,@,
```
Nigra batch file:

```
HBonn                Location
H                    Location
HMedia project       Order
H                    Order
H12                  Line
H8-24-2008           Date
Hsunny               Weather
HMeyer               Observer
HDL 101              Level
HNedo 2345           Staff
H                    Comments
H                    Comments
H10a                 2.Col.:0=Side,1=no Side,4=Line, 5=Level Check
*                    3.Col.:0=BF,BBFF,2=BFFB,4=BFBF,5=FBBF,4.Col.:a=altern.
H1                   Number off staff scales or readings
H0                   Scale constant for 2 staff graduations
H2                   Difference tolerance for two readings
H1                   Staff graduation 1=cm,feet,inches, 0.5=1/2cm
H1                   With distances, 1=yes, 0=no
H5                   Decimal places for heights in calculations
H5                   Decimal places for readings in calculations
E22m                 E/Mean value/Error class/Unit of measurement
D 12.96 b1.10690     1505                        19:54
D 13.06 f2.10700     1                            19:54
D 13.16 b3.10710     1                            19:58
D 13.66 f3.10750     2                            19:58
D 13.76 b3.10760     2                            20:00
D 13.86 f3.10770     3                            20:01
D 13.76 b1.11760     3                            20:02
D 13.86 f2.11770     4                            20:03
D 13.76 b2.12760     4                            20:04
D 13.86 f2.12770     5                            20:05
D 13.76 b3.12760     5                            20:06
D 13.86 f3.12770     1510                        20:07
E
```

Observation sequence CHECK = instrument check (with line levelling BF, BFFB, BBFF)

Explanations to the measuring methods are given in section 8.1.2.

**Selection of the appropriate levelling method**

For short levellings with simple precision use the observation sequence BF. For high precision levellings only use the BFFB or BF FB levellings to avoid systematic errors (line measurement BF in combination with observation sequence DL-100 aBF).

**Decimal Places**

The parameters *Decimal places for heights* and *Staff readings* have no influence on reformatting of raw data, but on the calculations output.
If all parameters are set correctly and header data are entered, start reformatting by clicking the **Run** button. Data are added to the existing measurement data file (file extension .NIG) of the current job.

Into the Nigra format can be transformed: point number, distance and staff reading (marked as backsight, side shot, foresight). Set-outs are kept as side shots.

Staff readings are kept with all digits. Distances are rounded to 2 decimal places. If the measurement was performed in units of measurement different from the current Nigra unit of measurement, measurement data will be converted automatically.

Before starting a batch file calculation, enter the heights for connecting points (**Heights** menu) and start **Reorganization of calculation numbers** (**Files** menu), if this has not been done automatically.

**Specials Functions**

**Remove free turning points**
Free turning points can be registered with the point number 0 (not available for some Topcon levels). It is also possible to eliminate free turning points like 1, 2, 3, etc. by inputting a higher number in the field **Remove turning point numbers** during reformatting.

**Note:** All measurement points must have a higher number.

**Single staff readings in measuring mode (test measurements):** With this measuring mode, readings are not marked as backsight, side shot, or foresight. Therefore, these data are not suitable for calculations. They will be ignored during reformatting.

**Repeated measurements (REP button):** The repeated measurements are not transferred into the Nigra format.

**Format Height File**

The heights of all points in the raw data, including starting- and end-points, are transferred into the height file. The date (max. 10 characters) and comments (max. 30 characters) are added from the header data. In contrast to the import of ASCII files, the mean value calculation is active. Other parameters, for example levelling method, have no influence.
The default setting of the calculation number is 777777. If the mean value of points was calculated, a mean value calculation protocol is generated in the calculation file (Calculate menu, View Calculations).

**Format Profile**

Creates an ASCII file (file extension .JOK) from point number, distance, and raw height of raw data, as starting file for the profile creation. This file can be displayed and edited in the Profile menu (menu item Edit Profile File). For the profile creation, the length of point numbers is limited to 8 characters. All points with heights are transferred, except the starting- and end-point of a levelling. The levelling must be performed in the mode BF, including side shots.

If a profile file already exists, the question "Profile file exist, overwrite?" appears. Clicking on the "No" button adds new data to the old file, clicking on "Yes" deletes the file and creates a new one.

As an alternative, a profile file can be created from calculation data. Please refer to section 10.1, Create Profile File, also for the format of a profile file.

**Point number extension**

During measurements with DL-100, only 8-digit numerical point numbers can be registered. Because often more than 8 digits are necessary, Nigra handles point number extensions, which are realized during the reformatting Format DL-100 → Nigra. In addition, point numbers of the kind 12.01, 12.02 etc. may be needed. These numbers can also be generated by the Nigra point number extension function from the numerically stored point number in the raw data.

Point number extensions are only displayed if they are activated in the Options menu (menu item Job Configuration).

This kind of point number extension is useful, if all point numbers of a file to be reformatted are to be extended with the same character, for example adding of a movement period. After this, point numbers, which should not be changed, must be set to the original value in the batch file.

With the entry of a character to extend the point numbers and the input position (start at the right), the original point numbers can be extended by any two alphanumeric strings of characters, i.e. insert numbers or letters, add or set them in front.
Examples:
Registered point number = 230
1\textsuperscript{st} string= KD, position from the right = 0 or no entry

\textbf{New point number:} 230KD

Registered point number = 56005
1\textsuperscript{st} string= . (point), position from the right = 3
2\textsuperscript{nd} string= 25, position from the right = 7

\textbf{New point number:} 25560.05

Registered point number = 1
1\textsuperscript{st} string= channel, position from the right = 9

\textbf{New point number:} channel00000001

Point numbers which are created with more than 14 digits by point number extension, are cut off from the left.

\textbf{Note:}
The position from the right in the second string is referred to the point number changed by the first string.

\textbf{Use of Codes for Header Data and Parameters}

If you have stored different levelling methods or different jobs in a raw data file or measured on different days, the allocation of header and control data is not identical. Proceed as described here, and all levellings of a raw data file will have the same header data and parameters.

Using Nigra-specific codes, header data and levelling parameters can already be registered in the field. The input of codes is performed at the begin of a levelling in infos 1 - 3:

\textbf{Note:}
\textit{If no codes are registered, header and control data defined on the screen mask are active.}

The corrections of staff readings with mean staff meter and coefficient of extensions can also be controlled with the codes.
Info 1 - Levelling parameters

abcde:
a = Levelling method (0, 1, 5, 6)
b = Mean value calculation (0-3)
c = Error class (1-4)
d = Decimal places heights (2-5)
e = Decimal places staff reading (2-5)

Explanation of levelling methods:

0 - BF S  Evaluation of side shots and turning points, observation sequences BF, BFFB, BBFF
1 - BF    Only distance levelling, observation sequences BF, BFFB, BBFF
5 - CHECK Instrument check, observation sequences BF, BFFB, BBFF
6 - DL-100 aBF, alternate observation sequence BF

Example of Info 1: 01144,

01144 means: Levelling method 0=BF S, mean value calculation 1=new, error class 1, decimal places for heights and staff readings for the calculation output is 4 in each case.

With the input 99, all control data are resetted to values defined in the screen masks.

Info 2 - Header data

Header data are stored sequentially and encoded in blocks of two in info 2. So, eight values can be defined with a maximum of 16 possible characters. Entered codes are substituted during reformatting into the Nigra format by characters from the table of references DLCODE.TXT.

Column 1-2 - Observer
Column 3-4 - Level
Column 5-6 - Staff
Column 7-8 - Line
Column 9-10 - Weather
Column 11-12 - Location
Column 13-14 - Order
Column 15-16 - Remark

Table of references is an ASCII file named DLCODE.TXT in the folder c:\Nigra\TEMPLATES (c:\Nigra = Nigra installation folder). You can create table of references according to the following format, or change the provided file with your text editor. A maximum of 500 entries is allowed.
The table of references first contains the code number and second, separated by an equal sign, the text to substitute the remark:

04 = Miller (optional text with name of observer which replaces the code)

The optional text after the equal sign is kept in the control data block of the measurement data file, instead of the code. Entries for location, order, and comment have a maximum length of 38 characters, the other entries 19 characters.

Example of data record in the raw data file:

b,28,128,7518,+11514500,0808091058,01144,040103,,[,

Data records in the reference file DLCODE.TXT:

04 = Miller
0001 = DL-102, 742358
000003 = Nedo 2645

Results in: name of observer Miller, level DL-102, 742358, and staff Nedo 2645.

The codes in info 2 can be entered in part. In the example above, missing header data are taken from the screen mask.

Info 3 - Staff correction

With info 3 it is possible to define the correction of staff readings with mean staff meter, coefficient of extensions, and staff constant. Staff calibration data must be stored in a calibration file named LATTE.CAL (see below).

Temperature and staff number must be entered in a distinct format in info 3:

- Column 1-3: Temperature backsight staff, in °C*10
- Column 4-6: Temperature foresight staff, in °C*10
- Column 7-10: Running number of backsight staff
- Column 11-14: Running number of foresight staff

Note:

Staff corrections are only made if unit of measurement is meters.

For the first registration, all entries are necessary. When changing the temperature, only this can be entered during a line levelling.
A re-enter of the staff numbers defined also new the staff s for the sequence B and F.

Corrections have to be entered **before** the first measurement in order to be effective. The entries of the running staff numbers must be identical to the entries in the file LATTE.CAL. If the staff number is not found in the file LATTE.CAL, a message is displayed.

Example of info 3: 18518474127413

Temperature backsight staff:  18.5 °C
Temperature foresight staff:  18.4 °C
Number backsight staff: 7412
Number foresight staff: 7413

At stations with even numbers (2, 4, 6 etc.), the backsight staff is changed to foresight staff and foresight staff to backsight staff. This change is taken into consideration by Nigra. For this reason, a change of staffs is not allowed during a levelling. If a levelling ends with a staff different from the starting staff and new levelling starts at that point, no change of staffs is required.

Reading sequences of the kind DL-100 aBF are processed correctly. For this levelling method, an even number of instrument stations must be observed for each levelling.

For side shots and set-out values, always use the foresight staff for all levelling methods.

**Note:**

*For all precision levellings, an even number of instrument stations should be observed. This eliminates any staff zero error. Additionally, distance sums should be virtually the same for back- and foresights.*

*Do not delete a complete levelling in the raw data file. First reformat the data, then delete the levelling from the batch file.*

Corrections are active until they are changed. Code 99 in info 1 resets all values, i.e. no corrections will be performed after this.

Nigra will take the change of sign for measurements with inverse staff into consideration. Negative staff readings below the zero point of the staff must be avoided, because the result will be wrong in combination with the staff offset.

If values of temperature, mean staff meter, and coefficient of extension are improbable, for example they have an illegal decimal point, a warning is displayed.
Improbable means:

- **T** (measurement Temperature): $< -20$ or $> 40 \, ^\circ C$
- **$m_0$** (Mean staff meter): $< -20$ or $> 20 \, ppm$
- **$\alpha_T$** (Linear coefficient of extension): $< 0$ or $> 1 \, ppm/\circ C$

**Formula for correction:**

$$L = l_0 + L' \times [1 + (m_0 + \alpha_T \times (T - T_0)) \times 10^{-6}] + v_G$$

- $L = \text{corrected staff reading} \ [m]$
- $L' = \text{staff reading} \ [m]$
- $l_0 = \text{index correction (zero correction)} \ [mm]$
- $v_G = \text{graduation correction} \ [mm]$
- $m_0 = \text{mean staff meter} \ [ppm]$
- $\alpha_T = \text{linear coefficient of extension} \ [ppm/\circ C]$
- $T_0 = \text{reference temperature} \ [\circ C]$
- $T = \text{temperature during the measurement} \ [\circ C]$

The values for $l_0, m_0, \alpha_T, v_G$ and $T_0$ can be taken directly from a current calibration protocol of the testing institutions.

To ensure that the corrections of staff readings become effective, Nigra transfers the readings into the batch file with 6 digits. Independent from this, calculation output is performed with 2 - 5 digits, dependent on the parameter of Decimal places of staff readings.

Values used for the corrections are documented in the batch file.

Calibration data from the check protocol (for example produced by the Technical University of Munich) have to be stored with an text editor in the ASCII file LATTE.CAL in the folder c:\Nigra\TEMPLATES.

c:\Nigra = Nigra installation folder.

**Format of calibration file LATTE.CAL:**

Columns 1-8 \ running number of staff
10-19 $\alpha_T = \text{Linear coefficient of extension in ppm/\circ C}$
20-29 $m_0 = \text{mean staff meter in ppm at reference temperature}$
30-39 $T_0 = \text{reference temperature for mean staff meter in \circ C}$
40-58 any staff description, is not evaluated. Entry is optional.
60-69 $v_G = \text{graduation correction in mm}$
70-79 $l_0 = \text{index correction (zero correction) in mm}$
All values are numerical, except the staff description. The first three lines are only for orientation. Their content may vary but must not be missing. Invalid calibration data can be faded out with an asterisk (*) without deletion from the file. The file can contain a maximum of 500 lines. Example of the file LATTE.CAL:

<table>
<thead>
<tr>
<th>Run.no.</th>
<th>aT[ppm/C]</th>
<th>mo [ppm]</th>
<th>To [C]</th>
<th>Staff description</th>
<th>vG [mm]</th>
<th>lo [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1234567890123456789012345678901234567890123456789012345678901234567890123456789</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9019</td>
<td>0.59</td>
<td>5.45</td>
<td>24.6</td>
<td>GPCL3 - Nedo 9019</td>
<td>2.0</td>
<td>0.0001</td>
</tr>
<tr>
<td>9020</td>
<td>0.49</td>
<td>-3.45</td>
<td>20.0</td>
<td>GPCL3 - Nedo 9020</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>*9021</td>
<td>0.34</td>
<td>3.45</td>
<td>21.8</td>
<td>GPCL3 - Nedo 9021</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Example Data**

To conclude this section, a complete protocol of measurement data including code is presented.

**DL-100 raw data:**

```
b,17,J01,11505,+1005506,1005241552,01144,,5,
g,17,+10670,+1376,+1016176,,11505,11505,1552,^,
i,17,+23268,+1286,+992908,,9723,1505,1553,5,
g,97,+15069,+2295,+1020575,,11505,1505,1554",",
i,97,+21070,+2306,+999505,,1,1505,1554,C,
g,17,+32071,+3312,+1031576,,1,1505,1554,A,
k,17,+31062,+1536,+1000514,,77,1505,1555,?,
k,57,+31073,+1535,+1000503,,10002,1505,1556,D,
k,17,+25074,+2546,+1006502,,10003,1505,1556,A,
i,17,+11075,+3466,+1020501,,100,1505,1558,%,
g,17,+21076,+1977,+1041577,,100,1505,1559,$,
i,17,+31077,+1986,+1010500,,2,1505,1600,[,
g,17,+11176,+2176,+1021676,,2,1505,1601,$,
i,17,+21177,+2188,+1000499,,11506,1505,1602,[,
w,17,J01,1506,0808241602,-5007,-
5007,+19706,+19706,+1000499,,x,
t,00,J01,11506,0808241602,,,,@,```
**Nigra batch file:**

RTest file for Topcon data

<table>
<thead>
<tr>
<th>x</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
</table>
| x Distance<--- Back Side Fore---><--- Point Number --->

1. HBad Godesberg Location
2. Location
3. H2. Control Order
4. Order
5. H15/23 Line
6. H05-24-2010 Date
7. Hsunny Weather
8. HMeyer Observer
9. HDL 102, GM0388 Level
10. HNedo 3327 Staff

11. H1 Comments
12. H0 Comments
13. H00 2.Col.:0=Side,1=no Side,4=Line, 5=Level Check
15. H1 Number off staff scales or readings
16. H0 Scale constant for 2 staff graduations
17. H2 Difference tolerance for two readings
18. H1 Staff graduation 1=cm,feet,inches, 0.5=1/2cm
19. H1 With distances, 1=yes, 0=no
20. H4 Decimal places for heights in calculations
21. H4 Decimal places for readings in calculations
22. El1m E/Mean value/Error class/Unit of measurement

| D 22.95 b1.50690 | 11505 | 15:54 |
| D 23.06 f2.10700 | 1 | 15:54 |
| D 33.12 b3.20710 | 1 | 15:54 |
| D 15.35 s3.10730 | 10002 | 15:56 |
| D 25.46 s2.50740 | 10003 | 15:56 |
| D 34.66 f1.10750 | 100 | 15:58 |
| D 19.77 b2.10760 | 100 | 15:59 |
| D 19.86 f3.10770 | 2 | 16:00 |
| D 21.76 b1.11760 | 2 | 16:01 |
| D 21.88 f2.11770 | 11506 | 16:02 |
Calculation output:

Company xyz
NigraWin - Levelling, Version 5.00 05-25-2010 Page: 1
Job: Sample

Test file for Topcon data
Calculation No.: 1
Location Bad Godesberg
Order 2. Control
Line 15/23 Date 05-24-2010
Weather sunny Observer Meyer
Level DL 102, GM0388 Staff Nedo 3327
Staff graduation 1 cm Reading sequence BF BF(S)

Comments
Calculation of Mean Values: new – calculated height is inserted

Misclosure = -1.6 mm Max. error E (1) = 2.9 mm

<table>
<thead>
<tr>
<th>Distance</th>
<th>Back</th>
<th>Side</th>
<th>Fore</th>
<th>Height</th>
<th>Point No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.95</td>
<td>1.5069</td>
<td></td>
<td></td>
<td>100.5506</td>
<td>11505</td>
</tr>
<tr>
<td>23.06</td>
<td></td>
<td>2.1070</td>
<td></td>
<td>99.9501</td>
<td>1</td>
</tr>
<tr>
<td>33.12</td>
<td>3.2071</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.35</td>
<td>3.1073</td>
<td>100.0497</td>
<td>10002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.46</td>
<td>2.5074</td>
<td>100.6496</td>
<td>10003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34.66</td>
<td>1.1075</td>
<td>102.0492</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.77</td>
<td>2.1076</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.86</td>
<td></td>
<td>3.1077</td>
<td>101.0488</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>21.76</td>
<td>1.1176</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.88</td>
<td></td>
<td>2.1177</td>
<td>100.0483</td>
<td>11506</td>
<td></td>
</tr>
</tbody>
</table>

Sum total distances = 197.06 m Delta-H= -0.50070 m
Sum backsight distances = 97.60 m
Sum foresight distances = 99.46 m

Sum of all distances (without side shots) = 197.06 m
Max. misclosure = -1.6 mm (calcul. no. 1)

7.4.4 Format Heights → Topcon Raw Data

Creates a file in the Topcon raw data format from points stored in the Nigra height file. This file can be transferred to the PCMCIA card of DL-101C and DL-102C level (for example fixed heights for connecting points or set-out).

The file is named 'job'.FixPt.TOP and stored in the current job folder. Also a file named COORDI.X will be created. Only the file COORDI.X must be transferred to the PCMCIA card.

Job = current job

The maximum length of a point number is 8 digits. If point numbers comprise more than 8 digits, only the right 8 digits are written. Only the characters -, 0 - 9 and A - Z are permitted. Other characters will be deleted and an error message displayed. Spaces in the Comment data field will be replaced with _.
Heights are rounded to 3, 4 or 5 decimal places in the current unit of measurement (meters or feet).

At the opening of the dialog box, an existing 'job'_FixPt.TOP file will be overwritten.

![Topcon DL-100 Heights in Raw Data Format](image)

**Creation of a Topcon Raw Data File**

A file is created after the entry of a number **From point no.** and a number **To point no.** and clicking on **OK**. This can be repeated with additional point numbers. Click on the **Exit** button after all points are written into the .TOP file.
7.5 SOKKIA/Topcon

7.5.1 SOKKIA SDL1X, Topcon DL-501

Identical to the Sokkia level SDL1X is the Topcon level DL-501. Therefore, the following description applies also to this level.

For the evaluation of data measured with the SOKKIA digital level SDL1X follow these steps:

- Transfer raw data to a computer
- Reformat raw data to Nigra format
- Enter heights of connecting points
- Start calculations

The point heights of the raw data file can also be transferred directly into the Nigra height file.

7.5.1.1 SOKKIA SDL1X Raw data → PC

Normally the raw data will be transmitted from the level to the internal interfaces USB stick or SD card and then copy to the job directory of Nigra:

Softkey Menu, choose Management, Job, Comms output, format CSV_1 or CSV_2, choose Com. locat. (SD, USB), confirm or modify the File ID (=file name), then softkey OK. The data are transmitted in a folder with the name of the job.

If the heights must be transferred, the format CSV_2 is required. For this, the complete job must be transferred.

With the menu item Sokkia SDL raw data → PC the transfer via the serial interface is enabled. For that ist the following description.

The transfer parameters must be the same in Nigra and the SDL1X.

Connect the serial interfaces on the SDL1X and on the PC with the communication cable and choose the available serial interface.

Enter any file name with the file extension .CS1 or .CS2 for the transfer into the current job folder in the text box File name or choose a file name by clicking on
the button on the right. It is useful to choose a file name with the current date of measurement, for example 10052013.CS2: measurement on 10/05/2013. If a file with the same name already exists, a dialog box appears and asks: "File exist, overwrite?". Click the "Yes" button to overwrite, or "No" to add data.

**Do not define any file extensions which are used by Nigra (.NIG, .MDB, .BER etc.)! It's recommended to use the file extension .CS1 or .CS2.**

If all parameters are set correctly, click the OK button. In the field below **Reading data records**, the command **Start data transfer at peripheral device – Waiting for data** appears. Then start on the level the data transfer.

The transferred data are displayed in a screen window. The data transfer can be interrupted on the PC by pressing the Esc key or by clicking the **Cancel** button. Do not interrupt on the SDL1X!

### 7.5.1.2 Edit SDL Raw data

For editing SOKKIA raw data before reformatting into the Nigra format, for example for the correction of point numbers. A dialog box to select a SOKKIA raw data file appears.

### 7.5.1.3 Format SDL → Nigra

By activating this menu item, existing SDL1X raw data will be reformatted into special Nigra formats. First, a dialog box for the selection of a SOKKIA raw data file is displayed.

In case you want to reformat your raw data only in part, perform the reformatting with the characters **x** and **e** in the first column of a data record of the raw data file:

- **x** All data records will be ignored until the next x.
- **e** End of reformatting, the following data will be ignored.
Single data can be ignored by inserting an asterisk (*) in the first column.

Examples of raw data records in the CSV _2 format (measuring mode **Height difference**, measurement procedure **aBFFB**):

```
A01,01,SDL1X Adv,1056-31-25, ,
A20,Job1,0, ,0, , , ,
A10, ,
B01,1,1,SDL1X Adv,100437, , , , , , , ,
B02,1001,1,0.00000,0.00000,4, , , , , , , ,
B20,1,1,1,9,+22.0,11:42:19,08/04/2013, , , , , , , ,
B21,1,100,2.076,0.06895,0.06894, , , , , , , ,
B21,2,101,3.709,0.09710,0.09708,-0.02815,-0.02814,-0.02815, , , , , , , ,
B23,100,0,2.076,0.06895,0.06895, , , , , , , ,
B24,1002,0,3.699,0.11914,-0.05020, ,2, , , , , , , ,
B24,1003,0,3.970,0.06544,0.00351, ,2, , , , , , , ,
B21,1,101,3.711,0.09699,0.09699,-0.02815, , , , , , , ,
B21,2,102,3.741,0.07991,0.07993,0.01708,0.01706,-0.01108, , , , , , , ,
B23,101,0,3.711,0.09699,0.06884, , , , , , , ,
B24,1002,0,3.698,0.11898,-0.05014, ,2, , , , , , , ,
B05,1,102,+22.0,11:49:42,08/04/2013, , , , , , , ,
```

For the evaluation of your levelling with Nigra select on the SDL1X the measuring mode **Height dif.:**

Softkey **Menu**, choose **Management**, choose **Job** (or create a new **Job**), choose existing **Route** or new **Route**, then **Meas., Height dif., Measurement, Start** (and **Start cond.** for a new **Route** (= line)).

For the evaluation later with Nigra, is at the start (and end) benchmark ID and benchmark height nothing to enter.

In case of interruption, the levelling can be continued after restarting of the level.

If a measurement must be repeated, make a new measurement before confirming with **OK**.

For all double measurements the difference between first and second measurement is displayed after completion a station. Should a station to repeat press the **ESC** key, then the station can be measured again - the first measurement is not stored.

**Measurement of intermediate (side shots):** Press the softkey **IM** after completion BF measurements of the station. Return to the measurement line with the **ESC** key.

**Set out:** After completing a station measurement change with the **FUNC** key the softkey, then **S-O** softkey.
Completing a level line (route): **END** softkey. When you start a new levelling (= new line/route), select a new route. Then, if necessary, the measurement procedure can be changed.

The point number has a maximum length of 14 digits in Nigra. If 16 points will be entered on the SDL1X, the point number is reduced on the left.

The data that appear in the Nigra calculation in the head, can be taken mostly from the SDL1X raw data. Nigra takes over from the raw data in the head of the measurement file:

- **Job name (A20) = Order**
- **Level + serial number(B01) = Level**
- **Line/Route (B02) = Line**
- **Measurement procedure (B02) = Measurement procedure (observation sequence)**
- **Input at route, memo 1 + memo 2 (B02) = Comments**
- **Input at start condition, observer (B20) = Observer**
- **Input at start condition, temperature (B20) = Temperature for staff correction**
- **Input at start condition, memo 1 + memo 2 (B20) = Backside staff, foresight staff for staff correction**
- **Date (B20) = Date**
- **Weather, wind (B20) = Weather**

* If the entry starts with "x" (small letter x), the data be taken over from the Nigra dialog header data.

** The date is stored in the SDL1X in the notation MM/DD/YYYY and will be converted in the spelling of the current localization.

*** After completion of a station the temperature can be changed by re-entering the start conditions. The input for the staffs in memo 1 and 2 must not be repeated.

At the next start conditions, the observer is not re-enter. The location name is entered in the header data of the Nigra dialog box.

The observation sequence (measurement procedure) aFBBF is treated as aBFFB. If the observation sequence aFBBF be documented, an entry can be made in the comments data field.

With measuring mode **Meas., Simple meas., Elevation meas.**, only the transfer of heights from the CSV_2 format is possible.

**Nigra Formats**
After selection a raw data file, raw data can be transformed into two different Nigra formats:

- **Measurements** Transfer of measurement data in the batch file for the execution of calculations.
- **Height file** Transfer of levelled raw heights of all points in the Nigra height file.

**Reformatting of Raw Data**

Select one of the described formats for data transfer.

**Format Measurements**

Raw data, supplemented with header data and parameters, are transferred into the Nigra batch file (=measurement file). If you want to change header data, click on the button **Header Data**. Explanations to header data are given in sections 3.2.3 and 8.1.1 of this manual.

Click on the **Parameters** button, if you want to make some changes for parameters. Comprehensive explanations of parameters are given in section 8.1.2.
Definition of Parameters

Select the item **BF** in the list box **Observation sequence**, if you have performed a normal levelling.

For observation sequences with 2 staff readings at one station (BBFF, BFBF, and BFFB), the parameter **Staff scale** is automatically set to the value 2, for BF to the value 1. For levellings with 2 staff readings, two readings must be performed also for side shots. If only one measurement exists, a second is added automatically. This measurement will be marked in the batch file with '*' at the right side.

Side shots (intermediate measurements) are only possible after completion the station measurement.

In addition, the following parameters are set to default values:

- **Staff graduation**: 1 (cm, i.e. ft)
- **Distances**: 1 (=yes)
- **Scale constant**: 0

For levellings with **two** staff readings, the **Diff. tolerance between scales** must be defined (difference 1

For levellings with **one** staff reading, the parameters **Scale constant** and **Diff. tolerance between scales** are meaningless.

Levellings with the observation sequence BFFB or BFBF, aBFFB or aFBBF are transferred into the Nigra batch file in the following format:

B1
Activate the check box **Evaluation of side shots/turning points** if the heights of side shots and turning points should be calculated. Otherwise, only the height difference between the start and end points is calculated.

For the definition of the evaluation method, the parameter **Levelling method**, combined from **Observation sequence** and **Evaluation of side shots/turning points**, is used by Nigra.

**Observation Sequence TEST = Instrument Test (with line measurement BF, BFFB, BFBF, BBFF)**

Explanations to the measurement methods are given in section 8.1.2.

**Decimal Places**

The parameters **Decimal places for heights** and **Decimal places for staff readings** have no influence on the reformatting of raw data, but do so on the later calculation output.

If all parameters are set correctly and the header data are entered, start reformatting by clicking the **Run** button. Data are added to an existing measurement data file (file extension .NIG) of the current job.

Into the Nigra format can be transformed: point number, distance and staff reading (marked as backsight, side shot, foresight). Set-outs are kept as side shots.

Staff readings are kept with all digits. Distances are rounded to 2 decimal places. If the measurement was performed in units different from the Nigra current unit of measurement, measurement data will be converted automatically.

Before starting a batch file calculation, enter the heights for connecting points (**Heights menu**) and start **Reorganize Calculation No.** (**Files** menu), if this has not been done automatically.

**Free turning points** (turning points without numbers): Free turning points can be registered with the point number 0.

Furthermore it is possible to eliminate free turning points like 1, 2, 3, etc. by inputting a higher number in the field **Remove turning point numbers** during reformatting (only effective for format **Measurements**).

**Note:** All measurement points must have a higher number.
**Measurements to ceiling heights:** To measure ceiling heights, the staff must be held inversely (zero point upwards). The SDL1X recognizes the inverse staff automatically and stores the readings with a negative sign.

**Point Number Extension**

Nigra allows point number extensions, which are performed during the reformatting Format SDL → Nigra.

The functions for point number extensions are only displayed if they are activated in the menu item **Job Configuration (Options menu).**

This method of point number extension is useful, if all point numbers of a file to be reformatted are to be extended with the same characters, for example when adding the movement period. After this, point numbers, which are not to be changed, must be set to the original value by editing the batch file.

After the entry of a character for the extension of the point numbers and the position (starting at the right) of entry, the original point numbers can be extended by any two alphanumerical character strings, i.e. insert numbers or letters, add or set before.

**Examples:**

Registered point number= 230  
1st string= KD, position from the right = 0 or no entry  
**New point number:**  230KD

Registered point number= 56005  
1st string= . (point), position from the right = 3  
2nd string= 25, position from the right = 7  
**New point number:**  25560.05

Registered point number= 1  
1st string= Channel, position from the right = 9  
**New point number:**  Channel00000001

Point numbers with more than 14 digits due to point number extensions are cut off from the left.

**Note:**

*The position from the right in the second string refers to the point number changed by the first character string.*

**Note to the unit Feet:**
The SDL1X knows the feet types U.S. Feet and International Feet. Nigra only convert U.S. Feet in meters correctly. Further details can be found in Section 2.3.

**Staff Correction**

Have you entered at **Start cond.** staff numbers in memo 1 and memo 2, these are used to correct the staff readings with mean staff meter, linear coefficient of extension and staff offset. Calibration data of the staffs are to be recorded in a calibration file named LATTE.CAL (see below).

Input Memo 1: backside staff, memo 2: foresight staff. The temperature is also taken out of the starting conditions.

**Note:**

*Staff corrections are performed only in the unit of measurement "meters".*

Corrections have to be entered **before** the first measurement to be effective. For the first registration **all** entries are necessary. For changing the temperature, the repetition of the staff numbers is not necessary. A re-enter of the staff numbers defined also new the staff s for the sequence B and F.

A temperature value of 0.0 is permitted. Entries of running staff numbers must be identical with entries in the file LATTE.CAL. If the staff number is not found in the file LATTE.CAL, an error message is displayed.

At stations with even numbers (2, 4, 6 etc.), the backsight staff is changed to foresight staff and the foresight staff to backsight staff. This change is taken into consideration by the program. For this reason, it is not allowed to change staffs during a line levelling. If a levelling ends with a staff different from the starting staff and new levelling starts at that staff, no change of staffs is required.

Reading sequences of the kind BFFB and the alternating observation sequences are processed correctly. For this levelling method, an even number of instrument stations must be observed for each levelling.

For side shots and set-outs, always use the foresight staff for all levelling methods.

**Note:**

*For all precision levellings, an even number of instrument stations should be observed. This eliminates any staff zero error. Additionally, distance sums should be virtually the same for back- and foresights.*

*Do not delete a complete levelling in the raw data file. First reformat the data, then delete the levelling from the batch file.*

Corrections are effective until they are changed.
Nigra recognizes the change of sign for measurements with inverse staff. Negative staff readings below the zero point of the staff must be avoided, because the result will be wrong in combination with staff offset.

If the values of temperature, mean staff meter, and coefficient of extension are improbable, for example they have an illegal decimal point, a warning is displayed. Improbable means:

- \( T \) (measurement Temperature): \(< -20 \text{ or } > 40 \, ^\circ\text{C} \)
- \( m_0 \) (Mean staff meter): \(< -20 \text{ or } > 20 \, \text{ppm} \)
- \( \alpha_T \) (Linear coefficient of extension): \(< 0 \text{ or } > 1 \, \text{ppm/}^\circ\text{C} \)

Formula for correction:

\[
L = l_0 + L' \times [1 + (m_0 + \alpha_T \times (T - T_0)) \times 10^{-6}] + v_G
\]

- \( L \) = corrected staff reading \([\text{m}]\)
- \( L' \) = staff reading \([\text{m}]\)
- \( l_0 \) = index correction (zero correction) \([\text{mm}]\)
- \( v_G \) = graduation correction \([\text{mm}]\)
- \( m_0 \) = mean staff meter \([\text{ppm}]\)
- \( \alpha_T \) = linear coefficient of extension \([\text{ppm/}^\circ\text{C}]\)
- \( T_0 \) = reference temperature \([\text{}^\circ\text{C}]\)
- \( T \) = temperature during the measurement \([\text{}^\circ\text{C}]\)

The values for \( l_0, m_0, \alpha_T, v_G \) and \( T_0 \) can be taken directly from a current calibration protocol of the testing institutions.

To ensure that the correction of staff readings becomes effective, Nigra transfers the readings into the batch file with 6 decimal places. Independently of this, calculation output is performed with 2 - 5 decimal places, dependent on the parameter of **Decimal places of staff readings**

Values used for the correction are documented in the batch file.

Calibration data from the test report (for example produced by the Technical University of Munich) have to be stored with a text editor in the ASCII file \text{LATTE.CAL} in the folder \text{\textbackslash Nigra\TEMPLATES}.  
c:\Nigra = Nigra installation folder

Format of calibration file LATTE.CAL:

Columns 1-8     running number of staff
10-19          \( \alpha_T \) = Linear coefficient of extension in ppm/\( ^\circ \)C
20-29          \( m_0 \) = mean staff meter in ppm at reference temperature
30-39          \( T_0 \) = reference temperature for mean staff meter in \( ^\circ \)C
40-58          any staff description, is not evaluated.
                Entry is optional.
60-69          \( v_G \), graduation correction in mm
70-79          \( l_0 \), index correction (zero correction) in mm

All values are numerical, except the staff description. The first three lines are only for orientation. Their content may vary but must not be missing. Invalid calibration data can be faded out with an asterisk (*) without deletion from the file. The file can contain a maximum of 500 lines. Example of the file LATTE.CAL:

<table>
<thead>
<tr>
<th>Run.no.</th>
<th>( aT[ppm/\circ C] )</th>
<th>( m_0 [ppm] )</th>
<th>( T_0 [\circ C] )</th>
<th>Staff description</th>
<th>( v_G [mm] )</th>
<th>( l_0 [mm] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>9019</td>
<td>0.59</td>
<td>5.45</td>
<td>24.6</td>
<td>GPCL3 - Nedo 9019</td>
<td>2.0</td>
<td>0.0001</td>
</tr>
<tr>
<td>9020</td>
<td>0.49</td>
<td>-3.45</td>
<td>20.0</td>
<td>GPCL3 - Nedo 9020</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>*9021</td>
<td>0.34</td>
<td>3.45</td>
<td>21.8</td>
<td>GPCL3 - Nedo 9021</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Format Height File**

The heights of all points in the raw data, including start- and end-points, are transferred into the height file. The date and comments (max. 30 characters) are added from the header data. In contrast to the import of ASCII files, the mean value calculation is active. Other parameters, for example levelling method, have no influence.

The default setting of the calculation number is 777777. If the mean value of points was calculated, a mean value calculation protocol is generated in the calculation file (**Calculate** menu, **View Calculations**).
Note on the calculation:
With the SDL1X you can adjust your leveling directly. There are the possibilities:

**Linear** = error distribution according to the number of measurements and
**Weighted** = error distribution is proportional to the length of the distances.

The adjusted heights are stored in a separate route name. Transfer this route as CSV_1 or CSV_2 file and read it into Nigra.

If you compare the calculated heights between Nigra and SDL1X, you will find that the heights of the intermediate points differ depending on the size of the error of closure. The reason is, that Nigra distributed the misclosure to the backsights and foresights and the SDL1X only to the foresights.

Example
To conclude this section, a complete protocol of measurement data and the evaluation is presented.

SDL1X Raw data in CSV_2-Format:

```
A01,01,SDL1X Adv,1056-31-25,,
A20,xJOB1,0,,0,,,
A10,,
B01,1,1,SDL1X Adv,100437,,,,,
B02,1001,1,,0.00000,,0.00000,4,Control Measure,ment,,,,
B20,1,1,9,+22.0,11:42:19,08/04/2013,Meyer II,,,,,
B21,1,100,12.076,1.06895,1.06894,0.00000,,,,
B21,2,101,13.709,1.09710,1.09708,-0.02815,-0.02814,-0.02815,,,,
B23,100,0,12.076,1.06895,1.06895,,,,
B24,1002,0,23.699,1.11914,-0.05020,2,,,,
B24,1003,0,25.970,1.06544,1.00351,2,,,,
B21,1,101,13.711,1.09699,1.09699,-0.02815,,,,
B21,2,102,15.741,1.07991,1.07993,0.01708,0.01706,-0.01108,,,,
B23,101,0,13.711,1.09699,1.06884,,,,
B24,1002,0,8.698,1.11898,-0.05014,2,,,,
B05,1,102,+22.0,11:49:42,08/04/2013,,,,
```
Nigra-Stapeldatei:

RControl Measurement
x234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901
Distance<---- Back Side Fore ---><---- Point Number --->
C1
HSt. Augustin Location
H Location
H20/2013 Order
H Order
H1001 Line
H08/04/2013 Date
HFine, calm wi. Weather
HMeyer II Observer
HSDLIX Adv, 100437 Level
H Staff
HControl Measurement Comments
H Comments
H02a 2.Col.:0=Side, 1=no Side, 4=Line, 5=Level test
* 3.Col.:0=BF, BBFF, 2=BFFB, 4=BFBF, 5=FBBF, 4.Col.:a=altern.
H2 Number of staff scales or readings
H0 Scale constant for 2 staff graduations
H2 Difference tolerance for two readings
H1 Staff graduation 1=cm, feet, inches, 0.5=1/2cm
H1 With distances, 1=yes, 0=no
H4 Decimal places for heights in calculations
H4 Decimal places for readings in calculations
E03m E/Mean value/Error class/Unit of measurement
D 12.08 b1.06895 100
D 12.08 b1.06894 100
D 13.71 f1.09710 101
D 13.71 f1.09708 101
D 23.70 s1.11914 1002
D 23.70 s1.11914 1002 *
D 25.97 s1.06544 1003
D 25.97 s1.06544 1003 *
D 13.71 b1.09699 101
D 13.71 b1.09699 101
D 15.74 f1.07991 102
D 15.74 f1.07993 102
D 8.70 s1.11898 1002
D 8.70 s1.11898 1002 *
E

The location St. Augustin and the order 20/2013 (instead of the job name xJob1) are entered in the Nigra dialog box. Line number, date, weather, level and comments were taken from the raw data.
Calculation Output:

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Job: sample

Control Measurement
Calculation No.: 1
Location         St. Augustin
Order            20/2013
Line             1001                Date 08/04/2013
Weather          Fine, calm wi.      Observer Meyer II
Level            SDL1X Adv, 100437   Staff
Staff graduation 1 cm                Reading sequence BFFB FBBF(SS)
Scale constant   0                   Diff. tolerance 2 [0.1 mm]
Comments         Control Measurement
Calculation of Mean Values: mean value - mean of old and new

Misclosure =  1.3 mm     Max. error E (3) =  2.9 mm

Distance   Back    d   Side    d   Fore    d      Height      Point No.
12.08      1.0690  0        78.7657            100
13.71      1.0971  0        78.7382            101
23.70      1.1191  0/0      78.7158            1002
25.97      1.0654  0/0      78.7695            1003
13.71      1.0970  0        78.7559            102
15.74      1.0799  0/0      78.7165            1002
 8.70      1.1190  0/0      78.7165            1002

Sum total distances     =     55.24 m   Delta-H= -0.01107 m
Sum backsight distances = 25.79 m
Sum foresight distances = 29.45 m

Sum of all distances (without side shots) = 55.24 m
Max. misclosure = 1.3 mm (calcul. no. 1)

Mean Value Report:

Meyer & Bolton
Nigra - Levelling, Version 5.2    08/05/2013    Page: 1
Job: sample
Control Measurement

Report of Calc. Mode for Mean Value

Error limit for repeatedly calculated points = 1 mm
*** = Error limit is exceeded, point with selection '0 - mean value'
     will be stored

Point No.   Diff.H.(mm)     Calculation No. Mean Value Calculation Mode
1002       0.7               1                   0 - mean value
7.5.1.4 *Format Heights → SOKKIA Raw Data*

This creates a file in the SOKKIA CSV_2 raw data format from points stored in the Nigra height file.

The file is named 'job'_FixPt.CS2 and stored in the current job folder.

At the opening of the dialog box, an existing 'job'_FixPt.CS2 file will be overwritten.

![Create SDL1X Raw Data](image)

A file is created after the entry of a number **From point no.** and a number **To point no.** and choosing the option **CSV_2 Format**, then clicking on **OK**. This can be repeated with additional point numbers. Click on the **Exit** button after all points are written into the .CS2 file.

This point data can be imported into SDL1X as follows:

Softkey **Menu**, choose **Management, Job**, choose **Management, Fix point data, Comms input, Location**, then **OK** softkey. Choose the point file and confirm with the **Enter** key.
7.5.2 SOKKIA SDL30/50, Topcon DL-502, DL-503

Note:

Identical to the Sokkia levels SDL30/SDL50 are the Topcon levels DL-502 and DL-503. Therefore, the following description applies also to these levels.

For the evaluation of data measured with the SOKKIA digital level SDL30/SDL50 follow these steps:

- Transfer raw data to a computer
- Reformat raw data to Nigra format
- Enter heights of connecting points
- Start calculations

The point heights of the raw data file can also be transferred directly into the Nigra height file.

7.5.2.1 SOKKIA SDL Raw data → PC

This activates the program for the transfer of raw data to a PC. If there is no program defined in the Program Configuration, Transfer programs for digital levels, the Nigra implemented data transfer is activated. This enables the data transfer from SDL30 to a PC. Data transfer from PC to the digital level, for example for the transfer of heights, is currently not possible with the SDL30.

Please define the name of the SOKKIA transfer program in the Program Configuration (Options menu), if you want to transfer data utilizing a program from SOKKIA. Open the program in the Digital Level, Sokkia, SDL Raw Data → PC menus (instead of the Nigra implemented data transfer). In the latter case, please refer to the manufacturer's program manual.
Data transfer SDL30 → PC

Data Transfer with the Nigra Interface

First, check the transfer parameters baud rate and parity: The same values must be set on the PC and the SDL30. The transfer parameters on the SDL30 can be adjusted in the menu 2, CONFIG, RS-232C.

Connect the serial interfaces on the SDL30 and on the PC with the communication cable and choose the available serial interface.

With the Save parameters button, the transfer parameters are stored in a file. This file receives the file extension .PRF and is stored in the folder c:\Nigra\TEMPLATES. With the Load parameters button you can load this parameters and use it later again.

Note:
In the case of a breakdown of the data transfer, please utilize a special SOKKIA transfer program.
Section 7 - Digital Level SOKKIA Menu

Data Transfer SDL30 → PC:

Enter any file name with the file extension .SDR or .CSV for the transfer into the current job folder in the text box File name button or choose a file name by clicking on the button on the right. It is useful to choose a file name with the current date of measurement, for example 10052010.SDR: measurement on 10/05/2010. If a file with the same name already exists, a dialog box appears and asks: "File exist, overwrite?". Click the "Yes" button to overwrite, or "No" to add data.

Do not define any file extensions which are used by Nigra (.NIG, .MDB, .BER etc.)! It's recommended to use the file extension .SDR or CSV.

If all parameters are set correctly, click the OK button. In the field below Reading data records, the command Start data transfer at peripheral device – Waiting for data appears. Choose in SDL30 Menu 1, Job, Output. After selecting a job the data format must be defined. You have the choice between CSV and SDR2X. Nigra supports both formats. To transfer measurement data, SDR2X is recommended; to transfer only heights, choose CSV.

The transferred data are displayed in a screen window. The data transfer can be interrupted on the PC by pressing the [Esc] key or by clicking the Cancel button (do not interrupt on the SDL30!).

7.5.2.2 Edit SDL Raw Data

For editing SOKKIA raw data before reformatting into the Nigra format, for example for the correction of point numbers. A dialog box to select a SOKKIA raw data file appears.

7.5.2.3 Format SDL → Nigra

By activating this menu item, existing SDL30 raw data will be reformatted into special Nigra formats. First, a dialog box for the selection of a SOKKIA raw data file is displayed.

In case you want to reformat your raw data only in part, perform the reformatting with the characters x and e in the first column of a data record of the raw data file:

x    All data records will be ignored until the next x.
e    End of reformatting, the following data will be ignored.
Single data can be ignored by inserting an asterisk (*) in the first column.

Examples of raw data records in the CSV format (measuring mode **Height**):

```
SDL30m,1203,001857,RCHT4,0,39,,,
0028,5557,1,1,1,21.76,0.8217,170.0000,
0029,5558,1,1,3,19.83,1.1822,169.6395,
0030,5560,1,1,3,18.14,2.4563,168.3654,
0031,5561,1,1,4,21.94,1.7554,169.0663,
```

The 1\(^{st}\) row with the header data:

```
da    b     c     d      e    f  g    h      i
0028,5557,1,1,1,21.76,0.8217,170.0000,
```

- **a** = Level name (SDL30m)
- **b** = Version number (1203)
- **c** = Serial number (001857)
- **d** = Job name (RCHT4)
- **e** = Unit of measurement, 0=m, 1=ft
- **f** = Number of data in the job (39)

From the 2\(^{nd}\) row following measuring data:

```
a    b   c  d  e   f      g      h      i
0028,5557,1,1,1,21.76,0.8217,170.0000,
```

- **a** = Number of data row (0028)
- **b** = Point number, maximum of 4 characters (5557)
- **c** = Back and for, 0=for, 1=back
- **d** = Measuring mode, 0=height difference, 1=height
- **e** = Measuring attribute, 0 =off, 1=back sight (BS), 2=foresight (FS), 3=intermediate (IS), 4=fix point (FIX)
- **f** = Distance (21.76)
- **g** = Staff reading (0.8217)
- **h** = Height difference or height (according to mode at **d**, 170.0000)
- **i** = Manual data input (=K) or nothing for digital measurement

In the CSV format the data fields are separated by commas. Nigra recognizes the CSV format with the characters **SDL30** in the first data row.

The same measurement in the SDR2X format:

```
00NMSDR20   V03-05    Feb-21-08  00:00  113111
61KI5557    170.000000
62LV000001555700000
63LV555721.76000000.82170000BS  0000100001000000.00000000
63LV555819.83000001.18220000IS  0000100000000000.00000000
63LV556018.14000000.25630000IS  0000100000000000.00000000
63LV556121.94000001.75540000FIX  0000100000000000.00000000
```
The SDR2X format is column-oriented. Nigra recognizes this format with the characters SDR2 in the first row.

The 1st row with the header data:

```
00NMSDR20 V03-05 Feb-21-08 00:00 113111
```

Columns 1-2 Type code (00)
Columns 3-4 Derivation code, NM = not measured
Columns 5-20 Version number (SDR20)
Columns 25-40 Date and time
Columns 41 Unit of measurement for angles
Column 42 Unit of measurement for readings and distances, 1=meter, 2=feet
Column 43 Unit of measurement for atmospheric pressure
Column 44 Unit of measurement for temperature
Column 45 Option for coordinate input
Column 46 Reserved (always 1)

Row with measuring data:

```
63LV555721.76000000.82170000BS 0000100001000000.00000000
```

Columns 1-2 Type code (63)
Columns 3-4 Derivation code (LV = levelling data)
Columns 5-8 Point number, maximum of 4 characters (5557)
Columns 9-18 Distance (21.76)
Columns 19-28 Reading (0.8217)
Columns 29-44 Description (BS=backsight)

The SDL30 also uses further codes. These codes are described in the SOKKIA data sheets to the output format of the SDL30.

To observe during levelling:

You can carry out your measurements in the measuring mode **H-Diff** or **Height**. After the measurement of the foresight, press the MENU key and acknowledge the change of the station with **Y**. If you want to finish your levelling, change the measurement code **FS** for foresight to **FIX**.

**Nigra Formats**

After selection a raw data file, raw data can be transformed into two different Nigra formats:

- **Measurements**
  Transfer of measurement data in the batch file for the execution of calculations.

- **Height file**
  Transfer of levelled raw heights of all points in the Nigra height file.
Reformatting of Raw Data

Select one of the described formats for data transfer.

**Format Measurements**

Raw data, supplemented with header data and parameters, are transferred into the Nigra batch file (=measurement file). If you want to change header data, click on the button **Header Data**. Explanations to header data are given in sections 3.2.3 and 8.1.1 of this manual.

Click on the **Parameters** button, if you want to make some changes for parameters. Comprehensive explanations of parameters are given in section 8.1.2.
Definition of Parameters

Observation sequences

**BF**: Normal levelling with side shots or distance levelling.

The SOKKIA levels only recognize the observation sequence BF. Furthermore it is also possible to measure side shots.

Activate the button **Evaluation of side shots/turning points** if the heights of the side shots and turning points are to be calculated, otherwise only the height difference between starting- and end-point will be calculated.

For the definition of the evaluation method Nigra uses the parameter **Levelling Method**, combined from **Observation sequence** and **Evaluation of side shots/turning points**.

Furthermore, the following parameters are always included:

- **Staff graduation**: 1 (cm)
- **Distances**: yes
- **Scale constant**: meaningless

**Observation sequence Check** = **Instrument check (with measurement BF)**

Explanations to the measuring methods are given in section 8.1.2.
Decimal Places

The parameters **Decimal places for heights** and **Staff readings** have no influence on reformatting of raw data, but on the calculations output.

If all parameters are set correctly and header data are entered, start reformatting by clicking the **Run** button. Data are added to the existing measurement data file (file extension .NIG) of the current job.

Into the Nigra format can be transformed: point number, distance and staff reading (marked as backsight, side shot, foresight).

Staff readings are kept with all digits. Distances are rounded to 2 decimal places. If the measurement was performed in units of measurement different from the current Nigra unit of measurement, measurement data will be converted automatically.

Before starting a batch file calculation, enter the heights for connecting points (**Heights** menu) and start **Reorganization of calculation numbers** (**Files** menu), if this has not been done automatically.

Specials Functions

**Leading zeros** will be removed from the point number. The point numbers with a maximum of 4 digits can be extended to 14 digits during reformatting (see later in this chapter).

**Remove free turning points**
Free turning points can be registered with the point number 0. Furthermore it is possible to eliminate free turning points like 1, 2, 3, etc. by inputting a higher number in the field **Remove turning point numbers** during reformatting.

**Note:** All measurement points must have a higher point number!

**Measurements to ceiling heights:** To measure ceiling heights, the staff must be held inversely (zero point upwards). The SDL30 recognizes the inverse staff automatically and stores the readings with a negative sign.

Format Height File

The heights of all points in the raw data, including starting- and end-points, are transferred into the height file. The date (max. 10 characters) and comments (max. 30 characters) are added from the header data. In contrast to the import of ASCII files, the mean value calculation is active. Other parameters, for example levelling method, have no influence.
The default setting of the calculation number is 777777. If the mean value of points was calculated, a mean value calculation protocol is generated in the calculation file (Calculate menu, View Calculations).

**Point Number Extension**

During measurements with SDL30, only 4-digit numerical point numbers can be registered. Because often more than 4 digits are necessary, Nigra allows point number extensions, which are performed during the reformatting Format SDL → Nigra. Sometimes, point numbers like 12.01, 12.02 etc. may be needed. These numbers can also be generated by the Nigra point number extension function from the numerically stored point number in the raw data format.

The functions for point number extensions are only displayed if they are activated in the menu item Job Configuration (Options menu).

This method of point number extension is useful, if all point numbers of a file to be reformatted are to be extended with the same characters, for example when adding the movement period. After this, point numbers, which are not to be changed, must be set to the original value by editing the batch file.

After the entry of a character for the extension of the point numbers and the position (starting at the right) of entry, the original point numbers can be extended by any two alphanumerical character strings, i.e. insert numbers or letters, add or set before.

Examples:

Registered point number= 230
1st string= KD, position from the right = 0 or no entry

**New point number:** 230KD

Registered point number= 56005
1st string= . (point), position from the right = 3
2nd string= 25, position from the right = 7

**New point number:** 25560.05

Registered point number= 1
1st string= Channel, position from the right = 9

**New point number:** Channel00000001

Point numbers with more than 14 digits due to point number extensions are cut off from the left.

**Note:**
The position from the right in the second string refers to the point number changed by the first character string.

Example

To conclude this section, a complete protocol of measurement data and the evaluation is presented.

SDL30 raw data (SDR2X format):

```
00NMSDR20   V03-05    Feb-21-10  00:00  113111
10NMRCHT4
13CPSea level crn: N
13CPC and R crn: N
13CPAtmos crn: N
06NM1.00000000
13JS10000
60LVE       001857100.000000
61KI5557    170.000000
62LV0000155570000
63LV555721.76000000.82170000BS   0000100001000000.00000000
63LV555819.83000001.18220000IS   0000100000000000.00000000
63LV556018.14000002.45630000IS   0000100000000000.00000000
63LV556121.94000001.75540000FIX   0000100000000000.00000000
```
### Nigra batch file:

RTest file for SOKKIA data

<table>
<thead>
<tr>
<th>C1</th>
<th>Location</th>
<th>Side</th>
<th>Fore</th>
<th>Point Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>Location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Order</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Line</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Date</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Weather</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Observer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Staff</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**H1th movement measurement comments**

- 2.Col.: 0 = Side, 1 = no Side, 4 = Line, 5 = Level test
- 3.Col.: 0 = BF, BBFF, 2 = BFFB, 4 = BFBB, 5 = BBFF, 4.Col.: a = altern.
- Number of staff scales or readings
- Scale constant for 2 staff graduations
- Difference tolerance for two readings
- Staff graduation 1 = cm, feet, inches, 0.5 = 1/2 cm
- With distances, 1 = yes, 0 = no
- Decimal places for heights in calculations
- Decimal places for readings in calculations

<table>
<thead>
<tr>
<th>E13m</th>
<th>Mean value/Error class/Unit of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>21.76 b0.82170</td>
</tr>
<tr>
<td>D</td>
<td>19.83 s1.18220</td>
</tr>
<tr>
<td>D</td>
<td>18.14 s2.45630</td>
</tr>
<tr>
<td>D</td>
<td>21.94 f1.75540</td>
</tr>
</tbody>
</table>

E
Calculation output:

Miller & Stanton Company
NigraWin - Levelling, Version 5.00          02-11-2010   Page: 1
Job: sokkia

Test file for SOKKIA data
Calculation No.: 1
Location          Sankt Augustin
Order             Movement Kingston Road
Line              123/99        Date          02-10-2010
Weather           sunny            Observer        Miller
Level             SDL30        Staff          Nedo 1245
Staff graduation  1 cm        Reading sequence BF BF(S)
Comments          1st movement measurement
Calculation of Mean Values: new - calculated height is inserted

Misclosure = 1.7 mm     Max. error E (3) = 2.8 mm

<table>
<thead>
<tr>
<th>Distance</th>
<th>Back</th>
<th>Side</th>
<th>Fore</th>
<th>Height</th>
<th>Point No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.76</td>
<td>0.8217</td>
<td></td>
<td></td>
<td>170.0000</td>
<td>5557</td>
</tr>
<tr>
<td>19.83</td>
<td>1.1822</td>
<td></td>
<td></td>
<td>169.6403</td>
<td>5558</td>
</tr>
<tr>
<td>18.14</td>
<td>2.4563</td>
<td></td>
<td></td>
<td>168.3662</td>
<td>5560</td>
</tr>
<tr>
<td>21.94</td>
<td></td>
<td>1.7554</td>
<td></td>
<td>169.0680</td>
<td>5561</td>
</tr>
</tbody>
</table>

Sum total distances = 43.70 m  Delta-H = -0.93370 m
Sum backsight distances = 21.76 m
Sum foresight distances = 21.94 m

Sum of all distances (without side shots) = 43.70 m
Max. misclosure = 1.7 mm   (calcul. no. 1)

7.5.2.4 Format Heights \(\rightarrow\) SOKKIA Raw Data

This creates a file in the SOKKIA CSV or SDR2X raw data format from points stored in the Nigra height file. The transfer to the SDL30 level is not possible at present (for example fixed heights for connecting points or set-out).

The file is named 'job'_FixPt.xxx and stored in the current job folder.

File extension .xxx = .SDR or .CSV

The maximum length of a point number is 4 digits. If point numbers comprise more than 4 digits, only the right 4 digits are written. Only the characters 0 - 9 are permitted. Other characters will be deleted and an error message displayed.

Heights are rounded to 3, 4 or 5 decimal places in the current unit of measurement (meters or feet).
At the opening of the dialog box, an existing 'job'_FixPt.xxx file will be overwritten.

### Creation of SDL30 Raw Data File

A file is created after the entry of a number **From point no.** and a number **To point no.**, choosing the output format and clicking on **OK**. This can be repeated with additional point numbers. Click on the **Exit** button after all points are written into the output file.
7.6 Terminal - Data Transfer

The Digital Lev menu, menu item Terminal - Data Transfer enables a standard transfer-protocol for peripherals ↔ PC. The function is used to transfer data from and to all peripherals which do not use company-specific transfer protocols.

Data Transfer

Data transfer is possible, for example, from Leica levels NA2002, NA3003 (from device software V 3.2), DNA03, DNA10, Sprinter 100M, 150M, 200M, 250M, Trimble DiNi/Dac E, SOKKIA and Topcon.

Data transfer is not possible, for example, from Leica GIF10, since this device uses company-specific control characters. For data transfer from GIF10, see Digital Level menu, menu item Leica.

Note:
In most cases, the transfer with company-specific control characters is safer and should be the prime selection. First see the Leica, Trimble, Topcon, and SOK-KIA submenus, whether these data transfer protocols can be used.

Click on the menu item Terminal - Data Transfer to transfer data by the Nigra terminal module.
Description of buttons

Transfer direction:
Receive data activated = receive data from peripheral
Send Data activated = send data to peripheral

Filename: Name of file to send or to receive. As a default, the date of the day without file extension is used. Please use the Nigra standard file extensions .NA2, .GSI, .DNA, .DIN, .TOP, SDR etc. for receiving data.

During manual input without drive and path, the file is stored or searched for in the job folder. Clicking the button on the right opens a dialog box for file selection.

Serial interface: Selection of the serial interfaces Com1, Com2,... Com16. Only the available serial interfaces will be shown.

Baud rate: Selection of the baud rate in the range from 110 to 256000. The highest transfer rates are only available if a special hardware is installed.

End mark: CR (carriage return) or CR/LF (carriage return + line feed).

Protocol: None, Xon/Xoff, RTS, Xon/RTS

Transfer format:
Data bits : 4 bis 8
Parity: EVEN, ODD, NONE, MARK and SPACE
If parity NONE is selected, normally the number of data bits must be enhanced by one.
Stop bits: 1, 1.5, 2

Not every peripheral enables all the described settings. Be sure to use identical parameter settings in the Nigra dialog box and at the peripheral. If not all the described parameters can be set on your device, you have to try it out. Please also see the manual of your device manufacturer.

With the Save parameters button, current transfer parameters are stored in a file. This file receives the file extension .PRF and is stored in the folder c:\Nigra\TEMPLATES. The creation of .PRF files is useful, if you are working with more than one device and with different parameters.
If you work with a single device only, the saving of the current transfer parameters is not necessary, since the last setting is loaded automatically (from the job folder).

With the button **Load parameters**, existing .PRF files can be loaded. The name of the current parameter file is shown in the window **Parameter file**. The files LEICANA3.PRF, LEICADNA.PRF (for Leica levels), DiNI.PRF (for Trimble DiNi/Dac E) and SDL30.PRF (for SOKKIA) are supplied with Nigra.

**To receive data:**

If all parameter are set correctly, click the **OK** button. In the field below of **Reading data records**, the command **Start data transfer at peripheral device – Waiting for data** appears.

Now start the data transfer at the peripheral.

**To send data:**

Prepare the peripheral to receive data. Set the parameters in the Nigra dialog box and click the **OK** button.

With the **Cancel** button a current data transfer can be interrupted.

**Example of Leica levels NA2002, NA3003, sending data to PC:**

The digital level must be prepared as follows:

- SET CONFIG KOMM Standard
- SET CONFIG KOMM USER: BAUD 9600, PROTOKOLL none

In the Nigra dialog box:

- **Transfer direction:** receive data
- **Serial interface:** Com1, Com2, ... (as available)
- **Baud rate:** 9600
- **Line terminator:** CR/LF
- **Protocol:** None
- **Data bits:** 7
- **Parity:** EVEN
- **Stop bits:** 1

Click the **OK** button and start data transfer at the level.

The complete file 1 will be transferred. A selection of addresses is not possible.
Note:
After turning the level off and on, PROTOKOLL is set to \textit{with} and must be reset to PROTOKOLL \textit{none} as described. Data transfer from a PC to a level is not available for the Leica levels with this data transfer.

Example of Leica levels DNA03 and DNA10, sending data to a PC:
The digital level must be prepared as follows:
Call the setting menu with the keys \texttt{SHIFT + Prog}. Then choose \textbf{2 All Settings} and afterwards \textbf{3 Communication}. Choose the standard settings Baud rate: 19200, Data bit: 8, Parity: None, CR/LF: CR/LF, Stop bit: 1.

Settings in the Nigra dialog box (or load profile file LEICADNA.PRF):

\begin{tabular}{ll}
Transfer direction: & Receive data \\
Serial interface: & Com1, Com2, ... (as available) \\
Baud rate: & 19200 \\
Line terminator: & CR/LF \\
Protocol: & None \\
Data bits: & 8 \\
Parity: & NONE \\
Stop bits: & 1
\end{tabular}

Then click on the \textbf{OK} button and start the data transfer on the level with the following description:

- Key DATA
- 4 DATA EXPORT
- Target: RS232
- Choose job
- Data: Measurement or fix points
- Form: GSI-8 or GSI-16
- File: -
- Folder: -
- After choosing the menu item EXPORT, the data transfer starts and stops automatically after the last data record is transferred.

To transfer fix points to the level, the data must first be stored on the PCMCIA card and then transferred to the memory of the level with the internal level data transfer.
Example of data transfer with Trimble DiNi/Dac E

Settings at Dac E:
BAUD: 9600
STOP: 1
FORMAT: REC E
PRTCL: XON/OF
PRTY: EVEN
LF: YES

In the Nigra dialog box:
Transfer direction: receive data (or send data)
Serial interface: Com1, Com2, ... (as available)
Baud rate: 9600
Line terminator: CR/LF
Protocol: Xon/Xoff
Data bits: 7
Parity: EVEN
Stop bits: 1

When transferring data to the DiNi/Dac E, an end mark is missing at the end of data transfer by the DiNi/Dac E, and after the time out an error message is displayed. To avoid this, add the line END at the end of the file to be transferred.
8 Options Menu

The Options menu is used to set all program and job parameters.

Program parameters for Nigra users are saved in the Windows user section. So every user has his own parameters. How to do this has been already described in section 2.1.

The Job Configuration is job-specific and valid only in the selected folder. It is stored in the file Projekt.XML. If a new Nigra job is initiated in any folder, all parameters are automatically set to values from the last used job. These values can be modified later, if necessary.

8.1 Job Configuration

With this menu item, a dialog box is activated for the input of header data, parameters, and individual program configuration:
Click on the tab **Header Data, Parameters, Indiv. Configuration**, or **Calendar** of the dialog box to open the desired input mask. Perform all necessary changes and then click on the **OK** or **Exit** button. Now, all changes are stored in the file Projekt.XML. By clicking the **Undo** button, all changes are ignored and the older configuration is shown.

### 8.1.1 Header Data

Header data defined in the input mask are automatically set before the measurement data during the reformatting of digital level raw data. With digital levels, it is also possible to store header data and parameters in info blocks already during the levelling process (see sections 7.1 Leica, 7.3 Trimble, 7.4 Topcon).

**Date**: During the reformatting of raw data, all characters of this field are written into the batch file.

A double-click on the **Date** input box writes the current system date.

**Comment**: During the reformatting of raw data, all characters of this field (a max. of 30) are written into the batch file.

The remaining header data consists of any text, which has no influence on the later evaluation.

The header data together with the parameters form the 21 sentences (=lines) comprising the control data block, which is set before all measurement data.

During a batch file calculation, the present content of this field is without meaning as the comments are taken from the batch file.

For more comprehensive explanations of header data, see section 3.2.3.
8.1.2 Parameters

**Parameters Input**

**Note:**
Parameters defined in the screen masks are only active during the reformatting of digital level raw data. They have no influence on batch file calculations, since these parameters are transferred into the control data block of the batch (=measuring) file. If changes are to be performed afterwards, for example change of the decimal places of calculation output, the respective values in the batch file must be changed.

**Observation sequence**

With this function, the sequence of backsight (B) and foresight (F) readings is selected. Nigra provides the following observation sequences:

- BF
- BFFB
- aBF  (BF alternate)
- Test
- LINE
Additional observation sequences can be selected during the reformatting of digital level raw data (see there).

The levelling method is defined in combination with the button **Evaluation of side shots/turning points**.

Since the definition of levelling methods is not unique in linguistic use, please refer to the following Nigra definitions.

**Levelling with side shots**

Also called line levelling or area levelling.

Select the observation sequence B F and activate the button **Evaluation of side shots/turning points**. Select this levelling method, if heights of side shots and turning points are to be calculated. If side shots are missing, at least the heights of turning points will be calculated.

The levelling is connected to fixed points at the start and the end. Distribution of the misclosure error corresponding to the number of fore- and backsights, or proportional to distances if distances were acquired and the parameter calculation **With distances** was activated.

The combination of characters **BF** defines the sequence of readings for two stations.

<table>
<thead>
<tr>
<th>Staff Scale</th>
<th>Value in Batch File</th>
</tr>
</thead>
<tbody>
<tr>
<td>BF</td>
<td>BBSSFFSS BSFS BSFS 00</td>
</tr>
<tr>
<td>BFFB</td>
<td>BSFS BSFS           02</td>
</tr>
<tr>
<td>aBF</td>
<td>BFS FBS             00a</td>
</tr>
</tbody>
</table>

When measuring with Trimble and Leica digital levels, side shots are permitted also after the measurement of a foresight. This sequence (B F S S ... ) is also evaluated correctly by Nigra.

**Distance levelling**

Levelling from fixed point to fixed point without side shots. Point numbers are entered only for the starting- and end-point. Delta-H and the sum of distances are calculated. This levelling is a pre-evaluation for the Nigra line adjustment or for the creation of a network file for adjustment with Nivnet.
Select any observation sequence BF and deactivate the button **Evaluation of side shots/turning points**.

The combination of the characters **BF** defines the sequence of readings for two stations.

```
  2 staff scale 1 staff scale value in batch file
BF   BBFF BBFF   BF BF   10
BFFB  BFFB BFFB    12
aBF   BBFF FFBB   BF FB   10a
```

**LINE = line adjustment**

In this case, no levelling is acquired, but existing height differences and distances are connected to a levelling line. This levelling method may not confused up with line levelling (=levelling including side shots). During the reformatting of digital level raw data, LINE cannot be selected.

The misclosure is distributed proportional to the distance. If no distances were inputted, the error distribution is performed according to the number of delta-H. Maximum values for input: distances 99999.9, height differences +/- 9999.9999.

Value in batch file: 4

**Test = Instrument test (check)**

The instrument test is performed according to Nääbauer, Förstner, Kukkamäki and 'from the middle' and measured as a distance levelling.

Value in batch file: 5
Procedure according to Näbauer: The level stations are lying outside of the staff stations. The distance $a$ is about 15 m.

Procedure 'from the middle': The first level station is in the middle between the staffs stations A and B. The distance between the staffs is about 30 m. The second level station is near the staff B (distance about 2 m, inside or outside).

Procedure according to Kukkamäki: The first level station is in the middle between the staffs stations A and B. The distance $a$ between the staffs is about 20 m. The second level station is outside from staff B with the distance from $a$. 
**Procedure according to Förstner:** The level stations are in the third points between the staffs stations A and B. The distance between the staffs is about 45 m.

Distances and readings 1 - 4 must be determined according to the figures above in the sequence 1-2-3-4.

The evaluation includes the determination of the theoretical reading for point 4 and, if distances exist, the calculation of maximum admissible distances differences back-fore for an error $\leq 0.05$ mm, the error for line of sight (in radians) and the influence of the line of sight error for $D=20$ m and $D=30$ m (unit of measurement is meters). Values for feet:

$D=60$ ft and 90 ft, error $< 0.15$ [0.001 ft]

For inches:

$D=800$ in and 1200 in, error $< 0.002$ in.

**Formula to calculate the line of sight error:**

\[
\text{line of sight error} = \arctan((a_1-a_2+a_3-a_4)/(d_1-d_2+d_3-d_4))
\]

$a =$ Readings, $d =$ Distances

**Max. admissible distances differences back-fore:** The determined value indicates the difference by which the distances to the staff may vary, so that the effect of the line of sight error does not exceed a value of 0.05 mm (or 0.15 [0.001ft], 0.02 in).
Example:

Calculated maximum admissible distance difference 5 m. Distance for backsight is 25 m, distance for foresight 29 m. Absolute distance difference back-fore is thus 4 m. Because of different target distances, an error is generated, but it is less than 0.05 mm.

Additional Parameters:

With distances

<table>
<thead>
<tr>
<th>value in batch file</th>
<th>activate (with input of distances or evaluation)</th>
<th>inactivate (no input of distances or evaluation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Independent of this parameter, registered distances were stored in the batch file with 2 decimal places during the reformatting of digital level raw data. If the check box With distances is not activated, a calculation without distance proportional error distribution is performed.

Staff scale

<table>
<thead>
<tr>
<th>value in batch file</th>
<th>1 = Levelling with one staff scale</th>
<th>2 = Levelling with two staff scales</th>
</tr>
</thead>
</table>

For the observation sequences BBFF and BFFB, the Staff scale must be set to the value 2.

Levellings with reversed staff (staff turned upside down) and two staggered graduations with scale constant <> 0

With this measuring method, staff readings will be registered with a negative sign. The height difference \( dH \) between two points is calculated with

\[
\frac{(B1+B2)}{2} - \frac{(F1+F2)}{2} \quad \text{and} \quad \frac{(B1+B2)}{2} - \frac{(S1+S2)}{2}
\]

The use of this formula is only correct if all readings of a station are performed with a reversed staff. It is also calculated correctly if, at the entire station, one staff is used with a different staff constant than at the former station. A change of staffs may be necessary, for example if points can be measured only with a shorter staff.

If a measurement is performed at one station once with a normal, then with a reversed staff, this formula can not be used, because the reversion of the staff
would be the same as changing the staff origin. The correct height difference with a reversed staff (readings < 0) is calculated with

\[
\frac{(B1+B2)}{2} + Sc - \left(\frac{(F1+F2)}{2} + Sc\right)
\]

with \(Sc\) = scale constant (absolute value) taken from the Nigra calculation header.

If only the side shot is performed with a reversed staff, the following formula is correct:

\[
dh = \frac{(B1+B2)}{2} - \left(\frac{(S1+S2)}{2} + Sc\right)
\]

Nigra allows an infrequent reversion of the staff. But only that staff may be used in this case, whose staff constant is defined in the calculation header.

**Note:**

*For instrument tests, back- and foresights must be performed with the same staff arrangement.*

**Staff graduation**

<table>
<thead>
<tr>
<th>Value in Batch File</th>
<th>cm</th>
<th>For Levelling Staffs with cm Graduation and Digital Staffs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

**Note:**

*Dependent on the selected unit of measurement, also feet or inches are displayed.*

**Scale constant**

Scale constant has an effect only if two readings for each staff or two staff scales are used.

Default scale constants:

- 0 - normally for digital levels
- 3.0150
- 3.9250 - normally for 2-meters and 1-meters staffs
- 3.0350
- 5.9150
- 5.9250 - normally for 3-meters staffs
- 6.0650
In the input box, any desired scale constant can be defined.

**Difference tolerance between scales**

The tolerated difference between scales is effective only for two readings at each staff or when using a staff with two scales. Differences of the measurement data left-right (1\textsuperscript{st} measurement – 2\textsuperscript{nd} measurement) to the real value of the scale constant in the unit mm/20 (for 1/2-cm staff) or mm/10 (for cm staffs). The given tolerance value may vary between 0 and 100.

Unit for a staff with graduation in feet: 0.0001 ft
Unit for a staff with graduation in inches: 0.01 in

Three asterisks (***') are added to d during the calculation output, if the tolerated difference is exceeded.

This value is also a threshold for the station difference. The station difference is derived from (B1-B2) - (F1-F2) - the same as (B1-F1) - (B2-F2).

**Mean value calculation**

<table>
<thead>
<tr>
<th>mean</th>
<th>new</th>
<th>old</th>
<th>without</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Old and new are meaned</td>
<td>A new height is stored</td>
<td>The older height is kept, new and old are compared.</td>
<td>No saving, no comparison</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

For comprehensive information, see section 3.2.3.

**Error class (order)**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error classes 1 - 4 can be selected.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decimal places for staff readings**

2 - 5 digits for the output of staff readings during calculations.

**Decimal places for heights**

2 - 5 digits for the output of heights and delta-H for distance levellings.

**Note:**
Do not select more digits for the output than are guaranteed by the measurement method.

### 8.1.3 Individual Configuration

Individual project configuration is already explained in section 2.3.

### 8.1.4 Calendar

With the left and right arrows at the top of the calendar you can go forwards and backwards. On the left appears a column with the number of the week.

The button **Current Date** shows the current date. **Search Date** searches for any date between 1-1-1800 and 12-31-9998.

**Notes** opens the file MEMO.TXT to store any memo or comment to your job(s) in the current folder.

### 8.2 Program Configuration

Program configuration is already explained in section 2.1.
9 Movements Menu

Movement measurements are used for the determination of movements or rising or existing buildings. The evaluation comprises the establishment of movement lists, which detect movements since the last and since the first measurement (=total movement).

Movement plots with movement lines over time must be established in addition, if statements are wanted about starting movements (in case the movement measurements did not start directly at the begin of construction) or end movements. In addition, a measurement is easily controlled by movement plots, since improbable results are immediately detected with the graphics.

Movement plots can be supplemented with additional details manually, or with a CAD program. With Nigra, movement lists and movement plots are created directly from data of the height file.

Points for evaluation must be numbered in a special format: the point name consists of the number of the measuring period and a running point number. The length of the running number may vary between 1 and 13 digits. Measuring periods are permitted in the range from 1 to 9999. The format of the point name has to be consistent over the complete evaluation section. The point number has a maximum length of 14 digits, which must not be exceeded.

Examples of numberings:

1150 Length of running number = 3, results in measuring period 1, point number = 150
12GVP347 Length of running number = 6, results in measuring period 12, point number = GVP347

Zeros between the measuring period and running point number are suppressed during the output.
There is no difference between the creation of a point name for movement lists and movement plots. You can create movement lists as well as movement plots from the points of your height file.

**But note the following:**

For the creation of movement lists it is sufficient that *one* point of a measuring period contains the date. For the creation of movement plots *each* point must contain a valid date.

Therefore, it is possible to copy together different movement plots with different numbers of measuring periods, if the first measuring date is identical for every point.

**Tips for the date:**

Larger jobs are normally not measured only in one day, although all points of this measuring period must be marked with the same measuring date. In this case, enter the mean date (to be considered during the evaluation) for **Measuring Date** and the current measuring date for **Comments**.

### 9.1 Create List

![Create Movement List](image)

Creation of Movement Lists
In the fields **From point no.** and **To point no.** enter the numbers of the first point (number including period) and the last point to be evaluated. In the field **Places for running number** (=number of positions without measuring period) enter the length of the running point number. In the following example, lists are created for the points kd0010 – kd0015 of the periods 1 - 5.

If the button **Delete old list** is activated, an existing list will be deleted. Otherwise, the newer list will be added to the older list.

The decimal places of the heights are set with the entry field **Decimals**. A maximum of 5 decimal places are allowed. Decimals of differences are generated according to this setting. Differences are calculated from the rounded heights of the list (to ensure that the list is consistent).

Lists are created in the unit of measurement, set in the current job configuration. Heights are displayed in the units meters, feet, or inches, and differences in the units millimeters, 0.001ft, or inches.

**Threshold for significant differences**

Should the movement list contain only significant changes, you can define a threshold for this. Only if this threshold (define in mm, 0.001 ft or inches) is exceeded, is the calculated difference between two measurements significant.

**Note:** If the threshold is not exceeded, the printed difference is 0.

The default for threshold is 0 – no function.

**Options**

In the **Options** frame, the format of the list is determined. Nigra creates lists for six different evaluation methods:

1. **Normal case** (with AMSL or local heights)
2. **Reduction to a reference point** or
3. **Reduction to a reference height** - for example for the control of horizontally laid crane rail tracts.

**Reference point** button activated: Input of a number for the reference point required (point must exist in the height file).

**Reference height** button activated: Input of a reference height
4. **Reduction to point of origin**, for example for the determination of the tilt behaviour of a building. In the **Height** column of the list, heights are written reduced by the height of the point of origin.

**Point of Origin** button activated: Input of a point number. It makes no difference whether the point number is entered with or without a period of measurement. The point of origin can be any point within the evaluation range. It must exist for all periods of measurement.

In contrast to methods 2 and 3, the point heights are here reduced to the height of the point of origin of a period. That means, relative tilt movements corresponding to the defined point of origin are determined. Changes of the point of origin itself are not considered. This list should therefore only be created in addition to the evaluation performed according to method 1.

5. **Theoretical-actual height** list, the improvement theoretical-actual is calculated. Theoretical heights and actual heights must be inputted with period 1 and period 2, respectively.

6. **Actual–theoretical height** list, the difference between actual-theoretical is calculated. Theoretical heights and actual heights must be inputted with period 1 and period 2, respectively.

**Paper format**

For the selection of portrait or landscape format. The page size allows the use of the paper formats A4 and US letter (8x11 inch).

The default settings for the number of lines per page are:

- Normal list (portrait) 93 lines
- Normal list (landscape) 46 lines
- Theoretical-actual list 69 lines

The values can be modified, if necessary, by the user.

If necessary, the movement list can be extended by a "comment" line in the header. If your list should contain comments, activate the button **List with comments**, and enter the desired text in the field **Text** as title (max. 11 characters). The text for the comments to each period is taken from the field "comment" from the height file of the current job.
For each period, only one comment may be defined. If points, belonging to one period have different comments, only the comment belonging to the lowest point number is evaluated. For this, it is sufficient, as it was for the date, if one point of a period contains the comment.

Compose your comments in such a way that they are meaningful for all points of a period. The maximum number of characters of the comment is dependent on the available space in the list header. For period 1 and period 2 a maximum of 13 and 23 characters is allowed, respectively. For all other periods a maximum of 30 characters is allowed.

In the following example, the movement list is extended by a header line for weather data:

Company xyz
NigraWin - Levelling, Version 4.26
Job: Sample

03-31-2009 Page: 1

Movement list with weather comments

<table>
<thead>
<tr>
<th>Date</th>
<th>07-07-2008</th>
<th>08-08-2008</th>
<th>10-10-2008</th>
<th>11-11-2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather:</td>
<td>sunny, 22 C</td>
<td>Rain, 16 C</td>
<td>changeable, 17 C</td>
<td>sunny, 5 C</td>
</tr>
<tr>
<td></td>
<td>Height AMSL m</td>
<td>Height AMSL m</td>
<td>Height AMSL m</td>
<td>Height AMSL m</td>
</tr>
<tr>
<td></td>
<td>D 2-1 mm</td>
<td></td>
<td>D 3-2 mm</td>
<td></td>
</tr>
<tr>
<td>kd0010</td>
<td>48.513</td>
<td>48.516</td>
<td>3</td>
<td>48.512</td>
</tr>
<tr>
<td>kd0011</td>
<td>48.498</td>
<td>48.514</td>
<td>16</td>
<td>48.519</td>
</tr>
<tr>
<td>kd0012</td>
<td>48.516</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>kd0013</td>
<td>48.520</td>
<td>48.511</td>
<td>1</td>
<td>48.522</td>
</tr>
<tr>
<td>kd0014</td>
<td>48.510</td>
<td>48.516</td>
<td>6</td>
<td>40.516</td>
</tr>
</tbody>
</table>

Additional possible remarks are time or general remarks.

**Print origin**

For movement measurements over a longer period of time usually points are destroyed and new reattached. In order to assess the overall subsidence better, the **Year of origin** or the **Period of origin** can be printed in the left column:
In the above example, the point kd0012 originated in the second period, all others in the first.

Using this option, the length of the running point number is limited to 10 characters.

If each entry is completed, click the OK button for the creation of the list.

The actual height, the difference to the last, and the difference to the first measurement (=original measurement) is outputted. If a point is taken into the observation sequence not at the first, but at a later period of measurement, is this its original measurement.

The date of the list header is taken from the first point of a measuring period containing a date.

The first page of an evaluation contains the periods of measurement 1 - 4. Then pages follow with the periods of measurement 5 - 7, 8 – 10, etc.

Evaluation does not necessarily start at period 1. The differences are determined correctly even if the evaluation is started with a higher period.

Note:
*If the first measuring period is \( \leq 4\), periods 1-3 are also displayed.*
Examples

In the following, some examples of different formats are presented.

The following points were used for the example printouts:

<table>
<thead>
<tr>
<th>Point number</th>
<th>Height</th>
<th>Calc.no.</th>
<th>Diff.</th>
<th>NC</th>
<th>Date</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1kd0010</td>
<td>48.5130</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>07-07-2008</td>
<td>sunny, 22 C</td>
</tr>
<tr>
<td>1kd0011</td>
<td>48.4980</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1kd0012</td>
<td>48.5160</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1kd0014</td>
<td>48.5200</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1kd0015</td>
<td>48.5100</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2kd0010</td>
<td>48.5160</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>08-08-2008</td>
<td>rainy, 16 C</td>
</tr>
<tr>
<td>2kd0011</td>
<td>48.5140</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2kd0013</td>
<td>48.5110</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2kd0014</td>
<td>48.5210</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2kd0015</td>
<td>48.5160</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3kd0010</td>
<td>48.5180</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>10-10-2008</td>
<td>cloudy, 17 C</td>
</tr>
<tr>
<td>3kd0012</td>
<td>48.5190</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3kd0014</td>
<td>48.5220</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3kd0015</td>
<td>48.5160</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4kd0010</td>
<td>48.7030</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>11-11-2008</td>
<td>sunny, 5 C</td>
</tr>
<tr>
<td>4kd0011</td>
<td>48.5110</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4kd0014</td>
<td>48.5230</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4kd0015</td>
<td>48.6140</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Example for Method 1 - Normal Case

Company xyz

NigraWin - Levelling, Version 4.26

Movement list for normal case

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Height AML</td>
<td>Height AML</td>
<td>Height AML</td>
<td>Height AML</td>
</tr>
<tr>
<td></td>
<td>m</td>
<td>m</td>
<td>m</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>D 2-1</td>
<td>D 3-2</td>
<td>D 3-1</td>
<td>D 4-3</td>
</tr>
<tr>
<td></td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1kd0010</td>
<td>48.513</td>
<td>48.514</td>
<td>48.515</td>
<td>48.703</td>
</tr>
<tr>
<td>1kd0011</td>
<td>48.498</td>
<td>48.514</td>
<td>48.515</td>
<td>48.511</td>
</tr>
<tr>
<td>1kd0012</td>
<td>48.516</td>
<td>48.514</td>
<td>48.515</td>
<td>-</td>
</tr>
<tr>
<td>1kd0013</td>
<td>48.511</td>
<td>48.514</td>
<td>48.515</td>
<td>48.523</td>
</tr>
<tr>
<td>1kd0014</td>
<td>48.520</td>
<td>48.521</td>
<td>48.522</td>
<td>48.614</td>
</tr>
</tbody>
</table>

Difference from 1st measurement always refers to first measurement of respective point (D=last-initial measurement)
Difference from measurement n-1 always refers to penultimate measurement (D=last-penultimate measurement)
### Example of Method 2 - Heights Reduced to One Reference Point

**Company xyz**

**Nigrawin - Levelling, Version 4.26**

Job: Sample

Heights Reduced to Reference Point kd0010 with Height 48.513 m

<table>
<thead>
<tr>
<th>Date</th>
<th>07-07-2008</th>
<th>08-08-2008</th>
<th>10-10-2008</th>
<th>11-11-2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Height mm</td>
<td>Height mm</td>
<td>Height mm</td>
<td>Height mm</td>
</tr>
<tr>
<td>kd0010</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>kd0011</td>
<td>-0.015</td>
<td>0.001</td>
<td>0.006</td>
<td>-0.002</td>
</tr>
<tr>
<td>kd0012</td>
<td>0.003</td>
<td>-0.002</td>
<td>0.004</td>
<td>0.010</td>
</tr>
<tr>
<td>kd0013</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.010</td>
</tr>
</tbody>
</table>

Difference from 1st measurement always refers to first measurement of respective point (E-last-initial measurement)
Difference from measurement n-1 always refers to penultimate measurement (D-last-penultimate measurement)

### Example of Method 4 - Heights Reduced to One Point of Origin

**Company xyz**

**Nigrawin - Levelling, Version 4.26**

Job: Sample

Tilting - Heights Reduced to Origin Point kd0010

<table>
<thead>
<tr>
<th>Date</th>
<th>07-07-2008</th>
<th>08-08-2008</th>
<th>10-10-2008</th>
<th>11-11-2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Height mm</td>
<td>Height mm</td>
<td>Height mm</td>
<td>Height mm</td>
</tr>
<tr>
<td>kd0010</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>kd0011</td>
<td>-0.015</td>
<td>-0.002</td>
<td>0.001</td>
<td>-0.192</td>
</tr>
<tr>
<td>kd0012</td>
<td>0.003</td>
<td>-0.005</td>
<td>-0.002</td>
<td>-0.089</td>
</tr>
<tr>
<td>kd0013</td>
<td>0.000</td>
<td>0.000</td>
<td>0.004</td>
<td>-0.150</td>
</tr>
<tr>
<td>kd0014</td>
<td>0.000</td>
<td>0.000</td>
<td>-0.002</td>
<td>-0.009</td>
</tr>
</tbody>
</table>

Attention: List contains only relative height differences - a change of origin point is not taken into account
Difference from 1st measurement always refers to first measurement of respective point (E-last-initial measurement)
Difference from measurement n-1 always refers to penultimate measurement (D-last-penultimate measurement)
Example of Method 5 – Theoretical-Actual Comparison

The example is based on the following heights:

<table>
<thead>
<tr>
<th>Point no.</th>
<th>Height</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>102+1250</td>
<td>48.5130</td>
<td>0 0.0 1 07-07-2007</td>
</tr>
<tr>
<td>102+1275</td>
<td>48.4980</td>
<td>0 0.0 1 07-07-2007</td>
</tr>
<tr>
<td>102+1300</td>
<td>48.5160</td>
<td>0 0.0 1 07-07-2007</td>
</tr>
<tr>
<td>102+1325</td>
<td>48.5200</td>
<td>0 0.0 1 07-07-2007</td>
</tr>
<tr>
<td>102+1350</td>
<td>48.5200</td>
<td>0 0.0 1 07-07-2007</td>
</tr>
<tr>
<td>102+1400</td>
<td>48.5100</td>
<td>0 0.0 1 07-07-2007</td>
</tr>
<tr>
<td>102+1450</td>
<td>48.4800</td>
<td>0 0.0 1</td>
</tr>
<tr>
<td>202+1250</td>
<td>48.5160</td>
<td>0 0.0 1 01-23-2008</td>
</tr>
<tr>
<td>202+1275</td>
<td>48.5140</td>
<td>0 0.0 1 01-23-2008</td>
</tr>
<tr>
<td>202+1300</td>
<td>48.5100</td>
<td>0 0.0 1 01-23-2008</td>
</tr>
<tr>
<td>202+1325</td>
<td>48.5110</td>
<td>0 0.0 1 01-23-2008</td>
</tr>
<tr>
<td>202+1350</td>
<td>48.5210</td>
<td>0 0.0 1 01-23-2008</td>
</tr>
<tr>
<td>202+1400</td>
<td>48.5160</td>
<td>0 0.0 1 01-23-2008</td>
</tr>
<tr>
<td>202+1500</td>
<td>48.5220</td>
<td>0 0.0 1</td>
</tr>
</tbody>
</table>

Theoretical-actual list:

To create this list, enter 102+1250 at From point no. and 202+1500 at To point no. The sign of the improvement results from the difference between the theoretical to the actual heights. In this example, only the theoretical height is present of point 102+1450 and the actual height of point 202+1500.
9.2 View List

To view or edit the created movement list.

Nigra recognizes a movement list by the file extension '.SET'. No lines are shown, when the lists are viewed with the editor. Lines starting with the character "#" contain control data. It is not allowed to delete or change these lines.

Remarks can be entered with the editor outside the "#" characters of a page, if no form feed is produced.

Finds Nigra in the project folder a text file with the name project 'SEL', the content of this file is automatically added as a new page to the movement list. ('project' = name of nigra project)
9.3 Print List

Prints the created movement list. The lines in the list are printed with the menu item Print List and not by printing with the editor. Editor printing is useful for concept prints.

Printing is performed in the currently set font (normally Courier or Courier New). The font size is set automatically by Nigra. Font color, bold or italic are printed. For the landscape format, nothing has to be changed at the printer.

**Print header graphics**: Activate this button if you want to print a header graphic. By activating the button Print header graphics in header line, the upper edge of the graphic is placed right-justified in the first line. The size of the header graphic must then not exceed approx. 2.5 cm x 2.5 cm.

Activate the Print preview button if you do not want to print for the time being, but only want to see a print preview (with header graphic and all lines).

After activating the check box **PDF Format**, a file in the Adobe Acrobat PDF format will also be generated. The file name will be created from the present file name and the file extension PDF, changing SAMPEL.SET to SAMPLE.SET.PDF.

After activating the check box **HTML Format**, a file in the HTML format will also be generated. The file name will be created from the present file name and the file extension HTM, changing SAMPEL.SET to SAMPLE.SET.HTM. The lines are not outputted if a HTML format is generated.
Click on the **Print** or **Print preview** button to start. Click on the **Cancel** button to stop the printout.

**Print Preview of Movement List**

The print preview starts with page 1. To scroll the list use the arrow keys:

To zoom in or out, click on the zoom buttons.

With **Show/hide pages navigation** the display of thumbnails is controlled. With the **Save** button, the list can be saved in various formats.

Click on the **Print** button to send the output to the printer. **Exit** closes the dialog box.

### 9.4 Delete List

Deletes an existing movement list.

### 9.5 Create Movement Plots

Nigra creates movement plots (movement curves over a period of time) in the HP-GL and DXF format directly from the points of the height file.

HP-GL = Hewlett-Packard Graphics Language

DXF = AutoCAD Drawing Exchange Format
HP-GL files can be plotted on every HP-GL compatible plotter, printed on a printer, and displayed on the monitor. In addition, most CAD programs can import DXF files.

The DXF format is the standard exchange format for CAD programs. Your CAD program needs a DXF interface for that. This interface not is always implemented in the standard version of your CAD program. Sometimes it must be additionally purchased.

After the import in your CAD program, diagrams can be modified (line type, color, line width, etc.) or extended with details, for example with company header, etc.

**Note:**
*When importing DXF files into a CAD program, it is possible that the line type and layer are not transmitted correctly.*

In most cases it is sufficient to create movement curves in the A4 or A paper format. Program routines are designed in such a way that the creation and output in these formats is performed nearly automatically.

**Movement Diagram**

For each point, a single plotting file is created. The file names are formed automatically from the point number and file extensions .HPG (HP-GL format) and .DXF (DXF format). If the point number contains characters, which are not permitted in file names, characters are substituted by "#".
Characters not permitted for the file name are: / \ : * ? " < > |

Example of the creation of a file name, evaluation of points 1kd0010 - 10kd0015 (1-10 = measuring periods):

File name:  
- kd0010.HPG respectively kd0010.DXF
- kd0011.HPG respectively kd0011.DXF
- kd0012.HPG respectively kd0012.DXF
- kd0013.HPG respectively kd0014.DXF
- kd0014.HPG respectively kd0014.DXF
- kd0015.HPG respectively kd0015.DXF

Point number -2.14 generates the file -2#14.HPG and -2#14.DXF, respectively. Existing files with identical names will be overwritten.

The appearance of movement plots can be influenced by parameters:

![Creation of Movement Plots](image)

Creation of Movement Plots

Enter in the field **From number** the number of the first point to evaluate (number including period), in the field **To number**, the number of the last point to evaluate, and in the field **Places for running no.** (=number of positions without measuring period) the length of the running point number.

**HP-GL formats**

**HP-GL**: if you use a HP-GL plotter
**HP-GL/2:** if you use a HP-GL/2 plotter

**Font:** for a country-specific adaptation select one of the following fonts:

ANSI US/ASCII
German
French F1
French F2
Italian
English
Spanish
Portuguese
Norwegian F1
Norwegian F2
Swedish
Swedish names
Intern. ref. vers.
JIS ASCII

**Without umlauts** (check box is displayed only in connection with a German font): Activate this check box, if your printer does not recognize umlauts. All umlauts and special characters are converted, for example ö in oe and ß in ss.

**DXF formats**

**Create DXF format:** If this check box is activated, the DXF format is generated in addition to the HP-GL format.

**All in one DXF file:** If this check box is activated, all DXF plots are written one beneath the other in one file. The file name is formed of the number of the first point. So, all movement plots can be transferred into the CAD program with a single command.

**OEM font:** Activate this check box, if German 'umlauts' are not shown correctly.

**Plot axis system + labelling:** if the check box is activated, the time- (=zero axis) and movement axis are drawn. In addition, the date of measurement, header line (including point number and starting height), and feeter are written.
Labelling of movement axis:

Dependent on the selected height scale, labelling is performed in steps of one, two, five or ten millimeters (respectively 0.001 ft or 0.1 in).

Date: If closely following dates would overwrite each other, they will be omitted.

If the button is inactive, only the movement line is drawn. This is convenient if the evaluation is to be merged with one (or more) additional file(s).

The point number is written at the end of the movement line.

**Time period (in years)**

Approximate period of movement measurements. Defines the scale for the presented period, in combination with the length of time axis (= zero axis)

\[ \text{time scale} = \frac{\text{length of time axis (cm/ft/in)}}{\text{period (years)}} \]

If movement lines are to be presented or drawn for multiple points, identical entries are necessary for the evaluation period and length time axis for all points. In addition, the measuring date of the first measuring period must be identical for all evaluations.

**Time axis length (=zero axis) in cm/ft/in**

Defines the length of the time axis. For A/A4 paper in landscape format, enter approx. 22 cm (0.72 ft, 8.7 in).

**Scale for movement axis  1:**

Defines the scale for the movement axis. For a movement and for a rise, a maximum of 8 cm (0.26 ft, 3.1 in) and 5 cm (0.16 ft, 2.0 in) are available.

Examples:

Entry 1 = representation of movements in original scale 1:1, 1 mm movement means 1 mm in the plot. A maximum of 80 mm movement can be presented.

Entry 0.5 = representation in double zoom, i.e. scale 2:1. A maximum of 40 mm movement can be presented.

If the movement line is higher or lower than the bar scale, please change the scale.
Reference height

For the entry 0 heights are reduced to the point height of the first measuring period to be evaluated. The movement line, in this case, starts at the point of origin.

If a special reference height is entered, all heights will be reduced to this height. Herewith, for example differences to a theoretical height can be determined. If movement differences get too large because of a carelessly selected reference height, and are not representable in the selected scale, an error message is displayed.

Plotting pitch (in mm or dots/inch)

Unit of measurement is meters:
Most plotters work with a plotter step size of 0.025 mm (=1016 dots/inch). If your plotter uses a different plotter step size, enter the appropriate plotter step size here. The plotter step size may only marginally deviate from 0.025, because otherwise the labelling will have an unfavourable ratio to the lines. If the entry is 0, the value 0.025 is used automatically.

Unit of measurement is feet or inches:
Plotter step size must be set to dots/inch. The default value is 1016 dots/inch. If the entry is 0, the value 1016 is used automatically.

Line type (0-6)

Defines the line type for the representation of the movement curve. With line type 0 a solid line is generated.

Overview:

<table>
<thead>
<tr>
<th>Line Type</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>---------------</td>
</tr>
<tr>
<td>2</td>
<td>-------------</td>
</tr>
<tr>
<td>3</td>
<td>- - - - - - -</td>
</tr>
<tr>
<td>4</td>
<td>- - - - - - -</td>
</tr>
<tr>
<td>5</td>
<td>- - - - - - -</td>
</tr>
<tr>
<td>6</td>
<td>- - - - - - -</td>
</tr>
</tbody>
</table>
Pen no./layer (1-255)

Here, a maximum of 255 different pens (HP-GL format) or layers (=layers in the DXF format) can be defined. Do not enter a pen number higher than the number of pens of your plotter. For printing and viewing of diagrams with Nigra, pen numbers represent the following colors:

- Pen 1 = black
- Pen 2 = red
- Pen 3 = green
- Pen 4 = yellow
- Pen 5 = magenta
- Pen 6 = cyan
- Pen 7 = blue
- Pen 8 = grey
- Pen 9-255 = black

The line type may not be transferred correctly during the import of the DXF file into your CAD program.

Text for feeter

Text entered here (for example name of location, job) is printed as feeter.

Evaluate time

With several movement measurements on the same day, it is possible to evaluate the time, which is stored in the field Comment of the Nigra Database. Valid time formats are:

- 8:30
- 8:30 h
- 8.30

The time is evaluated as fraction of a 24 h day. For days without information about time, the time is interpreted as 0:00. As a rule the Time period (in years) must be set to a fraction of a year.

By clicking the OK button, the creation of movement plots is initiated.

In contrast to the creation of movement lists, where only one point of a measuring period must contain a date, here all points must contain a valid date in the format MM-DD-YYYY. Example: 07-04-2002.
Note:
Nigra recognizes all date formats which are valid in Windows Regional Settings in the Control Panel. The date format used must be identical to the format set in Windows Regional Settings.

9.6 View/Print Movement Plots
After the input of point numbers From point – To point, movement plots (in the HP-GL format) are shown on the monitor or print to a printer. The numbers to enter correspond to the file names (enter without file extension .HPG).

For the display of one diagram, no entry for To point is necessary.

Is Merge movement plots activated, only one movement plot may contain axis system and labeling.

With activating PDF format, the diagrams will be created additionally in PDF format. The file has the name of the first movement plot with the file extension .PDF, for example 146.hpg.pdf.

The Print preview button opens the print preview. Print preview Ex opens an alternative print preview, with the exports in various formats are available.

With Print the diagrams will be printed with the printer.
It can only be printed diagrams that do not exceed the maximum available size of the printer paper.

With the button **Printer settings** a printer and paper size can be selected. Font and font size are set by Nigra and can not be changed. Nigra also automatically considered portrait or landscape format.

**Print Preview (standard)**

If you have selected more than one diagram, you can scroll back or forward by clicking on **Page**. To zoom in or out, click on the magnifying glass. By clicking on the Print button, all loaded moving diagrams will be printed in full scale.

End the display of movement plots by clicking **Close**.
Print Preview Ex

Three Movement Plots in one Output

The button **Print preview Ex** opens an alternative print preview.

In the example above, the movement diagrams for the points 147 and 148 are created without axis system and labelling and in a different color and line type.

If you have selected more than one diagram, you can scroll page by clicking on the arrow buttons. To zoom in or out, click on the zoom buttons. By clicking on the **Print** button, all loaded diagrams will be printed slightly reduced.

With **Show/hide pages navigation** the display of thumbnails is controlled. With the **Save** button, the diagrams can be saved in various formats.

End the display of movement plots by clicking **Exit**.
9.7 View Error List

An error in the date leads to the termination of the evaluation of the points. Any errors which may have occurred are written into the file 'job'.SER and can be viewed with this menu item.

An error message is also displayed, if the movement differences exceed the selected paper size, for example the reference height is entered incorrect, or the scale selected is incorrect.

9.8 Creating Replacement Points

If the movements of demolished points should be continued to be followed, this happens, as a rule, by fixing a replacement point near the demolished point. With this function Nigra takes over the heights of all measurements from the original point to the replacement point.

If it is possible to level the replacement point and original at the same time, then both points have the same measurement period. If the original point is demolished upon determination of the replacement point, the last measurement of the original point can be chosen for transition to the replacement point.

Note:

The measurement period of the replacement point must be equal or higher than the measurement period of the original point.

In the dialog box above, the replacement point 505 was first measured in the 4th measurement period. The original point 502 still existed at this measurement. The heights of point 502 from all four measurement periods are stored in the height database, of point 505 only the height of measurement period four is stored. From
the height difference of the points 400505 – 400502 and the heights of the points 100502, 200502 and 300502, the heights of the new points 100505, 200505 and 300505 are derived. The heights of the original point are not altered or deleted.

If many replacement points are to be created, it is wise to generate a text file which contains all the point numbers. Click on the Select Point List button to choose a text file. The text file can be created with the Nigra text editor.

The text file has the following format:

```
5              5
400201         400202
400502         400505
```

1st line:
Columns 1-14 contain the length of running number of the original points, 16-29 contain the length of running number of the replacement points

From the 2nd line of the point list:
Columns 1-14 contain number of original points, 16-29 the number of replacement points.
10 Profiles Menu

Nigra nearly automatically creates plot files from your levellings including side shots (but also from X,Y,Z-coordinates) for longitudinal and cross sections in all scales and for all paper sizes in the HP-GL and DXF format, and calculates the areas of profiles.

HP-GL = Hewlett-Packard Graphics Language
DXF = AutoCAD Drawing Exchange Format

HP-GL files can be plotted on every HP-GL compatible plotter, printed on a printer, and displayed on the monitor.

Nigra allows the creation of profiles with a lot of individually selectable options. But, because of a variety of profile types, sometimes retouching is necessary. In this case, use the DXF format, as it can be imported by most CAD programs. The DXF format is the standard exchange format for CAD programs. Your CAD program therefore needs a DXF interface.

After the import into your CAD program, profiles can be modified (line type, color, line width, etc.) or completed with details, for example with a special company header, etc.

How to Create Profiles from Levellings with Nigra

First perform a levelling including side shots, for all your profile points. Here, the instrument station should be located in the profile or in the profile extension. Also, points must be numbered with a distinct code (explanations follow).

Then perform the reformatting of measurement data into the Nigra format (Digital Level menu).
With the menu item **Create Profile File**, a normal batch file calculation is performed (the heights for connecting points must be entered first), and at the same time, a file named 'job'.JOK is created. This file, named **profile file** by Nigra, will be required for the creation of plot files in the HP-GL or DXF format. With these data, the plot file is created in the HP-GL and DXF format, respectively, by selecting the menu item **Create Profile**.

Another possibility is the creation of profiles from any formatted X,Y,Z-ASCII files of your tacheometric survey. How to create profiles from these files is explained in the section **Create Profiles from X,Y,Z-Coordinates**.

### 10.1 Create Profile File

#### 10.1.1 Profiles from Levellings

**Encoding of the Point Mark**

The point marks of a levelling has a special significance for the creation of the profile files of levellings, since the information left/right (-/+), point of origin of profile, running profile number, and running point number of the profile are derived from the point mark.

The point marks for profile points must be inputted with at least 5 alphanumeric positions (no decimal point!). Points with less than 5 positions in the point mark are not transferred to the profile file. Point marks with 5-7 positions are extended to 8 positions by adding zeros.

\[
\text{Code} < \text{Profile} > < \text{Run. Point No.} > \\
1 2 3 4 5 6 7 8
\]

The first position of an 8-digit point mark (viewed from the left) contains the situation code:

0 = point is to the right of the instrument station, station in the profile or in the profile extension.

1 = point is to the left of the instrument station (distance gets a negative sign), station in the profile or in the profile extension.

2 = point was measured by an instrument station outside of the profile axis. Distance is set to the value 0.000 during the creation of the profile file. The real distance in the profile must be determined elsewhere and added with an editor.

3 = no profile point (is not transferred into the profile file).
The definitions "left" and "right" refer to the orientation of the profile plot.

The profile number (from 001 to 999) is entered in the positions 2 - 4, the running number in the profile in the positions 5 - 8.

If the point of origin of the profile is not at the left, but at a different point, enter the running point number 0000 or 5000 for that point. During the creation of the plot file, all distances are reduced to that point. In all other cases, the point with the lowest distance value is used as point of origin for the station.

Note: 
The first position of the 8-digit point mark only serves for the encoding of the situation and is not transferred into the profile file or the calculation output. Also this position is deleted during the saving of heights in the height file.

Examples of a point mark:

00010001  Point is to the right of the station, profile number 001, running point number 0001
10001  same number as preceded line

10960000  Point is to the left of the station (distance is negative), profile number 096, running point number 0000, i.e., during the profile output, all distances are reduced to that point

29990013  Point was measured outside the profile, distance is transferred into the profile file as 0.000 and must be corrected with an editor, profile number 999, running point number in profile 0013.

With Create Profile File, a batch file calculation is started and at the same time, an ASCII-file named 'job'.JOK is created, which serves as starting file for the creation of a profile with the menu item Create Profile.
If a profile file already exists, the question "Overwrite existing profile file?" is displayed. By clicking the "No" button data are added to the old file; clicking on "Yes" deletes the existing file and creates a new one.

The selection of the range to be calculated is done by entering the calculation numbers from - to. Data (point number, distance, and height) are transferred into the profile file only from levellings with side shots. With the exception of the starting-point and end-point, all side shots and turning points (including the distance to the foresight) are transferred together with their point numbers (at least 5 positions).

After the end of calculations the following profile file is, for example, created:

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>1234567890123456789012345678901234567890123456789012345678901234567890</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profile&gt;</td>
<td>P-no. Distance/Y</td>
<td>X</td>
<td>Height/Z</td>
<td></td>
</tr>
<tr>
<td>50002</td>
<td>8.500</td>
<td></td>
<td>50.639 /S100.</td>
<td></td>
</tr>
<tr>
<td>50003</td>
<td>0.000</td>
<td></td>
<td>50.640</td>
<td></td>
</tr>
<tr>
<td>50004</td>
<td>10.120</td>
<td></td>
<td>51.902</td>
<td></td>
</tr>
<tr>
<td>50005</td>
<td>-3.560</td>
<td></td>
<td>51.903</td>
<td></td>
</tr>
<tr>
<td>160000</td>
<td>3.150</td>
<td></td>
<td>63.530</td>
<td></td>
</tr>
<tr>
<td>160001</td>
<td>-15.000</td>
<td></td>
<td>63.529</td>
<td></td>
</tr>
<tr>
<td>160002</td>
<td>5.000</td>
<td></td>
<td>45.616</td>
<td></td>
</tr>
<tr>
<td>5050002</td>
<td>0.000</td>
<td></td>
<td>53.430</td>
<td></td>
</tr>
<tr>
<td>5050005</td>
<td>5.060</td>
<td></td>
<td>53.529</td>
<td></td>
</tr>
<tr>
<td>5050008</td>
<td>12.120</td>
<td></td>
<td>55.616</td>
<td></td>
</tr>
</tbody>
</table>

Lines 1 and 2 with column designations only serve as orientation and are not part of the file. The end of the file is marked by a zero in column 19. The zero line is optional and can be missing for self-created profile files.
Columns 13-19  Point mark (13-15 profile number, 16-19 running point number in profile)
Columns 21-31  Distance in profile, Y-coordinate
Columns 33-43  Without content, X-coordinate
Columns 44-53  Height, Z-coordinate
From column 54 Optional parameter for stations (/S) and text (/T)

Point numbers, distances, and heights are taken from the batch calculations. The observation sequence of levelling is free, since the file is sorted automatically according to ascending profiles and running point numbers.

Stations and texts can be defined with optional parameters. These parameters can not created automatically. They must be added manually with an editor. In the preceding example, the starting station 100.000 is defined for profile 5 with /S100.

Recognized errors (for example point number too long, point number not numerical) are marked with *** and written at the end of the profile file. Remove these errors, before starting the plot creation.

Profile files can also be created directly from digital level raw data (see Digital Level menu, menu item Format Leica GSI → Nigra, Format DiNi Rec E → Nigra, Format DL-100 → Nigra).

10.1.2 Creating Profiles from X,Y,Z-Coordinates
Nigra also creates profiles from the X,Y,Z-coordinates of your tacheometric survey. In the described profile file, additional X,Y,Z-coordinates can be added in the same format with an editor (menu item Edit Profile File).

As an alternative, it is possible to process X,Y,Z-coordinates of any format in a distinct file. This is demonstrated, for example, with the following file xyz.jok:

```
12345678901234567890123456789012345678901234567890
                      1    2    3    4    5
  z    x      P-no  y            
1002.012  5622136.800  2000100  2574010.500  /S1000.000
1002.485  5622132.660  2000101  2574014.100
1001.004  5622130.400  2000102  2574020.780
1001.003  5622126.015  2000103  2574026.800
1001.850  5622119.800  2000104  2574030.800
1002.245  5622117.500  2000106  2574035.100
1003.001  5622116.350  2000205  2574036.550
1002.012  5622136.800  2010001  2574010.500
1002.485  5622132.660  2010101  2574014.100
1001.004  5622130.400  2015000  2574020.780
```
1001.003      5622126.015   2010103  2574026.800  
1001.850      5622119.800   2010104  2574030.800  
1002.245      5622117.500   2010106  2574035.100  
1003.001      5622116.350   2019999  2574036.550

Remark:
First two lines containing the column designations are not part of the file.

The file with the coordinates must be in the ASCII format. First, start an own job for this file, xyz in the example. Name the coordinate file with your job name and with the file extension .JOK, for example xyz.jok. Then copy your coordinate file into the appropriate job folder, for example in the folder c:\Nigra\miller. Add a first line with any entry (for example see above z x .....), if this line is missing in your original file.

Point marks consist of a profile number with a maximum of 3 digits and a 4-digit running point number, which is the same as it was for a profile file created of levelling data. The first and the last point of a profile define the transformation axis: All other points of the profile in question will be transformed to this axis for the determination of distances.

No sorting by running point numbers (except starting-point and end-point of the profile) is necessary, but only by profiles. If you create a sorted coordinate file with your survey program, you should number the points with the following mode, in order to avoid a manual resorting:

Left profile point → lowest running number, e.g. 1
Right profile point → highest running number, e.g. 9999
Reduction point → 5000 (may be missing)

Distances are reduced to the first (=left) profile point or the point with running number 5000 (for example view profile 201) during plot file creation. If the profile point of origin is to the right, enter 5000 for the number of the last (=right) profile point.

While cross sections normally start with station 0.000, longitudinal sections mostly have continued stations. For this, it is necessary to determine a station different from zero for the starting-point of the profile. This can be done by entering the station with the first profile point and the characters "/S".

The transformation of the side distances of the profile intermediate points is written into the general calculation file as the proof of straightness, together with a feet point calculation. The protocol can be viewed with the menu item View
Calculation in the Calculate menu. The decimal points correspond to the defined when creating the profile decimal places for the Station and Height.

Before starting the creation of the plot file in the HP-GL or DXF format with the menu item Create Profile, please fill in the text box Columns point no./Y/X/Z (columns from-to) in the dialog box for profile creation. Columns must be entered in the sequence P-no., Y-coordinate, X-coordinate, Z-coordinate, each separated by slash (/). For the preceding example, the entry must be 29-35/38-48/15-25/1-8.

Limits for X,Y,Z:
X, Y: max. 7 digits before the decimal point and 3 decimal places
Z: max. 5 digits before the decimal point and 3 decimal places

To get Correct Profiles Automatically

Inexactness of measurements can have fatal consequences in some cases: If the points are very close (for example top and bottom of kerbstones), it may happen (for example prism stick is not exactly vertical) that a point at a greater distance is calculated before the closer point.

Therefore, already pay attention at the acquisition of data in order, to avoid the fatal consequences of the inexactness of measurements. Whether your profiles are created correctly, can be checked with the transformation performed by Nigra, if the points of the profile file (file extension .JOK) are in the correct sequence. After the profile creation, select the menu item View Calculation. There, points are in the same sequence as in the profile file. If stations are not in ascending order, an error is present.

Note:
Profile files created from levelling data and X,Y,Z-coordinates in any format cannot be processed in a single job at the same time.

10.1.3 Optional Parameters

These parameters are optional. They must be entered for each first point of a profile in the profile file, starting with column 54 using the Nigra standard format, and after the last column block using the free format. They can be repeated for every profile with different values.

/Sn n defines an optional increase of stations to reduced stations, e.g. with /S1500 all stations are increased by 1500.
/Ta a defines an optional text, which is printed in the centre above the profile at the top of the page, e.g. /TStation 2 + 350.

10.1.4 Representation of Planning Profiles

If plannings should also be drawn in the profile, observe the following points:

- The profile numbers must be > 500. A profile number > 500 causes the heights to be written in the "Planning" line.

- The reference horizon normally must be defined first (not automatically!) and must correspond to the related topography profiles.

- The planning profile must contain the identical length reference point as the associated topography profile.

- Scales must be selected identical for the planning profile and the corresponding topography profile.

- Activate Verticals, Distances/heights and deactivate Frame in the frame Plotting contents.

For the plotting, topography and planning profile can be merged and send together to the plotter or printer. For the format HP-GL/2 it is necessary to remove the last line of the first file with PG;.

10.2 Edit Profile File

You can add distances for points taken from outside of the profile, planning data or additional manually inputted data, and X,Y,Z-coordinates. You can also enter the optional parameters /S and /T.

10.3 Create Profiles

Plot files in the HP-GL or DXF format are created from the content of the file ‘job’.JOK. In a single file, a maximum of 999 profiles with each 4000 points can be handled.

With this menu item, it is possible to start different sequences of operations. First enter the plotting options for text, scales, output format, etc. in the dialog box. For entries outside of the tolerated values, a beep sounds and the cursor jumps to the faulty line.
The following plotting parameters can be defined:

**Profile range:**
Input of the first and last profile number.

**Output of:**
Check box **Plot File** activated: Plot files in the HPGL-format are created.
Check box **Area** activated: Profile areas are calculated.
Profile area refers to the area above the reference horizon, with the consequence that rectangle areas must be considered, if profiles with different reference horizons should be processed together in a earthwork volume computation.
Profile areas are written into the general calculation file and can be shown on the screen with menu item **View Calculation** or printed with **Print Calculation**. The number of decimal places of the reference horizon correspond to the decimal places defined for the height.
Check box **Del. old calc.** activated: deletes an existing calculation.

**Decimal places**
Input of decimal places for stations and heights (0 - 3 digits).
**HP-GL formats**

**HP-GL:** if you use a HP-GL plotter

**HP-GL/2:** if you use a HP-GL/2 plotter

**Font:** for a country-specific adaptation select one of the following fonts:

- ANSI US/ASCII
- German
- French F1
- French F2
- Italian
- English
- Spanish
- Portuguese
- Norwegian F1
- Norwegian F2
- Swedish
- Swedish names
- Intern. ref. vers.
- JIS ASCII

**Without umlauts (vowel-change,** check box is displayed only in connection with German font): Activate this check box, if your plotter does not recognize umlauts. All umlauts are converted, for example ö in oe and ß in ss.

**DXF formats**

**Create DXF format:** If the check box is activated, the DXF format is created in addition to the HP-GL format.

**All in one DXF file:** If the check box is activated, all DXF plots are written into one file. The file name is derived from the number of the first point. In this way, all profile plots can be transferred into the CAD program with a single command.

**OEM font:** Activate this check box, if vowels are not shown correctly.

**Plotting contents**

The course of the profile line is always presented. Beyond this, the following contents can be selected:

**Frame** activated: a frame and a header field (on the right bottom) is drawn.

**Verticals** activated: vertical lines are drawn.

**Distances/heights** activated: stations and heights are written
Example of **Frame activated, Vertical activated, Distances/heights activated:**

![Diagram of profiles menu with activated features](image)
For profile numbers > 500:

Frame inactivated, Verticals activated, Distances/heights activated:
Select this combination to present plannings in combination with the topography. The drawing of heights depends on the profile number (<= 500 = topography or > 500 = planning):
Frame inactivated, Verticals activated, Distances/heights inactivated:

With frame, verticals, distances/heights inactivated, only the profile line is presented.

If stations are very close, it is possible for stations and heights to overlap. In this case, the labelling is moved to the right until there is no overlapping.

**Profile number right/left**

For marking the orientation of cross sections. If the button is activated, the profile number and the profile number together with the apostrophe (') are written in the left and right profile margins; for example left 102, right 102'.

**Distances left of point of origin negative**

If the check box is activated, distances which are located left of the point of origin are written with a negative sign.

**Point number**

If the check box is activated, point numbers are printed below of the profile base.

**Vertical scale**

Any scale for heights.

If the scale is selected so that the profile does not fit into the picture area (paper width x paper length minus margins), an error message is written into the error file. The creation of the plot file is not interrupted.

**Horizontal scale**

Any scale for lengths.
If the scale is selected so that the profile does not fit into the picture area (paper width x paper length minus margins), an error message is written into the error file. The creation of the plot file is not interrupted.

For cross sections, normally the vertical and horizontal scale should be identical.

**Paper height and paper width (in cm/ft/in)**

You can enter any paper format available on your plotter or printer. Normally, profiles are created with a paper height of 29.70 cm (A4 portrait format). The paper width is dependent on the profile length. If the picture size is larger than the selected paper format, an error message is outputted.

Usual paper formats:

width x height in cm

29.7 x 21.0 A4 landscape  
42.0 x 29.7 A3  
120.0 x 29.7 A4 in the height, width variable

Starting with the defined paper format, a double frame is drawn, with a left and right margin of 2 and 1 cm respectively, and a top and bottom margin of 1 cm each. These values may vary during the profile output, since the exact margins are dependent on the insertion of the paper and the hardware limits of your printer/plotter. The smallest available paper format is 21x12 cm (width/height).

The picture size available for the profile is approximate paper width - 9 cm, paper height - 10.5 cm.

**Distance profile base (in cm/ft/in)**

Defines the distance of profile base above the box at the bottom. The minimum distance is 1 cm. Larger distances must be selected if manual or CAD program entries are set below the profile.

**Text for upper line**

A maximum of 11 characters of optional text for labelling in the upper line ("Planning") in the left profile box.

**Text for middle line**

A maximum of 11 characters of optional text for labelling in the middle line ("Topography") in the left profile box.
Text for lower line

A maximum of 11 characters of optional text for labelling in the lower line ("Distances") in the left profile box.

**Reference horizon (in m/ft/in) or a (a for automatically)**

Automatically: a or an (n=numeric value)

Reference horizon in m, e.g.: 99.700

The reference horizon can be selected by the user or determined automatically by the program.

With the automatic determination, the reference horizon is determined by the integer value of the lowest height - 1. If the character a is followed by a numerical value, the reference horizon is determined by the integer value of the lowest height reduced by the numerical value.

Examples of the automatic determination of the reference horizon, lowest height = 47.81 m/ft/in:

Entry a: reference horizon = 46.00 m/ft/in
Entry a0: reference horizon = 47.00 m/ft/in
Entry a7: reference horizon = 40.00 m/ft/in
Entry a-.5: reference horizon = 47.50 m/ft/in

If the value of the reference horizon is selected by the user, this value must be less than the lowest height. In this way, it is avoided that the profile line touches or crosses the writing border.

If a planning is to be subsequently added to a topography, the reference horizon must be selected in such a way that it is lower than the lowest height (=Zmin) of the terrain and the planning. The value of this reference height must be identical for both plots. See also the section **Entry of Plannings**.

Example:
Topography: Zmin = 47.11 m, planning: Zmin = 42.50 m

The reference horizon must be less than 42.50 m for both plots.
Plotting pen/layer (1-255)

Selection of pen number (HP-GL) or layer (DXF). Do not define pen numbers larger than the number of pens your plotter have. For the printing and viewing of diagrams with Nigra, pen numbers represent the following colors:

Pen 1 = black
Pen 2 = red
Pen 3 = green
Pen 4 = yellow
Pen 5 = magenta
Pen 6 = cyan
Pen 7 = blue
Pen 8 = grey
Pen 9-255 = black

The following agreement applies for the layers: the frame, except the header labelling, is generated in the defined layer. For additional character contents, the layer is enhanced by one:

Header = defined layer +1
Profile line = defined layer +2
Vertical = defined layer +3
Distances/heights = defined layer +4

In this way, single contents of characters can easily be cut out when processing with a CAD program.

Plotting pitch in mm or dots/inch

Unit of measurement is meters:

Most plotters work with a plotter step size of 0.025 mm (=1016 dots/inch). If your plotter uses a different plotter step size, enter the respective plotter step size here. The plotter step size may only marginally differ from 0.025, because otherwise the labelling gets in an unfavourable ratio to the lines. If the entry is 0 the value 0.025 is used automatically.

Unit of measurement is feet, inches:

Plotter step size must be set in dots/inch. The default value is 1016 dots/inch. If the entry is 0 the value 1016 is used automatically.
Prefix for plot file name

If there is no entry in this field, the file names of plot files are generated by default of the profile number and the file extension .PLT (for HP-GL) or .DXF (for DXF); for example profile 23 results in the file name 23.PLT and 23.DXF, respectively. For each profile an independent file is created.

With the parameter **Prefix for plot file names** the name of the plot file can be supplemented by a leading text, for example a short description of the order. Please remember that not all available characters are allowed for file names.

Not permitted characters for the file name are: / \ : * ? " < > |

The entry "test" results in the file names TEST23.PLT and TEST23.DXF for profile 23.

**Project name** and **Reference/drawing number**

Profiles can be labelled with a project/job description and a reference or drawing number consisting of max. 38 alphanumeric characters. These texts are printed for each profile at the bottom right side.

In addition, the company name, defined in the dialog box **Program Configuration**, is printed in the lowest profile line.

**Columns point-no./y/x/z**

An entry is necessary only for the evaluation of X,Y,Z-coordinate files in any format. The column designations are given in the sequence point number, Y-coordinate, X-coordinate, Z-coordinate (=height), entered as from-to, and separated by slash (/) - see section 10.1.2.

**Load plot options/Save plot options**

Herewith the defined plot options can be saved in a file (file extension .POP) and loaded to use with other projects.

Wrong entries may generate an unspecific error. If your profile file was created from levelling data, this line must be kept empty.

**Start profile creation**

The creation of plot files is started by clicking the **OK** button. Reduced distances together with the heights are written additionally in the calculation output and can be viewed with the menu item **View Calculation** in the **Calculate** menu.
10.4 View/Print Profiles

After the input of profile numbers **From profile** – **To profile**, profiles (in the HP-GL format) are shown on the monitor or print to a printer.

The numbers to enter correspond to the file names (without file extension .PLT). For a single profile, no entry is necessary in **To profile**.

With activating **PDF format**, the diagrams will be created additionally in PDF format. The file has the name of the first profile plot with the file extension .PDF, for example 146.plt.pdf.

The **Print preview** button opens the print preview. **Print preview Ex** opens an alternative print preview, with the exports in various formats are available.

With **Print** the diagrams will be printed with the printer.

It can only be printed diagrams that do not exceed the maximum available size of the printer paper.

With the button **Printer settings** a printer and paper size can be selected. Font and font size are set by Nigra and can not be changed. Nigra also automatically considered portrait or landscape format.
Print Preview (standard)

If you have selected more than one profile, you can scroll back or forward by clicking on Page. To zoom in or out, click on the magnifying glass. By clicking on the Print button, all loaded profiles will be printed in full scale.

End the display of profiles by clicking Close.
Print Preview Ex

Viewing Profiles

The button Print preview Ex opens an alternative print preview.

If you have selected more than one profile, you can scroll page by clicking on the arrow buttons. To zoom in or out, click on the zoom buttons. By clicking on the Print button, all loaded profiles will be printed slightly reduced.

With Show/hide pages navigation the display of thumbnails is controlled. With the Save button, the diagrams can be saved in various formats.

End the display of movement plots by clicking Exit.

10.5 View Error List

If errors occur during the profile creation, they are written into the file 'job'.PER. By clicking on the menu item View Error List, the file 'job'.PER is shown.

Example of an error message:

Profile number 134 contains more than 4000 points
A single profile may not contain more than 4000 points.

If the reference horizon or scale are selected improperly in combination with the paper format, it may happen that the profile does not fit in the defined plotting area. Also, in this case, an error message is outputted.
11 Nivnet Menu (Network)

Nigra, in combination with the software Nivnet (Copyright Prof. Dr.-Ing. Hans Fröhlich, Germany), enables a network adjustment. Nivnet is only available in German language as supplemental program for Nigra.

Levnet is no longer supported.

There are two versions of Nivnet:
Nivnet200 for a max. of 200 points and 1000 Observations
Nivnet1000 for a max. of 1000 points and 3000 Observations

Points mean both, reference points and new points.

If Nigra and Nivnet are used in combination, a nearly unlimited number of points can be evaluated.

The creation of a network file, program start, display, and printout of results are enabled by the Nigra menus. These functions are described in the following. In the Nivnet manual, the adjustment technique and the Nivnet program application is explained.

If the program Nivnet is not installed, only the menu items Create Network File and Edit Network File are activated.

How to proceed:

1. Acquisition of measurement data of levellings including side shots and distances levellings in the field with digital levels, or with manual input.

2. Marking of fixed points: Numbers of fixed points have to be entered in the measurement file within the range to be evaluated at any position in a single line, each in the format Axxxxx (A or a=code, xxxxx= point number).

Example: a34532
The code a is positioned in the first column. This establishes the point 34532 as a fixed point. During the automatic creation of a network file, the Nigra height file is searched for the height. If a corresponding point exists, the height is written into the network file. If the point is not stored, an error message is displayed.

The coding of fixed points can be simplified, if the fixed points are stored in the height file with the calculation number 999999:

With the code A* all points with the calculation number 999999 are written into the network file.

Note: 
As an alternative to the here described method of data acquisition, measurement and point data can be entered directly into the network file with an editor.

3. Input of fixed heights in the height file (Heights menu).

4. Automatic creation of a network file with measurement and point data from the Nigra batch file with the declaration of calculation numbers from - to. Evaluated are levellings including side shots, distances levellings and line adjustments.

5. Start network adjustment

6. Transfer heights into the height file

7. Possibly start Nigra batch file calculation for the calculation of additional points with levellings with side shots or line adjustments.

11.1 Create Network File

Creates a network file (file extension .NIV for Nivnet) from the measurement data of the batch file. This file is used for network adjustments with the program Nivnet.

Format of Network File:

The network file consists of measurement data in the first section (point number start and end, height difference and distance) with the marks MO (= standard deviation in mm/0.001ft/in for 1km/1000ft/1000in levelling distance) and CC (= mark for participation in the adjustment) and in the second section of point data of fixed points with point number, height, and point mark CH. The network file is named 'job'.LEV or 'job'.NIV.
Lines 1 and 2 with column headings serve the purpose of orientation and are not part of the file. The first text line is taken from the batch file (=remark line). It is printed on the cover of the network adjustment. With the start of column 60 the calculation number of the batch file calculation is given out for information purposes. An asterisk (*) behind the calculation number means that the levelling is measured in the opposite direction. The calculation number is not evaluated during network adjustment and may be missing in files created with an editor.

The end of measurement and point data is marked by zeros in columns 1-14. Recognized errors (for example missing distances, point number start = point number end, missing fixed heights) are marked with *** and written at the end of file.

Distances > 0 and < 0.005 km/1000ft/1000in are rounded to 0.01 km/1000ft/1000in.

Any errors must be corrected before the start of a network adjustment.

**Format of observation data:**

| Columns 1-14 | Starting-point number, alphanumeric |
| Columns 16-29 | End-point number, alphanumeric |
| Columns 31-41 | Height difference start – end in m/ft/in |
| Columns 43-49 | Distance start – end in km/1000ft/1000in |
| Columns 51-54 | Standard deviation MO in mm/0.0001ft/in for 1km/1000ft/1000in levelling distance |
| Column 56 | Observation mark CC, 1=measurement takes part in evaluation, 0=line has no significance |

From column 60 Calculation number in the batch file
Format point data:

Columns 1-14  Point number of fixed point, alphanumeric
Columns 16-25 Height in m/ft/in
Column 27    Mark CH, 1=point is fixed point, 0=point has no significance.

The creation of a network file can be controlled with options:

**Creation of a Network File**

**From calculation no. - To calculation no.** determines the range of the batch file to be evaluated. **Page no.** defines any starting number for the page numbering of the calculation output.

The heights of the fixed points may be read from the height file of the current job, an external height file, or from a central height file (view section 5.1, **Batch File Calculation**)

If the button **Delete old batch file calculation** is activated, an existing batch file calculation (not the old network file!) will be deleted.

As a default setting, only height differences and distances from starting-point to the end-point of a levelling are written in the network file. If the check box **Write side shots/turning points into network file** is activated, height differences are calculated for the side shots and turning points in question.

With the function **Standard deviation MO** (= standard deviation for 1km/1000ft/1000in levelling distance), measurements with different precision can be weighted corresponding to their precision. If all measurements have the same precision (and therefore the same MO), this value has no influence on the calculated heights, but on the detection of significant errors.
Valid values: MO > 0 and MO < 99.9

Default: 1.0

By clicking the Run button a batch file calculation is started and a network file (in the order by ascending point numbers) is created at the same time. If a network file already exists, the question **Overwrite existing network file?** appears. By clicking No, new data are added to the old file. By clicking Yes, the existing file will be deleted and a new one created.

A batch file calculation must be considered as a pre-evaluation and for the detection of used measurement data. Heights of new points, without error distribution and in part calculated in the local network, are not transferred into the height file.

Levellings with side shots, distances levellings, and line adjustments are evaluated. Height differences and point heights are transferred into the network file with 5 decimal places.

The following default values are set for measurement and point data:

CC =1 Observation participates in the adjustment
CH =1 Point is a fixed point or a point for transformation to fix points

Nigra calculates the standard deviation for 1km/1000ft/1000in if levelling distances are measured double and write it on the end of the network file (see section 11.3).

**Tips:**

In case that your job contains less than 200 (connecting and new points), activate the button **Write side shots/turning points into network file.** Enter the numbers of connecting points with code A in the batch file and start the creation of the network file. Now, in an automatic data flow, you will receive the network file directly, without manual after-treatment. Then start the network adjustment. All points of your job will be calculated.

For larger networks with more than 200 points, a little more planning is necessary. First, select junction points (max. 200), and then perform your levellings as levellings including side shots from junction point to junction point. Inactivate the button **Write side shots/turning points in network file.** Then, only height differences and distances from junction point to junction point are transferred into the network file.
Start the network adjustment (herewith junction points are calculated) and transfer the calculated heights into the Nigra height file. Then the other points can be calculated in the **Calculate** menu with **Batch Calculations**. By doing it in this way, the number of points to evaluate nearly is unlimited.

### 11.2 Edit Network File

For editing the network file: To change marks, delete or add observations and points.

### 11.3 Calculate Standard Deviation

Nigra calculates the standard deviation for 1km/1000ft/1000in during creation of network file if levelling distances are measured double and write it at the end of the network file. Furthermore, the differences between forward and back levelling are calculated and compared with the admissible difference defined under **Program Configuration**. Exceedings of error limits are reported.

Further, the percentages for levelling pairs within the first error half, within the second error half and error limits exceeded are displayed.

**Note:** Prior to the calculation of the standard deviation, the network file is sorted. If line pairs were measured more than twice, it may results in an other combination and the standard deviation and the differences between forward and back levelling are calculated differently.

With this menu item you can start again the calculation of standard deviation.

**Formula:**

\[
\sigma = \frac{1}{2} \cdot \sqrt{\frac{1}{n} \left( \frac{dd}{l_{km}} \right)}
\]

\(\sigma = \text{Standard deviation for 1 km/1000 ft/1000in double levelling}\)

\(d = \text{Height difference between two points}\)

\(n = \text{Number of line pairs}\)

\(l = \text{Length of line pairs in km/1000 ft/1000 in}\)

The number of line pairs must be a minimum of two. With only a small number the calculated standard deviation is uncertain.
11.4 Run Network Adjustment

Starts the program Nivnet. The name of the current job is submitted from Nigra to Nivnet. With the Nivnet dialog box the necessary calculation parameters (for example free adjustment or constrained adjustment) are set.

In a single calculation run a maximum of 200 (Nivnet200) and 1000 (Nivnet1000) points (connecting points and new points) can be calculated.

If a configuration error was located during network adjustment (e.g., missing connecting points), the next run will be automatically the network solvability. Click on View Network Adjustment to see the result. Remove the detected errors in the network job'.NIV and run network adjustment again.

11.5 View Network Adjustment

For viewing calculation results of network adjustment. The results of network adjustment are stored in the file 'job'.OUT.

11.6 Print Network Adjustment

To output the results of network adjustment to a printer.

11.7 Network Heights → Height File

After network adjustment, the file 'job'.NET contains connecting points as well as new points together with the related heights. With this menu item, the transfer to the Nigra height file of the current job (and the external height file if activated for creating network file or batch calculation, respectively), is initiated. With click on button Height File you can choose another height file.

Mean value calculation mode is set to 1 (=new, i.e. old heights will be overwritten). Fixed points with the calculation number 999999, in contrast to the batch file calculation, will be also overwritten. Date, comments, and calculation number can be added freely. If no entry is in these fields, previously stored values are retained.
Transfer of Network Heights into the Height File

The standard deviation $s_H$ from the network adjustment is stored in the data field Difference.
12 Help Menu

Online help is activated by selecting the item Nigra Help from the ? (Help) menu or pressing F1, if all dialog boxes are closed.

In case you need information about a particular topic, select the register Search in the help window. The help topic is selected by clicking the term in question in the help window.

By using hyperlinks you can navigate in online help. Hyperlinks can be recognized by underlined words. If you want to branch to this term, just click on it. If the underline is interrupted, the program will not branch out, but a special window with explanations will be opened.

Nigra comes also with an online manual in the PDF format. PDF files can be viewed and printed with the program Acrobat Reader.

Menu Item About

With the menu item About in the help menu you receive information about the program version and a copyright notice.

Menu Item Nigra on the Web

With this menu item the Nigra web site will be called. There must be an active connection to the web.

Menu Item E-mail

This calls your default email program with the recipient address of Trukk-Soft
13 Sample Levellings

Now follows a number of sample levellings (Job SAMPLE.NIG). You may install this file during Nigra installation.

The explanatory texts adjacent to the headers in the measurement file are created automatically from file ENGLISH.LAG when converting raw data. They have no influence on the calculations and may be edited or replaced by the user's own comments.
### Line Levelling with Side Shots

**Measurement File:**

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<tr>
<th>Location</th>
<th>Side</th>
<th>Fore</th>
<th>Point Number</th>
</tr>
</thead>
<tbody>
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<td>HSankt Augustin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
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<tr>
<td>Weather</td>
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<td></td>
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<tr>
<td>Observer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff</td>
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</tr>
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<td>Comments</td>
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<td>Number of staff scales</td>
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<td></td>
</tr>
<tr>
<td>Scale constant for 2 staff graduations</td>
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<td>Difference tolerance between scales</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Staff graduation</td>
<td></td>
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<td>With distances, 1=yes, 0=no</td>
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</tr>
<tr>
<td>Decimal places for readings in calculations</td>
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<table>
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<td></td>
</tr>
<tr>
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</tr>
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<td>1504</td>
<td></td>
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</tr>
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<tr>
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<td></td>
<td>18.44</td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>
Calculation:

Company xyz
NigraWin - Levelling, Version 4.0 05-27-2008 Page: 1
Job: SAMPLE

Test file for all levelling methods
Calculation No.: 1
Location Sankt Augustin
Order 12. Movement Measurement
Line 12/95 Date 01-16-2008
Weather sunny Observer Miller
Level Leica NA3003 345678 Staff Nedo 5416
Staff graduation 1 cm Reading sequence BF BF(S)
Comments Levelling with side shots
Calculation of Mean Values: new - calculated height is inserted

Misclosure = -4.0 mm Max. error E (3) = 3.9 mm
*** Error limit exceeded

<table>
<thead>
<tr>
<th>Distance</th>
<th>Back</th>
<th>Side</th>
<th>Fore</th>
<th>Height</th>
<th>Point No.</th>
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<tbody>
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<td></td>
<td></td>
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<tr>
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<td>1503.5o</td>
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<tr>
<td>18.54</td>
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<td>-0.105</td>
<td>50.820</td>
<td>1560</td>
<td></td>
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</tr>
</tbody>
</table>

Sum total distances = 150.97 m Delta-H= 1.58200 m
Sum backsight distances = 75.39 m
Sum foresight distances = 75.58 m

Remarks concerning Averaging

Refer to the codes in column 1 in the measurement file. Point 1503.5: Height 47.764 deletes any height in the height file and the mean between it, and the following height 47.763 is then determined. Height 47.765 does not change the value in the height file and is only for comparison purposes.

The mean is determined between point 1505 and any point contained in the height file.

The new height then applies for all other points.
## 13.2 Precision Levelling with Side Shots

### Measurement File:

- **RTTest file for all levelling methods**
- **x**2345678901234567890123456789012345678901234567890123456789012345678901234567890

<table>
<thead>
<tr>
<th>Distance</th>
<th>Back</th>
<th>Side</th>
<th>Fore</th>
<th>Point Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **HSankt Augustin** Location
- **H12. Movement Measure** Order
- **Hement** Order
- **H12/95** Line
- **H01-16-2008** Date
- **Hsunny** Weather
- **HMiller** Observer
- **HDini 10, 345678** Level
- **HNedo 5416** Staff

<table>
<thead>
<tr>
<th><strong>Comments</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>H with side shots</td>
</tr>
</tbody>
</table>

- **H00** 2.Col.:0=Side,1=no Side,4=Line, 5=Level test
- ***H2** Number of staff scales
- **H5.925** Scale constant for 2 staff graduations
- **H3** Difference tolerance between scales
- **H.5** Staff graduation 1=cm,feet,inches, 0.5=1/2cm
- **H1** With distances, 1=yes, 0=no
- **H5** Decimal places for heights in calculations
- **H4** Decimal places for readings in calculations

### E13m

- **E**/Mean value/Error class/Unit of measurement

<table>
<thead>
<tr>
<th>D</th>
<th>20.56 b6.6793</th>
<th>6014</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>20.56 b.7542</td>
<td>6014</td>
</tr>
<tr>
<td>D</td>
<td>5.12 s7.1589</td>
<td>6015</td>
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<tr>
<td>D</td>
<td>5.12 s1.2339</td>
<td>6015</td>
</tr>
<tr>
<td>D</td>
<td>6.55 s7.8642</td>
<td>6016</td>
</tr>
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<td>D</td>
<td>6.55 s1.9394</td>
<td>6016</td>
</tr>
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<td>D</td>
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<td>D</td>
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<td>D</td>
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<td>6100</td>
</tr>
<tr>
<td>D</td>
<td>13.95 f2.1303</td>
<td>6100</td>
</tr>
</tbody>
</table>

E
**Calculation:**

Company xyz  
Nigrawin - Levelling, Version 4.00  
03-12-2008  
Page: 2

Job: Sample

Test file for all levelling methods  
Calculation No.: 2  
Location: Sankt Augustin

Order: 12. Movement Measurement  
Line: 12/95  
Date: 01-16-2008

Weather: sunny  
Observer: Miller

Level: Dini 10, 345678  
Staff: Nedo 5416

Staff graduation: 1/2 cm  
Reading sequence: BBFF BBFP(SS)

Scale constant: 5.925  
Diff. tolerance: 3 [0.2 mm]

Comments: Precision levelling with side shots

Calculation of Mean Values: new - calculated height is inserted

<table>
<thead>
<tr>
<th>Distance</th>
<th>Back d</th>
<th>Side d</th>
<th>Fore d</th>
<th>Height</th>
<th>Point No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.56</td>
<td>6.6793</td>
<td></td>
<td></td>
<td>44.85600</td>
<td>6014</td>
</tr>
<tr>
<td></td>
<td>0.7542</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.12</td>
<td></td>
<td>7.1589</td>
<td></td>
<td>44.61623</td>
<td>6015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.2339</td>
<td>0/1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.55</td>
<td></td>
<td>7.8642</td>
<td></td>
<td>44.26353</td>
<td>6016</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.9394</td>
<td>-2/3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.98</td>
<td>8.6710</td>
<td></td>
<td></td>
<td>43.86027</td>
<td>6017</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.7459</td>
<td>1/0</td>
<td></td>
</tr>
<tr>
<td>14.31</td>
<td>7.0227</td>
<td></td>
<td></td>
<td>43.34400</td>
<td>6100</td>
</tr>
<tr>
<td></td>
<td>1.0975</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.95</td>
<td>8.0553</td>
<td></td>
<td></td>
<td>43.34400</td>
<td>6100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.1303</td>
<td>0/2</td>
<td></td>
</tr>
</tbody>
</table>

Sum total distances = 69.80 m  
Delta-H = -1.51220 m

Sum backsight distances = 34.87 m

Sum foresight distances = 34.93 m
### 13.3 Line Levelling (without calculating the heights)

**Measurement File:**

RTest file for all levelling methods

<table>
<thead>
<tr>
<th>Distance</th>
<th>Back</th>
<th>Side</th>
<th>Fore</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HSankt Augustin</td>
<td>Location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H12. Movement Measur</td>
<td>Order</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hement</td>
<td>Order</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H12/95</td>
<td>Line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H01-16-2008</td>
<td>Date</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hsunny</td>
<td>Weather</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMiller</td>
<td>Observer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDini 10, 345678</td>
<td>Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HNedo 5416</td>
<td>Staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HLine levelling</td>
<td>Comments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Comments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H10</td>
<td>2.Col.:0=Side, 1=no Side, 4=Line, 5=Level test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* 3.Col.:0=BF, BBFF, 2=BFFB, 4=BFBB, 5=FBBF, 4.Col.:a=altern.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2</td>
<td>Number of staff scales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H5.925</td>
<td>Scale constant for 2 staff graduations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H3</td>
<td>Difference tolerance between scales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H.5</td>
<td>Staff graduation 1=cm, feet, inches, 0.5=1/2cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1</td>
<td>With distances, 1=yes, 0=no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H5</td>
<td>Decimal places for heights in calculations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H4</td>
<td>Decimal places for readings in calculations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E03m</td>
<td>E/Mean value/Error class/Unit of measurement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| D | 20 b6.6793 | 1001 |
| D | 20 b7.542 | 1001 |
| D | 6 | f8.6710 |
| D | 6 | f2.7459 |
| D | 14 b7.0227 |     |
| D | 14 b1.0975 |     |
| D | 17 | f7.8231 | 6019 |
| D | 17 | f1.8981 | 6019 |
| E |     |       |     |
Calculation:

Company xyz
Nigrawin - Levelling, Version 4.00  03-12-2008  Page: 3
Job: Sample

Test file for all levelling methods
Calculation No.: 3
Location Sankt Augustin
Order 12. Movement Measurement
Line 12/95  Date 01-16-2008
Weather sunny  Observer Miller
Level Dini 10, 345678  Staff Nedo 5416
Staff graduation 1/2 cm  Reading sequence BBFF BBFF
Scale constant 5.925  Diff. tolerance 3 [0.2 mm]
Comments Line levelling

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Distance</th>
<th>Back</th>
<th>Fore</th>
<th>Point No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001</td>
<td>20.00</td>
<td>6.6793</td>
<td>1</td>
<td>1001</td>
</tr>
<tr>
<td>20.00</td>
<td>0.7542</td>
<td>8.6710</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.00</td>
<td>2.7459</td>
<td>1/0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.00</td>
<td>7.0227</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.00</td>
<td>1.0975</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6019</td>
<td>17.00</td>
<td>7.8231</td>
<td>0/2</td>
<td>6019</td>
</tr>
<tr>
<td>17.00</td>
<td>1.8981</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From bench mark 1001 To bench mark 6019
Sum total distances = 57.00 m  Delta-H= -1.39610 m
Sum backsight distances = 34.00 m
Sum foresight distances = 23.00 m
13.4 Line Adjustment

Measurement File:

R Test file for all levelling methods
x23456789012345678901234567890123456789012345678901234567890123456789012
x Distance| Back | Side | Fore |
-----------|-----|-----|-----|
C4
HSankt Augustin  Location
H  Location
H12. Movement Measure Order
Hement  Order
H12/95  Line
H01-16-2008  Date
Hsunny  Weather
HMiller  Observer
HDini 10, 345678  Level
HNedo  5416  Staff
HLine adjustment  Comments
H  Comments
H4  2. Col.: 0=Side, 1=no Side, 4=Line, 5=Level test
*  3. Col.: 0=BF,BBFF, 2=BFFB, 4=BFBF, 5=FBBF, 4. Col.: a=altern.
H1  Number of staff scales
H5.925  Scale constant for 2 staff graduations
H3  Difference tolerance between scales
H1  Staff graduation 1=cm, feet, inches, 0.5=1/2cm
H1  With distances, 1=yes, 0=no
H5  Decimal places for heights in calculations
H4  Decimal places for readings in calculations
E13m  E/Mean value/Error class/Unit of measurement
D  200  -0.0747  1760
D  40  -0.2090  1711
D  300  8.008  1710
D  290  -5.9492  1702
D  40  0.0486  1701
D  1700
E
**Calculation:**

Company xyz
Nigrawin - Levelling, Version 4.00
Job: Sample

Test file for all levelling methods
Calculation No.: 4
Location Sankt Augustin
Order 12. Movement Measurement
Line 12/95 Date 01-16-2008
Weather sunny Observer Miller
Level Dini 10, 345678 Staff Nedo 5416
Staff graduation 1 cm Reading sequence LINE
Comments Line adjustment
Calculation of Mean Values: new - calculated height is inserted

Misclosure = -1.7 mm  Max. error E (3) = 5.7 mm

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Distance</th>
<th>Height Difference</th>
<th>Height</th>
<th>Point No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1760</td>
<td>200.0</td>
<td>-0.0747</td>
<td>48.38600</td>
<td>1760</td>
</tr>
<tr>
<td>1711</td>
<td>40.0</td>
<td>-0.2090</td>
<td>48.31091</td>
<td>1711</td>
</tr>
<tr>
<td>1710</td>
<td>300.0</td>
<td>8.0080</td>
<td>48.10183</td>
<td>1710</td>
</tr>
<tr>
<td>1702</td>
<td>290.0</td>
<td>-5.9492</td>
<td>56.10924</td>
<td>1702</td>
</tr>
<tr>
<td>1701</td>
<td>40.0</td>
<td>0.0486</td>
<td>50.15948</td>
<td>1701</td>
</tr>
<tr>
<td>1700</td>
<td></td>
<td></td>
<td>50.20800</td>
<td>1700</td>
</tr>
</tbody>
</table>

Sum D= 870.0 m  Delta-H= 1.82370 m
### 13.5 Testing the Instrument

**Measurement File:**

RTest file for all levelling methods

<table>
<thead>
<tr>
<th>Distance</th>
<th>Back</th>
<th>Side</th>
<th>Fore</th>
<th>Point Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Location:**
- HSankt Augustin
- H

**Order:**
- H12/Movement Measure
- Hement
- H12/95
- H01-16-2008
- Hsunny
- HMiller
- HDini 10, 345678
- HNedo 5416
- HInstrument test

**Comments:**
- 2.Col.: 0=Side, 1=no Side, 4=Line, 5=Level test
- Number of staff scales
- Scale constant for 2 staff graduations
- Difference tolerance between scales
- Staff graduation 1=cm, feet, inches, 0.5=1/2cm
- With distances, 1=yes, 0=no
- Decimal places for heights in calculations
- Decimal places for readings in calculations

**Units:**
- E13m E/Mean value/Error class/Unit of measurement

<table>
<thead>
<tr>
<th>D</th>
<th>20.02 b1.7807</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>40.01</td>
<td>f2.0000</td>
</tr>
<tr>
<td>D</td>
<td>20 b4.0000</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>40 f3.7827</td>
<td>2</td>
</tr>
</tbody>
</table>

**E**
Calculation:

Company xyz
Nigrawin - Levelling, Version 4.0 03-12-2008 Page: 5
Job: Sample

Test file for all levelling methods
Calculation No.: 10
Location  Sankt Augustin
Order  12. Movement Measurement
Line 12/95 Date 01-16-2008
Weather sunny Observer Miller
Level Dini 10, 345678 Staff Nedo 5416
Staff graduation 1 cm Reading sequence BF BF
Comments Instrument test

Instrument Test, Method 'Naebauer/Foerstner'

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Distance</th>
<th>Back</th>
<th>Fore</th>
<th>Point No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.02</td>
<td>1.7807</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>40.01</td>
<td>2.0000</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>20.00</td>
<td>4.0000</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>40.00</td>
<td>3.7827</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

Theoretical reading for 4:  3.7807
Error for line of sight (in radians) = 0.000050
Error for D = 20 m = 1.00 mm
Error for D = 30 m = 1.50 mm
Max. admissible distance diff. b-f for error <= .05 mm = 1.0 m

Message after Finishing all Calculations:

Sum of all distances (without side shots) = 1147.77 m
Max. misclosure = -4.0 mm (calcul. no. 6)

*** 1 Error has occurred

Report of Calculation Mode for Mean Value

Company xyz
Nigrawin - Levelling, Version 4.0 03-12-2008 Page: 1
Job: Sample

Test file for all levelling methods

Report of Calculation Mode for Mean Value

Error limit for repeatedly calculated points = 3 mm
*** = Error limit is exceeded, point with selection '0 - mean value' will be stored

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Diff.H.(mm)</th>
<th>Calculation No.</th>
<th>Mean Value Calculation Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>1503.5</td>
<td>-1.0</td>
<td>6</td>
<td>0 - mean value</td>
</tr>
<tr>
<td>1503.5</td>
<td>1.5</td>
<td>6</td>
<td>2 - old, compare only</td>
</tr>
<tr>
<td>1505</td>
<td>1.1</td>
<td>6</td>
<td>0 - mean value</td>
</tr>
</tbody>
</table>
14 Frequently Asked Questions

In this section we will answer frequently asked questions. If you have a problem, read this chapter before you call your distributor or Trukk Soft. In many cases you will find the solution to your problem here.

**Question:** Why are NA3003 raw data stored in my job file (*.NIG)?

**Answer:** The reason is that you have used the file extension .NIG when transferring data. NIG files automatically define a Nigra job. Always name the Leica raw data file with the file extension .NA2.

**Question:** If I have converted the raw data into Nigra measurement format, it is not possible to run a batch calculation.

**Answer:** You have switched off the automatic reorganization of the calculation numbers. Choose the File menu and run Reorganize Calculation No.

**Question:** I have selected 4 decimal places for heights in the Options menu, item Job Configuration. If I run a batch calculation, the output shows only 3 decimal places.

**Answer:** The decimal places in the dialog box Parameters are only effective when converting the raw data into the Nigra format. If you run a batch calculation, the decimal places are taken from the header data in the measurement file. Change the data record number 19 of the header data from H3 to H4.

**Question:** The output of my calculation shows only a line levelling (no side shots), but I also want to calculate the heights of the side shots and turning points. What must I do?

**Answer:** You must change the header data for the levelling method in the measurement file from 1 to 0. You also must enter the heights for the fixed points in the height file. Note: The levelling method is fixed during the conversion of the raw data into Nigra format.
Question: For my movements I must create point numbers which include a point, i.e., 123.05. How can I achieve this?

Answer: During the levelling, register the point with the number 12305. When converting the raw data into the Nigra format, use the alphanumeric point number extension. Enter for **1st String** the character . and for **Position from right** the character 3. All point numbers contain, after the conversion is over, a point at the 3rd place from the right.

Question: The conversion of Leica raw data into the Nigra format doesn't work, no raw data is received in the measurement file.

Answer: Probably there is missing a row like 110001+00010500 83..16+01002900 in the raw data. These characters define the beginning of a levelling. The beginning of a levelling (START LEVELING) is defined with code '11' in the columns 1 and 2 and the code '83..1' in the columns 17-21 of the raw data format (GSI-8 format). If this succession of characters is missing, all data records will be ignored (except code information used by Nigra).

Question: If I manually compute the misclosure with the backsight and foresight readings from the calculation output, I get 1 mm, yet Nigra outputs 3 mm. How is this possible?

Answer: Supposing your calculation output contains only 3 decimal places, yet Nigra used all decimal places, which are stored in the measurement file to calculate the misclosure and the heights. If you use only 3 decimal places, the result will be wrong.
Question: While starting Nigra I received the message "File ENGLISH.LAG not found. Program running aborts".

Answer: The file ENGLISH.LAG contains all text for printouts. This file will be searched in the folder c:\Nigra\TEMPLATES (c:\Nigra = Nigra installation folder) and it must be present while starting Nigra. Perhaps the file USER32.OPT or PROJEKT.XML (since Nigra 5.0) stored in your user folder is damaged. You can delete this file without any trouble, for if it is missing, Nigra creates this file with default values.

Question: If I create a network file using the menu item Create Network File, there are no data in the network file afterwards.

Answer: If the network file contains no data, the reason maybe that there is a fault in the measurement file (*.NIG). During the creation of a network file, Nigra also runs a calculation in a local net. This calculation serves as evidence for the used data. You can view the calculation file by choosing View Calculation in the Calculate menu. Perhaps you can find error messages here.
Nigra has an integrated simply text editor like Notepad to edit raw data, measurement file, ASCII height file, and other text files. In addition to Notepad shows the Nigra editor row and column and provides a print preview. From the print preview the file can be saved in various formats such as PDF.

If you have no other editor defined (see Options menu, item Program Configuration) always Nigra's built-in editor will be used to edit a file.

The file size can amount to many megabyte.

Page feed, for example in calculating output, are not displayed by the editor.

The utilization of the Nigra editor is not different from other text editors for Windows. If you want to delete a chapter of text, you first must select the text. Text from other text editors can be pasted using the Window's clipboard.
Repeatedly used functions can be chosen directly by clicking an icon in the heading. Moving the mouse pointer over an icon will show a tool tip.

If a file has changed and you quit the editor, you will automatically be asked whether the file should be saved.

Font, font style, font size and font color are separately managed by the editor in contrast to the chosen font settings for printing with Nigra.

For all Nigra outputs only non-proportional fonts are useful, such as Courier. You can print all Nigra text files, except the movement lists, in A4 portrait format, with a 10-point font.

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