Nigra

Special Software for Levellings

Reference Manual

Nigra for Windows

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Table of Contents

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 the website http://www.nivellement.de or write an e-mail with your question to andrae@magenta.de. 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 7/8/8.1/10 and 11.

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 can store approximately 10 million 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

Before installation: Make sure that the latest Windows updates are installed on your computer.

Close all running applications. Insert the Nigra CD-ROM into the CD drive. If the Nigra setup does not start automatically, navigate to the appropriate folder, and run setup.exe.

Then click on the OK button. The installation starts.

If you got the Nigra setup from a download, unzip the zip file, and start setup.exe.

Follow the setup instructions on the screen. If you have already installed an older Nigra version, choose a different installation folder for Nigra version 7.0 and higher than for the earlier versions. This way you can continue to work with both versions in parallel for a while and gradually switch to Nigra 7.0.

When updating a Windows version of Nigra from 7.0, install Nigra in the same folder as the previous version.

Nigra requires the .Net Framework 4.7.2 or higher to run. If this is not available on your PC, it must be installed separately.

After the installation is complete, an entry is created in the Start menu and an icon on the desktop. Double-click on the Nigra icon to start Nigra.

After installation: The Nigra templates folder is installed by default in *c:\programs (x86)\nigra\templates*. Copy the complete folder to another location (drive or folder) where you have full access rights. Then change the template folder entry in Nigra under *Options, Program Configuration, Misc.* to the new folder.

c:\programs (x86)\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.

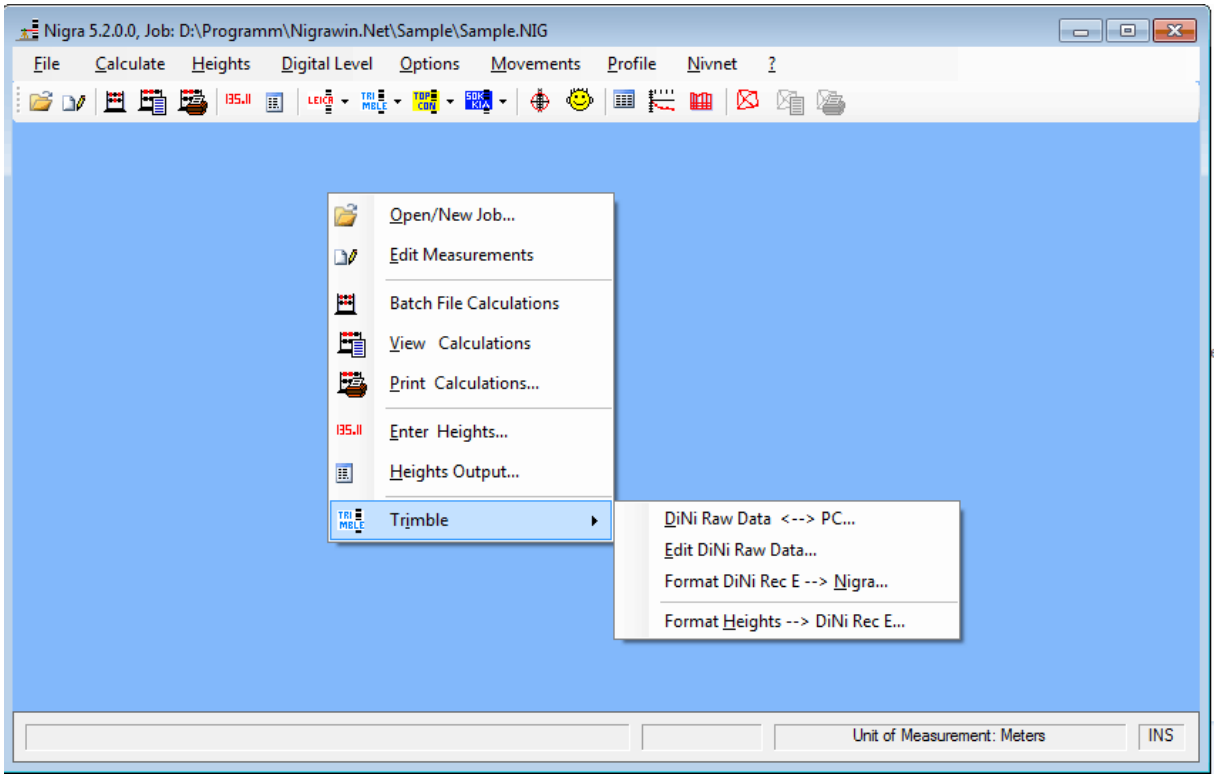
If you are already familiar with the use of Windows software, you can now continue with Section 2, First Steps.

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

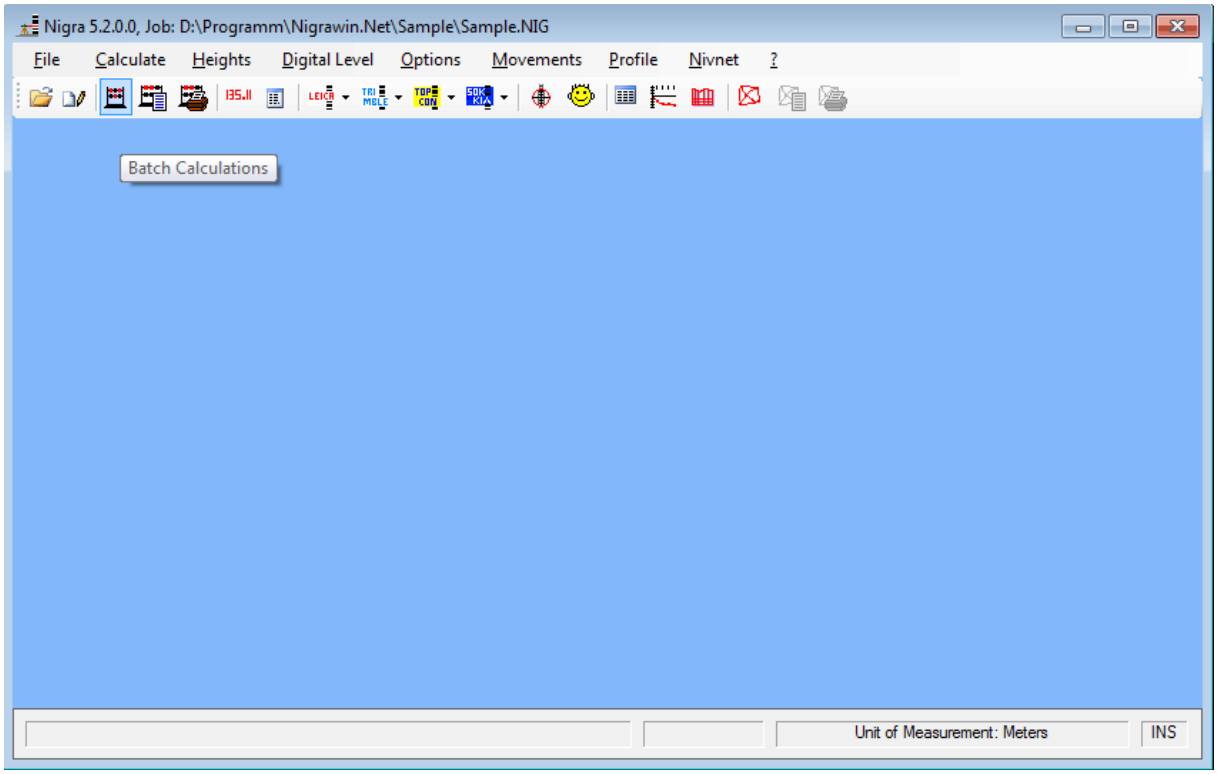
Nigra is equipped with a menu system and a menu bar with symbols:



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

Open/New Job...	Ctrl+O	Select existing or new job
Edit Measurements	F4	Editing measurements in current job
Reorganize Calculation No.	Ctrl+R	Numbering of levellings in the batch file
Print Measurement...		Measurement report from calc. no. to calc. no.
Edit Files...		Edit any ASCII file
Delete Files...	Ctrl+L	Delete project files in current folder
Convert ASCII → ANSI		Convert files from ASCII into ANSI
Print...	Ctrl+P	Print any ASCII file
Printer Setup...		Select default printer
Printer Font...		Select printer font
Exit	Ctrl+E	Quit Nigra
1 D:\Nigra\GUT\MAR.NIG 2 D:\Nigra\GUT\KD.NIG		This lists the last six jobs executed

Calculate Menu

Batch...	F5	Batch processing from calc. no. to calc. no.
View Calculation	F6	View the calculations of the current job
Print Calculation…		Print the calculations of the current job
Delete Calculation		Delete the calculations of the current job

Heights Menu

Enter Heights...	F7	Enter, view, edit, and delete heights
Delete Points...		Deletes points from number to number
Renumber Points...	Ctrl+U	Renumbering of points
Heights Output...	Ctrl+V	Screen, ASCII file and printer
Edit ASCII File		Edit ASCII file of the current job
Import Nigra Heights...		Import heights from other Nigra jobs
Import ASCII Heights...		Import heights from any ASCII file

Digital Level Menu

Leica	Functions for Leica digital level
Trimble	Functions for Trimble digital level
Topcon	Functions for Topcon digital level
SOKKIA	Functions for SOKKIA digital level
Terminal Data Transfer...	Data transfer for standard devices

Leica Submenu

GIF 10 ↔ PC...	F8	Data transfer GIF 10 ↔ PC
NA/DNA/Sprinter Raw Data ↔ PC...		Data transfer NA/DNA/Sprinter level ↔ PC...
Edit Raw Data...		Edit Leica raw data
Format NA-GSI → Nigra...	Ctrl+	Reformat Leica NA-GSI raw data
Format DNA/LS → Nigra...		Reformat Leica DNA/LS raw data
Format Sprinter-GSI → Nigra...		Reformat Leica Sprinter-GSI raw data
Format Heights → Leica GSI...		Create GSI format from the height database

Trimble Submenu

DiNi Raw Data ↔ PC...	F9	Data transfer
Edit DiNi Raw Data...		Edit DiNi DiNi raw data
Format DiNi Rec E → Nigra...	Ctrl+Z	Reformat DiNi DiNi raw data
Format Heights → DiNi Rec E...		Create Rec E format from the height database

Topcon Submenu

DL-100 Raw Data → PC...	Ctrl+B	Data transfer
Edit DL-100 Raw Data...		Edit DL-100 raw data
Format DL-100 → Nigra...	Ctrl+T	Reformat DL-100 raw data
Format Heights → Topcon Raw Data...		Create Topcon raw data format from the height database

SOKKIA Submenu

SDL Raw Data → PC...	Ctrl+B	Data transfer
Edit SDL Raw Data...		Edit SDL raw data
Format SDL → Nigra...	Ctrl+T	Reformat SDL raw data
Format Heights → SOKKIA Raw Data...		Create SOKKIA raw data format from the height database

Options Menu

Job Configuration...	F2	Header data, parameters, indiv. program config.
Program Configuration...	F3	Enter company name, error limits, etc.

Movements Menu

Create List…	Crtl+S	Movement list from points of current height database
View List		View movement list of current job
Print List…		Print movement list of current job
Delete List		Delete movement list of current job
Create Movement Plot...	Ctrl+G	Movement plots in HP-GL and DXF format
View/print Movement Plot...		View and print movement plots
View Error List		View errors

Profile Menu

Create Profile File...	Ctrl+F	Based on data of current job
Edit Profile File		Edit profile file of current job
Create Profile...		Create plot file in HP-GL and DXF format
View/print Profiles...		View and print profiles
Print Profiles...		Print profiles
View Error List		View errors

Nivnet Menu (=Network Adjustment Nivnet)

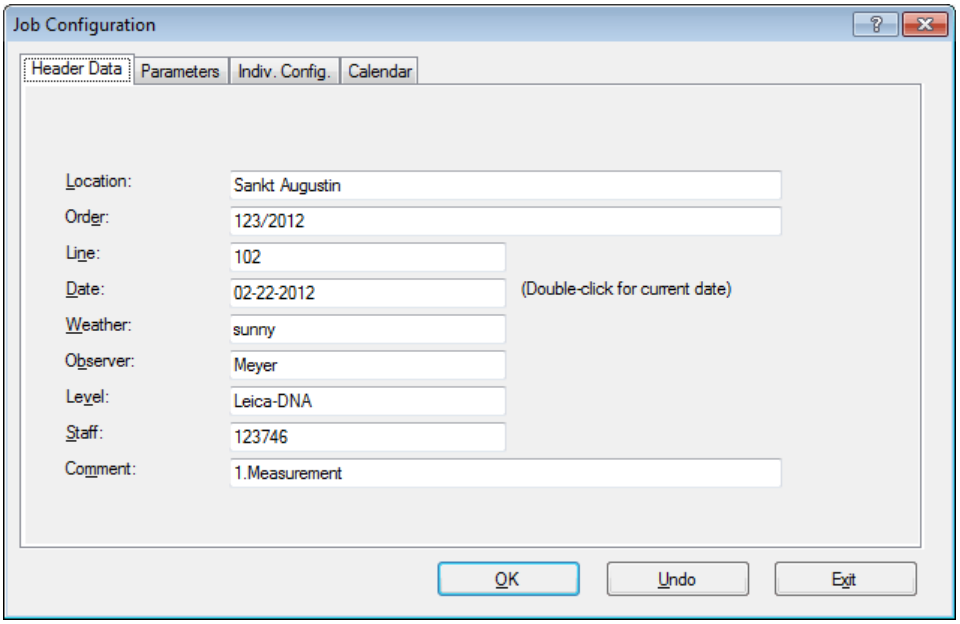
Create Network File...	Ctrl+N	Based on data of current job
Edit Network File		Edit network file in current job
Calculate Standard Deviation		Calculate standard deviation for 1 km double levelleling
Run Network Adjustment...	Ctrl+A	Run Nivnet
View Network Adjustment		View results of network adjustment
Print Network Adjustment…		Print results of network adjustment
Network Heights → Height Database ...		Transfer heights into height database of current job or other height databases

? Menu (Help)

Nigra-Help	F1	Shows Nigra help file
About		Show information on program (version, etc.)
Nigra on the web		Connecting to the Nigra website
E-mail…		Calling the default e-mail program

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

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 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:

Data Field	Nigrawin	Delta/DOS
Date	10 characters, e.g., 10-15-2010	8 characters, e.g., 10-15-10
Remarks/ Comments	max. 30 characters	max. 19 characters
Y-coordinate	Y-coordinate	not available
X-coordinate	X-coordinate	not available

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, 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 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. Since 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 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

Most errors are 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

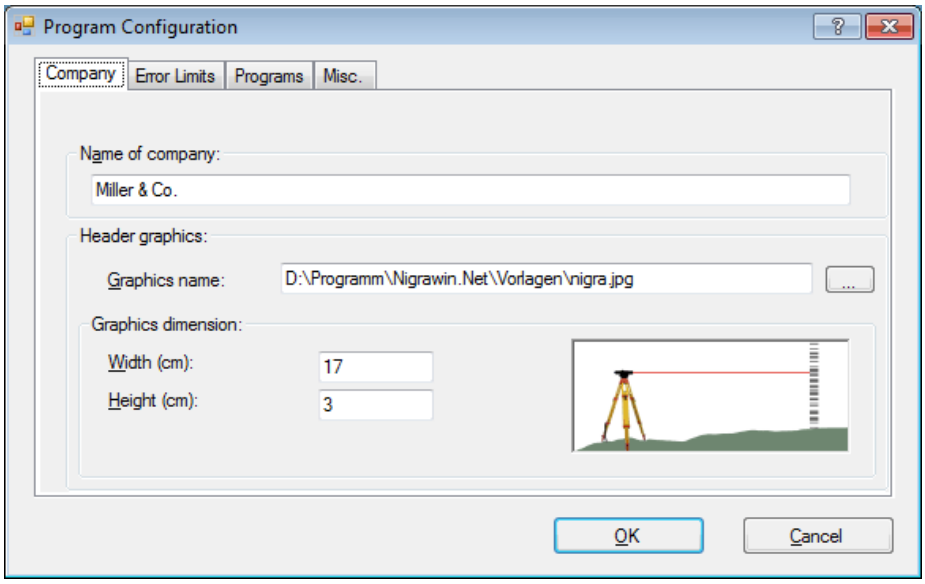
Nigra does not make automatic backups. Make sure tobackup your measurement data regularly ('job'.NIG), the height database ('job'.MDB) and, as far as available, profile (plot) files ('job'.JOK), and network files ('job'.LEV or 'job'.NIV) on an external data medium.

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.



Setting Program Parameters

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.

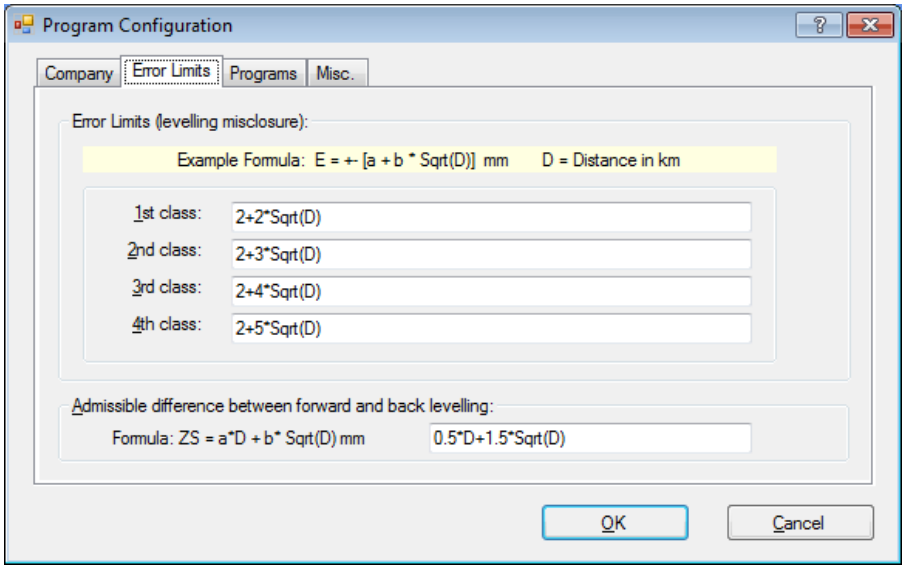
The graphic will be printed with right justification. If you print from the editor, the graphics will not be printed.

Error Limits:

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

Misclosure E (in mm) = a + b * √D (in km)

(a = constant error part in mm, b = systematic error part in mm, D = 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*Sqrt(D). "Sqrt" 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*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:

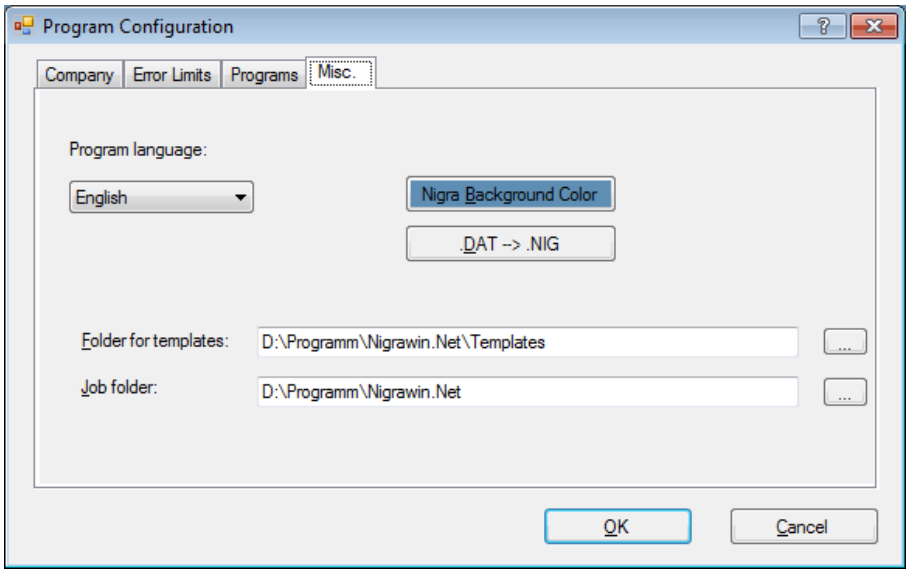
Transfer programs for digital levels: Here an entry is only required if you do not want to use the integrated Nigra data transfer. Enter the name of the transfer program supplied by your manufacturer, including file extensions.

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 must 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.

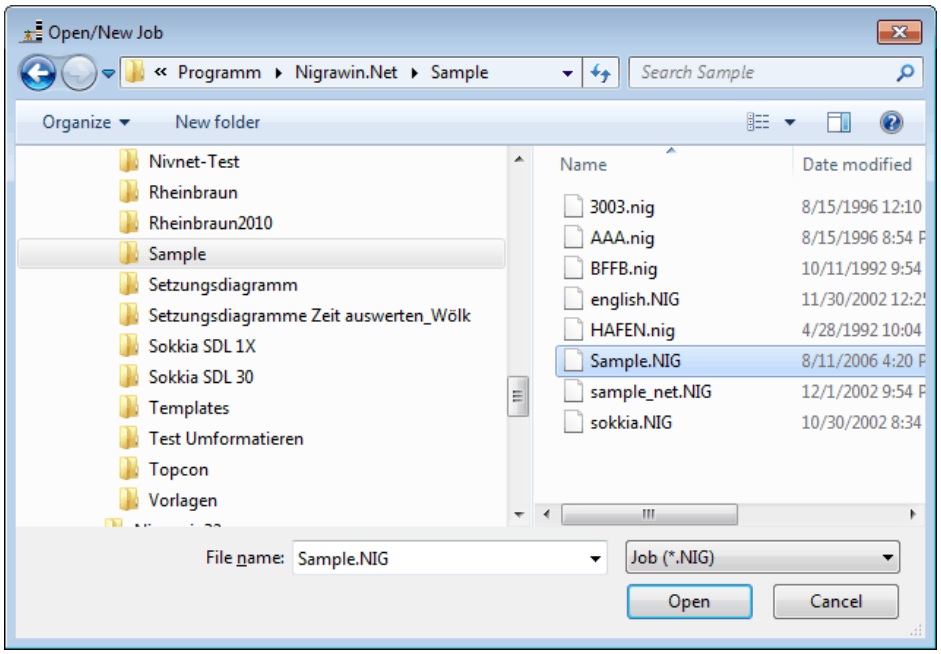
When all data have been entered, click **OK**.

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:

```
ROptional text for job description up to column 72
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
x        1         2         3         4         5         6         7
xDistance<--- Back    Side    Fore ---><--- Point Number --->
```

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 must 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.**

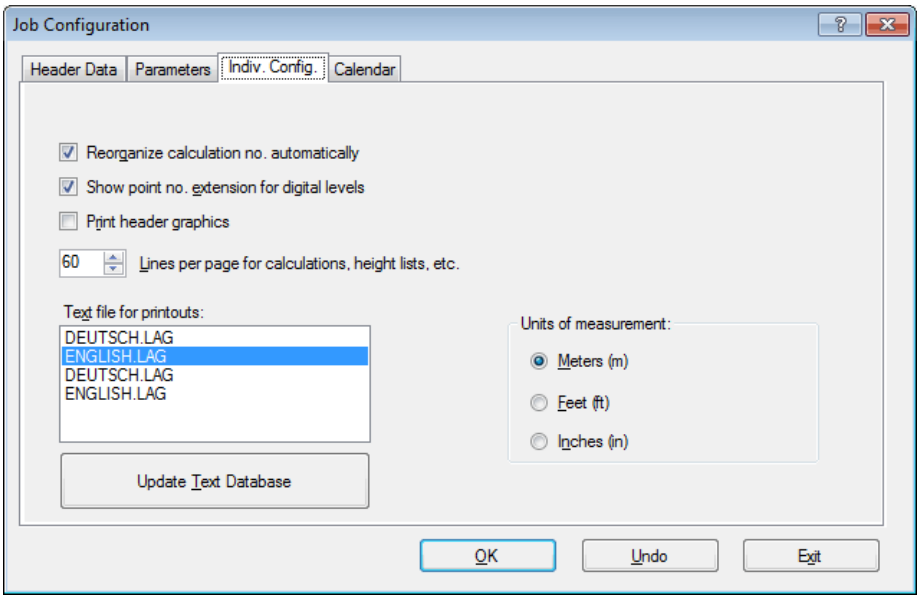
Apart from these job files there are also job-unconnected files, for example, the raw data after transfer to the PC. They will be allocated to a job only after being reformatted into the Nigra format.

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

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 must be 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 in- 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:

```
Meter = Feet*1200/3937        Meter = Inch/39.37
Feet  = Meter*3937/1200       Feet  = Inch/12
Inch  = Meter*39.37           Inch  = Feet*12
```

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 also knows 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 must 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.

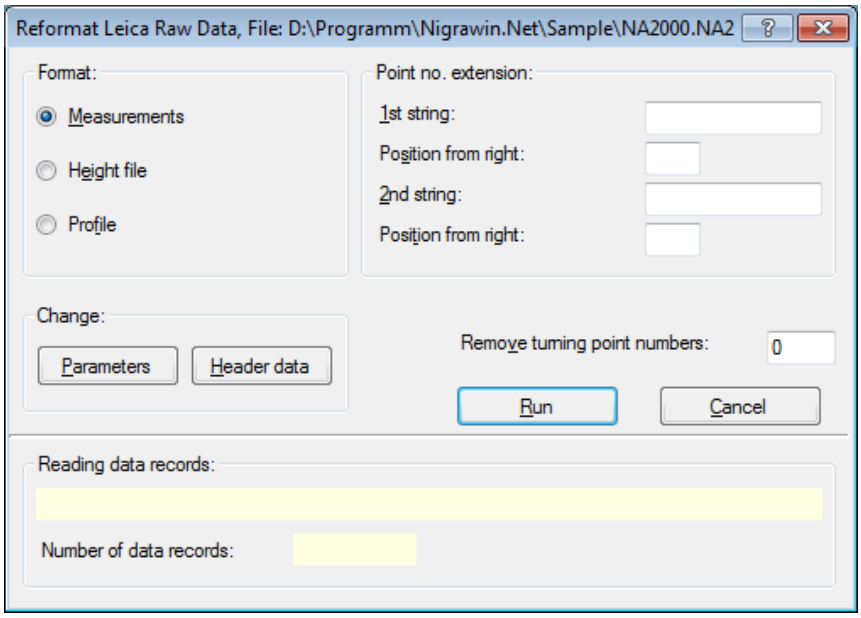
Click the **Leica, Trimble, Topcon** or **SOKKIA** icon or select the item **Leica, Trimble, Topcon** or **SOKKIA** from the **Digital Level** menu.

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.

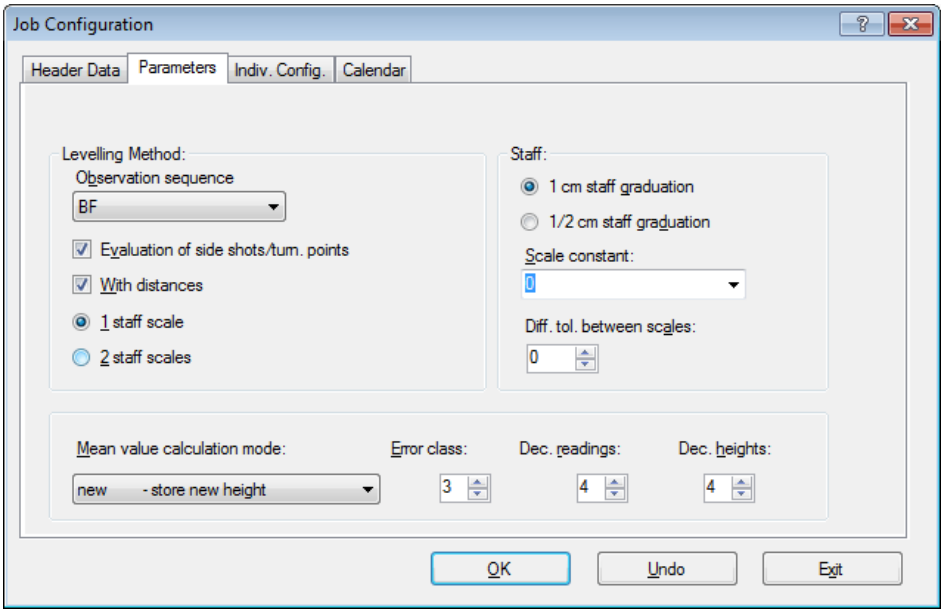
Subsequently, the data transmitted to the PC are reformatted into the Nigra format with the menu item **Format NA/DNA/LS/Sprinter → Nigra, Format Sprinter-GSI → Nigra, Format DiNi Rec E → Nigra, Format DL-100 → Nigra** or **Format SDL → Nigra**. A dialog box for the selection of the file name for the 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**.



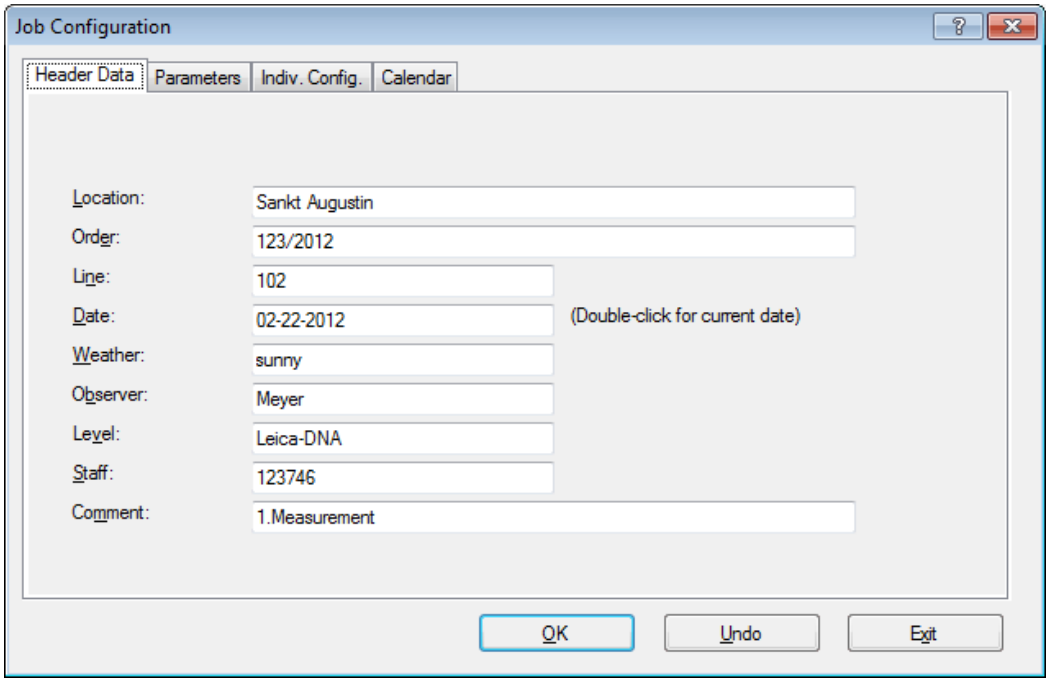
Reformatting Raw Data

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

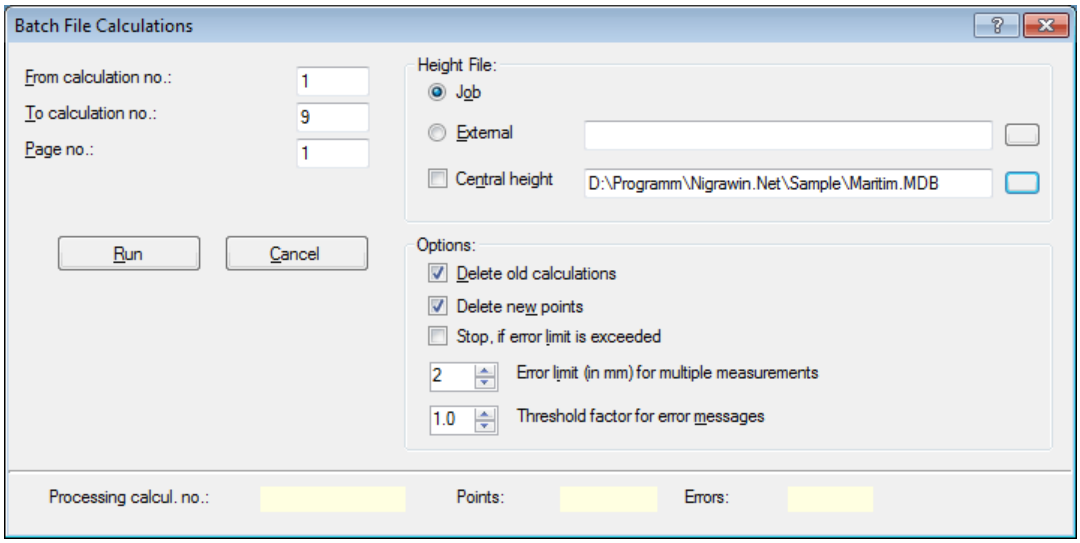


When all entries are completed, click on **OK** or **Exit**.

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:



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 can 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 must 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 fixed points 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
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
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
0   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:

```
                Characters    Significance
1st   line            Raaa    Remark/Comment, a=alphanumeric text
2nd   line            x23456. Text of no
3rd   line            x       significance
4th   line            x Distance ......."
1st   levelling -->   Cn       C=Code for calculation number
                               n=Calculation number
                      Hxx..    H=Header/parameters (20 lines), x=Text
                               or parameters
                      Hxx..    Header/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
                      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
                      .
                      |_____________ 1st column
```

The first column of a data set contains a code (R, C, H, D, E, 0, 1, 2, 3). The fixed points 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:

		Permissible Char.	**Default Value**
Rec. 1	Location (char. 1-19)	alphanumeric	
Rec. 2	Location (char. 20-38)	alphanumeric	
Rec. 3	Order (char. 1-19)	alphanumeric	
Rec. 4	Order (char. 20-38)	alphanumeric	
Rec. 5	Line	alphanumeric	
Rec. 6	Date	alphanumeric	
Rec. 7	Weather	alphanumeric	
Rec. 8	Observer	alphanumeric	
Rec. 9	Level	alphanumeric	
Rec. 10	Staff	alphanumeric	
Rec. 11	Comment (Char. 1-19)	alphanumeric	
Rec. 12	Comment (Char. 20-38)	alphanumeric	

Control data:

Rec. 13 levelling method

1st character, type of evaluation:

- 0 = heights calculation of side shots and turning points — Cancel
- 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 BFBF FBFB
H05a or H15a FBBF BFFB

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 in mm/20 or mm/10 for meters 0.0001 ft for feet 0.01 for inches	numeric	
Rec. 17	Staff graduation/units	1 = cm .5 = 1/2 cm	1
Rec. 18	Calculation with distances	1 = yes 0 = no	1
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	2nd column: 1 3rd column: 3 4th column: m

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 (=**N**umber of **C**alculations) 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 fixed points 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:

```
1      1st Class   +- (2 + 2 * √D) mm
2      2nd Class   +- (2 + 3 * √D) mm
3      3rd Class   +- (2 + 5 * √D) mm
4      4th Class   +- (2 + 7 * √D) mm
for D in km
```

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:

```
D    20.5 b12.5678                    CD123456789
0    15.0           s2.345            CD123456790
```

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 must 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 must 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 (=**n**umber of **c**alculations) 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.

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.

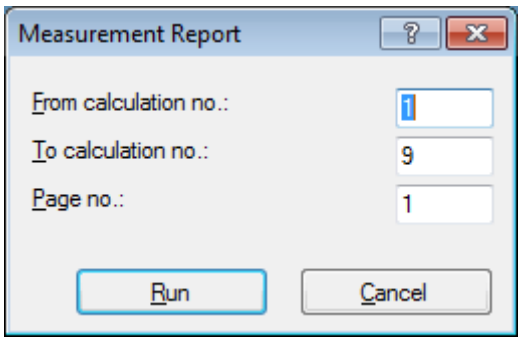
Example:

```
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.



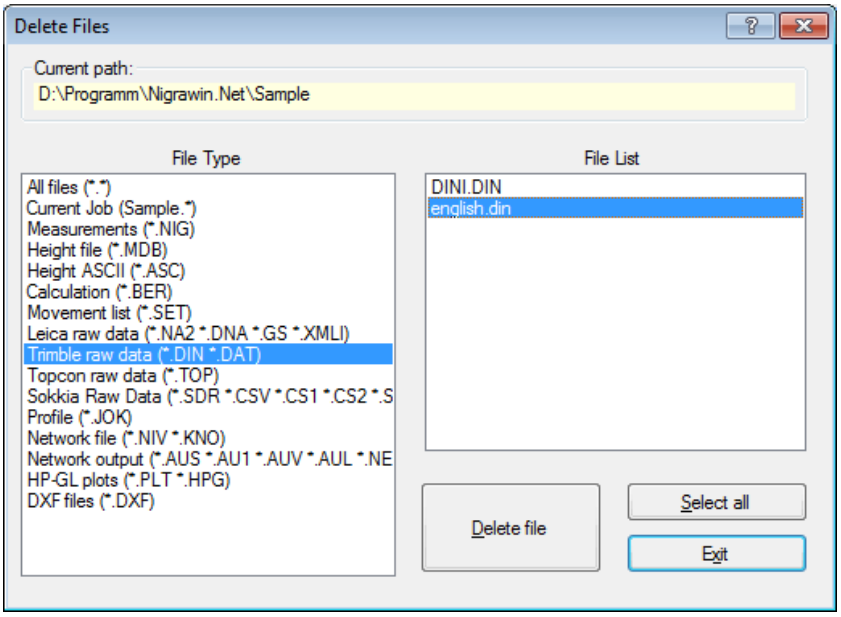
Printing Measurement Data Protocol

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.



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

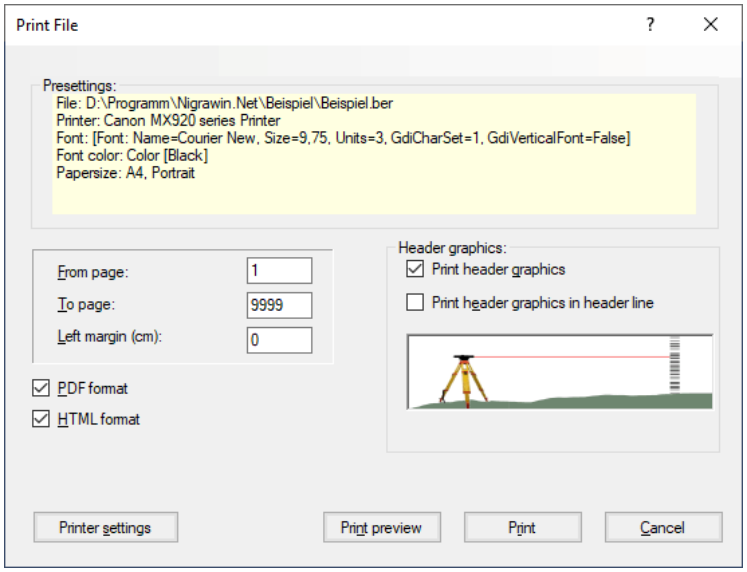
The conversion of ASCII→ANSI is advisable if old DOS files, for example, a *.DAT file from Delta/DOS, are to be used with Windows. This ensures the correct display of the German 'umlauts'.

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**.

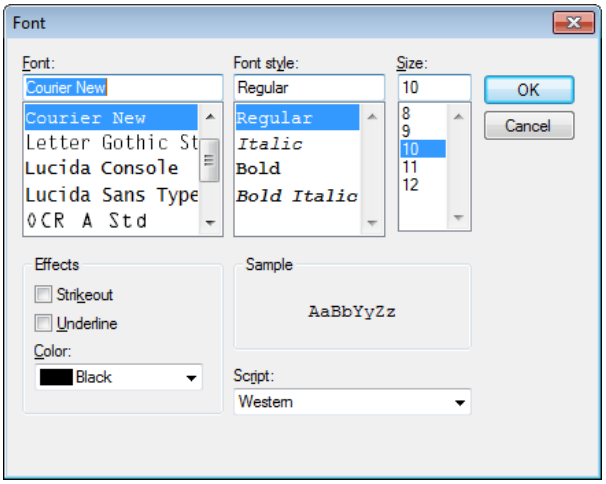
4.9 Printer Setup

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

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

4.11 Exit

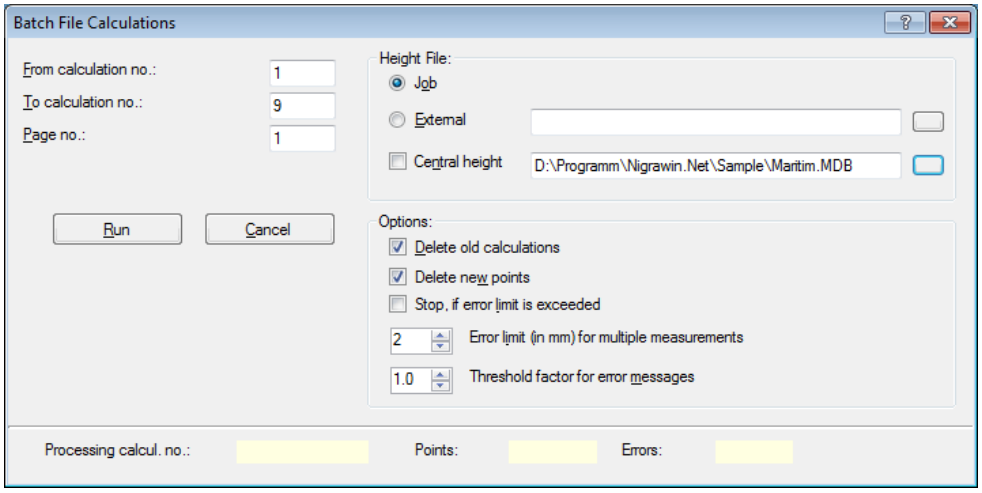
Closes Nigra.

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

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 start 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 considered. 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** are not considered 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 must 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:

Height	-10000 to +10000 m, numeric
Date	measurement date, max. 10 characters, alphanumeric, e.g., 05-15-2010
Calculation no.	<= 999999, numeric
NC	1-99, number of determinations, simultaneously mean weight, numeric
Difference	mean difference in mm, -9999.9 to +9999.9, numeric
Comment	max. 30 characters, alphanumeric
Y-coordinate	-9999999 to +9999999 m, numeric
X-coordinate	-9999999 to +9999999 m, numeric

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
```

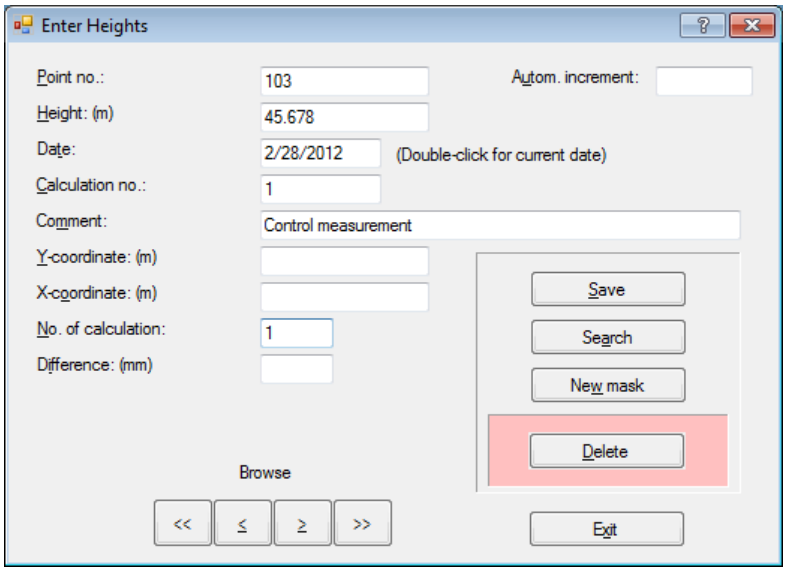
Note:
The digit 0 is also a valid character in the point number. Therefore, the point numbers 1 and 01 are not identical. However, when reformatting digital level raw data, preceding zeros are eliminated.

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 is 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**.

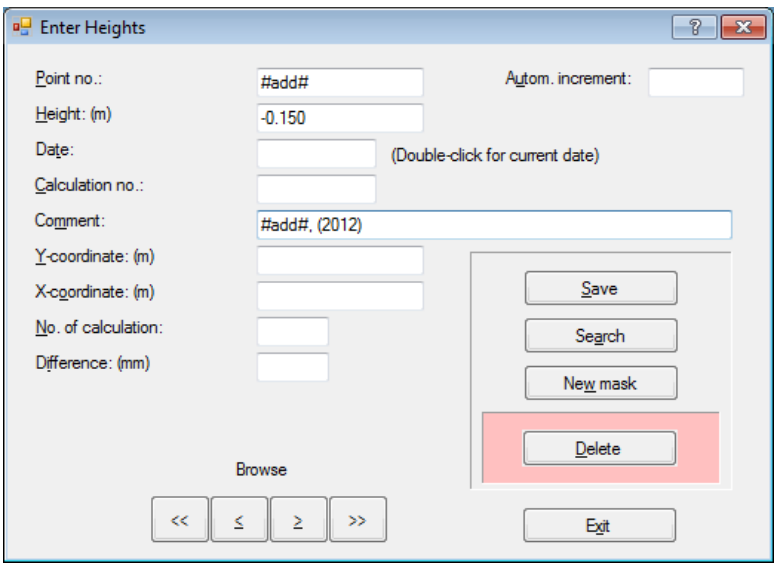
Modifying many heights (for example, to change to another height system)

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#new text** adds "new text" to the old text. Without #add#, the old text will be overwritten by the new text.



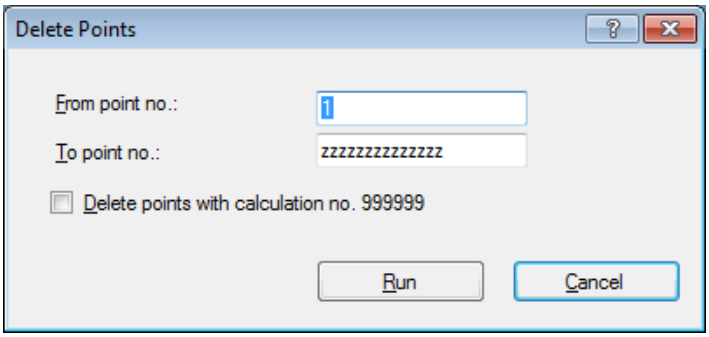
In the example above, the amount 0.15 is subtracted from the stored heights. Also, the text ", (1999)" is added to the database field **Comment**.

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.**).



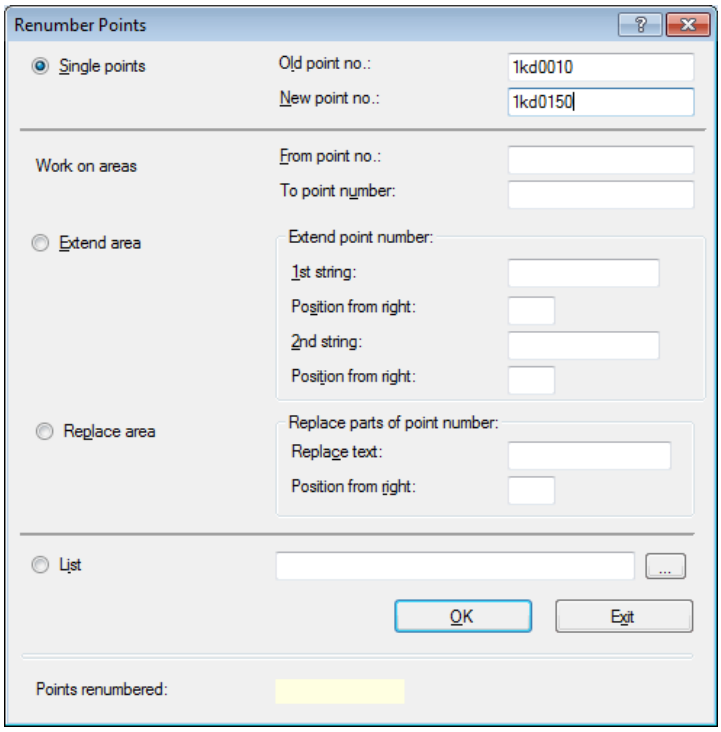
Deleting points

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:

1st 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 are processed one after the other like a single renumbering.

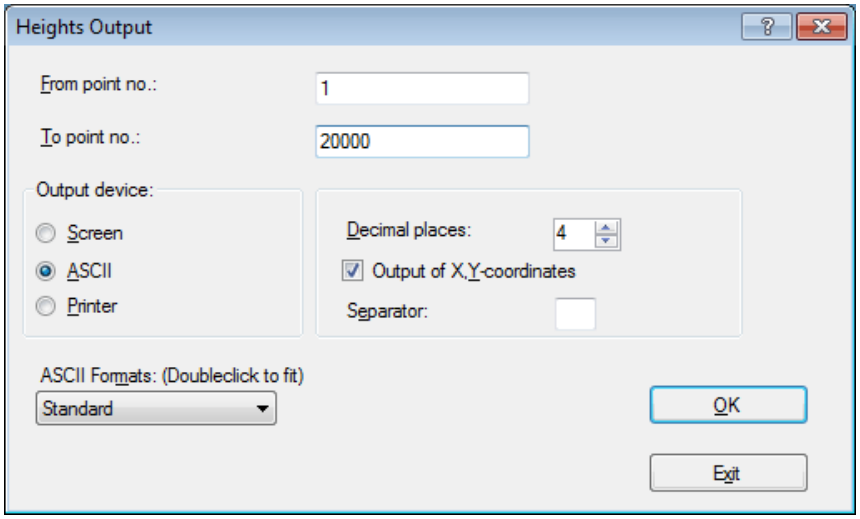
A report of the renumbering and errors by Nigra recognized (e.g., new point number already exists) will be written to a LOG file, which can be shown after the end of renumbering.

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 of **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.

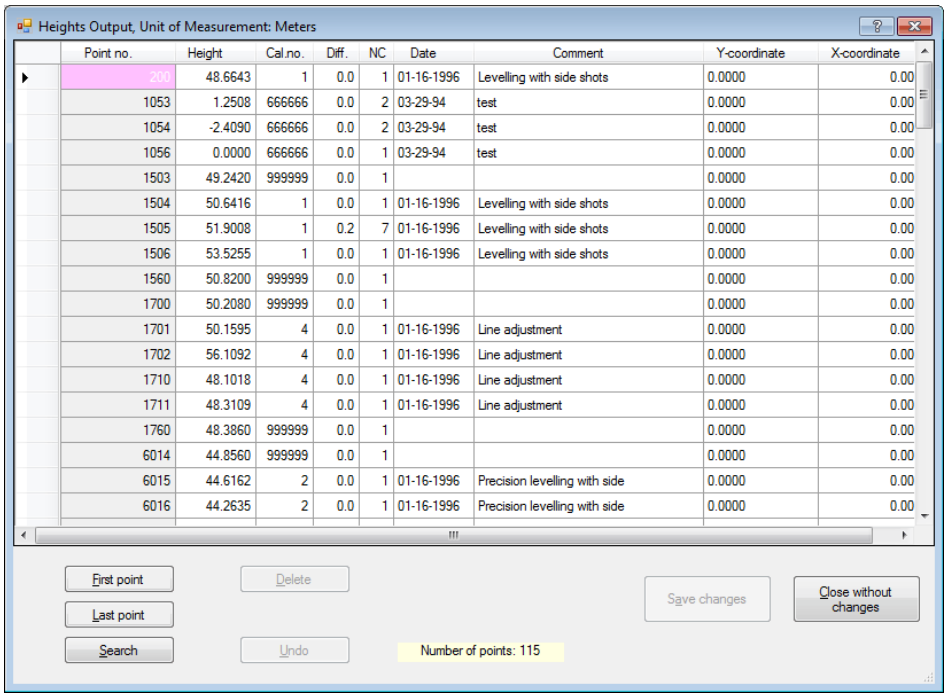
If the **ASCII** output (only standard format) is used, a character can be optionally used as **separator** between the data fields. This is probably useful if data are to be exported to different software.

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:



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 cannot 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

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

User defined ASCII List

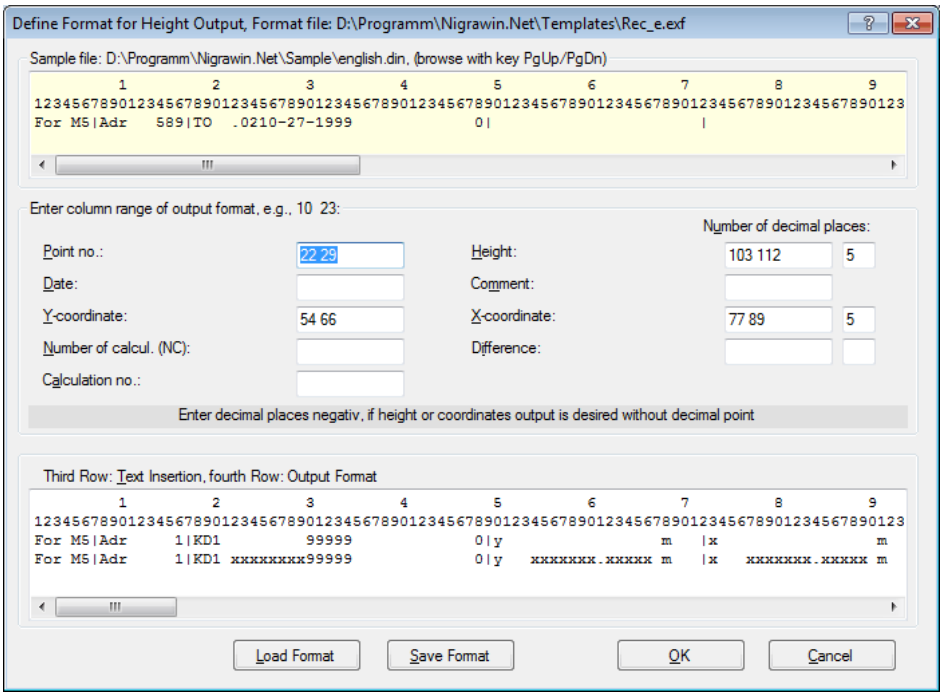
In addition to the Nigra standard format, users can define their own output format. All data fields can be outputted. Invariable text can be inserted.

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:



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

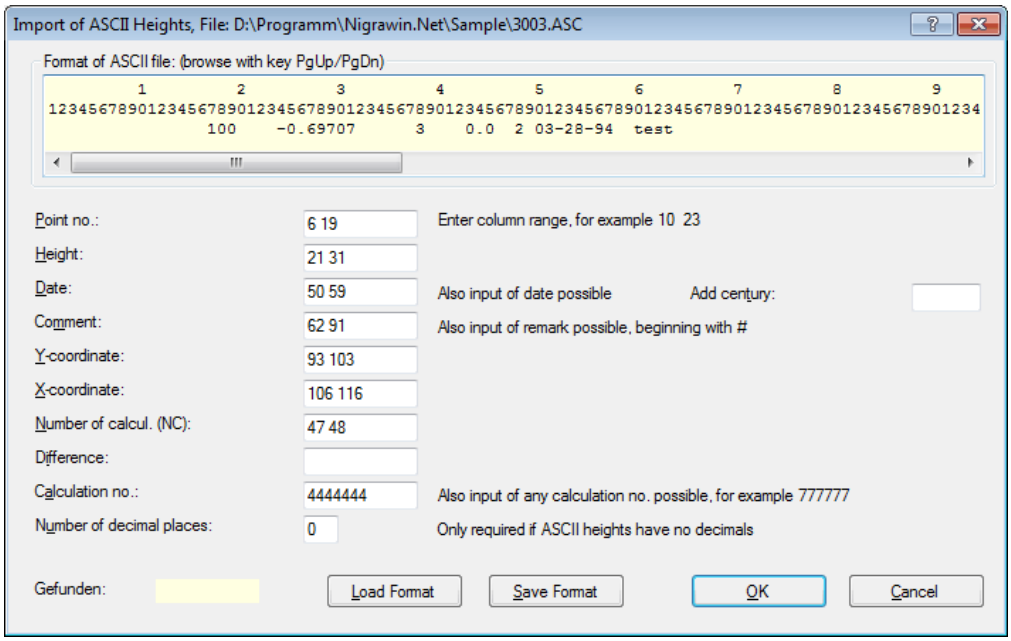
After selecting the point range, a constant calculation number may be defined in the field **Calculation no.** for all points to be imported. Clicking **OK** starts the import.

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 must 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 add 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.

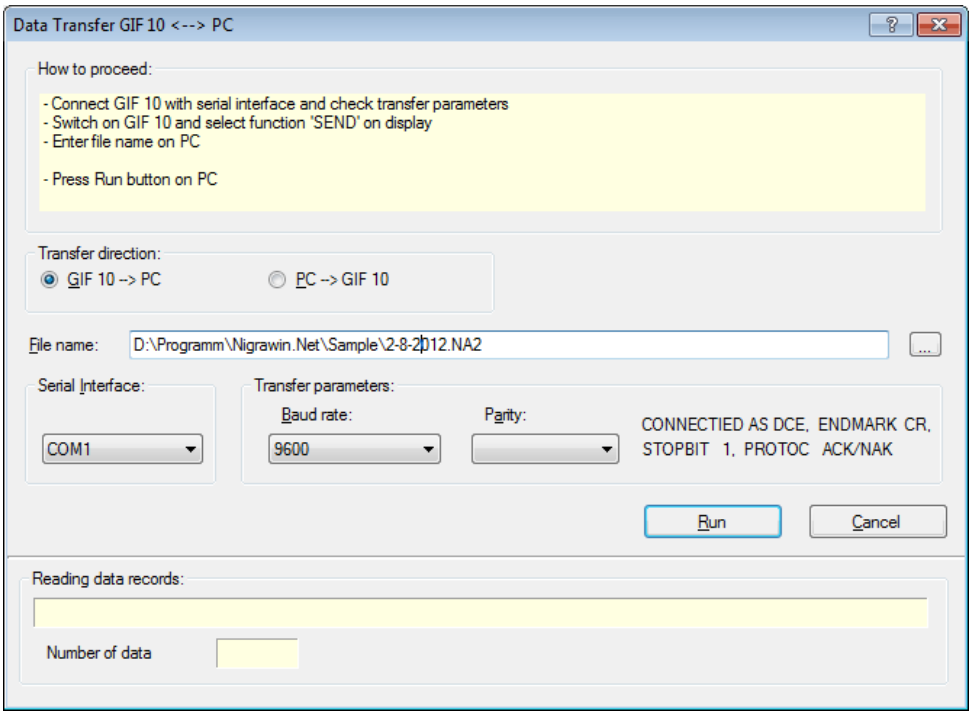
NA2000, NA2002, NA3000, NA3003: Data storage on the REC module and data transfer by GIF 10.

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

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:

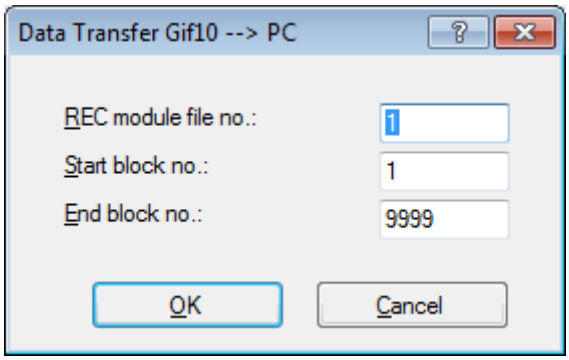
If this not yet the case, activate the option **GIF 10 → PC**. Use the default file name for raw data (current date and file extension .NA2) or enter any file name with the file extension .NA2 for the transfer in the current job folder. Alternatively click on the **File name** button to get a dialog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



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- and 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 data formats.

Example for GSI-8:

```
Point no.       Distance        Staff reading
```

```
11 0003+00900111 32..00+00014570 331106+00014960
```

The following WI are used for levellings:

```
11    Point number
330   Staff reading (MEASURE ONLY)
331   Staff reading backsight
332   Staff reading foresight
333   Staff reading side shot
334   Staff reading set out
335   Staff reading backsight 2
336   Staff reading foresight 2
32    Distance to staff
52    Number and standard deviation of staff reading in the
      case of multiple measurements
83    Height of a point
```

After the start of a levelling and the input of a start 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, info 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):

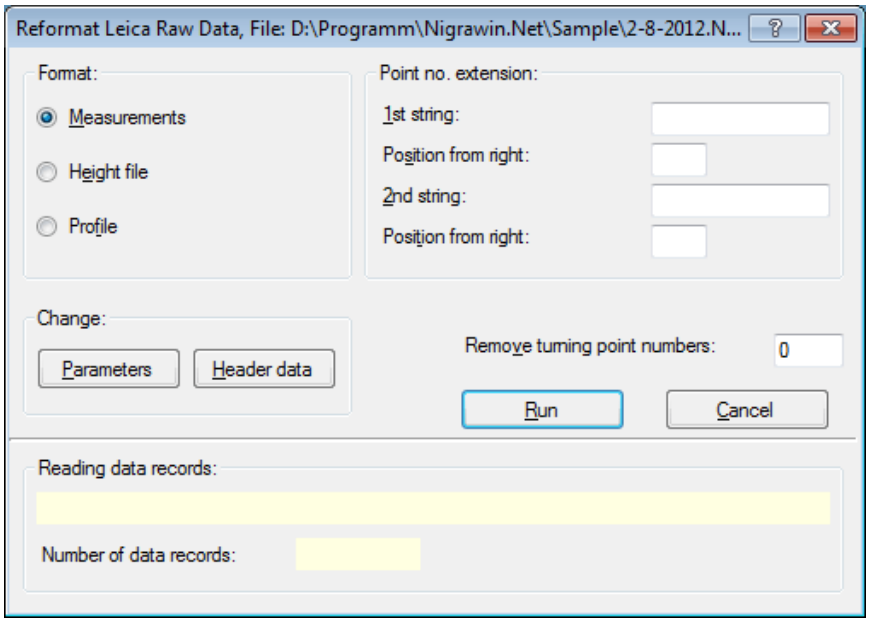
```
Code no.         Info 1          Info 2          Info 3          Info 4
 410001+00000001 42....+04262008 43....+00001234 44....+00000003 45....+00000000
```

In this example, the date 04-26-2008 is entered in info 1 using the characters 04262008. Info are registered right justified. Not all four info 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.

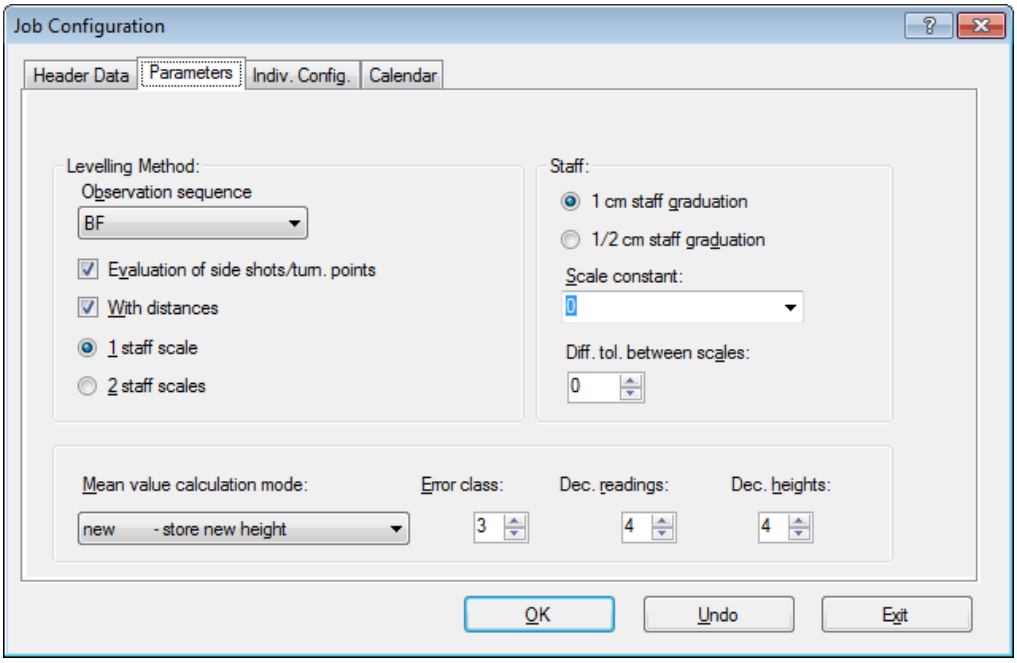
Measurement Data Format

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 in this section.

Methods of Levelling

The method of levelling is consisting 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 start 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+00002240 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:

```
RGSI-8
HSan Augustin        Location
H                    Location
HMovement            Order
H                    Order
H123/97              Line
H04-01-2008          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   30.12 b1.00160                              143
D   30.12 b1.00163                              143
D   32.36                  f1.67388             144
D   32.36                  f1.67386             144
D   15.17          s1.54142                    2736
D   15.17          s1.54144                    2736
E
```

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:

```
B1.....
B2.....
                F1.....
                F2.....
    S1.....
    S2.....
```

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 points 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:

```
110018+00616270 83..16+00000000
110019+00616270 32..00+00017560 331106+00005898
110020+00000000 32..00+00020960 332106+00028104 83..06-00022206
110021+00000000 32..00+00020960 331106+00028102
110022+00416290 32..00+00017560 332106+00005897 83..06-00000001
110023+00000001 32..00+00015560 333106+00005897 83..06-00000001
110024+00000001 32..00+00015560 333106+00005895 83..06+00000001
```

Nigra batch file:

```
RTest measurement BFFB
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
x        1         2         3         4         5         6         7
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.....
            F1.....
    S1.....
    S2.....
```

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 points 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 331106+00012530
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:

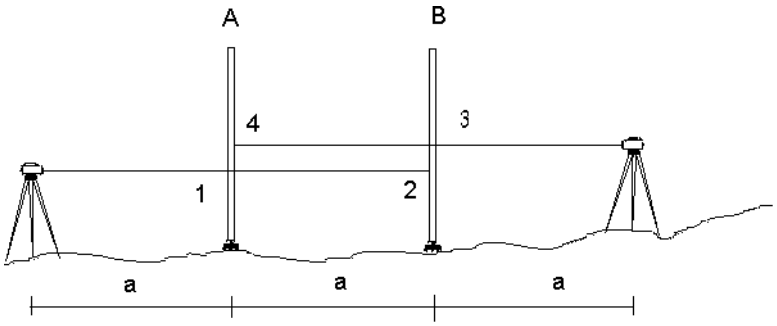
```
RLeica aBF
HSan Augustin        Location
H                    Location
HMovement            Order
H                    Order
H123/97              Line
H05-11-2008          Date
Hsunny               Weather
HJohnson, C.         Observer
HNA3003              Level
H123124              Staff
H                    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
D   17.56 b0.58980                          616270
D   20.96                 f2.81040          416290
D   17.56          s1.58950                      1
D    9.41 b1.55280                          416290
D    7.98                 f1.25300           10001
D    9.41          s1.55290                      3
D    7.98          s1.65300                      4
E
```

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 (1st measurement minus 2nd 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 info 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 sR of staff reading and integration time It:

```
D   10.00          s0.94235              120        n=5/sR=0.30 mm/It=4 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) Bw instead of the standard deviation:

Band width Bw:

```
D   30.00                    f1.29742     121        n=5/Bw=0.20 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 start 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 start 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 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, must 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
                          ...+00000123
1st string= KD, position from the right = 0 or no entry


New point number:                  230
                                123KD

Registered point number= ...+00056005
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 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 (e.g., 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 are 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 info
```

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 info
```

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, BFBF, aFBBF, SimBF, SimBFFB. 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 (xxxxxxxx) are replaced by characters from the table of reference file NACODE.TXT during reformatting into the Nigra format:

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

Info 4 not used

Code block 2 (all levels)

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

Info 2
43....+xxxxxxxx Staff

Info 3
44....+xxxxxxxx Line

Info 4
45....+xxxxxxxx Weather

Code block 3 (all levels)

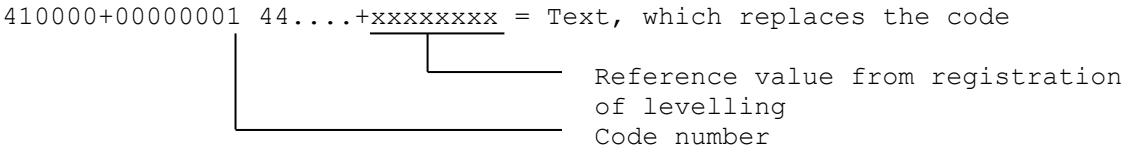
Info 1
410029+00000003 42....+xxxxxxxx Location

Info 2
43....+xxxxxxxx Order

```
Info 3
                44....+xxxxxxxx       Comments

Info 4
                45....+00000000       not used
```

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:



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,
```

```
                                in example 15.8 °C
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 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 must 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 staff s 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 levelling. If a levelling ends with a staff different from the starting staff and the new levelling 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 outs, 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 takes 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
m0 (Mean staff meter):                    < -20 or > 20 ppm
αT (Linear coefficient of extension): < 0 or > 1  ppm/°C
```

Formula for correction:

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

```
L  = corrected staff reading [m]
L' = staff reading          [m]
l0 = index correction (zero correction)  [mm]
vG = graduation correction   [mm]

m0 = mean staff meter  [ppm]
αT = linear coefficient of extension [ppm/°C]
T0 = reference temperature       [°C]
T  = temperature during the measurement [°C]
```

The values for l_0, m_0, α_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) must be stored with a text editor in the ASCII file LATTE.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   αT = Linear coefficient of extension in
                ppm/°C
        20-29   m0 = mean staff meter in ppm at reference
                temperature
        30-39   T0 = reference temperature for mean
                staff meter in °C
        40-58   any staff description, is not evaluated.
                Entry is optional.
        60-69   vG, graduation correction in mm
        70-79   l0, 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:

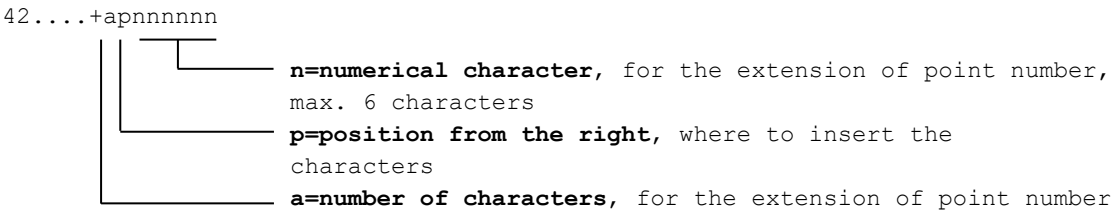
```
Run.no.  aT[ppm/C] mo [ppm]  To [C]    Staff description   vG [mm]   lo [mm]
         1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890
9019     0.59      5.45      24.6      GPCL3 - Nedo 9019   2.0       0.0001
9020     0.49      -3.45     20.0      GPCL3 - Nedo 9020   1.5
*9021     0.34      3.45      21.8     GPCL3 - Nedo 9021
```

Code block 5 (all levels)

```
Info 1
410012+00000005 42....+00nnnnnn    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:



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
                            └──── number=4, position=7,  extension=0308

110028+00950002 32..00+00002230 331116+00016810
          └──── 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
                                  (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+0000000000000010 42....+000000000000bcde
```

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 info 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):

```
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+00012503 83..06+00918127
110008-00000001 32..00+00018770 331106+00019233
110009+00416260 32..00+00016470 332106+00006153 83..06+00931207
110010+00416260 32..00+00016470 333106+00006153 83..06+00931207
110011+00416260 32..00+00019740 331106+00028574
110012+00616270 32..00+00020100 332106+00006424 83..06+00953357
110013+00616270 32..00+00020650 331106+00025638
110014-00000152 32..00+00025440 332106+00000996 83..06+00977999
110015-00000152 32..00+00021980 331106+00027352
110016+00416280 32..00+00018220 332106+00005885 83..06+00999466
110017+00416280 32..00+00015570 331106+00016414
110018-00000151 32..00+00014500 332106+00022930 83..06+00992950
110019-00000151 32..00+00017750 331106+00005661
110020+00900112 32..00+00011300 332106+00006017 83..06+00992594
```

Corresponding table of references NACODE.TXT:

```
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....+00000015=NA3000, Nr. 25345
410000+00000002 43....+00000002=Nedo 5432, 5433
410000+00000002 43....+00000012=Nedo 5445, 5446
410000+00000002 44....+00000022=Line 2a
410000+00000002 44....+00000122=Line 46
410000+00000002 45....+00000001=sunny
410000+00000002 45....+00000002=cloudy
410000+00000002 45....+00000011=overcast
410000+00000003 42....+00000001=Sankt Augustin
410000+00000003 42....+00000021=Chicago
410000+00000003 43....+00000011=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
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
x        1         2         3         4         5         6         7
xDistance<--- Back    Side    Fore ---><--- Point Number -->
C1
HSankt Augustin      Location
H                    Location
H2008-123/4          Order
H                    Order
HLine 2a             Line
H04-12-2008          Date
Hsunny               Weather
HLincoln             Observer
HNA2000, Nr. 14235   Level
HNedo 5445, 5446     Staff
H2nd movement measur Comments
Hement March 2008    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
H3                   Decimal places for heights in calculations
H4                   Decimal places for readings in calculations
E12m                 E/Mean value/Error class/Unit of measurement
D   14.57 b1.49600                        3617900111
D   17.50                   f1.25030               1
D   18.77 b1.92330                                 1
D   16.47                   f0.61530       3617416260
D   16.47          s0.61530                3617416260
D   19.74 b2.85740                         3617416260
D   20.10                   f0.64240       3617616270
D   20.65 b2.56380                         3617616270
D   25.44                   f0.09960              152
D   21.98 b2.73520                                152
D   18.22                   f0.58850       3617416280
D   15.57 b1.64140                         3617416280
D   14.50                   f2.29300              151
D   17.75 b0.56610                                151
D   11.30                   f0.60170       3617900112
E
```

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

Distance   Back        Side        Fore          Height      Point No.
 14.57    1.4960                                91.567     3617900111
 17.50                             1.2503        91.813              1
 18.77    1.9233
 16.47                             0.6153        93.120     3617416260
 16.47                0.6153                     93.120     3617416260
 19.74    2.8574
 20.10                             0.6424        95.335     3617616270
 20.65    2.5638
 25.44                             0.0996        97.799            152
 21.98    2.7352
 18.22                             0.5885        99.946     3617416280
 15.57    1.6414
 14.50                             2.2930        99.294            151
 17.75    0.5661
 11.30                             0.6017        99.258     3617900112

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:

Level input	**Assignment to Nigra header data**
Job name	Order
Observer name	Observer
Line name	Line
Date	Date
Comment 1	Weather
Comment 2	DNA: Level, LS: Location
Staff 1 + Staff 2	Staff

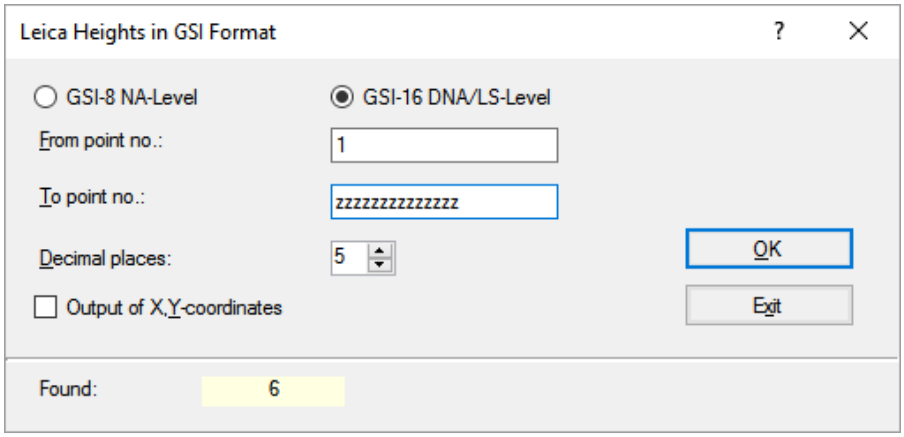
The reformatting of XML format is executed with the menu item **Format DNA/LS → Nigra**. Nigra distinguishes the GSI and XML format automatically. Error messages during reformatting refer to the file …XML_.GSI, which Nigra creates as an intermediate format from the Leica XML raw data.

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.

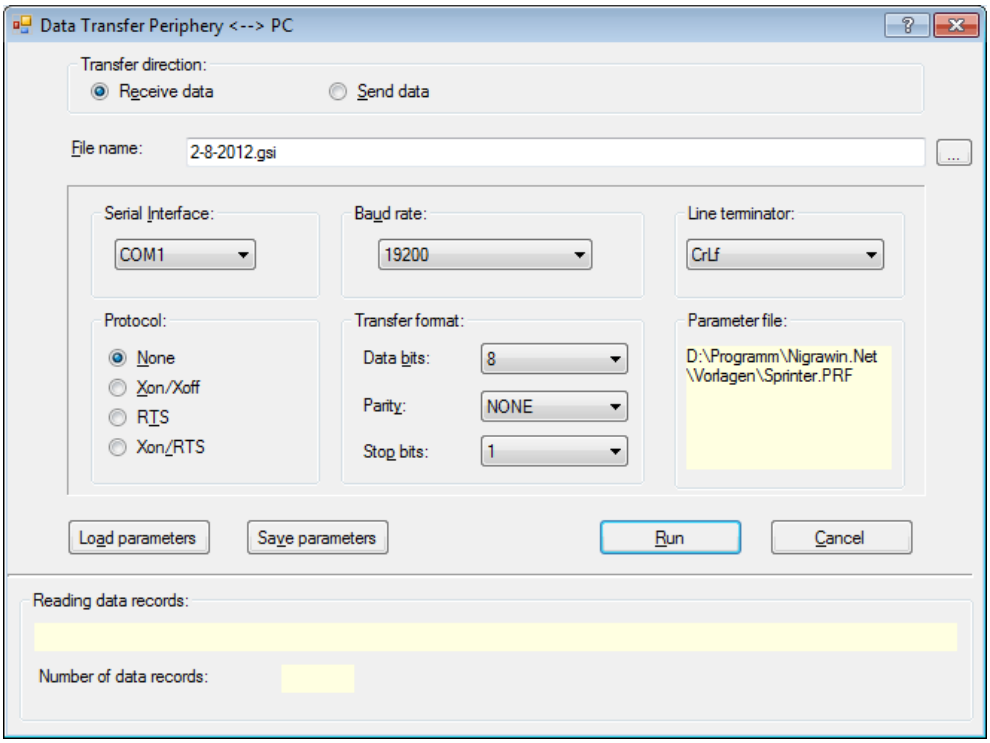
7.2.3 Sprinter Raw Data → PC

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 parameters 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:

```
      Point no.       Distance       staff reading
11....+00900111 32..00+00014570 330.06+00014960
```

The following word identification (WI) are used for levellings with Sprinter:

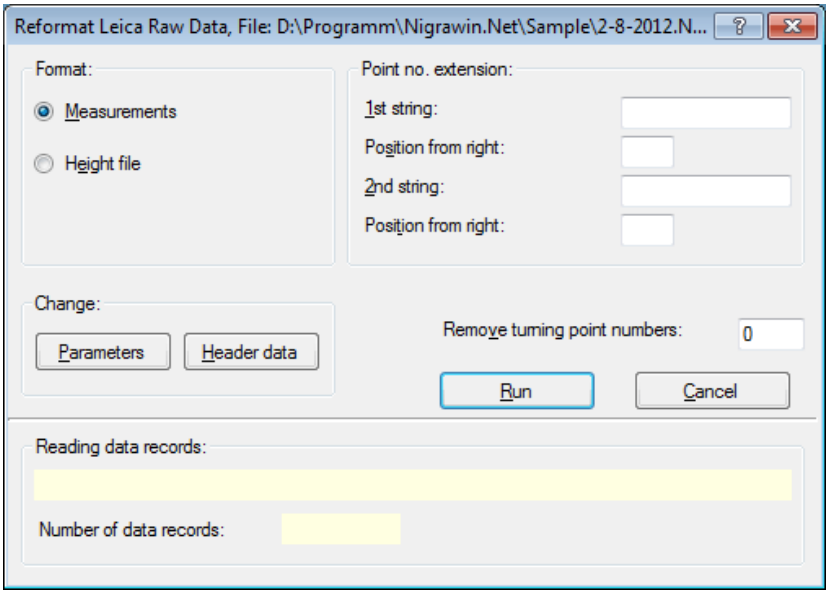
```
11     Point number
330   Staff reading (Measure Only)
331   Staff reading, backside  (since firmware P01.01.03)
332   Staff reading, foreside (since firmware P01.01.03)
32     Distance to staff
83     Height of a point
```

Nigra also processed 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, must 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
                         ...+00000123
1st string= KD, position from the right = 0 or no entry

New point number:                  230
                                123KD

Registered point number= ...+00056005
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
```

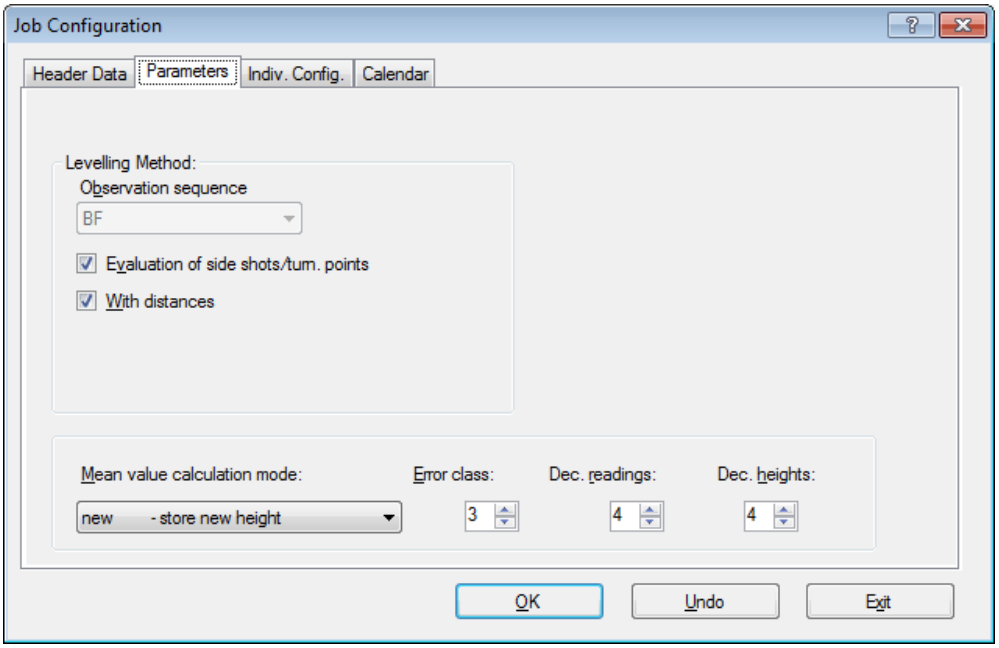
The negative sign (for points not to be changed) and leading zeros will be removed from the point number. Point numbers with more than 14 digits due to point number extensions are cut off from the left.

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 **Remove turning point numbers** during reformatting (only effective for format **Measurements**).

Note: All measurement points must have a higher number!

Defining Parameters



Defining Parameters

Levelling Method

The method of levelling is consisting 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 start 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 start 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....+00000000 32...6+00088621 331.06+00009280 .....
11....+00000400 32...6+00098621 332.06+00010281 .....
```

Nigra batch file:

```
RTest measurement with Leica Sprinter
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
x        1         2         3         4         5         6         7
xDistance<--- Back    Side    Fore ---><--- Point Number -->
C1
HSankt Augustin      Location
H                    Location
HTest                Order
H                    Order
H12a                 Line
H05/09/2010          Date
Hsunny               Weather
HMeyer               Observer
HLeica-Sprinter      Level
H4 m                 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
```

```
D    7.86                   f0.828100
D    8.86 b0.928000
D    9.86                   f1.028100            400
E
```

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

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

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 mm[1)], 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.

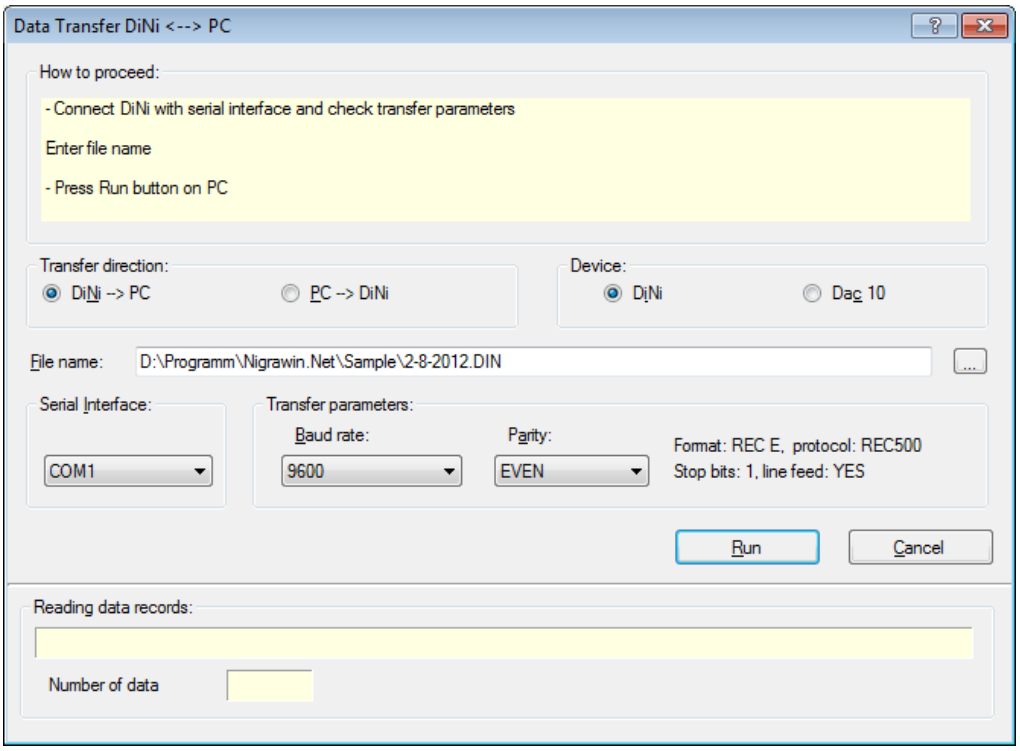
7.3.1 DiNi Raw Data ↔ PC

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

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 breakdown 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.

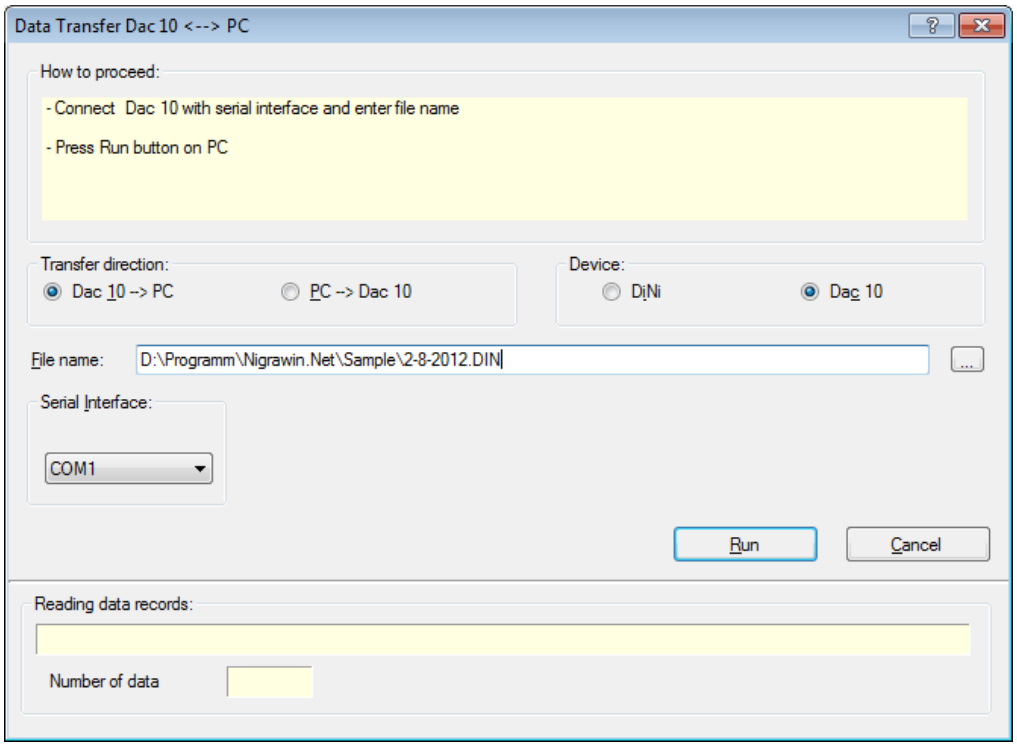
Data Transfer with Dac 10

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**.

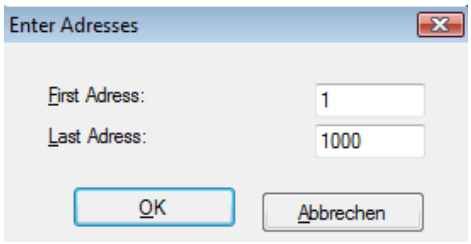
Because the Dac 10 has no power switch on and no possibility of entering transfer parameters, the device will be fully controlled by Nigra. For technical information, the transfer parameters used are baud rate 9600, parity None, data bits 7, stop bits 2.

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) and 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 reformatting 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):

```
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678
```

```
        1        2        3        4        5        6        7        8        9       10       11
For M5|Adr     4|TO  Start-Line      BF       5|                  |                  |                  |
For M5|Adr     5|KD1     1000    2           5|                  |                  |Z       123.4567 m  |
For M5|Adr     6|KD1     1000    2           5|Lr       0.9446  m  |E          3.53 m  |                  |
```

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, the line number, 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 start 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:

```
For M5|Adr     4|TO  Start-Line BF          5|                  |                  |                  |
For M5|Adr     5|KD1     1000    2           5|                  |                  |Z       123.4567 m  |
```

Meanings:

```
Start-Line BF = line measurement with observation sequence BF
1000          = start 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 information**.

Individual remarks line:

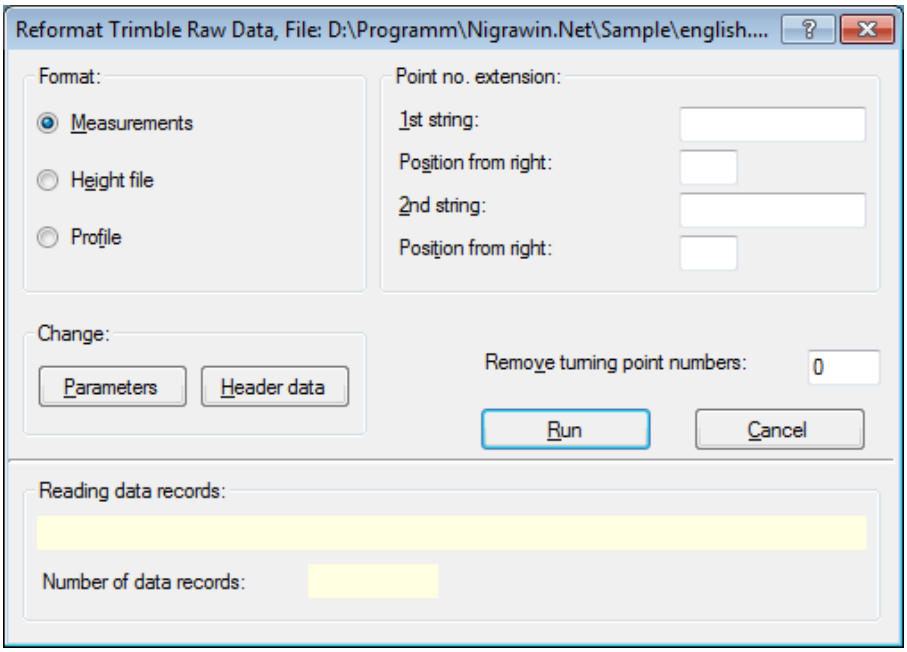
```
For M5|Adr    10|TO  .0210-10-2008             |                  |                  |                  |
```

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.



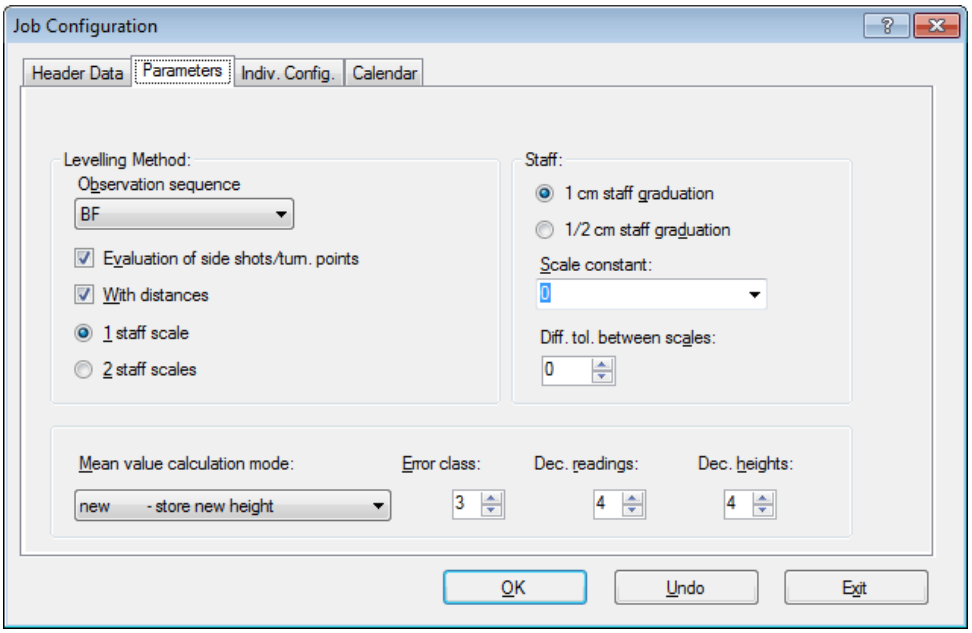
Reformatting of Raw Data

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 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, resp. ft or in)
Distances:           1 (=yes)
Scale constant:      0
```

For levellings with **two** staff readings, the **Diff. tolerance between scales** must be defined (difference 1st measurement – 2nd 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
```

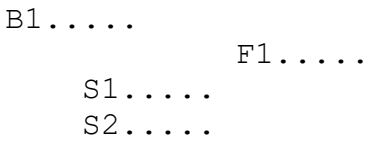
Observation Sequence DiNi aBF (with line BF)

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 points 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:



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        0.94346 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        4   11 14:39:39    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        1.45321 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         9|Sr         52.980 m   |Sv        53.150 m   |Z       124.49747 m   |
For M5|Adr    34|TO  End-Line                  9|                    |                    |                    |
```

Nigra Batch File:

```
RTest DiNi aBF S
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
x        1         2         3         4         5         6         7
x Distance<--- Back  Side   Fore---><--- Point Number --->
C1
HBonn                Location
H                    Location
HTest                Order
H                    Order
H12                  Line
H09-17-2010          Date
Hsunny               Weather
HMeier               Observer
HDiNi 10             Level
HNedo 2345, 2346     Staff
HTest DiNi-aBF Z     Comments
H                    Comments
H00a                 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.
H1                   Number of staff scales for readings
H0                   Scale constant for 2 staff graduations
H0                   Difference tolerance for two readings
H1                   Staff graduation 1=cm,feet,inches, 0.5=1/2cm
H1                   With distances 1=yes, 2=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   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          s1.42990                  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   14.39          s1.43993                   1160003           11 14:39:53    9
D   14.69          s1.44563                   1160004           11 14:40:33    9
D   12.39          s1.45321                   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, line number, 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 start 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:

```
      Hi = Ha + [hi] + vi     with vi = w * [Si] / [Sn]
      Hzi= Hi + [hzi
With:
      Ha    = Fixed point height
      Hi    = Turning point height i
      Hz    = Side point height
      [hi]  = Sum of measured height differences b-f till
              point i
      [hzi] = Height difference  b-s
      w     = Misclosure
      [Si]  = Sum of distances b and f to point i
      [Sn]  = 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** P**rofile File**). For the profile creation, the length of point numbers is limited to 8 characters. All points including heights, are transferred, except the related start 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+, resp. 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 information**.

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

.01aabcde:

```
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

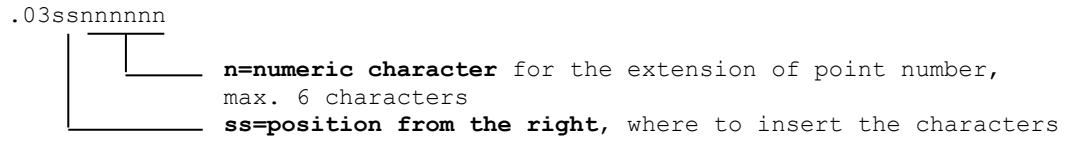
.0210-10-2008 = date 10-10-2008

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.*

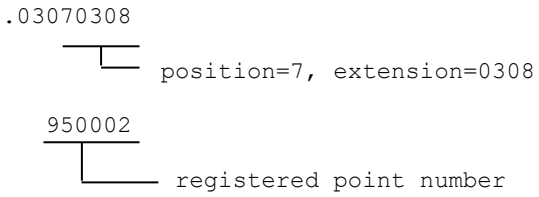
Code .03 - Point number extension

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:



Example:



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)
  ||└──────── remark from registration of levelling
  |└───────── code number
```

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 must 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 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.

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
m0 (Mean staff meter):                    < -20 or > 20 ppm
αT (Linear coefficient of extension): < 0 or > 1  ppm/°C
```

Formula for correction:

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

```
L  = corrected staff reading [m]
L' = staff reading          [m]
l0 = index correction (zero correction)  [mm]
vG = graduation correction   [mm]

m0 = mean staff meter  [ppm]
αT = linear coefficient of extension [ppm/°C]
T0 = reference temperature       [°C]
T  = temperature during the measurement [°C]
```

The values for l_0, m_0, α_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) must be stored with a 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   αT = Linear coefficient of extension in
                ppm/°C
        20-29   m0 = mean staff meter in ppm at reference
                temperature
        30-39   T0 = reference temperature for mean
                staff meter in °C
        40-58   any staff description, is not evaluated.
                Entry is optional.
        60-69   vG, graduation correction in mm
        70-79   l0, 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:

```
Run.no.  aT[ppm/C] mo [ppm]  To [C]    Staff description   vG [mm]   lo [mm]
         1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890
9019     0.59      5.45      24.6      GPCL3 - Nedo 9019   2.0       0.0001
9020     0.49      -3.45     20.0      GPCL3 - Nedo 9020   1.5
*9021     0.34      3.45      21.8     GPCL3 - Nedo 9021
```

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, 2nd part

Code .26 = Direct entry order

Code .27 = Direct entry order, 2nd part

Code .28 = Direct entry comments

Code .29 = Direct entry comments, 2nd 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.

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     1|TO  .01001355                |                    |                    |                    |
For M5|Adr     1|TO  .0209-10-2008              |                    |                    |                    |
For M5|Adr     1|TO  Start-Line         BF     9|                    |                    |                    |
For M5|Adr     2|KD1      123   22             9|                    |                    |Z       123.45600 m |
For M5|Adr     3|KD1      123   22 14:33:21     9|Lr        0.94346 m |E          23.577 m |                    |
For M5|Adr     4|KD1        1   22 14:33:32     9|Lv        0.30990 m |E          23.592 m |                    |
For M5|Adr     5|KD1        1   22 14:33:32     9|                    |                    |Z       124.08956 m |
For M5|Adr     6|KD1        1   22 14:33:48     9|Lr        1.04343 m |E          21.677 m |                    |
For M5|Adr     7|KD1        2   22 14:33:56     9|Lv        2.14900 m |E          22.492 m |                    |
For M5|Adr     8|KD1        2   22 14:33:56     9|                    |                    |Z       122.98399 m |
For M5|Adr     9|TO  Repeat measurement          9|                    |                    |                    |
For M5|Adr    10|KD1        2   22 14:34:16     9|Lv        2.14988 m |E          22.492 m |                    |
For M5|Adr    11|KD1        2   22 14:34:16     9|                    |                    |Z       122.98311 m |
For M5|Adr    12|KD1        2   22 14:34:28     9|Lr        0.94346 m |E          33.287 m |                    |
For M5|Adr    13|TO  Intcal. Sightings           9|                    |                    |                    |
For M5|Adr    14|KD1     4401   22 14:34:48     9|Lz        1.60890 m |E           4.592 m |Z       122.31767 m |
For M5|Adr    15|KD1     4402   22 14:35:01     9|Lz        1.55990 m |E           4.894 m |Z       122.36667 m |
For M5|Adr    16|TO  End of intcal. sight.      9|                    |                    |                    |
For M5|Adr    17|KD1        3   22 14:35:22     9|Lv        0.30990 m |E          34.592 m |                    |
For M5|Adr    18|KD1        3   22 14:35:22     9|                    |                    |Z       123.61667 m |
For M5|Adr    19|KD1        3   22              9|                    |dz       0.00133 m |Z       123.61800 m |
For M5|Adr    20|KD2        3   22   3          9|Sr         78.550 m |Sv         80.670 m |Z       123.61667 m |
For M5|Adr    21|TO  End-Line                    9|                    |                    |                    |
```

Nigra batch file (measurement data):

```
RMeasurement with DiNi 10
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
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    9
D   23.59                  f0.30990                 1           22 14:33:32    9
D   21.68 b1.04343                                 1           22 14:33:48    9
D   22.49                  f2.14988                 2           22 14:34:16    9
D   33.29 b0.94346                                 2           22 14:34:28    9
D    4.59           s1.60890                    4401           22 14:34:48    9
D    4.89           s1.55990                    4402           22 14:35:01    9
D   34.59                  f0.30990                 3           22 14:35:22    9
E
```

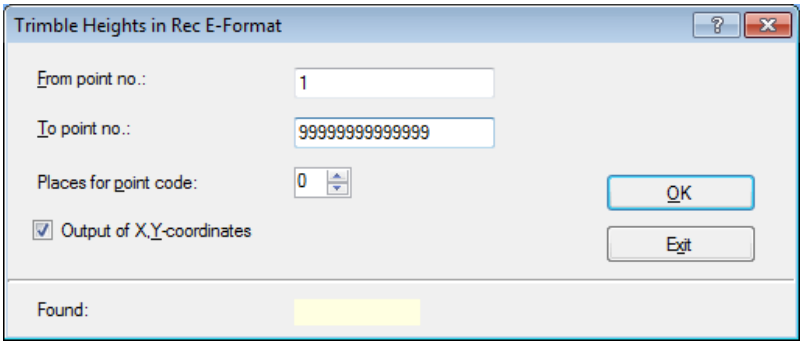
Nigra calculation output:

```
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

Distance   Back        Side        Fore          Height      Point No.
 23.58   0.94346                              123.45600            123
 23.59                            0.30990      124.08995              1
 21.68   1.04343
 22.49                            2.14988      122.98387              2
 33.29   0.94346
  4.59               1.60890                  122.31871           4401
  4.89               1.55990                  122.36771           4402
 34.59                            0.30990      123.61800              3

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 overwritten.

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) cannot read Y-,X-coordinates. In this case deactivate 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 M5|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.

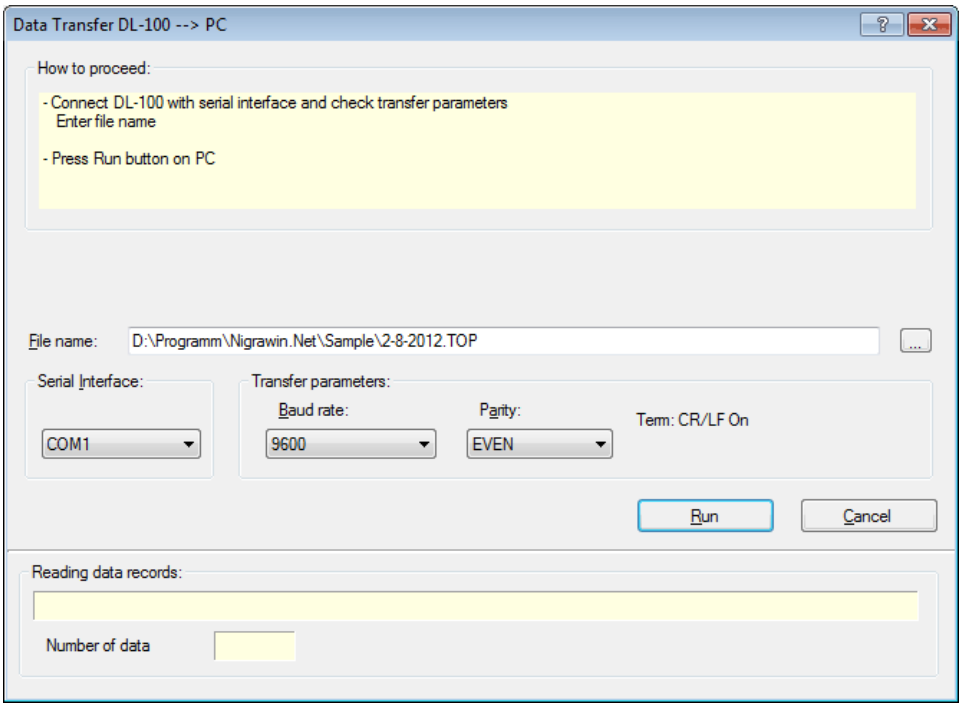
7.4.1 Topcon DL-100 Raw Data → PC

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 and 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 example10052008.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 levellings 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:

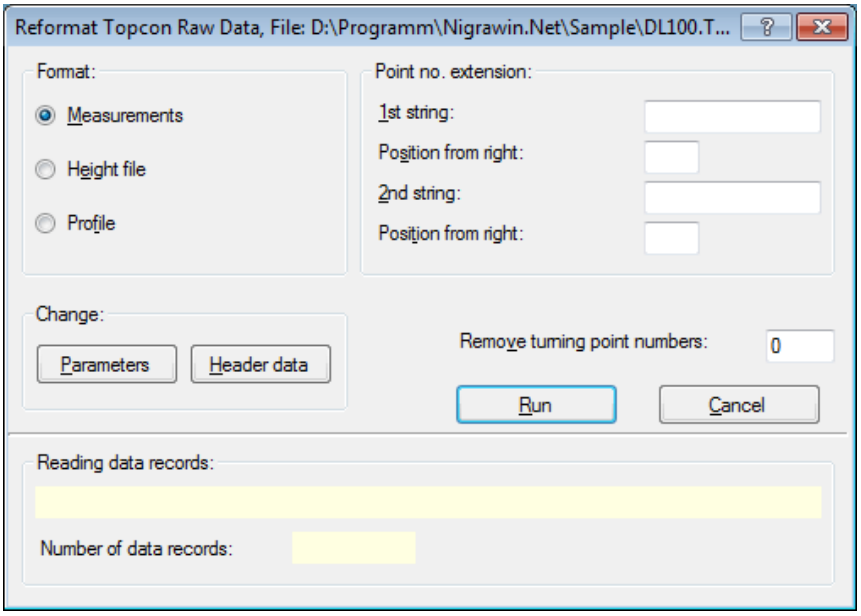
```
b             = Line measurement with observation sequence BF
7518          = Start point number
+11514500     = Ground height  115.14500
```

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.



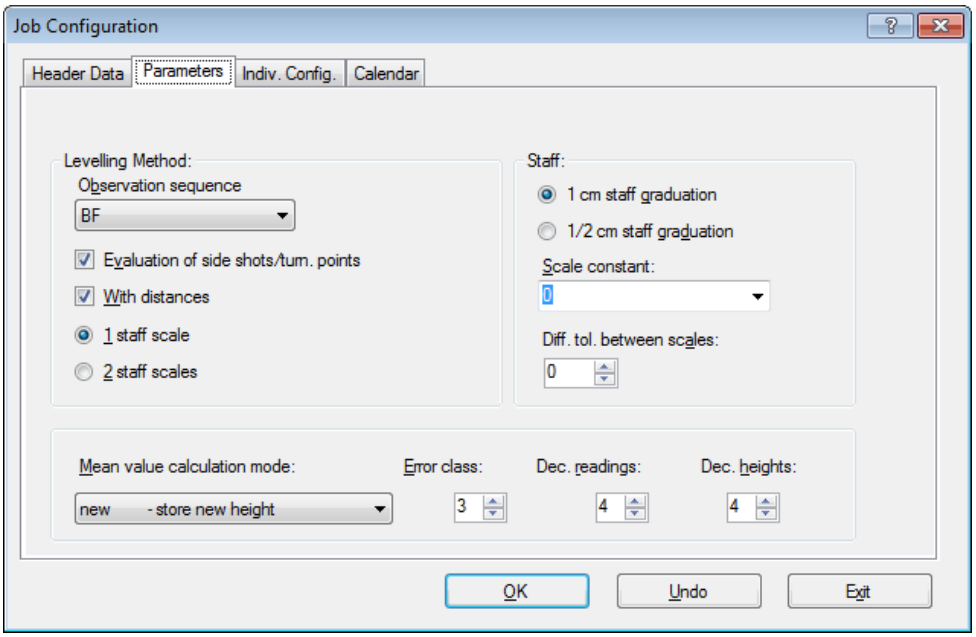
Reformatting of Raw Data

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 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 1st measurement minus 2nd 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 points 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:

```
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,,,1,1505,1958,%,
i,17,+31071,+1316,+1001066,,,2,1505,1958,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,+1001066,,,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 start 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 start 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
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 which are created with more than 14 digits by point number extension, are cut off from the left.

Note:
The position from the right in the second string is referred to the point number changed by the first string.

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 info 1 - 3:

Note:
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)
 └────────────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,,[,
                                                 └─ Info 2
```

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 must be entered **before** the first measurement 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 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 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 °C
m0 (Mean staff meter):                    < -20 or > 20 ppm
αT (Linear coefficient of extension): < 0 or > 1  ppm/°C
```

Formula for correction:

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

```
L  = corrected staff reading [m]
L' = staff reading          [m]
l0 = index correction (zero correction)  [mm]
vG = graduation correction   [mm]

m0 = mean staff meter  [ppm]
αT = linear coefficient of extension [ppm/°C]
T0 = reference temperature       [°C]
T  = temperature during the measurement [°C]
```

The values for l_0, m_0, α_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) must be stored with a 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   αT = Linear coefficient of extension in
                ppm/°C
        20-29   m0 = mean staff meter in ppm at reference
                temperature
        30-39   T0 = reference temperature for mean
                staff meter in °C
        40-58   any staff description, is not evaluated.
                Entry is optional.
        60-69   vG, graduation correction in mm
        70-79   l0, 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:

```
Run.no.  aT[ppm/C] mo [ppm]  To [C]    Staff description   vG [mm]   lo [mm]
         1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890
9019     0.59      5.45      24.6      GPCL3 - Nedo 9019   2.0       0.0001
9020     0.49      -3.45     20.0      GPCL3 - Nedo 9020   1.5
*9021     0.34      3.45      21.8     GPCL3 - Nedo 9021
```

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,J01,11506,0808241602,-5007,-
5007,+19706,+19706,+1000499,,,X,
t,00,J01,11506,0808241602,,,,,,,@,
```

Nigra batch file:

```
RTest file for Topcon data
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
x        1         2         3         4         5         6         7
x Distance<--- Back  Side   Fore---><--- Point Number --->
C1
HBad Godesberg       Location
H                    Location
H2. Control          Order
H                    Order
H15/23               Line
H05-24-2010          Date
Hsunny               Weather
HMeyer               Observer
HDL 102, GM0388      Level
HNedo 3327           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
H4                   Decimal places for heights in calculations
H4                   Decimal places for readings in calculations
E11m                 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

Distance   Back        Side        Fore          Height      Point No.
 22.95    1.5069                              100.5506          11505
 23.06                              2.1070       99.9501              1
 33.12    3.2071
 15.35                3.1073                  100.0497          10002
 25.46                2.5074                  100.6496          10003
 34.66                              1.1075      102.0492            100
 19.77    2.1076
 19.86                              3.1077      101.0488              2
 21.76    1.1176
 21.88                              2.1177      100.0483          11506

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).

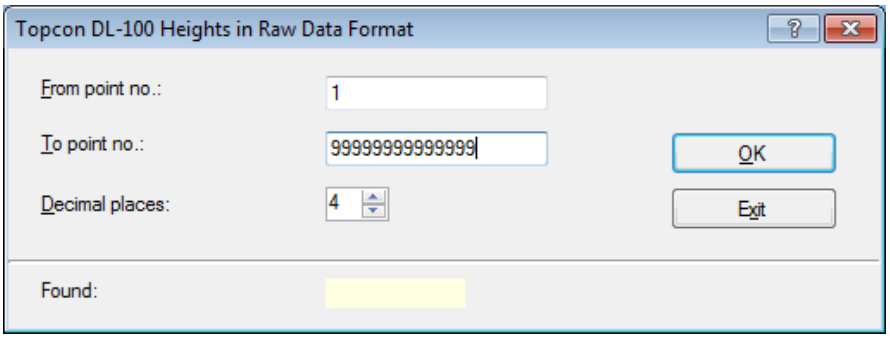
The file is named **'job'_FixPt.TOP** and stored in the current job folder. Also, a file named **COORDI.X** will be created. Only the file COORDI.X must be transferred to the PCMCIA card.

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.TOPfile will be overwritten.



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 is 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,,,
B01,1,1,1,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,,,0.00000,,,,,
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) fixed points ID and fixed points 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 must not re-entered. The location name is entered in the header data of the Nigra dialog box.

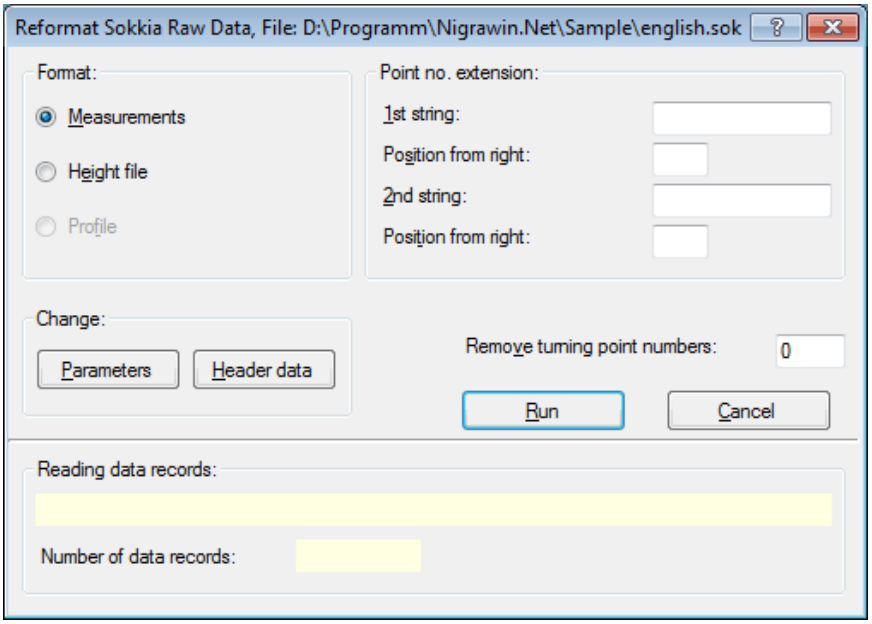
The observation sequence (measurement procedure) aFBBF is treated as aBFFB. If the observation sequence aFBBF be documented, an entry can be made in the comments data field.

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.



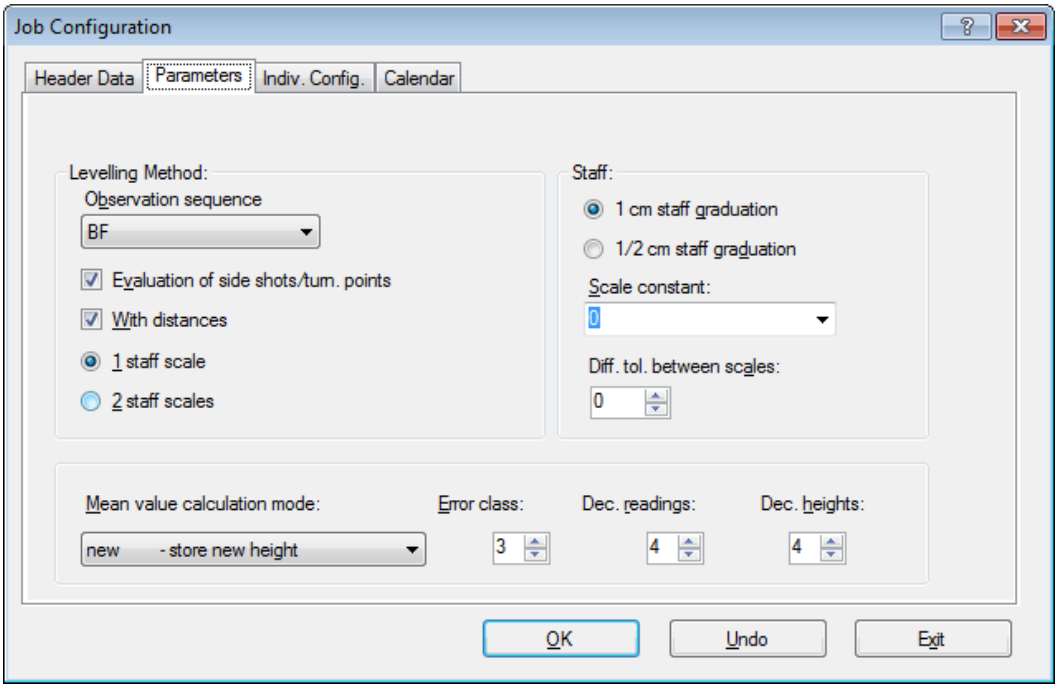
Reformatting of Raw Data

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, resp. ft)
Distances:           1 (=yes)
Scale constant:      0
```

For levellings with **two** staff readings, the **Diff. tolerance between scales** must be defined (difference 1st measurement – 2nd 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 or BFBF, aBFFB or aFBBF are transferred into the Nigra batch file in the following format:

```
B1
```

```
B2
                    F1
                    F2
```

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 converts 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 must 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 or > 40 °C
m0 (Mean staff meter):                  < -20 or > 20 ppm
αT (Linear coefficient of extension): < 0 or > 1  ppm/°C
```

Formula for correction:

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

```
L  = corrected staff reading [m]
L' = staff reading          [m]
l0 = index correction (zero correction)  [mm]
vG = graduation correction   [mm]

m0 = mean staff meter  [ppm]
αT = linear coefficient of extension [ppm/°C]
T0 = reference temperature       [°C]
T  = temperature during the measurement [°C]
```

The values for l_0, m_0, α_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) must be stored with a 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   αT = Linear coefficient of extension in
                 ppm/°C
        20-29    m0 = mean staff meter in ppm at reference
                 temperature
        30-39    T0 = reference temperature for mean
                 staff meter in °C
        40-58    any staff description, is not evaluated.
                 Entry is optional.
        60-69    vG, graduation correction in mm
        70-79    l0, 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:

```
Run.no.  aT[ppm/C] mo [ppm]  To [C]    Staff description   vG [mm]   lo [mm]
         1         2         3         4         5         6         7
123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
9019     0.59      5.45      24.6      GPCL3 - Nedo 9019   2.0       0.0001
9020     0.49      -3.45     20.0      GPCL3 - Nedo 9020   1.5
*9021     0.34      3.45      21.8     GPCL3 - Nedo 9021
```

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,,,
B01,1,1,1,SDL1X Adv,100437,,,,,,
B02,1001,1,,0.00000,,0.00000,4,Control Measurement,,,,
B20,1,1,1,9,+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
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
x        1         2         3         4         5         6         7
xDistance<--- 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
HSDL1X 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:

```
Meyer & Bolton
Nigra - Levelling, Version 5.2                08/05/2013    Page:   1
Job: sample1

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                                78.7657            100
          1.0689   0
 13.71                             1.0971        78.7382            101
                                   1.0971   0/0
 23.70                1.1191                    78.7158           1002
                      1.1191   0/0
 25.97                1.0654                    78.7695           1003
                      1.0654   0/0
 13.71    1.0970
          1.0970   0
 15.74                             1.0799        78.7559            102
                                   1.0799   0/0
  8.70                1.1190                    78.7165           1002
                      1.1190   0/0

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:

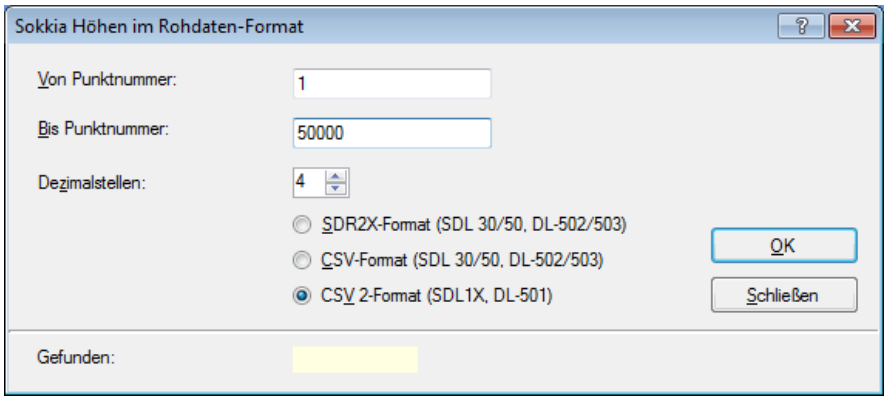
```
Meyer & Bolton
Nigra - Levelling, Version 5.2                08/05/2013    Page:   1
Job: sample1
Control Measurement
               Report of Calc. Mode for Mean Value

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

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:

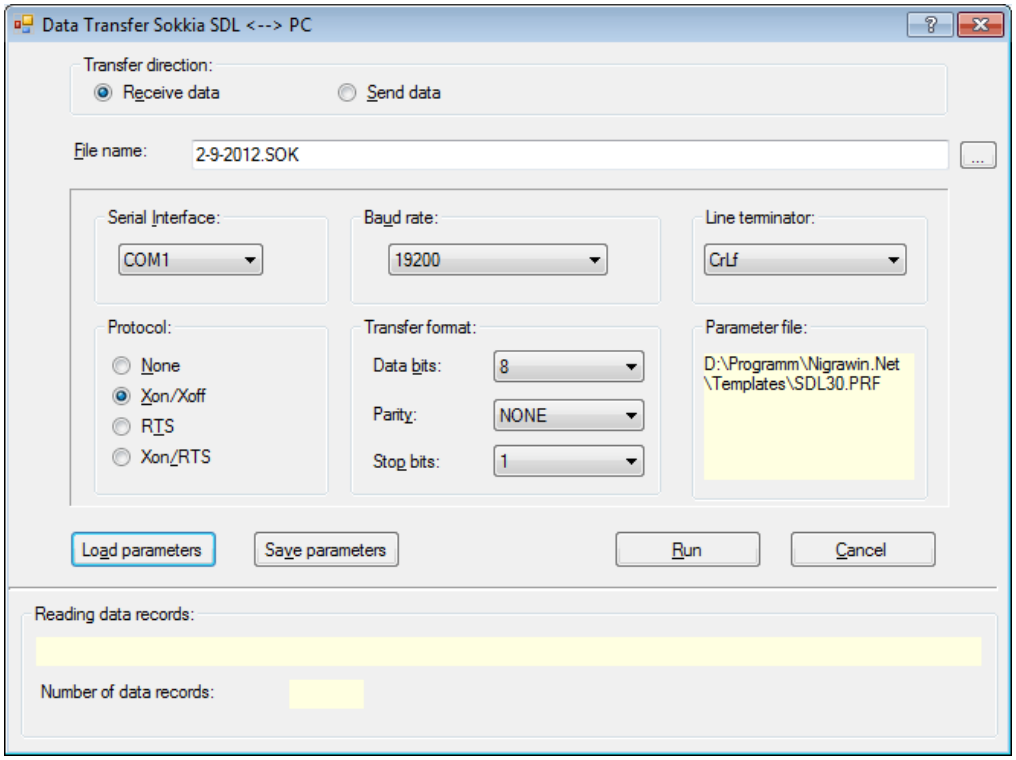
- Transfer raw data to a computer
- Reformat raw data to Nigra format
- Enter heights of connecting points
- Start calculations

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 these parameters and use it later again.

Note:
In the case of a breakdown of the data transfer, please utilize a special SOKKIA transfer program.

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 1st row with the header data:

```
SDL30m,1203,001857,RCHT4,0,39,,,
  a      b     c     d   e f ghi
```

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 2nd row following measuring data:

```
0028,5557,1,1,1,21.76,0.8217,170.0000,
 a    b   c d e   f      g      h      i
```

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=backsight (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
62LV00001555700000
63LV555721.76000000.82170000BS              0000100001000000.00000000
63LV555819.83000001.18220000IS              0000100000000000.00000000
63LV556018.14000002.45630000IS              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:

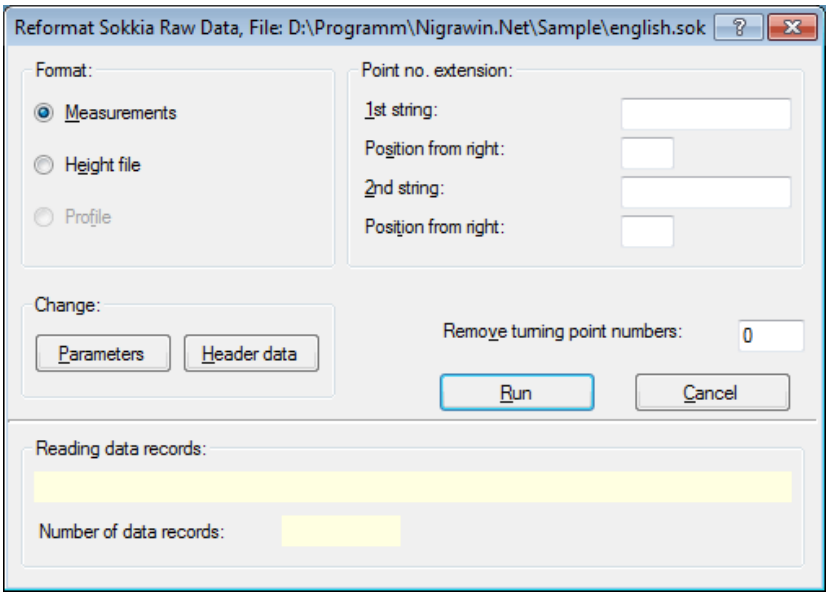
You can carry out your measurements in the measuring mode **H-Diff** or **Height**. After the measurement of the foresight, press the MENU key and acknowledge the change of the station with **Y**. If you want to finish your levelling, change the measurement code **FS** for foresight to **FIX**.

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.



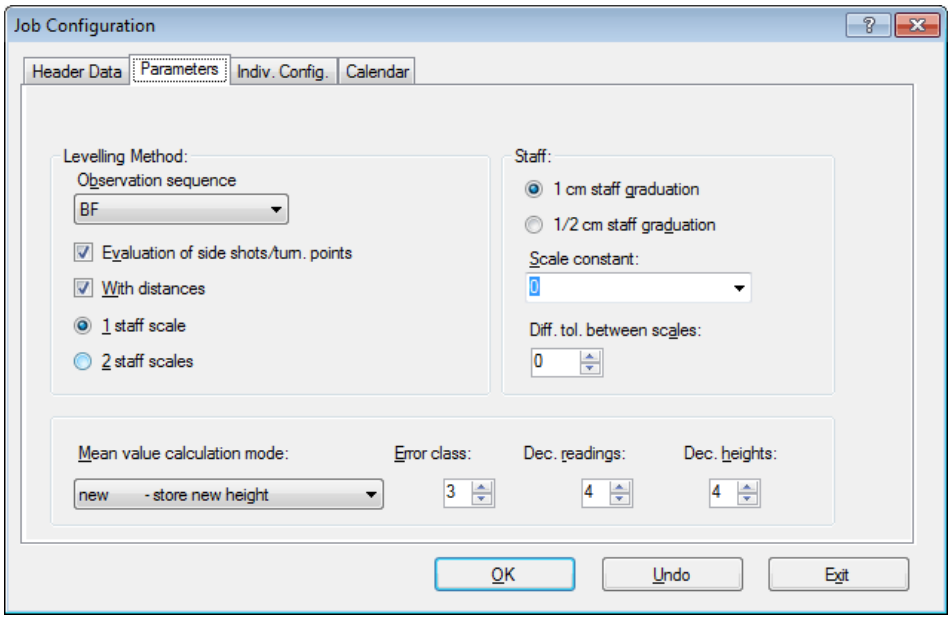
Reformatting of Raw Data

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 start 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 start 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
62LV00001555700000
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
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
x        1         2         3         4         5         6         7
xDistance<--- Back    Side    Fore ---><--- Point Number -->
C1
HSankt Augustin      Location
H                    Location
HMovement Kingston R Order
Hoad                 Order
H123/99              Line
H02-10-2010          Date
Hsunny               Weather
HMiller              Observer
HSDL30               Level
HNedo 1245           Staff
H1st movement measur Comments
Hement               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  21.76 b0.82170                                5557
D  19.83          s1.18220                       5558
D  18.14          s2.45630                       5560
D  21.94                   f1.75540              5561
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

Distance   Back        Side        Fore          Height      Point No.
 21.76    0.8217                                170.0000          5557
 19.83                1.1822                    169.6403          5558
 18.14                2.4563                    168.3662          5560
 21.94                             1.7554       169.0680          5561

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 → 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).

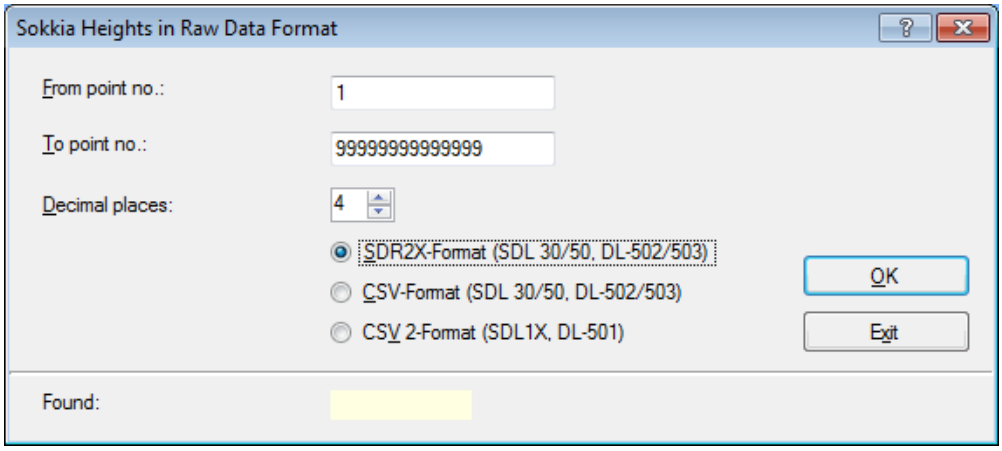
The file is named **'job'_FixPt.xxx** and stored in the current job folder.

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.

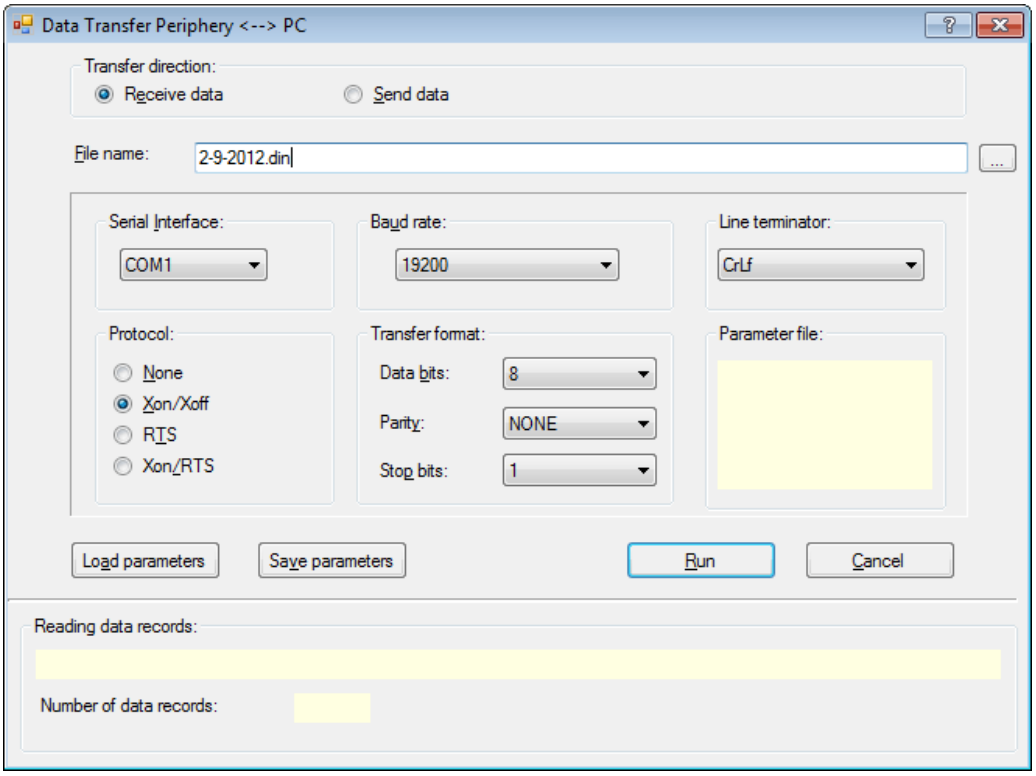


Creation of SDL30 Raw Data File

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 SOKKIA 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 must 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 parameters 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 **with** and must be reset to PROTOKOLL **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 **SHIFT + Prog**. Then choose **2 All Settings** and afterwards **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):

```
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
```

Then click on the **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

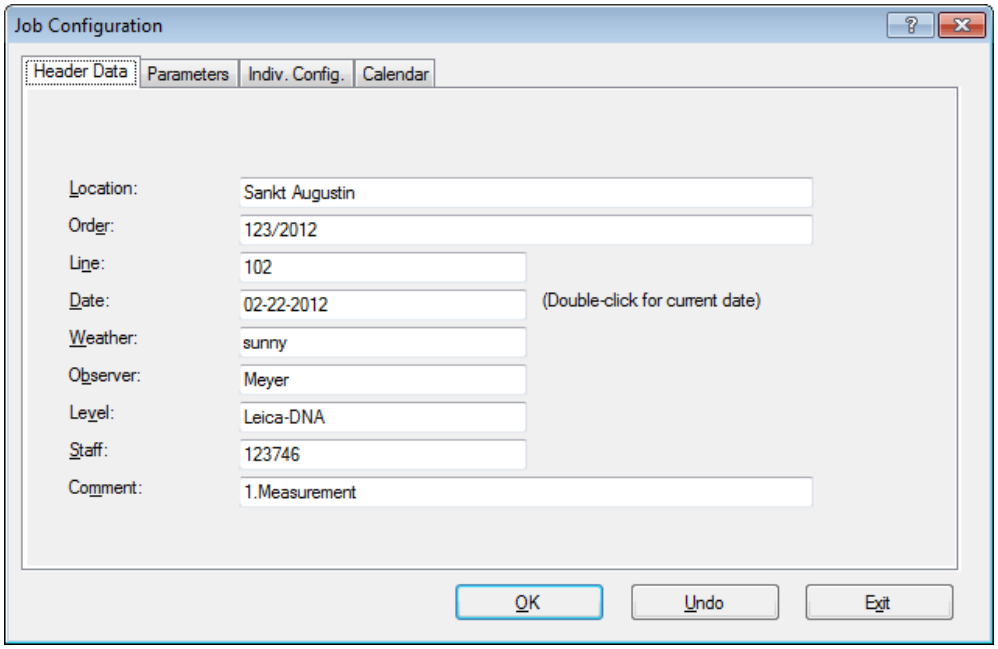
The **Options** menu is used to set all program and job parameters.

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:



Input of Header Data

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.

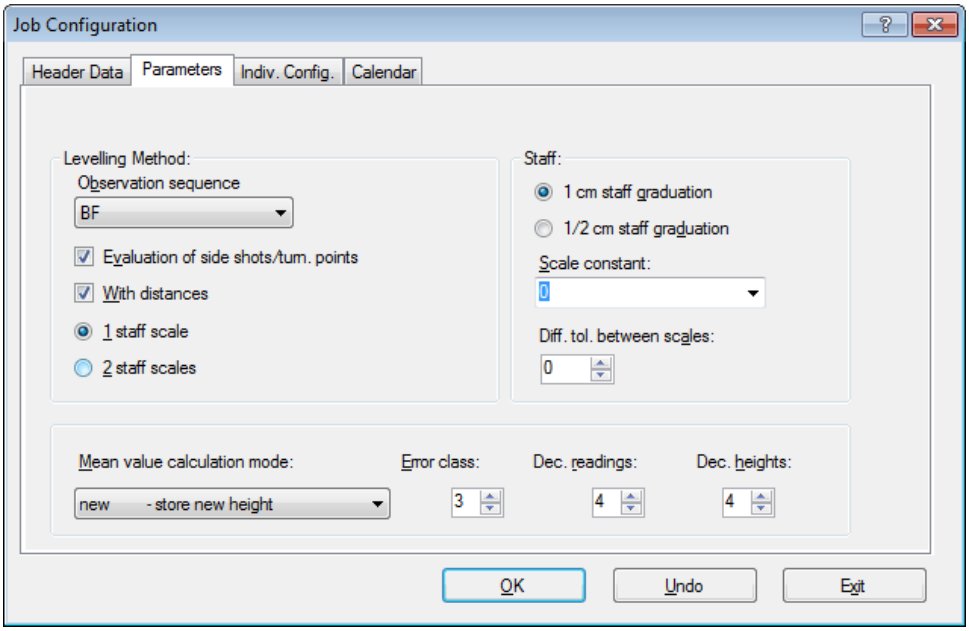
The remaining header data consists of any text, which has no influence on the later evaluation.

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.

	2 staff scale	1 staff scale	value in batch file
BF	BBSSFFSS BBFFSS	BSFS BSFS	00
BFFB	BFFBSS BFFBSS		02
aBF	BBFFSS FFBBSS	BFS FBS	00a

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 start 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 must not be confused 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.

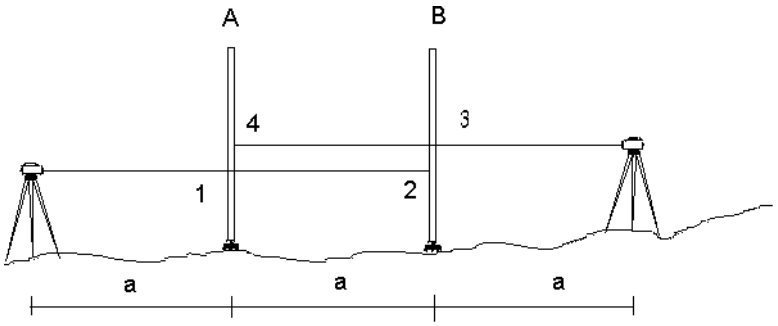
Value in batch file: 4

Test = Instrument test (check)

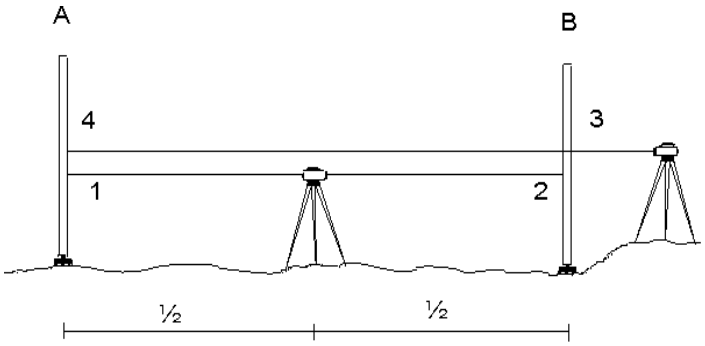
The instrument test is performed according to Näbauer, Förstner, Kukkamäki and 'from the middle' and measured as a distance levelling.

Value in batch file: 5

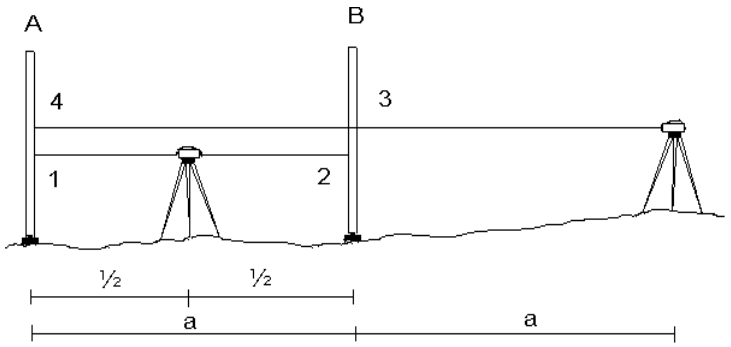
Procedure according to Näbauer: The level stations are lying outside of the staff stations. The distance ***a*** is about 15 m.



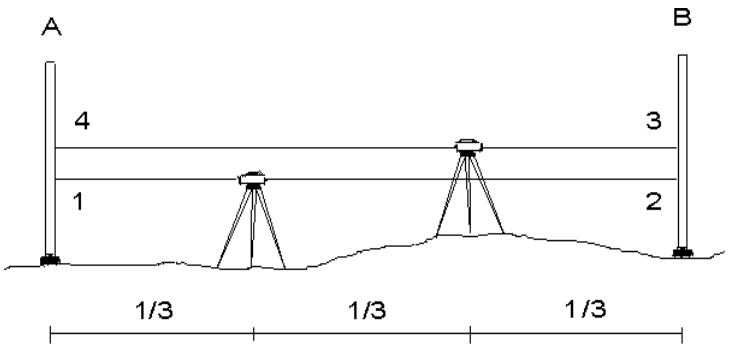
Procedure 'from the middle': The first level station is in the middle between the staffs stations A and B. The distance between the staffs is about 30 m. The second level station is near the staff B (distance about 2 m, inside or outside).



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.



Nigra identifies the right procedure with the help of the combinations of the distances. Please note that the procedures according to Näbauer and Förstner have the same combinations of the distances.

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 <= 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:

line of sight error = arctan((a1-a2+a3-a4)/(d1-d2+d3-d4))

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

```
                                                  value in batch file
activated  (with input of distances or evaluation)       1
inactivated (no input of distances or evaluation)        0
```

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

```
                                              value in batch file
1 = Levelling with one staff scale                   1
2 = Levelling with two staff scales                  2
```

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

```
(B1+B2)/2 - (F1+F2)/2 and
(B1+B2)/2 - (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 cannot 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

```
(B1+B2)/2 + Sc - ((F1+F2/2) + Sc)
```

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 = (B1+B2)/2 - ((S1+S2)/2 + Sc)
```

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

```
                                          value in batch file
cm      for levelling staffs with cm graduation      1
        and digital staffs
1/2 cm  for levelling staffs with 1/2 cm graduation  0.5
```

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 (1st measurement – 2nd 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

```
                                              value in batch file
mean      - Old and new are meaned                    0
new       - A new height is stored                    1
            If the point is already existing,
            it will be overwritten
old       - The older height is kept, new
            and old are compared.                     2
without   - No saving, no comparison                  3
```

For comprehensive information, see section 3.2.3.

Error class (order)

```
1     -      2     -    3     -     4
```

Error classes 1 - 4 can be selected.

Decimal places for staff readings

```
2 - 5 digits for the output of staff readings during calcula-
tions.
```

Decimal places for heights

2 - 5 digits for the output of heights and delta-H for distance levellings.

Note:

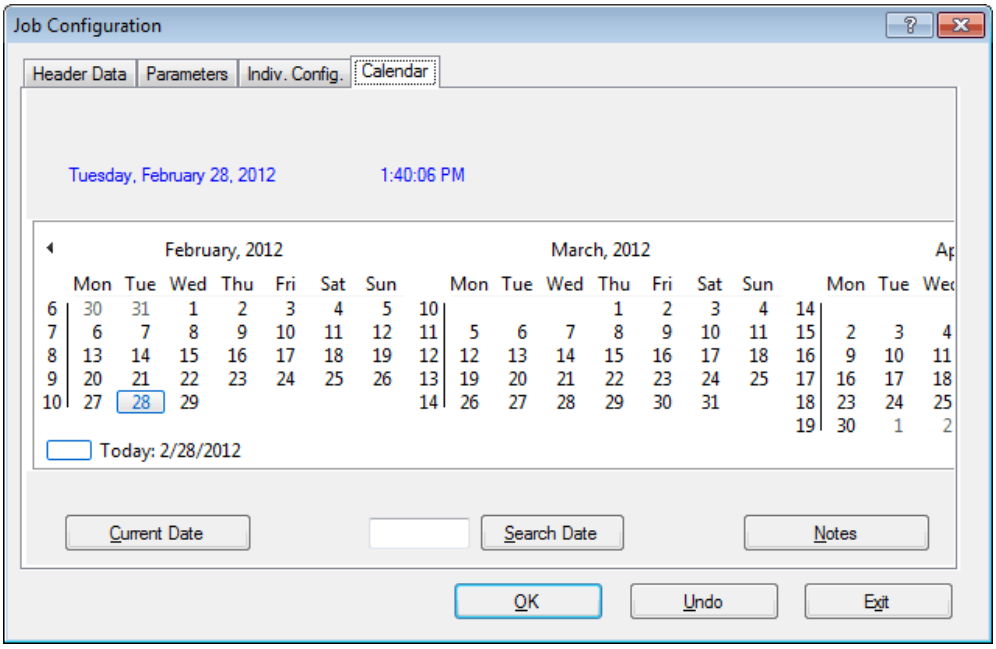
Do not select more digits for the output than are guaranteed by the measurement method.

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.



Calendar

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 must 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:

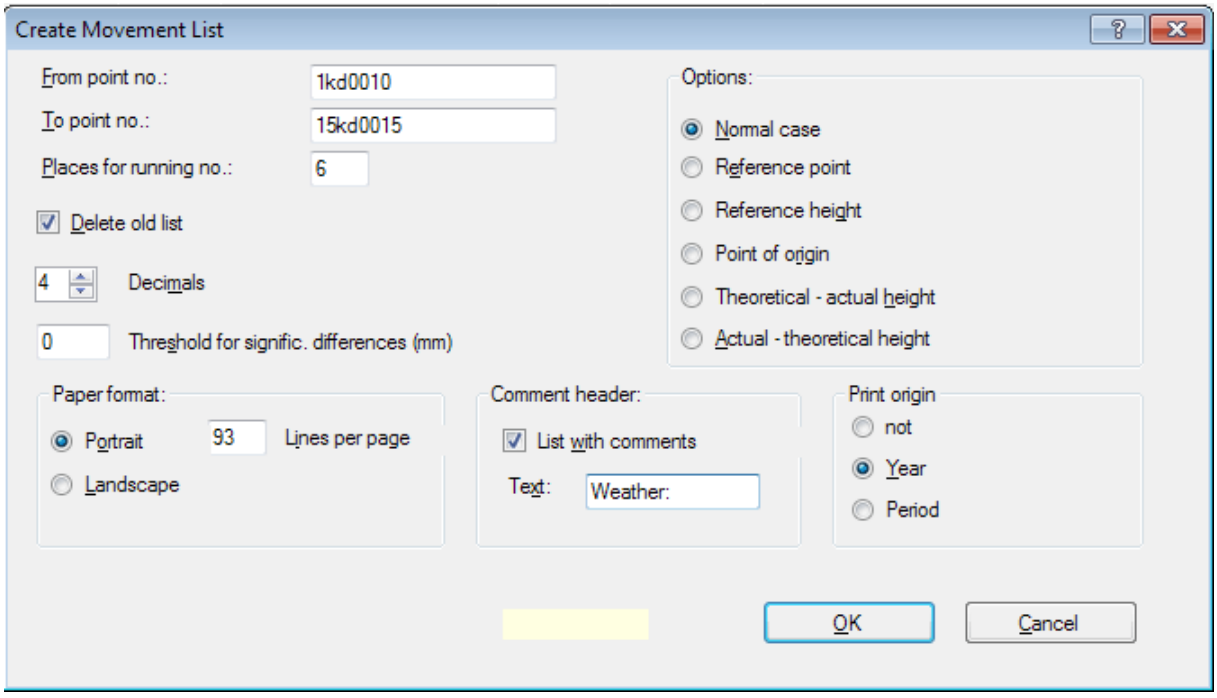
For the creation of movement lists it is sufficient that ***one*** point of a measuring period contains the date. For the creation of movement plots ***each*** point must contain a valid date.

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



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, e.g., for the determination of the tilt behavior 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 03-31-2009 Page: 1
Job: Sample

Movement list with weather comments

Date:	07-07-2008	08-08-2008		10-10-2008			11-11-2008		
Weather:	sunny, 22 C	Rain, 16 C		changeable, 17 C			sonnig, 5 C		
Point No.	1. Measurem. Height AMSL m	2. Measurem. Height AMSL m	D 2-1 mm	3. Measurem. Height AMSL m	D 3-2 mm	D 3-1 mm	4. Measurem. Height AMSL m	D 4-3 mm	D 4-1 mm
kd0010	48.513	48.516	3	48.518	2	5	48.703	185	190
kd0011	48.498	48.514	16				48.511	-3	13
kd0012	48.516			48.519	3	3			
kd0013		48.511							
kd0014	48.520	48.521	1	48.522	1	2	48.523	1	3
kd0015	48.510	48.516	6	48.516	0	6	48.614	98	104

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)

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. To assess the overall subsidence better, the **Year of origin** or the **Period of origin** can be printed in the left column:

Date:		07/07/1989	08/08/1989		10/10/1989			11/11/1989		
Weather:		sunny, 22 C	rainy, 16 C		variable, 17 C			sunny, 5 C		
Ori.	Point No.	1st Measur. Height AMSL m	2nd Measurement Height AMSL m	D 2-1 mm	3rd Measurement Height AMSL m	D 3-2 mm	D 3-1 mm	4th Measurement Height AMSL m	D 4-3 mm	D 4-1 mm
1	kd0010	48.5130	48.5160	3.0	48.5180	2.0	5.0	48.7030	185.0	190.0
1	kd0011	48.4980	48.5140	16.0				48.5110	-3.0	13.0
1	kd0012	48.5160			48.5190	3.0	3.0			
2	kd0013		48.5110							
1	kd0014	48.5200	48.5210	1.0	48.5220	1.0	2.0	48.5230	1.0	3.0
1	kd0015	48.5100	48.5160	6.0	48.5160	0.0	6.0	48.6140	98.0	104.0

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)

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 <=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:

Point number	Height	Calc.no.	Diff.	NC	Date	Remark
1kd0010	48.5130	0	0.0	1	07-07-2008	sunny, 22 C
1kd0011	48.4980	0	0.0	1		
1kd0012	48.5160	0	0.0	1		
1kd0014	48.5200	0	0.0	1		
1kd0015	48.5100	0	0.0	1		
2kd0010	48.5160	0	0.0	1	08-08-2008	rainy, 16 C
2kd0011	48.5140	0	0.0	1		
2kd0013	48.5110	0	0.0	1		
2kd0014	48.5210	0	0.0	1		
2kd0015	48.5160	0	0.0	1		
3kd0010	48.5180	0	0.0	1	10-10-2008	cloudy, 17 C
3kd0012	48.5190	0	0.0	1		
3kd0014	48.5220	0	0.0	1		
3kd0015	48.5160	0	0.0	1		
4kd0010	48.7030	0	0.0	1	11-11-2008	sunny, 5 C
4kd0011	48.5110	0	0.0	1		
4kd0014	48.5230	0	0.0	1		
4kd0015	48.6140	0	0.0	1		

Example for Method 1 - Normal Case

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NigraWin - Levelling, Version 4.26 03-31-2009 Page: 1
Job: Sample

Movement list for normal case

Date:	07-07-2008	08-08-2008		10-10-2008			11-11-2008		
Point No.	1. Measurem. Height AMSL m	2. Measurem. Height AMSL m	D 2-1 mm	3. Measurem. Height AMSL m	D 3-2 mm	D 3-1 mm	4. Measurem. Height AMSL m	D 4-3 mm	D 4-1 mm
kd0010	48.513	48.516	3	48.518	2	5	48.703	185	190
kd0011	48.498	48.514	16				48.511	-3	13
kd0012	48.516			48.519	3	3			
kd0013		48.511							
kd0014	48.520	48.521	1	48.522	1	2	48.523	1	3
kd0015	48.510	48.516	6	48.516	0	6	48.614	98	104

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
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Job: Sample

Heights Reduced to Reference Point 1kd0010 with Height 48.513 m

Date:	07-07-2008	08-08-2008		10-10-2008			11-11-2008		
Point No.	1. Measurem. Height m	2. Measurem. Height m	D 2-1 mm	3. Measurem. Height m	D 3-2 mm	D 3-1 mm	4. Measurem. Height m	D 4-3 mm	D 4-1 mm
kd0010	0.000	0.003	3	0.005	2	5	0.190	185	190
kd0011	-0.015	0.001	16				-0.002	-3	13
kd0012	0.003			0.006	3	3			
kd0013		-0.002							
kd0014	0.007	0.008	1	0.009	1	2	0.010	1	3
kd0015	-0.003	0.003	6	0.003	0	6	0.101	98	104

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 4 - Heights Reduced to One Point of Origin

Company xyz
NigraWin - Levelling, Version 4.26 03-31-2009 Page: 1
Job: Sample

Tilting - Heights Reduced to Origin Point kd0010

Date:	07-07-2008	08-08-2008		10-10-2008			11-11-2008		
Point No.	1. Measurem. Height m	2. Measurem. Height m	D 2-1 mm	3. Measurem. Height m	D 3-2 mm	D 3-1 mm	4. Measurem. Height m	D 4-3 mm	D 4-1 mm
kd0010	0.000	0.000	-	0.000	-	-	0.000	-	-
kd0011	-0.015	-0.002	13				-0.192	-190	-177
kd0012	0.003			0.001	-2	-2			
kd0013		-0.005							
kd0014	0.007	0.005	-2	0.004	-1	-3	-0.180	-184	-187
kd0015	-0.003	0.000	3	-0.002	-2	1	-0.089	-87	-86

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 (D=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:

Point no.	Height				Date
102+1250	48.5130	0	0.0	1	07-07-2007
102+1275	48.4980	0	0.0	1	07-07-2007
102+1300	48.5160	0	0.0	1	07-07-2007
102+1325	48.5200	0	0.0	1	07-07-2007
102+1350	48.5200	0	0.0	1	07-07-2007
102+1400	48.5100	0	0.0	1	07-07-2007
102+1450	48.4800	0	0.0	1	
202+1250	48.5160	0	0.0	1	01-23-2008
202+1275	48.5140	0	0.0	1	01-23-2008
202+1300	48.5100	0	0.0	1	01-23-2008
202+1325	48.5110	0	0.0	1	01-23-2008
202+1350	48.5210	0	0.0	1	01-23-2008
202+1400	48.5160	0	0.0	1	01-23-2008
202+1500	48.5220	0	0.0	1	

Theoretical-actual list:

Company xyz
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Job: Sample

Theoretical-actual comparison

Date:	07-07-2007	1-23-2008	
Point No.	Real Height m	Act. Height m	Correc. Real-Act. mm
2+1250	48.513	48.516	-3
2+1275	48.498	48.514	-16
2+1300	48.516	48.510	6
2+1325	48.520	48.511	9
2+1350	48.520	48.521	-1
2+1400	48.510	48.516	-6
2+1450	48.480		
2+1500		48.522	

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.

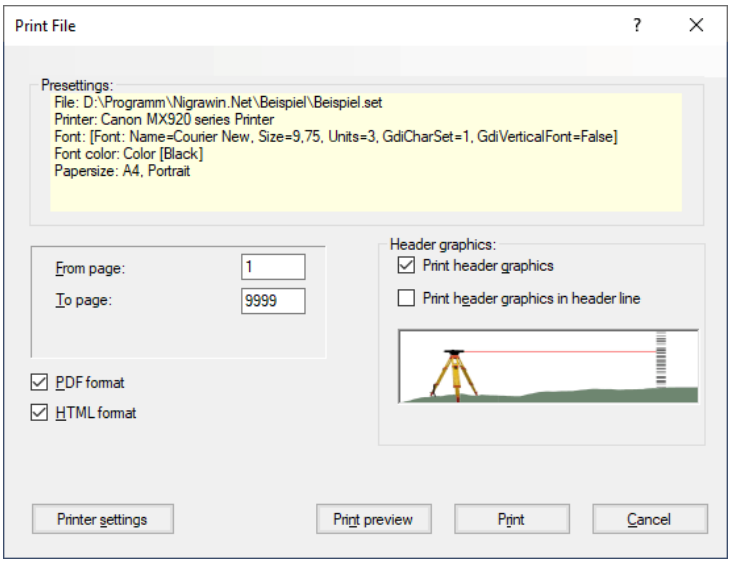
Nigra recognizes a movement list by the file extension '.SET'. No lines are shown when the lists are viewed with the editor. Lines starting with the character "#" contain control data. It is not allowed to delete or change these lines.

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 must be changed at the printer.

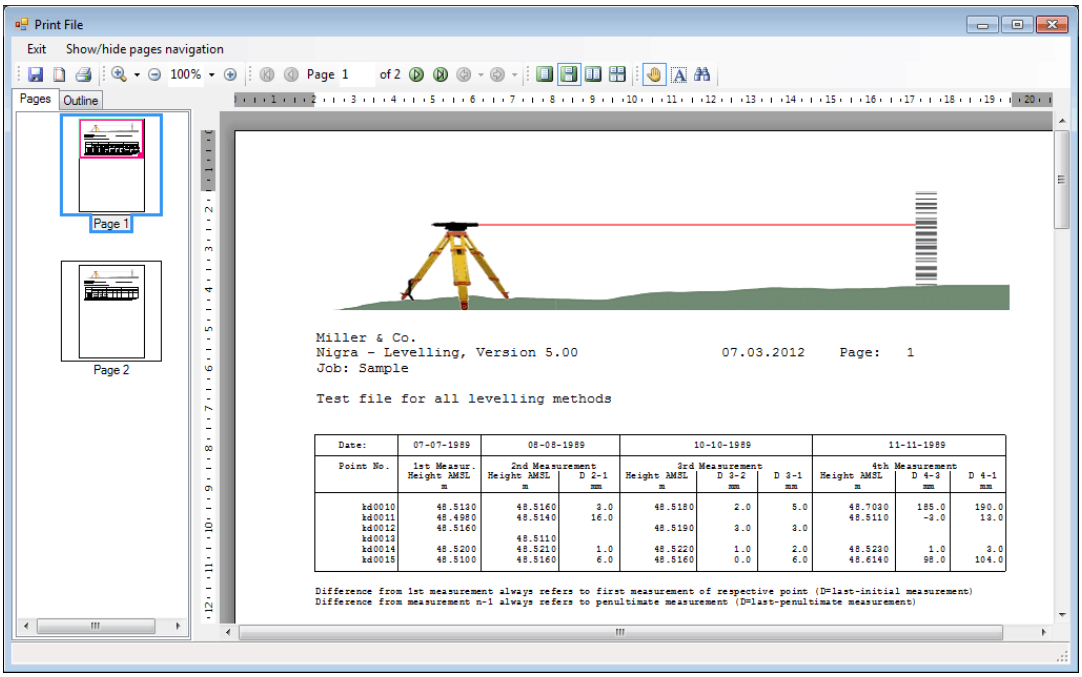
Print header graphics: Activate this button if you want to print a header graphic. By activating the button **Print header graphics in header line**, the upper edge of the graphic is placed right justified in the first line. The size of the header graphic must then not exceed approx. 2.5 cm x 2.5 cm.

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

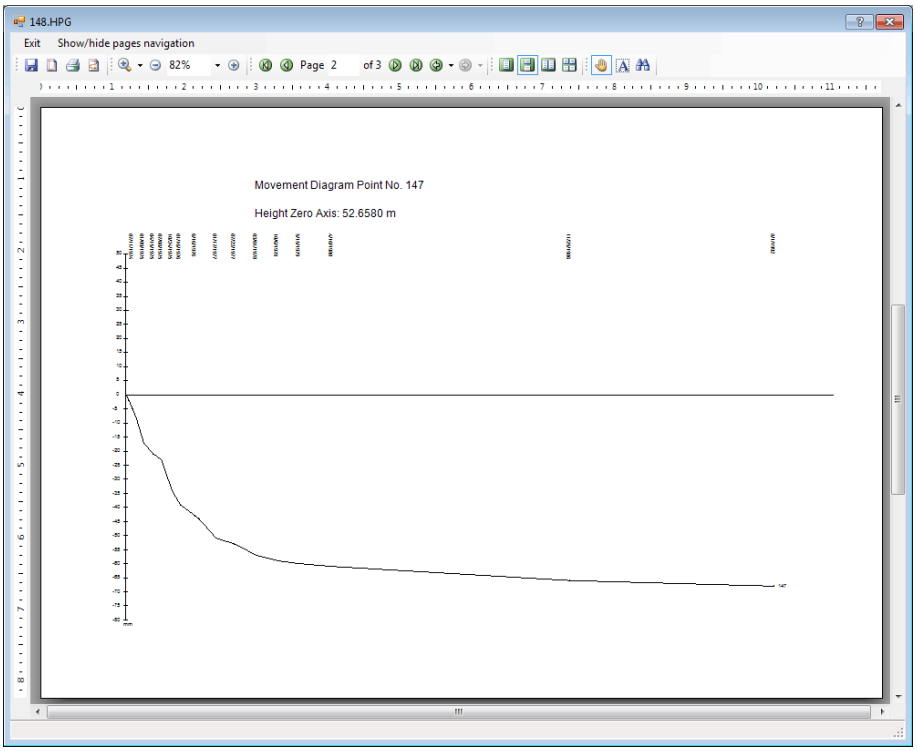
HP-GL files can be plotted on every HP-GL compatible plotter, printed on a printer, and displayed on the monitor. In addition, most CAD programs can import DXF files.

The DXF format is the standard exchange format for CAD programs. Your CAD program needs a DXF interface for that. This interface is not 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 "#".

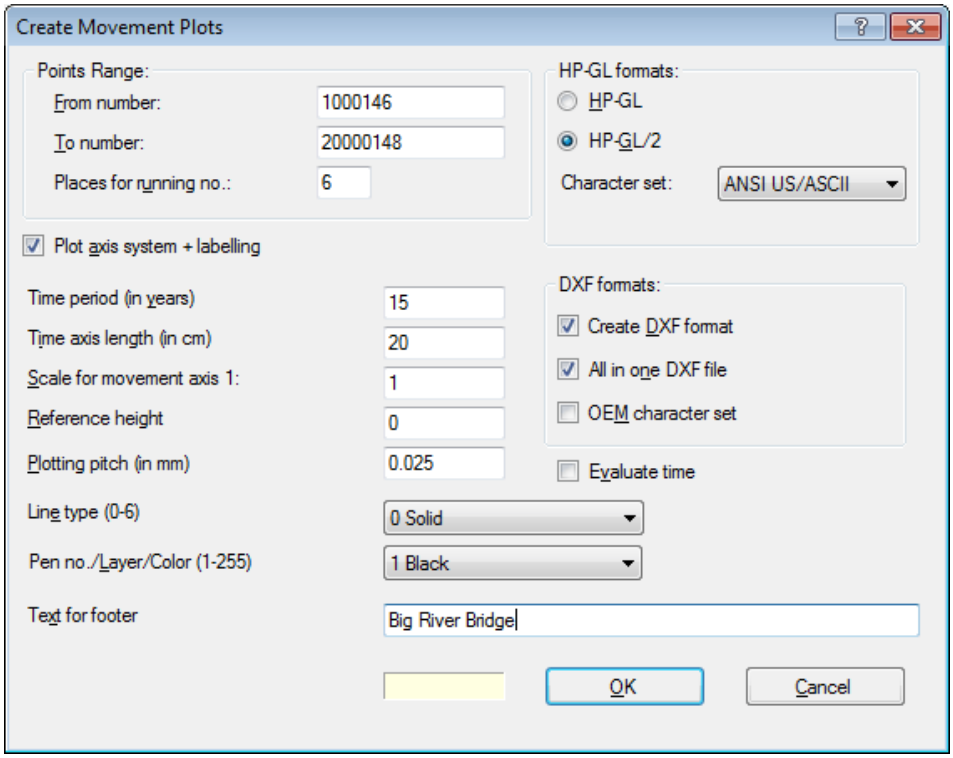
Characters not permitted for the file name are: / \ : * ? " < > |

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

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 footer 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)

time scale = length of time axis (cm/ft/in) / 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, e.g., 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)

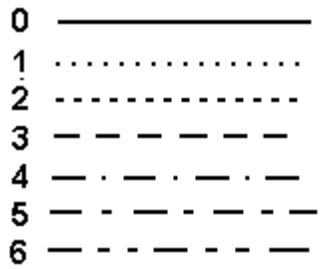
Unit of measurement is meters:
Most plotters work with a plotter step size of 0.025 mm (=1016 dots/inch). If your plotter uses a different plotter step size, enter the appropriate plotter step size here. The plotter step size may only marginally deviate from 0.025, because otherwise the labelling will have an unfavorable 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:



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 footer

Text entered here (for example name of location, job) is printed as footer.

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.

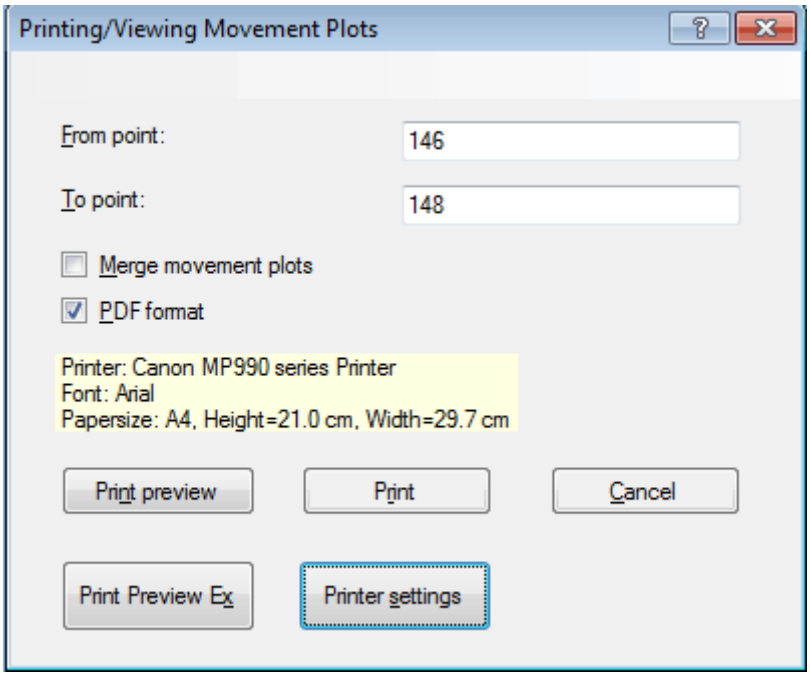
By clicking the **OK** button, the creation of movement plots is initiated.

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).



Selection of Point Number Range for Viewing

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.

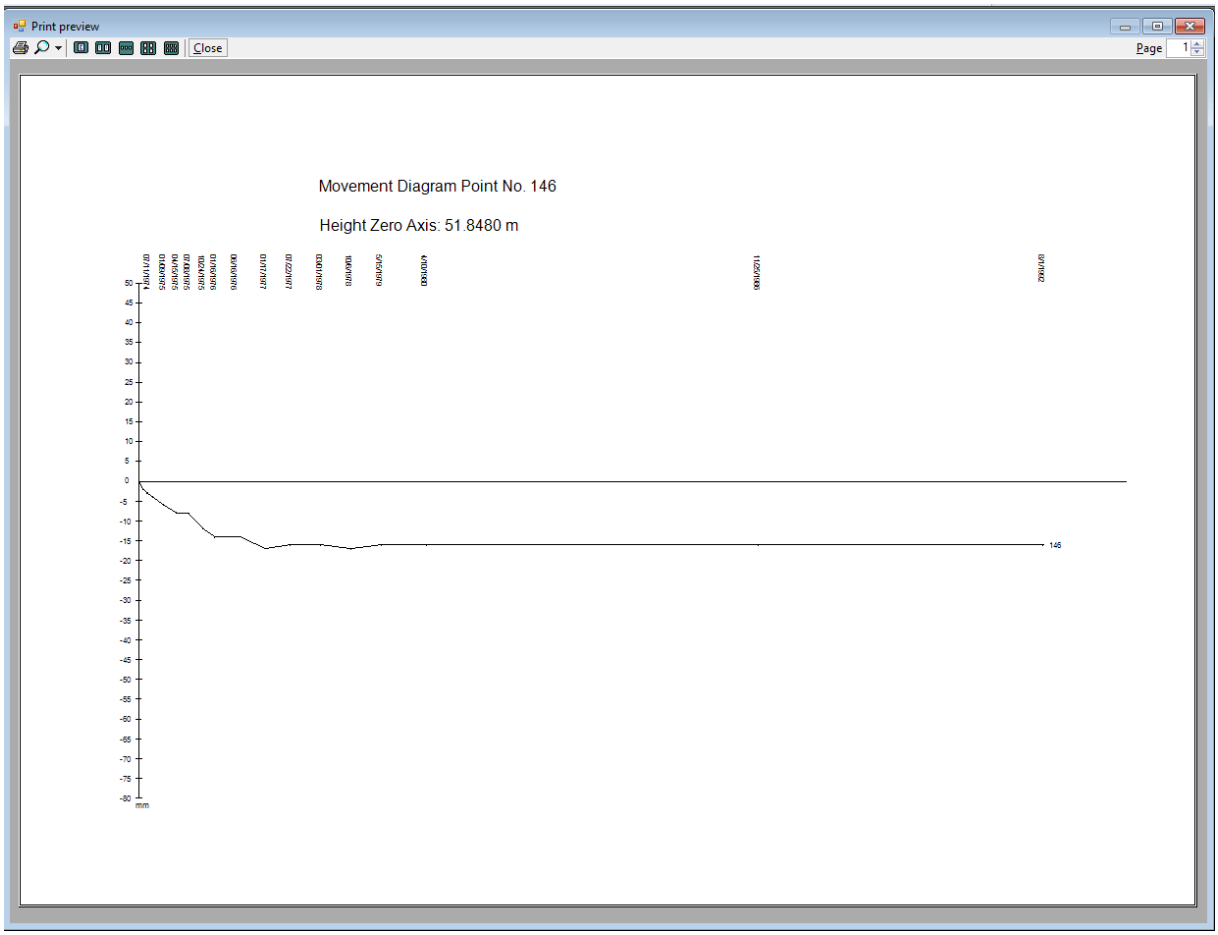
The **Print preview** button opens the print preview. **Print preview Ex** opens an alternative print preview, with the exports in various formats are available.

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 cannot be changed. Nigra also automatically considered portrait or landscape format.

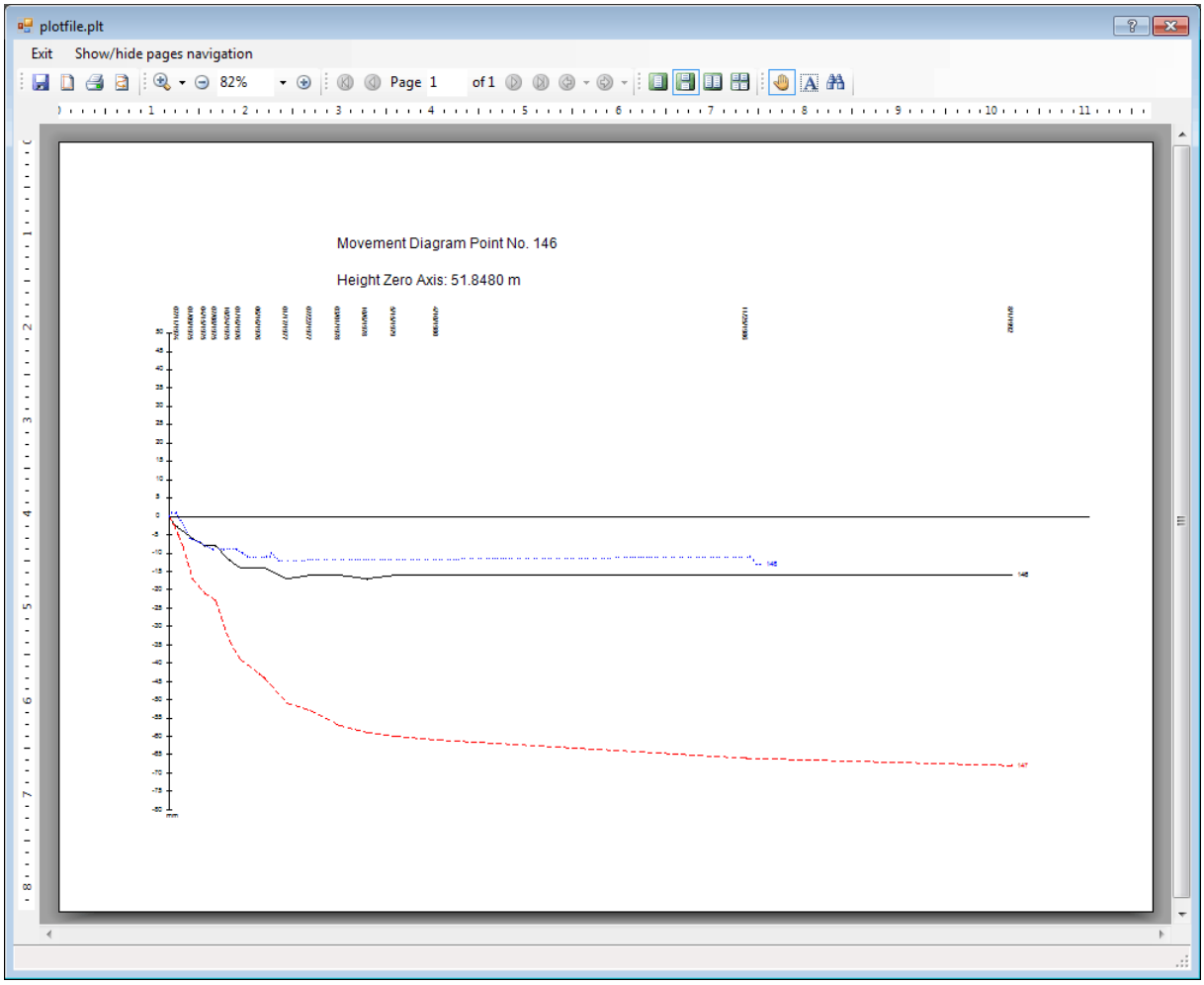
Print Preview (standard)



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.

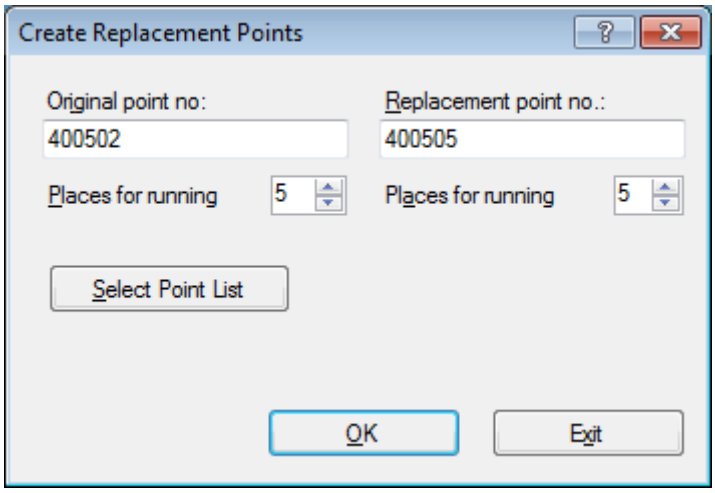
9.8 Creating Replacement Points

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 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**.

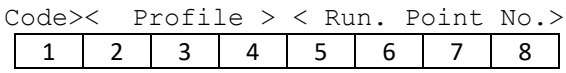
10.1 Create Profile File

10.1.1 Profiles from Levellings

Encoding of the Point Mark

The point marks of a levelling have 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.



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.

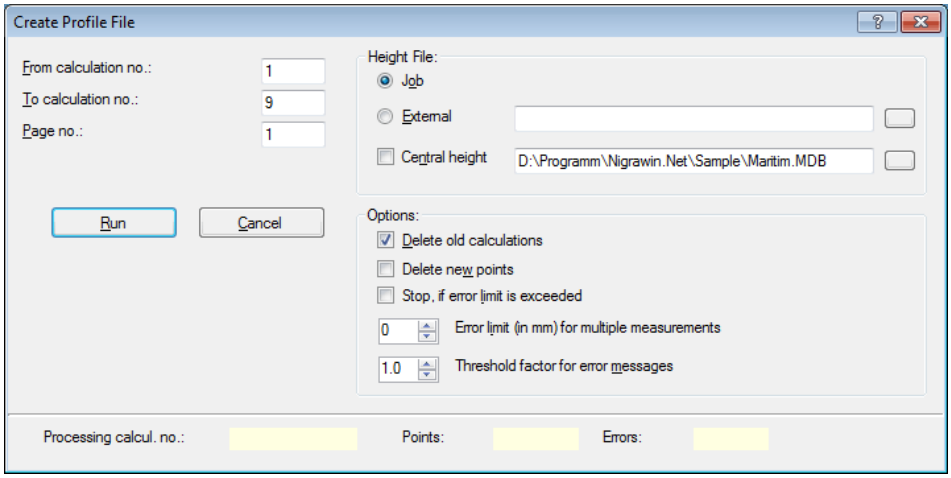
Examples of a point mark:

```
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**.



Creation of a Profile File

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. Except for the start 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:

```
         1         2         3         4         5
12345678901234567890123456789012345678901234567890123456789012345
       Profile><P-no. Distance/Y      X        Height/Z
              50002       8.500                50.639 /S100.
              50003       0.000                50.640
              50004      10.120                51.902
              50005      -3.560                51.903
             160000       3.150                63.530
             160001     -15.000                63.529
             160002       5.000                45.616
            5050002       0.000                53.430
            5050005       5.060                53.529
            5050008      12.120                55.616
                  0
```

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 cannot create 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 start 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, 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 start 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 foot 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 curbstones), 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 center 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;**.

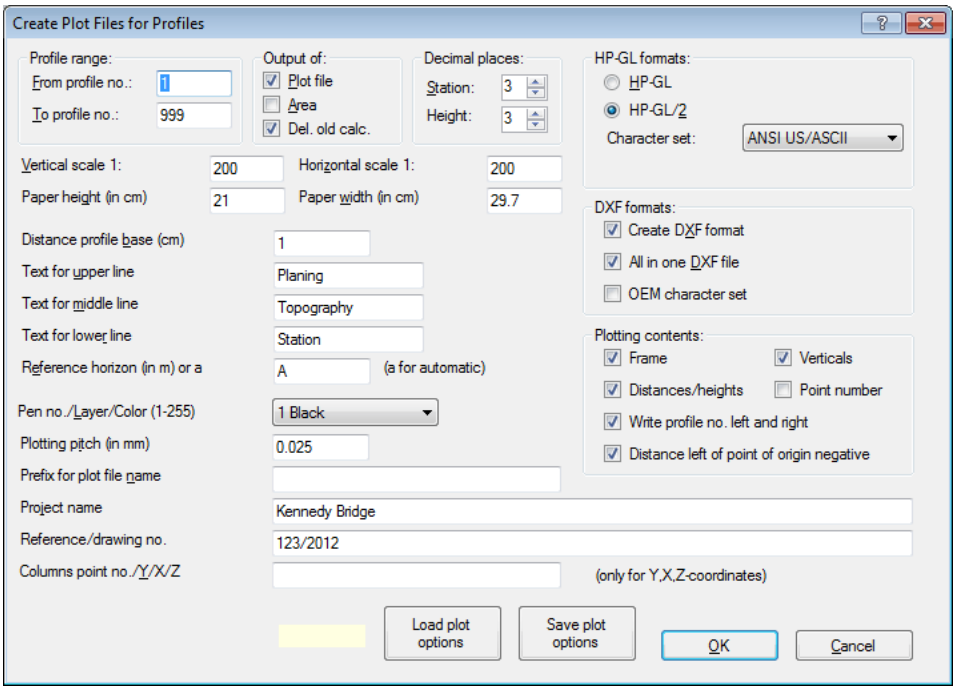
10.2 Edit Profile File

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 an 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

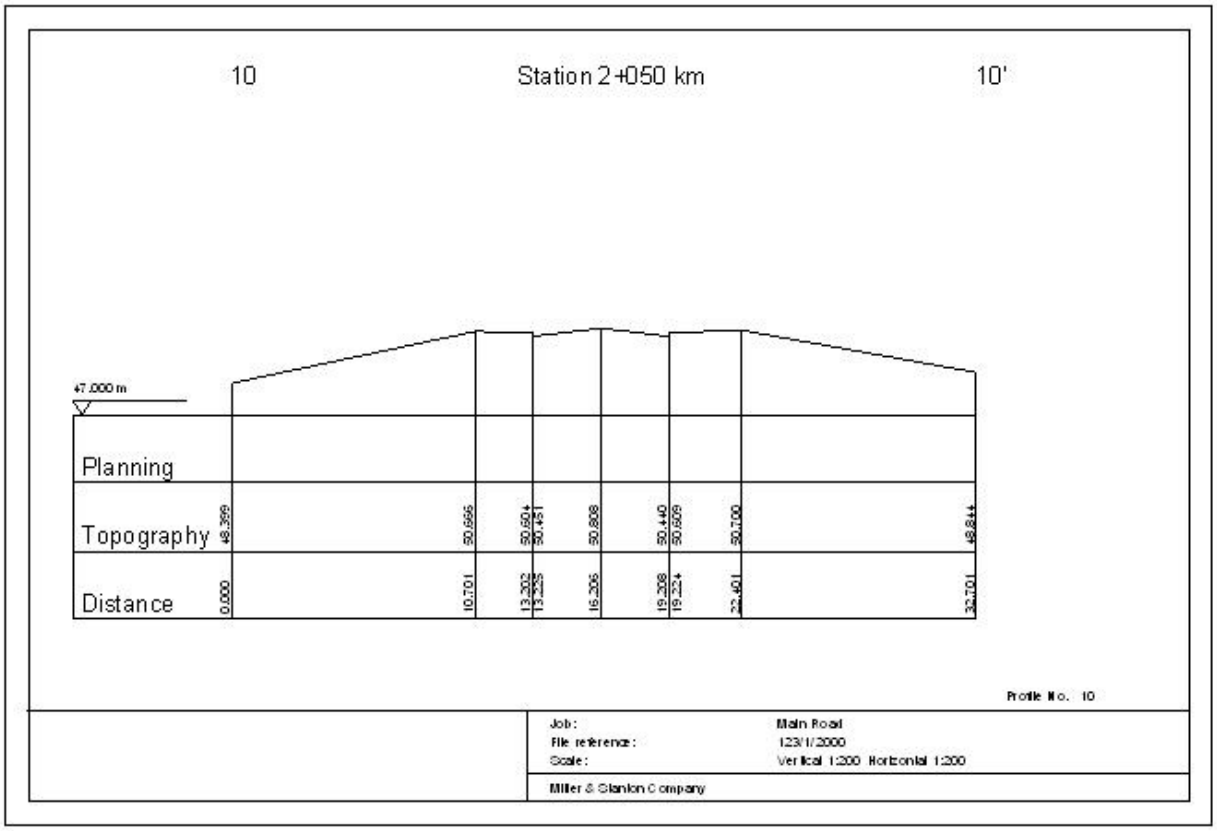
The course of the profile line is always presented. Beyond this, the following contents can be selected:

Frame activated: a frame and a header field (on the right bottom) is drawn.

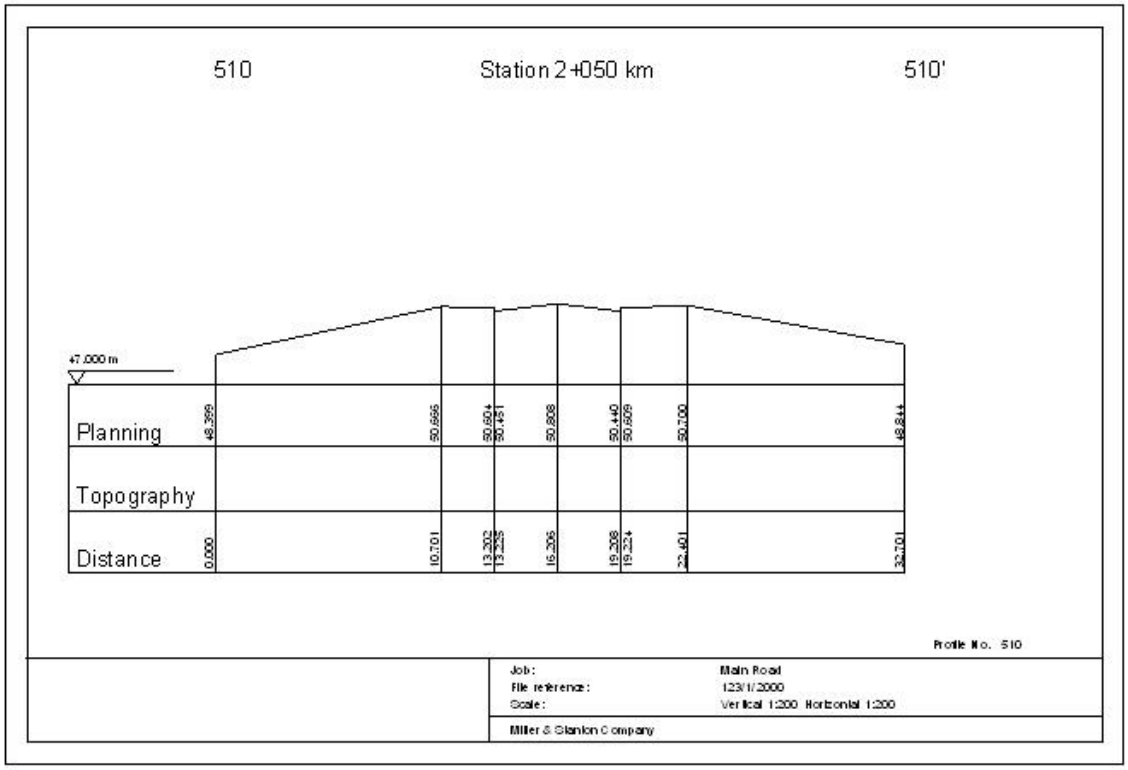
Verticals activated: vertical lines are drawn.

Distances/heights activated: stations and heights are written

Example of **Frame activated, Vertical activated, Distances/heights activated:**

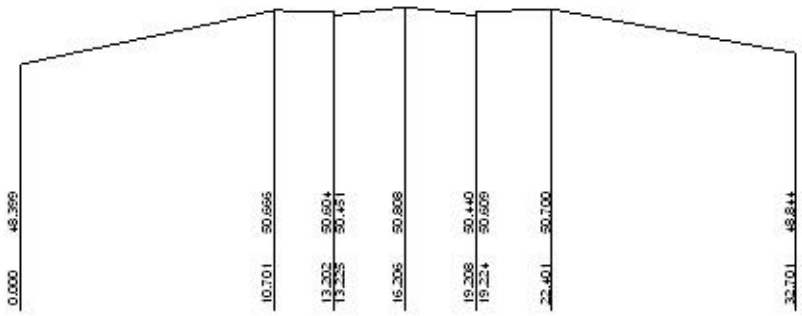


For profile numbers > 500:



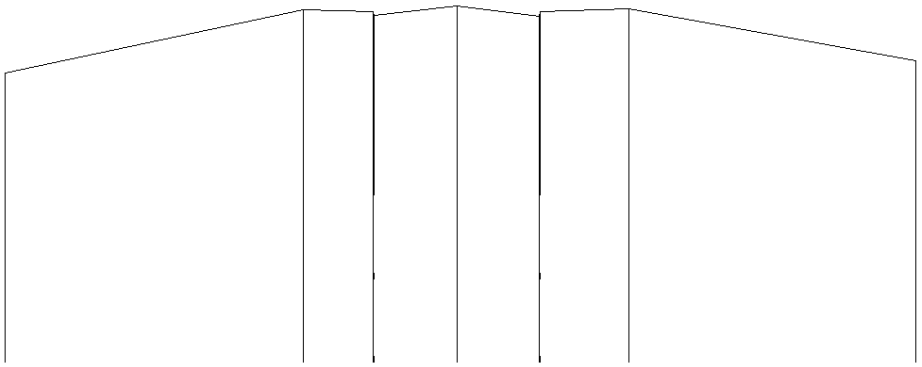
Frame inactivated, Verticals activated, Distances/heights activated:

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=numerical 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 unfavorable 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.

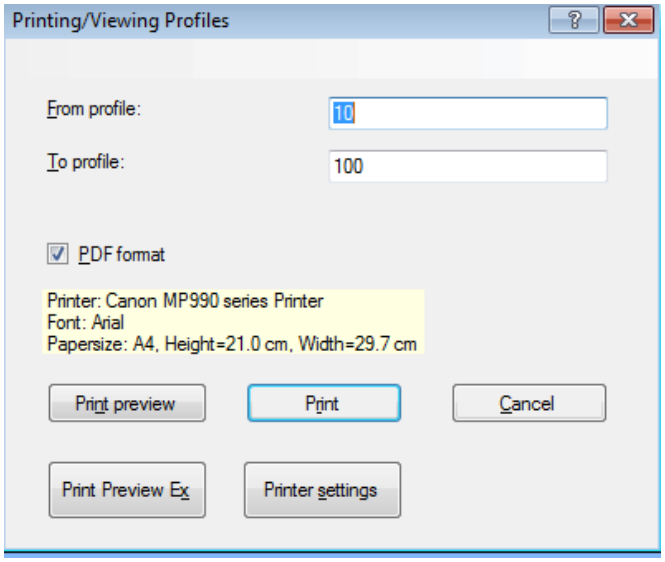
Wrong entries may generate an unspecific error. If your profile file was created from levelling data, this line must be kept empty.

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.

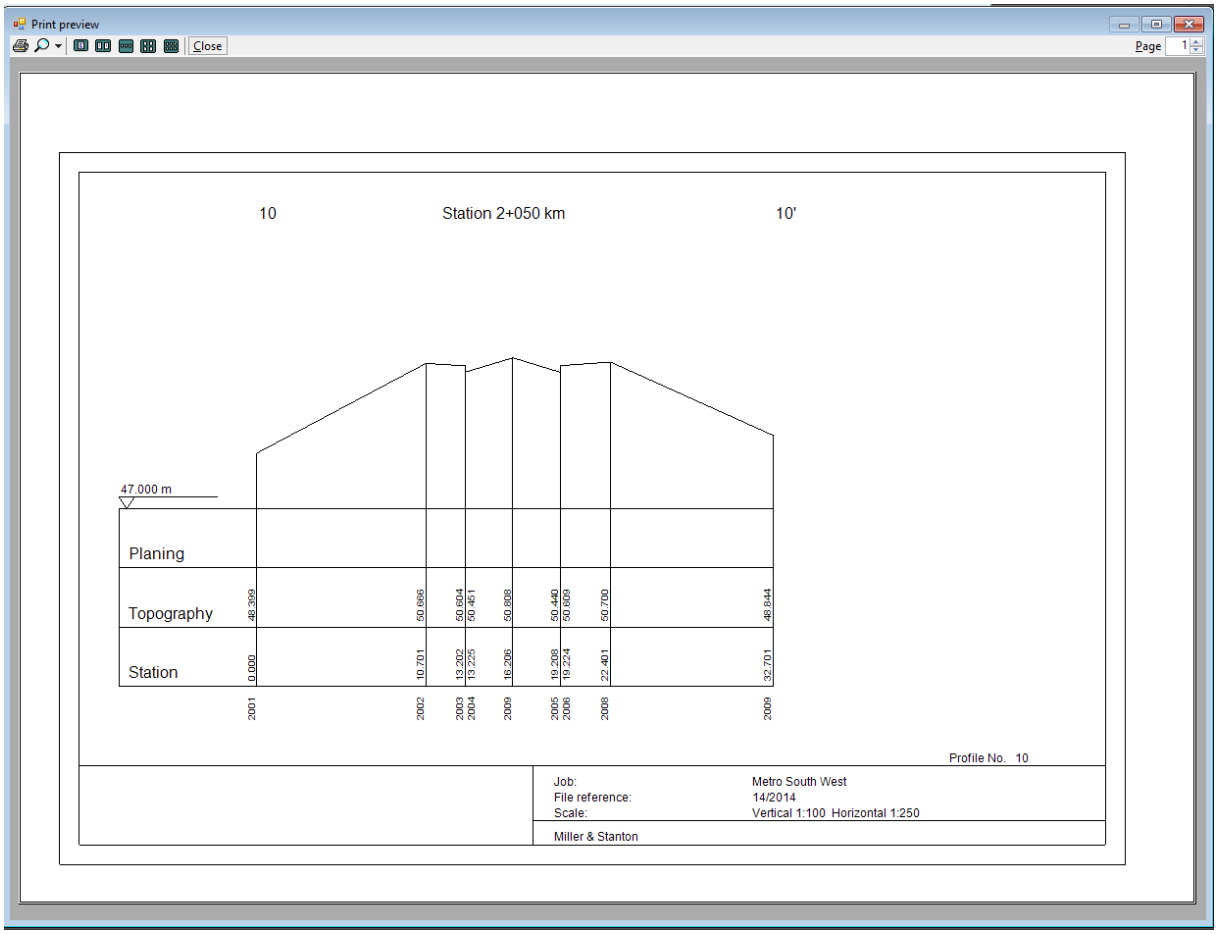
The **Print preview** button opens the print preview. **Print preview Ex** opens an alternative print preview, with the exports in various formats are available.

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 cannot be changed. Nigra also automatically considered portrait or landscape format.

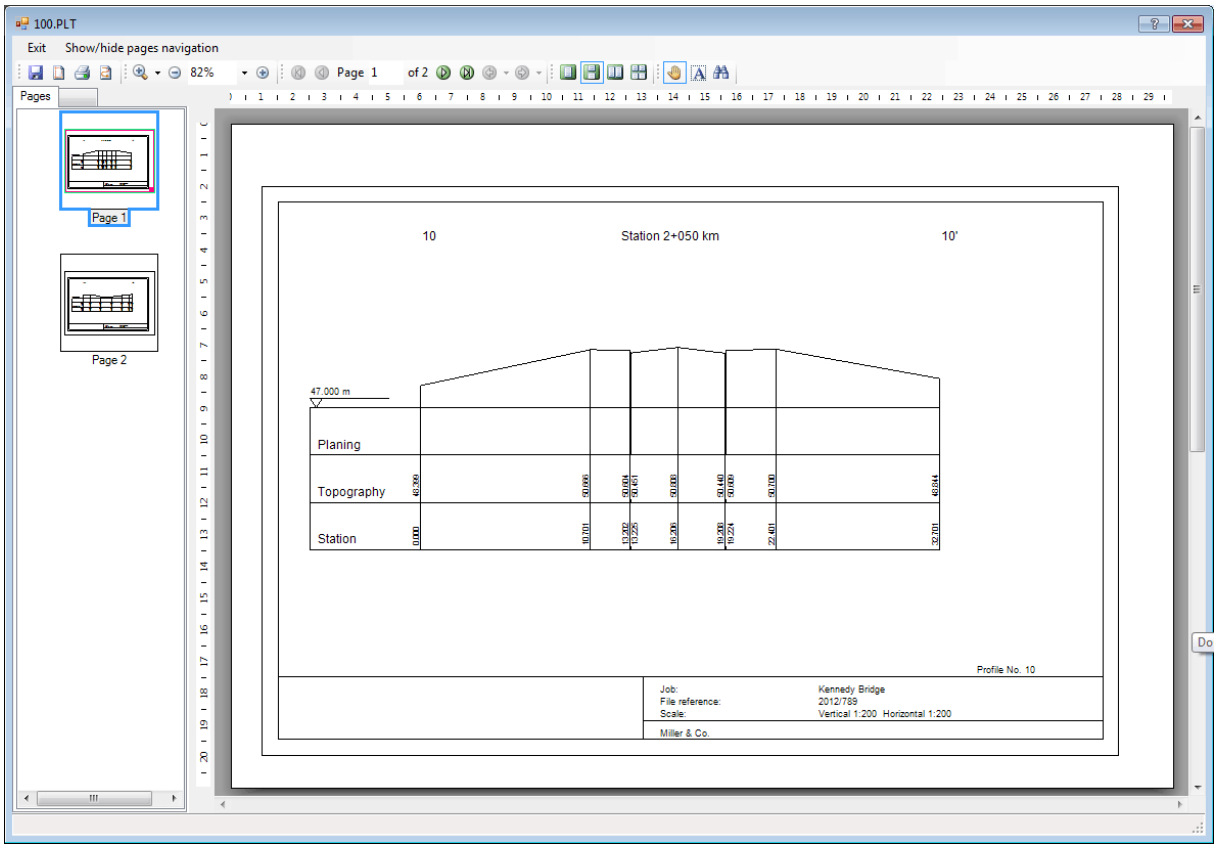
Print Preview (standard)



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 must 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.

```
         1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678901234567890
Job description (1st line from 'job'.DAT)
     From No.       To No.   Height Diff.   D[km]  MO CC  Calcul. No.
           10           20     3.76401    0.04  1.0 1       26*
           10           20    -3.76400    0.03  1.0 1       27
         1001         6019    -0.39613    0.00  1.0 1       15
         1001         6019    -0.39618    0.11  1.0 1       16*
         1503         1560     1.57603    0.01  1.0 1       12*
         1503         1560     1.57604    0.00  1.0 1       13
         1700         1760     1.82375    0.93  1.0 1        8
         1700         1760     1.82370    0.94  1.0 1        9*
         6014         6100    -1.51221    0.12  1.0 1       20
00000000000000 00000000000000
         1503   49.24212 1
         1560   50.82600 1
00000000000000
*** Between 1001 and 6019 no distance
*** Between 1503 and 1560 no distance
```

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.

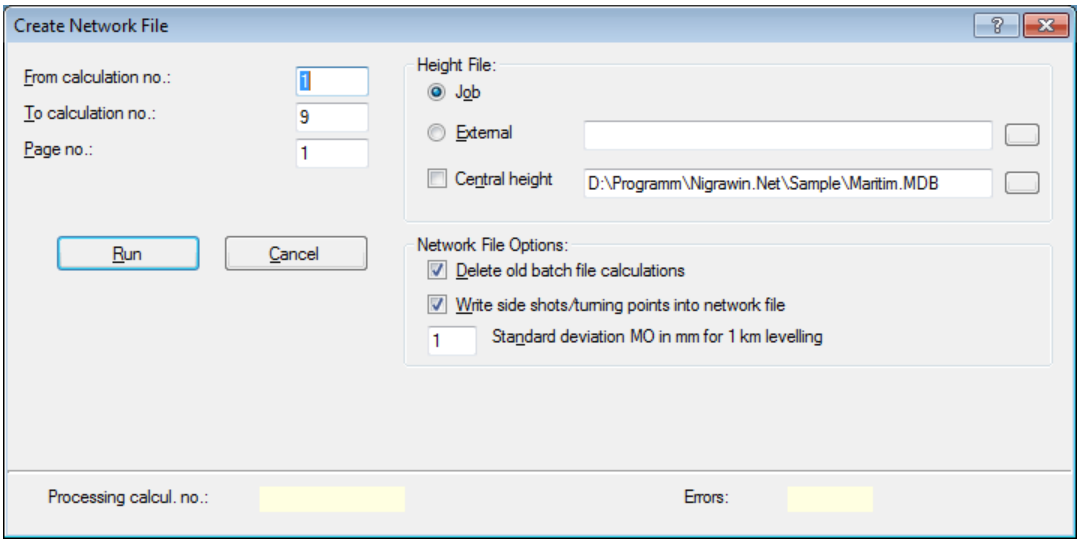
Format of observation data:

```
Columns  1-14   Start 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 start 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**. Exceeding 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 result in another 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:

$$\sigma = \frac{1}{2} \bullet \sqrt{\frac{1}{n}\left[\frac{dd}{l_{km}}\right]}$$

σ = Standard deviation for 1 km/1000 ft/1000in double levelling
d = Height difference between two points
n = Number of line pairs
l = 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.

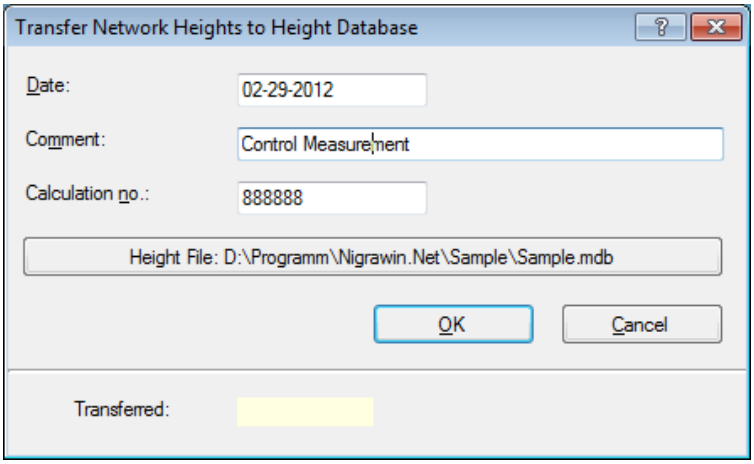
11.6 Print Network Adjustment

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 sH 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 Kurt Andrä

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.

13.1 Line Levelling with Side Shots

Measurement File:

```
RTest file for all levelling methods
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
x        1         2         3         4         5         6         7
xDistance<--- Back    Side    Fore ---><--- Point Number -->
C1
HSankt Augustin      Location
H                    Location
H12. Movement Measur Order
Hement               Order
H12/95               Line
H01-16-2008          Date
Hsunny               Weather
HMiller              Observer
HLeica NA3003 345678 Level
HNedo 5416           Staff
HLevelling with side Comments
H shots              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
H0                   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
H3                   Decimal places for heights in calculations
H3                   Decimal places for readings in calculations
E13m                 E/Mean value/Error class/Unit of measurement
D   25.26 b1.423                                  1503
D   15.47           s2.900                      1503.5
0   15.47           s2.901                      1503.5
2   15.47           s2.899                      1503.5
D   15.47           s2                             200
D   26.15                     f0.022              1504
D   31.59 b1.262                                  1504
0   30.99                     f.001               1505
D   18.54 b1.520                                  1505
D   12.43           s-.105                      1506
D   18.44                     f2.6                1560
E
```

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

Distance   Back        Side        Fore          Height      Point No.
 25.26     1.423                                 49.242          1503
 15.47                 2.900                     47.764        1503.5
 15.47                 2.901                     47.763        1503.5m
 15.47                 2.899                     47.765        1503.5o
 15.47                 2.000                     48.664           200
 26.15                             0.022         50.642          1504
 31.59     1.262
 30.99                             0.001         51.901          1505m
 18.54     1.520
 12.43                -0.105                     53.525          1506
 18.44                             2.600         50.820          1560

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:

```
RTest file for all levelling methods
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
x        1         2         3         4         5         6         7
xDistance<--- Back    Side    Fore ---><--- Point Number -->
C2
HSankt Augustin      Location
H                    Location
H12. Movement Measur Order
Hement               Order
H12/95               Line
H01-16-2008          Date
Hsunny               Weather
HMiller              Observer
HDini 10, 345678     Level
HNedo 5416           Staff
HPrecision levelling Comments
H with side shots    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.
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
D   20.56 b6.6793                                  6014
D   20.56 b.7542                                   6014
D    5.12           s7.1589                       6015
D    5.12           s1.2339                       6015
D    6.55           s7.8642                       6016
D    6.55           s1.9394                       6016
D   20.98                     f8.6710             6017
D   20.98                     f2.7459             6017
D   14.31 b7.0227                                  6017
D   14.31 b1.0975                                  6017
D   13.95                     f8.0553             6100
D   13.95                     f2.1303             6100
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 BBFF(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

Misclosure =        0.2 mm        Max. error E (3) =   3.1 mm

Distance   Back    d   Side    d   Fore   d      Height      Point No.
 20.56    6.6793                                44.85600           6014
          0.7542   1
  5.12                 7.1589                  44.61623           6015
                       1.2339   0/1
  6.55                 7.8642                  44.26353           6016
                       1.9394  -2/3
 20.98                           8.6710        43.86027           6017
                                 2.7459   1/0
 14.31    7.0227
          1.0975   2
 13.95                           8.0553        43.34400           6100
                                 2.1303   0/2

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
x2345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012
x        1         2         3         4         5         6         7
xDistance<--- Back    Side    Fore ---><--- Point Number -->
C3
HSankt Augustin      Location
H                    Location
H12. Movement Measur Order
Hement               Order
H12/95               Line
H01-16-2008          Date
Hsunny               Weather
HMiller              Observer
HDini 10, 345678     Level
HNedo 5416           Staff
HLine levelling      Comments
H                    Comments
H10                  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
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
E03m                 E/Mean value/Error class/Unit of measurement
D      20 b6.6793                                 1001
D      20 b.7542                                  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

     Point No. Distance    Back      d     Fore      d        Point No.
          1001   20.00    6.6793                                 1001
                 20.00    0.7542     1
                  6.00                     8.6710
                  6.00                     2.7459    1/0
                 14.00    7.0227
                 14.00    1.0975     2
          6019   17.00                     7.8231                 6019
                 17.00                     1.8981    0/2

From fixed points 1001 To fixed points 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:

```
RTest file for all levelling methods
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
x        1         2         3         4         5         6         7
xDistance<--- Back    Side    Fore --->Point Number -->
C4
HSankt Augustin      Location
H                    Location
H12. Movement Measur 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          -.0747                          1760
D      40          -.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          03-12-2008    Page: 4
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

     Point No.   Distance  Height Difference    Height       Point No.
          1760                                 48.38600            1760
                   200.0        -0.0747
          1711                                 48.31091            1711
                    40.0        -0.2090
          1710                                 48.10183            1710
                   300.0         8.0080
          1702                                 56.10924            1702
                   290.0        -5.9492
          1701                                 50.15948            1701
                    40.0         0.0486
          1700                                 50.20800            1700

Sum D=       870.0 m   Delta-H=     1.82370 m
```

13.5 Testing the Instrument

Measurement File:

```
RTest file for all levelling methods
x234567890123456789012345678901234567890123456789012345678901234567890123456789012
x        1         2         3         4         5         6         7
xDistance<--- Back    Side    Fore --->Point Number -->
C5
HSankt Augustin      Location
H                    Location
H12. Movement Measur Order
Hement               Order
H12/95               Line
H01-16-2008          Date
Hsunny               Weather
HMiller              Observer
HDini 10, 345678     Level
HNedo 5416           Staff
HInstrument test     Comments
H                    Comments
H5                   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
H0                   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   20.02 b1.7807                                  1
D   40.01                   f2.0000
D      20 b4.0000
D      40                   f3.7827               2
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'

     Point No. Distance    Back             Fore              Point No.
             1   20.02    1.7807                                    1
                 40.01                     2.0000
                 20.00    4.0000
             2   40.00                     3.7827                    2

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

    Point No.   Diff.H.(mm)     Calculation No. Mean Value Calculation Mode
       1503.5      -1.0              6         0 - mean value
       1503.5       1.5              6         2 - old, compare only
         1505       1.1              6         0 - mean value
```

14 Frequently Asked Questions

In this section we will answer frequently asked questions. If you have a problem, read this chapter before you call Kurt Andrä. 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, e.g., 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.*

Appendix A - Text Editor

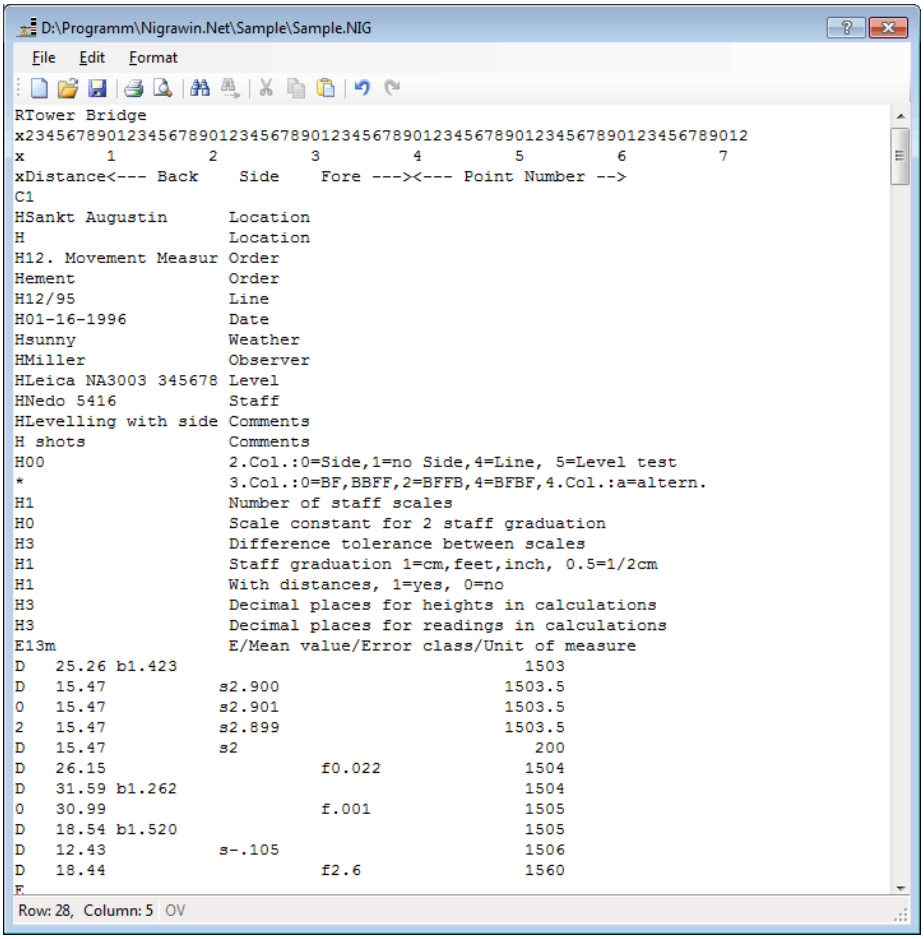
Nigra has an integrated simply text editor like Notepad to edit raw data, measurement file, ASCII height file, and other text files. In addition to Notepad shows the Nigra editor row and column and provides a print preview. From the print preview the file can be saved in various formats such as PDF.

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 megabytes.

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.

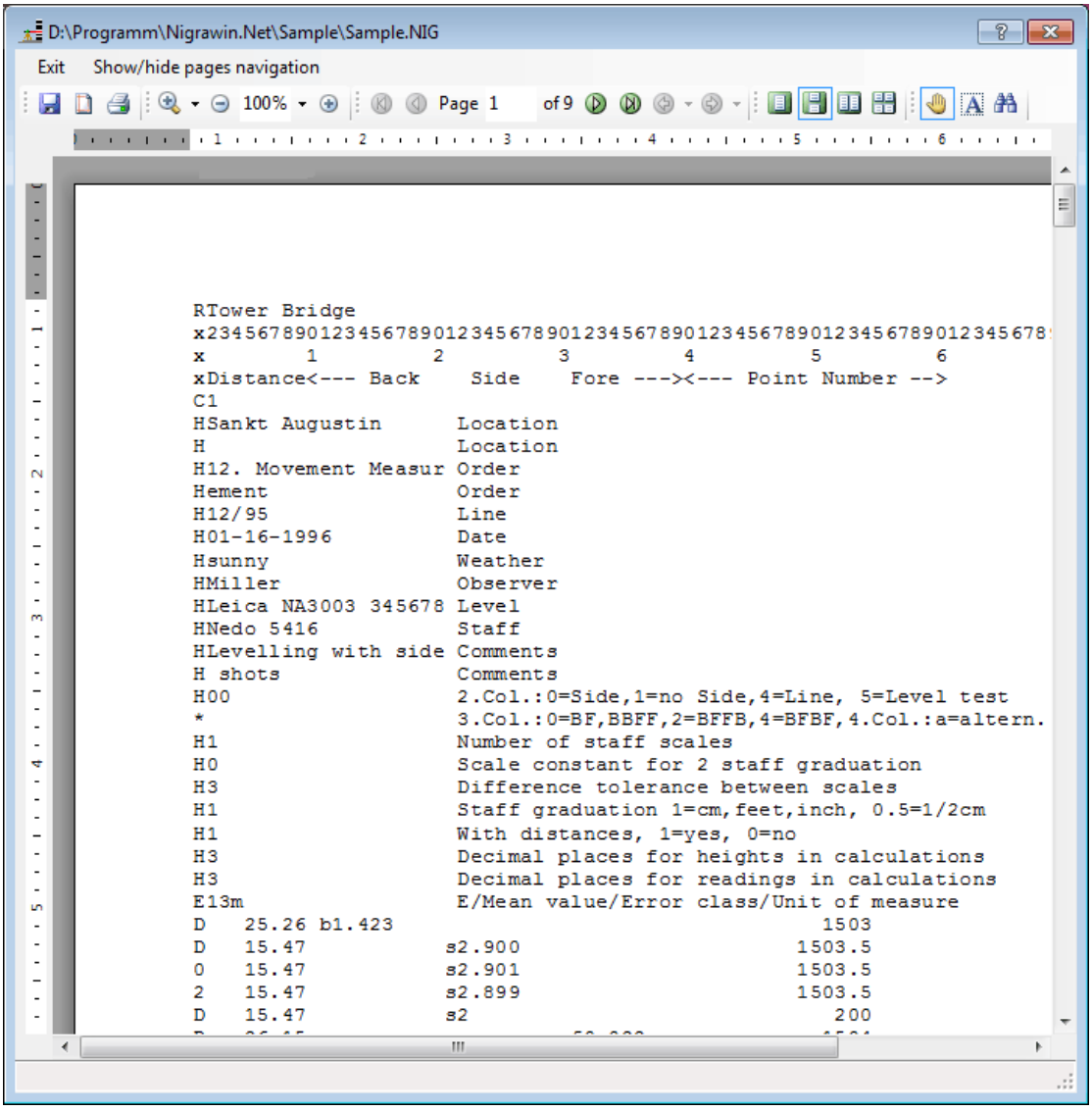


Repeatedly used functions can be chosen directly by clicking an icon in the headline. Moving the mouse pointer over an icon will show a tool tip.

If a file has changed and you quit the editor, you will automatically ask 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.



Nigra-Editor Print Preview

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