AMBERG TECHNOLOGIES

Amberg Applications

Your tunnel under control

User manual

01/07/2016 (Application Version 6.x)

Art.No. 21448

Amberg Technologies AG
Trockenloosstrasse 21
8105 Regensdorf
Switzerland

Phone: +41 44 870 92 22
Mail: support.tunnel@amberg.ch
http://www.amberg.ch/at

Table of Contents

Introduction 5
1 What is Amberg Applications 5
2 Tunnel construction in general 5
3 Software license agreement 5
4 Installation 5
4.1 System requirements 5
4.2 Software installation 5
5 Instruments 6
6 Maintenance & Support contract 7
6.1 Licence key input 7
7 Project data 9
8 Quick start 10
8.1 Installation 11
8.2 Software start 12
8.3 Licence key input 12
8.4 Loading a Project 14
8.5 Configuration 15
8.6 Position and measure 16
1 General introduction 19
1.1 General workflow 19
1.2 Concepts 19
2 General operation of the software 21
2.1 Overview 21
2.2 Main navigation page 21
3 Amberg ProScan plus 23
3.1 Introduction 23
3.2 Workflow 23
3.3 Main menu 23
3.4 Configuration 24
3.4.1 Position mode 24
3.4.2 Measure mode 25
3.4.3 Surveyor 25
3.4.4 Next position 25
3.4.5 Stationing mode 25
3.4.6 Projection mode 25
3.4.7 Accuracy 25
3.4.8 Compensator 26
3.4.9 Ignore compensator error 26
3.5 Position and measure 27
3.6 Measure 27
3.6.1 Measurement results 27
3.6.2 Mode String 30
3.6.3 Mode Profile 32
3.6.4 Mode Horizontal profile 39
3.7 Project management 43
3.7.1 Load project 43
3.7.2 Construction Stage 44
3.7.3 Reset 45
4 Amberg SetOut 47
4.1 Introduction 47

4.2 Workflow ... 47
4.3 Main menu ... 47
4.4 Configuration ... 48
4.4.1 Position mode ... 48
4.4.2 Stationing mode ... 49
4.4.3 Projection mode ... 49
4.5 Position and measure ... 49
4.6 Measure ... 49
4.6.1 Measurement results ... 50
4.6.2 Setup of parameters ... 52
4.6.3 Task Types ... 53
4.7 Project management ... 57
4.7.1 Load project ... 57
4.7.2 Construction Stage ... 58
4.7.3 Reset ... 59
4.8 Log File ... 59
5 Amberg SetUp ... 61
5.1 Introduction ... 61
5.2 Main menu ... 61
5.3 Configuration ... 62
5.3.1 Setup mode ... 62
5.3.2 Measure mode ... 62
5.3.3 Target ... 62
5.3.4 NumTarget Points ... 62
5.3.5 Measure Two Faces ... 63
5.3.6 Max Coord Sigma ... 63
5.3.7 Max Orient Sigma ... 63
5.4 Setup wizard ... 63
5.4.1 Measurements to targets ... 63
5.4.2 Calculation of position ... 64
5.4.3 Check of the instrument position ... 65
5.4.4 Check of measured point ... 65
5.4.5 Set position ... 66
5.5 Log File ... 66
Glossary ... 67

Introduction

This is the user manual of Amberg Applications for hardware with Smartworks VIVA operating systems.It contains all information about working with the Amberg Applications application (e.g. positioning of the instrument, executing profile measurements and staking out points).

This manual builds on the manual Amberg Tunnel - Base. For reference on how to define a project with design data refer to the Amberg Tunnel - Base manual.

1 What is Amberg Applications

Amberg Applications contains the tools to measure or stake out points in tunnel and shaft headings. The measurements are carried out by means of a tachymeter. The software controls the instrument, evaluates the measurement data and displays correction values to the design of the tunnel heading or stakes out points according their definition in the project.

2 Tunnel construction in general

To minimize costs in tunnel construction, it is necessary to build as close to the design as possible. To avoid interruptions of the heading, daily work steps should be made as efficient as possible. Amberg Applications will support you to reach this goal.

Amberg Applications strives to make surveying tasks in tunnel construction faster and simpler while, at the same time, giving the user the flexibility to react to changing requirements.

3 Software license agreement

You can find the software license agreement on the Amberg website: www.ambergtechnologies.ch/license-agreement.

4 Installation

This section describes the installation of the software and its components.

4.1 System requirements

The table below shows minimal software specifications for running the software.

Table 1. System requirements

Requirement	Description
Operating system	Leica Smartworxs Viva

4.2 Software installation

4.2.1 Latest software release

You may download the latest release of Amberg Applications **with personal login information** from the Amberg website: www.ambergtechnologies.ch/downloads.

4.2.2 Installation

The Amberg Applications software is supplied on a storage device or can be downloaded from the Amberg website. Before you can use the program Amberg Applications you must install the software on your instrument.

The language of Amberg Applications follows the Leica language settings. Additional languages can be uploaded within the Leica software. Make sure that the language files are uploaded before installing the Amberg Applications.

The procedure is as follows:

1. The program named `AmbergApplications.axx` must be copied to the `\SYSTEM` directory on the memory card.
2. Insert the memory card to the instrument.
3. Load the application on the instrument.

The installation is done analog other Leica on-board software. Please read the appropriate section in the manual of your Leica system.

For working with a CS10/CS15 (Leica Viva) remote, install the software also on your remote control and input the **same** licence keys as on the instrument. Make sure the remote and the instrument are both switched on and connected.

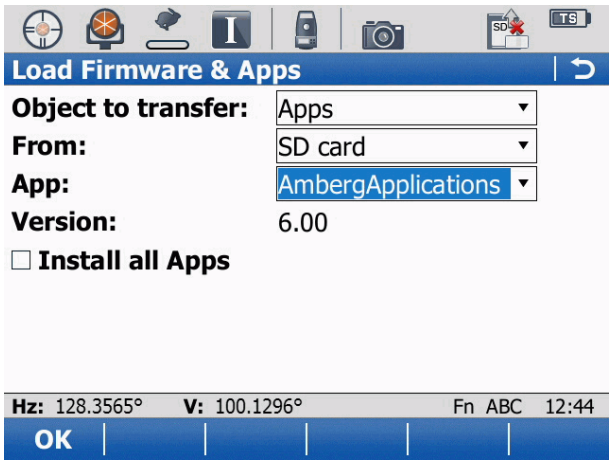

Figure 1. Load Firmware and Apps

4.2.3 Software updates

Whenever there is a new release of the software Amberg Applications, simply install it according to the instructions above.

4.2.4 Uninstallation

Please use the Leica uninstallation mechanism to remove the software from the instrument. Please read the appropriate section in the manual of your Leica system.

5 Instruments

The following instruments are are compatible with Amberg Applications.

Instruments without **PowerSearch** or **Lock Mode** can be used with Amberg Applications, but there are some limitations. Tasks requiring these functionalities cannot be executed (e.g. positioning task **Amberg SetUp automatic** requiring PowerSearch or tracking of prisms in task **ProScan plus (tunnel disk)** requiring lock mode.

Other Instruments from Leica Geosystems, which are not listed here, are not supported.

Table 2. Leica Viva instruments

Model	Description
TS15 M	Not supported (no ATR)
TS15 A	Limited (no PowerSearch)
TS15 G	Not supported (no coaxial visible laser)
TS15 P	Supported
TS 15 I	Supported

Table 3. Leica Nova instruments

Model	Description
MS50	Supported
TS50 I	Supported
TM50	Limited (no PowerSearch, no lock mode)
TM50 I	Limited (no PowerSearch, no lock mode)

6 Maintenance & Support contract

After the first installation of Amberg Applications on your tachymeter, the individual modules must be unlocked by entering a valid license key.

License keys are stored on the instrument after installing the software. It is not necessary to input a new key after an update of the application.

Amberg Applications is continuously improved and maintained. For updating to a newer version of the application or installing it the first time, it is required to have a valid Maintenance & Support contract. The validity of the Maintenance & Support contract is verified by the according license key.

For upgrade information contact your local distributor or Amberg Technologies AG (support.tunnel@amberg.ch[1]).

6.1 Licence key input

The necessary steps are identical for the Maintenance & Support license key as well as for all modules. After starting Amberg Applications, the main menu appears.

[1] mailto:support.tunnel@amberg.ch

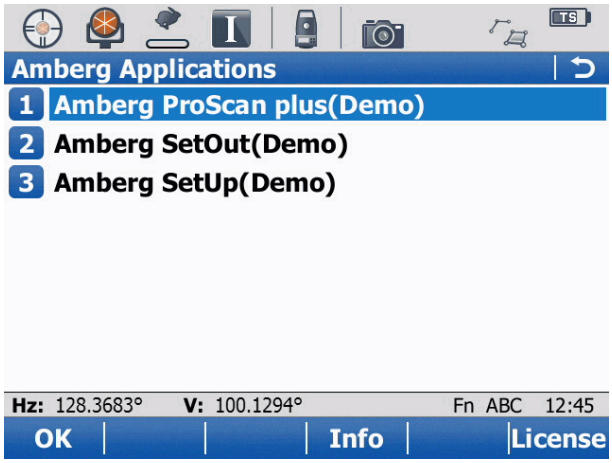

Figure 2. Main menu before licence key input

1. Press **F6: Licence**. A screen for entering the license key is shown.

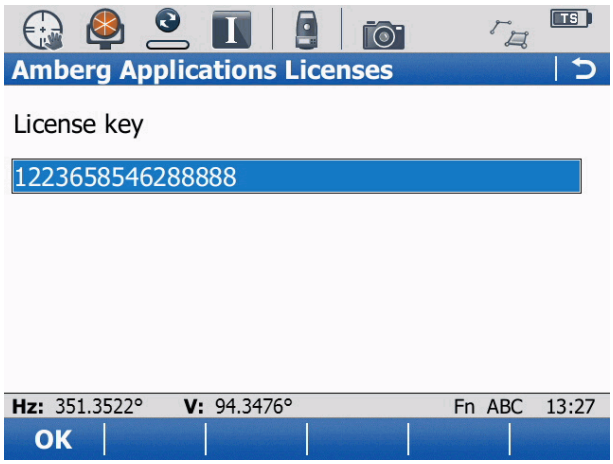

Figure 3. Licence key input example

2. Enter the valid **Maintenance & Support** key for the instrument. If the key is valid, the instrument is ready to enter the license keys for the purchased modules.
3. Press **OK**.
4. After the entering of the **Maintenance & Support** key, the modules of the application are still in demo mode. To unlock the full functionality, it is necessary to input the license keys of the modules.

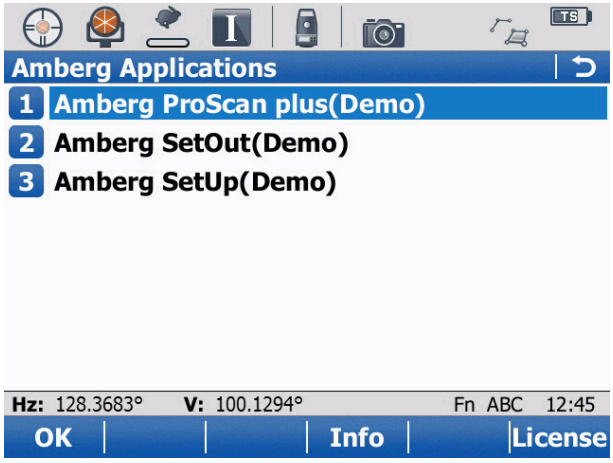

Figure 4. Main menu after Maintenance & Support licence key input

5. Press **F6: Licence** again. A screen for entering the license key is shown.
6. Enter the valid **Module** licence key for the instrument.

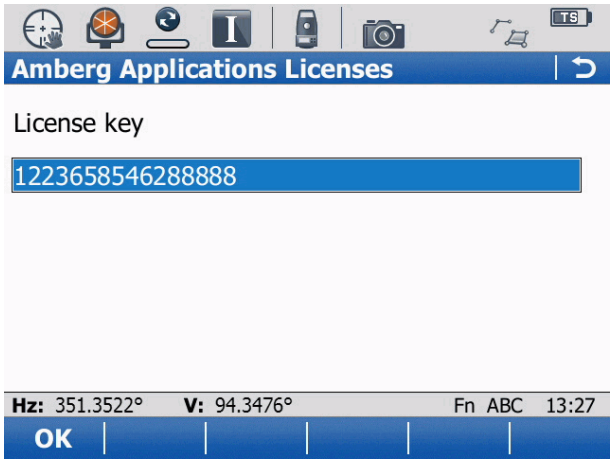

Figure 5. Module licence key input example

7. After entering the module license key, the the name of the module and its status is refreshed (demo, time-limited or full). In demo mode, only reduced operations are possible.

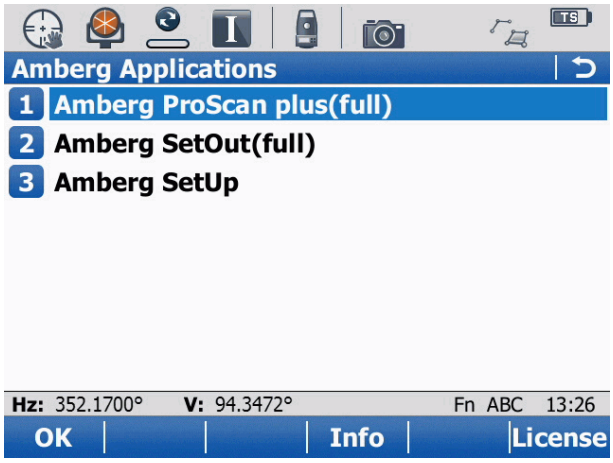

Figure 6. Main menu after licence key input

7 Project data

In order to use Amberg ProScan plus and Amberg SetOut, project data needs to be loaded on the instrument. This data is defined in the Amberg Tunnel office application and can from there be exported for Amberg Applications.

Create a directory named `\TMS` in the root directory of the memory card. The appropriate project export files must be copied to this directory. Control points (control job) must be stored in the `\DBX` directory on the memory card.

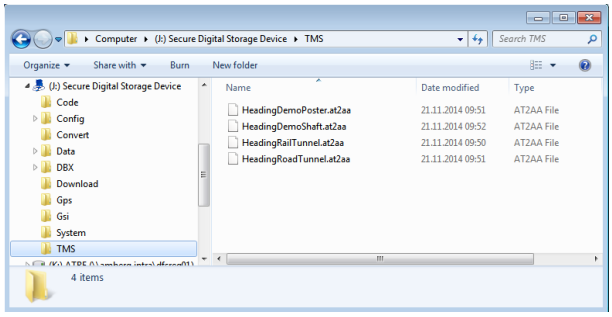

Figure 7. Project files in the TMS directory (example)

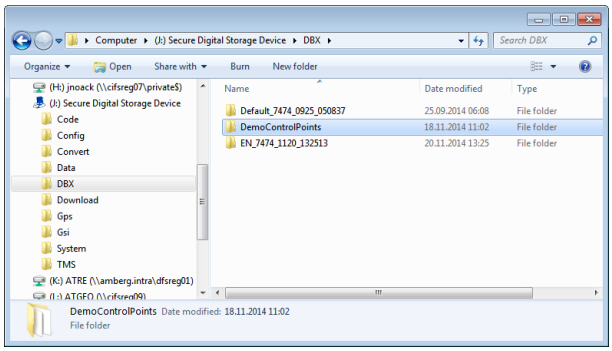

Figure 8. Data files in the DBX directory (example)

The project data is exported from Amberg Tunnel into a single file with extension `.at2aa`.

These files must in no case be edited manually. If files are edited manually, no warranty for the system and no support can be provided.

8 Quick start

These instructions are intended to help you taking Amberg Applications into operation in a fast way. For details refer to the more extensive descriptions in this manual.

There are some basic preparations that should be done before the installation and measurement.

1. The program named `AmbergApplications.axx` must be copied to the `\SYSTEM` directory on the memory card.
2. Create a `\TMS` directory on the memory card. The appropriate project export files created with Amberg Tunnel must be copied to this directory on the memory card.
3. Control points (**Control job**) must be stored in the `\DBX` directory on the memory card. The control job containing the control points must be chosen in the Leica menu.

Figure 9. Choose control job (example)

4. Select a **Working job** to store the measurements. They can be transferred to Amberg Tunnel for analysis.

Figure 10. Choose working job (example)

8.1 Installation

The installation procedure is described below:

1. Insert the memory card containing the file `AmbergApplication.axx` in the directory `\SYSTEM` directory.
2. Load the application on the instrument.

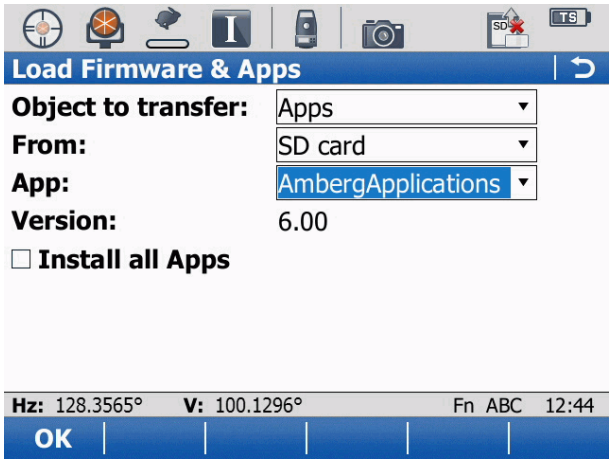

Figure 11. Load Firmware and Apps (example)

8.2 Software start

The software can now be found in the Leica **Survey+** menu.

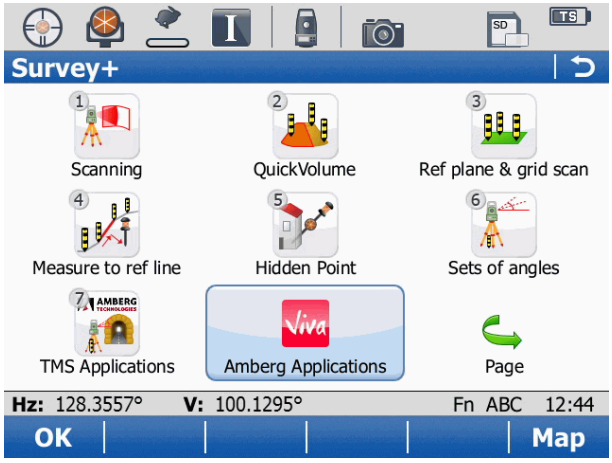

Figure 12. Amberg Applications in the Leica Survey+ menu

8.3 Licence key input

The necessary steps are identical for the Maintenance & Support license key as well as for all modules. After starting Amberg Applications, the main menu appears.

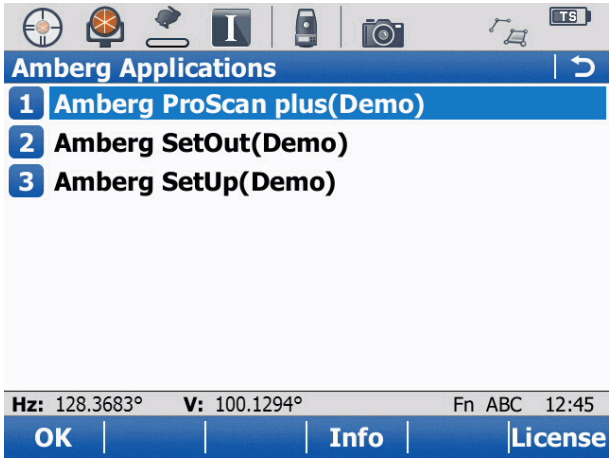

Figure 13. Main menu before licence key input

1. Press **F6: Licence**. A screen for entering the license key is shown.

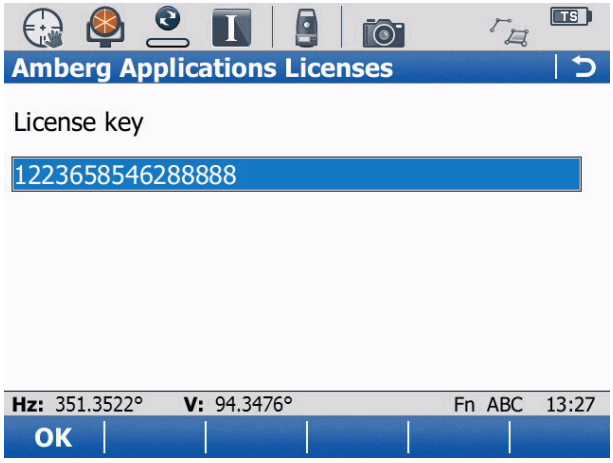

Figure 14. Licence key input example

2. Enter the valid **Maintenance & Support** key for the instrument. If the key is valid, the instrument is ready to enter the license keys for the purchased modules.
3. Press **OK**.
4. After the entering of the **Maintenance & Support** key, the modules of the application are still in demo mode. To unlock the full functionality, it is necessary to input the license keys of the modules.

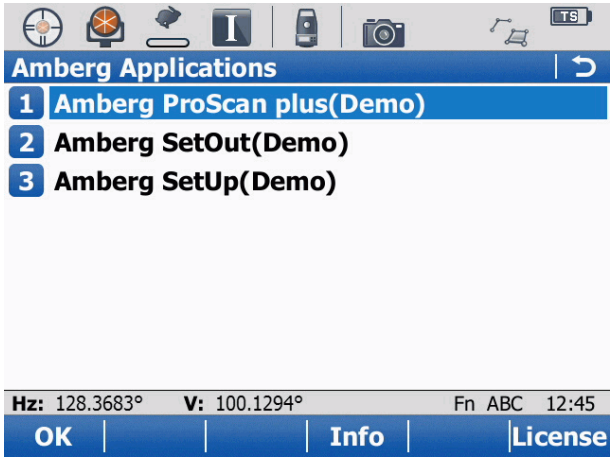

Figure 15. Main menu after Maintenance & Support licence key input

5. Press **F6: Licence** again. A screen for entering the license key is shown.
6. Enter the valid **Module** licence key for the instrument.

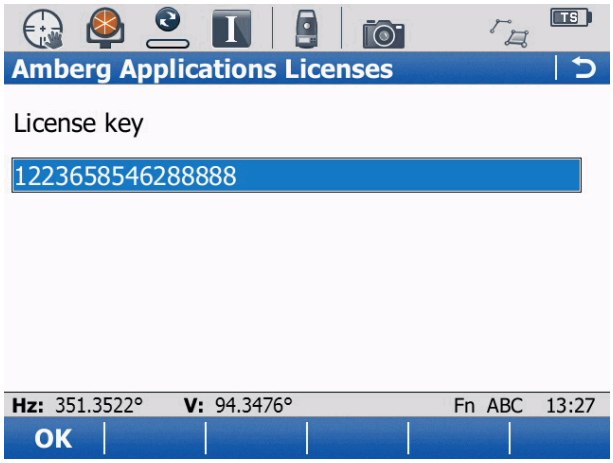

Figure 16. Module licence key input example

7. After entering the module license key, the the name of the module and its status is refreshed (demo, time-limited or full). In demo mode, only reduced operations are possible.

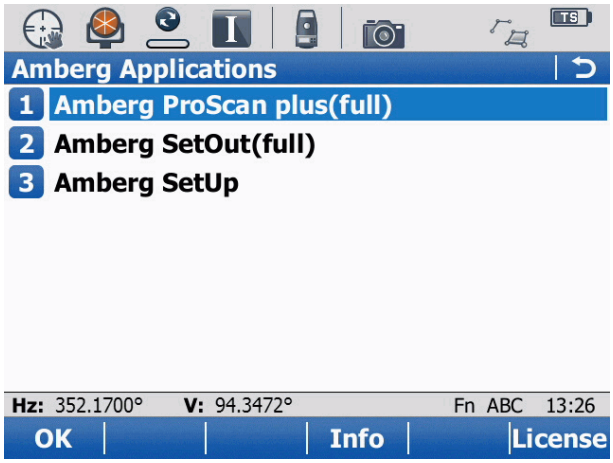

Figure 17. Main menu after licence key input

8.4 Loading a Project

Load project data in the **Project management** area of Amberg ProScan plus or Amberg SetOut.

1. Navigate to the **Project management** area.

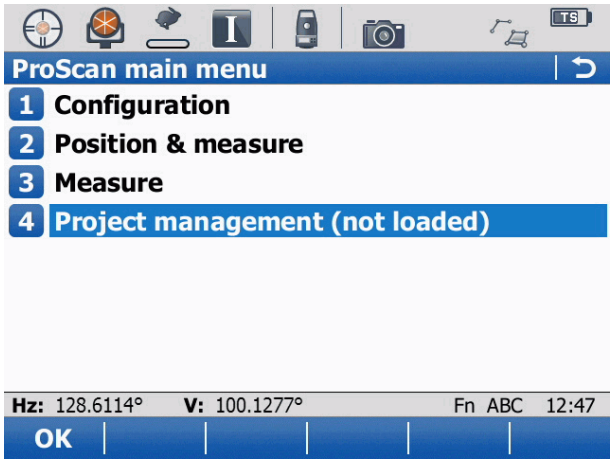

Figure 18. ProScan main menu (no project loaded)

2. Load a project file (e.g. the demo project). Project files have the file extension `.at2aa`.

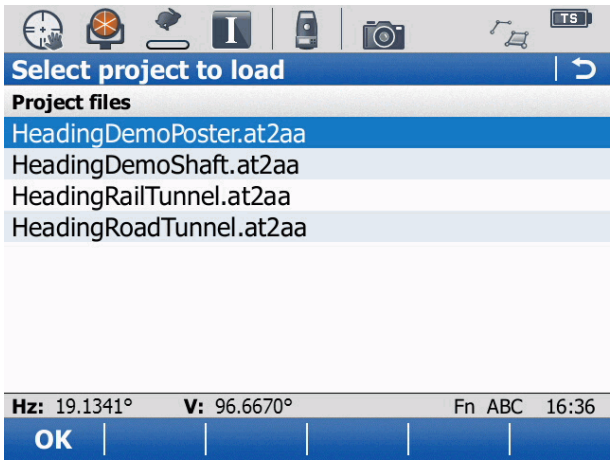

Figure 19. Project management area

3. Press **OK**.
4. Leave the administration area.

8.5 Configuration

1. On the main navigation page, select **Configuration**.

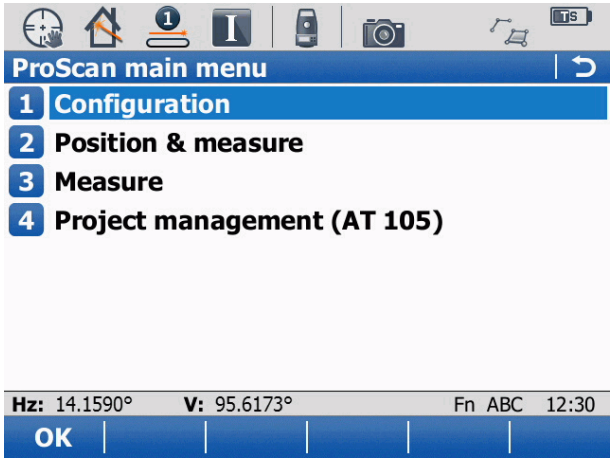

Figure 20. ProScan main menu

2. Select a measurement mode and press **OK** to return to the main menu. Make sure all settings match your requirements.

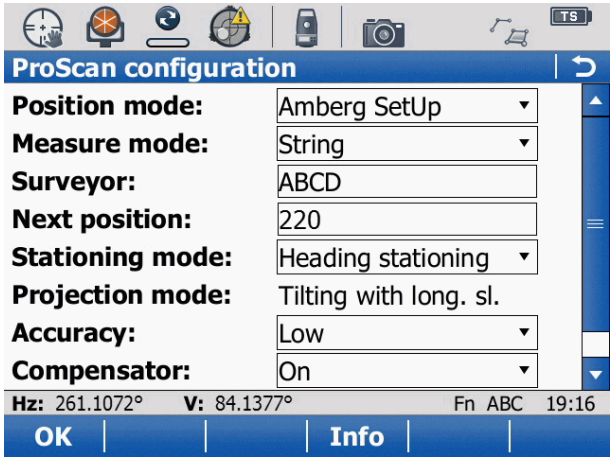

Figure 21. ProScan configuration (example)

8.6 Position and measure

1. On the main navigation page, select **Position & measure**.

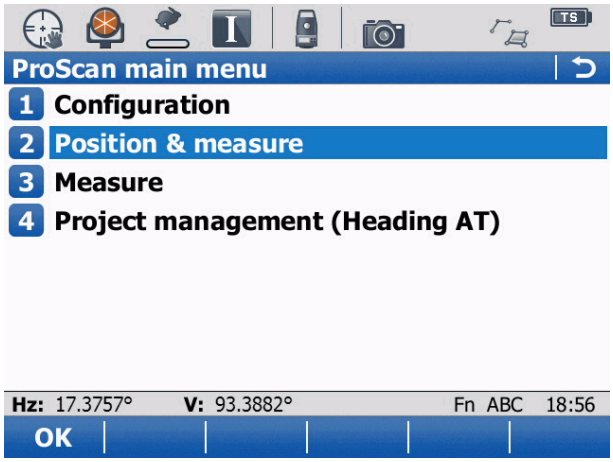

Figure 22. ProScan main menu

2. Follow the wizard in Amberg SetUp or position the instrument with the Leica setup application.

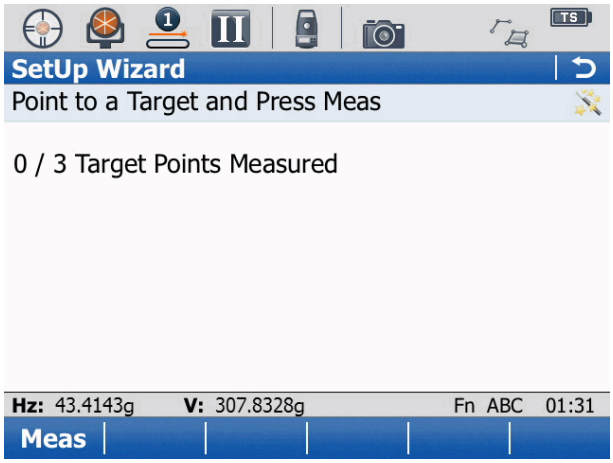

Figure 23. SetUp example

3. After setting up the instrument successfully, the measurement screen is displayed. You can start taking measurements with the selected module.

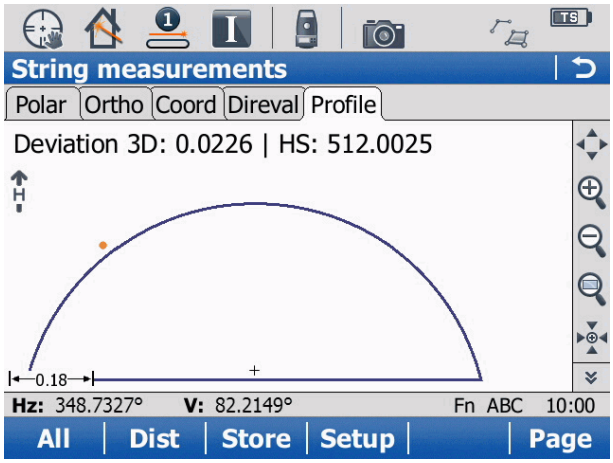

Figure 24. ProScan String mode example

4. After you have finished the measurements, close the software and turn off the instrument.

Chapter 1 General introduction

In this chapter you will get general information about the range of possibilities with Amberg Applications. Before you start working with Amberg Applications, please read through this chapter carefully.

Amberg Applications is the on-board software of Amberg Tunnel, consisting of the following modules:

- Amberg ProScan plus
- Amberg SetOut
- Amberg SetUp

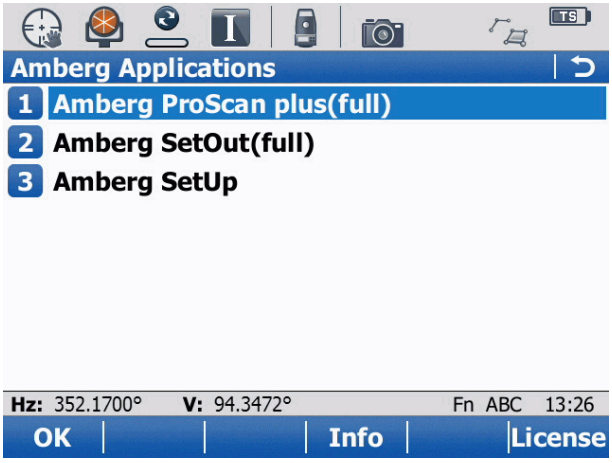

Figure 25. Amberg Applications main menu

1.1 General workflow

Amberg Tunnel exports project files with design data for Amberg Applications. These project files can be loaded on the tachymeter with Amberg Applications as a base to control profiles or stake out points during the tunnel construction process. The measurements can be transferred to the Amberg Tunnel Profil for analysis, visualization and creation of reports for the customer.

1. Export the project file from Amberg Tunnel.
2. Load the project file in Amberg Applications.
3. Position of the instrument with help of Amberg SetUp or a Leica setup application.
4. Measure profiles with Amberg ProScan plus or stake out points with Amberg SetOut.
5. Analyse the measured profiles with Amberg Profile.

For further reference consult, the Amberg Tunnel - Base and Profile manuals.

1.2 Concepts

The two applications Amberg Applications and Amberg Tunnel build a complete solution for automatic stake out and profile measurement in tunnel and shaft construction.

Amberg Tunnel - Base serves to manage the project data (axis, theoretical profiles, control points, etc.).

Amberg Tunnel - Profile is used to evaluate the profile measurements done with the Amberg ProScan plus application.

Depending on the loaded project and settings, Amberg Applications operates in 3D Tunnelmeter or Heading stationing. Accordingly, the stationing values are displayed as **TM** or **HS**.

Depending on the theoretical profiles settings of the selected construction stage, Amberg Applications calculates axis coordinates in **2D** or **3D** mode. Set the theoretical profiles settings in Amberg Tunnel to **always vertical** or **tilted with longitudinal slope** according to your requirements. Accordingly, the axis coordinates are displayed as **L/H** for 2D and **X/Y** for 3D mode.

For more details consult the Amberg Tunnel - Base and Profile manuals.

Chapter 2 General operation of the software

2.1 Overview

The operation of the program is driven by dialogs and function keys.

The dialogs lead the user in a wizard-mode through the programs. Each dialog can be escaped with the **ESC** key. When a dialog is escaped with the **ESC** key, changed fields in the dialog are not stored.

For more information about Leica built-in functionality (for example the Leica setup application) that can be used from within Amberg Applications, refer to the appropriate manual.

The following function keys are present on many pages in the application and associated with the following commands:

ESC	The ESC key brings you back to the previous page.
OK	The OK key brings you to the next page.
Selection list	The selection list displays a group of options. The selected entry is highlighted.

2.2 Main navigation page

After the start of the software, the main screen of Amberg Applications is shown.

Select a **module** and press **OK** to work with the selected module.

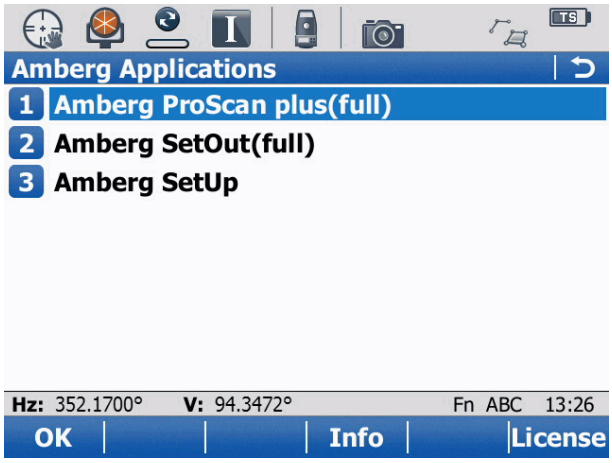

Figure 26. Main menu

Chapter 3 Amberg ProScan plus

3.1 Introduction

The on-board application **Amberg ProScan plus** scans surfaces fully automatic with the reflectorless distance measurement mode. The results are automatically stored to the working job.

Amberg ProScan plus has standard measuring sequences and procedures. Even inexperienced users are guided through the process to achieve correct operation and accurate results.

Project data The project data (`.at2aa` file) exported from Amberg Tunnel must be copied to the directory `\TMS` of the memory card.

Measurement data The profile measurement data is stored in the selected working job.

3.2 Workflow

Normally these steps are required for single or profile measurements with ProScan plus.

1. Start Amberg ProScan plus.
2. Load the project data.
3. Position of instrument with control points.
4. Measurement of single points or profiles.

3.3 Main menu

After starting the program, the ProScan plus main menu is displayed.

Configuration In the configuration dialog, set the parameters which control the measurement and the positioning.

Position and measure This function automatically guides you through **Positioning** and **Measurement**. It is used after installing the instrument on a new position.

Measure This function allows the execution of additional automatic measurements with Amberg ProScan plus from the same instrument position. If you intend to use other parameters for the measurement, you must change the according settings in the configuration before using this function.

Project management The project data is loaded automatically when the program starts (if the required files are available on the memory card in the directory `\TMS`).

The currently loaded project is shown in brackets:

- **Not loaded**: No project data is loaded.
- **Heading name**: The project with the displayed heading name is loaded.

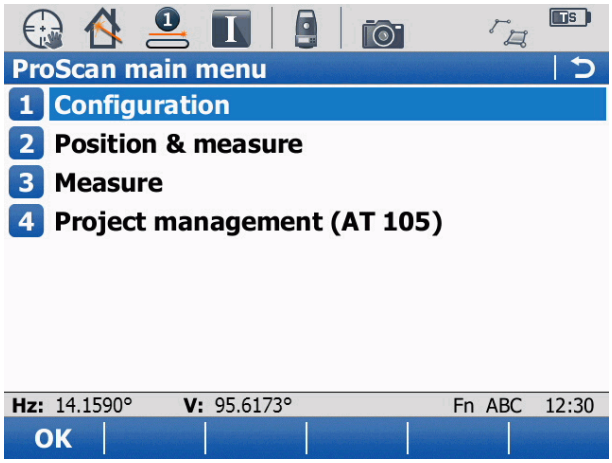

Figure 27. ProScan main menu

3.4 Configuration

Before a measurement with Amberg Applications can be started, it needs to be configured to your requirements. This section explains the basics and describes the options available with the software.

F1: OK Stores the current configuration and closes the configuration dialog.

F4: Info Displays information about Amberg Applications and the instrument.

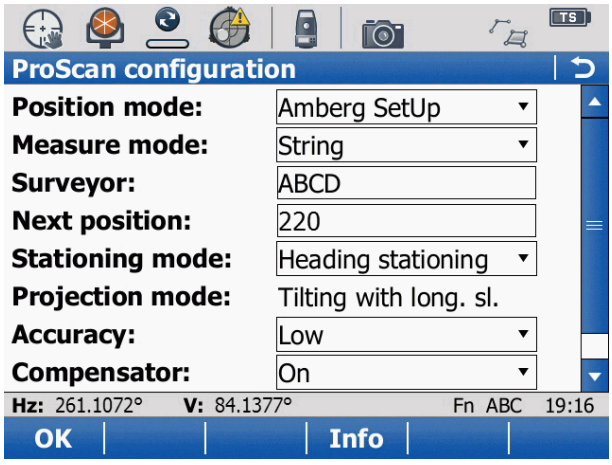

Figure 28. ProScan configuration

3.4.1 Position mode

Select this to see which method is used for positioning of the instrument.

Leica Setup Select the list entry **Leica Setup** if you want to set up the instrument with the methods of the Leica Setup application. The selection of the method is done later in the positioning sequence.

Amberg SetUp Select the list entry **Amberg SetUp** if you want to set up the tachymeter with this setup method. The configuration of this method is done on the configuration page of the SetUp module.

For further information please refer to Chapter 5, *Amberg SetUp* on page 61.

3.4.2 Measure mode

Select here which of the automatic measuring methods shall be used.

String	Manual measurement of specific points.
Profile	Measurement of profile(s). One profile is always measured through the instrument plane, optional measurement of parallel profiles.
Horizontal profile	Measurement of horizontal profile(s). One profile is always measured through the instrument plane, optional measurement of parallel profiles.

When a vertical shaft project is loaded, only the measurement modes String and Horizontal profiles are available.

3.4.3 Surveyor

Enter the name of the surveyor.

3.4.4 Next position

Enter the number of the next position. Each position contains one or more profiles. The item number is increased by one automatically on the basis of the last measured position.

3.4.5 Stationing mode

Select which stationing should be displayed during for the direct evaluation of measurements.

Heading stationing	Stationing values along the situation of the heading axis act as a reference during construction, usually zero at the tunnel portal and increasing in heading direction.
3D Tunnelmeter	Stationing values along the 3D path of the heading axis (taking into account the vertical alignment defined in Amberg Tunnel), usually zero at the tunnel portal (where Heading stationing is zero) and increasing in heading direction.

3.4.6 Projection mode

Tilting with longitudinal slope	Theoretical and measured profiles are aligned perpendicular to the axis, respecting the vertical alignment definition. If the axis is inclined, the theoretical profile will lean forward or backwards according to the longitudinal alignment at the specific position.
Always vertical	Theoretical and measured profiles are always aligned vertically, independent from the vertical alignment definition. Also if the axis is inclined, the theoretical profile will be always vertical and not lean forward or backwards.

3.4.7 Accuracy

Depending on the selected accuracy settings **Low**, **Middle** and **High**, measurement speed can be significantly increased. The drawback of higher measurement speed is reduced accuracy of the point position in **Low** or **Middle** mode.

Different measurement modes will use different accuracy for the telescope position and EDM modes for the profile measurements.

Telescope position

Precise The instrument will turn exactly to the calculated angles of measurement point.

Fast The instrument will turn with lower accuracy to the calculated angles, resulting in a less uniformly measured profile.

Measurement mode (EDM)

Fast The instrument will measure a new point always after the telescope position is fully reached. Angle and distance measurement are made at the same position.

Tracking The measurement can measure a new point during the movement of the telescope. Angle and distance measurement may not be made precisely at the same time and position.

Table 4. Accuracy modes

Accuracy mode	Telescope position mode	EDM mode	Time required vs. High mode
Low	Fast	Tracking	35 %
Middle	Fast	Fast	80 %
High	Precise	Fast	100 %

3.4.8 Compensator

On The compensator is switched on during the automatic measurement. This may slow down the measurement.

Off The compensator is switched off during the automatic measurement. This can accelerate the automatic measurement.

During the manual measurement and in the positioning dialog, the compensator is in the mode as it has been set in the base configuration of the instrument.

3.4.9 Ignore compensator error

Depending on the selected setting **Yes** or **No** the software will stop the profile measurement in case the compensator runs out of tolerance (this applies only when the compensator is active).

In case you measure profiles on unstable ground, the instrument will stop in case of compensator warnings and you have to press the **OK** button to continue the profile measurement. In case the **Ignore compensator error** option is set to **Yes**, the software will suppress the warnings automatically. The instrument continues the measurement, but the point with the compensator error is not stored in the DBX file. This function can be used to get only points with high accuracy in case you measure on unstable ground under time pressure. It is recommended to have the option **Ignore compensator error** always on **No**.

3.5 Position and measure

Amberg Applications guides you during the sequence of automatically measuring profiles through positioning of the instrument. The basics about positioning are explained in Chapter 5, *Amberg SetUp* on page 61. There are the two positioning methods available:

Leica Setup Amberg Application calls the instrument positioning from the standard Leica programs.

Amberg SetUp Amberg Application calls Amberg SetUp for instrument positioning. See Chapter 5, *Amberg SetUp* on page 61.

3.6 Measure

Before a measurement is started the basic parameters in the configuration must be set and the positioning sequence gone through. Only after having done this, an automatic measurement can be started.

Make sure the right project data is loaded.

Avoid a manual obstruction of the program controlled rotation of the instrument.

All the measurements are stored automatically to the working job, which is defined on the instrument.

Depending on the configuration of the **Measure mode**, various function keys may be available or not. At any time, all the function keys which are available are shown on the display.

3.6.1 Measurement results

The measured values are shown in one of the following formats on different pages/tabs. To select a different page press **F6: Page** or touch the page header.

3.6.1.1 Polar coordinates page

Remark Input additional point information
V Current vertical angle
Hz Current horizontal angle
SlopeDist Last measured slope distance

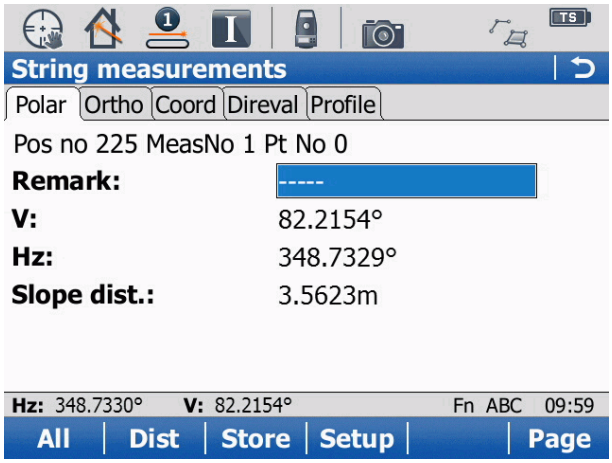

Figure 29. Page polar example

3.6.1.2 Orthogonal coordinates page

Remark	Input additional point information
Hz	Current horizontal angle
Horiz. dist.	Last measured horizontal distance
Height. diff.	Last measured elevation difference between vertical axis of instrument and measured point

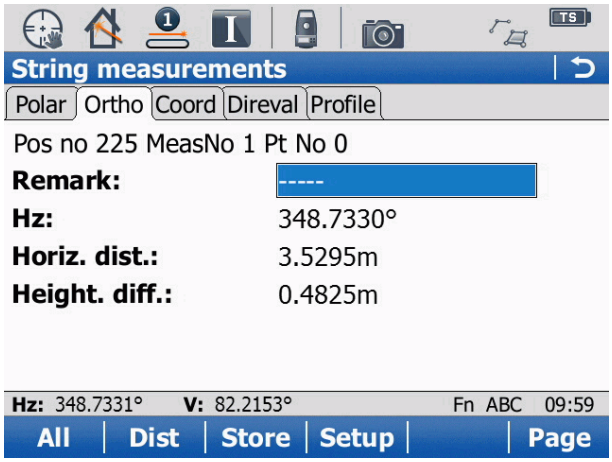

Figure 30. Page orthogonal example

3.6.1.3 Cartesian coordinates page

Re-mark	Input additional point information
East	Last measured Easting coordinate
North	Last measured Northing coordinate
Height	Last measured elevation

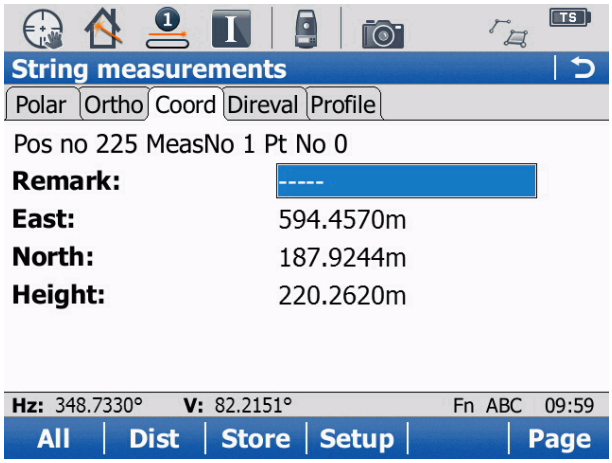

Figure 31. Page coordinates example

3.6.1.4 Direct evaluation page

Remark Input a additional point information.

HS or TM Heading stationing or 3D Tunnelmeter on axis. Displayed label and values depends on the **Configuration** setting **Stationing mode**.

X or L Horizontal offset of measured point relative to centerline (+ right of axis, - left of axis). X or L is displayed depending on the currently selected construction stage.

Y or H Vertical offset of measured point relative to centerline (+ above axis, - below axis). Y or H is displayed depending on the currently selected construction stage.

Deviation 2D or 3D Distance of measured point relative to theoretical profile (+ over-profile, - underprofile). 2D or 3D is displayed depending on the loaded heading and construction stage.

Theoretical Profile The name of the theoretical profile defined at the last measured stationing. The theoretical profile is taken from the section definition of the currently selected construction stage in the project management.

Page is not available for horizontal profile mode.

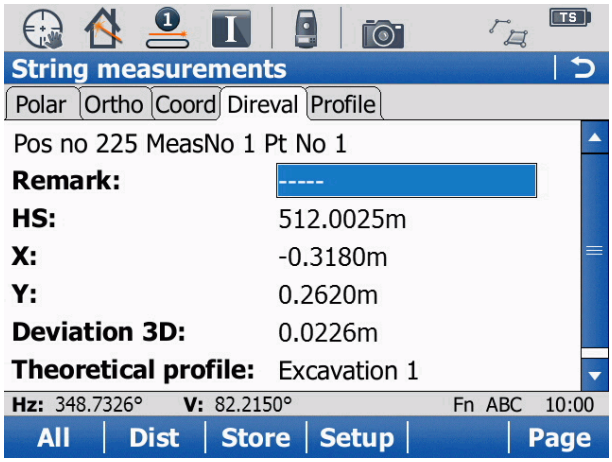

Figure 32. Page direct evaluation example

3.6.1.5 Profile page

Deviation 2D or 3D Distance of measured point relative to theoretical profile (+ overprofile, - underprofile). 2D or 3D is displayed depending on the loaded heading and construction stage.

HS or TM Heading stationing or 3D Tunnelmeter on axis. Displayed label and values depends on the **Configuration** setting **Stationing mode**.

Graphics Visualization of the theoretical profile at the measured position and the measured points. The theoretical profile is taken from the section definition of the currently selected construction stage in the project management.

Page is not available for horizontal profile mode.

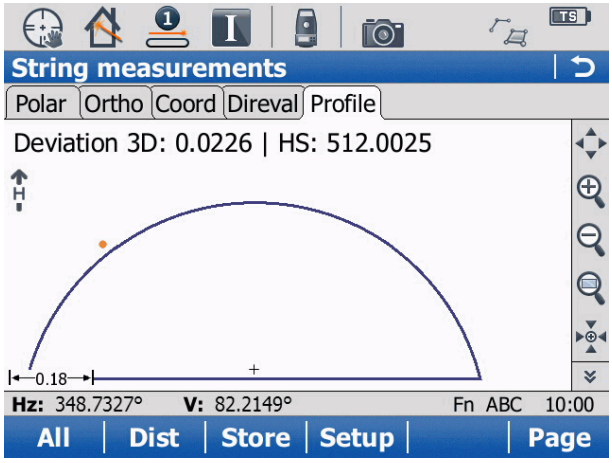

Figure 33. Page profile example

3.6.2 Mode String

In the selected mode different function keys and setting dialogs are available, depending on the page.

3.6.2.1 Operation during measurement

F1: All A distance measurement is made and together with the angles the result is stored to the working job.

F2: Dist A distance measurement is made and the result is shown on the display. No data is stored to the working job.

F3: Store The last measurement is stored to the working job.

F4: Setup Access the **String profile setup page** to change measurement mode to prism or reflectorless and to input correction types like prism height or prism radius to measure with pole or tunnel disk.

F6: Page Changing between the different pages.

Fn+F2: Remrk Enter the names: Name of the instrument position and name of the current measurement.

Fn+F5: New Pr Stores new measured points to a new profile in the working job.

Fn+F6: Graph Starts the graphical direct evaluation. In the graphic all the measured points of the current profile are shown.

ESC To end the current measurement, press ESC.

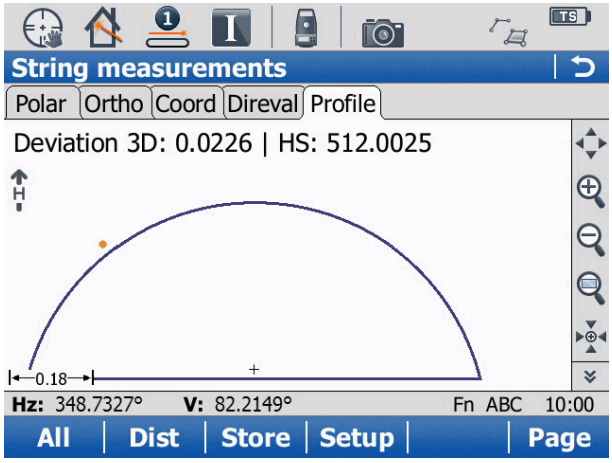

Figure 34. Function keys example

3.6.2.2 Setup of parameters

A manual profile string measurement can be accomplished both reflectorless and with reflector. To measure profiles with a prism, the instrument must support **ATR**and **Lock** functionality.

Press **F4: Setup**. The following settings are available:

Measure mode

Reflectorless Measures the point of the profile by reflectorless measurement.
Infrared Measures the point of the profile by infrared.

Target

Displays the active prism type for the infrared measure mode. The default prism type is **Leica circular prism**. Select a different prism type from the list with **F3: Prism**.

Corr. type

Prism height Measurement of points with a prism stick. Correction is applied strictly on the height value of the measurement.
Prism radius Measurement of points covered with prism disk. Correction is applied radially to the theoretical profile in the plane of the theoretical profile. This is not available for a vertical shaft project.

Corr. value

Depending upon the prism height or radius of the prism disk.

Figure 35. String mode profile setup

3.6.3 Mode Profile

In the selected mode different function keys and setting dialogs available depending on the page.

3.6.3.1 Operation before automatic measurement

F1: Start	Starts the automatic measurement with the current parameters.
F2: Single	Executes one distance reading (Single point) for which a text can be entered.
F3: Setup	Opens the dialog **Setup**. In this dialog all the parameters for the current measuring method and rotation method are set.
F6: Page	Changing between the different pages.
Fn+F2: Remrk	Enter the names: Name of the instrument position and name of the current measurement.
Fn+F6: Graph	Starts the graphical direct evaluation. In the graphics all the measured points of the current profile are shown.
ESC	To end the current measurement, press ESC.

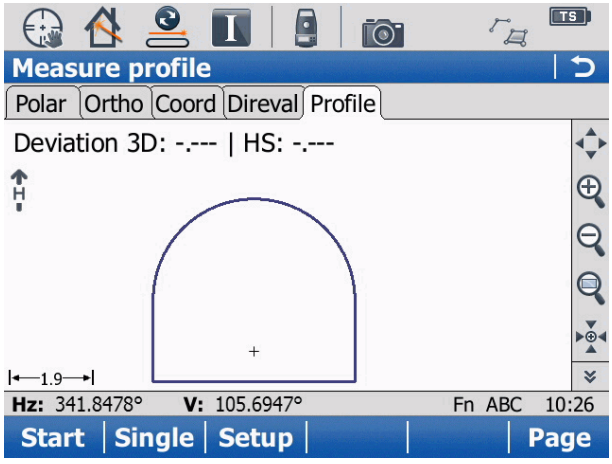

Figure 36. Profile mode measure profile

3.6.3.2 Setup of measuring parameters for profile measurements

On the Setup page, the parameters which are required for the current configuration are set. The following settings are available:

Step Type (Rotation method)

Angle The spacing between two subsequent points is defined by the angle at the instrument.

Distance The spacing between two subsequent points is defined by the distance on the surface.

Step distance or **Step angle**

Step angle Input the maximum spacing angle (equivalent to 100%).

Step distance Input the maximum spacing distance (equivalent to 100%).

Direction

Defines the direction of the measurement

Increasing The rotation is made in the direction of increasing angles.

Decreasing The rotation is made in the direction of decreasing angles.

Range active

Yes The measurement is made only between the beginning and the end angle.

No The measurement is made without stop. The settings for the beginning and end angle are not considered. This means as well, that the instrument will not rotate to the beginning angle at the start of the measurement.

Angle begin

Input or measure with **F2: Get** the vertical angle of the first point to be measured in the profile.

Angle end

Input or measure with **F2: Get** the vertical angle of the last point to be measured in the profile.

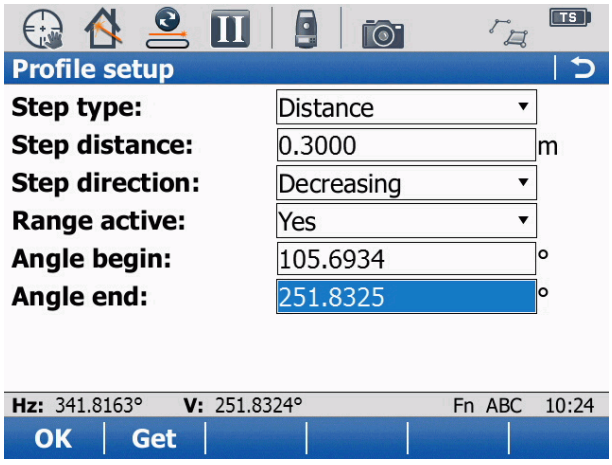

Figure 37. Profile mode profile setup page

F1: OK Stores the setting and open the Measure profile page.

3.6.3.3 Operation during automatic measurement

F1: Stop Stop the automatic measurement

F2: Pause Pause the automatic measurement.

During the automatic measurement, the keys are not checked continuously. It may take a while until the key stroke is recognised by the program.

After having paused an automatic measurement (with **F2: Pause**), only the following key is available:

F4: OK Resume the automatic measurement

3.6.3.4 Setup of parameters after measurement of reference profile

If the measurement of the reference profile is finished, you can input the parameters for the parallel profiles with **F4: Parallel.**

The following settings are available:

Instr. HS or TM

The computed Heading stationing or 3D Tunnelmeter of the instrument position. This value is displayed for information only and can not be modified.

Range type

Define the range type that you want to use to measure the parallel profiles.

Relative	The range is defined relative to the instrument position.
Absolute	The range is defined by absolute stationing values.
Stng. from file	Define an ASCII file (outside of Amberg Tunnel) with the stationing values of the desired profiles. Save the ASCII file under the name `stationing_list.txt` in the `\TMS` directory on the memory card.

Begin HS or TM

Relative mode	Input a relative distance in stationing direction to set the position where the first parallel profile will be measured.
Absolute mode	Enter the smallest stationing, where the first parallel profile will be measured.
Stng. from file mode	Enter the smallest stationing, where the a parallel profile will be measured. Amberg ProScan checks with the stationing list where parallel profiles should be measured.

End HS or TM

Relative mode	Input a relative distance in stationing direction to set the position where the last parallel profile will be measured.
Absolute mode	Enter the largest stationing, where the last parallel profile will be measured.

Stng. from file mode Enter the largest stationing, where the a parallel profile will be measured. Amberg ProScan checks with the stationing list where parallel profiles should be measured.

Interval HS or TM

Input the interval between two subsequent parallel profiles.

Tolerance

Input the tolerance of the measurement in the parallel profile. The software checks for every measured target point the stationing to the measured profile. If the stationing of the measured point is outside this tolerance to the profile the instrument does a correction to find the point in the given tolerance around the profile that should be measured.

Modify base

No For the measurement of the parallel profiles, the program always uses the shape of the reference profile (in the instrument plane) for the projection into the parallel plane. The number of points to be measured is always identical.

Yes The program adopts continuously to the shape with the new measured points in the parallel profile. If a point can not be measured in one parallel profile, the number of points to be measured is reduced accordingly in the subsequent profile.

Close profile

Because the section below the instrument can not be measured in the reference profile, this part of the vertical profile needs to be treated separately.

No No additional measurement is made in the parallel profiles.

Yes The program interpolates the straight line between the first measured point and the last measured point of the reference profile with the selected interval and measures these points additionally in the parallel profiles.

Close dist.

This is the current distance, to close the parallel profiles.

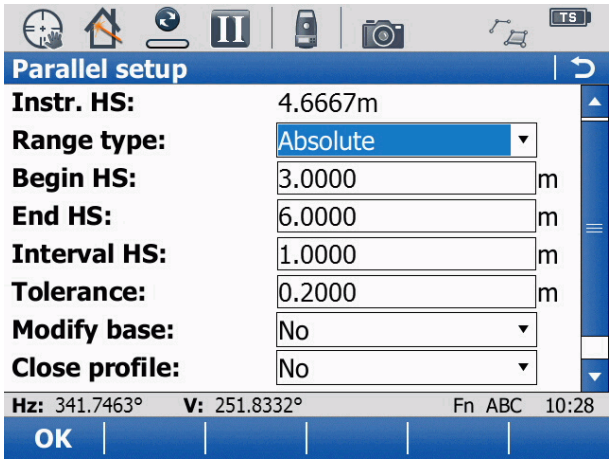

Figure 38. Parallel setup page

F1: OK Stores the setting and open the Measure profile page.

Press **F1: Start** on the profile measurement page to execute the profile measurement.

3.6.3.5 After the measurement of parallel profiles

After the completion of the measurement with several parallel profiles, the following dialog is shown.

F1: Main Ends the current measurement. Subsequently, the measurements are not available for further graphic direct evaluation.

F3: Parallel Select this option, if additional parallel profiles need to be measured. Subsequently, the dialog for the definition of the measuring parameters is shown. The previously measured plus the new parallel profiles are available for direct evaluation.

F5: Graph Select this option to start the graphical direct evaluation. The subsequent dialog shows the available profiles (including the base profile) in a list from which you can select. Additionally, the theoretical profile can be selected.

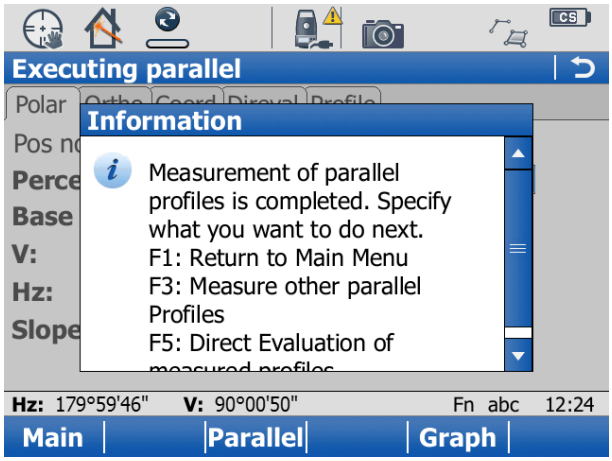

Figure 39. Information after profile measurement

3.6.3.6 Direct evaluation of profiles

Press **F5: Graph** to start the graphical direct evaluation. The subsequent dialog shows the available profiles (including the base profile) in a list from which you can select. Additionally, the theoretical profile can be selected.

Measured prof. Ends the current measurement. Subsequently, the measurements are not available for further graphic direct evaluation.

Construction stage Select the construction stage witch should be used to compare the profile measurements.

As default, the section definition of the construction stage is used. In case a single theoretical profile should be used, select it in the next step.

F1: OK Starts the computation. The duration of the computation depends on the number of measured points and the complexity of the centerline (number and geometry type of segments). After the completion of the computation, the graphic is shown.

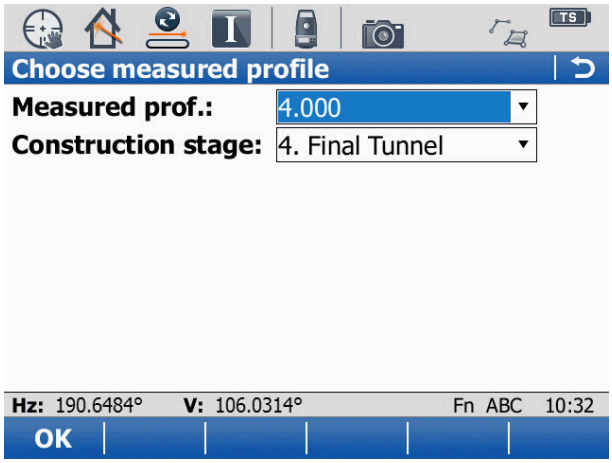

Figure 40. Choose measured profile

3.6.3.7 Graphical direct evaluation

The measured values are shown in one of the following formats on different pages.

Page Profile

The theoretical profile is shown. Points outside the theoretical profile indicate overprofile (+ values). Points inside the theoretical profile indicate underprofile (- values).

In the upper part you can see the values of:

Construction stage or Theoretical profile	Use construction stage or use theoretical profile for calculations. Can be changed with **Fn+F6**.
Deviation 2D or 3D	Result of deviation value of measured point to the theoretical section or profile.
HS or TM	Stationing value, according to the stationing settings.

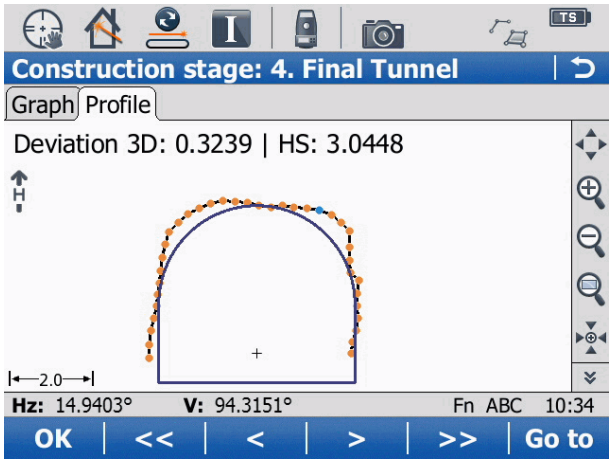

Figure 41. Example profile graphic page

Page Graph

The theoretical profile line is shown as a horizontal straight line. The vertical axis on the graphic represents the deviation between the measured profile and the theoretical profile. (The line of measured profile points above the horizontal axis indicates overprofile).

In the upper part you can see the values of:

Construction stage or Theoretical profile	Used construction stage or used theoretical profile for calculations. Can be changed with **Fn+F6.**

The lower part of the graphic shows an information line with the following results:

Construction stage or Theoretical profile	Used construction stage or used theoretical profile for calculations. Can be changed with **Fn+F6.**
Point number / number of points	Point number and number of points in the measured profile.
Deviation	Result of deviation value of measured point to the theoretical section or profile.
HS or TM	Stationing value, according to the stationing settings.
Derolment	Length along the theoretical profile from the origin of the theoretical profile definition.

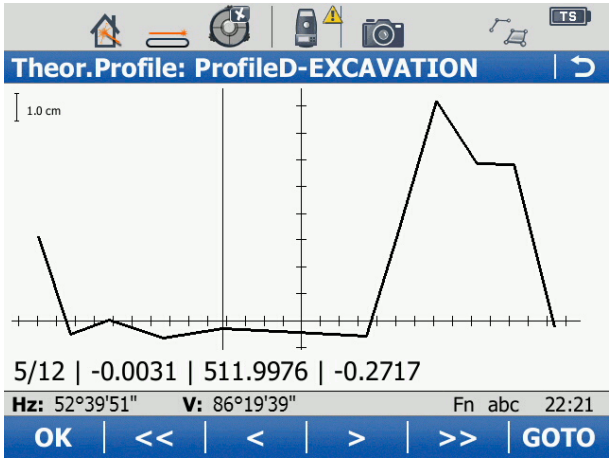

Figure 42. Example Graph page

Keys

F1: OK	Closes the graphic direct evaluation.
F2: <<	5 points to the left
F3: <	1 point to the left.
F4: >	1 point to the right.
F5: >>	5 points to the right
F6: Go to	The instruments highlights the position of the selected point with the visible red laser.
Fn+F5: Range	For the selected point the program detects if the area is under or overprofile. Subsequently it visualises continuously the beginning and end of the region of under or overprofile. This is executed until the user presses **F1: Stop**.

The instrument shows only the first and the last point of the range. The instrument always rotates in the shortest direction to the destination point. The red laser is switched off during the rotation.

Fn+F6: C.Stage	Changes the construction stage or theoretical profile. After the change, the graphic is updated.

Buttons for navigation

The following additional functions in the graphic dialog are available:

Arrow Up (1), Arrow Down (2) With the help of these buttons you can go to the next measured profile in heading direction or against heading direction.

Arrow Left (3), Arrow Right (4) With the help of these buttons you can go to the next or previous measured profile point in the selected profile.

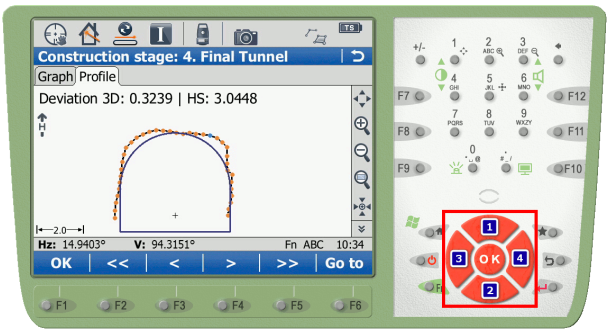

Figure 43. Buttons for navigation

3.6.4 Mode Horizontal profile

The selected mode consists of several steps where different function keys and setting dialogs are available.

3.6.4.1 Operation before automatic measurement

F1: Start Starts the automatic measurement with the current parameters.

F2: Single Executes one distance reading (Single point) for which a text can be entered.

F3: Setup Opens the dialog **Setup**. In this dialog all the parameters for the current measuring methods and rotation method are set.

F6: Page Changing between the different pages.

Fn+F2: Remrk Enter the names: Name of the instrument position and name of the current measurement.

ESC To end the current measurement, press ESC.

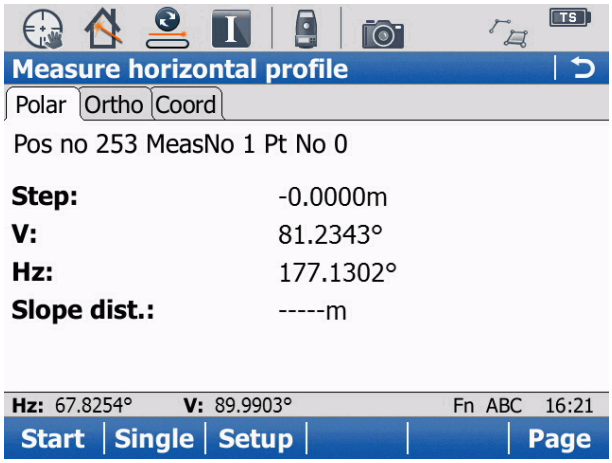

Figure 44. Profile mode measure profile

3.6.4.2 Setup of measuring parameters for profile measurements

In the Setup the parameters which are required for the current configuration are set. Please find the explanations to the different values on the following page.

During the establishment the following function keys are available:

Step Type (Rotation method)

Angle The spacing between two subsequent points is defined by the angle at the instrument.

Distance The spacing between two subsequent points is defined by the distance on the surface.

Step distance or **Step angle**

Step angle Input the maximum spacing angle (equivalent to 100%).

Step distance Input the maximum spacing distance (equivalent to 100%).

Direction

Defines the direction of the measurement.

Increasing The rotation is made in the direction of increasing angles.

Decreasing The rotation is made in the direction of decreasing angles.

Range active

Yes The measurement is made only between the beginning and the end angle.

No The measurement is made without stopping. The settings for the beginning and end angle are not considered. This means as well that the instrument will not rotate to the beginning angle at the start of the measurement.

Angle begin

Input or measure with **F2: Get** the vertical angle of the first point to be measured in the profile.

Angle end

Input or measure with **F2: Get** the vertical angle of the last point to be measured in the profile.

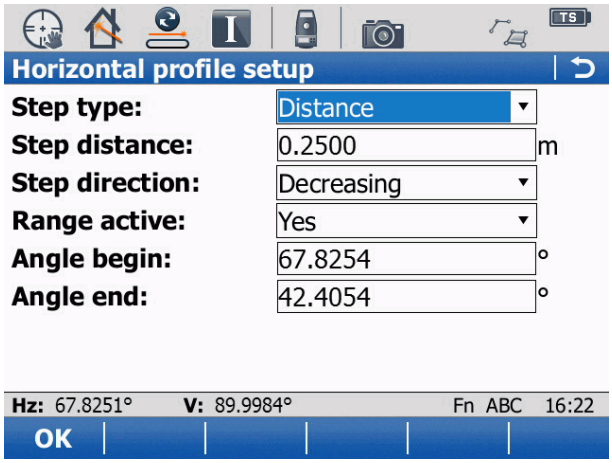

Figure 45. Horizontal profile mode setup page

F1: OK Stores the setting and open the Measure profile page.

3.6.4.3 Operation during automatic measurement

F1: Stop Stop the automatic measurement.
F2: Pause Pause the automatic measurement.

During the automatic measurement, the keys are not checked continuously. It may take a while until the key stroke is recognised by the program.

After having paused an automatic measurement (with **F2: Pause**), only the following key is available:

F4: OK Resume the automatic measurement.

3.6.4.4 Setup of parameters after measurement of reference profile

If the measurement of the reference profile is finished you can input the parameters for the parallel profiles with **F4: Parallel**.

The following settings are available:

Begin dist.

Enter the distance, where a profile needs to be measured.

End dist

Enter the distance, where a profile needs to be measured.

Interval HS or TM

Input the interval between two subsequent horizontal parallel profiles.

Tolerance

Input the tolerance of the measurement in the horizontal parallel profile. The software checks for every measured target point the stationing to the measured profile. If the stationing of the measured point is outside this tolerance to the profile the instrument does a correction to find the point in the given tolerance around the profile that should be measured.

Modify base

No For the measurement of the parallel profiles, the program always uses the shape of the reference profile (in the instrument plane) for the projection into the parallel plane. The number of points to be measured is always identical.

Yes The program adopts continuously the shape with the new measured points in the parallel profile. If a point can not be measured in one parallel profile, the number of points to be measured is reduced accordingly in the subsequence profile.

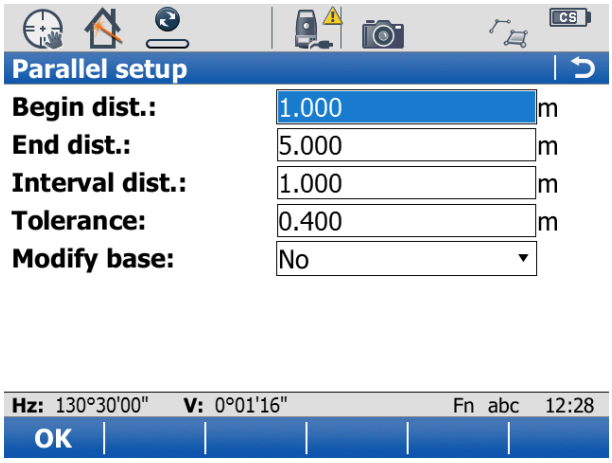

Figure 46. Horizontal parallel setup page

F1: OK Stores the setting and open the Measure profile page.

Press **F1: Start** on the profile measurement page to execute the profile measurement.

3.6.4.5 After the measurement of parallel profiles

After the completion of the measurement with several parallel profiles, the following dialog is shown.

F1: Main Ends the current measurement. Subsequently, the measurements are not available for further graphic direct evaluation.

F3: Parallel Select this option, if additional parallel profiles need to be measured. Subsequently, the dialog for the definition of the measuring parameters is shown. The previously measured plus the new parallel profiles are available for direct evaluation.

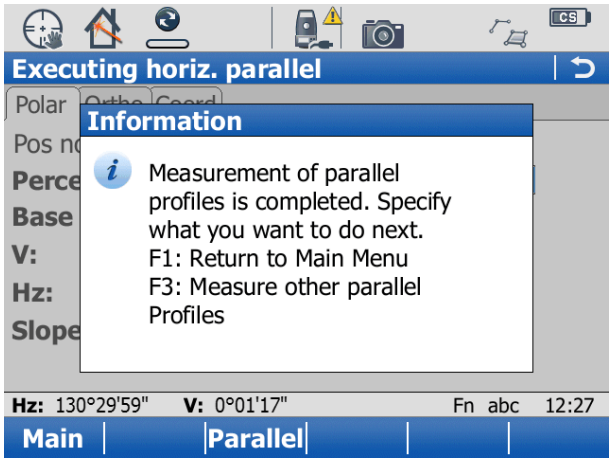

Figure 47. Information after horizontal profile measurement

There is no graphic direct evaluation available for horizontal profile measurements.

3.7 Project management

To work with Amberg ProScan plus, the project data is required on the instrument. They are defined previously in Amberg Tunnel and exported to the memory card in the `\TMS` directory. The project data is loaded into Amberg ProScan plus. If no project data is loaded or another project should be loaded, select the option **Project data** in the main menu. If no project is loaded, a list of all available project files on the memory card is displayed. The following functions are available:

F1: OK Stores the selection and returns to the main menu.
F3: Load Load project
F5: C.Stage Select a different construction stage from the loaded project.
F6: Reset Project reset.

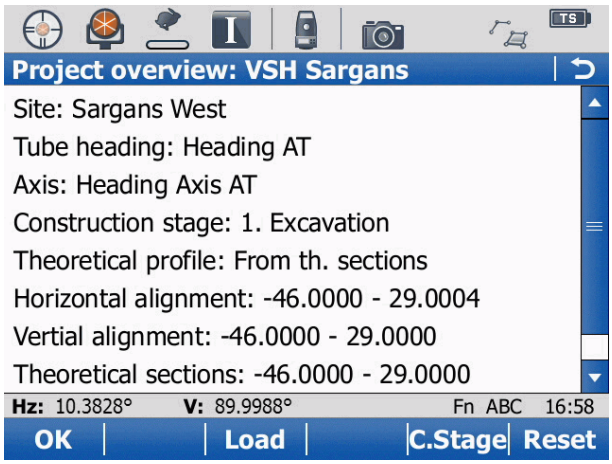

Figure 48. Project overview

3.7.1 Load project

The project is loaded into the internal memory of the instrument. This can take some minutes depending on the size of the project. Subsequently an overview of the project data appears. It is indicated which information is available from the the project file and whether it is valid.

Select the desired project and continue with **F1: OK**.

F1: OK Loads the selected project.

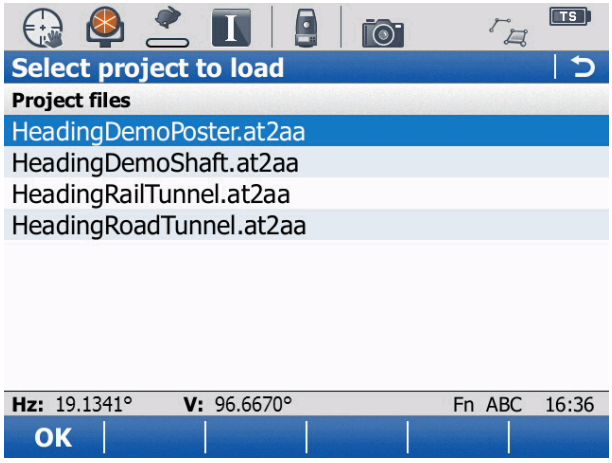

Figure 49. Select project to load

3.7.2 Construction Stage

Construction stage selection

A project can contain multiple construction stages. Select from the list which construction stage is to be used for the comparison with the measurements.

Per default the theoretical section definition of the selected construction stage is used to assign a theoretical profile for stationing ranges. This behaviour can be changed by selecting explicitly a theoretical profile.

F1: OK Opens the selected construction stage from the list to select a theoretical profile.

F1: ESC Returns to the project overview page.

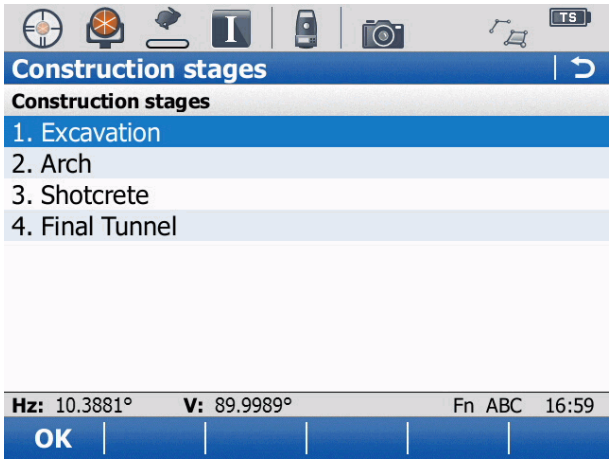

Figure 50. Select construction stage

Theoretical profiles

From the list can be selected which theoretical profile is to be used for the comparison with the measurements. If a section definition for the theoretical profiles in the Amberg Tunnel was made it is available here. Select **From th. Sections** to use the section definition.

F1: OK Stores the selected profile from the list and returns to the project overview page.
F1: ESC Returns to the construction stage page.

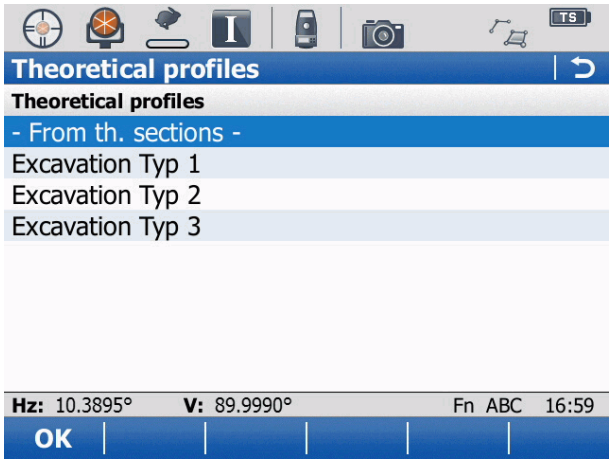

Figure 51. Select profile or theoretical section

3.7.3 Reset

Press **F6: Reset** to reset and unload the project data.

Chapter 4 Amberg SetOut

4.1 Introduction

The program Amberg SetOut serves for the automatic setting out of interval points (single point or sequence of points). Each point can thereby be placed over the definitions for the deviation (lateral, height). As shown in the introduction, different axis referenced SetOut task types can be used.

This section contains all the information for the operation of Amberg SetOut. Please first read the introduction to get an overview of all the operation methods.

Project data The project data (`.at2aa` file) exported from Amberg Tunnel must be copied to the `\TMS` directory of the memory card.

4.2 Workflow

Normally these steps should be done to stake out points with Amberg SetOut.

1. Start Amberg SetOut.
2. Load the tunnel project.
3. Position of instrument with control points.
4. Start the stake out with the selected task.

4.3 Main menu

After starting the program the dialog SetOut the main menu appears.

Configuration In the configuration dialog, set the parameters which control the measurement and the positioning.

Position and measure This function automatically guides you through **Positioning** and **Measurement**. It is used after installing the instrument on a new position.

Measure This function allows the execution of additional automatic measurements with Amberg SetOut from the same instrument position. If you intend to use other parameters for the measurement, you must change the according settings in the configuration before using this function.

Project management The project data is loaded automatically when the program starts (if the required files are available on the memory card in the directory `\TMS`).

The currently loaded project is shown in brackets:

- **Not loaded**: No project data is loaded.
- **Heading name**: The project with the displayed heading name is loaded.

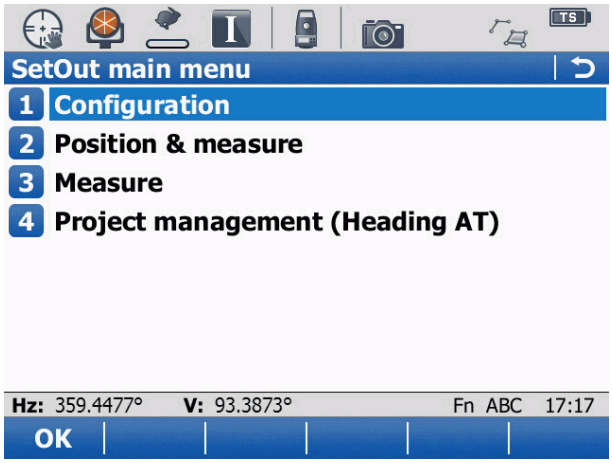

Figure 52. SetOut main menu

4.4 Configuration

Before a measurement with Amberg Applications can be started, it needs to be configured to your requirements. This section explains the basics and describes the options available with the software.

F1: OK Stores the current configuration and closes the configuration dialog.

F4: Info Displays information about Amberg Applications and the instrument.

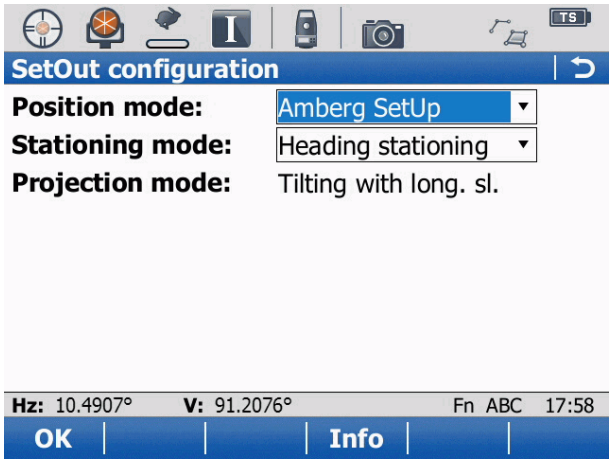

Figure 53. SetOut configuration

4.4.1 Position mode

Select this to see which method is used for positioning of the instrument.

Leica Setup Select the list entry **Leica Setup** if you want to set up the instrument with the methods of the Leica Setup application. The selection of the method is done later in the positioning sequence.

Amberg SetUp Select the list entry **Amberg SetUp** if you want to set up the tachymeter with this setup method. The configuration of this method is done on the configuration page of the SetUp module.

For further information please refer to Chapter 5, *Amberg SetUp* on page 61.

4.4.2 Stationing mode

Select which stationing should be displayed during for the direct evaluation of measurements.

Heading stationing Stationing values along the situation of the heading axis act as a reference during construction, usually zero at the tunnel portal and increasing in heading direction.

3D Tunnelmeter Stationing values along the 3D path of the heading axis (taking into account the vertical alignment defined in Amberg Tunnel), usually zero at the tunnel portal (where Heading stationing is zero) and increasing in heading direction.

4.4.3 Projection mode

Tilting with longitudinal slope Theoretical profiles are aligned perpendicular to the axis, respecting the vertical alignment definition. If the axis is inclined, the theoretical profile will lean forward or backwards according to the longitudinal alignment at the specific position.

Always vertical Theoretical and measured profiles are always aligned vertically, independent from the vertical alignment definition. Also if the axis is inclined, the theoretical profile will be always vertical and not lean forward or backwards.

4.5 Position and measure

Amberg Applications guides you during the sequence of automatically measuring profiles through positioning of the instrument. The basics about positioning are explained in Chapter 5, *Amberg SetUp* on page 61. There are the two positioning methods available:

Leica Setup Amberg Application calls the instrument positioning from the standard Leica programs.

Amberg SetUp Amberg Application calls Amberg SetUp for instrument positioning. See Chapter 5, *Amberg SetUp* on page 61.

4.6 Measure

Before a measurement is started, the basic parameters in the configuration must be set and the positioning sequence gone through. Only after having done this, the automatic measurement can be started.

Make sure the right project data is loaded.

Avoid a manual obstruction of the program controlled rotation of the instrument.

All the measurements are stored automatically to the log file, which is stored in the `\TMS` directory on the memory card.

Depending on the configuration of the **Task type**, various function keys may be available or not. At any time, all the function keys which are available are shown on the display.

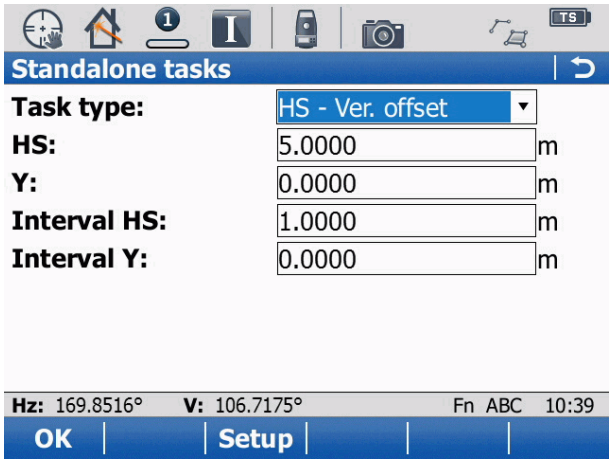

Figure 54. Function keys example

F1: OK Starts the task.

F3: Setup Open the dialog to setup parameters.

ESC Returns to the main menu of SetOut.

4.6.1 Measurement results

The measured values are shown in one of the following formats on different pages/tabs. To select a different page press **F6: Page** or touch the page header. The following keys are available:

F1: Start/Stop Starts or stops the automatic stakeout procedure.

F2: Dist By interrupting the stakeout procedure, an individual measurement can be obtained.

F3: Log Writes the up-to-date values shown in the read out into the log file.

F4: < Goes to the next stakeout point.

F5: > Goes to the previous stakeout point.

F6: Page Changes between the different read outs. Depending upon the task type, different values are indicated.

Before starting the stakeout procedure, the instrument should be pointed roughly toward the first point to be set out.

4.6.1.1 Differences

ΔHS or ΔTM Differences of Heading stationing or 3D Tunnelmeter to stakeout point. The displayed label and value depend on **Configuration** setting **Stationing mode**.

ΔY or ΔH Vertical offset of measured point relative to stakeout point. Y or H is displayed depending on the loaded heading and construction stage.

X or L Horizontal offset of measured point relative to the axis. X or L is displayed depending on the loaded heading and construction stage.

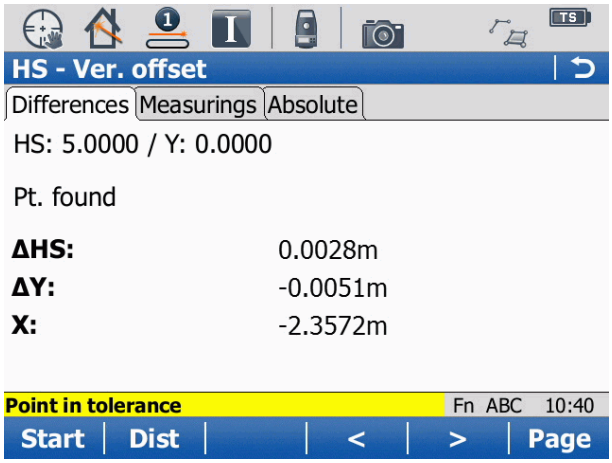

Figure 55. Page differences example

4.6.1.2 Measurements

HS or TM Heading station or 3D Tunnelmeter on axis. The displayed label and value depend on **Configuration** setting **Stationing mode**.

X or L Horizontal offset of measured point relative to centerline (+ right of axis, - left of axis). X or L is displayed depending on the loaded heading and construction stage.

Y or H Vertical offset of measured point relative to centerline (+ above axis, - below axis). Y or H is displayed depending on the loaded heading and construction stage.

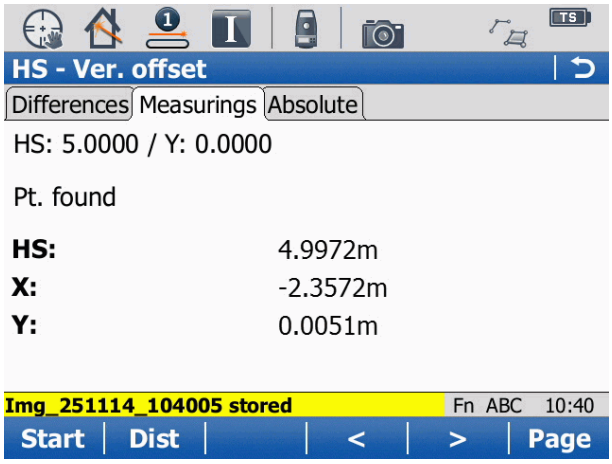

Figure 56. Page measurements example

4.6.1.3 Absolute

Easting Last measured Easting coordinate.

Northing Last measured Northing coordinate.

Height Last measured elevation.

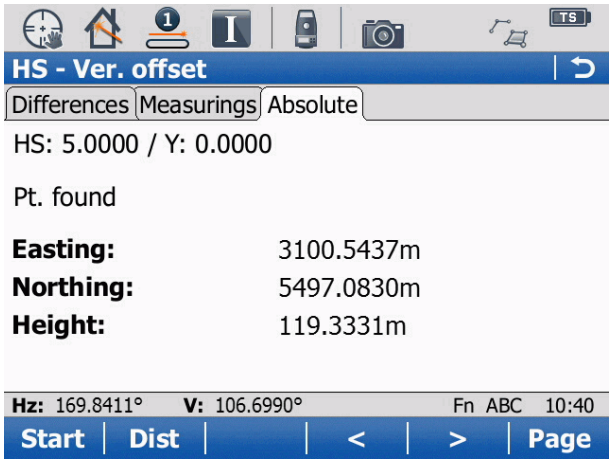

Figure 57. Page absolute example

4.6.2 Setup of parameters

An automatic stake out can be accomplished both reflectorless and with reflector. To stake out with a prism, the instrument must support **ATR** and **Lock** functionality.

Press **F4: Setup**. The following settings are available:

Measure mode

Reflectorless	Measures the point of the profile by reflectorless measurement.
Infrared	Measures the point of the profile by infrared.

Target

Displays the active prism type for the infrared measure mode. The default prism type is **Leica circular prism**. Select a different prism type from the list with **F3: Prism**.

Prism height

Measurement of points with a prism stick. Correction is applied strictly on the height value of the measurement.

Tolerance

When staking out a task point, the instrument tries to find the point on the tunnel wall, where the vector of the task point intersects the surface. As the tunnel surface is not known precisely, this is an iterative process. The accuracy value of this setting is used to decide if the point found is close enough to the design or if another iteration is required.

Number of iterations

This is the maximum amount of iterations, the application tries to correct the position of the telescope and measure until it finds the stake-out point which is sufficiently close to the design point. If the point cannot be found within the specified number of trials, the search process will be aborted and the user will be informed that the point was not found.

SetOut mode

Manual	Determine manually when the instrument shall set out the next point.

Automatic After a certain wait time, the instrument automatically sets out the next point.

Wait time (s) Time in seconds for how long to be waited in the automatic stakeout mode until the next point is started.

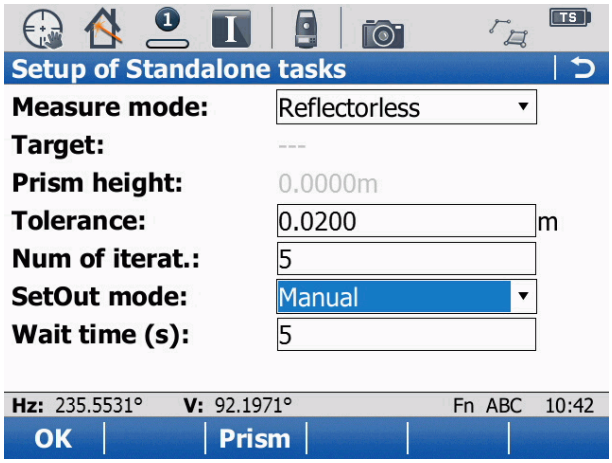

Figure 58. Page differences example

4.6.3 Task Types

Depending on the selected task type, different settings must be set. The following keys are available:

F1: OK Starts the task.

F3: Setup Open the dialog to setup the parameters.

ESC Returns to the main menu of Amberg SetOut.

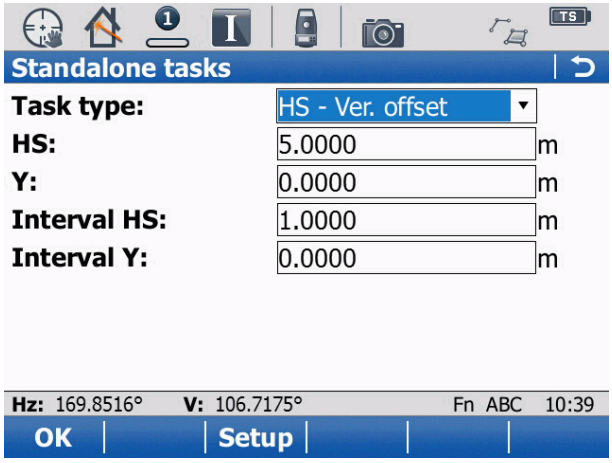

Figure 59. Function keys example

4.6.3.1 Task type: HS/TM - Ver. offset

Allows staking out points at given stationing and vertical offset values. This task type is suitable for staking out points on the tunnel wall.

Task type Displays the selected task type.

HS or TM Enter the stationing of where the stakeout should begin.

Y or H Enter the vertical offset to the project axis.

Interval HS or TM Enter an incremental step in stationing.
Interval Y or H Enter a vertical step to be used per station.

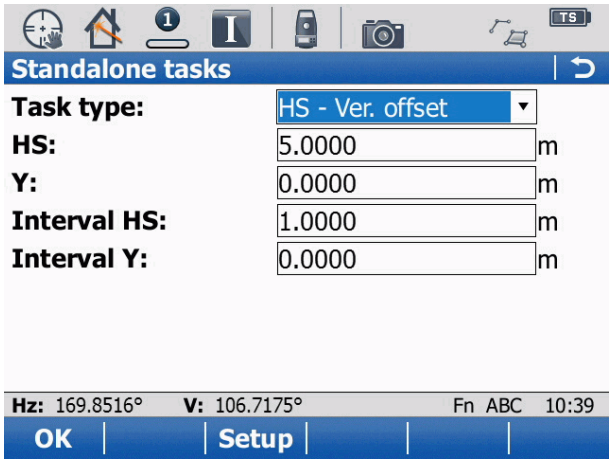

Figure 60. HS/TM - Vertical Offset

4.6.3.2 Task type: HS/TM - Hor. offset

Allows staking out points at given stationing and horizontal offset values. This task type is suitable for staking out points on the tunnel floor or ceiling.

Task type Displays the selected task type.
HS or TM Enter the stationing of where the stakeout should begin.
X or L Enter the horizontal offset to the project axis.
Interval HS or TM Enter an incremental step in stationing.
Interval X or L Enter a horizontal step to be used per station.

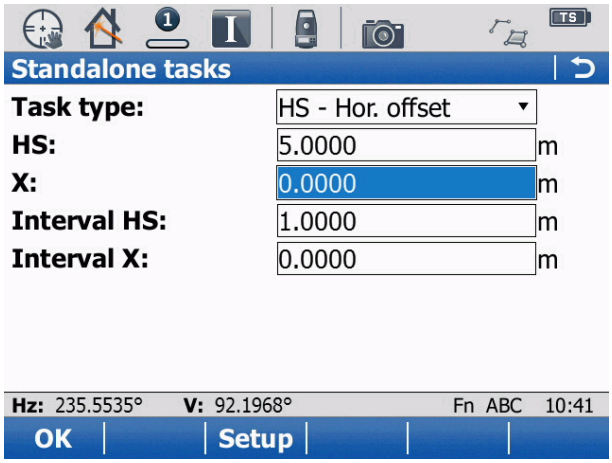

Figure 61. HS/TM - Vertical Offset

4.6.3.3 Task type: Vert. Offset - Hor. offset

Allows staking out points at given stationing and vertical offset values. This task type is suitable for staking out points on the tunnel face.

Task type Displays the selected task type.
X or L Enter the horizontal offset to the project axis.
Y or H Enter the vertical offset to the project axis.

Interval X or L Enter a horizontal step.
Interval Y or H Enter a vertical step.

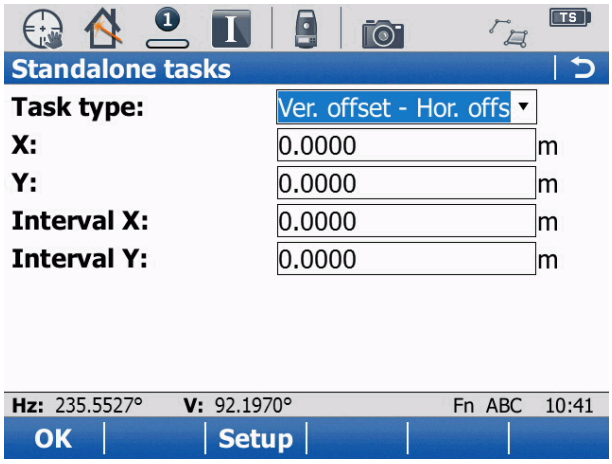

Figure 62. Vert. Offset - Hor. Offset

4.6.3.4 Task type: HS/TM - Height

Allows staking out points at given stationing and absolute values. This task type is suitable for staking out points on the tunnel wall.

Task type Displays the selected task type.
HS or TM Enter the stationing of where the stakeout should begin.
Height Enter a absolute Height
Interval HS or TM Enter an incremental step in stationing.
Interval Height Enter an incremental step in absolute Height

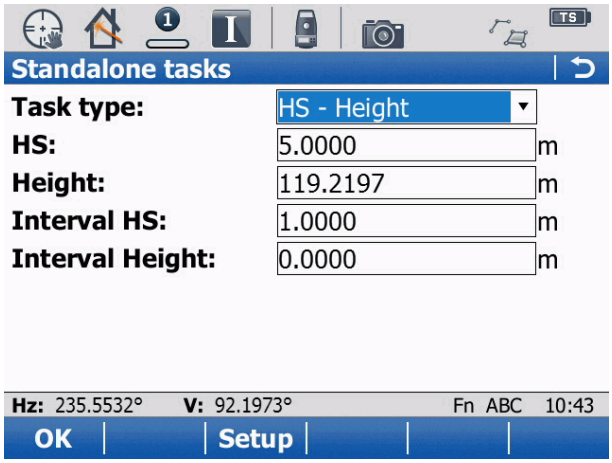

Figure 63. HS/TM - Height

4.6.3.5 Task type: Easting - Northing

Allows staking out points at given Easting and Northing values. This task type is suitable for staking out points on the tunnel floor or ceiling.

Task type Displays the selected task type.
Easting Enter the Easting absolute coordinates.
Northing Enter the Northing absolute coordinates.

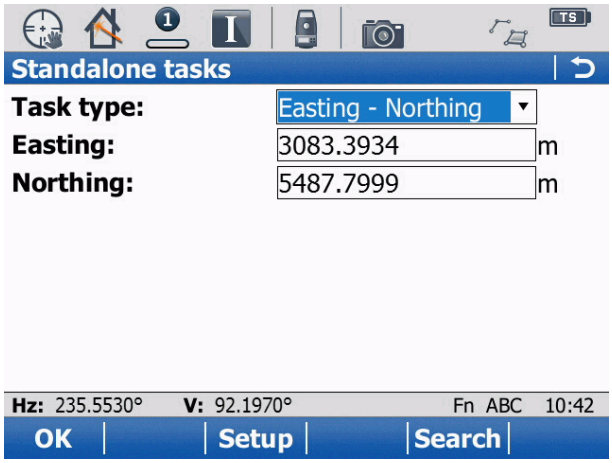

Figure 64. Easting - Northing

4.6.3.6 Task type: Auxiliary Axis

Allows staking out points relative to an auxiliary axis defined by two points with absolute co-ordinates.

Task type	Displays the selected task type.
Easting	Enter the Easting absolute coordinates for the start of the line.
Northing	Enter the Northing absolute coordinates for the start of the line.
Height	Enter a absolute Height for the start of the line.
End Easting	Enter the Easting absolute coordinates for the end of the line.
End Northing	Enter the Northing absolute coordinates for the end of the line.
End Height	Enter a absolute Height for the end of the line
Abscissa	Enter the abscissa concerning the reference line and their step.
Ordinate	Enter the ordinate concerning the reference line and their step.

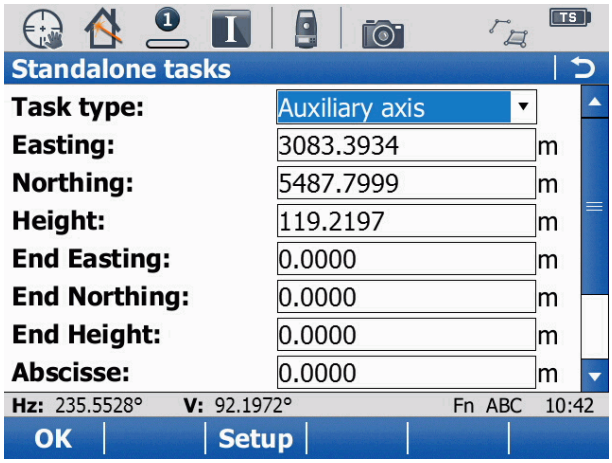

Figure 65. Auxiliary Axis

4.7 Project management

To work with Amberg SetOut, the project data is required on the instrument. They are defined previously in Amberg Tunnel and exported to the memory card in the `\TMS` directory. The project data is loaded into Amberg SetOut. If no project data is loaded or another project should be loaded, select the option **Project data** in the main menu. If no project is loaded, a list of all available project files on the memory card is displayed. The following functions are available:

F1: OK Stores the selection and returns to the main menu.
F3: Load Load project.
F5: C.Stage Select a different construction stage from the loaded project.
F6: Reset Project reset.

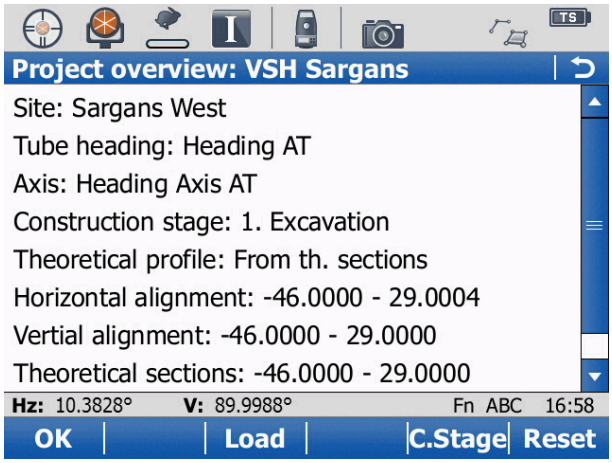

Figure 66. Project overview

4.7.1 Load project

The project is loaded now into the internal memory of the instrument. This can take some minutes depending on the size of the project. Subsequently an overview of the project data appears. It is indicated whether the project files are valid and for which range of information they are present.

Select the desired project and continue with **F1: OK**.

F1: OK Loads the selected project.

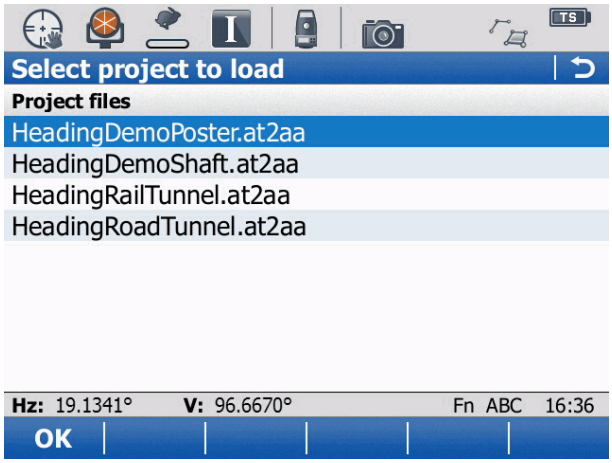

Figure 67. Select project to load

4.7.2 Construction Stage

Construction stage selection

A project can contain multiple construction stages. Select from the list which construction stage is to be used for the comparison with the measurements.

Per default the theoretical section definition of the selected construction stage is used to assign a theoretical profile for stationing ranges. This behaviour can be changed by selecting explicitly a theoretical profile.

F1: OK Opens the selected construction stage from the list to select a theoretical profile.

ESC Returns to the project overview page.

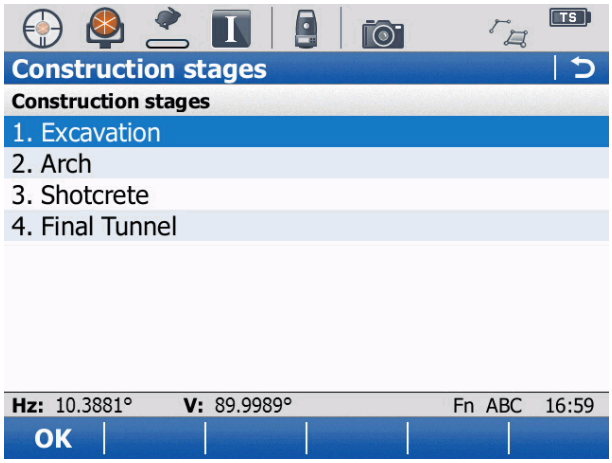

Figure 68. Select construction stage

Theoretical profiles

From the list can be selected which theoretical profile is to be used for the comparison with the measurements. If a section definition for the theoretical profiles in the Amberg Tunnel was made it is available here. Select **From th. Sections** to use the section definition.

F1: OK Stores the selected profile from the list and returns to the project overview page.

ESC Returns to the construction stage page.

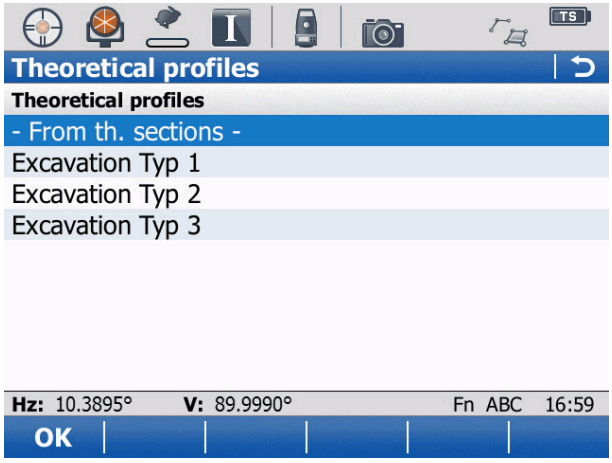

Figure 69. Select profile or theoretical section

4.7.3 Reset

Press **F6: Reset** to reset and unload the entire project.

4.8 Log File

The log file contains information about the stake out points. It is always stored in the directory `\TMS` under the name `setout.log`.

Chapter 5 Amberg SetUp

5.1 Introduction

This section contains all the information for the operation of Amberg SetUp. Please first read the introduction to get an overview about the operation methods.

With Amberg SetUp you are able to perform an absolute position of a instrument in an easy way without the need to input point IDs. With an absolute positioning the instrument is always set to absolute coordinates.

As a result of this method, after the measurement to the target points (max. 8 points) the position of the instrument is calculated as Resection Helmert and the calculated instrument position is stored as known instrument coordinates. The orientation is set to the last measured point and stored as backsight point. The orientation is stored together with the measured points for Amberg Tunnel Profile.

Amberg SetUp identifies the control points from the **Control job** selected on the instrument. In case the target points are distributed very regularly in lateral and vertical position along the tunnel, the positioning can be ambiguous, wrong or may fail.

After calculation of the instrument position, the Heading stationing / 3D Tunnelmeter of the instrument position is displayed. Additionally, the instrument points to a known target point while displaying its point ID. In case you accept these checks without verifying the displayed information carefully, your position may be incorrect and the measurements will be wrong.

To calculate the Heading stationing / 3D Tunnelmeter value of the instrument position, valid project data must be loaded in Amberg ProScan plus or Amberg SetOut.

5.2 Main menu

After starting the program, the dialog SetUp main menu is displayed.

Configuration The settings for the operation of the application can be viewed and edited in here.

Setup Wizard Positioning wizard for the instrument will start.

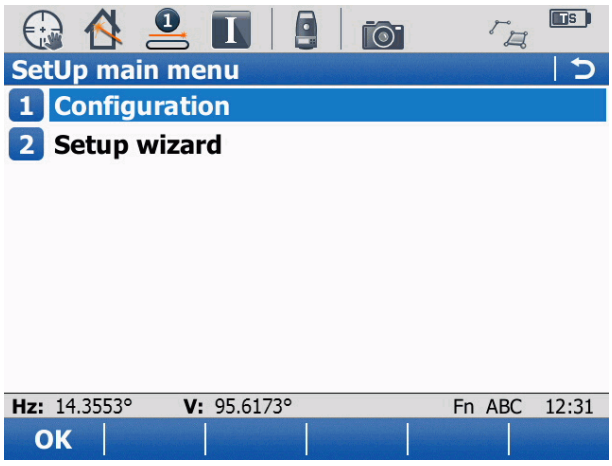

Figure 70. SetUp main menu

5.3 Configuration

Parameters which control the behaviour of the application are set in the configuration of Amberg SetUp. These settings only have an influence on the application Amberg SetUp.

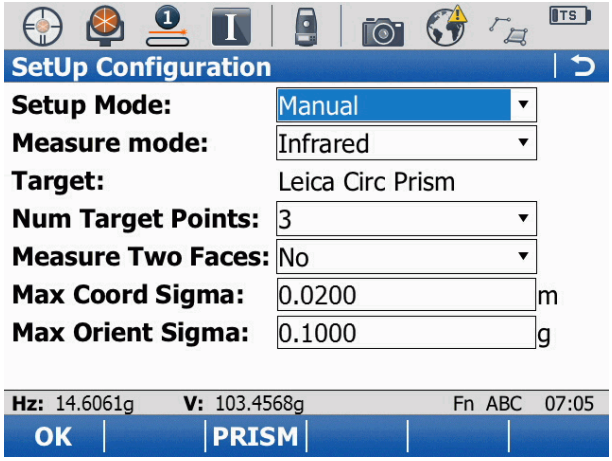

Figure 71. SetUp configuration

5.3.1 Setup mode

Select here, how the instrument is positioned.

Automatic The target points are found by PowerSearch. The instrument turns 360 degrees to find and measure all visible targets. This mode is only available for instruments with the PowerSearch module. Measure mode **Infrared** is automatically selected when using this option.

Manual The target points are measured manually by pointing the instrument to the target point and pressing **F1: Meas**. In case **Infrared** is selected as **Measure mode**, **ATR** is used to precisely aim to the target.

5.3.2 Measure mode

Infrared The distance to the prism is measured with infrared. **ATR** is used to precisely aim to the target. This mode must only be used if the target is equipped with the appropriate prism.

Reflectorless The distance to the target point is measured by a reflectorless measurement.

5.3.3 Target

Target Selected target is displayed. To select a different target press **F3: Prism** and select a target from the list.

5.3.4 NumTarget Points

3 to 8 Minimum number of target that must be measured for a valid setup.

5.3.5 Measure Two Faces

Yes Measurements to target points are done in two face mode. This results in two measurements per point. This option is available only with **Infrared** mode (prisms are used as target).

No Each point is measured only in first face.

5.3.6 Max Coord Sigma

Value Defines the acceptable coordinate standard deviation of a valid instrument setup.

5.3.7 Max Orient Sigma

Value Defines the acceptable orientation standard deviation of a valid instrument setup.

5.4 Setup wizard

The tachymeter is positioned with the pages of this wizard. Follow the wizard to position the instrument.

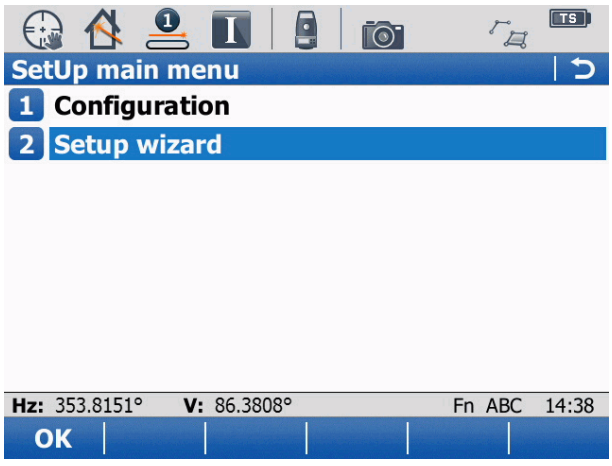

Figure 72. SetUp main menu

5.4.1 Measurements to targets

The measurement procedure depends on the selected **Setup mode** in the configuration.

Manual mode **F1: Meas** Measurement to a target point (1 or 2 faces, depending on configuration).

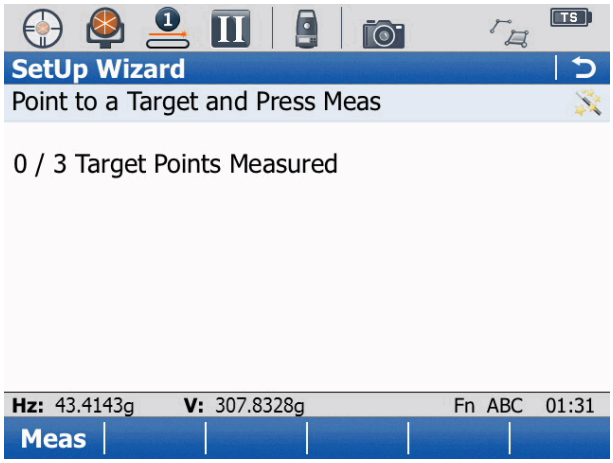

Figure 73. SetUp manual mode

Automatic mode **F1: Start** Starts PowerSearch to find and measure all visible target points (1 or 2 faces, depending on configuration).

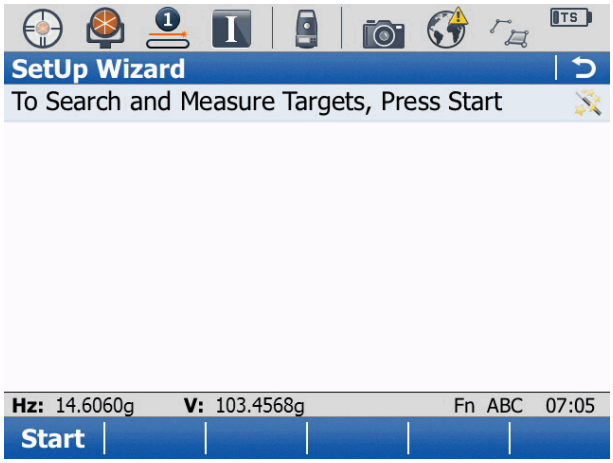

Figure 74. SetUp automatic mode

5.4.2 Calculation of position

After the measurement to the target points (manual or automatic mode), the calculation screen is displayed.

As a result of this method, after the measurement to the target points (max. 8 points) the position of the instrument is calculated as Resection Helmert and the calculated instrument position is stored as known instrument coordinate.

F1: Calc Calculation of the instrument position.

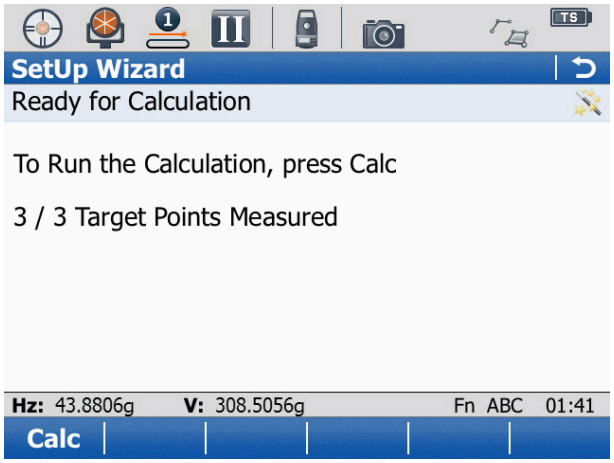

Figure 75. SetUp automatic mode

5.4.3 Check of the instrument position

After the calculation of the instrument position, the instrument position check screen is displayed.

F1: Yes Accept the instrument position.

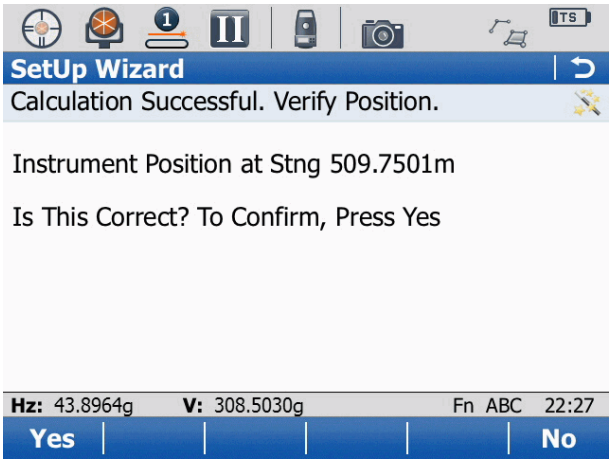

Figure 76. SetUp Verify position

To use the Heading stationing / 3D Tunnelmeter check, a valid project of your tunnel must be loaded in Amberg ProScan plus or Amberg SetOut.

5.4.4 Check of measured point

After the calculation of the instrument position, the instrument position check screen is displayed.

F1: Yes Confirm the instrument position.

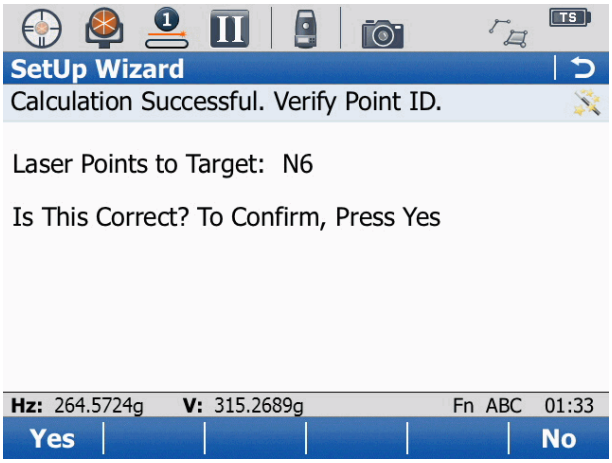

Figure 77. SetUp Check of target point

5.4.5 Set position

After the instrument point check the Set position screen is displayed.

F1: Yes Accepts and stores the instrument position
F5: More Show detail information about position.

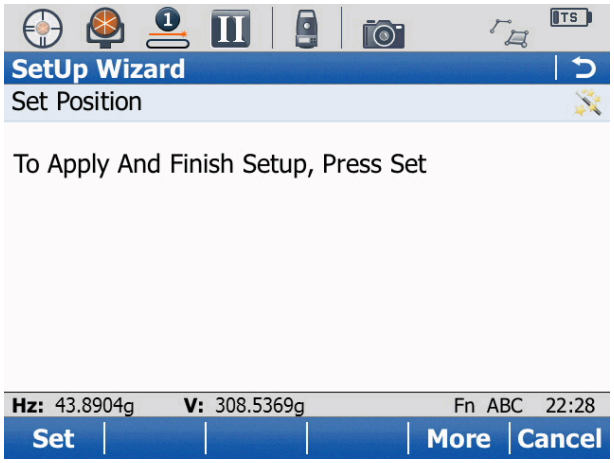

Figure 78. SetUp Set Position

After pressing **F1: Set**, the position of the instrument is stored and can be used in the other Amberg Applications programs.

5.5 Log File

The log file contains information, which permits the Administrator to reconstruct the work done with the application. It is always stored in the directory `\TMS` under the name `setup.log`.

Glossary

3D Tunnelmeter	Longitudinal value along the axis as defined in the vertical alignment for a tube heading axis in the Construction part of the project. Zero at the tunnel portal (where Heading stationing is zero) and increasing in heading direction.
Absolute coordinates	Position described by a coordinate triple of Easting, Northing and Height values.
Axis coordinates	Position described by a coordinate triple of Chainage/Heading stationing, Horizontal offset and Vertical offset.
Azimuth	Angle between cartographic north and measurement direction defined clockwise. Zero is equal to north direction.
Block axis	Computed axis within a task block, that is defined as a straight line that intersects the heading axis at the rear and front of the block.
Chainage	Stationing value along a chainage axis as a reference of the finished structure, e.g. railway or highway axis.
Chainage axis	Axis in Structure view of the project.
Construction	Top node for all sites, tube and shaft headings with heading axes, design data, measurement data and analyses of a project (Construction view).
Construction stage	Design of the tunnel at a certain stage of construction, holds theoretical profiles, theoretical sections and optional transverse slope definition.
Control point	Points that can be used for the calculation of the instrument position by the position tasks Tripod, Tripod automatic and Console. See manual Amberg Tunnel - Base for details.
Design point	Part of the target point, before the application of offsets, defined in a task section, station or block in axis coordinates. If no offsets are applied, it is identical to the target point.
Heading axis	Axis in Construction view of the project
Heading check point (HCHP)	Point in the tunnel to check the position of the instrument before and/or after executing a measurement task. It is set by the position task Set HCHP. Task settings Check HCHP before/after task refer to this point.
Heading stationing	Stationing value along a heading axis as a reference during construction, usually zero at the tunnel portal and increasing in heading direction.

Horizontal alignment	Geometry of an axis in a horizontal plane defined by straight, arc and clothoid elements (Situation).
HS	See Heading stationing.
Interpolation	Theoretical section with different start and end theoretical profile. Intermediate theoretical profiles are generated depending on the input theoretical profiles.
Longitudinal slope	Inclination of an axis in longitudinal direction, defined by vertical alignment.
Position task	Wizard-like tasks for determining the instrument position. Position tasks are configured on project level and are available in all headings.
Prism	Reflector, e.g. on a control point. Only prisms with addition constant 0 are supported, e.g. Leica Round prisms.
Profile plane coordinates	Position of a point in the plane of a theoretical profile relative to the axis point. The profile plane can be vertical or tilting with longitudinal slope.
Search vector	Vector in space along which target points are staked out. The origin of the search vector is the target point, the direction depends on the task type. On the search vector Right and Up deviations equal zero.
Shaft	Element of a finished tunnel structure. Can contain chainage axes (Structure view).
Shaft heading	Shaft under construction, defined as strictly vertical. Contains a heading axis, design data, measurements and analyses (Construction view).
Site	Contains tube and shaft headings of a project (Construction view).
Structure	Top node for tubes and shafts with chainage axes of the finished structure (Structure view).
Target point	Point to be staked out in the tunnel, defined in a task section, station or block in axis coordinates. Its coordinates result from the design point and the applied offsets.
Task (Measurement task)	A reoccurring work step in the tunnel which is carried out by the tunnelling crew. Related to the design data of a construction stage.
Task block	Design element of a block-based task which can contain task points. The task points of a task block are defined precisely at the stationing value of the block. When the task is executed, the task block is selected by the operator. The heading stationing borders of the block define the block axis.

Task section	Design element of a section-based task which can contain task points. Within a task section, the task points are defined over the complete range of the section. When the task is executed, the task section and its task points are selected based on the measured stationing value.
Task station	Design element of a station-based task which can contain task points. The task points of a task station are defined precisely at the stationing value of the task station. When the task is executed, the task station is selected by the operator.
Theoretical profile	Polyline defining the shape of a tunnel as designed.
Theoretical section	Defines the design of a construction stage by describing which theoretical profile is to be built along the heading axis.
Tilting with longitudinal slope	Attribute of a theoretical profile describing that is defined as perpendicular to the vertical alignment. If the axis is inclined, the theoretical profile will lean forward or back according to the longitudinal slope at the specific place along the axis.
TM	See 3D Tunnelmeter.
Transverse slope	Defines the inclination of the theoretical profiles along the heading axis according to the design.
Tube	Element of a finished tunnel structure. Can contain chainage axes (Structure view).
Tube heading	Tube or part of a tube under construction, can be declined. Contains a heading axis, design data, measurements and analyses (Construction view).
Task check point (TCHP)	Control point with the shortest distance to the instrument from the currently valid instrument setup. Set by position tasks Tripod, Tripod automatic and Console. Task settings Check TCHP before/after task refer to this point.
Temporary control point	Points measured and stored with the position task Temporary control points with strictly temporary character. They can optionally be used as control point coordinate source by the position tasks Tripod, Tripod automatic and Console.
Vertical	Attribute of a theoretical profile describing that is defined in vertical direction, regardless the axis vertical alignment. If the axis is declined, the theoretical profile will still be strictly vertical and not lean forward or back according to the longitudinal slope.
Vertical alignment	Height/Gradient points along the horizontal alignment, optionally with arc or parabola round-offs.

Amberg Technologies AG
Trockenloosstrasse 21
8105 Regensdorf
Switzerland

Phone: +41 44 870 92 22
Mail: support.tunnel@amberg.ch
http://www.amberg.ch/at

AMBERG TECHNOLOGIES