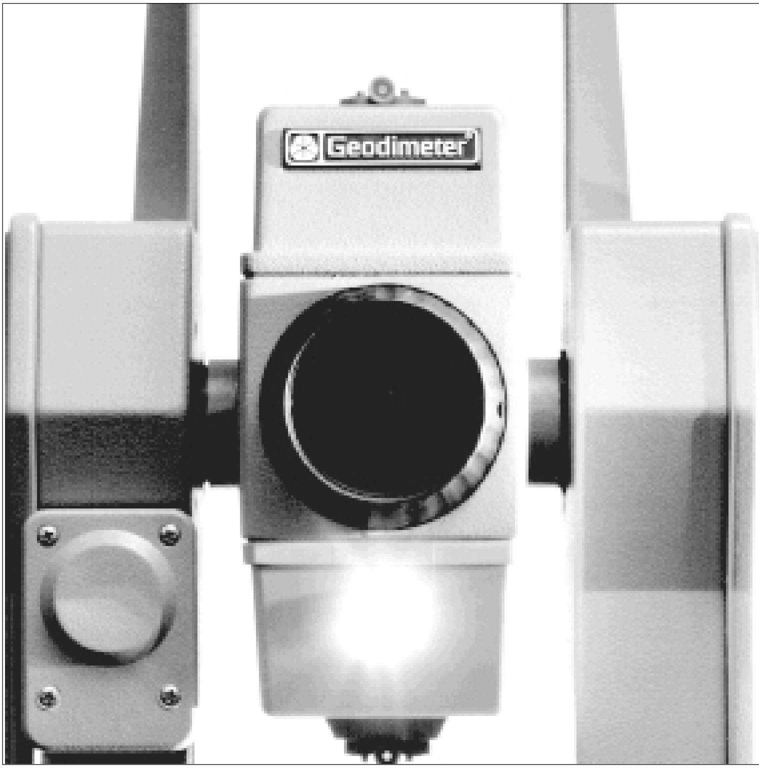
Geodimeter® System 500



User Manual

Ver. 6 Publ.No. 571 701 041

FEDERAL COMMUNICATIONS COMMISSION
RADIO FREQUENCY INTERFERENCE STATEMENT

This equipment generates and uses radio frequency energy but may not cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B digital device in accordance with the specification in Subpart J of Part 15 FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by switching the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures.

— reorient the receiving antenna
— relocate the instrument with respect to the receiver
— move the instrument away from the receiver

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commisions helpful:

'How To Identify And Resolve Radio-TV Interference Problems'.

This booklet is available from the US Goverment Printing Office, Washington, DC 20402, Stock No. 004-000-00345-4.

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Welcome to Geodimeter System 400 & 500

In 1986, Geotronics introduced a new concept in total stations: Geodimeter System 400 formed a class by itself.

In 1992 Geodimeter System 500 was released. It is now possible for the operator to create his own measuring system.

Geodimeter System 400 and 500 have been developed into increasingly powerful instruments. They are available with servo drive (only System 400), alphanumeric / numeric keyboards, Tracklight etc.

Geodimeter System 400/500 also includes a great variety of software for data collection and field calculation, internal memories for storing up to 10 000 points, an external memory in the form of our recording unit Geodat and / or a computer via a two way serial communication port (RS 232).

This manual will show you the different kinds of instruments included in Geodimeter System 400/500. Use the manual for basic information on how to operate your instrument.

About this manual

The contents of this manual are as follows:

Part 1. Operator's instructions

Chapter 1, Introduction, describes the contents of the transport case and the functions of the controls, keyboard and display.

Chapter 2, Pre-Measurement, explains what you should do and think about when you are out measuring in the field, and what parameters should be preset. This chapter also describes how to make special settings such as the number of decimals, how to read the display, etc.

Chapter 3, Station Establishment, contains step-by-step instructions on how to set up your instrument and then establish the station at a known or an unknown point.

Chapter 4, Carrying out a Measurement, contains step-by-step instructions on how to carry out distance and angle measurements.

Chapter 5, Important Pages, contains important information such as an ASCII code table and an Info code list.

Del 2, Technical description ("Yellow Pages")

Chapter 1, Angle Measurement System, explains how the angle measurement system is built up and how it functions.

Chapter 2, Distance Measurement System, explains how distance measurement works. It covers the system's different measuring methods, accuracy, range, etc.

Chapter 3, Tracklight, explains how Tracklight works, how it is activated and how it is set.

Chapter 4, Data Logging, describes how to collect and transmit data.

Chapter 5, Power Supply, explains the different types and capacities of batteries and types of chargers available for Geodimeter System 400/500, and gives some tips on charging nickel-cadmium batteries.

Chapter 6, Definations & Formulas.

Chapter 7, Care & Maintenance.

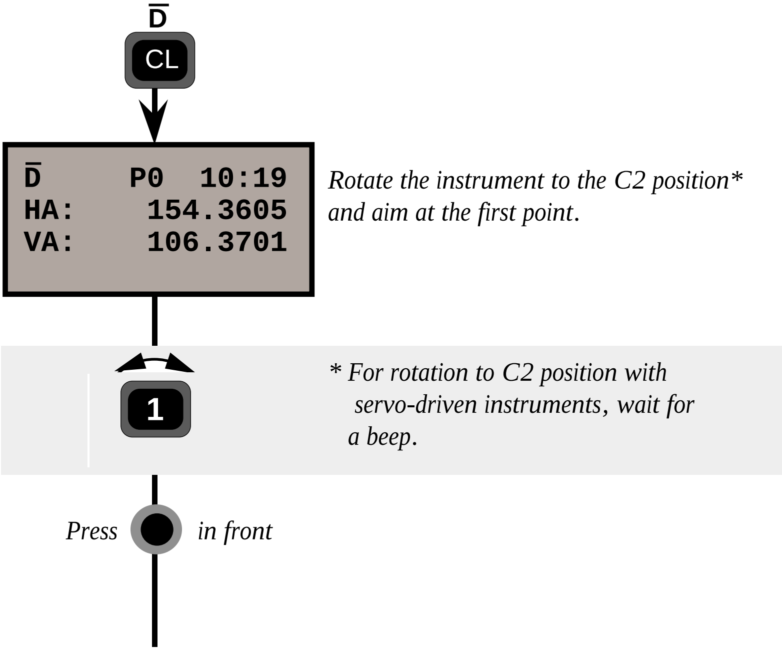
How to use this manual

The manual for Geodimeter System 400/500 is divided into two parts.

Part 1 gives step-by-step instructions, from unpacking the instrument to advanced setting out. Instructions which are specific to instruments with servo assistance are indicated by a shaded field (see below).

Note! ☛
Only Servo-driven Instruments

C2:I



Part 2 provides a technical description of the main components of the instrument. Since all pages in Part 2 are printed on yellow paper we refer to them as the "yellow pages".

This manual deals with all models in Geodimeter System 400/500.

The cover also contains an appendix section, in which Appendix A is a complete list of labels, and Appendix B is an overview of the instrument's Main Menu. Appendix B can be spread out when you are working with Chapters 2, 3 and 4 in Part 1.

Short form instructions are also supplied with your instrument. They can be used for quick reference when you are working in the field, after you have become familiar with Geodimeter System 400/500.

If you or your colleagues have any comments about this manual, we would be grateful to hear from you. Please write to:

Geotronics AB
Marketing Communication Dept.
Box 64
182 11 DANDERYD
SWEDEN

Part 1

Operating Instructions

Chapter 1

Introduction

Illustrations

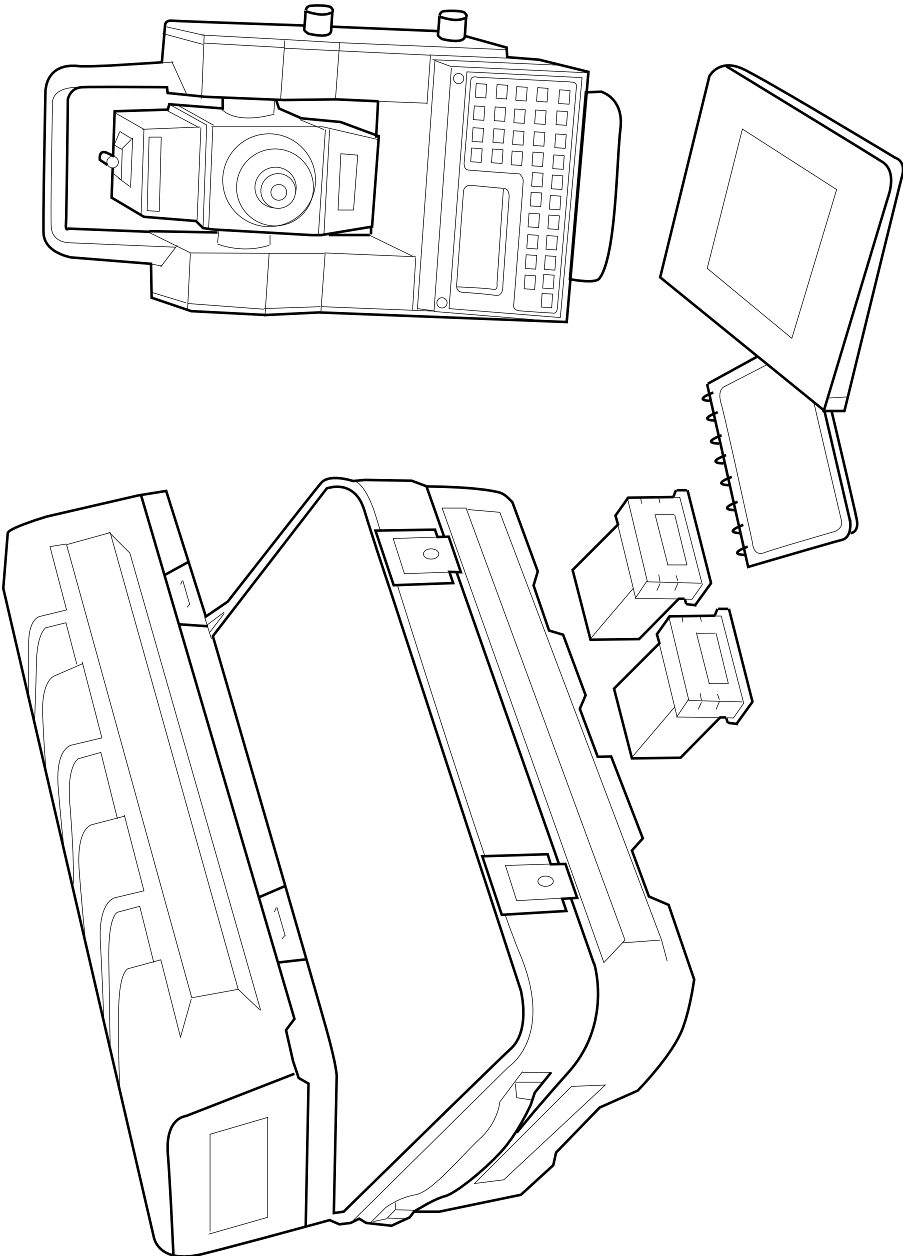


Fig 1.1 Geodimeter System 500

Unpacking & Inspection

Before we begin to describe the operating procedure of your Geodimeter, it is first necessary to acquaint yourself with the equipment received:

- ❑ Instrument Unit
- ❑ Transport case
- ❑ Internal battery (2pcs)
- ❑ Tribrach
- ❑ Rain cover
- ❑ Sight marks (stick-on)
- ❑ ASCII Table (stick-on), only instr. with numeric keyboard
- ❑ User Manual
- ❑ Short Form Instruction
- ❑ Software & Data communication manual

Note!
Some equipment is market dependent

Inspection

Inspect the shipping container. If it is received in poor condition, examine the equipment for visible damage. If damage is found, immediately notify the carrier and the Geotronics Service Department. Keep the container and packing material for the carrier´s inspection.

Aiming at the target

To get the correct measurement with system 500 it is important that you aim at the sight marks of the target and in the middle of the range pole.

Fig 1.2 Geodimeter Controls

Controls

Listed below is a description of controls shown in Fig. 1.2. Please take a moment to familiarize yourself with the names and locations of the controls:

Item	
1	Prism symbol which marks the instrument height (I.H) (also on left side)
2	Vertical motion lock
3	Two-speed vertical motion control (not seen)
4	Two-speed horizontal motion control
5	Horizontal motion lock
6	Control for the signal volume of the measuring beam. (not seen)
7	Control for the display contrast and viewing angle. (not seen)
8	Coarse Sight.

Special controls for Servo-driven instruments

Some instruments are servo-assisted for horizontal and vertical adjustment. See Fig. 1.3.
These instruments have no horizontal or vertical locks, since the clutch automatically prevents any undesired turning.

Fig 1.3 Geodimeter Controls (servo instruments)

Display

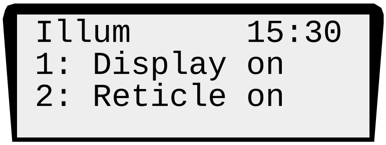
The Geodimeter instrument has a four-row Liquid Crystal Display (LCD) where each row contains 16 characters for an instrument with a numeric keyboard and 20 characters for an instrument with an alphanumeric keyboard. Both alpha and numerical characters can be displayed. Black images on a bright background make the display easy to read. The display has illumination and adjustable viewing angle for good readability under all conditions. The first row displays the measurement method, program choice, clock and indication of signal return (∗). In instruments with an alphanumeric keyboard it also displays if alpha mode (∝), shift (^) or lower case (1) is activated. The second to fourth rows display the respective labels and values of the measurement method selected by the operator . Each display table consist of a series of "pages" which can be "turned" with the ENT - key.

Fig. 1.4 Display with alphanumeric keyboard

Illumination (System 500)

Illumination of the display and reticle

The display and reticle (crosshair) of the instrument is illuminated in the menu by pressing MNU18. Select 1 for display illumination and/or 2 for illumination of the reticle.
The following display appears when selecting MNU 18.



Illumination (System 400)

The display of the instrument is illuminated in the menu by pressing MNU18.

Pre-setting of display contrast

With the help of a potentiometer (7) on the left underside of the front panel, it is possible to preset both the contrast and the viewing angle of the display. This is normally done after instrument setup by turning the adjustment control (7) until the display characters can be read clearly.

User-defined display tables

With the "Set Display" application it is possible to define your own display table, if the existing table does not fulfill your needs during the execution of a special survey application.
For further information refer to page 1.2.11.
All labels in the Geodimeter System can be displayed.

Fig 1.5 Geodimeter with alphanumeric keyboard

Fig1.6 Geodimeter with numeric keyboard

Keyboard

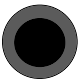
The keyboards in Geodimeter instruments are ergonomically and logically designed. All functions except aiming are controlled from the keyboard. The instrument is equipped with either a numeric or an alphanumeric keyboard. The following describes the alphanumeric keyboard with alternative keys for the numeric keyboard.

The alphanumeric keyboard consists of 33 keys: the numerals 0-9, letters A-Z, and control keys. The control keys comprise the choice of functions 0-99, choice of menu, choice of program and choice of measurement method, together with clear and enter functions.

The numeric keyboard consists of 20 keys on two separate pads comprising 16 and 4 keys. See fig 1.6.

Key functions

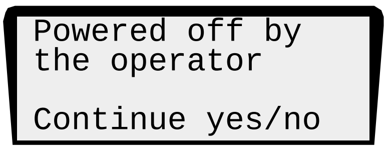
or



ON / OFF key

Turns power on when pressed once, turns power off when pressed again. If no key is pressed within 60 seconds from power on the instrument automatically turns off. This function is called "Time Out"

When the instrument is turned on again within 2 hours from latest use you will get the question "Powered off by the operator, Continue yes/no".



If you answer yes to this question the Geodimeter returns to the mode that was current when the Geodimeter was turned off.

All the instrument's parameters and some functions, such as instrument height, signal height, coordinates, bearing, dual axis compensation, etc. are stored in the instrument for two hours. If you answer "NO" the Geodimeter is reset and all parameters are lost.

Batlow Total Station

If batlow occurs no measurements can be carried out. The next time the instrument is turned on you will be prompted "Powered off by Battery Low, Continue yes/no". Answer yes to return to the mode that was current before battery low. Note that no measurements can be carried out before replacing the drained battery.

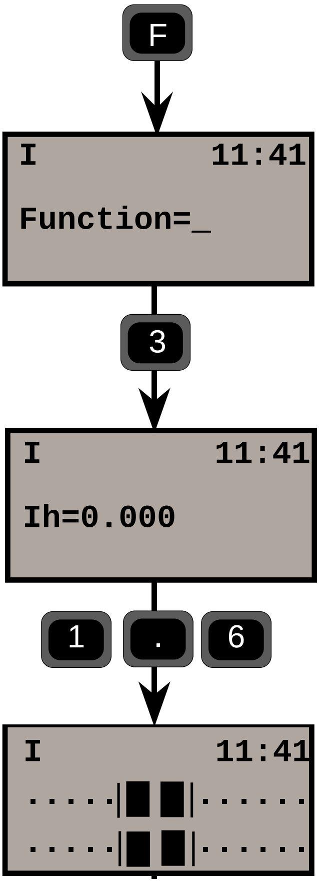
Function keys/Labels

The data stored under labels can be viewed or altered by the operator. In some cases the data also influence the system. Changing the data in the time label will, for instance, set the system real time clock. However, just calling up a label, viewing the data and restoring without any editing will not influence the system at all. Data stored under labels can be retrieved by the F (Function) key or in the U.D.S (User Defined Sequences) (additional software).

A complete list of functions and labels can be found in Appendix A.

Example:

How to store the instrument height (IH)



Turn on the instrument, press the function key, the following will be displayed.

Key in the label number for instrument height, 3 and press the ENT-key.

The display shows the current value for the instrument height
Accept the value by pressing YES or ENT or key in a new value.
In this case we key in 1.6 and press ENT.

You now return to the mode that was current before you pressed the function key. The new instrument height is now stored in the instrument.

Menu key

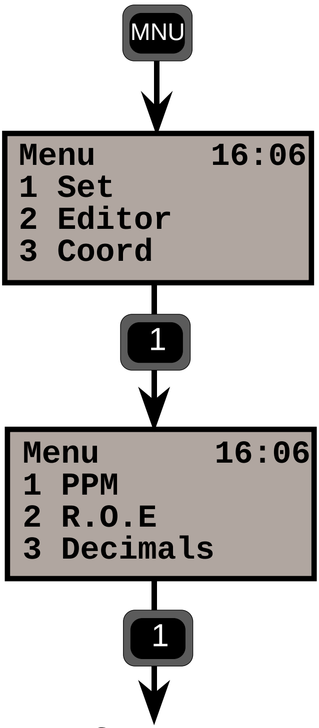
Despite sophisticated built-in technology, operation is very simple, since everything is controlled from the keyboard and the self -instructing display.

Many functions are controlled from the MNU-system that is presented on the display. The menu makes it easy to follow and alter, if required, measurement units, display tables, coordinates, correction factors etc.

The main menu configuration can be seen in Appendix B.

How to store the factor for atmospheric correction (PPM).

Example:



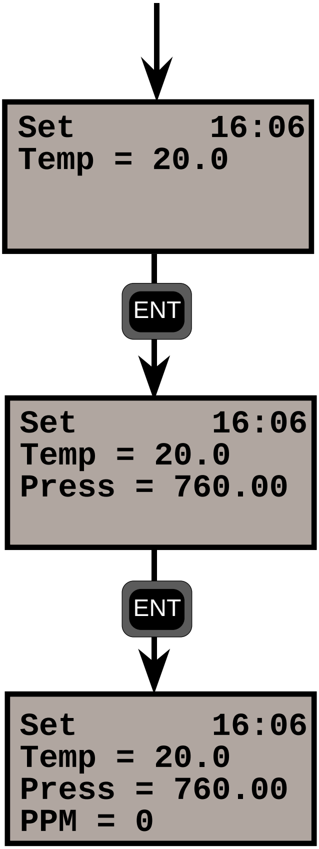
See next page

Turn on the instrument, press the MNU key, the following will be displayed (it is assumed that the compensator has been switched off or that calibration has been made)

Select SET by pressing 1 and the display shows.......

Select PPM by pressing 1 and the display shows....

See previous page.



Key in the present value for temperature e.g + 20°C. Press ENT.....

Key in the present value for air pressure e.g 760mm/Hg. Press ENT...

The correction factor is immediately calculated and shown on the display.

Key in other values for temperature and pressure and see how the ppm changes.
Input at label 56 and 74, via Function key also alters PPM value.
The PPM value can also be set directly by enter at label 30.

Fast step-through menu
When you have become well aquainted with the menu structure it is very easy to step to a submenu with a minimum of key strokes. To go to menu 1.4.1, Select display (see Appendix B) simply press the MNU-key followed by 141.

PRG

Program key

Choice of program. With this key select the different programs installed in your Geodimeter. The programs comprise a number of different options, and are listed below. The operating instructions for each program are described in a separate manual called "Geodimeter Software Manual".

Option	Programs Supplied
UDS	P1-19 - User Defined P20 - Station Establishment incl. 3-dim. free station P40 - Create UDS P41 - Define Label P43 - Enter Coordinates P50 - Set Format P51 - Set Protocol
Set Out	P20 - Station Establishment incl. 3-dim. free station P23 - Set Out P43 - Enter Coordinates
Pcode	P45 - Define Pcode
Edit	P50 - Set Format P51 - Set Protocol P54 - File Transfer
View	P50 - Set Format P51 - Set Protocol
Internal Memory	P54 - File transfer
DistOb	P26 - Distance / Bearing. between 2 objects
RoadLine	P20 - Station Establishment incl. 3-dim. free station P29 - Roadline P43 - Enter Coordinates
Z/IZ	P21 - Ground/Inst. Elevation P43 - Enter Coordinates
RefLine	P24 - Reference line P20 - Station Establishment incl. 3-dim. free station P43 - Enter Coordinates
Ang. Meas.	P22 - Angle Measurement*
Station Establishm	P20 - Station Establishment incl. 3-dim. free station
Area Calc.	P25 - Area & Volume Calculation
Obstructed Point	P28 - Obstructed Point

* Only available in servo - driven instruments, and installed as standard.

PRG

Choose program

There is two ways to choose a program:

1. Short press

With a short press on the program key you get the following display:

```
STD    P0  13:08

Program=20
```

Key in the desired program. In this example we key in 20, Station establishment, and press enter.

2. Long press

With a long press on the program key you step to the program menu. Here you can display all the available programs for Geodimeter System 400/500. Any optional program that is not installed in your instrument is surrounded by two brackets, ( ).

```
UDS    P0  13:08
540 582-09
Program 0
Dir <-- --> Exit
```

<- Current library and program number
<- Instrument model and program ver.
<- Current program name
<- Key functions

Key functions:

Dir	Step between the UDS and PRG-library
<-- -->	Step backwards/forward in the chosen library
Exit/MNU	Exit without starting any program
ENT	Start the chosen program

ENT

Enter key
Activates keyboard operations and turns display table pages.

CL

Clear key
For correction of keyed in but not entered errors.

STD

or

STD 0

Standard mode key
Choice of Standard Mode. This key activates the Standard Measuring Mode. The instrument automatically assumes the STD mode after going through the Startup Procedure. Standard Mode is described in detail on page 1.4.2 and in the "yellow pages", 2.2.4.

TRK

or

TRK -/.

Tracking mode key
Choice of Tracking Mode. This key activates the tracking measurements (continuous measurements). Tracking Mode is described in detail on page 1.4.23 and in the "yellow pages", 2.2.5.

$\overline{D}$

or

$\overline{D}$ CL

D-bar mode key
Choice of Automatic Arithmetical Mean Value Mode. D - bar mode is described in detail on page 1.4.7 and in the "yellow pages", 2.2.4

M

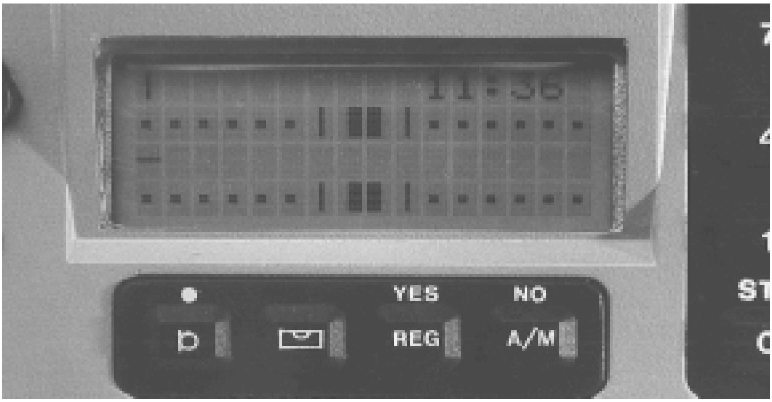
or

Tracklight key

Tracklight ON/OFF. See more about Tracklight in the "yellow pages", 2.3.1

Electronic level key

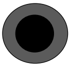
Display of the horizontal electronic level. The electronic level on Geodimeter instruments can be levelled without the need to rotate the instrument through 90 degrees (100 gon). This is achieved by having two separate rows on the display, each with its own separate cursor, to show the level status of both axes of the instrument (see fig below).



The accuracy of the electronic level, i.e. each individual left or right movement of the cursor, represents 3^{c} (300^{cc}) = approximately 1' 40". This level mode is termed the "coarse level mode". After calibration of the dual-axis compensator, this level mode automatically changes to the "fine level mode" which can be compared to the normal accuracy of a 1-second theodolite. In this fine mode each left or right single step movement of the cursor represents 20^{cc} (approximately 7"). The fine level mode is designed for use during traversing using force-centering.

Measurement keys

Start of measurement cycle. Internal storage of angle values in C2 and C1.



A/M-key at the front when measuring in two faces (C1 and C2).

Registration key

For registration of measurement values.

ASCII

Alpha character keying in (numeric keyboard)

It is also possible to enter alpha characters in instruments with the numeric keyboard. This is done by pressing the electronic level/ASCII key. If alpha characters are to be used in the middle of an numeric point number or point code title, exit from and re-entry into the alpha mode is achieved by pressing the electronic level/ASCII key. Follow the example below.

The instrument also gives you the oppurtunity to select special characters for different languages. This can be done via Menu 19. A complete list of values for different characters for different languages is shown on page 1.5.2

Example:
Alphanumeric input using the ASCII table

The point number to be keyed in is 12 MH 66 which is the field notation for Point Number 12, which happens to be a manhole with a 66 cm diameter cover.
Press F5. PNO is seen on the display. Key in 12. Press the electronic level/Alpha key. ASCII is seen on the display. Key in 77 72 = MH. Press once again the electronic level/Alpha key. Then key in 66. Finalize the keying in by pressing the ENT key. This ASCII possibility can of course be used with other functions – e.g. Operator, Project, etc.,etc.– in fact all functions except the labels which are directly connected with measured and calculated survey values.

YES
α

Alpha mode key

For activation / deactivation of the Alpha Mode and for answering YES to questions shown in the display. When the alpha mode is activated, it is indicated by an (α) symbol in the right-hand corner of the display.

Note! ☛ It is also possible to enter alpha characters in instruments with numeric keyboard, see page 1.1.18.

How to use the alphanumeric keys.

The numerical keys can be used both for ordinary numerals and letters. To use the letters as indicated on each key, first press key [α]. The keyboard is now locked for letters, and this is indicated by an (α) symbol in the upper right hand corner of the display. To enter a particular numerical character in combination with an alpha character, press the key [●]. A (^) symbol in the upper right-hand corner of the display window indicates that the shift key is activated. For small letters, press shift [●] directly followed by "Lower Case" [LC].
The figure (1) in the upper right-hand corner of the display window will appear immediately indicating lower case mode. To return to numerical keys, press key [α].

The instrument also gives you the opportunity to select special characters (not shown on the keyboard). The special characters differ between languages. Language is changed via Menu 19. These special characters are displayed in the bottom row in groups of five.To step between the different characters press keys [●] and [CON].
The characters are entered by first pressing shift and then the corresponding key below the character.

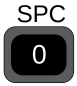
W
LC

Lower case key

Lower case is used together with the Shift key [●] to be able to use the alphanumeric keyboard with lower case letters.
This is indicated by the figure "1" in the right hand corner of the display.

Shift key

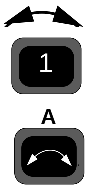
Shift Key. For entering a numeric value when the keyboard is set in the alpha mode, or vice versa and to answer NO to questions shown in the display. When the shift key is activated, this is indicated by a ^, sign in the right-hand corner of the display.



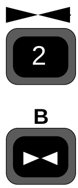
Space bar key

Activated when selecting the alpha mode.

Servo Control keys (numeric and alphanumeric keyboards)



When measuring in two faces, this key is used for switching between C1 and C2.



Key for horizontal positioning.

Key for vertical positioning.

Pre-Measurement

Illustrations

Office Setup

This chapter is to familiarize you with your new Geodimeter before you enter the field. We will not follow all steps in the normal field procedure.

Connecting the internal battery

The internal battery slides onto the underside of the measuring unit – i.e along the tracklight housing. The battery needs to be recharged when drained, using the charging converter over a period of 14-16 hours. When fully charged, it will supply power to the instrument for 1.5-2 h of continuous use. See the "yellow pages" 2.5.1.

System 500

System 400

Fig. 2.1 Connecting the internal battery

TURN ON POWER

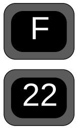
To turn the Geodimeter on, press the On/Off key. A built in test sequence displays the following display tables.

On/Off

Geodimeter 540

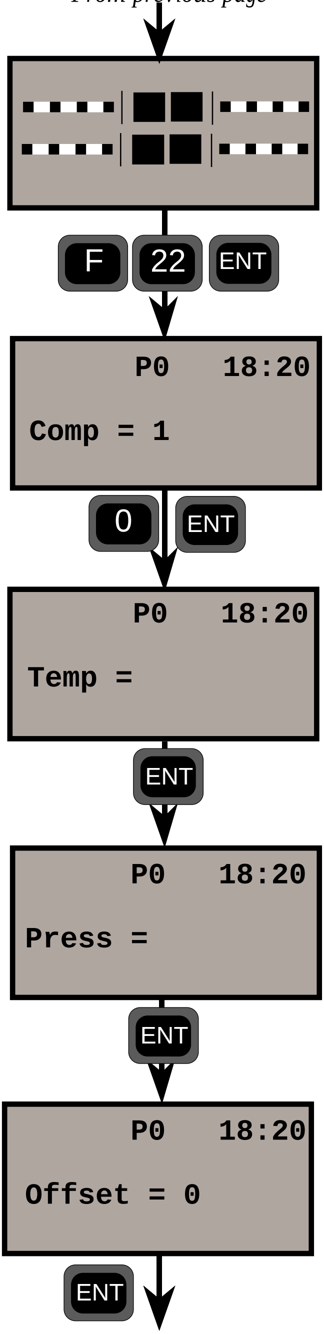
A built in test sequence displays Geodimeter and model type followed by….

See next page



Compensator On/Off

From previous page



.....display of the electronic level which indicates the level status of both axes of the instrument. As no measurements are to be made we will disconnect the dual axis compensator with function No. 22. Press F22 ENT.

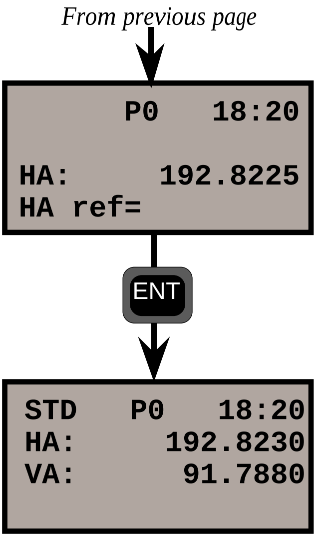
Comp = 1 on display.
Key in 0 to switch off. Press 0 ENT.

As no measurements are to be made, press only ENT.

As no measurements are to be made, press only ENT.

As no measurements are to be made, press only ENT.

See next page



As no measurements are to be made, press only ENT.

Here you come automatically to the Standard Measurement mode. As no measurements are going to be made at the moment, we will continue with the Pre-Setting routine.

Pre-Settings

MNU
1
SET

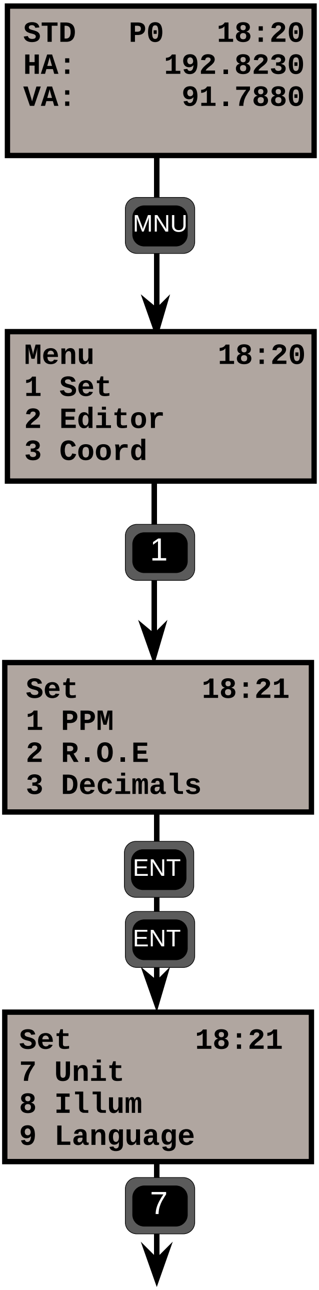
Before starting this exercise fold out Appendix B showing the main menu configuration.
The subject Settings can be divided into three different categories:

- ❑ Measurement settings – settings of PPM, Offset, HAref and Station data. These settings will be dealt with in the section "Start Procedure" on page 1.2.3.

- ❑ Special measurement settings – these range from the setting of decimal point and defining display tables to setting diff-erent switches. These settings will be dealt with on page 1.2.11 "Special Settings".

- ❑ Pre-Setting – settings which can be decided and executed in advance are the following: MNU 17 = Unit (i.e metres, feet, grads, degrees, etc) and MNU 15 = Time & Date.

Set unit (e.g metres, feet, grads, degrees, etc)



Now it is time to make use of the menu function. Press the MNU key.

You are going to begin the SET routine. Press 1.

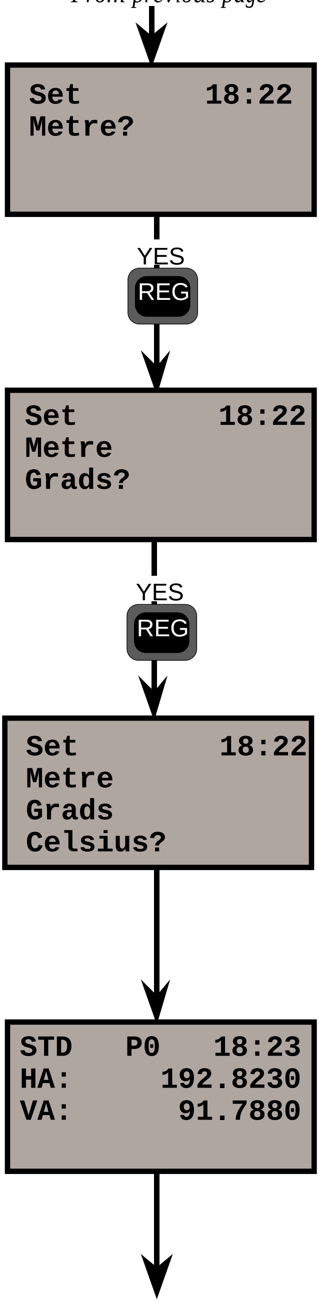
Step by pressing ENT twice.

Note!
This is not needed if you know the code for the desired function. Just key in the entire code, in this case 17 in order to save key-strokes.

You are going to set the unit parameters – i.e., metres, feet, grads, degrees, etc. Press 7.

See next page

From previous page



Answer YES to accept the displayed unit or NO if you want to change to feet. Here press YES.

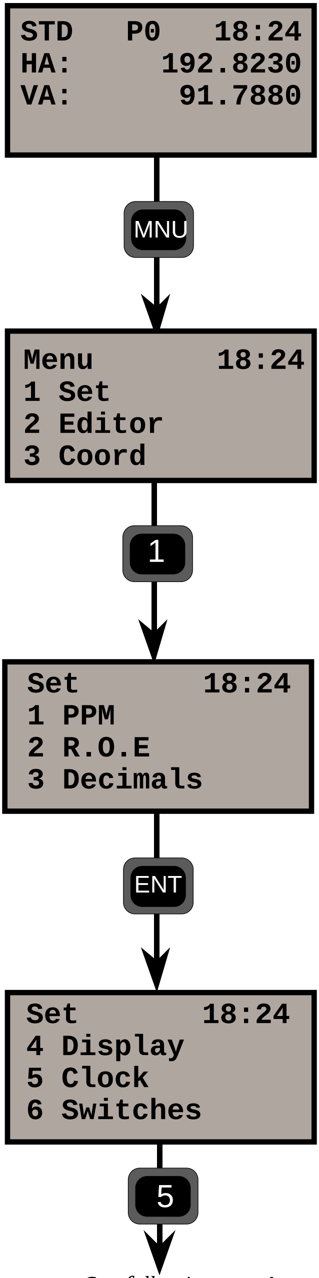
Answer YES to accept, or NO if you want to change to degrees, mills or decimal degrees. Here press YES.

After you have answered YES or NO to the choice of temperature unit and the air pressure unit, the display automatically changes to….

……prog. P0. It is now time to set the clock and the date which can be displayed in several formats, depending on the standard within your own region.

See next page

Set time & date



Now it is time to make use of the MNU function. Press MNU key.

You are going to begin the SET routine. Press 1.

Step by pressing ENT or 5 directly.

You are going to set the clock. Press 5.

See following page!

From previous page

```
Time          18:24
1 Set time
2 Time system
```

You wish to calibrate the clock. Press 1.

Note!
Time and date can also be set by using function 52 (F52) and function 51 (F51).

1

```
Time          18:25
Date = 1990.0607
```

These values were in the instrument at the time it left the factory. Key in today's actual values and press ENT.

ENT

```
Time          18:25
Date = 1990.0607
Time = 18.2540
```

Key in your time (no seconds!). Press ENT when the time is synchronized.

ENT

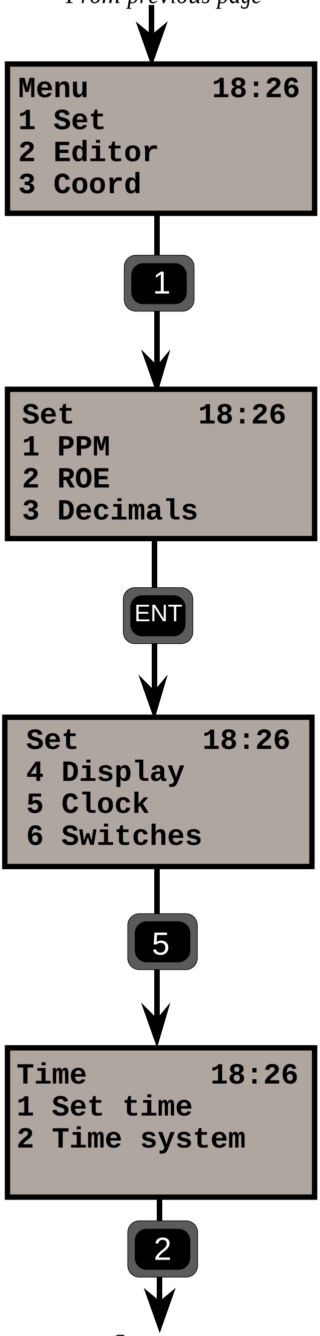
```
STD   P0    18:25
HA:       192.8230
VA:        91.7880
```

You are returned to prog. P0.
If you are not used to the order of year/month/day and would rather have the normal European standard of day/month/year,press MNU.

MNU

See next page

From previous page



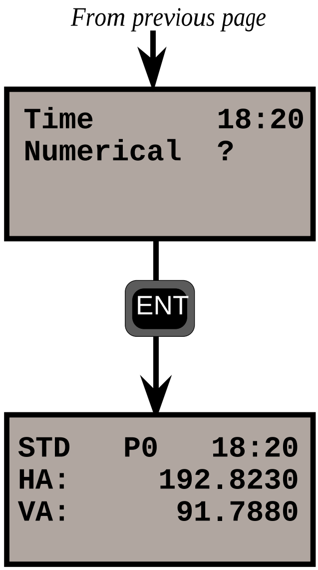
Choose Set by pressing 1.

Press the ENT key or 5 direct to access the clock option.

Choose Clock by pressing 5.

Choose Time system by pressing 2.

See next page



Here you are able to select which type of date system you want – e.g Numerical?, 12h mm-dd-yyyy or 24h mm-dd-yyyy and also if you want to change to dd-mm-yyyy. Let's press YES or ENT for Numerical.

You are returned to the Standard mode program 0 (P0).

You have now completed the pre-settings, which normally don´t have to be changed.

Note! ☛ The back-up battery

The backup battery is expected to last for at least 3 years and can only be replaced by an authorized service shop. When the backup battery is drained "INFO=26" will be displayed.

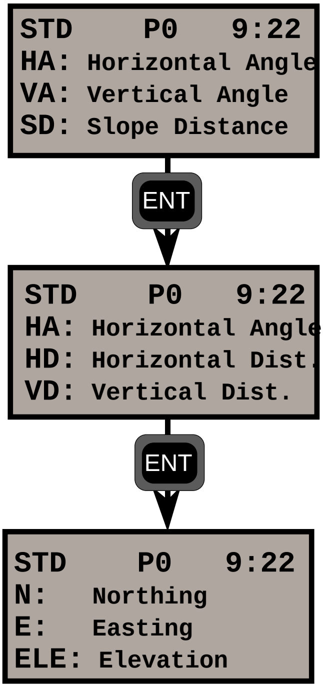
Special Settings

The special measurement settings range from defining display tables, setting decimal point and setting different switches such as: Targ. test on ?, AIM/REG off ?, Pcode on ?, Pow. save on/off and Info. ack on/off.

Create & Select display tables

Various display combinations can be created by the operator. However, we consider the following 3 examples as standards and have chosen to set them in the instrument before it leaves the factory.

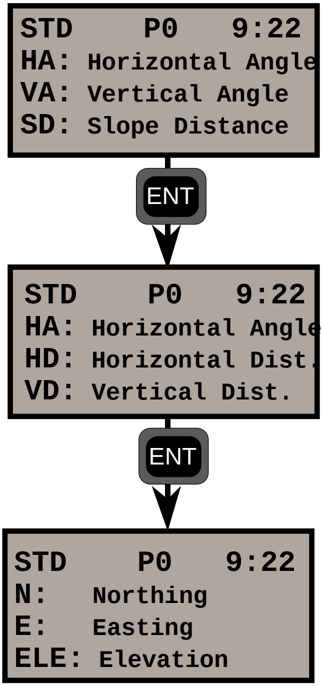
Table 0 (Standard)



Other settings can be made with the help of the main menu using MNU 14 and option No. 2, Create Display e.g MNU 142.
There are 5 tables available (Tables 1–5). Table 0 is standard and cannot be changed (see above). 16 different pages can be defined in each table or 48 using only one table. 3 rows can be specified on each page.

Create & Select a new display

To give you an idea as to how this works, let us take a look at our standard table 0. After measuring the distance the following will be displayed:



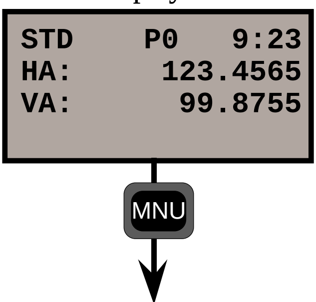
Page 1

Page 2

Page 3

If for example you would like to display eastings before northings, you can change the display table according to the following example: (page 1 and 2 unchanged)

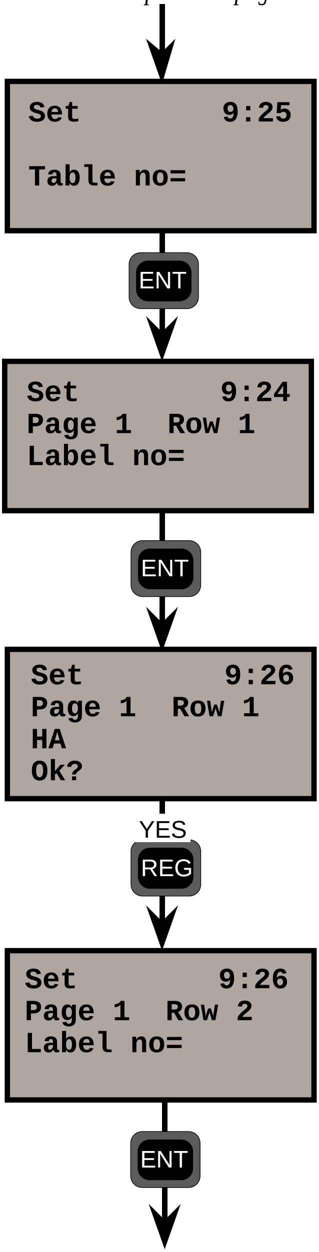
Create Display.



To be able to set your own display tables you have to access the main menu.
Press MNU 142…..

See next page

From previous page



Choose, for example, 1. Press 1 ENT…

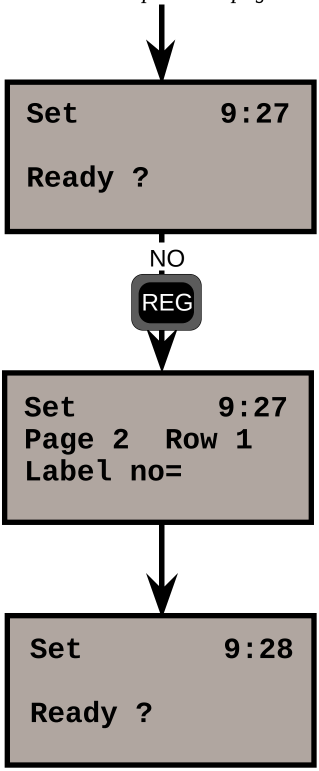
Check the list of function labels in appendix A. Press 7 (HA) ENT..

Press YES.....

Continue with label 8 (VA) and 9 (SD). After keying in label 9 and Yes press only ENT.

See next page

From previous page

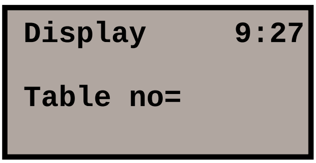


When page 1 is completed, continue with page 2. Press NO.....

Continue with label 7 (HA), 11(HD) and 49 (VD) using the same procedure as for page 1.
When you come to page 3, key in the labels below in the following order:
38 Easting coordinate
37 Northing coordinate
39 Elevation coordinate

You have now created your own display table. Press YES and you will be returned to program 0 (P0).

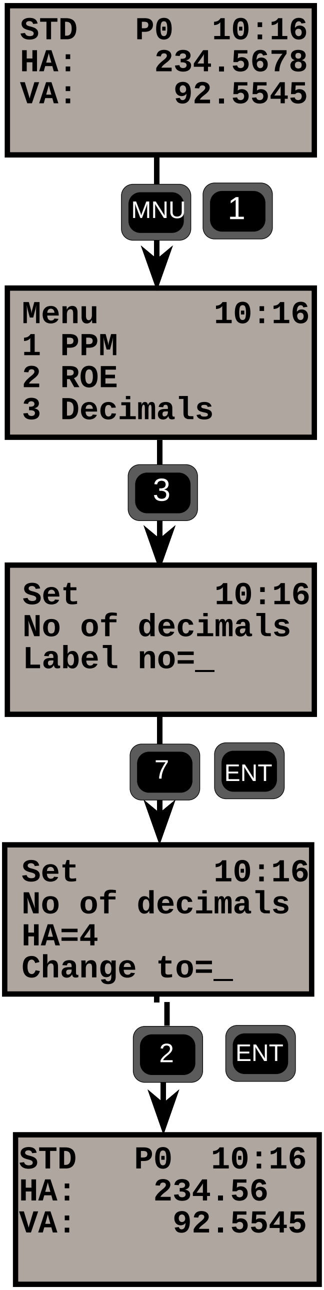
Select display



To be able to use your newly created display table, select MNU 14 and option 1. Select display.
Key in the current Table No. and press ENT. This Table No. now becomes the default version, until you select another Table No.

Note! ☛ If the data output is to be similar to your display table, then it also has to be set. See "Data Communication", "yellow pages" 2.4.4.

Number of decimals



To set the number of decimals, you must first choose the service of the menu……

Select number 3 Set Decimals

In this example, let us change the number of decimals in, for example, the HA = label No 7.

We assume that you want to work only with 2 decimal places in this example ……

You are now returned to the standard (STD) mode. To change other labels, choose the menu and repeat.

Note! ☛
A complete list of Functions and labels can be found in App. A.

MNU 1 6

Switches: Targ. test on ?, AIM/REG off?, Pcode on ?, Pow.save on/off, Info ack on, HT_meas on?, North=0 ?, Prg_num on?

Seven different switches can be set in the instrument, by using the menu's SET function, Option 6, Set switches.

Note! ☞
The Target Data Test is created for your own safety. It prevents you from storing an old distance with new angle values. When the target test is set to off, there is a risk of this, if you forget to measure a distance when measuring the remaining points.

```
Set            11:22
Targ.test        on?
```

For activation/deactivation of the Target test; answer Yes / No.
For more information see "yellow pages" 2.2.7.

YES

```
Set            11:22
Targ.test        on?
AIM/REG         off?
```

For activation/deactivation of the AIM/REG answer Yes / No.
AIM/REG is used onlyfor Geodat 122/124. Otherwise it should be deactivated.

YES

```
Set            11:22
Targ.test        on?
AIM/REG         off?
Pcode            on?
```

When using the additional software Pcode, this allows you to switch the Pcode-table on/off.

YES

```
Set            11:22
AIM/REG         off?
Pcode            on?
Info ack.       off?
```

If you want to accept any info message that may appear switch this label on. All info messages will then be followed by "Press any key". The display returns to normal after 3s.

YES

```
Set            11:22
HT_meas on?
```

If the station height has been established in e.g. P20 (Station Establishment) you can, by entering menu 16 from P0, choose whether to include the station height or not.

YES

See next page

From previous page

```
Set           11:22
HT_meas   on?
Pow.save on?
```

Only System 500
The distance meter can be set in power save, which means that the distance meter is only active during distance measurement given. This is indicated in the display with an "s". (Only in STD- and D-bar mode).

```
Set           11:22
HT_meas    on?
Pow.save   on?
North=0 ?
```

If you wish to work with a north oriented coordinate system, press YES to this question. If you press NO, the system will be south oriented. (A north oriented system is the most common).

```
Set           11:22
Pow.save    on?
North=0 ?
Prg_num     on?
```

If Prg_num is on, the current program number will be stored first in the job file when you start a program. (P20-P29).

Select type of language

MNU 1 9

This function is used when you have to select special characters for your language. You have the opportunity of selecting between Swedish, Norwegian, Danish, German, Japanese, UK, US, Italian, French and Spanish. An instrument with an alpha-numeric keyboard gives you the characters on the last row of the display when working in alpha mode. An instrument equipped with a numeric keyboard and ASCII mode displays the special characters by selecting the numeric value for different characters. See complete list on page 1.5.2.

Note! ☛

```
Language     13:16
Sw No De Ge Ja
Uk Us It Fr Sp
1:Change
```

1 ENT

Note-Language
The special texts used in instruments with non-English display texts usually demand the corresponding language setting.

Test Measurements

MNU

5

TEST

When the instrument arrives at your office, certain horizontal and vertical collimation and horizontal axis error correction factors have been stored in the instrument. These correction factors allow you to measure as accurately in one face as you can in two faces. The instrument corrects all horizontal and vertical angles that are measured in one face only.

The test procedure can be described as follows:

The displayed values are used to correct your angles. If these stored values are no longer relevant your angles will not be correct when doing a one-face measurement. If you wish to measure in one face only and achieve maximum accuracy you need to carry out a new test measurement. Thereafter any remaining differences which are indicated by dH and dV are errors caused by bad pointing.

If any further use is to be made of the stored collimation and horizontal axis tilt correction factors, other than for correction, they could be used as a basis to build up a statistical picture of the instrument's stability. See the list for "Test Notes" in the Geodimeter System 400/500 Short Form Instruction.

Collimation and horizontal axis tilt correction factors in excess of 0.02gon cannot be stored in your Geodimeter, as the instrument will refuse to accept them during the test procedure.

If the measured collimation and tilt of the horizontal axis correction factors prove to greater than 0.02gon, then the instrument must be mechanically adjusted at the nearest Geodimeter service shop.

Note! ☛ Test measurements should be carried out regurarely, particulary when measuring during high temperature variations and where high accuracy in C1 is required.

Measurement of Collimation & Tilt of Horizontal Axis

MNU
5
TEST

Set up the instrument in the normal way according to the start procedure instructions described in chapter 3 "Station Establishment".

```
STD   P0  10:16
HA:    123.4567
VA:     99.9875
```

You are now in the STD measurement mode. To begin the test procedure, press MNU 5.

MNU 5

```
Test       10:16
1 Measure
2 View current
```

Here you can measure new and/or view old values. In this example we shall display the old ones first. Press 2.

2

```
Test       10:17
HA Col:   0.0059
VA Col:   0.0014
Tilt Ax:  0.0184
```

These are the values which are to be updated. To measure your new values, press ENT.

Note! ☞ Minimum test distance = 100m

Note - Minimum test distance !
It is important that the test measurements are carried out over a distance greater than 100m to achieve a correct test result.

ENT

```
STD   P0  10:17
HA:    123.4567
VA:     99.9875
```

To return to option 1, Measure, to start collimation and horizontal axis measurements, press MNU 51.

See next page

Test Procedure (cont.)

MNU
5
TEST

MNU
5 1

```
Test          10:16
Collimation

Face II: 0
```

Rotate the instrument to C2 and aim accurately at the point both horizontally and vertically.*

Note!
Only Servo-driven Instruments

1

**For rotation to C2 position with servo-driven instruments, wait for a beep.*

C2:I — *Press* ● *in front*

To measure and record angles, press the A/M key in front. A beep is heard…

C2:II — *Press* ● *in front*

Make at least two sightings to the point, approaching from different directions , and then press A/M in front.….

Note!

Note!
The rule when measuring angles in this mode is that the same number of sightings must be made in both C2 and C1.

*Rotate the instrument to C1 position** and aim at the point.*

Note!
Only Servo-driven Instruments

Press ● *in front*

*** Rotate the instrument to C1 position by depressing the A/M key in front for approx. 2 sec.*

See next page

Test Procedure (cont.)

MNU

5

TEST

```
Test       10:18
Collimation
Face II: 2
Face I : 0
```

Aim accurately at the point both horizontally and vertically, press A/M.

C1:I — A/M

```
Test       10:18
Collimation
Face II: 2
Face I : 1
```

Make the second aiming, press A/M.

C1:II — A/M

The second C1 angle measurement and indication of completion are very quickly shown in the display.

```
Test       10:19
HA Col: -0.0075
VA Col:  0.0017
Store?
```

The display shows correction factors. Answer Yes or No to the question Store?………

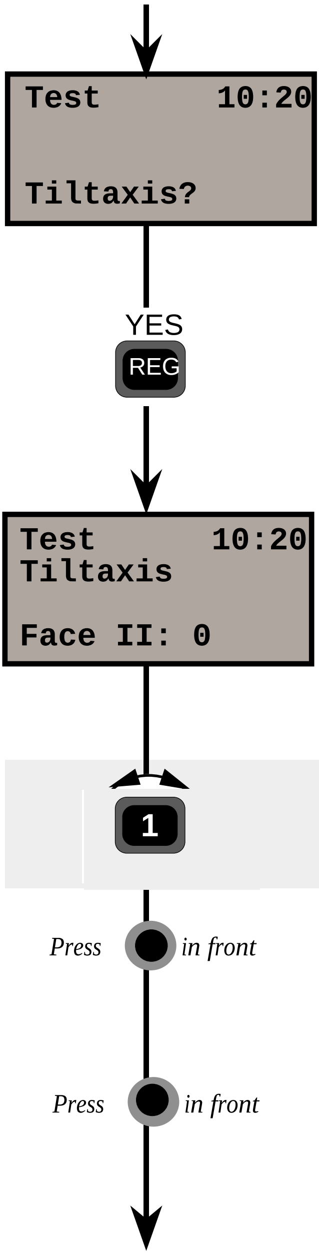
Note! ☛ — YES REG

Note!
If you are not to sure about the accuracy of the displayed values, due to sighting errors for instance, you should answer No to the question Store? and repeat the measurements.

See next page

Test Procedure (cont) Tilt of horizontal axis

TEST



If you answered Yes, the question for measurement of the tilt of the horiz. axis appears. Press Yes.

Note!
If you consider it unnecessary to measure the tilt of the horizontal axis, you can avoid this by answering No to the question.

Rotate the instrument to C2; aim at a point which is at least 15gon above or below the horiz. plane.*
Press A/M in front after each sighting.
(Make two sightings for each point.)

Note! ☛
Only Servo-driven Instruments

**For rotation to C2 position with servo-driven instruments, wait for a beep.*

C2:I

Press the A/M key in front. A beep is heard…

C2:II

Make at least two sightings to the point, approaching from different directions , and then press A/M in front…..

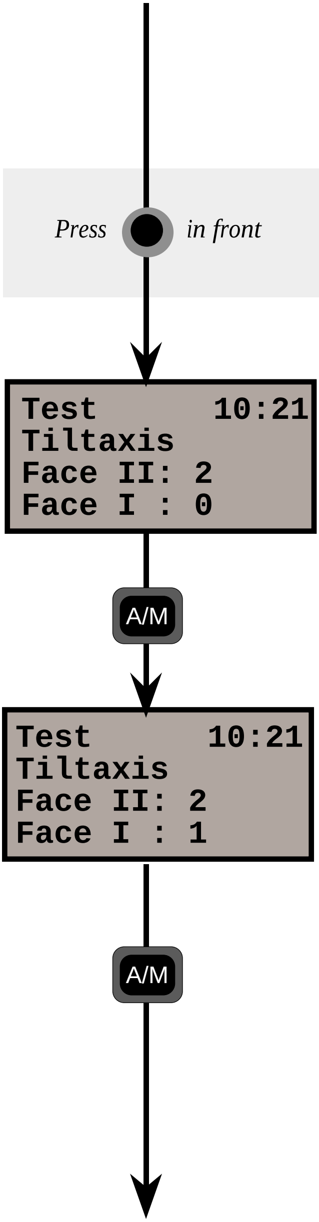
See next page

Note!
The rule when measuring angles in this mode is that the same number of sightings must be made in both C2 and C1.

TEST

Note! ☛
Only Servo-driven Instruments

Test Procedure (cont.)



*Rotate the instrument to C1 position** and aim at the point.*

*** Rotate the instrument to C1 position by pressing the A/M key in front for approx. 2 sec.*

Aim at the point, press A/M.

Make the second aiming, press A/M.

The second C1 angle measurement and indication of completion are very quickly shown in the display.

See next page

MNU

5

TEST

Test Procedure (cont.)

```
Test        10:22
Tiltax: 0.0150

Store?
```

If satisfactory, press Yes.

Note!

Note!
If the horizontal axis tilt correction factor is greater than 0.02gon, a "Fail Remeasure?" message will be shown on the display. This question must be answered by Yes and the measurement procedure repeated. If the factor is greater than 0.02gon and you do not answer Yes to the remeasurement question, the instrument will retain and use the last measured correction factor which is presently stored in the instrument. However, if the factor proves to be greater than 0.02gon, then the instrument must be mechanically adjusted at the nearest authorized Geodimeter service shop.

YES

REG

```
STD    P0   10:23
HA:     123.4567
VA:      99.9875
```

After answering Yes to storage of the horizontal axis tilt correction factor, you are automatically returned to the P0 start procedure.

Station Establishment

Illustrations

Start Procedure

The start procedure for Geodimeter instruments can be divided into two different parts:
Measurement settings which can be decided and executed in advance. These settings have already been dealt with in chapter 2 "Pre-Measurement", section "Pre Settings".
In this section, we will deal with calibration of the dual-axis compensator, setting of PPM, offset, HAref and station data (coord).

Field Setup

Slide the battery into position along the housing of the track-light, (see fig 3.1), or attach the external battery on the tripod and connect the battery cable.

System 400

System 500

Fig. 3.1 Connecting the internal battery

Note! ☞ Setting up

It is assumed that the operator is familiar with optical theodolites. Setting up, centering with the optical plummet and levelling with the plate level are not described.

Note! ☞ Counterweight

The Internal battery is used as a counterweight and should always be connected even if you use the external battery.

Startup

- ❑ Switch on the Geodimeter and place the display of the instrument parallel to two of the foot screws on the tribrach.

- ❑ Level the instrument by first rotating the foot screws in the normal theodolite levelling manner – i.e, equal and opposite to each other.

  Rule: The lower bubble will follow the direction of the left thumb.

- ❑ When the cursor is in the correct position you adjust the upper bubble with the third foot screw, without rotating the instrument. Clockwise rotation of this screw will move the cursor to the right. Levelling must be within 10^c(approx 6'), otherwise a warning signal will be given after attempting to calibrate the compensator. The electronic level at this stage is in the "coarse mode". "Fine mode" is achieved after calibration of the dual-axis compensator (see fig 3.2).
  At intervals during measurement you can view the electronic levelling bubble whenever you wish, simply by pressing the level symbol key. See more about the electronic level key on page 1.1.17.

Electronic Level Key

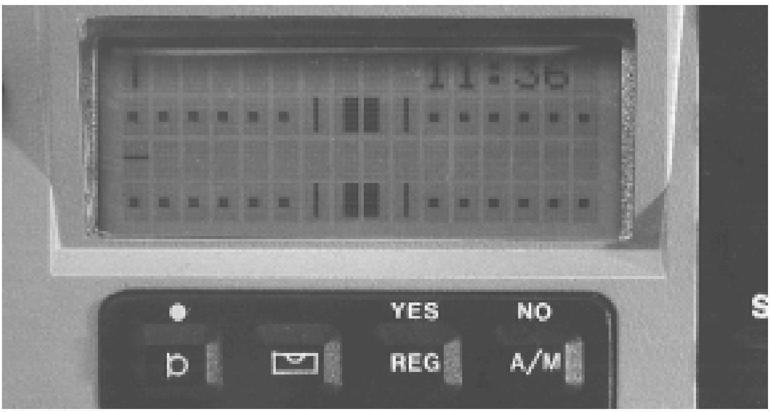


Fig 3.2 Display when level appears thus "Fine mode"

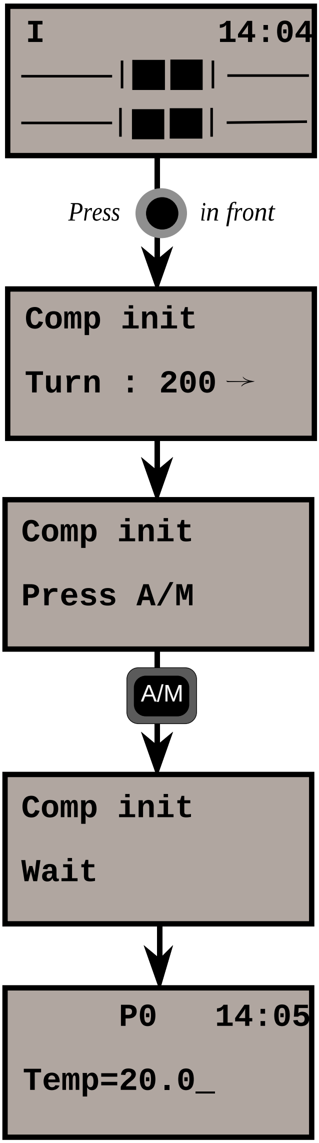
Calibration of the dual-axis compensator

This should be done to gain highest accuracy.

Note! ☛

Note!

For calibration of servo-driven instruments, see next page.



The instrument is levelled.
Start compensator calibration by turning the display 200g (180°) away from you .

A beep is heard.
Wait for a double beep after approx 6-8 sec and the display will change to.....

Turn the instrument back 200 gon(180°) and the display will automatically change to.....

.....when the instrument is within 1 gon of a 200 gon rotation.

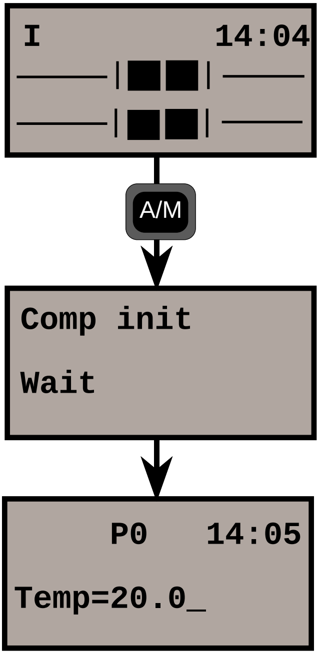
A beep is heard and and the display will change to.....

Wait for a double beep after approx. 6-8 sec.
The display will automatically change to....

.....program 0. The apperance of PO indicates that the instrument is sufficiently well levelled and that the compensator is now engaged. It also means that the electronic level is in the "fine mode" in which each individual left or right movement of the cursor represents 20 ^{cc}

Calibration of the dual-axis compensator (Servo).

Calibration of the dual-axis compensator in servo-driven instruments:



The instrument is levelled.
Start compensator calibration by pressing the A/M-key.

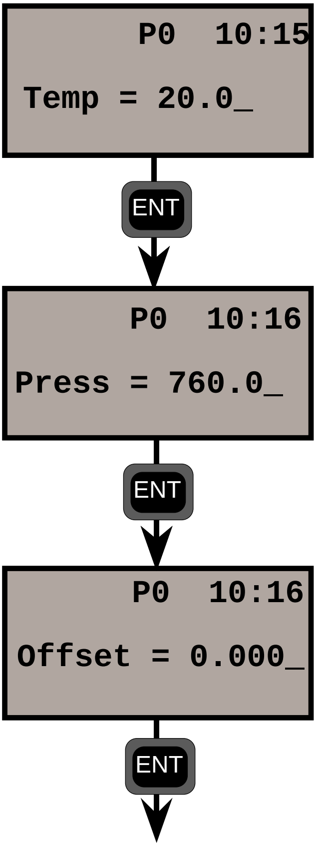
A beep is heard and the display will change to.....

A double beep is heard after approx. 6-8 sec. The instrument then automatically turns 200 gon (180°) away from you
After a few seconds the instrument turns back and the display will change to.....

.....program 0. The apperance of PO indicates that the instrument is sufficiently well levelled and that the compensator is now engaged. It also means that the electronic level is in the "fine mode" in which each individual left or right movement of the cursor represents 20 ^{cc}.

Pre-setting of Temp., Press., Offset & HAref

The pre-setting of these distance correction and angle orientation values can be entered in program 0, see below. The PPM factor can also be changed or up-dated with the help of the SET 1 routine in which the instrument itself will calculate the atmospheric correction factor, after you have keyed in the new temperature and pressure values. PPM, Offset and HAref angle can also be changed with the functions F30, F20 and F21 respectively. You are therefore never forced into a situation where you must accept the displayed or keyed-in values. These can be changed at any time.



After calibration of the compensator the display will automatically change to program 0. This was the last temp. value keyed into the instrument. Accept or key in a new value.

Accept or key in a new value for pressure.

Key in distance correction offset or accept zero value (Default value=0).
If you have a distance correction offset<>0 this will be indicated in the display with a "!" sign in the time indicator, e.g. 12!00.
See also prism constant, page 2.2.8.

See next page

(cont) Pre-Setting of Temp, Pressure, Offset and HAref.

From previous page

```
       P0  10:16

HA:     123.4567
HA ref = _
```

Key in a new HA bearing, e.g. 234.5678, zero, or accept displayed value .

```
       P0  10:16

HA:     123.4567
HAref= 234.5678
```

Aim instrument to R.O. (Reference Object) and press the ENT key.

Note!
If you use F21 to pre-set the HAref angle, the instrument must be pointing at the R.O. before pressing the ENT key.

ENT

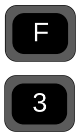
```
STD    P0  10:16
HA:     234.5678
VA:      92.5545
```

The instrument automatically assumes the standard (STD) mode and it is now orientated to your own local coord. system.

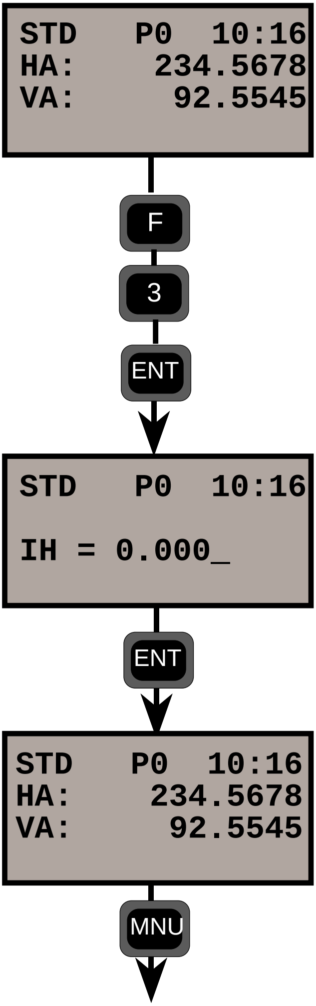
At this stage you could start to choose which measurement mode you are going to use – i.e. D-bar, Tracking and Standard (automatically selected). Let's continue by setting the station data.

Station data (Instr. Height, Signal Height, Stn. Coord.)

To work with direct and immediate calculation of point coordinates and elevations, the operator can easily and quickly key in the instrument station coordinates via the main menu, option 3, Coord, or option 1, Stn. Coord. or with F37, F38 and F 39. Instrument and signal height can be keyed in via functions F3 and F6 respectively. Let us begin this example by informing the instrument of the station data i.e. instrument height, signal height, instrument station coordinates and in that order.



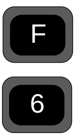
Instrument Height



To inform instrument of the instrument height, we will select function 3.....

The previous value is shown. Accept or key in new I.H.

You are now returned to the standard (STD) mode. Repeat the above instructions with function 6 (F6) to key in the signal height (SH).
After keying in IH (F3) and SH (F6), choose the menu function to access the "3 Coord" option.



Signal Height

See next page

(cont.) Station Data

From previous page

```
MNU          10:16
1 Set
2 Editor
3 Coord
```

Choose option No. 3 Coord.....

3

```
Coord        10:16
1 Stn Coord.
2 Setout Coord.
```

Choose option No 1. Stn. Coord.....

Note ! ☛
Keying in of SetOut Coords will be explained on page 1.4.27

1

```
Coord        10:16
N=0.000_
```

Zero or the previously entered Northing is displayed. Key in new station Northing, e.g., 100…

ENT

```
Coord        10:16
N=100
E=0.000_
```

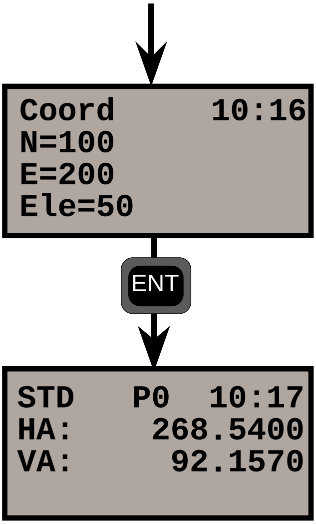
Eastings, e.g., 200….

ENT

See next page

(cont.) Station data

From previous page



Elevation, e.g., 50.....

The Station data have now been keyed in. You are returned to the STD P0 position.

At this point you have keyed in all the information which is needed to commence the survey work. And since you have now keyed in the instrument station data including the pre-calculated bearing (HAref) you will be able to see, if required, the northings, eastings and elevations of measured points on the instrument´s display directly in the field.

Station Establishment - P20

PRG
20

In general

Station Establishment (P20) is a basic software package for all Geodimeter field calculation programs. This program is used to calculate and store instrument setup data upon which certain field calculations will later be based. The programs that follow P20 today are UDS, SetOut, RoadLine and RefLine (see Fig. 3.5). If you try to activate any of these programs without first establishing your station, you are taken directly to P20.

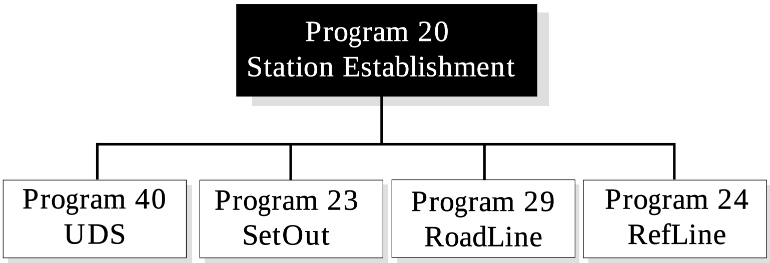


Fig. 3.5. Station establishment is included in the above programs

Program 20 Station Establishment

The program is divided into two main functions:

1. Known station — for station establishment when the coordinates for your station points and reference-object are known.

2. Free station — for free station establishment using 2-10 points whose coordinates are known.

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1. Known Station

When establishing a station at a known point, you need give only the point numbers for your station points and reference objects. The instrument will then calculate bearing and distance automatically. Before station establishment can take place therefore, the coordinates and point numbers must be stored in an Area file — either in the internal memory or external memory Geodat — using P43 (Enter Coordinates). These coordinates are then shown automatically in P20 when you retrieve the correct Area file and Pno.

You can also transfer coordinates between Geodat and Imem using P54 (File Transfer) or, in some models, directly from a computer.

When running Known Station in P20, you decide whether or not elevations are to be used in other calculation programs. Here you also indicate in what Job file station data and possibly other data to be calculated later will be stored, and in what Area file the coordinates are stored. The following data are stored in the selected Job file with Known Station establishment:

Job file
Stn.
Stn. coord.
RefObj.
RefObj. coord.
HAref
HD
IH

2. Free Station

You choose free station establishment when the station point is unknown — that is, N, E and possibly ELE will have to be calculated. This function allows free establishment in which several different combinations of objects, angles and distances can be used. The calculation is a combination of resectioning and triangulation. If you make several measurements, you obtain not only the mean value but also the standard deviation (S_dev). The calculation is done according to the least square adjustment method. If good results are to be obtained using this method, it is

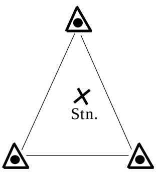
important that the traverses and networks are of high quality. For this reason we have provided the Free Station routine with a function called Config. (configuration). This allows you to use factors such as the scale factor (stored under label = 43), weight factors to weight your points with regard to the distance from your free station to the known point (used mainly in Germany), and also to create a point list in which all measured data for each individual measured point can be made available for editing and possible recalculation. In the example on page 1.3.22 we have chosen not to use Config. but to treat it separately on page 1.3.31.

Free station establishment can be done with a large number of different combinations of points, angles, and distances (see Fig. 3.6)

With station establishment using 3-10 known points, the following combinations are possible:

N.B. ☞

If only 3 angles are used, try to establish within the "triangle" in order to avoid the "dangerous circle".



1. Angles and distances
2. Only angles. But note that three points alone will not provide enough data to be able to calculate an optimal solution — that is, they will not give a standard deviation.

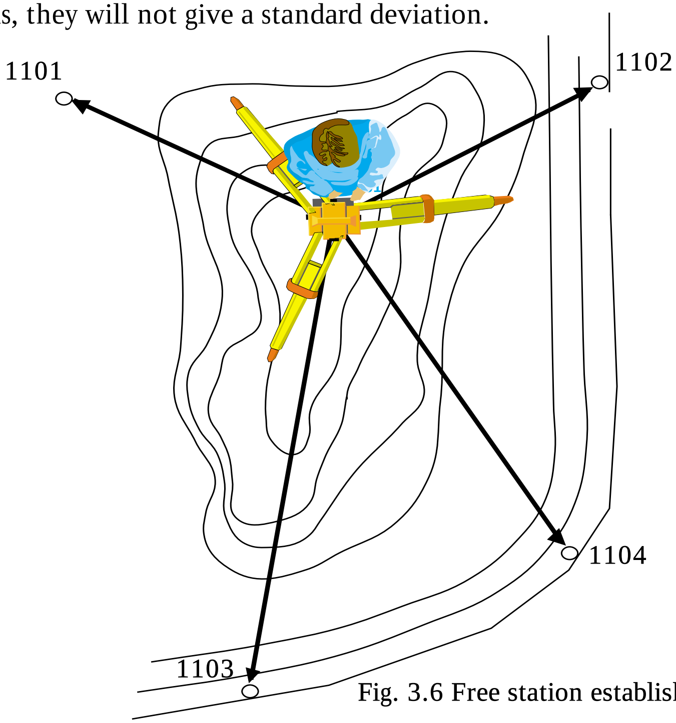


Fig. 3.6 Free station establishment

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In free station establishment with two known points, the following is valid:

1. Angles and distances.

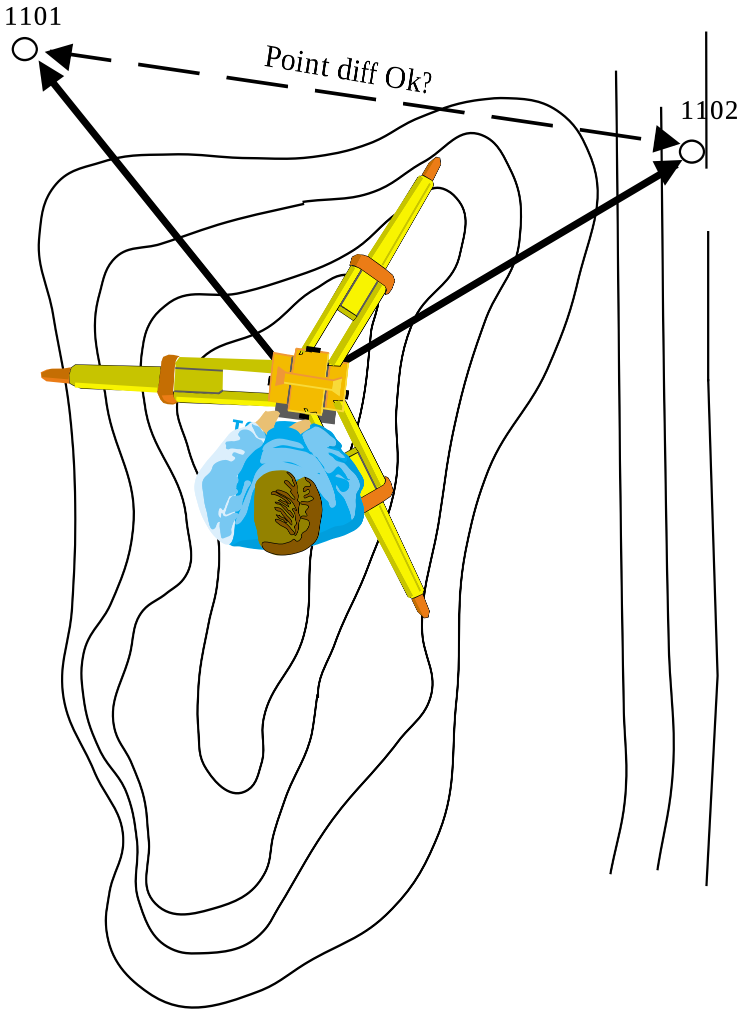
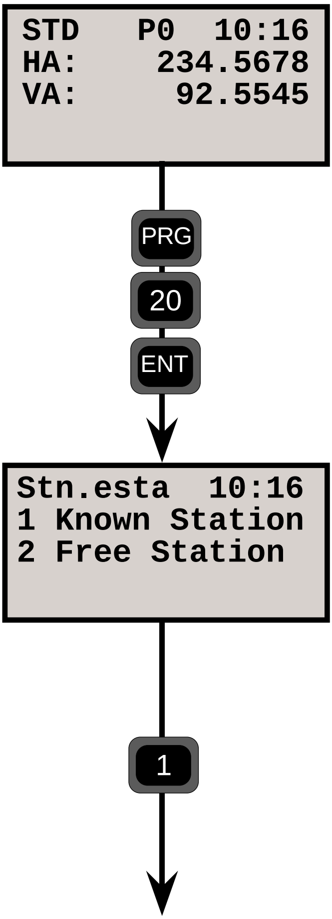


Fig. 3.7. Free station establishment with 2 known points

How to use P 20 - Station Establishment

The practical examples that follow deal with two kinds of station establishment: Known Station and Free Station. It is assumed that you are familiar with the operation of your Geodimeter. Switch on the instrument and go step by step through program 0 until you are in theodolite mode — i.e. HA and VA are shown in the display.



The instrument is now in theodolite mode. Select P20 (Station Establishment).

In this first example we will establish the instrument at a known station with a known reference object. These are stored as Pno and coordinates in an Area file, using P43 (Enter Coordinates). Pno 1101 is our station point and Pno 1102 is our reference object, as in the example on page 1.3.16.
Now we will select function 1, Known Station.

N.B. ☛
An example of free station establishment is found on page 1.3.21.

See next page.

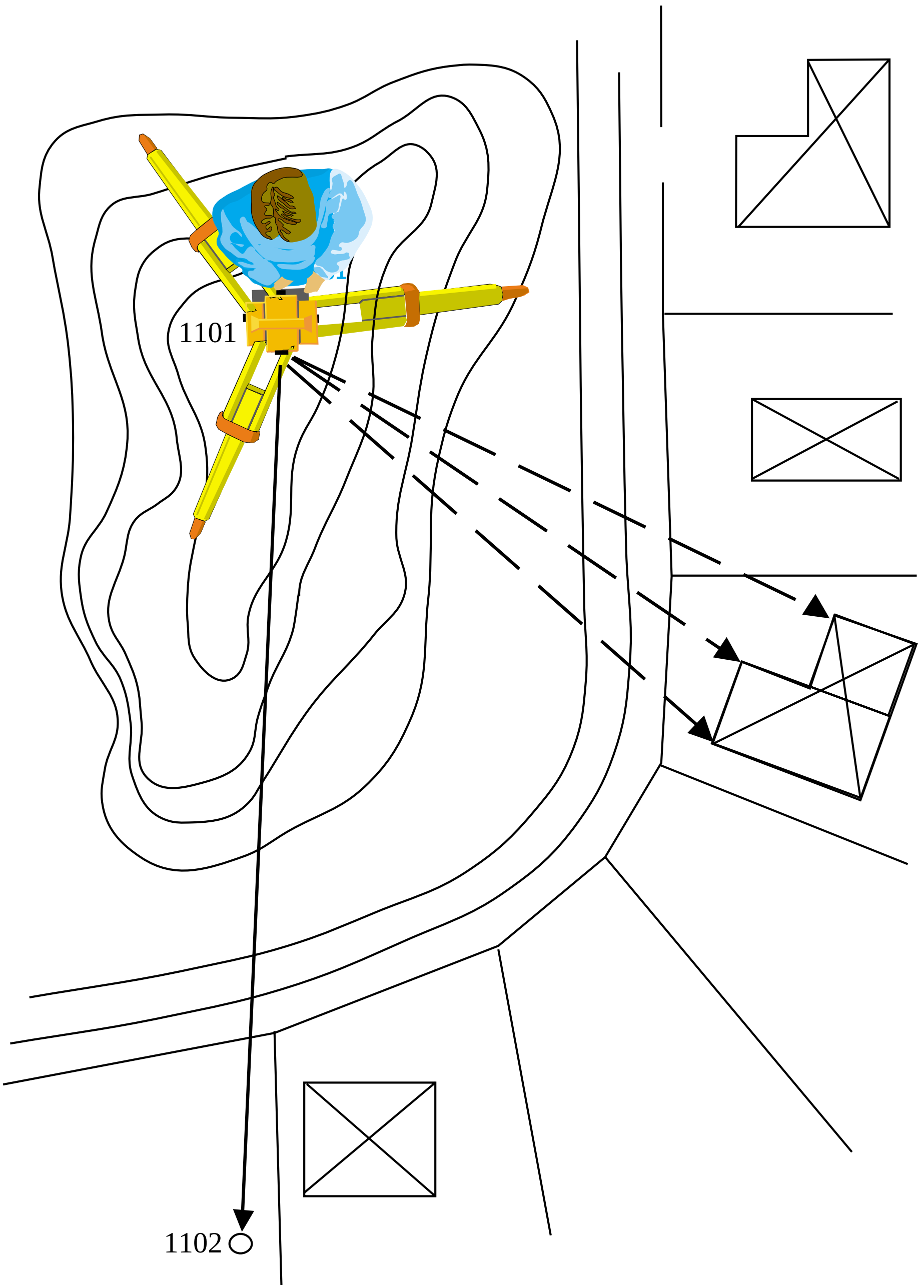
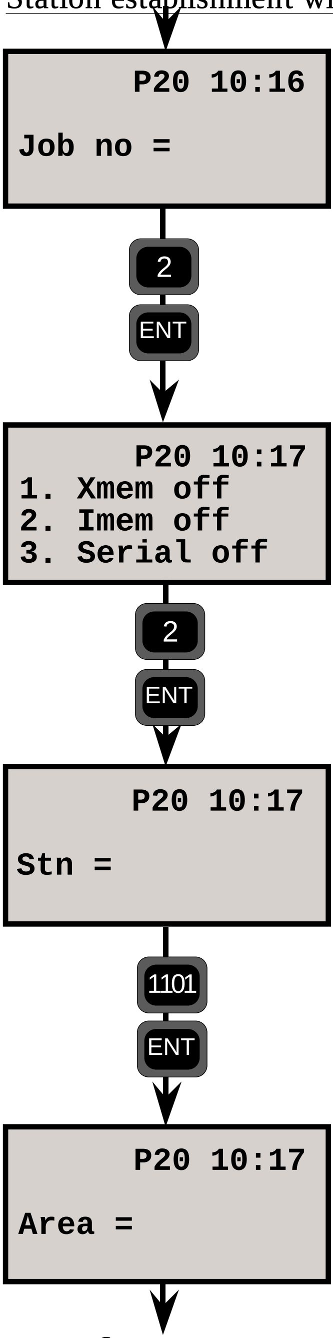


Fig 3.8. Station establishment with a known station

Known Stn.

Station establishment with a known station



Here you key in the number or name of the Job file in which you wish to store data for your station establishment. A list of data stored in the selected Job file can be seen on page 1.3.12. Select, for example, Job no = 2.

Where will you store your Job file? Choose a suitable memory unit by indicating 1, 2 or 3 for activation/deactivation. Then press ENT. Here we have chosen to work with the internal memory.

Key in your station number.

Key in the name of the Area file in which you have stored your station point and your reference object.
If you leave the line blank you are able to enter the coordinates manually.

See next page.

PRG

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Known Stn.

From previous page

1 ENT

```
Sel device10:17
1 Xmem
2 Imem
```

In which memory unit is your Area file stored? In our example, use the internal memory (Imem).

2

From previous page

Enter the coordinates manually

Note ! ☞
Enter the coordinates manually

```
Coord      10:17
N=xxxx
E=xxxx
ELE=xx
```

Enter your station coordinates. Leave the ELE blank for no height establishment.

ENT

```
Stn ok ?
N=xxxx
E=xxxx
ELE=xx
```

Are your coordinates correct? Press Yes (ENT) to accept them. If you press No you will return to the question about Stn= and Area=. If the coordinates have to be changed, use Edit or P43 (Enter Coordinates). In this example we will continue by accepting them.

ENT

Note ! ☞
Only shown if your coordinates includes ELE.

```
HT measure ?
```

Are you going to measure heights? Accept this question by pressing ENT (Yes). If you decide not to measure heights (press No) it means that the instrument height (IH) and signal height (SH) will be ignored.
In this example, we will be measuring heights. Press ENT.

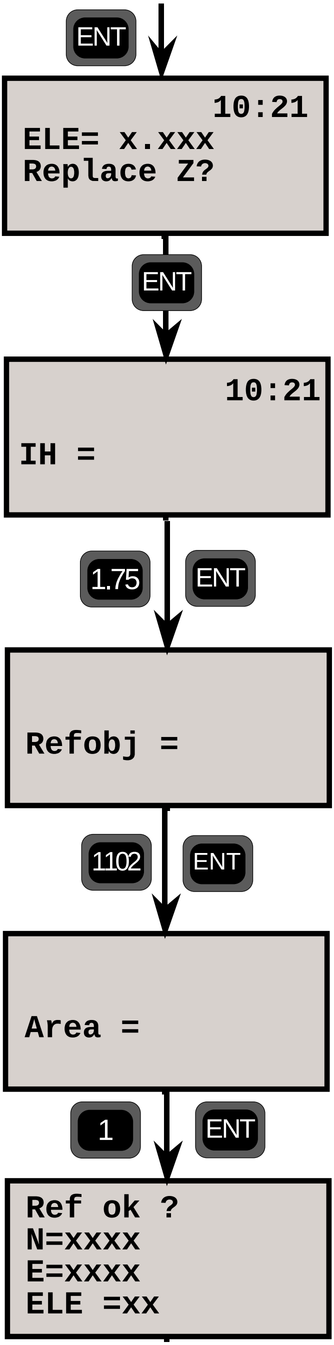
See next page

PRG
20
Known Stn.

Note ! ☛ *Only shown if your coordinates includes ELE.*

Note ! ☛ *Only shown if your coordinates includes ELE.*

From previous page.



This is your old station ground elevation. Press ENT /Yes) if you want to replace the old elevation with the new or press NO to keep it. In this example we press ENT. (This display will only appear if the ground elevation has already been determined).

Enter your instrument height (IH), e.g. 1.75.

Key in the Pno of your reference object, e.g. 1102.

Key in the name of the Area file in which you have stored your reference object. If you leave the line blank you will have the opportunity to enter the coordinates manually in the same way as for the station coordinates.

Are your coordinates correct? Press ENT to accept them. If you press No you return to the question Refobj=. If they have to be changed, use Edit or P43 (Enter Coordinates). We will continue by accepting them.

PRG

20

Known Stn.

From previous page

ENT

```
Aim to refobj.
Press A/M
```

Aim at your reference object. Then press the A/M key.

A/M

```
STD   P20 10:18
HAref:xx.xxxx
HA:   xx.xxxx
REG=Exit
```

HAref is the calculated bearing between the station point and the reference point.
If you wish to check the distance to the reference object, press ENT.
Otherwise press REG to store the station establishment.

ENT

```
STD   P20 10:18
SHD: xxx.xxx
HD :
REG=Exit
```

If the reference object is marked with a reflector, you can also check the horizontal distance by pressing the A/M key.
Otherwise press REG to store the station establishment.

NO

A/M

```
STD   P20 10:19
SHD: xxx.xxx
HD : xxx.xxx
REG=Exit
```

Here you can compare the calculated distance with the actual measured distance.
Press REG to store station establishment in the Job file you have chosen (see page 1.3.12).
Note !
The REG key must always be used if you want to store the station establishment.

N.B. ☛
PRESS REG

YES

REG

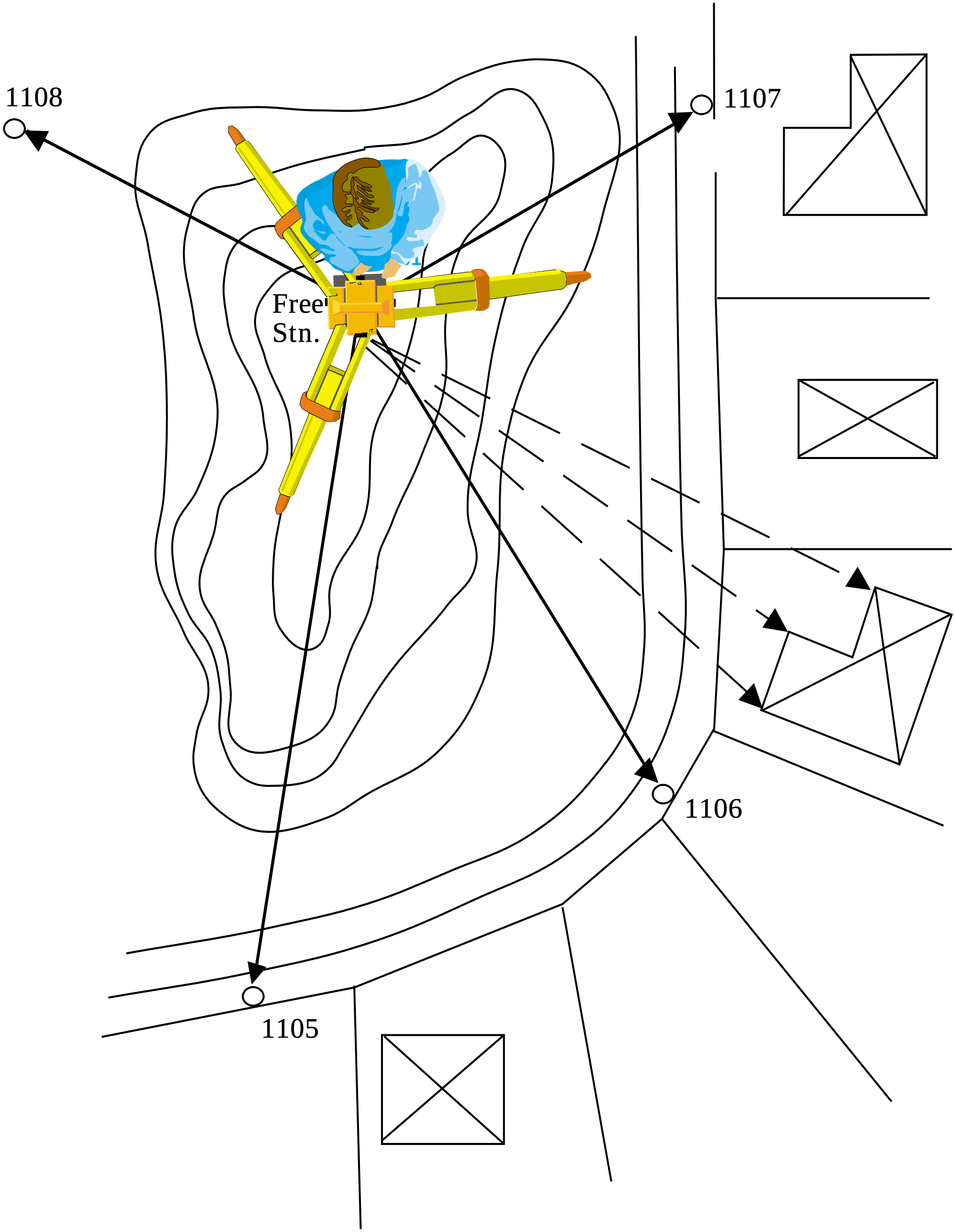


Fig 3.9. Free station establishment

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Free Station

Free station establishment

PRG 20 ENT

Select Program 20.

```
Stn. esta 10:19
1 Known Station
2 Free Station
```

In this example, we shall establish a free station. The known points we will be using have been stored as Pno's and coordinates in an Area file using P43 (Enter Coordinates). We'll choose function 2, Free Station.

2

```
      P20 10:19

Job no =
```

Here you key in the number or name of the Job file in which you wish to store data from your station establishment. A list of data stored in the selected Job file can be seen on pages 1.3.37, 38. Select, e.g. Job no = 20.

20 ENT

```
      P20 10:19
1. Xmem off
2. Imem off
3. Serial off
```

Where do you want to store your Job file? Choose a suitable memory unit by indicating 1, 2 or 3 for activation/deactivation. Then press ENT.

2 ENT

See next page.

PRG

20

Free Station

From previous page

```
      P20 10:20

Stn =
```

Here you choose a name/number for your free station. You decide this yourself.

ENT

```
Free stat.10:20
1. Free Station
2. Config.
```

Here you may choose to continue with your free station, or select point 2. Config. (Configuration) is used to activate functions like scale factor, point list and weight factor. Weight factor is used when your network is of poor quality, or when legislation and regulations require it. All of the parameters in the following examples are set thus:
Scale factor = Off
point list = Off
Weight factor = 1 = On
Config. is explained in greater detail on page. 1.3.31.

N.B. ☛
2. Config, will be explained on page 1.3.31.

1

ENT

```
      P20 10:20

HT Measure?
```

Do you wish to measure heights? Accept this question by pressing ENT (Yes). If you decide not to measure heights (press No) it means that the instrument height (IH) and signal height (SH) will be ignored. In this example, we will be measuring heights. Press ENT.

ENT

See next page.

PRG

20

Free Station

From previous page.

```
      P20 10:20

IH=0.0000
```

Enter your instrument height (IH). For example 1.75

1.75

ENT

```
      P20 10:20

Area =
```

Key in the name of the Area file in which you have stored your known Pno and coordinates. Then press ENT.

ENT

```
Sel device10:20
1. Xmem
2. Imem
```

In which memory unit is your Area file stored? In our example, we use the internal memory (Imem).

N.B. ☞
Info 32

2

Note !
If you get Info 32 when selecting a memory unit, it may be due to one of the following:
1. You have chosen the wrong memory unit.
2. The Area file you are looking for is not located in the memory you have selected.
3. The Stn (Pno) which you are looking for is not stored in the Area file you have selected.
The program will thus return to the question "Area =" so that you can enter another Area file number or point number.

See next page.

PRG

20

Free Station

From previous page.

```
                10:21

Pno =
```

Enter the first point number you wish to aim at. Then press ENT.

ENT

```
Pno ok?
N = xxxxx.xxx
E = xxxxx.xxx
ELE = xxx.xx
```

Are your coordinates correct? Press Yes (ENT) to accept them. If they have to be changed, use Edit or P43 (Enter Coordinates). We will continue by accepting them.

ENT

```
                10:21

SH = 0.0000
```

Enter the signal height (SH).
For example 1.1 and press Enter.

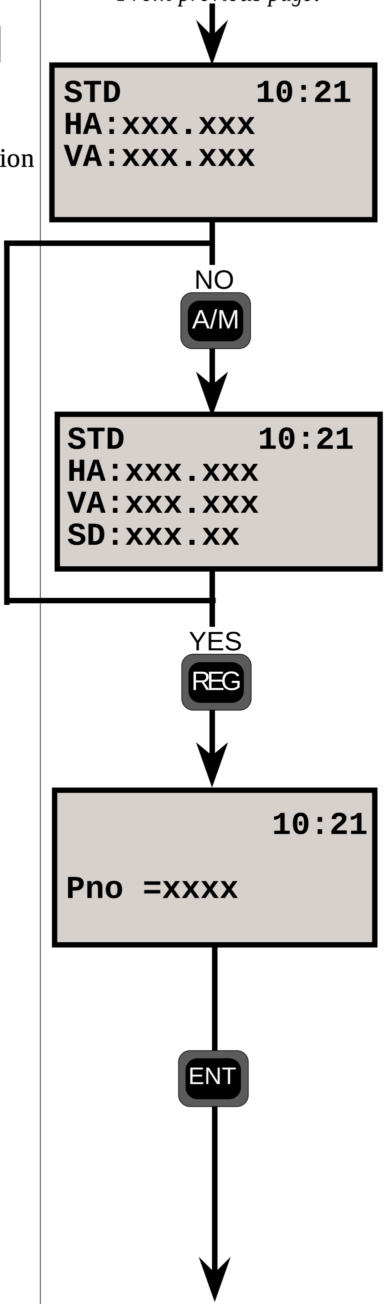
1.1

ENT

See next page

PRG 20
Free Station

From previous page.



The instrument is now in theodolite mode and is ready to measure. Aim it at the chosen target. Press the A/M key if distance is to be measured, otherwise REG.

N.B. ☛

Note !
Distance measurement must be carried out when measuring heights.

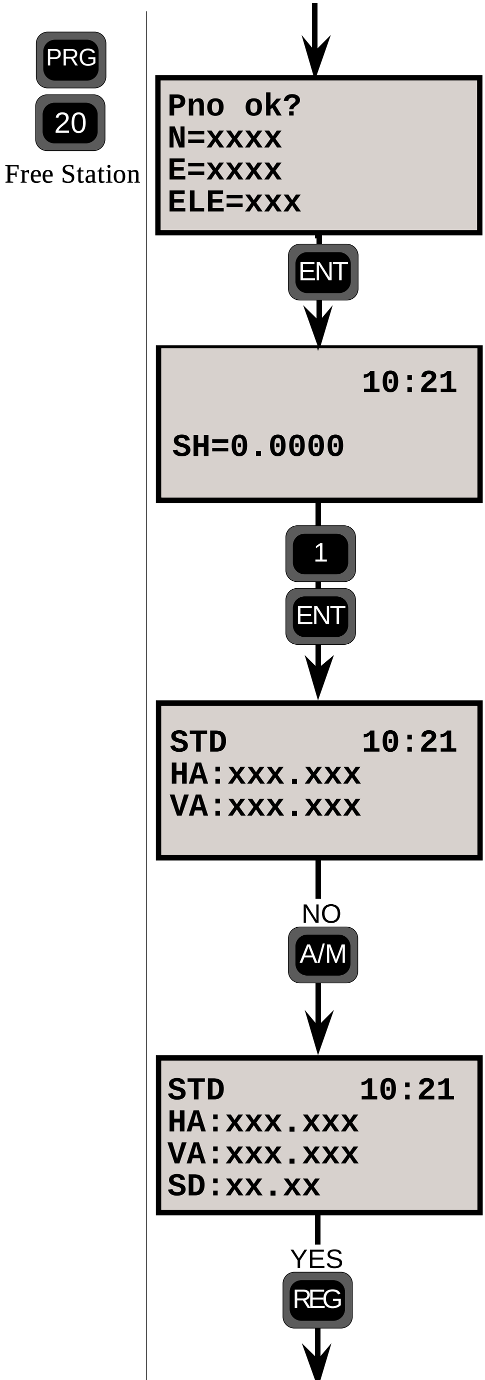
The instrument displays HA, VA and SD for your first point. Your measurement can now be registered. Press the REG key.

Enter the next Pno to be used in your free station (the display here shows the most recently used Pno). Then press ENT.

N.B. ☛

Note !
The points selected for your station establishment can be measured in any order you wish.

See next page.



Are your coordinates correct? Press Yes or No. If they have to be changed, use Edit (MNU 2) or P43. In this case, we'll answer Yes.

Enter the signal height (SH). In this case 1 and press ENT.

Aim at your chosen target. Then press the A/M key.

The instrument has now measured angles and distance to the second point of your free station establishment. Your measured data can now be registered.

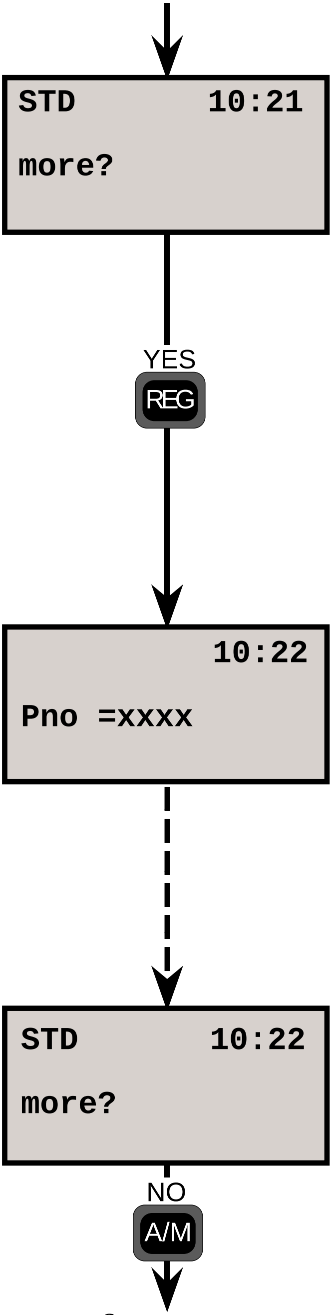
See next page.

PRG

20

Free Station

From previous page.



Are you going to use more known points for your station establishment, or are you satisfied with only two? Note the following. If complete measurements have been carried out — that is, angles and distances — two points will suffice. If, on the other hand, only angles have been measured, at least three points are needed. This is not an optimal solution, and the display warns you with the message ”Not Optimized”. In our example we shall continue to measure and register two more points (maximum number = 10). Press Yes.

Key in the third point to be used, and repeat the procedure described above. In this example, we have measured and stored a total of four points whose coordinates are known for our free station.
Assuming that these have been measured and registered, let us continue directly to the question ”more?” after storing the last point.

All points to be used for our free station establishment are now stored. Answer ”more?” with No. The program immediately calculates your free station coordinates.

See next page.

PRG

20

Free Station

From previous page.

```
STD          10:22
N: xxxxx.xxx
E: xxxxx.xxx
S_dev: x.xxx
```

These are your new station coordinates plus any standard deviation there may be. To see the standard deviation in N and E plus the scale factor used, switch the display by pressing the ENT key.

ENT

```
STD          10:22
S_devX:xxx.xxx
S_devY:xxx.xxx
SF = 1.00000
```

This is the standard deviation in N and E plus the scale factor used (scale factor = 1.0000 if it is off.) Press ENT.

ENT

```
STD          10:22

ELE = xxx.xxx
S_devZ= x.xxx
```

Here is your new station elevation, shown if you have chosen to measure heights.
Here you can also see the standard deviation based on all observations. If the standard deviation or difference in elevation (in the case of 2 points) should be too large you should perform the measurement again without storing the actual data.

N.B. ☞
Pointlist ON
see page 1.3.34.

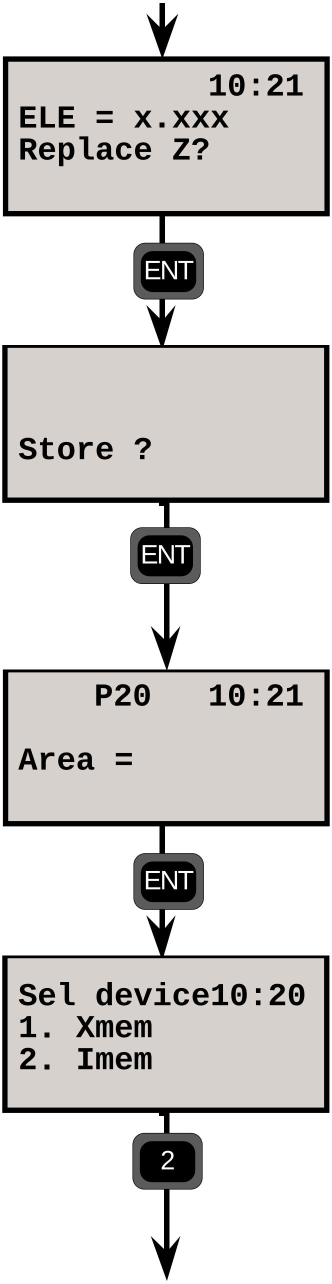
```
Free Stat 10:16
1. Pointlist
2. Recalc.
3. Exit
```

Note !
If we had activated the point list under heading 2. Config., we would at this point be able to list deviations for each point measured. It would then be possible to correct and recalculate them. For more information about the point list, see page 1.3.34.

ENT

See next page.

PRG 20 Free Station



This is your old station ground elevation. Press ENT (Yes) if you want to replace the old elevation with the new or press No to keep it. In this example we press ENT. (This display will only appear if the ground elevation has already been determined).

Now the instrument is orientated. Do you want to store the point in an Area file answer this question with ENT (Yes).

Key in the name of the Area file in which you want to store the point. Then press ENT.

In which memory unit is your Area file to be stored? In our example we use the internal memory (Imem).

N.B. ☛

Note !
See page 1.3.37 for a list of the data that can be stored in the selected Job or Area file.

See page 1.3.37

PRG

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Free Station Config.

How to use "Config."

In this example, we will describe in greater detail the routine in the free station establishment program called ”Config.”.
This option can only be accessed when starting the program with a long press on the PRG-key.

```
      P20 10:15
1 Run
2 Config
```

Press 1 to start the program or select 2 to onfigurate the program. In this example we press 2. Config.

2

```
      P20 10:15
1 Exit
2 Options
```

Press 1.Exit to return to the previous menu or press 2 Options to start the configuration. In this example we press 2.

2

```
      P20  10:15

Scalefactor  on
on=1        off=0
```

Here you are given the opportunity to activate/ deactivate a scale factor. The scale factor for free station establishment is calculated and defined based on the internal relation between your known points. The following applies for the scale factor:

- *Scale factor = 1.0000 if it is not activated (Off).*
- *If a UTM scale factor (F43) has been given, this value is multiplied by the scale factor calculated for free station establishment.*
- *The scale factor that has been used is displayed after calculation of your free station (see page 1.3.29).*

In this example, we will activate the scale factor.

1 ENT

See next page.

PRG

20

Free Station Config.

From previous page..

```
     P20  10:15

Pointlist     on
on=1       off=0
```

Here you can activate/deactivate a point list. In the list you will be able to analyse and alter any deviations for each point. The deviations are displayed as "dev" (radial deviation) and "Abs/ord" (right offset and radial offset). See Fig. 3.10 below.

Note !
For a more detailed explanation of how to work with the point list, see page 1.3.34.
.

1

ENT

See next page.

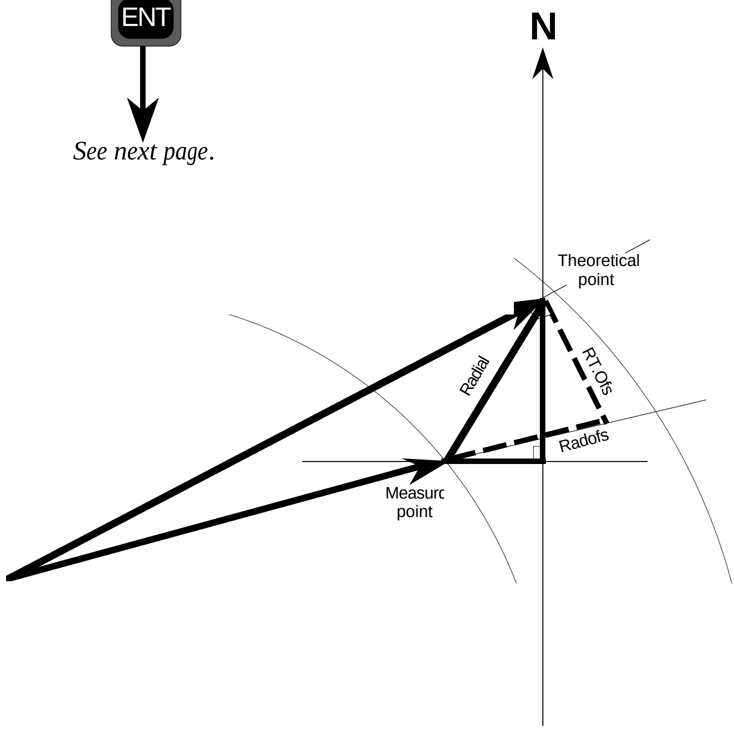


Fig. 3.10. Definition of deviations presented in the point list

PRG

20

Free Station Config.

N.B. ☛
Formulae for calculating the weight factor (for the German market).

100/S

```
     P20 10:15
Weightfactor
100/s  off
on=1    off=0
```

$1000/S^{3/2}$

```
     P20 10:15
Weightfactor
1000/s**3/2off
on=1     off=0
```

$1000/S^{2}$

```
     P20 10:15
Weightfactor
1000/s**2 off
on=1    off=0
```

From previous page.

```
      P20 10:15
Weightfactor
s/1    on
on=1      off=0
```

By using a weight factor you can give priority to your known points with reference to distance. To put it simply, points that are farther from your free station have a lower priority than the points that are closer. This function is used mostly in Germany.
Normally no weight factor is used when the network is of good quality. This means that you should choose the weight factor that is defined as s/1.
By pressing the ENT key in steps you can produce three different bases of calculation for the weight factor (see the margin, left). These are intended mainly for Germany, and are not used otherwise. Since we will not be using this function and since weight factor s/1 is the default in position ON, you need press only ENT until the display shows…

```
      P20 10:15
1 Exit
2 Options
```

Here you can choose to continue with your free station establishment, or repeat your configuration. If you wish to continue with free station establishment, press 1 and then choose 1 Run to start the program. See page 1.3.23 for instructions.

How to use the point list

PRG

20

Free Station

In this example we shall take a closer look at the point list which is obtained after you have established your free station (here we assume that the point list has been activated under ”Config.”).

```
Free Stat. 10:16
1. Pointlist
2. Recalc.
3. Exit
```

The point list allows you to look at, and deactivate, any deviations there may be for each point. The deviations are displayed as ”dev =” (radial deviation) and ”Abs/Ord” (right offset and radial offset). We'll select point 1.

1

ENT

```
Free Stat. 10:16
1. dev.
2. Abs/ord
```

Here you can look at 1 (dev = radial deviation). If there is a major radial deviation, you can make a more detailed analysis by selecting 2 (Abs/ord = right offset and radial offset).

1 / 2

1:

```
STD          10:16
Pno = 1
Diff = xxxxx
```

Here the radial error is displayed for point no. 1. For an explanation of "dev", see page 1.3.32. By pressing ENT you can check the radial errors for all points.

ENT

This is the difference in distance between your measured point and the theoretical point, along the line of measurement. A minus sign indicates that the measured point lies beyond the theoretical point. A plus sign indicates that it is ahead of that point.

See next page.

2:

```
Pno = 1
RT.ofs = XXX on
on=1        Off=0
```

This is the difference in distance — i.e. how much to the left (- value) or right (+ value) your theoretical point lies relative to your measured point (see Fig. 3.10, page 1.3.32). Select activation/ deactivation and then press ENT.

ENT

```
Pno = 1
Rad.ofs = X on
on=1        Off=0
```

See next page.

From previous page.

From previous page.

ENT

ENT

```
Pno = 1
dELE = XXX on
on=1    Off=0
```

This page is shown for all points with 2 coordinates and one measured distance. Any one of these points can be used for calculation of the station height. The displayed value is the difference between the calculated average height and the height, calculated from this point only.

ENT

```
Free Stat.10:16
1. Pointlist
2. Recalc.
3. Exit
```

After going through the point list and possibly deactivating one or more parameters of your points, you will have to recalculate using the coordinates you want for your free station establishment. Do this by selecting function 2, Recalc.

2

ENT

```
STD         10:16
N: 61732.568
E: 21806.327
S_dev: 0.002
```

These are your new station coordinates together with any standard deviation. To see the standard deviation in N and E plus the scale factor used, switch the display by pressing the ENT key.

ENT

```
STD         10:16
S_devX:
S_devY:
SF = 1.00000
```

This is the standard deviation in N and E plus the scale factor that has been used (scale factor = 1.0000 if it is Off). Press ENT.

ENT

See next page.

PRG

20

Free Station

From previous page.

```
STD          10:16
ELE = xxxx.xxx
S_devZ = x.xxx
```

Here is your new station elevation, shown if you have chosen to measure heights.
Here you can also see the standard deviation based on all observations. If the standard deviation or difference in elevation (in the case of 2 points) should be too large you should perform the measurement again without storing the actual data.

ENT

```
Free Stat.10:16
1. Pointlist
2. Recalc.
3. Exit
```

Here you select function 3, Exit.

3

ENT

```
STD          10:16
ELE= xxx.xxxx
Replace Z ?
```

This is your old station ground elevation.
Press ENT (Yes) if you want to replace the old elevation with the new or press No to keep it. In this example we press ENT.
(This display will only appear if the station ground elevation has already been determined).

ENT

```
STD          10:16

Store ?
```

N.B. ☛

Now the instrument is orientated.
Do you want to store the point in an Area file answer this question with ENT (Yes).

ENT

PRG

20

Free Station

From previous page.

```
   P0    10:16

Area =
```

Key in the name of the Area file in which you want to store the point. Then press ENT.

ENT

```
Sel device10:16
1. Xmem
2. Imem
```

In which memory unit is your Area file to be stored? In our example we are using the internal memory (Imem).

2

N.B. ☛
Data that can be stored in the selected Job or Area file.

Pointlist ON

Job file	Area file
Pno	Pno(Stn)=
SH	N=
Raw data	E=
Scale factor = 1 if OFF	S_dev=
Weight = s/1 if OFF	ELE=
dHA*	Info: S_dev_Z
S_dev	
Info: S_devZ	* dHA=correction value of the calculated bearing (orientation), which is normally a low figure.
Info=Point list	
Pno	
Used raw data	
dN	
dE	
dELE	
Stn no	
Stn coordinates	
RefObj=Blank	
RefObj coordinates=000	
HAref	
HD=0	
IH	

Here are the data that can be stored in the Job or Area file you have chosen, if you have activated the point list in the configuration routine.

PRG

20

Free Station

N.B. ☛
Data that can be stored in the selected Job or Area file.

From page 1.3.29.

Pointlist OFF

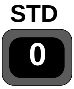
Job file	Area file
Pno	Pno(Stn)=
SH	N=
Raw data	E=
Scale factor = 1 if OFF	S_dev=
Weight = s/1 if OFF	ELE=
dHA*	Info: S_devZ=
S_dev	
Info: S_devZ	* dHA=correction value of the calculated bearing (orientation), which is normally a low figure.
Stn no	
Stn coordinates	
RefObj=Blank	
RefObj coordinates=000	
HAref	
HD=0	
IH	

Here are the data that can be stored in the Job or Area file you have chosen, if you have deactivated the point list in the configuration routine.

Carrying Out A Measurement

Illustrations

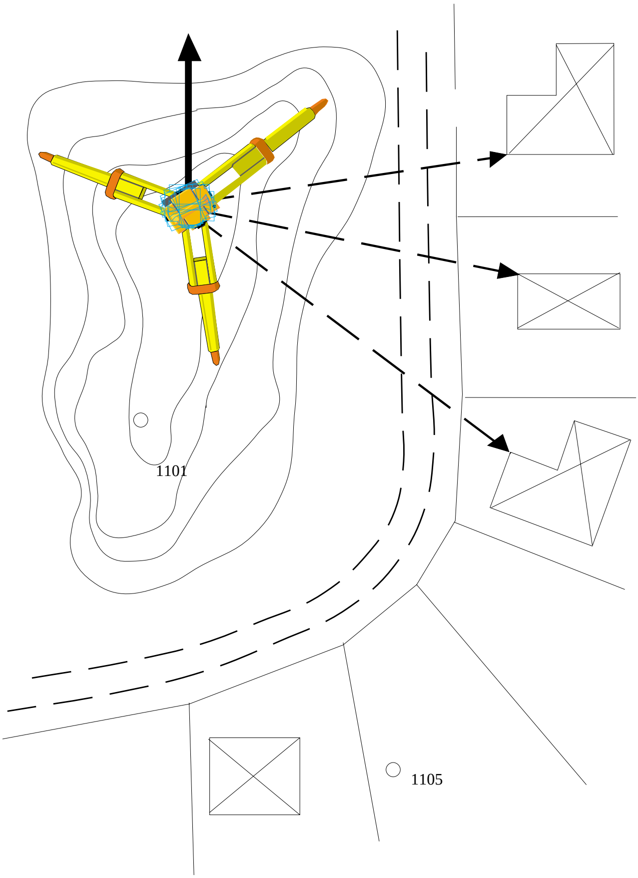
Distance & Angle Measurement

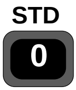


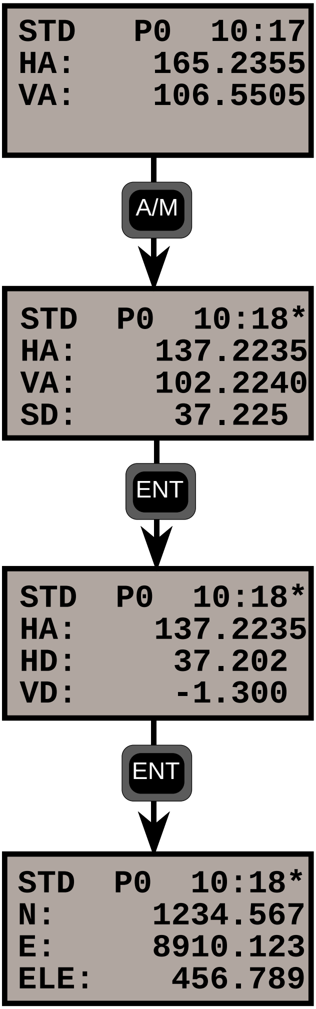
Standard measurement(STD Mode)

This measurement mode is normally used during control surveys – e.g., traversing, small tacheometric exercises, survey point accuracy control, etc.

Geodimeter System 400/500 carries out the measurement of and displays horizontal and vertical angles and slope distances (HA, VA & SD) with the possibility of also displaying horizontal distance and difference in height (HD &VD) and the northings, eastings and elevation of the point by pressing the ENT key twice.







Aim instrument at the point. A signal is heard if it is marked with a prism. To measure a distance press the A/M-key……..

Note! ☞
System 400 Long Range (<1000m or 3280ft) is adopted by pressing the A/M-key until "Long Range" is displayed.

After 4-5 sec. the slope distance (SD) is seen on the display. If you want to see the other values – i.e. horizontal distance (HD) and vertical distance (VD), press ENT….

If you wish to see the coords and elevation of the point, press ENT…..

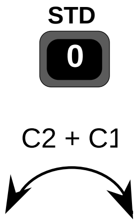
These values are directly related to the Stn. data and IH & SH. To measure to the next point, aim the instrument horizontally and vertically at the prism and repeat the above instructions.

Note! ☞
R.O.E

Note-ROE
R.O.E is automatic in the display modes HA, HD, VD & N, E, ELE when the telescope is turned vertically.

Note! ☞
Live Data

Note-Live Data
If you turn the instrument horizontally after carrying out a measurement, the values for N, E and ELE are automatically updated (within certain limits).

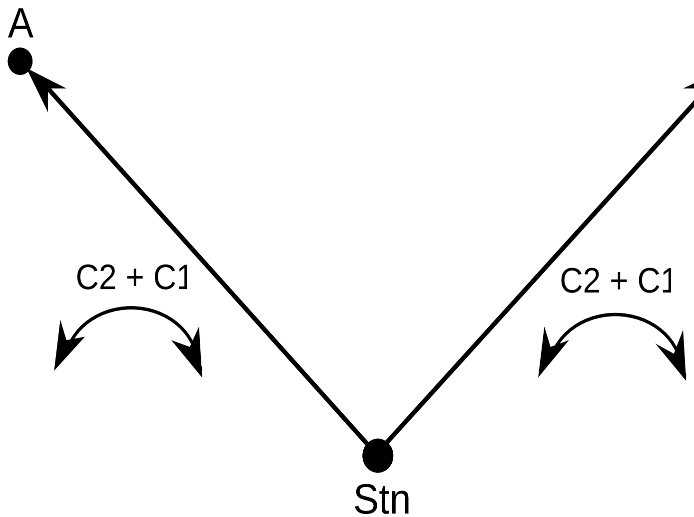


Two-face standard measurement (C1/C2)

This measurement mode is normally used during control surveys – e.g. traversing, survey point accuracy control, etc.

This mode measures and displays horizontal and vertical angles and their respective differences in C2 & C1 and slope distances with the possibility of also seeing horizontal distance, height difference and the northings and eastings by simply pressing the ENT key twice.

Two-face measurements always start in the C2 position. Distance measurement can only be carried out with the instrument in the C1 position. The asterisks (*) beside the displayed differences between C2 & C1 positions, i.e dH & dV, indicates that face 2 and face 1 differences are in excess of 100^{cc} (≈ 30"). This is a good indication that it is time to carry out the instrument collimation measurement or that the instrument has been badly aimed at the target, either in C2 or the C1 position.



STD

0

C2 + C1

```
STD    P0   10:17
HA:      154.3598
VA:      106.3707
```

Rotate the instrument to the C2 position.*

Note! ☞

Only Servo-driven Instruments

1

**For rotation to C2 position with servo-driven instruments, wait for a beep*

Press ● *in front*

To measure and record angles, press the A/M key in front. A beep is heard…
Both the horizontal and vertical angles at the time the A/M key is pressed are stored in the working memory of the instrument. When the instrument is rotated to the C1 position both these stored values can be seen, if required,simply by pressing the ENT key to step through the display tables.

*Rotate the instrument to C1 position** by depressing the A/M key in front for approx. 2 sec. A signal is heard if the point is marked with a prism….*

Note! ☞

Only Servo-driven Instruments

Press ● *in front*

*** Rotation to C1 position is made by depressing the A/M key in front for approx. 2 sec.*

```
STD    P0   10:18*
HA:      154.3599
VA:      106.3704
dH:02        dV:02
```

The dH & dV values displayed are half the differences between the C2 & C1 angle values. These values, along with the angles and distances, can be stored in your selected memory device.
To measure distance press A/M key….

Note! ☞

System 400 Long Range (<1000m or 3280ft) is adopted by pressing the A/M-key until "Long Range" is displayed.

A/M

See next page.

STD

0

C2 + C1

From previous page!

```
STD   P0  10:18*
HA:     154.3599
VA:     106.3704
SD:      98,473
```

After 5 sec. the slope distance (SD) is seen in the display. If you want to see the other values , i.e., horizontal distance (HD) and vertical distance (VD), press ENT….

ENT

```
STD   P0  10:18
HA:     154.3599
HD:      97.981
VD:      -9.836
```

If you wish to see the coords and elev. of the point, press ENT…..

ENT

```
STD   P0  10:18
N:      -73.861
E:      64.380
ELE:     -9.836
```

These coord & elevation values are directly related to the Stn. data, IH & SH. If you want to see the HA & VA (C2) angles, press ENT….

ENT

```
STD   P0  10:18
HAII:   354.3581
VAII:   293.6284
```

One more press of ENT returns you to the STD mode and you are ready to measure to the next point.Aim the instrument horizontally and vertically at the prism and repeat the above instructions.

Note! ☛ The R.O.E feature also operates in this two face STD mesurement mode exactly the same as in the one face STD measurement mode.

$\bar{D}$

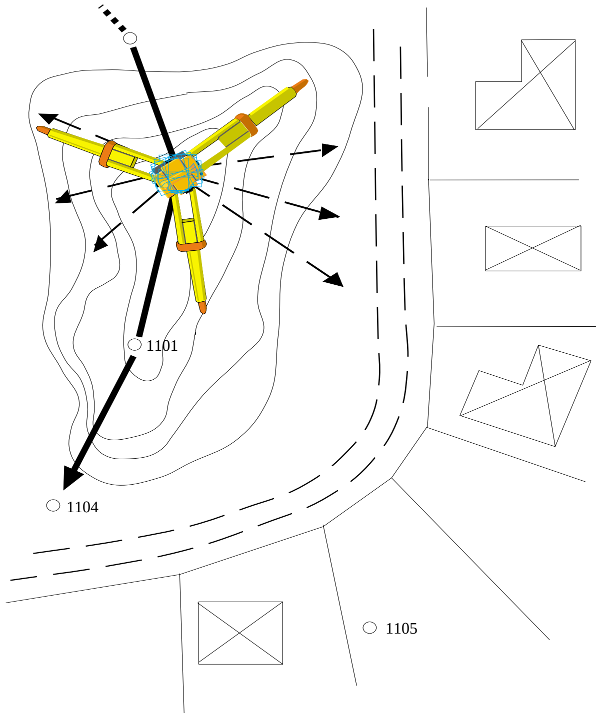
CL

D-bar measurement (D-bar Mode)

This measurement mode is similar to the one face STD mode, the major difference being that distance measurement is carried out in an automatically repeated measurement cycle. The arithmetic mean value is automatically calculated, resulting in a greater degree of accuracy.

The instrument measures and displays horizontal and vertical angles and slope distances, you can also display horizontal distance and difference in height, and the northings, eastings and elevation of the point by pressing the ENT key twice.

The R.O.E function is similar to the one face STD mode. However, there is one major difference. The instrument must be told when distance measurement is to be stopped; this is done quite simply by pressing the A/M key. After 99 measurements the operation is stopped automatically.



D̄ CL

```
STD   P0  10:18
HA:     399.9995
VA:     104.8845
```

To assume the D-bar mode, press the D-bar key.......

Note! ☞ *Note ! When using a Geodimeter 540 you will have the opportunity to choose whether to work in 1.Normal or 2.High resolution. 2. High resolution will enable you to measure horizontal angles with 5 decimals.*

D̄ CL

```
D     P0  10:19
HA:     399.9995
VA:     104.8805
```

Aim towards point in the C1 position. If marked with a prism, a signal is heard. Press A/M.....

A/M

Note! ☞ *System 400 Long Range (<1000m or 3280ft) is adopted by pressing the A/M-key until "Long Range" is displayed.*

```
D     P0  10:19*
HA:     123.9995
VA:     102.2205
SD:      33.113
```

The distance is continuously updated.
If you wish to view the calculated data of the measured point, use the ENT key to step through the different display tables, ie: to view HD & VD, press ENT.
***Note!** When measuring with Geodimeter 540 the slope distance is displayed with 4 decimals.*

ENT

```
D     P0  10:20*
HA:     123.9995
HD:      32.363
VD:      -1.155
```

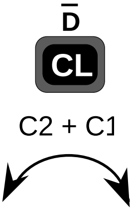
To view the N, E and ELE of the point.....

ENT

```
D     P0  10:20*
N:      5143.113
E:      2008.156
ELE:     187.554
```

If you measure to the next point with the display in this mode, N, E and ELE of the point will be displayed first.

Note! ☞ The amount of time you allow the instrument to measure and update the distance is up to you. However, under normal clear visibility conditions, the distance resolution will normally stabilize after approx. 10 - 15 sec.



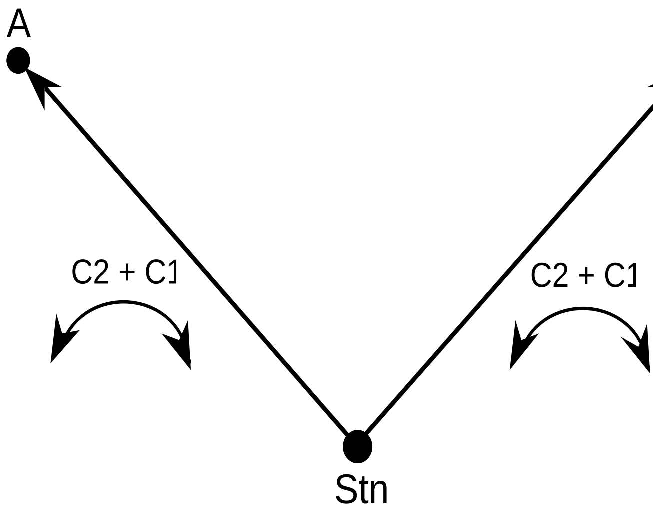
D-bar two -face measurement (C1/C2)

Note! ☛ *Automatic arithmetic mean value of both angles and distance*

This measurement mode is normally used during control surveys – e.g., traversing, survey point accuracy control etc. I.e: when you need high accuracy.

The distance measurement is carried out in a repeated measurement mode resulting in a greater degree of distance accuracy. The mean horizontal and vertical angles of all measurements made in both C2 and C1 positions are automatically calculated and presented in the display.

The instrument measures and displays mean horizontal and vertical angles as well as angular differences between both faces, and slope distance. You can also display horizontal distance, height difference and the northings, eastings and elevation of the point by pressing the ENT key twice. Collimation and horizontal axis tilt errors are fully compensated and operator error is minimized.



D̄ CL

C2 + C1

```
STD    P0   10:17
HA:      154.3605
VA:      106.3701
```

D̄ CL

To assume the D-bar mode, press the D-bar key…….

Note ! When using a Geodimeter 540 you will have the opportunity to choose whether to work in 1.Normal or 2.High resolution. 2. High resolution will enable you to measure horizontal angles with 5 decimals.

```
D      P0   10:19
HA:      154.3605
VA:      106.3701
```

Rotate the instrument to the C2 position. Wait for a beep and aim at the first point.*

Note! *Only Servo-driven Instruments*

1

**For rotation to C2 position with servo-driven instruments, wait for a beep.*

C2:I — *Press* ● *in front*

To measure and record angles, press the A/M key in front. A beep is heard… Both the horizontal and vertical angles at the time the A/M key was pressed were stored in the internal memory of the instrument.

The number of sightings is entirely up to you, the operator, and will depend mainly on the visibility conditions and the type and required accuracy of the survey work. In this example we have chosen to make two sightings in C2. Approach the point from the other direction and press A/M in front…..

C2:II — *Press* ● *in front*

After pressing A/M the second time, the mean of angular C2 values is stored in the memory of the instrument. The rule when measuring angles in this mode is that the same number of sightings must be made in both C2 and C1.

Note!

Note ! When using a Geodimeter 540 in high resolution mode the measurement in face 2 will take appr. 10 sec and you will hear a double beep when the measurement is ready.

See next page

D̄ **CL**
C2 + C1

From previous page.

*Rotate the instrument to C1 position** and aim at the point. A signal is heard if the point is marked with a prism....*

Note! ☛
Only Servo-driven Instruments

Press ● *in front*

*** Rotate the instrument to C1 position by depressing the A/M key in front for approx. 2 sec.*

C1:I

```
D      P0   10:21
HA:      154.3605
VA:      106.3701
II:2          I:1
```

Approach the point from the other direction and press A/M.

A/M

The second C1 angle measurement and indication of completion (i.e., II:2) is very quickly shown in the display..

C1:II

```
D      P0   10:22
HA:      154.3601
VA:      106.3731
dH:04       dV:09
```

However, the values now seen in the display are the final mean horizontal and vertical angle values of the mean of the angles measured in both faces.
The dH & dV values displayed are the values by which the angles have been adjusted – i.e., half the sum of the remaining horizontal and vertical collimation and pointing errors.
To measure the distance, press A/M....

A/M

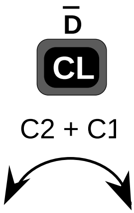
Note! ☛
System 400 Long Range (<1000m or 3280ft) is adopted by pressing the A/M-key until "Long Range" is displayed.

```
D      P0   10:21*
HA:      154.3601
VA:      106.3731
SD:        98.472
```

Distance is continually measured and up-dated while mean angular values are frozen.
To view the HD and VD to the point, press ENT....

ENT

See next page



From previous page

```
D      P0  10:21*
HA:     154.3601
HD:       97.979
VD:       -9.840
```

To view the N, E and ELE of the point.....

ENT

```
D      P0  10:21*
N:        -73.861
E:         64.378
ELE:       -9.840
```

If you measure to the next point with the display in this mode, N, E and ELE of the point will be displayed first. If you want to see the HA & VA (C2) angles press ENT....

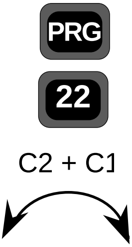
ENT

```
D      P0  10:21*
HAII:   354.3597
VAII:   293.6278
```

If you want to see the HA & VA (C1) angles press ENT....

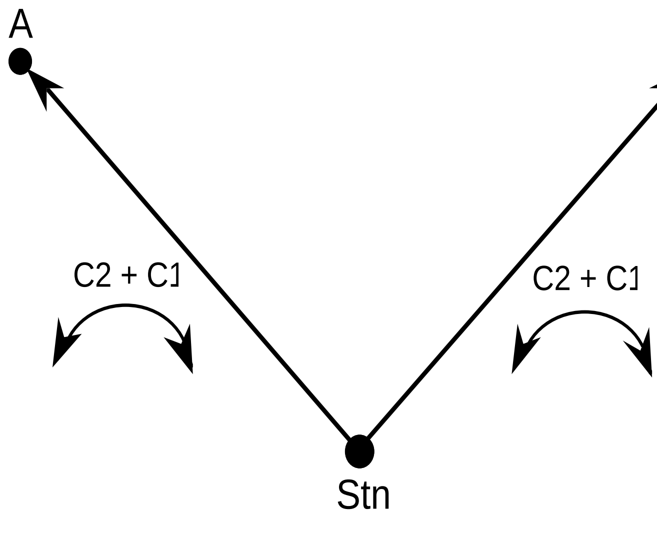
ENT

```
D      P0  10:21*
HAI:    154.3605
VAI:    106.3741
```



Two-face angle measuring with servo-driven instr.
(Program 22 only in servo-driven instruments)

When using program 22, all you need to do is to locate the targets once in C1. When all targets are located and stored in your internal or external memory, you are able to select the measuring mode in which you want to work: Standard or D-bar mode. Now the instrument's servo motors will do the rest. The instrument will rotate and point directly in C2 against the first registered target, you will then make the necessary fine adjustments and registrations by pressing the A/M-key in front. For rotation to C1, depress the A/M key for a couple of seconds.



PRG

22

C2 + C1

```
STD   P0   13.38
HA:     310.8390
VA:      98.1720
```

The Geodimeter is now in program 0 (P0). Choose program 22 - Angle Measurement.

PRG

```
STD   P22   13.38

Job no:
```

The program name "Ang. Meas." is seen very briefly in the display followed by the Job file in which you want to store your angle measurements. Key in, e.g. 16.

ENT

```
STD   P22   13.38
1: Xmem off
2: Imem off
3: Serial off
```

Here you select in which memory device you wish to store the Job file by choosing the appropriate number 1 or 2. In this example we will select No. 2: Imem….
(3 Serial is not valid for this operation).

Note! ☛
See "Data Logging" page 2.4.1

2

ENT

```
STD   P22   13.38

Stn =
```

Key in the Stn. point name / number– e.g 1000. Press ENT.

See next page

PRG

22

C2 + C1

From previous page

```
STD   P22  13.38

HT measure?
```

If heights are to be measured the next question would be IH (instrument height). In this example we will press NO, which means that instrument and signal height are not taken into account.

NO

```
STD   P22  13.39

Pcode ?
```

Here you have the opportunity to choose the a pcode. We will answer NO …

NO

```
STD   P22  13.39

Pno =
```

Key in the number of the first target at which you wish to begin your angle measurement, e.g .200 ENT…

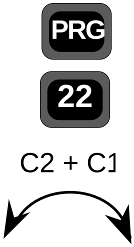
ENT

```
STD   P22  13.39

Aim to point
Press REG
```

Make a coarse aiming towards the first target, then press REG……

See next page



From previous page

```
            13.39

more ?
```

In this example we will continue to measure the distance to more targets. Press YES.....

```
STD   P22   13.39

Pno =
```

Key in the second target number – e.g., 201 ENT....

```
STD   P22   13.39

Aim to point
Press REG
```

Make a coarse aiming towards the second target, then press REG......

See next page

PRG

22

C2 + C1

From previous page

```
            13.39

more ?
```

Repeat the instructions above for your following targets. When all your targets are stored you will answer no to this question. Press NO.....

NO

```
Select mod 13.39
1 Std.
2 D bar.
```

The program gives you the opportunity to select in which measuring mode you want to work. In this example we will select No. 2= D-bar mode....

2

The instrument starts to rotate to C2 position, aiming at target No. 200.

Note ! ☛
If D-bar mode (GDM 540) is chosen you will have the opportunity to choose if you want to work in normal or high resolution mode

```
Select mod 13.39

1 Normal
2 High res.
```

The number of sightings is entirely up to you, the operator, and will depend mainly on the visibility conditions and the type and required accuracy of the survey work. In this example we have chosen to make two sightings in C2. Approach the target from the other direction using the motion screws and press A/M...

C2:I — *Press* ● *in front*

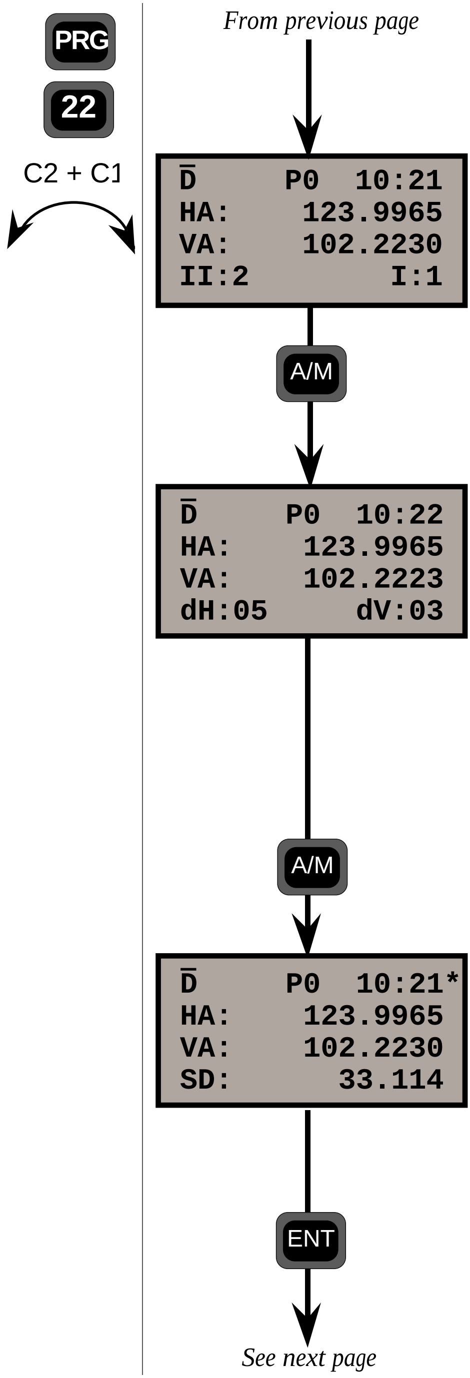
C2:II — *Press* ● *in front*

After pressing A/M a second time, the mean of angular C2 values is stored in the memory of the instrument.

Press ● *in front*

Rotate the instrument to C1 position by depressing the A/M key in front for approx 2 sec.

See next page

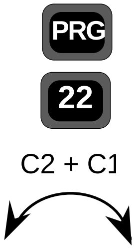


Approach the target from the other direction using the motion screws. Press A/M.

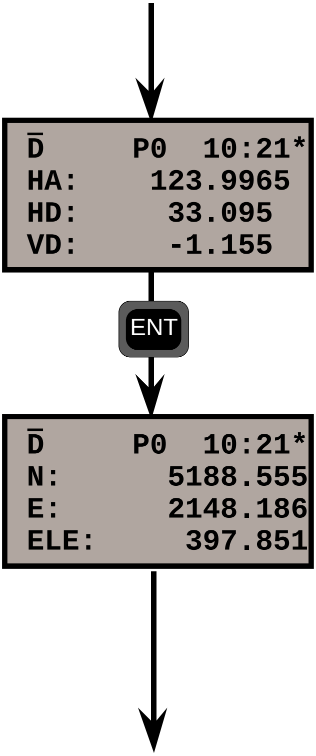
The second C1 angle measurement and indication of completion (i.e., II:2) is very quickly shown in the display..

However, the values now seen in the display are the final mean horizontal and vertical angle values of the mean of the angles measured in both faces.
The dH & dV values displayed are the amounts by which the angles have been adjusted – i.e., half the sum of the remaining horizontal and vertical collimation and pointing errors.
Now it is time to measure the distance. Press A/M….

Distance is continually measured and updated while mean angular values are frozen. To view the HD and VD to the point, press ENT….



From previous page



Press ENT to view the N, E and ELE of the point.

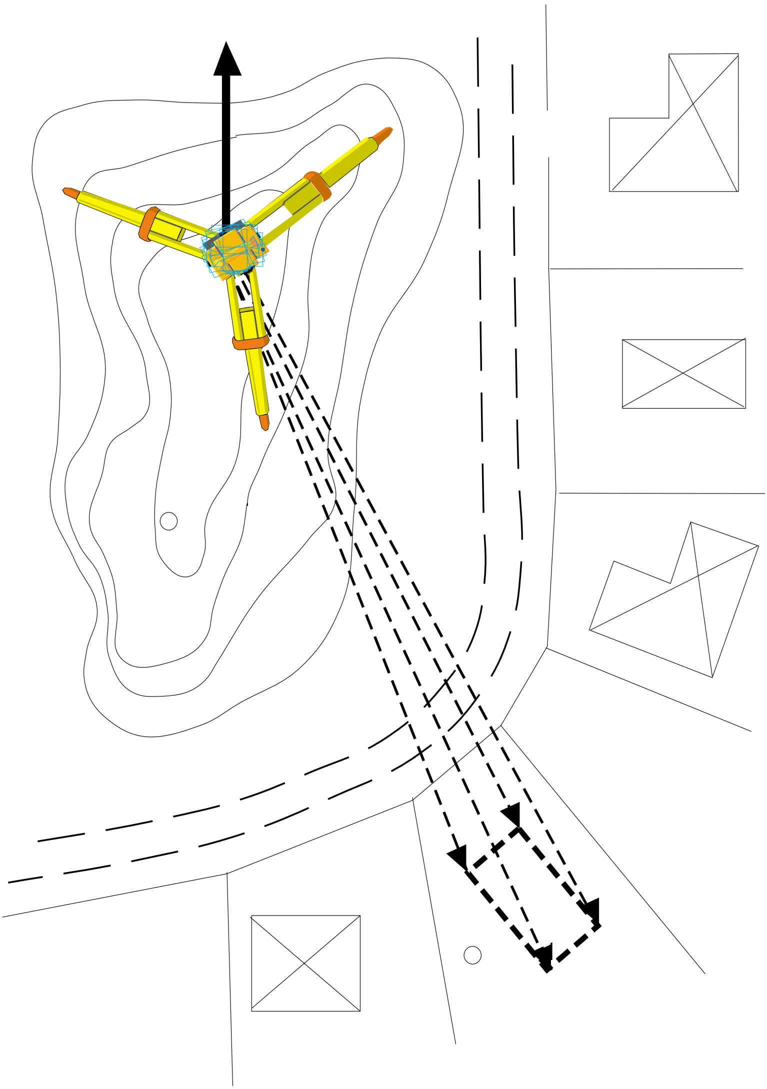
To continue, press the REG key and the instrument will aim at the next target in C2 position. Repeat the instructions above.

TRK

-/.

Collecting detail & Tacheometry (TRK-Mode)

This measurement mode is normally used during both large and small topographic exercises. The TRK mode is fully automatic. All measured values will be updated 0.4 sec. after making contact with the prism. No keys have to be pressed between measurements.



TRK
-/.

```
STD   P0   10:17
HA:      165.2355
VA:      106.5505
```

To engage tracking mode, press TRK key.....

TRK

```
TRK   P0   10:17
```

Aim towards the point. Distance measurement starts automatically and there is no need to press A/M.

```
TRK   P0  10:17*
HA:      159.8700
HD:      104.36
VD:        -8.508
```

HD & Vd appear in the display. To view coords. and height of point, press ENT.....

ENT

```
TRK   P0  10:17*
N:      1234.5678
E:      9101.1121
ELE:      31.415
```

To view HA, VA & SD to the point, press ENT.........

ENT

```
TRK   P0  10:17*
HA:      159.8710
VA:      105.1785
SD:      104.71
```

Aim at the next point and repeat the above instructions.

Note! ☛ R.O.E is automatic in the display modes HA, HD, VD & N, E, ELE when the telescope is turned vertically.

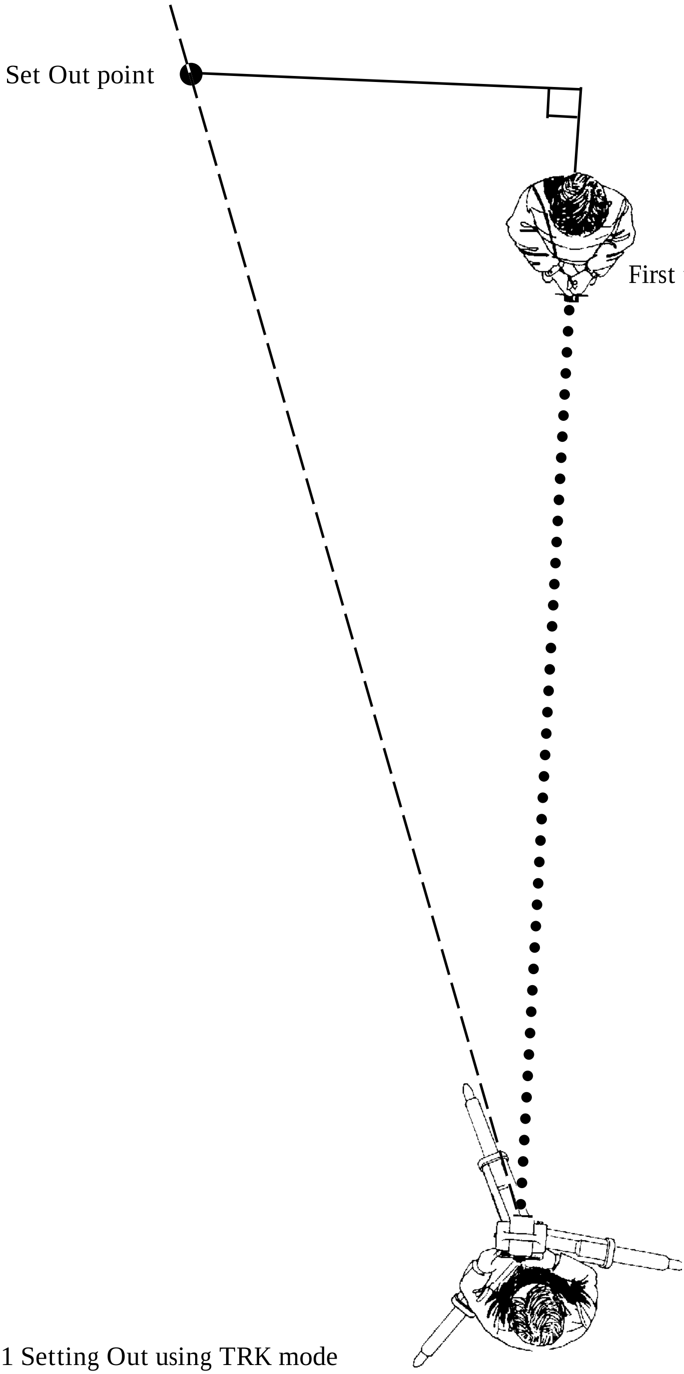


Fig 4.1 Setting Out using TRK mode

TRK

-/.

Setting Out (TRK Mode)

The tracking measurement mode is excellent for setting out, with the option of using a countdown to zero of both the horizontal bearing (azimuth) distance and height to the setting out point. The instrument very quickly calculates the difference between the present direction and the required direction to the point to be set out, and the difference between the horizontal measured distance and the required distance to the point. These differences are visible on the display. When both the dHA (difference in horizontal angle) and dHD (difference in horizontal distance)= 0, the range rod is then being positioned over the setting out point.

The setting out routine can be carried out in two different methods. The "normal way" is to key in the SHA (setting out bearing), SHD (setting out horizontal distance) and SHT (setting out height) values. This is done by using F27, F28 and F29 respectively. The point height is set out using the R.O.E feature.

The second method is to carry out setting out calculations using the main menu, Option 3: Coord, choices 1 &2 – i.e. keying in the instrument station data (including instrument height = IH), and set out point data. The instrument will then calculate the bearing = SHA and horizontal distance = SHD between the instrument station point and each individual setting out point. If elevation is keyed in the SHT will also be calculated. After setting out the point and checking the point coordinates and elevation, you re-enter the main menu: Option 3, choice 2 and key in the coords and elevation of the next set out point.
The following pages will give examples of setting out, first in the normal way (keying in SHA, SHD and SHT) and then by using the main menu: Option 3, choices 1 & 2.

TRK

-/.

Setting Out using pre-calc. bearings & horizontal distances SHA & SHD.

```
STD   P0    10:17
HA:       33.7965
VA:      109.3960
```

To engage tracking mode, press TRK key.....

TRK

```
TRK   P0   10:17*
HA:       33.7965
VA:      109.3960
```

To key in setting out bearing, press F27 (F27 = SHA).......

Note! ☛

F27 = SHA

F

27

```
TRK   P0   10:17*
SHA = 88.9510
```

Key in bearing to setting out point for example, 88.9510, then ENT.....

ENT

```
TRK   P0   10:17*
HA:       33.7965
dHA:      55.1550
```

To key in horizontal distance to setting out point press F28 (F28=SHD)...

Note! ☛

F28= SHD

F

28

See next page

TRK

-/.

From previous page

```
TRK    P0   10:17*

SHD = 104.324
```

Key in horizontal distance to setting out point, for example 104.324 and press ENT....

ENT

Note! ☛
Height Setting Out

If you wish to carry out 3 dimensional point setting out, key in the setting out height with F29 = SHT.

```
TRK    P0   10:17*
HA:        33.7965
dHA:       55.1550
```

HA and dHA appear.Rotate instrument. until it displays approx. 0.0000 opposite dHA – i.e., it is pointing in the direction of the first setting out point. HA is the calculated bearing to the set out point.*
No sign before dHA means the instrument must be turned to the right.

Note! ☛
Only Servo-driven instruments

2

**When positioning in the horizontal direction press this key and wait for a beep.*

3

**When positioning in the vertical direction, if SHT has been keyed in, press this key.*

Note! ☛
Tracklight

◐

This is where Tracklight can be used to its advantage, by directing the prism holder so that he/she is in line for the first setting out point and able to follow the Tracklight.

```
TRK    P0   10:17*
HA:        88.9510
dHA:        0.0000
dHD:       -7.256
```

As soon as the prism comes within the measurement beam you will see dHD (minus sign before dHD means the prism must be moved towards the instrument). Continue this procedure until both the dHA and dHD = 0. The correct keyed in bearing (azimuth) of 88.9510 will also appear opposite HA in the display. The correct position of the point has now been set out.

See next page

TRK

-/.

Note! ☛

F29 = SHT

From previous page

F **29**

Height setting out can be carried out directly after the establishment of the point´s correct position, by keying in F 29 SHT.

```
TRK    P0   10:17*

SHT = 45.363
```

We assume that the elevation has been keyed in using MENU 31 and IH using F3. Signal height (F6) can be set to 0 when using R.O.E. This means that the crosshair will point towards the correct elevation

ENT

```
TRK    P0   10:17*
dHA:        0.0000
dHD:        0.0000
dHT:        1.236
```

Turn the telescope vertically until dHt is zero ..

```
TRK    P0   10:17*
dHA:        0.0000
dHD:        0.0000
dHT:        0.000
```

To view the N, E and ELE, press ENT.....

ENT

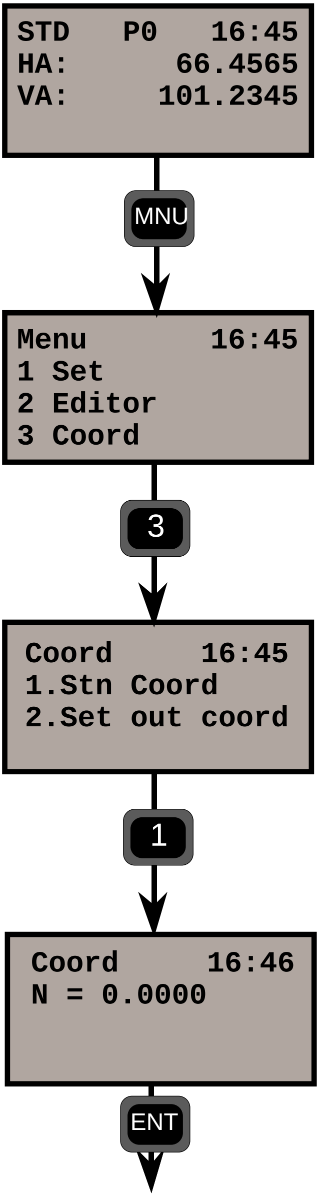
```
TRK    P0   10:17*
N:         203.99
E:         100.24
ELE:        45.363
```

To continue, aim at the next point and follow the above instructions.

See the following pages for setting out when using instrument station data and set out point data.

TRK -/.

Setting Out using coordinates.



After the start procedure, enter the main menu by pressing MNU…

Choose option No. 3…

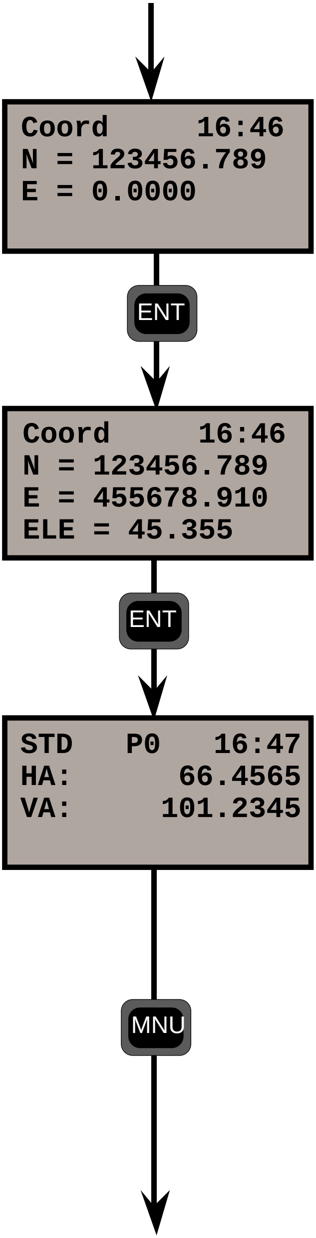
Choose option No. 1 (instrument station data)…..

Key in "N"(coordinate value of instrument station point) and press ENT…..

See next page

TRK

From previous page



Key in "E"coordinate value of instrument station point.Press ENT….

Key in height value of instrument station ground point. Press ENT…

All three values are now stored in the instrument's memory. Now use the functions F3 and F6 to key in instrument height (IH) and setting out reflector height (SH). Then press MNU.

Note! ☛
R.O.E

Note!
It is recommended that the setting out point SH be set to zero if you wish to carry out 3 dimensional point setting out. This means that the actual height of the object which is being set out (e.g: finished road level centre line point, top of concrete pour etc. etc.), can be marked directly on the marker pole or concrete shuttering, exactly at the point at which the centre of the Geodimeter telescope reticle (horizontal crosshair) is pointing.

See next page

From previous page

```
Menu         16:48
1 Set
2 Editor
3 Coord
```

Press option No. 3.....

3

```
Coord        16:48
1.Stn Coord
2.Set out coord
```

Note! ☛

Choose option No. 2 (Set out point data)
Note !
If the orientated bearing isn't available, you may key in the Ref.Obj as the first SetOut coord. The bearing towards the Ref.Obj will then be calculated and can be found under function 27 (F 27). You can then use this result as HAref.

2

```
Coord        16:48
SON = 0.0000
```

Key in "SON" coordinate value of set out point. Press ENT.....

ENT

```
Coord        16:49
SON = 123556.789
SOE = 0.0000
```

Key in "SOE" coordinate value of set out point. Press ENT.....

ENT

See next page

See previous page!

```
Coord        16:49
SON = 123556.789
SOE = 455778.910
SHT =    40.5000
```

Key in the height of the set out point.
Press ENT…

ENT

```
STD   P0    16:49
HA:        66.4565
VA:       101.2345
```

Aim the instrument at the Ref. Object and key in the orientated bearing using F21, then press ENT and choose the tracking mode…*

ENT

**see note on previous page.*

TRK

```
TRK   P0   16:50
HA:        29.5070
dHA:       20.4930
```

When HA and dHA appear, rotate the instrument until it displays approx. 0.0000 opposite dHA – i.e., it is pointing in the direction of the first setting out point. HA is the calculated bearing to the set out point. No sign before dHA means the instrument must be turned to the left.*

Note! ☛
Only Servo-driven Instruments

2

**When positioning in the horizontal direction press this key and wait for a beep.*

3

**When positioning in the vertical direction, if carrying out 3 dimensional setting out, press this key.*

Note! ☛
Tracklight

◐

This is where Tracklight can be used to its full advantage, by directing the prism holder so that he/she is in line for the first setting out point and able to follow the Tracklight.

See next page

From previous page

```
TRK   P0  16.51*
HA:      50.000
dHA:       0.0000
dHD:       2.03
```

As soon as the prism comes within the measurement beam you will see dHD (minus sign before dHD means the prism must be moved towards the instrument). Continue this procedure until both the dHA and dHD = 0. The correct keyed in bearing (azimuth) of 50.000 will also appear opposite HA in the display. The correct position of the point has now been set out. By pressing the ENT key at this stage you can check the accuracy of the set out point by checking the HD, VD, N, E and Elevation.

ENT

```
TRK   P0  16:52*
HA:      50.0000
HD:     141.142
VD:        0.00
```

50.0000 is the correct bearing to the point and 141.42 is the correct distance. Now for the Height, press ENT.

ENT

```
TRK   P0  16:52*
N:    123556.787
E:    455778.911
Ele:      40.500
```

Elevation of the point to be set out is 40.500. Turn telescope upwards until it shows this value. You are now ready to set out the next point. Press MNU, choose Option 3, choice No. 2, SetOut Coord, and repeat the above instructions.

Important Pages

ASCII Table

ASCII

The ASCII table can be used to enter alpha characters directly from the keyboard on instruments with a numerical keyboard.
This can be done with the help of the electronic level (ASCII) key.

Value	ASCII Char.								
32	Space	51	3	70	F	89	Y	108	l
33	!	52	4	71	G	90	Z	109	m
34	"	53	5	72	H	91	[	110	n
35	#	54	6	73	I	92	\	111	o
36	$	55	7	74	J	93	]	112	p
37	%	56	8	75	K	94	^	113	q
38	&	57	9	76	L	95	_	114	r
39	`	58	:	77	M	96	-	115	s
40	(	59	;	78	N	97	a	116	t
41	)	60	<	79	O	98	b	117	u
42	*	61	=	80	P	99	c	118	v
43	+	62	>	81	Q	100	d	119	w
44	-	63	?	82	R	101	e	120	x
45	_	64	@	83	S	102	f	121	y
46	.	65	A	84	T	103	g	122	z
47	/	66	B	85	U	104	h	123	(
48	0	67	C	86	V	105	i	124	|
49	1	68	D	87	W	106	j	125	)
50	2	69	E	88	X	107	k	126	~

MNU 19

The instrument also gives you the opportunity to select special characters for different languages. This can be done via Menu 19. The following languages and characters can be selected.

Value	Sw	No	De	Ge	Uk	It	Fr	Sp
35					#			
64		É	É	*f*			à	
91	Ä	Æ	Æ	Ä		°	°	1́
92	Ö	0	0	Ö			Ç	Ñ
93	Å	Å	Å	Ü		é	*f*	¿
94	Ü	Ü	Ü					
96	é	é	é			ù		
123	ä	æ	æ	ä		a	é	ë
124	ö			ö		õ	ù	ñ
125	å	å	å	ü		e	è	
126	ü	ü	ü				ë	1̀

Info Codes

No	Description
1	Compensator out of range.
2	Wrong measuring procedure e.g not possible to track in C2.
3	Distance already recorded.
4	Measurement invalid.
5	Undefined mode, display or output table not set, measurement incomplete.
6	Vertical angle less than 15 gon from horizontal in Test Mode, (Tilt Axis).
7	Distance not yet measured.
8	Battery low not possible to register.
9	Battery low, in external unit
10	Memory device not connected.
19	Communication error (Program 54), file transfer not ok.
20	Label error, label not accepted.
21	Disturbance in the serial channel or wrong parameters.
22	No or wrong device connected.
23	Time out
24	Tries to communicate in face C2 or not in theodolite mode.
25	Real time clock error.
26	Recommendation to change back up battery.
29	Output or display table activated, operation not allowed.
30	Syntax error.
31	Out of range.
32	Not found (Files and / or programmes).
34	Wrong data record separator.
35	Data error. Wrong data input e.g Offset value too large or alpha sign in a numerical value.
36	Memory full. Imem, Xmem or buffer

Info Codes (cont.)

No	Description
41	Wrong label type.
42	UDS programme memory full.
43	Calculation error, redo the procedure.
46	GDM power error, RPU can't switch on GDM
47	U.D.S. Call stack error.
48	No, or wrong stn. establ., redo the stn. establ.
49	RPU not logged on to GDM.
103	No carrier, disturbance or no contact.
107	Channel busy, try to change channel.
122	Radio not connected.
123	Time out in transmission of data via the radio.
153	Limit switch engaged.
155	The horizontal positioning isn't good enough*
156	The vertical positioning isn't good enough*
157	The horizontal and vertical positioning isn't good enough*
158	Can not find the target, redo the search procedure.
161	The target is lost.
166	No measuring signal from prism.
199	Internal program error.
201	Calculation error.
207	To many commands sent on the serial channel.
218	Input string too long.
Note	In some cases the info code also includes a device code e.g. 35.2 Here below is a list of device codes: 1 Serial 2 Imem 3 Xmem 6 Radio * if this error appears frequently leave the instrument to authorized service for adjustments.

Measurement Hints

Backup of memory

As a safety measure always backup your memory to protect yourself from memory loss. Ensure that your data can be found in more files than one and if possible in both an internal and an external memory.
Backup is easily done with Program 54 which enables you to transfer Job- and Area-files between the different Geodimeter units, see "Software and Data communication" for more information. You can also use the PC-program GST (Geodimeter Software Tools), ask your local dealer for a demonstration.

Pointing errors

System 400&500 is equipped with an extra wide measurement beam in order to make it easier to carry out measurements over large distances. That means that you can get a return signal from the prism even though the instrument is not exactly pointing in the middle of the prism (System 500) or below the prism (System 400). It is therefore important to fine adjust the aiming before registering. Use STD-mode or D-bar mode to enable the highest possible accuracy.

Collimation errors

The instrument will automatically correct the measured angles for both horizontal and vertical collimation errors as well as for trunnion axis errors by using premeasured values. By carrying out a test procedure, see chapter 2, you can update these values for the actual conditions. We recommend you to do this regurarely especially when measuring during high temperature variations and where high accuracy is demanded.

Trunnion axis

When measuring towards a point, the instrument will correct the measured angles as described above. If you thereafter tilt the instrument upwards you will find that the horizontal angle will change, this is because the instrument is correcting the measured angles continuosly. This will of course also happen if the instrument is tilted and the electronic compensator is activated.

Part 2

Technical Specifications

Angle Measurement System

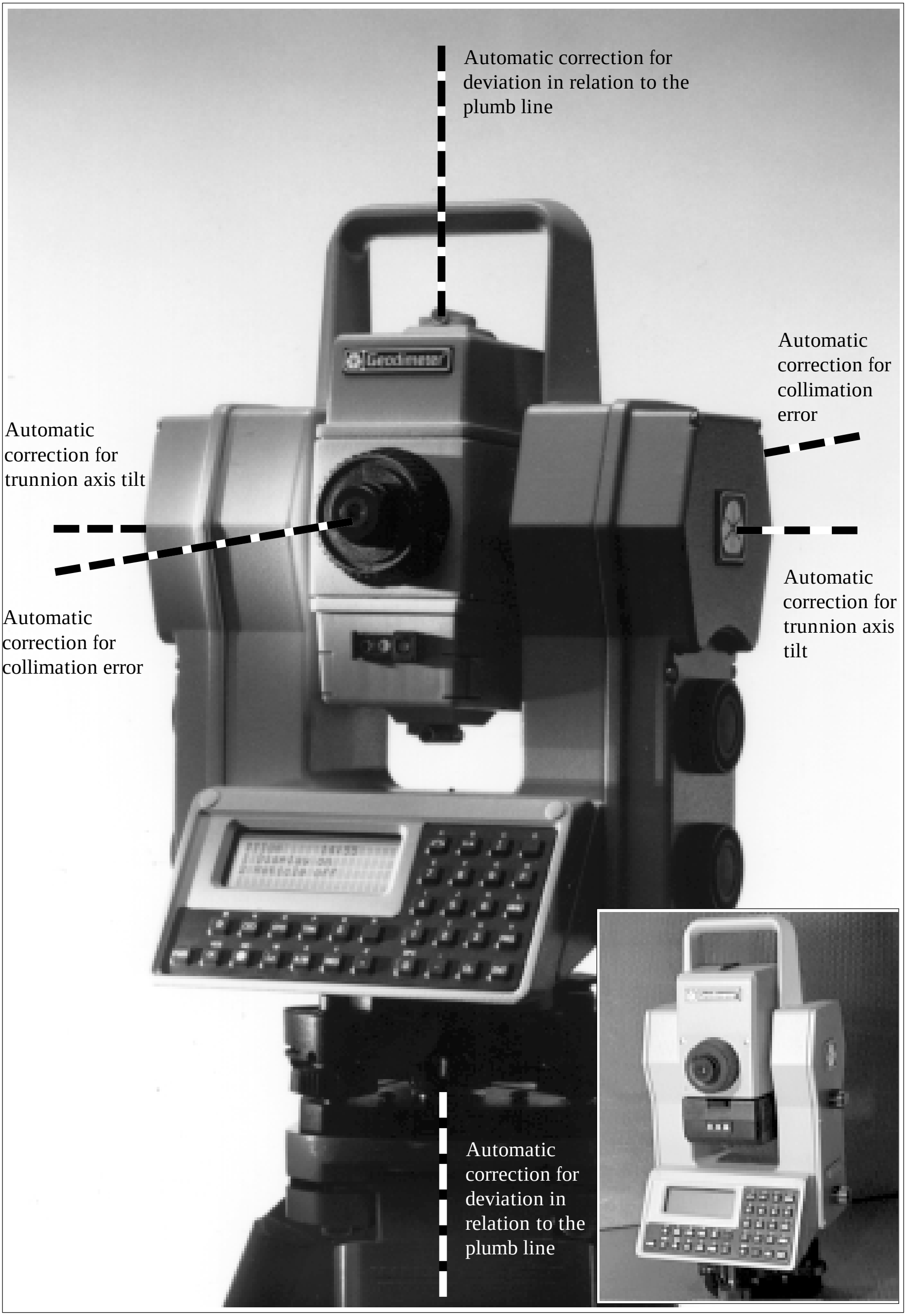


Fig 1.1 The Angle Measurement System

Overview

The Geodimeter System 400/500 meets all demands for efficient and accurate angle measurement. It also allows you to choose the measuring method with which you feel most comfortable. The angle measurment system gives you full compensation for the following:

- *Automatic correction for vertical and horizontal angle error*.
- *Automatic correction for collimation error and trunnion Axis tilt*.
- *Arithmetic averaging for elimination of pointing errors*.

The Angle Measuring Technique

One of the prominent design features of Geodimeter System 400/500 is its electronic angle measurement system, which eliminates the horizontal and vertical angle errors that normally occur in conventional theodolites. The principles of measurement are based on reading an integrated signal over the whole surface of the horizontal and vertical electronic device and producing a mean angular value. In this way, inaccuracies due to eccentricity and circle graduation are completely eliminated.

Dual Axis Compensator

The instrument is also equipped with a dual axis compensator which will automatically correct both horizontal and vertical angles for any deviations in the plumb line. The microprocessor, which is electronically connected to this compensator, is warned immediately of any alterations in excess of 10^{c} (6') which occur in the original centre of gravity of the instrument.

Correction for Collimation Errors

By carrying out a very simple pre-measurement test procedure, both horizontal and vertical collimation of the instrument can be quickly measured and stored immediately prior to commencing angular measurement. All angles measured thereafter are automatically corrected by these stored values via the microprocessor. These collimation correction factors remain in the internal memory until they are measured and restored.

Correction for Trunnion Axis Tilt

During the same pre-measurement test procedure, it is also possible to measure and store angular imperfections in the horizontal trunnion axis relative to the vertical axis. This stored correction factor is applied automatically thereafter to all measured horizontal angles via the microprocessor.

When should these test be carried out?

1. After being transported some distance or after servicing.
2. When the temperature differs by > 10°C from the previous application.
3. If you know that the instrument has fallen during transport.
4. Immediately prior to high precision angle measurement.

How are these tests carried out?

See "Test Measurement", part 1, page 1.2.18.

Calculation of the Horizontal Angle

The formula below is used to calculate the horizontal angle:

HA = HAs + Eh x 1 / sin v + Yh x 1 / tan v + V x 1 / tan v

(sin v = collimation tan v = levelling tan v = horizontal axis)

HAs = Horizontal angle measured by the electronic circle

Eh = Horizontal collimation error

Yh = Levelling error at right angle to the line of collimation

V = Horizontal axis error

Calculation of the Vertical Angle

The formula below is used to calculate the vertical angle:

V = Vs + Ev + Yv

Vs = Vertical angle measured by the electronic circle.

Ev = Vertical collimation error.

Yv = Deviation in the vertical axis.

Two -Face Angle Measurement

The measurement unit can be used in exactly the same manner as a conventional theodolite – i.e. in both the left and right face. These two-face situations will here after be referred to as Circle 1 and Circle 2 positions. Circle 1 position is adopted with the keyboard facing the operator, Circle 2 with the keyboard away from the operator.

Compared directly to angular measurement in one face only, with the values for collimation and horizontal axis errors stored in the instrument, no improvement in angular precision is achieved by executing 2 face angle measurement. However it is often the case that local statutory survey laws require angular measurements in both Circle 1 and 2. It was mentioned in the chapter which dealt with angular measurement in one face only that the human error for inexact point-of-lay and plummeting errors due to optical imperfections in the tribrach are not compensated. This also applies to Circle 2 measurement. Tribrach optical imperfections can be minimized with frequent checks and adjustments; point-of-lay errrors can be minimized with frequent sightings as described in the following section.

How to Compensate/Minimize Point-of-Lay Sighting Errors

This is achieved simply by measuring angles in both Circle 1 and Circle 2. These values can be either registered and/or manually booked.

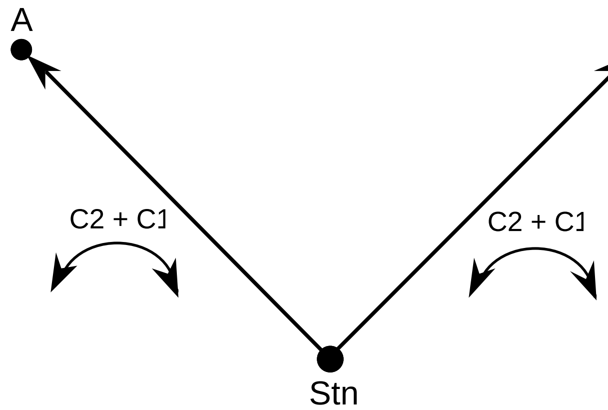


Fig. 1.2 Two-Face Angle Measurement.

Due to the design concept of Geodimeter System 400/500 the inherent intelligence of the system can also be utilized by applying the methods described below:

While measuring in C2 and C1 with or without distance measuring, all angular values are stored in the internal memory of the instrument and can be stored simultaneously with the distance.

While measuring in C2 and C1, repeated sightings are used to automatically compare, calculate, store and display mean angular value resolutions. That is mean angle values measured in C2 are automatically stored and compared with the mean angle values of the angular sightings made in C1.

By adopting one of these three angle measurement procedures, it is possible to utilize the inherent intelligence of the instrument in order to minimize, very simply, the risk of making sighting errors, either by the external use of a computer program after transfer of stored values from the instrument, or directly in the field. For further information regarding angle measurement, refer to part 1, chapter 4.

Summary, Angle Measurement

During One Face Only angular measurements, if the compensator is engaged and pre-measurement and storage of collimation and tilt axis errors have been executed, each displayed angle will be compensated for the following:

- ❑ Horizontal and vertical circle graduation and eccentricity errors.
- ❑ Plumb line deviation errors.
- ❑ Horizontal and vertical collimation errors.
- ❑ Tilt axis errors.

It is worth mentioning that human error sources such as telescope sighting (these errors can be almost nullified by measuring in two faces) and imperfections in the optical plummet of the tribrach still remain.

Distance Measurement System


Geodimeter

Overview

The distance module of Geodimeter System 400/500 operates within the infrared area of the electromagnetic spectrum. It transmits an infrared light beam. The reflected light beam is received by the instrument and, with the help of a comparator, the phase delay between transmitted and received signal is measured .Via a built-in microprocessor, the time measurement of the phase delay is converted and displayed as a distance with mm accuracy on a four-row L.C. display.

Distance Measurement

The internal function of the distance measurement module can be varied depending on the nature of the particular survey application in question.There are three methods of distance measurement.

STD **0**

- ❑ Standard measurements towards stationary targets (standard mode)

$\bar{D}$ **CL**

- ❑ Precision measurements towards stationary targets (arithmetical mean value D-bar mode)

TRK **-/.**

- ❑ Measurements towards moving targets (tracking mode) e.g., setting out or hydrographic surveying. Also functions as automatic measuring mode for polar measurement and tacheometry.

The choice of measurement method is often based on the experience of the operator and of course the practical precision demanded by the current survey task.

STD 0

Standard measurement (STD Mode)

This measurement mode is normally used during control surveys – e.g., traversing, minor tacheometric exercises, survey point accuracy control, etc. Measurement time to each point takes 5 seconds (7 seconds for long-range mode, system 400). This measurement mode is also normally used where a normal degree of angle and distance accuracy is required.

The instrument carries out the measurement and display of horizontal and vertical angles and slope distances. Horizontal distance and difference in height, and the northings, eastings and elevation of the point will all be displayed by pressing the ENT key twice. Collimation and horizontal axis tilt errors are fully compensated and full angle accuracy can be achieved with one-face measurements. The instrument also offers the possibility of using the R.O.E. function in the STD measurement mode whereby all measured and calculated values will be immediately updated after completion of the distance measurement and vertical rotation of the telescope. Limited horizontal movement of the instrument telescope, i.e. within 30 cm, will also result in the northings and eastings of the measured point changing.This feature is used when measuring eccentric objects (see page 2.2.7.)

$\bar{D}$ CL

Precision measurement (D bar)

This measurement mode is normally used during control surveys – e.g., traversing, minor tacheometric exercises, survey point accuracy control, etc. Measurement time to each point takes 5 seconds (7 seconds for long-range mode, system 400). This measurement mode is similar to the one-face STD mode, the major difference being that distance measurement is carried out in a repeated measurement cycle thus resulting in higher accuracy.

The instrument carries out the measurement and display of horizontal and vertical angles and slope distances. Horizontal distance and difference in height, and the northings, eastings and elevation of the point will all be displayed by pressing the ENT key twice. Collimation and horizontal axis tilt errors are fully compensated and full angle accuracy can be achieved with D-bar one-face measurements. The instrument also offers the possibility of using the R.O.E. function in the D-bar measurement mode whereby all measured and calculated values will be immediately updated after completion of the distance measurement and vertical rotation of the telescope. However, there is one very important difference when using this R.O.E. feature. The instrument must be told when distance measurement is to be stopped; this is done by quite simply pressing the A/M button. Limited horizontal movement of the instrument telescope up to 30 cm will result in the northings and eastings of the measured point changing, also after pressing the A/M button.

With Geodimeter 540 it is possible to measure angles with a higher accuracy. When choosing D-bar mode you will have the opportunity to select normal or high resolution mode. In high resolution mode the horizontal angle, HA, can be determined with up to 5 decimals.

TRK

-/.

Tracking measurement (Setting Out)

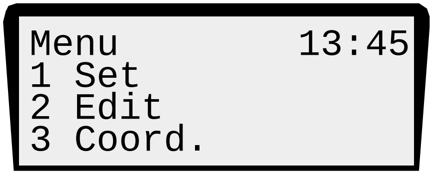
The tracking measurement mode is used for setting out with the option of using countdown to zero of both the horizontal bearing (azimuth) and distance to the setting out point. This is achieved by using the inherent intelligence of the instrument – i.e. the instrument very quickly calculates the difference between the present direction and the required direction to the point to be set out and the difference between the horizontal measured distance and the required horizontal distance to the point. These differences are visible in the display and when both the dHA (difference in horizontal angle) & dHD (difference in horizontal distance) = 0 ("countdown to zero "), the range rod is then being held over the required setting out point.
The actual setting out can be carried out in two different ways with the standard version of the instrument:

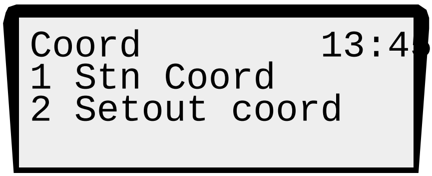
SHA = F27
SHD = F28
SHT = F29

❑ Keying in of bearings (SHA), distances (SHD) and height (SHT) to the points, after using F27 (SHA), F28 (SHD) and F29 (SHT) respectively.

Stn coord./
SetOut coord

- Keying in of instrument station data (including instrument height =IH) and set out point data by using the main menu , Option 3 , Coord, choices 1 and 2. The instrument will then calculate the bearing (SHA), the horizontal distances (SHD) and the height (SHT), between the instrument station point and each individual keyed in setting out point. After setting out the point and checking the point coordinates and elevation, you re-enter the main menu and key in the coords and elevation of the next setting out point. For more information see Page 1.4.27.





Measurement towards moving targets

The TRK mode is fully automatic. All measured values will be updated 0.4 sec. after making contact with the prism. No keys have to be pressed between measurements. All measurements in the tracking mode are carried out in long range which is ideal when working at distances where the kilometre figure changes and you wish to register the raw measurement data in Internal memory/Geodat. It is worth pointing out that battery power consumption is a little higher in this measurement mode compared to the execution of tacheometry in STD mode. R.O.E is automatic in this measurement mode.

Target Data Test On/Off

This allows measurements to points over which the prism range pole cannot be placed – eg., in a corner or at the centre of a large tree. In such a case the instrument can be redirected to the correct point after distance measurement. The offset distance from the inaccessible point is limited to +/-30cm or 50mgon rotation of the instrument for distances within 400m. This limit allows you to calculate and record the coordinates and elevation of the correct point – i.e. the eccentric point. For distances in excess of 400m the offset limit is proportional to the distance to the point – e.g. at a distance of 1000m, the instrument can be re-directed to the correct point up to an offset distance of 75 cm.

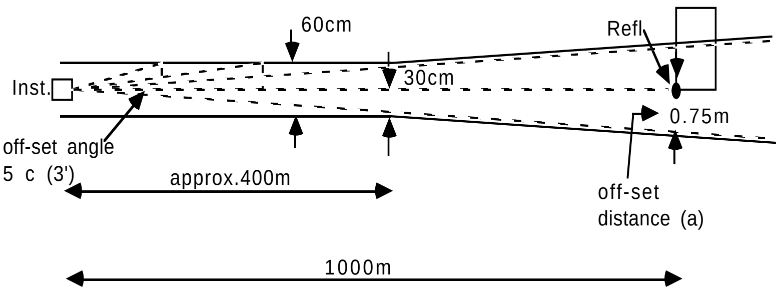


Fig. 2.1 Measurement towards an eccentric point.

Target Data Test On/Off

MNU 1 6

This +/-30 cm or 50mgon limit can be deactivated by using the main menu SET function, Option 6, Set switches, Target Data Test OFF mode. The default(standard) setting of this switch will always be ON when the instrument is first turned on.

Warning!
The target Data Test is created for your own safety. It prevents you from storing an old distance with new angle values. When Target Data Test is set to Off that risk will occur, if you forget to measure a distance when measuring the following points.

Automatic control of signal level

The Geodimeter instruments have an automatic signal control. The main advantage of this is when measuring in the tracking mode. Despite the range and the time delay between a temporarily lost and recovered measurement signal, the distance is still updated and displayed within 0.4 seconds.

Measurement beam width

System 500
The infrared measurement beam has a width of 15 cm/100m (37.5inch/300feet)(2.5 mrad).

System 400
The infrared measurement beam has a width of 25 cm/100m (10inch/300feet)(2.5 mrad).

The wide measurement beam simplifies considerably both target/ prism acquisition and setting out exercises.

Measurement range

The Geodimeter instruments have an range capability of 0.2m to 3300m (depending on the type of instrument) with only one prism in normal weather conditions. The range can be extended to as much as 7km with 8 prisms.
Long range - System 400
Long range distances (>1000m or 3280ft) are measured in STD and D-bar modes by pressing the A/M-key until "Long Range" appears oin the display.

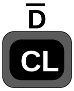
Prism constant

MNU
6
1
Configure Prism const.

If you measure towards a Geodimeter prism, you’ll have the prism constant 0. But if you wish to use a prism from another manufacturer, you may have to enter another prism constant.
If you have a prism constant <>0 this will be indicated in the display with a "!" sign in the time indicator, e.g. 12!00.
See also distance correction offset, page 1.3.5.

Accuracy

Accuracy of distance measurement in the standard mode varies for each type of Geodimeter instrument. The accuracy factor is expressed as ±(3 mm + 3 ppm, for Geodimeter 540) or ±(5 mm + 5 ppm, for System 400).
The PPM (parts per million) factor is wholly dependent on range. In practice the PPM accuracy factor can be thought of in terms of millimetres per kilometre, as there are 1 million millimetres in 1 kilometre. In other words , the term 5 PPM means 5 mm/ km or 0.5mm/100 m.



If very high accuracy is required, then distance measurement should be carried out in D-bar mode. This involves automatically and continuously repeated distance measurements. The mean value of all of these measurements is also repeated and updated continuously on the display of the instrument. Accuracy in this D-bar mode is expressed as ±(2 mm + 2 ppm, for Geodimeter 540) or ±(2mm + 3 ppm, for System 400).

During measurements in the tracking mode, e.g. in setting out work or rapid and intense detail tacheometry,the accuracy factor is expressed as ±(10 mm + 5 ppm) (5 ppm for Geodimeter 540).

R.O.E (Remote Object Elevation)

The R.O.E. measurement function is used to measure heights of objects where it is neither practical nor possible to place a reflector. In order to measure the height of an object, an initial distance measurement is carried out to a reflector held at a point which lies in the same vertical plane as the point to which the height is required. Once the distance has been measured, the height can be measured to any point which lies within the same vertical plane as the point's location – i.e., within the nadir or zenith positions of the measured point.
The difference in height (DHT) is defined as the difference between the horizontal collimation axis of the theodolite and the point at which the reticle of the vertically transited theodolite telescope is pointed.

MNU 1 2

"R.O.E preset"

With Geodimeter Instruments it is possible to make use of the R.O.E. feature in all three measurement modes, i.e. Standard, D-bar and Tracking. As it is possible to key in instrument station coordinates and elevations, and instrument and signal heights, and employ the instantaneous calculating ability of the microprocessor and the choice of display mode of the instrument, it is also possible to work with and immediately see the northings, eastings and elevations of the points. This will allow you to work directly from the engineer's drawing without needding to pre-calculate lots of bearings, distances and heights. R.O.E can be preset to any start elevation by using menu 12 "R.O.E preset"

Different combinations of Instrument Height (IH) & Signal Height (SH)

It is important to know what the different combinations of instrument and signal heights will produce in the form of displayed results.

1) If neither instrument nor signal height is keyed in, then the vertical distance (VD) shown on the display is the difference between the horizontal axis of the instrument and the point at which the telescope reticle centre is pointing.

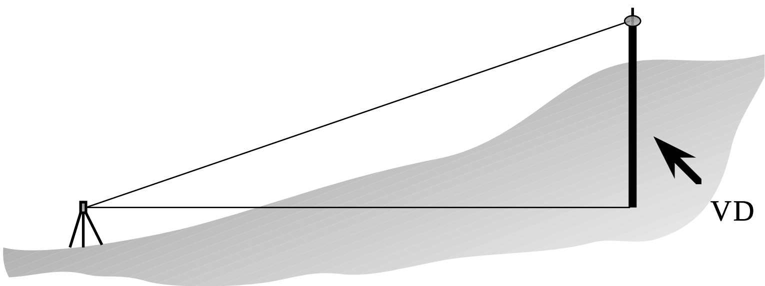


Fig. 2.2

2) If you key in the height of the instrument (IH) and the height of the survey point over which the instrument is placed, and set the signal height value of the target to ZERO, the vertical distance (VD) shown on the display is the difference in height between the height point and the point at which the telescope reticle centre is pointing. The VD value, obtained by changing display page, shows the absolute height. This is the method which should be used when setting out of heights directly from the engineer's drawing, for example.

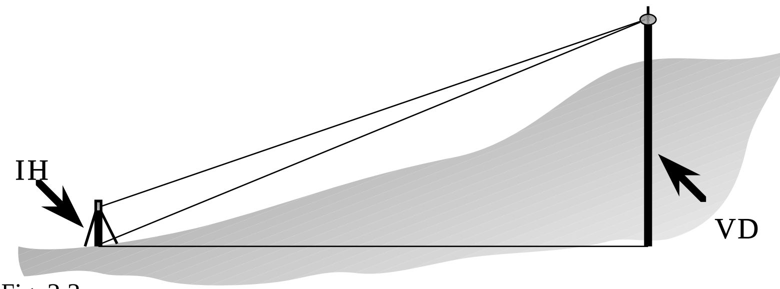


Fig. 2.3

3) If you key in both the instrument and signal height, then the vertical distance (VD) which is shown in the display is the difference in height between the point over which the instrument is placed and the ground level of the point at which the tripod or reflector is placed – i.e. the actual difference in elevation between the two ground points.

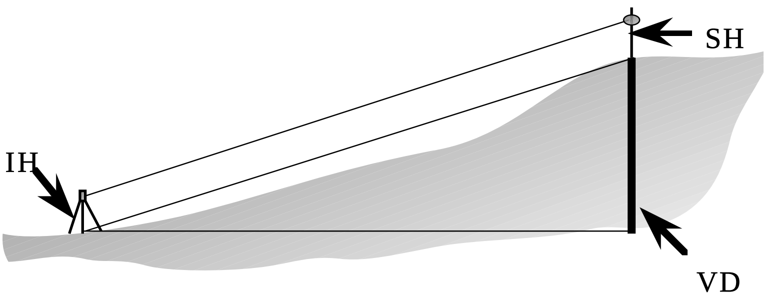
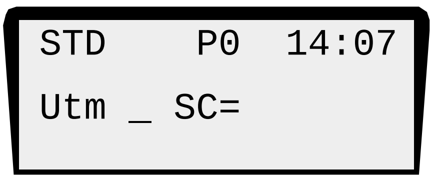


Fig. 2.4

UTM Scale Factor Corrected Distances

In all Geodimeter instruments you can set the UTM Scale Factor (UTM = Universal Transverse Mercator Scale Factor) and can therefore carry out both Tacheometry and Setting Out using UTM Scale Factor corrected distances.
UTM Scale Factor tables can be acquired from local goverment surveying authorities. The scale factor used by the operator is solely dependent on the location of the survey area in relation to its East-West distance from the UTM zone central meridian. These zones are 6° degrees wide and originate from the 0° Greenwich Meridian. North-South distances within the UTM zone have no influence on the scale factor. The scale factor at the CM (Central Meridian) of UTM zones is 0.9996. This is the smallest value. The UTM Scale Factor towards the east and west from the CM will therefore increase upwards towards 1.000400. These values are listed in tables showing corresponding UTM Scale Factors in relation to distance (E-W) from the CM of the zone.
The UTM Scale Factor is set with Function 43. The UTM set in Geodimeter is always the same for both Tacheometry and Setting Out. The display shows the following when selecting F43.



Examples of optional programs with which Function 43 can be used:

P20 : Known Stn./Free Stn.
P23 : SetOut
P26 : DistOb (Distance between 2 objects)
UDS which includes distance measurements.

F
4
3

UTM Example

The UTM coord. distance is represented by the line AB (see sketch below). The measured horizontal distance CD on the Geoid must therefore be reduced to AB, with the UTM scale factor for example 0.999723. This is simply done by multiplying CD (the horizontal distance) by your scale factor. This routine will be carried out automatically when keying in a UTM Scale Factor using Function 43.

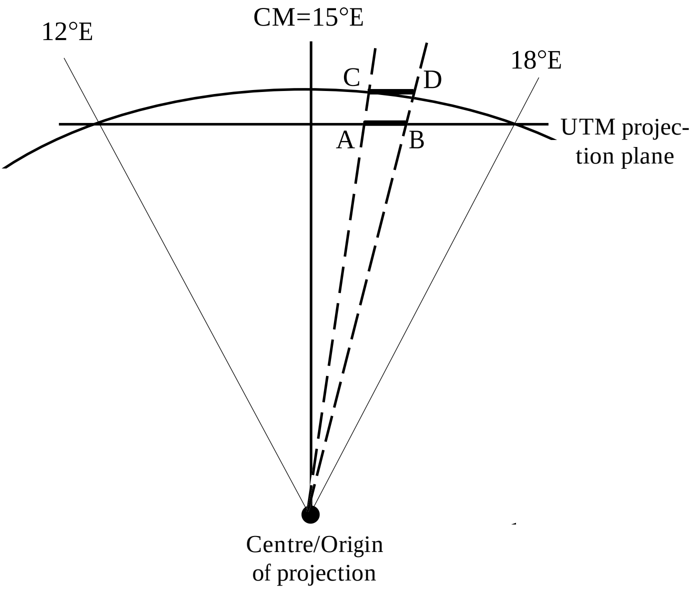


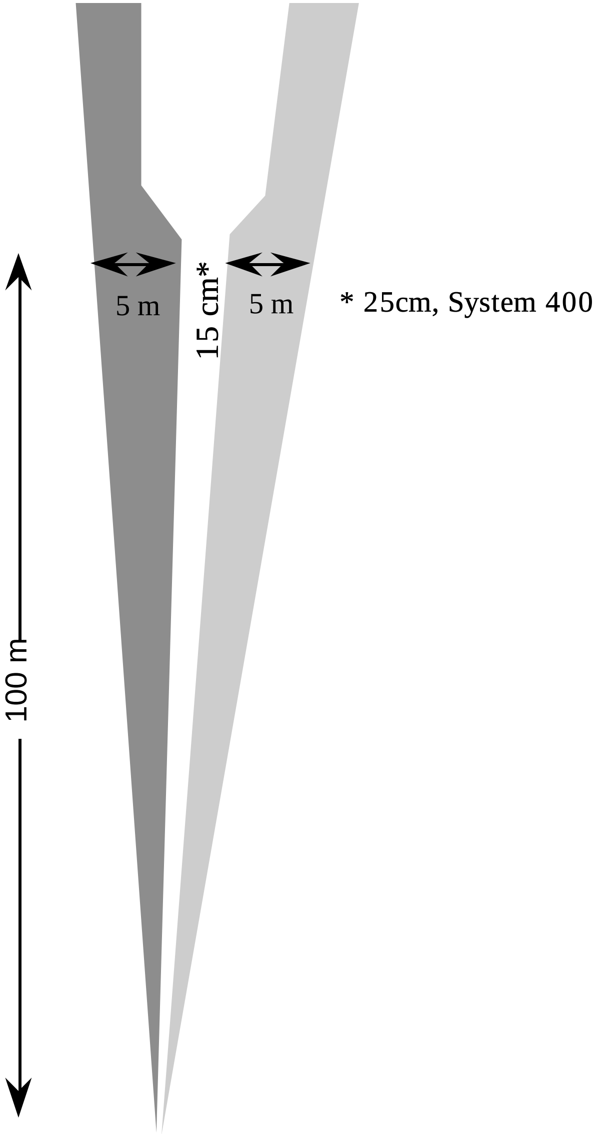
Fig. 2.5 UTM Scale Factor.

* * *

Tracklight®

Illustrations

Fig 3.1 Tracklight emits a red, white and green sector of flashing light where the white light coincides with the measuring beam.



For activation of Tracklight

Overview

Tracklight is a visible guide light which enables the staffman to set himself on the correct bearing. It consists of a flashing three coloured light, each colour lying within its own lateral projection sector. If the staffman is to the left of the measuring beam, he will observe a green flashing light; if to the right, a red flashing light; if on-line with the measuring beam of the instrument, a white flashing light.

The frequency of the flash will increase by 100% as soon as the light beam strikes the reflector, which will confirm for the staff - man that he/she is holding the rod in the correct position. Once the staffman is on-line, the distance will immediately appear on the display. Tracklight also provides the operator with an excellent facility for clearing sight lines and for working during the hours of darkness.

From the figure on the previous page, it can be seen that the instrument measuring beam width at 100 m is 15 cm for system 500 and 25 cm for system 400. The width of the tracklight beam at the same distance is 10 m.

The tracklight unit on Geodimeter System 500 slides onto the underside of the measuring unit (see fig 3.2 below) and it is activated from the keyboard.

The tracklight unit for Geodimeter System 400 is mounted on the underside of the telescope part of the instrument by authorised service and is activated from the keyboard.

Fig 3.2 The Tracklight unit slides onto the underside of the measuring unit.

How to activate Tracklight

Tracklight is activated from the keyboard by pressing key. The display now shows:

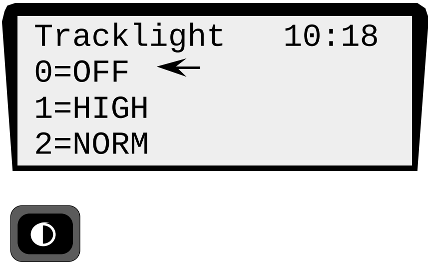


Fig 4.2 Activation of Tracklight

- ❑ Key in 0 if you wish to switch off Tracklight during measurement.
- ❑ Key in 1 if you wish to switch on or change over to highbeam intensity during bad visibility conditions.
- ❑ Key in 2 if you wish to switch on Tracklight with normal light intensity.

Tracklight is switched off automatically when the instrument is switched off. It is worth noting that the life length of the track-light bulb will be considerably diminished if the high intensity mode is used frequently. Use this setting only during bad visibility or when the distance demands it.

Changing the bulb - System 500

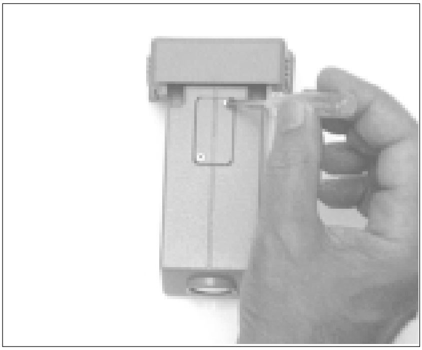


Fig 3.3

In order to change the track-light bulb, open the cover under which the bulb is situated (fig 3.3).

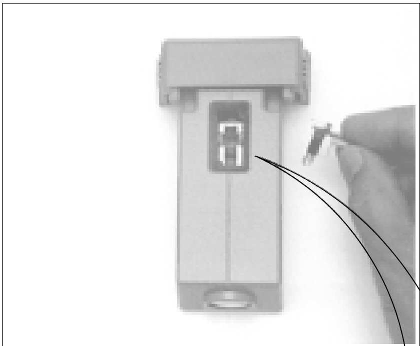


Fig 3.4

Remove very carefully the bulb housing and replace the spent bulb with a new one. Replace the bulb housing and connect the cover with a screwdriver (fig 3.4).

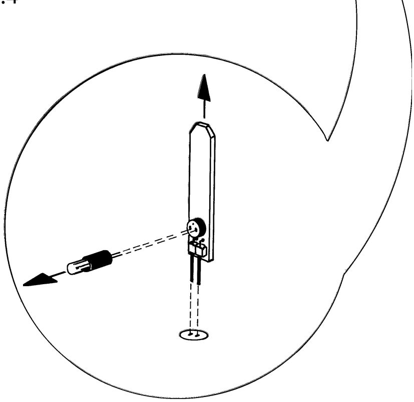


Fig 3.5 The sketch shows how the Tracklight bulb (6.3V /0.2A) should be removed from the connection socket.

Changing the bulb - System 400

In order to change the tracklight bulb, the instrument should be placed in the face 2 position. Lift up the rubber protection cover under which the bulb is situated. Remove very carefully the bulb housing and replace the spent bulb with a new one. Replace the bulb housing and press home the rubber protection cover properly. See fig. 3.6 below.

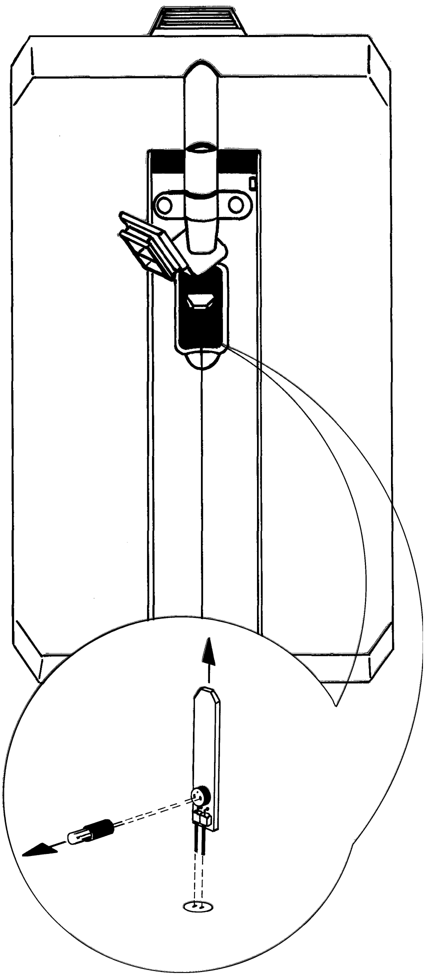


Fig 3.6 The sketch shows how the Tracklight bulb (6.3V /0.2A) should be removed from the connection socket.

Data Logging


Geodimeter
T3100

Data Recording

The recording of data when using Geodimeter System 400/500 is based on the general system of labels and label numbers which describe the different data items. The system has 100 different data types, which can all be registered as singular and separate items directly from the keyboard of the instrument, or they can be recorded using the User Definable Sequences (U.D.S.) available in the additional software.

The possibilities of recording instrument data are now greatly enhanced compared to previous Geodimeter total stations.

All data measured and calculated by the instrument can now be recorded.

Angle registration can be carried out during both single and double face measurements. A special feature, which can be of great help, is that angles measured in both face II and face I can be recorded with the instrument in the face I position. The angle values are stored in face II by pressing the A/M button and can then be displayed and recorded in the face I position. In this case angle recording is carried out under separate labels for face I and face II. Instrument data can be recorded according to tab 5.1

Instrument Data	Prompt	Label
Horiz. Angle C1/C2	HA	7
Vert. Angle C1/C2	VA	8
Horiz. Angle C2	HA II	17
Vert. Angle C2	VA II	18
Horiz.Angle C1	HAI	24*
Vert. Angle C1	VAI	25*
Horiz. Diff.	dH	16*
Vert. Diff.	dV	19*
Slope Dist.	SD	9
Horiz. Dist.	HD	11
Diff. in Height	dHT	10
Vert. Dist	VD	49
North. Coord.	N (X)	37
East. Coord.	E (Y)	38
Elev. Coord.	Ele (Z)	39
Rel. Coord. North.	Xr	47
Rel. Coord. East.	Yr	48

Tab 5:1 Data for recording.

* Only in D-bar. Normally C1 angles are read in label 7 and 8. But in D- bar label 7 and 8 represent the allover mean value.

Control of data registration

The instrument checks the validity of data before recording. It checks, for instance, that the instrument is on target. This can be selected with Targ. test on? MNU 16 - i.e. that measured angles and distances correspond to each other. For more information about eccentric objects, see "yellow pages" 2.2.7.

Data Output

MNU 4

A standard table for output is set for each measurement mode of the instrument. If a different output is required, 5 additional output tables can be specified by the user directly from the keyboard. This is done with MNU 42, Create table function.
The choice of the type of recording device that shall be used for the transfer of the data - e.g., Internal memory, external memory, Geodat or Serial for direct transfer to and from a computer - is also controlled directly from the keyboard of the instrument with MNU 41, Select device function.

Note! ☛ A complete list of Function and labels can be found in Appendix A.

Different output tables or the same table can be activated for more than one device simultaneously.

Standard output

Output of measured data from Geodimeter System 400/500 can be set completely independently of the displayed data. The standard output tables have been set for recording horizontal angle, vertical angle and slope distance for the different measuring modes. If output of other data is required, special output tables can be set by the operator.The standard output, Table 0 (see tab. 5:2, page 2.4.5), is adapted to the function of the different modes of measurement, while User Defined Tables 1, 2, 3, 4 and 5 will be independent of choice of mode.

STD mode One-face (C1)		STD mode Two-face (C2)		
Prompt	Label	Prompt	Label	Comments
HA	7	HA	7	Horiz. Angle C1
VA	8	VA	8	Vert Angle C1
SD	9	SD	9	Slope Dist.
		HA II	17	Horiz. Angle C2*
		VA II	18	Vert Angle C2*

Tab 5:2 Table 0 Standard Mode, STD

The above data can be recorded when measuring in standard mode (STD) in selected memory device.

Note! ☛ In theodolite mode only label 7 & 8 will be registered. Table 0, 1, 2, 3 and 4 are only available after a distance measurement.

Tracking mode (TRK)

In tracking, measurement and recording can only be made in the face one position. Recording follows the procedure of one-face measurements in the Standard mode as described above.

D-bar mean value mode

In D-bar measurements recording can be done according to table 5:3 (see following page).
After two-face measurements the reduced mean value of the angles from the two faces (C1/C2) can be recorded with labels 7 and 8, the mean angular value for angles in C1 are recorded with labels 24 and 25, and the mean angular value for angles in C2 are recorded with labels 17 and 18. A mean value of the slope distance (SD) will also be recorded with label 9.

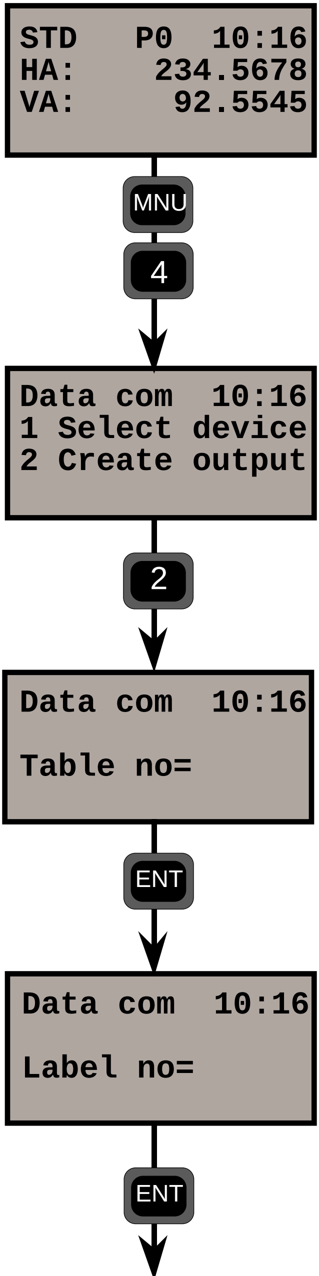
D-bar mode One-face (C1)		D-bar mode Two-face (C2)		
Prompt	Label	Prompt	Label	Comments
HA	7			Horiz. Angle
VA	8			Vert. Angle
SD	9			Slope Dist. Mean value
		HA II/I	7	Mean value of angle sightings, corrected for difference between C2 and C1.*
		VA II/I	8	Resolution 0.1 mgon (1").*
		HA II	17	Mean value for sighting in face 1 (C2).*
		VA II	18	*
		HA I	24	Mean value for sightings in face 2 (C1).*
		VA I	25	
		SD	9	Slope distance mean value

Tab 5:3 Table 0, D-bar.

User defined output

If the standard output, Table 0, is not suitable, five user defined output tables, Tables 1 to Table 5, can be set up by entering the required labels from the keyboard.
The output table can contain any data measured or calculated by the instrument - e.g., reduced distance or coordinates. Time and date are updated in the instrument and can be recorded. Other data such as Point Number and Point Codes can also be included in the output table. However, each corresponding data value must then be updated using the function key.

How to create an output table



To be able to create a new output table, you must first choose function 4 ("Data com") from the menu……

Select number 2 "Create output"..

Select table number = (1,2,3,4,5)and then press ENT…..

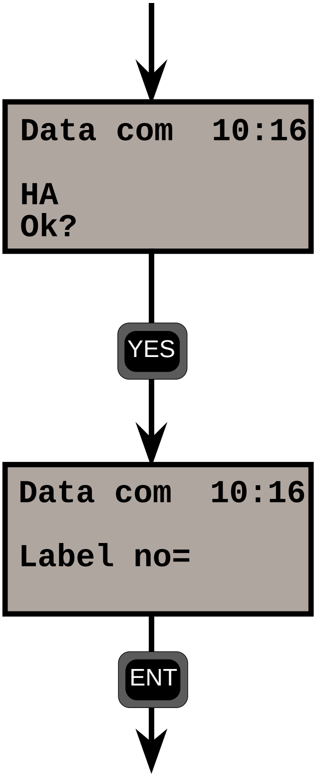
Select desired label – e.g., HA = label 7. Press ENT…..

Note - Table 5 !
No measured or calculated distances can be stored in table 5.

Note! ☛
A complete list of Functions and labels can be found in Appendix A.

See following page

How to create an output table (Cont.)



Program 0

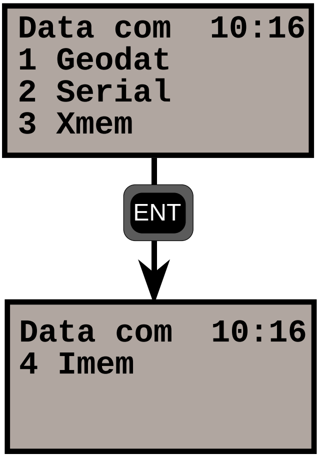
The label is confirmed or rejected with Yes or No. Press Yes…

The question "Label no=" will be repeated until all required labels have been entered. When arriving at the end of selection of labels, answer by pressing only ENT. The display returns to program 0.

Note! ☛ User defined output tables can only be activated and used in combination with fully completed measurement cycles which must include distance measurement.

Type of memory device

Selection of memory device can be made with menu function 4, option 1 "Select device".
The following choices are available:

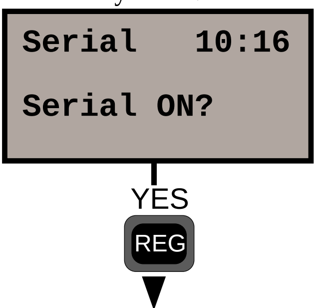


1 Geodat

Select MNU 411 for recording to Geodat. The display will show Table = and 0 is keyed in for standard recording or 1, 2 or 3 for a user defined output table. Note that when a Geodat table has been selected (Standard or User Defined) it will be stored in the memory and activated the next time the instrument is switched on.

2 Serial output

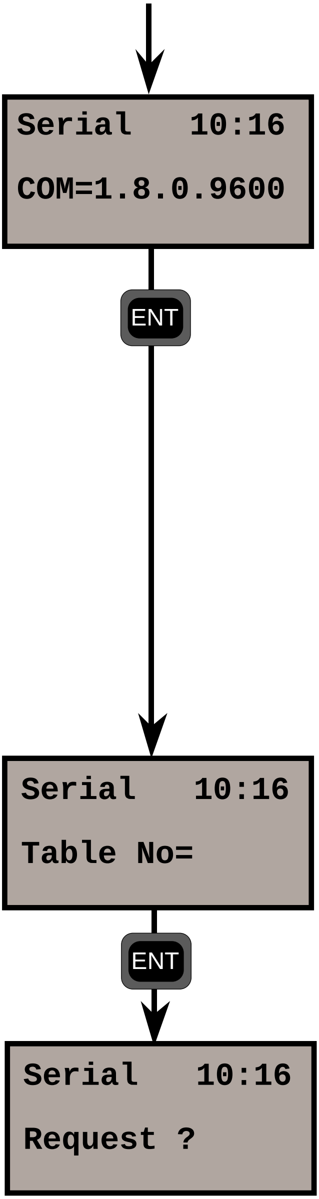
Select MNU 412 for output to external computer equipment via the serial interface connection. Setting the communication is done by following the instructions in the display and answering via the keyboard.



Connected device switched on or off ? Press Yes to continue. (Computer is switched on).

See next page

2 Serial output (Cont.)



Transmission parameters. The parameter setting can be accepted by just pressing ENT, changed completely by overwriting from the beginning, or changed by erasing each character using the CL-key.
The four transmission parameters which are separated by decimal points can have the following values:
Pos. 1: Number of stop bits 1 or 2
2: Number of data bits 7 or 8
3: Parity: No parity = 0
Odd parity = 1
Even parity = 2
Pos. 4: Baud rate: 50–19200 baud standard rates, e.g 300, 1200, 2400, 4800, 9600, 19200.

Select output table number = 0,1,2 or 3 and then press ENT.

Control of the output can be done 1) by the computer (Request?), 2) by pressing the REG-key of the instrument (REG key?) or 3) output can be continuous (Slave?).
Choice of method is made by answering YES to one of the following questions: Request?, REG Key? or Slave?.

Serial commands

When "Request" is selected data output is initiated from the computer by sending one of the following commands. The command is executed upon the carriage return.

RG, arg

Read Geodimeter

arg: (11=ddd)

Description: An output request is generated by this command.

Examples: To set the horizontal angle:
RG, 7=123.2345 (Label No=data)
RGN, HA=123.2345 (Label name=data)
RGD, 123.2345 (Only data, no label transmitted)
RGV, 7 (Label and data without equal)

WG, arg

Write to Geodimeter

arg: (11=ddd)

Description: The data associated with the label are transmitted to the instrument. The instrument must be in the correct mode to receive the data.

Examples: To set prism offset: WG, 20=0.065

TG arg

Trig Geodimeter

arg: < start measuring
> start long range measuring

Description: This command is equivalent to pressing the A/M key.

Examples: For measuring a short distance: TG

Larg

Load Memory

arg: <dir>=<file>; dir can be I (Area), M (Job), U (UDS) or * (Dumped Memory)

Description: Load the internal memory of the instrument or Geodat with a file.

Examples: To load U.D.S-program 15: LU=15

Oarg

Output from memory

arg: <dir>=<file>; dir=C, I, M, U, *

Description: To send out files from the internal memory of the instrument or external mem. (Geodat).

Examples: Output of all files in the AREA directory: OI*

When "REG-Key" is selected data corresponding to the actual output table will be transmitted when the REG-key is pressed.

The "Slave"-mode setting means that data are automatically transmitted every time an instrument measurement is completed without needing to press the REG key.

Hardware connection serial (RS-232/V24)

A cable (Part No. 571 136 756) is available which connects the Geodimeter instrument, the external battery and the computer. Computer connection is made via the 25 S female connector with the following configuration:

Pin	Signal
2	Data in (RXD)
3	Data out (TXD)
7	Ground (BATT–)
8	12 V (BATT+)

Tab. 5:5 Computer connection configuration

Value	Description
0	Instrument operating correctly, all required data are available.
3	The measured distance has already been recorded. A new distance measurement is required.
4	Measurement is invalid and recording not possible.
5	Recording is not possible with the selected mode setting of the Geodimeter instrument.
20	Label error. This label cannot be handled by the instrument.
21	Parity error in transferred data (between Geodimeter and interface).
22	Bad or no connection, or wrong device connected.
23	Time Out
30	Syntax error.
35	Data error.

Tab 5.3 Status Description

Output format.

The standard format of data from the interface is:

< Label > = < data >

Status.

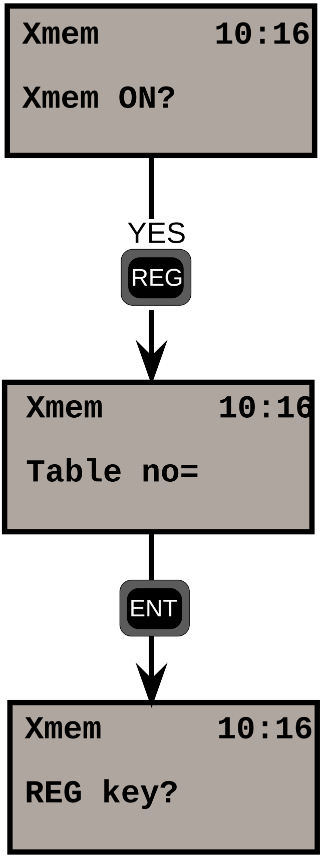
Status is a numeric value, transmitted before measurement data, and indicates those values which are about to be transmitted. This status value is non-zero if an error is detected. See table 5:3 for status description.

End of Transmission

The end of transmission, EOT, character is set in label 79, where the equivalent ASCII number is set. (Default is 62, e.g ">"). If set to 0 no EOT will be sent.

3. External memory

Select MNU 413, External Memory function, to use Geodat (which will act as a receiver of recorded data using the REG-Key of the instrument). The setup procedure contains the following display instructions:



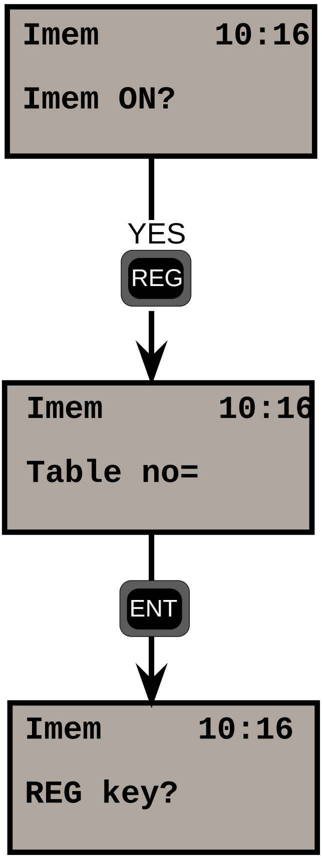
Yes to continue,No to interrupt. Press Yes..

Select output table number = 0,1,2 or 3 and then press ENT.

Control of the output can be done by pressing the REG key of the instrument (REG-key?) or continuous (Slave?). Choice of method is made by answering Yes to one of the following questions: REG-key? or Slave?.

4. Internal memory

Select MNU 414, Internal Memory, for recording to the additional software "Internal Memory". See more about the internal memory in the "Software Manual". The setup procedure contains the following display instructions:



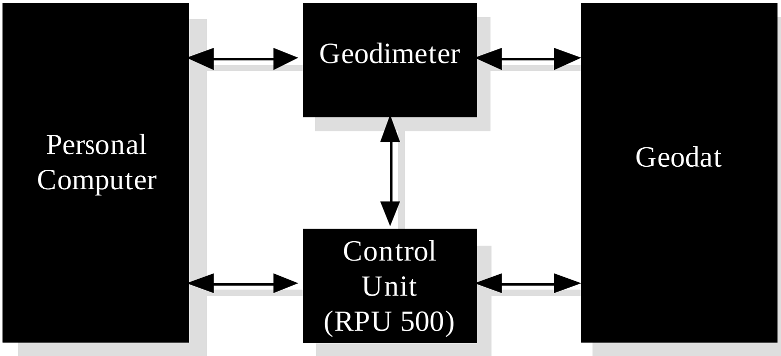
Yes to continue, No to interrupt. Press Yes..

Select output table number = 0,1,2 or 3 and then press ENT.

Control of the output can be done by pressing the REG key of the instrument (REG-key?) or continous (Slave?). Choice of method is made by answering Yes to one of the following questions: REG-key? or Slave?.

Data Communication

Geodimeter System 400/500 can be connected to an external device via a built in serial interface (RS-232) as described on the previous pages. This part of the manual will describe how to transfer data from and to the Geodimeter instruments. It also describes how to communicate with the control unit if you work with RPU 500 (only system 500).



Geodimeter ←→ Geodat

Connect the instrument and the Geodat via the cable 571 136 752 or via the battery using cables 571 136 754. Switch on both units and enter program 54 in the instrument.
Choose (From Geodat, To Imem) if data are to be transferred from the Geodat to the instrument or choose (From Imem, To Xmem) if data are to be transferred in the other direction.
See more about program 54 on page 2.4.18.

Control unit (RPU 500)←→ Geodat

Note! ☞ Only available in system 500.

Connect the Control unit and the Geodat to a charger via the cable 571 181 352 (220V), 354 (115V). Switch on both units and follow the Geodimeter - Geodat instructions for file transfer between the two units.

Note! ☞

Note !
To be able to transfer data from or to the RPU´s internal memory the Control unit has to be detached from the RPU

Geodimeter ◄──► Personal Computer

Connect the Geodimeter and the computer to a battery via the cable 571 136 756 and turn on both units. There are two ways to transfer data between these units:

1. Program 54

Enter program 54 in the instrument and choose (From imem, To serial) for transfer files from the instrument to the computer or choose (From serial, To imem) to transfer files in the other direction. In the second case the transfer is initiated by copying the file from the computer to the communication port.
See more about program 54 on page 2.4.18.

2. RS-232 commands

By sending the appropriate commands from the computer you can transfer data between the instrument and computer. Look at page 2.4.11 for a complete list of serial commands or see the Geodimeter interface compendium for further information.

Note! ☞ *Only available in system 500.*

Control unit (RPU 500) ◄──► Personal Computer

Connect the Control unit and the computer to a charger via the cable 571 136 874/876 and turn on both units. Then follow the Geodimeter-Personal Computer instructions for file transfer between the two units.

Note! ☞ *Only available in system 500.*

Control unit ◄──► Geodimeter

Connect the Station unit and the Control unit to a battery via the cable 571 181 350. Turn on both units and enter program 54. First choose (From Serial, To Imem) in the unit which shall receive data then choose (From Imem, To Serial) at the unit which shall send data. See more information about program 54 at page 2.5.19.

Note! ☞

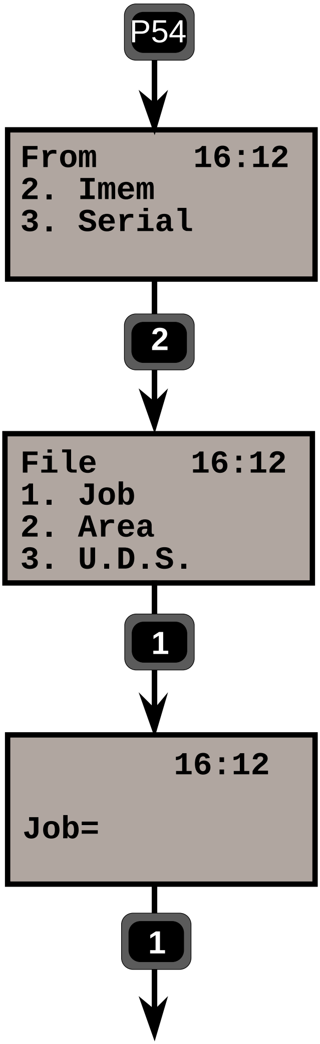
Note!

If no mains is available connect the cable 571 136 754 to a battery and use the 15-pin connector instead of the charger.

Program 54 - File transfer

Connect the two units with the appropriate cable and switch them on. Follow the instructions below:

Operation at the source unit



Choose program 54

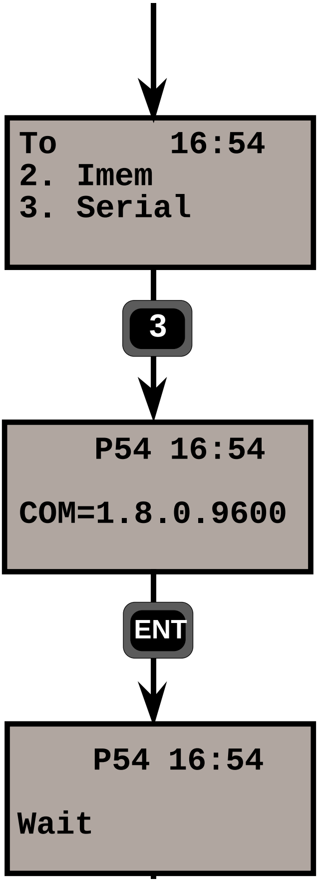
Choose device from which you want to transfer files.
In this example we choose 2 Imem.

Here you can choose the type of file you want to transfer:
1. A jobfile 2. An areafile or 3. An U.D.S.-file. In this example we choose 1. A jobfile.

Key in the name of the file.
In this example we key in Job=1

See next page

From previous page



To which device are you going to send the chosen files from the source unit.
Here we choose 3. serial.

Enter new serial parameters or accept the current.
Here we accept the current with enter.

Note! ☛

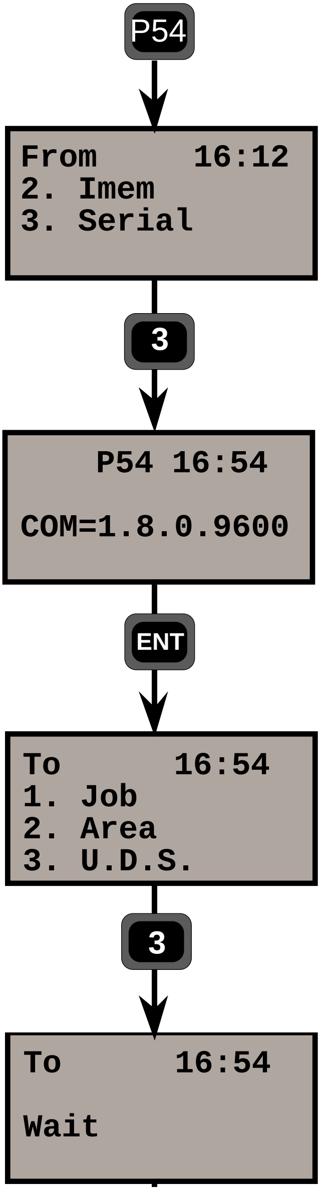
Note !
Prepare the target unit before accepting the serial parameters for a successful file transfer.

The file/s are sent via the cable and the display shows "Wait" during the transfer and you will then exit program 54.

Note! ☛

Note - Info19
If info 19 appears during a file transfer it means that the file transfer was not successful. In that case you should run the file transfer again and look for where it fails, that is when info 35 (Data error) will show. Check your file for any errors and if possible correct them with the editor.

Operation at the target unit



Choose program 54

From which device are you going to send files to the target unit. In this case it is 3. Serial.

Enter the serial parameters which must be same as the serial parameters at the source unit. In this example we accept the current with ENT.

What type of file should the transferred files be saved as: 1. Job, 2. Area or 3. U.D.S. In this example we choose 1. Job since we are transferring a Jobfile.

The unit is now ready to receive the transferred files. Now you should start the transfer from the source unit.

Power Supply

Batteries

Internal Battery

The internal (on-board) NiCd 12V, 1.0 Ah battery slides onto the underside of the measuring unit. This is the standard battery for the measuring unit. It can be recharged when drained via a charging converter over a period of 14 - 16 hours. It can also be recharged completely in 2 hours with the new fast battery charger. When fully charged it will supply power to the instrument for up to 2 hours of continuous use.

System 500

System 500:
Internal battery, part no.
571 200 320.

System 400

System 400:
Internal battery, part no
571 143 014

External Battery

The external NiCd 12V, 2Ah battery (Part No. 571 132 010) is common also to other Geodimeter instruments and is connected to the instrument by a special cable; it is attached to the tripod by one of two brackets onto which our data recording unit Geodat can also be attached. After drainage, it is charged by a battery charger over a period of 14-16 hours. When fully charged it will supply power to the instrument for 4 hours of continous use.

Fig 5.2 External Battery, 12V, 2Ah

External Heavy Duty Battery

The external NiCd 12 V, 6 Ah battery (Part No. 571 125 272) which is also common to other Geodimeter instruments, is connected to the instrument by a special cable; it is attached to the tripod by one of two brackets onto which our data recording unit Geodat can also be attached. After drainage, it is charged by a battery charger over a period of 14-16 hours. When fully charged it will supply power to the instrument for 12 hours of continous use.

Fig 5.3 External Heavy Duty Battery, 12V, 6Ah

Battery Cables

A battery cable is required if an external battery or car battery is used. The different types of cables are listed below:

Cable 571 136 754, for connecting Geodat to Geodimeter System 400/500 with external batteries.

Cable 571 136 756, for connecting Geodimeter System 400/500 to computer via RS 232 C V 24 interface and external battery.

Cable 571 125 140, adapter cable for connecting a car battery to the cables listed above.

Battery Charging

Geotronics AB produces special NiCd battery chargers which should be used at all times to charge Geodimeter batteries.
The system contains two different types of chargers:

Charger (571 901 017)

220 V or 115 AC battery charger. The charger has dual outputs that can handle two 6 Ah batteries (External heavy duty battery) or two charging converters, or one 6 Ah battery and one charging converter.

Charger BC 400 (571 126 090)

220 V or 115 AC battery charger for connection to the charging converter, for simultaneous charging of 3 batteries. With the charger connected to the charging converter each battery is treated individually.
The battery is first discharged, then charged for about 14 hours. When the charging is complete the charger switches over to trickle charge.

Fast Battery Charger (571 905 973/974) 220/115V

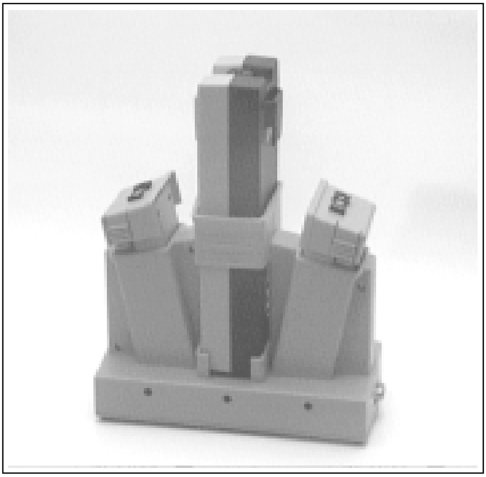
220V or 110VAC battery charger for all Geodimeter batteries equipped with a charging connector.
The charger has one output which can handle one battery.
The fast battery charger will decrease the charging time since it does not discharge the battery before charging it. The charging takes about 1 hour from empty to full. When the charging is complete the charger switches over to trickle charge.
The temperature while charging should be above +10°C, but should not exceed room temperature.

Charging Converter (571 143 984) - System 400

The charging converter is for single and multiple simultaneous charging of 1 external battery, 2 internal batteries in combination with the battery charger 571 126 090. This will supply the operator with power for 8 hours of continuous use.

Charging Converter (571 200 034) - System 500

The charging converter is for single and multiple simultaneous charging of 3 internal batteries in combination with the battery charger 571 901 017. This will supply the operator with power for 8 hours of continuous use.



About charging NiCd batteries

Charging time for a discharged NiCd battery is approximately 14-16 hours when using the standard charger. The temperature while charging should be above +5°C, but should not exceed room temperature. The condition of the battery will be better preserved by discharging it until the Geodimeter indicates "Bat Low", or until the automatic cut-out function is activated. Discharge of stored batteries can vary considerably, depending on the quality of the individual cells, especially at higher temperatures. It is therefore recommended to charge batteries which have not been used for two weeks or more.

Note

When your batteries need to be repaired or the battery cells have to be replaced, it is important that you leave your batteries to an authorised Geodimeter Service Shop for repair. Otherwise we do not guarantee the capacity of the batteries.

Bat Low

When battery capacity drops too low, "Bat Low" appears in the display window, and the instrument shuts off automatically. This gives you an opportunity to change the battery without losing instrument parameters and functions such as instrument height, signal height, coordinates, bearing, dual axis compensation, etc. Note that the battery change must not take longer than 2 hours; otherwise the above parameters and functions will be lost.

N.B.
This safety backup of the instrument's parameters and functions will work only when "Bat Low" appears on the display. It will not function if the battery is removed during operation.

Definitions & Formulas

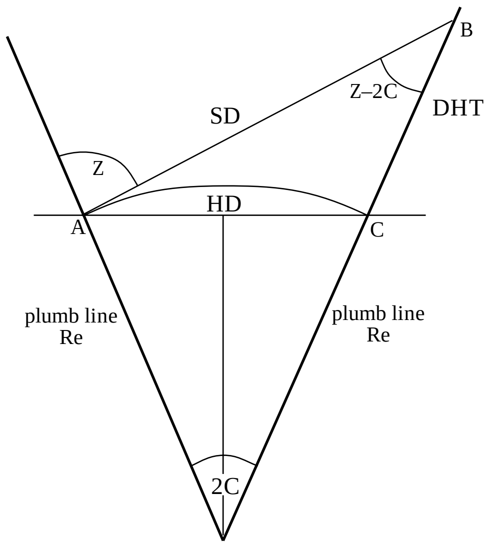
Corrections for Refraction, Curvature & Mean sea level errors

If projected distances and heights are computed by only multiplying the measured slope distance respectively by the sine and cosine of the measured zenith angle, the errors can be considerable due to the earth's curvature, refraction and height above mean sea level.
The two formulae which are used in the instrument for the automatic calculation of curvature, refraction and mean sea level errors can be seen below. If working at great heights these error factors can be calculated manually . It must be pointed out, that local values of Re and K will vary, depending on the geographical location of the survey area.

$$DHT = SD \times \cos Z + \frac{(SD)^2 \times \sin^2 Z}{2\,Re} (1 - K)$$

$$HD = SD \times \sin Z - \frac{(SD)^2 \times \sin 2Z}{2\,Re} (1 - K/2)$$

HD = Horizontal Distance, DHT = Difference in Height,
SD = Slope Distance, Re = Earth radius mean value = 6372 km
K = Refraction constant mean = 0.142

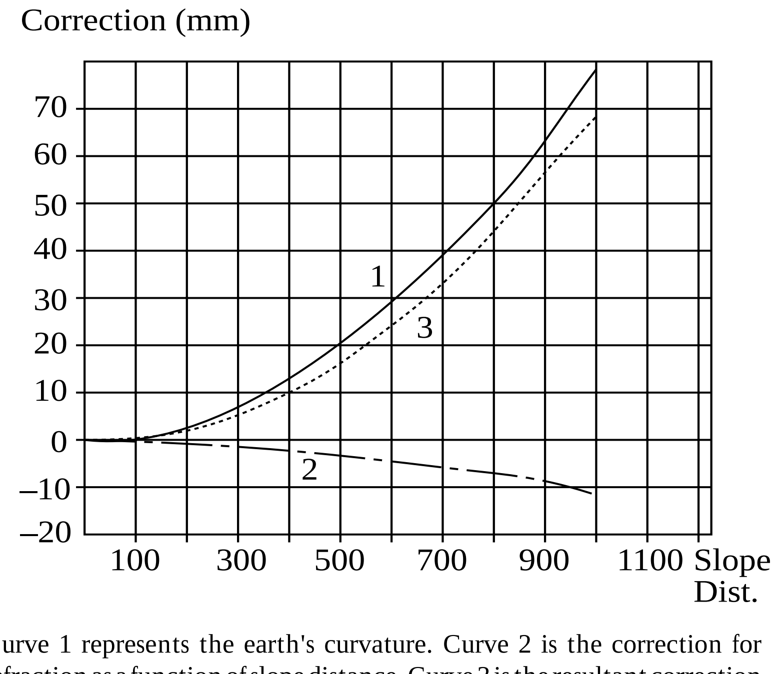


Correction for difference in height

Case 1:
Slope distance has not been corrected when displayed or recorded.

Case 2:
If different values of K and /or Re are used, adjust accordingly to the formula's standard values, which can be seen on the previous page; these values can normally be obtained from the local Ordnance Land Survey Authorities.

Example
Correction for the difference in height when close to the horizontal plane.

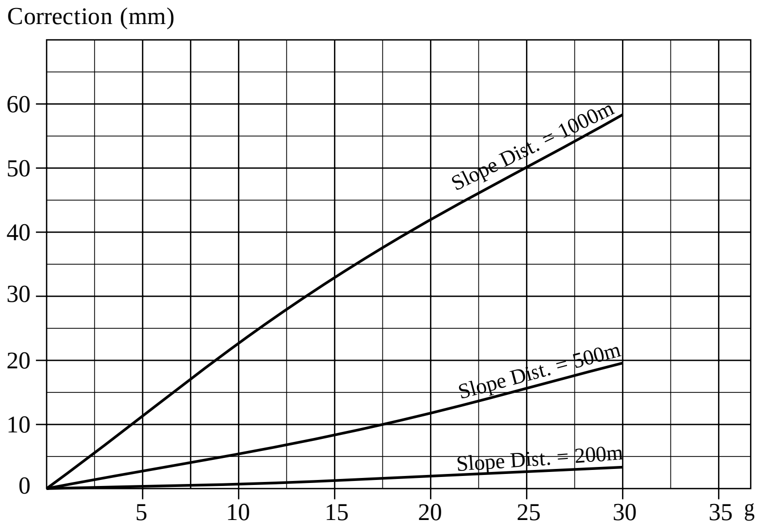


Curve 1 represents the earth's curvature. Curve 2 is the correction for refraction as a function of slope distance. Curve 3 is the resultant correction to be applied to the height obtained by multiplying the slope distance by cos z. This correction changes relatively slowly in relation to the deviation from the horizontal plane. At 20g (Z=80g), the corrections will have decreased 10%.

Correction of horizontal distance with regard to Mean sea level.

The correction for the earth's curvature and refraction that has to be applied to the horizontal distance (which has been obtained by multiplying the slope distance by sine Z) follows the curve shown in the figure below. The correction is proportional to the square of the slope distance and approximately directly proportional to the deviation from the horizontal plane for moderate elevations.

Example:
Correction of the horizontal distance.



Instrument Height

Instrument height is the vertical distance between the bench mark/ height point and the centre of the prism symbols on the side of the instrument – i.e., the line of collimation of the telescope.

Signal Height

Signal height is the vertical distance between the point of the rod and the centre of the target arrow marks on the Geodimeter System 400/500 reflector system. Remember to take into consideration the penetration depth of the ranging rod if working on very soft surfaces and if carrying out accurate survey work!

Atmospheric Correction

The speed of light varies slightly when passing through different air pressures and temperatures so an atmospheric correction factor must be applied in order to achieve the correct distance. This atmospheric correction factor is calculated according to the following formula:

$$ppm = 275 - 79.55 \times \frac{p}{273 + t}$$

p = pressure in millibars
t = air temperature in degrees centigrade (celsius)

Geodimeter System 400/500 calculates and corrects for this automatically.

Care & Maintenance

Overview

Geodimeter System 400/500 is designed and tested to withstand field conditions, but like all other precision instruments, it requires care and maintenance.

- ❑ Avoid rough jolts and careless treatment.
- ❑ Keep lenses and reflectors clean. Always use lens paper or other material intended for cleaning optics.
- ❑ When the instrument is not being used, keep it protected in an upright position.
- ❑ We strongly recommend you not to carry the instrument while it is mounted on the tripod in order to avoid damage to the tribrach screws.
- ❑ Servo instruments only
  Do not rotate the instrument by the handles.This may have an effect on the HA ref. How much it effects the value depends on the quality of the tribrach and tripod. Use instead the servo controls to rotate the instrument.

Warning: Geodimeter System 400/500 is designed to withstand normal electromagnetic disturbance from the environment. However, the instrument contains circuits sensitive to static electricity and the instrument cover must not be removed by unauthorized personnel. If the instrument cover has been opened by an unauthorized person, the function of the instrument is not guaranteed and the instrument guarantee becomes invalid.

Cleaning

Caution must be exercised when the instrument is cleaned, expecially when sand and dust are to be removed from lenses and reflectors. Never use coarse or dirty cloth or hard paper. Anti-static lens paper, cotton wad or lens brush are recommended.

Condensation

After survey in moist weather the instrument should be taken indoors, the transport case opened and the instrument removed. It should then be left to dry naturally. It is recommended that condensation which forms on lenses should be allowed to evaporate naturally.

Packing for Transport

The instrument should always be transported in its transport case,which should be locked.

For shipment to a service shop, the names of the sender and the receiver should always be specified clearly on the transport case.

When sending this instrument for repair, or for other service work,a note describing fault, symptoms or requested service should always be enclosed in the transport case.

Warranty

GEOTRONICS AB guarantees that the Geodimeter instrument has been inspected and tested before delivery. The length of the warranty is stated in the Warranty Conditions.

All enquiries regarding the warranty should be directed to the local Geodimeter representative.

APPENDIX A – LABEL LIST

F

No.	Text	Description
0	Info	Information
1	Data	Data used in INFO/DATA combination
2	Stn	Station No
3	I H	Instrument Height
4	Pcode	Point Code
5	Pno	Point Number
6	SH	Signal Height
7	HA	Horizontal Angle
8	VA	Vertical Angle
9	SD	Slope distance
10	DHT	Vertical Distance (IH and SH not included)
11	HD	Horizontal distance
12	SqrAre	Surface area (Result from Program 25)
13	Volume	Volume (Result from Program 25)
14	Grade	Percent of grade ((DHT/HD)*100)
15	Area	Area file
16	dH	Difference between C1 and C2 horizontal angles (Only Geo-dimeter Instru-ment)
17	HAII	Horizontal angle which was measured in C2 and stored (Only Geo-dimeter Instru-ment)
18	VAII	Vertical Angle which was measured in C2 and stored (Only Geo-dimeter Instru-ment)
19	dV	Difference between C2 and C1 vertical angles (Only Geo-dimeter Instru-ment)
20	Offset	Offset constant which can be added to or subtracted from the SD
21	HAref	Horizontal Reference Angle
22	Comp	Compensator ON=1, OFF=0
23	Units	Status of unit set, ex. Status=3214 (Mills Meter Fahrenheit InchHg)
24	HAI	Horizontal angle which was measured in C1
25	VAI	Vertical angle which was measured in C1
26	SVA	Setting out vertical angle
27	SHA	Setting out horizontal angle
28	SHD	Setting out horizontal distance
29	SHT	Setting out height
30	PPM	Atmospheric Correction, parts per million (PPM)
31	BM ELE	Benchmark elevation
33	PrismC	Prism constant
37	N	Northing coordinates. Cleared when power OFF
38	E	Easting coordinates. Cleared when power OFF
39	ELE	Elevation coordinates. Cleared when power OFF (39=49+STN HT)
40	dN	Relative to stored X (N) coord of set out point (P23)
41	dE	Relative to stored Y (E) coord of set out point (P23)
42	dELE	Relative to stored Z (ELE) coord of set out point (P23)
43	UTMSC	Universal Transverse Mercator Scale Factor.

F

APPENDIX A – LABEL LIST

No.	Text	Description
44	Slope	Slope inclination
45	dHA	Difference in height when establishing the station (P20)
46	S_dev	Standard deviation
47	Nr	Rel. North Coord.
48	Er	Rel. East Coord.
49	VD	Vertical distance (IH and SH included) (49 = 10+3-6)
50	JOB No	Job No file for storage of raw and calculated data.
51	Dat.	Date
52	Time	Time
53	Operat	Operator identification
54	Proj	Project identification
55	Inst.No	Instrument Number
56	Temp	Temperature
57	Blank	Empty row in UDS's where it is convenient to have a blank line.
58	EA Rad	Earth Radius
59	Refrac	Refraction
60	ShotID	Shot Identity
61	Activ	Activity Code
62	Ref Obj	Reference Object
63	Diam	Diameter
64	Radius	Radius
65	Geom	Geometry
66	Figure	Figure
67	SON	Northing Coordinate of setting out point
68	SOE	Easting Coordinate of setting out point
69	SHT	Elevation of setting out point
72	Radoffs	Radial offset dimension calculated in setting out program.
73	Rt.offs	Right angle offset dimension calculated in setting out program.
74	Press	Air Pressure
75	dHT	Difference between ELE and SHT (75=29-39)
76	dHD	Difference between setting out distance & measured distance
77	dHA	Difference between setting out bearing & the present instr. pointing
78	Com	Communication protocol parameter settings.
79	END	Signifies the end of the User Definable Sequence
80	Sec	Section
81	A-param	A-parameter
82	SecInc	Section Interval
83	Cl.ofs.	Center line offset
90-99	–	Labels which can be defined by the user

MNU

APPENDIX B – MAIN MENU CONFIGURATION

1 Set	1 PPM	Temp Press PPM
	2 ROE	ROE preset
	3 Decimals	No of decimals Label no
	4 Display	1 Select display 2 Create display
	5 Clock	1 Set time 2 Time system
	6 Switches	Targ. test on? AIM / REG off? Pcode on? Info.ack off ? HT_meas on?¤ Pow. save on?* North=0 ?, Prg_num on ?
	7 Unit	Metre Feet Deg Grads Decdeg Mills Cels Fahr mmHg InHg mbar
	8 Illum	1 Display 2 Reticle*
	9 Language	Sw No De Ge Ja Uk Us It Fr Sp
2 Editor	1 Xmem	
	2 Imem	
3 Coord	1 Stn Coord	N (X) E (Y) ELE (Z)
	2 SetOut Coord	SON SOE SHT
4 Data com	1 Select device	1 Geodat 2 Serial 3 Xmem 4 Imem
	2 Create table	Table no
5 Test	1 Measure	Measure New Collimation & Hor Axis Tilt
	2 View current	H Collimation V Collimation Hor Axis Tilt
6 Configure	1 Prism const.	

¤ Only if the station has been established

* Only valid for System 500