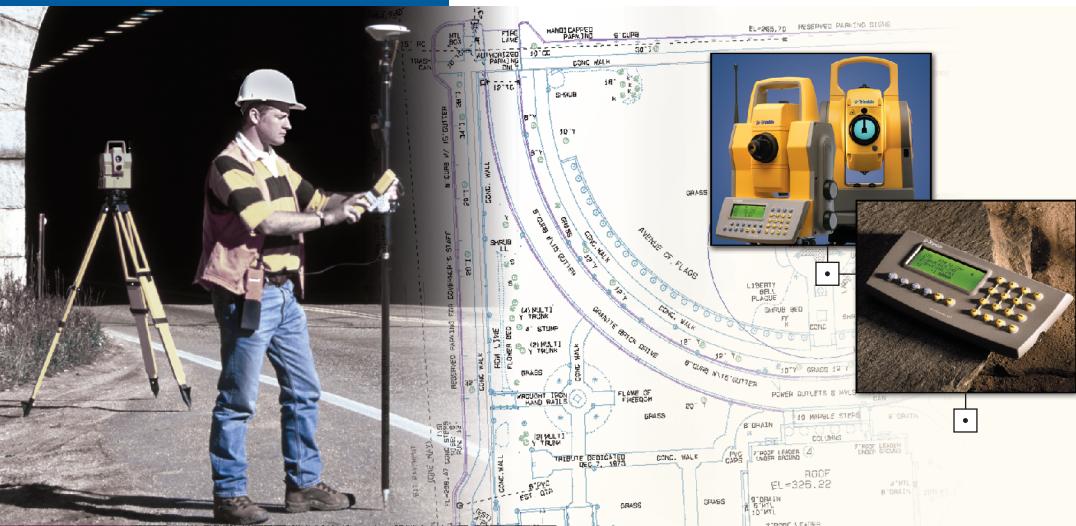
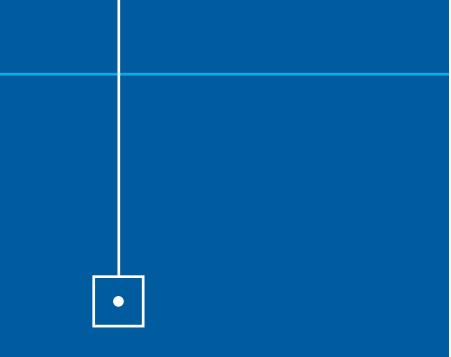


Geodimeter® CU

1



www.trimble.com

 **Trimble**™

Geodimeter® CU

User Guide Part 1



Version 03.00
Part Number 571 702 001
June 2005

Corporate Office

Trimble Navigation Limited
5475 Kellenburger Road
Dayton, Ohio 45424-1099
U.S.A.

800-538-7800 (Toll Free in U.S.A.)
+1-937-233-8921 Phone
+1-937-233-9441 Fax
www.trimble.com

Copyright and Trademarks

Copyright © 2001-2005, Trimble Navigation Limited. All rights reserved.

Geodimeter, Terramodel, Tracklight and Trimble are trademarks of Trimble Navigation Limited, registered in the United States Patent and Trademark Office.

The Globe & Triangle logo and Autolock are trademarks of Trimble Navigation Limited.

All other trademarks are the property of their respective owners.

Release Notice

This is the June 2005 release version 03.00 of the Geodimeter CU User Guide part 1, part number 571702001. It applies to the Geodimeter CU Control Unit

The following limited warranties give you specific legal rights. You may have others, which vary from state/jurisdiction to state/jurisdiction.

Hardware Limited Warranty

Trimble Navigation Limited warrants that this hardware product (the "Product") will perform substantially in accordance with published specifications and be substantially free of defects in material and workmanship for a period of one (1) year starting from the date of delivery. The warranty set forth in this paragraph shall not apply to software products.

Software License, Limited Warranty

This Trimble software product, whether provided as a stand-alone computer software product, built into hardware circuitry as firmware, embedded in flash memory, or stored on magnetic or other media, (the "Software") is licensed and not sold, and its use is governed by the terms of the relevant End User License Agreement ("EULA") included with the Software. In the absence of a separate EULA included with the Software providing different limited warranty terms, exclusions and limitations, the following terms and conditions shall apply. Trimble warrants that this Trimble Software product will substantially conform to Trimble's applicable published specifications for the Software for a period of ninety (90) days, starting from the date of delivery.

Warranty Remedies

Trimble's sole liability and your exclusive remedy under the warranties set forth above shall be, at Trimble's option, to repair or replace any

Product or Software that fails to conform to such warranty ("Nonconforming Product") or refund the purchase price paid by you for any such Nonconforming Product, upon your return of any Nonconforming Product to Trimble in accordance with Trimble's standard return material authorization procedures.

Warranty Exclusions and Disclaimer

These warranties shall be applied only in the event and to the extent that the Products and Software are properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Trimble's relevant operator's manual and specifications, and: (ii) the Products and Software are not modified or misused. The preceding warranties shall not apply to, and Trimble shall not be responsible for defects or performance problems resulting from (i) the combination or utilization of the Product or Software with hardware or software products, information, data, systems, interfacing or devices not made, supplied or specified by Trimble; (ii) the operation of the Product or Software under any specification other than, or in addition to, Trimble's standard specifications for its products; (iii) the unauthorized modification or use of the Product or Software; (iv) damage caused by accident, lightning or other electrical discharge, fresh or salt water immersion or spray; or (v) normal wear and tear on consumable parts (e.g., batteries). Trimble does not warrant or guarantee the results obtained through the use of the Product.

THE WARRANTIES ABOVE STATE TRIMBLE'S ENTIRE LIABILITY, AND YOUR EXCLUSIVE REMEDIES, RELATING TO PERFORMANCE OF THE PRODUCTS AND SOFTWARE. EXCEPT AS OTHERWISE EXPRESSLY PROVIDED HEREIN, THE PRODUCTS, SOFTWARE, AND ACCOMPANYING DOCUMENTATION AND MATERIALS ARE PROVIDED "AS-IS" AND WITHOUT EXPRESS OR IMPLIED WARRANTY OF ANY KIND BY EITHER TRIMBLE NAVIGATION LIMITED OR ANYONE WHO HAS BEEN INVOLVED IN ITS CREATION, PRODUCTION, INSTALLATION, OR DISTRIBUTION INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, TITLE, AND NONINFRINGEMENT. THE STATED EXPRESS WARRANTIES ARE IN LIEU OF ALL OBLIGATIONS OR LIABILITIES ON THE PART OF TRIMBLE ARISING OUT OF, OR IN CONNECTION WITH, ANY PRODUCTS OR SOFTWARE. SOME STATES AND JURISDICTIONS DO NOT ALLOW LIMITATIONS ON DURATION OR THE EXCLUSION OF AN IMPLIED WARRANTY, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

TRIMBLE NAVIGATION LIMITED IS NOT RESPONSIBLE FOR THE OPERATION OR FAILURE OF OPERATION OF GPS SATELLITES OR THE AVAILABILITY OF GPS SATELLITE SIGNALS.

Limitation of Liability

TRIMBLE'S ENTIRE LIABILITY UNDER ANY PROVISION HEREIN SHALL BE LIMITED TO THE AMOUNT PAID BY YOU FOR THE PRODUCT OR SOFTWARE LICENSE. TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, IN NO EVENT SHALL TRIMBLE OR ITS SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER UNDER ANY CIRCUMSTANCE OR LEGAL THEORY RELATING IN ANY WAY TO THE PRODUCTS, SOFTWARE AND ACCOMPANYING DOCUMENTATION AND MATERIALS, (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION, OR ANY OTHER PECUNIARY LOSS), REGARDLESS WHETHER TRIMBLE HAS BEEN ADVISED OF THE POSSIBILITY OF ANY SUCH LOSS AND REGARDLESS OF THE COURSE OF DEALING WHICH DEVELOPS OR HAS DEVELOPED BETWEEN YOU AND TRIMBLE. BECAUSE SOME STATES AND JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

NOT WITHSTANDING THE ABOVE, IF YOU PURCHASED THIS PRODUCT OR SOFTWARE IN THE EUROPEAN UNION, THE ABOVE WARRANTY PROVISIONS MAY NOT APPLY. PLEASE CONTACT YOUR DEALER FOR APPLICABLE WARRANTY INFORMATION.

Notices

Class B Statement – Notice to Users. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes and modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under Federal Communications Commission rules.



Welcome to Geodimeter CU Control unit

Comments about this manual	B
Glossary of terms used with Geodimeter CU	B
Environmental Information	E

1 Introduction

Unpacking & Inspection	1-2
Inspection	1-2
The Control unit	1-2
Detachable Control Unit	1-3
Assigned Control Units.....	1-4
Additional Control Units.....	1-4
The Display	1-6
Settings.....	1-7
Key Functions	1-10
Alpha Character Keying in (Numeric CU)	1-21
Alpha Character Keying in (Alphanumeric CU)	1-22
Servo Control Keys (Num. and Alphanum. CU).....	1-24
Continue Key	1-25
Temporary Horizontal Angle Key	1-25

2 Memory Units

Introduction	2-2
Unit Description	2-2
Unit Capacity	2-2
Program 54 – File Transfer	2-3
Edit.....	2-3
Setting up Internal Memory as an Active Memory Device	2-4
Info Messages	2-6
Data Communication	2-6

Table of Contents

Setting up CU as an Active Memory Device.....	2-7
3 Memory Structure	
Introduction	3-2
Memory Structure	3-2
Job Files	3-2
Area Files	3-3
Edit File.....	3-4
File Transfer.....	3-5
4 Data Communication	
Introduction	4-2
Data Transfer	4-2
Control Unit Personal Computer	4-2
Serial Communication.....	4-4
Description of the Command Instructions	4-4
Geodimeter Language (Geo/L) Syntax Structure	4-6
Protocol	4-8
Directory	4-10
Kill	4-11
Load	4-12
Memory.....	4-13
Mode	4-14
Output	4-15
Position	4-16
Read	4-17
Trig.....	4-20
Write	4-21
Status Description	4-22

5 Pre-Measurement

Office Setup	5-2
Connecting the External Battery to the Control Unit....	5-2
Turn on Power.....	5-2
Pre-Settings	5-5
Set Unit (e.g Metres, Feet, Grads, Degrees etc.).....	5-6
Set Time & Date	5-8
Special Settings	5-13
Create & Select Display Tables	5-13
Create & Select a New Display	5-14
Number of Decimals	5-18
Switches	5-20
Standard Measure.....	5-26
Select Type of Language	5-27
Test Measurements	5-28
Measurement of Collimation & Tilt of Horizontal Axis.	5-29
Tracker Coll – Calibration of the Tracker (Only for Trimble System 5600).....	5-35
Instrument Test.....	5-37

6 Start Procedure

Start Procedure.....	6-2
Field Setup	6-2
Startup	6-3
Calibration of Dual-Axis Compensator With Servo	6-4
Calibration of Dual-Axis Compensator Without Servo	6-5
Pre-Setting of Temp., Press, Humidity, Offset & HArefer.....	6-7
Station Data (Instr. Height, Signal Height, Stn. Coord.).....	6-10
Coordinate System	6-15

Table of Contents

7 Carrying Out A Measurement	
Distance & Angle Measurement	7-2
Standard Measurement (STD Mode)	7-2
Two-Face Standard Measurement (C1/C2)	7-5
Fast Standard Mode	7-9
D-bar Measurement (D-bar Mode)	7-10
D-bar two-face Measurement (C1/C2)	7-13
Collecting Detail & Tacheometry (TRK-Mode).....	7-18
Setting Out (TRK Mode)	7-22
Setting Out Using Pre-calc. Bearing & Horizontal Distances SHA & SHD	7-23
Setting Out Using Coordinates	7-27
Measuring Differences Robotic Surveying (Servo)....	7-35
8 Direct Reflex (only DR Instruments)	
In General	8-2
Settings.....	8-4
Standard Deviation.....	8-4
Measuring method	8-5
Distance Interval	8-6
Pointer	8-8
Measuring Object.....	8-13
Distance C1/C2	8-14
STD DR Measurement	8-16
Problems to Reach the S_Dev.....	8-17
9 Surveying methods	
In General (only servo)	9-2
Conventional Surveying With Servo	9-2
Autolock (Only Servo).....	9-3
Robotic Surveying (Only Servo)	9-3

RMT Configuration.....	9-4
Conventional Surveying With Autolock (Only Servo).....	9-6
Important Information When Measuring With High Accuracy (and Using the Instrument's Tracker)	9-6
How to Work With Autolock	9-7
Aiming	9-8
Robotic Surveying (Only Servo)	9-10
Important Information When Measuring With High Accuracy (and Using the Instrument's Tracker)	9-10
Equipment	9-10
Radio Communication	9-11
How to Work With Robotic Surveying	9-11
Search Window	9-13
Activation of the RPU.....	9-15
Aim & Measure.....	9-17
Establishing Contact From a Detached Control Unit ...	9-19
Switch to Measurement Towards an Ordinary Prism...	9-20
Switch Back to Robotic Surveying	9-21
Search Functions in Robotic Surveying	9-23
Automatic: on (in Autolock or Robotic Mode).....	9-24
Adv.lock: on (Only in Robotic Mode)	9-24
RMT600TS: on (Only in Robotic Mode and With RMT600TS).....	9-25
Eccentric Point.....	9-25
The RPU Menu	9-29

10 Important Pages

ASCII Table	10-2
General Measurement Hints.....	10-4
Backup of Memory	10-4
Reboot the Keyboard Unit	10-4

Table of Contents

Collimation Errors	10-6
Tilt Axis	10-6
How to Combine Labels 26, 27, 28 and 29	10-6
Fetch Station Data (MNU 33).....	10-7
How to set out Using Autolock (Only Servo).....	10-7
Measuring Towards Corners Using Autolock.....	10-8
How to Check What is Installed in Your Keyboard Unit...	
10-8	
Temporary Horizontal Angle in P0.....	10-9
Description of Label 23	10-9
Info Codes	10-11
11 Angle Measurement System	
Overview	11-3
The Angle Measuring Technique	11-3
Dual Axis Compensator	11-3
Correction for Collimation Errors.....	11-4
Correction for Trunnion Axis Tilt.....	11-4
Calculation of the Horizontal Angle	11-5
Calculation of the Vertical Angle.....	11-5
Single-Face Angle Measurement	11-6
Two-Face Angle Measurement.....	11-6
12 Distance Measurement System	
Overview	12-3
Distance Measurement.....	12-3
Standard Measurement (STD Mode)	12-4
Fast Standard Measurement (STD mode)	12-5
Switch Between Fast Standard and Standard Measurement Mode	12-5
Precision Measurement (D-bar).....	12-5
Tracking Measurement (Setting Out)	12-6

Measurement Towards Moving Targets.....	12-7
Long Range Measurements.....	12-7
Target Data On/Off	12-8
Automatic Control of Signal Level.....	12-9
Measurement Beam Width.....	12-9
Measurement Range.....	12-9
Accuracy	12-10
Important Information When Measuring With High Accuracy	12-10
R.O.E (Remote Object Elevation).....	12-10
Different Combinations of Instrument Height (IH) & Signal Height (SH)	12-12
UTM Scale Factor Corrected Distances	12-14
UTM Example	12-15
13 Tracklight	
Overview	13-3
How to Activate Tracklight.....	13-4
14 Servo	
Servo Controls	14-2
Servo Control keys.....	14-2
15 Tracker (only for servo instruments)	
Overview	15-3
Tracker Operation	15-3
Search Criteria (OPTIONAL for Autolock)	15-3
Lock on Target	15-4
Controlling the Tracker (OPTIONAL for Autolock)	15-5
Window Control.....	15-5
Search Control	15-7

Table of Contents

Guidelines	15-9
Reference Control in Robotic Mode	15-10
16 Radio	
Overview	16-2
Radio Controls	16-2
Select Radio Channel.....	16-2
Station Address	16-2
Radio License.....	16-3
Radio Contact.....	16-3
Range	16-4
Info Codes.....	16-4
External Radio	16-5
17 Data Logging	
Data Recording	17-2
Control of Data Registration.....	17-3
Data Output	17-4
Standard Output	17-4
Tracking Mode (TRK)	17-5
D-bar Mean Value Mode.....	17-5
User Defined Output	17-7
How to Create an Output Table	17-7
Type of Memory Device	17-9
1. Internal Memory	17-10
2. Serial Output	17-11
Serial Commands	17-13
3 Xmem.....	17-17
Data Communication	17-19
CU PC	17-19
Instrument With CU PC	17-20
CU Instrument With CU	17-20

Instrument With CU Card Memory	17-21
Card Memory PC	17-22
18 Definitions & Formulas	
Corrections for Refraction and Curvature	18-2
Correction for Difference in Height	18-4
Correction of Horizontal Distance	18-5
Instrument Height	18-5
Signal Height	18-6
Atmospheric Correction	18-6
19 Appendix A	
Label List	19-1
20 Appendix B	
Main Menu Configuration.....	20-1

Table of Contents

Welcome to Geodimeter CU Control unit

Trimble® AB, has since the release of Geodimeter® System 400 presented a large number of inventions within the surveying field; the tracklight®, the alpha-numeric keyboard, servo, one-person total station etc.

In 1994 we introduced the first flexible total station, Geodimeter System 600, which made it possible for the user to physically tailor his or her total station to his/her needs. In 1998 Geodimeter System 600 Pro was introduced which included a number of technical improvements such as a faster CPU and faster and smoother servo positioning.

The first introduction in 2000 was the Geodimeter 600 ATS. An instrument that can also be used for machine control.

To improve productivity of the Geodimeter System 600 even further, a new Direct Reflex and servo driven model, DR200+, was launched the same year.

The Trimble 5600 series was introduced in 2001 and in 2002 came the introduction of DR Standard and DR300+.

The system includes, of course, all the features that are typical for Geodimeter, such as servo-assisted drive (optional), numeric or alpha-numeric control units (keyboards), tracklight, tracker (optional), radio side cover (optional) and RS-232C communication.

Comments about this manual

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

Trimble AB

Technical Information
Box 64
SE-182 11 DANDERYD
Sweden

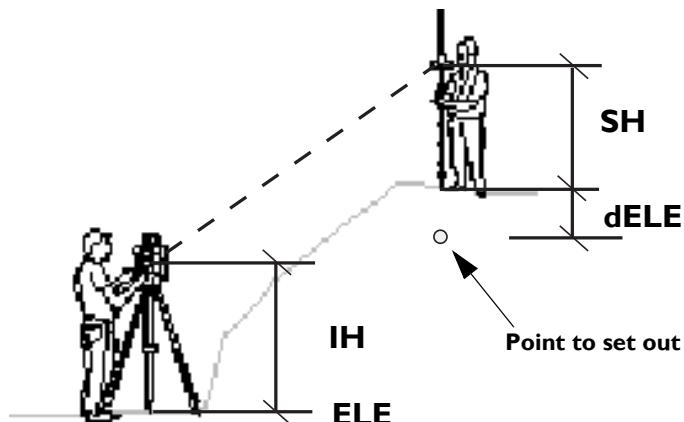
Or send an e-mail to: info@trimble.se

Glossary of terms used with Geodimeter CU

- Area File:** A file in a Geodimeter CU memory device that holds known coordinates (Pno, N, E etc.) or Roadline data.
- A/M-key:** Aim/Measure button. Initiates a measurement and controls search and remote measurements.
- D:** Accurate measurement with mean value calc.
- dH & dV:** These values represents the collimation errors. When performing D-bar measurements in two faces these errors are blanked out and do not affect the accuracy of the measurement (HA, VA). If the values differs a lot from 0 it is recommended that you perform a test measurement (MNU5), see page 5-28.

Free Station:	Also known as Resection. Location of the total station by measuring distance and/or angles to 2 or up to 8 points.
FSTD:	Fast Standard measurement, with A/M.
IH:	Instrument height over the point.
Job File:	A file in a Geodimeter CU memory device that holds data collected in the field. This file can consist of any data.
Log on:	Entering Job file and memory unit when designing an U.D.S with program 40.
Offset:	Length offset to measured slope distance.
Prism const:	The prism's length offset from the 0-constant.
Ref. Obj:	Reference Object, also back sight.
REG-key:	The register key. This stores data in the data collector.
RMT:	Remote Measuring Target. The special prism used when performing robotics surveying (or remote surveying with auto lock), i.e. carrying out one-person measurements.
R.O.E:	Remote Object Elevation. See page 12-10.
RPU:	Remote Positioning Unit. The rod half of the system when performing remote or robotic surveying.
SH:	Signal height.
STD:	Standard measurement, with A/M.

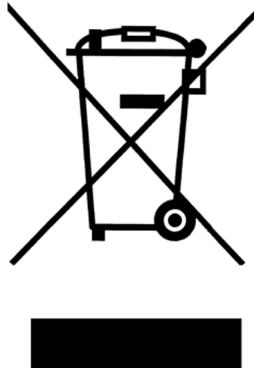
-
- TRK:** Tracking measurement, automatic and continuous measurement.
- U.D.S.:** User Defined Sequence. A program designed by the user determining what is collected, its order of collection and how it is displayed on the screen.



Environmental Information

NOTICE FOR TRIMBLE'S EUROPEAN UNION CUSTOMERS

Trimble is pleased to announce a new recycling program for our European Union customers. At Trimble, we recognize the importance of minimizing the environmental impacts of our products. We endeavor to meet your needs, not only when you purchase and use our products, but also when you are ready to dispose of them. That is why Trimble is actively pursuing, and will continue to pursue, the expanded use of environmentally friendly materials in all its products, and why we have established a convenient and environmentally friendly recycling program.



As Trimble makes additional recycling facilities available for your use, we will post their locations and contact information to our Recycling Instructions web page.

For product recycling instructions and more information, please go to

www.trimble.com/environment/summary.html

Recycling in Europe:

To recycle Trimble WEEE,

Call +31 497 53 2430, and ask for the "WEEE Associate"

Or

Mail a request for recycling instructions to:

Trimble Europe BV
c/o Menlo Worldwide Logistics
Meerheide 45
5521 DZ Eersel, NL

1

Introduction

Unpacking & Inspection	1-2
Inspection.....	1-2
The Control unit	1-2
Detachable Control Unit.....	1-3
Assigned Control Units	1-4
Additional Control Units	1-4
The Display	1-6
Settings	1-7
Key Functions	1-10
Alpha Character Keying in (Numeric CU)	1-21
Alpha Character Keying in (Alphanumeric CU).....	1-22
Servo Control Keys (Num. and Alphanum. CU).....	1-24
Continue Key	1-25
Temporary Horizontal Angle Key	1-25

Unpacking & Inspection

Before we begin to describe the operating procedure of your Geodimeter Control Unit, it is first necessary to acquaint yourself with the equipment & User manuals received.

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 Trimble sales representative. Keep the container and packing material for the carrier's inspection.

The Control unit

The CU is available in an alphanumeric version. The alphanumeric control unit simplifies the entering of point codes and basic editing by having all alpha characters on separate keys. The alphanumeric control unit consists of 33 keys: the numerals 0-9, letters A-Z, and control keys. The control keys comprise the choice of functions 0-126, choice of menu, choice of program and choice of measurement mode, together with clear and enter functions etc. see figure 1.1. The control unit is more than just a keyboard, it also contains the internal memory as well as any of the softwares that are available.



Figure 1.1 Geodimeter CU alphanumeric control unit.



Figure 1.2 Geodimeter 600 CU alphanumeric control unit.

Detachable Control Unit

The control unit is detachable and this makes it very easy for the user to transfer data. Simply detach the control unit after a survey and bring it to the office (it's very handy and fits in a normal size pocket). Attach the control unit to a computer using the multi functional cable. Run Program 54 or Terramodel® Field Data Module to transfer data between the units.

Note – The control unit should not be attached/detached when the instruments is switched on.



Figure 1.3 How to attach/detach the control unit.

Assigned Control Units

In a surveying team each member can have his/her own control unit with his/her own setups, software and internal memory. This means that any operator can attach his/her assigned control unit to any Trimble System 5600 and get it to work with His/her specific U.D.S's and setups.

Additional Control Units

With System 5600 you can work with two control units attached at the same time: one at the back of the instrument that serves as a master control unit and one at the front that serves as a slave unit.

Having two control units attached at the same time can be useful having in mind that they also contain internal memories.

The control unit at the front can also be very useful when measuring in two faces when you want to keep control of the point to measure in face 2.

The Display

The Geodimeter CU has a four-row Liquid Crystal Display (LCD) where each row contains 20 characters. 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 mode, program choice, clock, indication of returned signal (*) and battery condition (■).



Figure 1.4 Geodimeter CU display

If an offset or a prism offset has been set this will be indicated by (!) between the hour and the minute in the clock. Alpha-numeric keyboard also display if alpha mode α , shift (^) or lower case (l) is activated. The second to fourth rows display the respective labels and values of measurement. Each display table consist of a series of “pages” which can be “turned” with the ENT-key.

Settings

MNU 1 3

By pressing MNU, 1, 3 you can set the following:

- Display illumination
- Reticle illumination
- Contrast and viewing angle
- Reflected Signal volume

Press the corresponding key below “Sel” to select what to set. Use the corresponding key right below “Exit” to return to the main menu.

Display illumination

Press the corresponding key below “OFF” to turn the illumination ON/OFF. Press the corresponding key below “<-” to decrease the illumination. When you have reached the maximum resp. minimum illumination one of the arrows is blanked out. The arrows will not be shown if the option is turned off. A long press on the  key will turn the display illumination on/off.



Note – OFF indicates that the corresponding key below will turn the option off.

Contrast and viewing angle

Press the corresponding key below “<-” to decrease the contrast and press the corresponding key below “<-” to increase the contrast. When you have reached the maximum resp. minimum contrast one of the arrows are blanked out. The arrows will not be shown if the option is turned off.



Note – You will find that the contrast setting is most effective under cold temperature conditions.

Reticle illumination

Press the corresponding key below “Off” to turn the illumination ON/OFF. Press the corresponding key below “<-” to decrease the illumination and press the corresponding key below “->”. When you have reached the maximum resp. minimum illumination one of the arrows is blanked out. The arrows will not be shown if the option is turned off.



Note – Off indicates that the corresponding key below will turn the option off.

Reflected signal volume

Press the corresponding key below “<-” to decrease the volume level and press the corresponding key below “->” to increase the volume level. When you have reached the maximum resp. minimum level one of the arrows is blanked out. The arrows will not be shown if the option is turned off.

Hint! Aim the instrument towards the prism so that you can hear the current volume level. Only in prism mode if it is a DR instrument.



User-defined display tables

With the “Config Display” application it is possible to define your own display table, if the existing table does not fulfil your needs during the execution of a special survey application.

For further information refer to page 1-7. All labels in the System can be displayed.

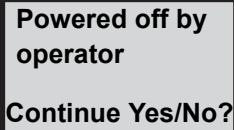
Key Functions

ON/OFF key



Turns power on when pressed once, turns power off when pressed again. If no key is pressed within 5 minutes from power on the instruments automatically turns off.

When the instrument is turned on again within 2 hours from latest use you will get the question “Continue Yes/No?”.



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

All the instrument's parameters and all 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 Instrument is reset and some parameters are lost, e.g. IH, SH.

Batlow Total Station

If batlow occurs no measurements can be carried out. The next time (within 2 hours) the instrument is turned on you will be prompted “Powered off by battery low?”. 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 or connecting an external battery to the instrument.

Battery condition ■

You can see the condition of the connected battery at the end of the first row in the display. As the battery becomes drained the battery symbol will change from full to empty. Note that this function depends on the battery condition and on the charging method and should only be regarded as a coarse indication.

Function keys/labels

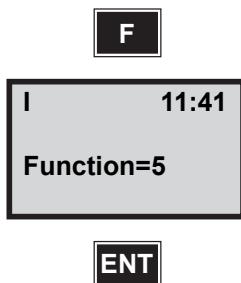
The data stored under labels can be viewed or altered by the operator. In some cases the data also influence the system. Changing the data in the time label will, for instance, set the system real time clock. However, just calling up a label, viewing the data and restoring without any editing will not 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.

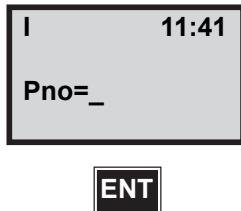
Example: How to store a point number (Pno).

Turn on the instrument, press the function key.

Key in function 5 for point number and press the ENT-key.



The display shows the current value for the point number.
Accept the value by pressing YES or ENT or key in a new value.



You now return to the mode that was current before you pressed the function key. The new point number 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-instructive 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.

Example:

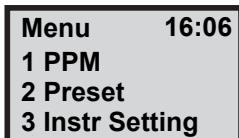
How to store the factor for atmospheric correction (PPM).

Turn on the instrument, press the MNU key. Select SET by pressing 1.



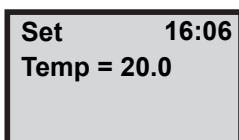
1

Select PPM by pressing 1.



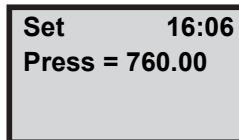
1

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



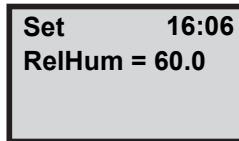
ENT

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



ENT

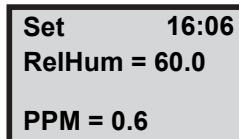
Key in Relative Humidity. Default is 60%. (If you have chosen Wet Temperature from MNU6.5 this will be shown instead).



ENT

Note – This menu is shown only if the switch “PPM Adv.” is enabled in MNU6.1

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



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 acquainted 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, Set time (see Appendix B) simply press the MNU-key followed by 141.

Program key



Choice of program. With this key you select the different programs installed in your Geodimeter CU. The programs comprise a number of different options which are listed below. The operating instructions for each program are described in a separate manual called “Geodimeter CU User Guide Software”.

Option	Programs Supplied
UDS	P1-19 - User Defined Sequences P20 - Station Establishment incl. 3-dim. free station P40 - Create UDS P41 - Define Label
Set Out	P23 - Set Out P20 - Station Establishment incl. 3-dim. free P43 - Enter Coordinates P30 - Measure Coordinates directly to an Area file
Pcode	P45 - Define Pcode
Edit	P54 - File Transfer
View	-
Internal Memory	P54 - File Transfer

1 Introduction

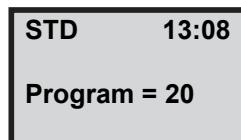
Option	Programs Supplied
DistOb	P26 - Distance / Bearing. between 2 objects
RoadLine2D or RoadLine3D	P29 - RoadLine2D P39 - RoadLine3D P20 - Station Establishment incl. 3-dim. free station P43 - Enter Coordinates P30 - Enter Coordinates directly to an Area file
Z/IZ	P21 - Ground/Inst. Elevation P43 - Enter Coordinates
RefLine	P24 - Reference Line P20 - Station Establishment incl. 3-dim. free station P43 - Enter Coordinates P30 - Enter Coordinates directly to an Area file
Ang. Meas.	P22 - Angle Measurement (only for servo instruments)
Station Establishment	P20 - Station Establishment incl. 3-dim. free station
Area Calc.	P25 - Area & Volume Calculation
MCF	P27 - Moving Coordinates Forward
Obstructed Point	P28 - Obstructed Point
Measure Coord.	P30 - Measure Coordinates directly to an Area file.
Angle Meas.+	P32 - Angle Measurement +
Athletics	P60 - Athletics
CoGo	P61 - CoGo
Field Application	P65 - Field Application
Monitoring	P66 - Monitoring

Choose program

There are two ways to choose a program:

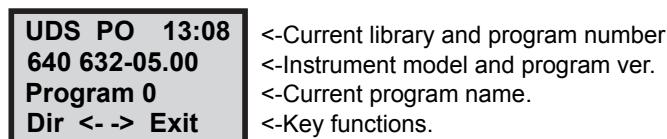
1. Short press

With a short press on the program key the operator will be prompted to key in the desired program number. 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 available programs for Geodimeter CU. Any optional program that is not installed in your instruments is surrounded by two brackets, ().



Key functions:

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

Configuration menu

By choosing a program with a long press, you will also have the chance to configure the chosen program in most cases. See more about how to configure programs in the “Geodimeter CU User Guide Software” manual.

Enter key



Activates keyboard operations and turns display table pages, a switch of face or a compensator initiation.

Clear key



For correction of keyed in but not entered errors and to break a search routine.

Standard mode key



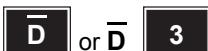
Choice of Standard Mode. This key activates the Standard Measuring Mode. The instrument automatically assumes the STD mode after going through the Start-up Procedure. Standard Mode is described in detail on page 7-2 and page 12-4, see also Fast Standard mode on page 7-9 and page 12-5.

Tracking mode key



Choice of Tracking Mode. This key activates the tracking measurements (continuous measurements). Tracking Mode is described in detail on page 7-18 and page 12-6.

D-bar mode key



Choice of Automatic Arithmetical Mean value Mode. D-bar mode is described in detail on page 7-10 and page 12-5.

Tracklight key



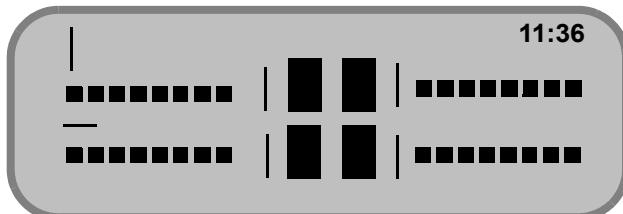
Tracklight ON/OFF. See more about Tracklight on page 13-1. With a long key and one beep it turns on the display illumination. With a long key and two beeps it resets the Instruments Settings.

Electronic level key



Display of the horizontal electronics level. The electronic level on Trimble instruments can be levelled without the need to rotate the instrument through 90 degrees (100 grads). 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 lower cursor indicates the levelling in the measuring

direction and the upper cursor indicates the levelling perpendicular to the measuring direction.



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-centring.

Measurement keys

Start of measurements cycle (STD, FSTD, D-bar). Internal storage of angle values in C2 and C1.



A/M-key at the front (on instruments with no front panel) when measuring in two faces (C1 and C2).



Registration key



For registration of measurement values. (In FSTD working with UDS this key both measures and registers with a single press.)

Alpha Character Keying in (Numeric CU)



It is also possible to enter alpha characters in the numeric control unit. This is done by pressing the REG-key/ASCII-key. If alpha characters are to be used in the middle of a numeric point number or point code title, exit from and re-entry into the alpha mode is achieved by pressing the REG/ASCII key. Follow the example bellow.

The instrument also gives you the opportunity to select special characters for different languages. This can be done via Menu 6.6. A complete list of values for different characters for different languages is shown on page 10-2.

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 and ENT. PNO is seen on the display. Key in 12 Press the REG-key/Alpha-key- ASCII is seen on the display. Key in 77 72 = MH. Press once again the REG/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.

Alpha Character Keying in (Alphanumeric CU)

Alpha mode key (alphanumeric CU)



For activation / deactivation of the Alpha Mode. When the Alpha mode is activated, it is indicated by an (a) symbol in the right-hand corner of the display.

Note – It is also possible to enter alpha characters in instruments with a numeric control unit, see page 1-21.

How to use the alphanumeric keys (alphanumeric CU)



α



↑



Lc



CON

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 66. 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.

Lower case key (alphanumeric CU)

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.



Lc



Shift, ↑

Shift key (alphanumeric CU)



Shift key. For entering a numeric value when the keyboard is set in alpha mode, or vice versa and to answer NO to the

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 (alphanumeric CU)



Activated when selecting the alpha mode.

Servo Control Keys (Num. and Alphanum. CU)

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



Key for horizontal positioning.

A short press of this key results in a horizontal positioning to the set HA Ref value. A long press of this key results in a 180 /200 grads horizontal rotation from the instrument's current direction.



Key for vertical positioning.



Note – when setting out:

- If you press this key without measured distance ELE=the height at the theoretical set out point.

- If you press this key with measured distance ELE=the height at the measured set out point.
- If you press this key longer than 1 sec. With measured distance ELE=the height at the theoretical set out point.

Key for both horizontal and vertical positioning.



Continue Key



Continue key. With a press on this key you can leave the editor if you are working with an alphanumeric keyboard. In some of the internal software, this key can be used to exit the program. Together with the PWR-key, this key reboots the keyboard unit, see page 10-4.

Temporary Horizontal Angle Key



The temporary horizontal angle feature in program 0 can be useful if you want to turn the instrument without affecting the original HA. This function is called HA_L, Horizontal Angle from a Line, and results in an extra line in the display showing HA_L=0.0000. You activate the HA_L function by pressing key 5 in Program 0. Reset HA_L by pressing key 5 again. Exit HA_L with a long press on key 5.

Note – this function only works in Program 0.

1 Introduction

CHAPTER

2

Memory Units

Introduction	2-2
Unit Description.....	2-2
Unit Capacity.....	2-2
Program 54 – File Transfer	2-3
Edit.....	2-3
Setting up Internal Memory as an Active Memory Device ...	2-4
Info Messages.....	2-6
Data Communication	2-6
Setting up CU as an Active Memory Device	2-7

Introduction

Geodimeter CU includes an internal memory for data storage. When there is a need of more memory capacity, Trimble offers an external memory unit, card memory. This unit can be connected to the instrument during the survey work and/or when finished the measuring operations. This part of the manual will describe the internal memory.

Note – As a safety measure always backup your memory to protect yourself from memory loss. It is easily done with Program 54 which enables you to transfer Job. and Area-files between different units.

See, Geodimeter CU User Guide Software for more information.

Unit Description

Geodimeter CU are equipped with an internal memory for the storage of raw data, point information and calculated coordinate data. The memory volume is completely self supportive and can be used separately without the need of having other external memory devices connected. The total memory capacity can be enhanced by connecting a external memory device, card memory.

Unit Capacity

The internal memory of Geodimeter CU has a capacity of appr. up to 8.000 points if storing of only Pno, HA, VA and SD. Data can be stored in an unlimited number of files. All Field Data=survey point information plus angles, distances and calculated coordinates, are stored in a Job File an all Know Data=survey site control point and traverse point

coordinates and elevations are stored in an Area File as described in Memory Structure.

Program 54 – File Transfer

Program 54 is included with Internal Memory. This program is designed for transferring Job-, Area- and U.D.S-files between different units. Internal transfer is also possible within each unit. See Geodimeter CU User Guide Software for more information about program 54.

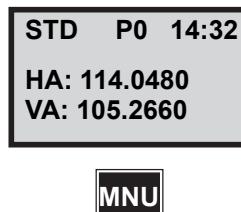
Edit

With the program Edit installed in the Geodimeter CU it is possible to view and change data that been collected and stored in the internal memory. Edit is described in Geodimeter CU User Guide Software.

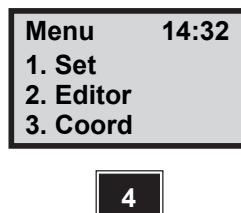
Setting up Internal Memory as an Active Memory Device

When you are using most of the programs in your Geodimeter CU you will be prompted to select an active memory device in which you can register your measurements. If you wish to setup the internal memory as an active memory device outside any program the following steps must be taken.

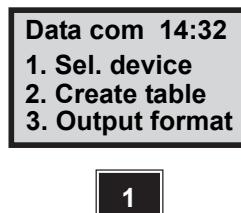
First step to the main menu by pressing the MNU key.



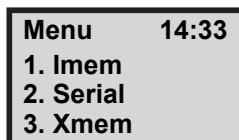
In order to choose 4 Data comm. Press 4



Choose option 1 Select device.

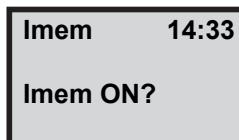


Choose 1 Imem (Internal memory)



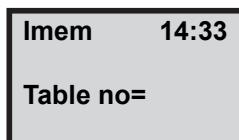
1

Press YES to continue or No to interrupt.



YES

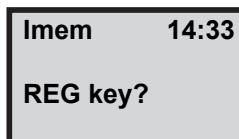
Select output table number (0-5 depending on instrument) and then press ENT.



ENT

Control of the output can be done by pressing the REG key of the instrument (REG key?) or continues (Slave?).

Choose REG by REG key? answering YES or press NO to be able to choose Slave.



Info Messages

No	Message
20	Illegal label number
21	Parity error
22	No or wrong device is connected 22.3 means Xmem error
23	Time out normally seen after attempt to transfer data from device
26	Backup battery to old
30	Syntax error
32	Not found (Files, points and/or programs)
34	Wrong data-record separator
35	Data error (Label not containing any value or text, i.e 5=)
36	Memory device is full
37	Protocol error
39	Overrun error
45	Incompatible device (e.g. when trying P50)
50	System error - contact your nearest service shop!

Data Communication

Computer as controller

When using RS 232C, the command shall be sent as a normal ASCII string ending with the ETX sequence. In this case Protocol is always assumed to be 0.

Geo / L Syntax Construction

O = Output data from memory

L = Load data into memory

K = Erase memory

M = Available memory

File Types

M = Job file

I = Area file

D = Protocol

Commands

Output / Input / Kill + File Type = Job No / Area No

Examples

OM=1	Output of Job No 1 from Geodat to computer
LI=2	Load data into Area 2 from computer to Geodat
KM=SITE2	Erase Job No SITE2 from Job file
O*C	Output of all catalogues from Geodat to computer
K*	Re initializes the Geodat after System error (Error 50), erases all memory

For more information see Chapter 4.

Setting up CU as an Active Memory Device

When using most of the programs to your instrument you will be prompted to choose in which memory device you wish to register your measurements.

If you wish to setup the memory outside any program the following steps must be taken.

2 Memory Units

Connect the Geodimeter CU to the instrument and place it in the Theodolite Mode by going through the start procedure, P0.

You begin with calling upon the main menu. Press MNU

STD P0 14:32
HA: 114.0480
VA: 105.2660

MNU

In order to choose 4 Data comm. Press 4.

Menu 14:32
1 Set
2 Editor
3 Coord

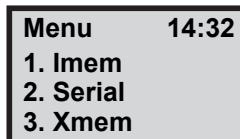
4

Choose option 1 Select device. Press 1.

Data com 14:32
1. Sel. device
2. Create table
3. Output format

1

Choose option 3 Xmem. Press 3. If you wish to record into the Internal Memory of Geodimeter press 1. Imem.



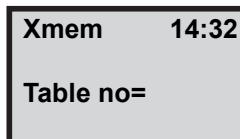
3

Press YES to select or NO to interrupt.



YES

Select output table number 0-5 (depending on instrument) and then press ENT.



ENT

Control of the output can be done by pressing the REG key of the instrument (REG key?) or continues (Slave?).

2 Memory Units

Choose REG by pressing YES or press NO to be able to choose Slave.



CHAPTER

3

Memory Structure

Introduction	3-2
Memory Structure.....	3-2
Job Files.....	3-2
Area Files.....	3-3
Edit File	3-4
File Transfer.....	3-5

Introduction

This part will describe how the memory is structured and what happens when data is stored and collected from the memory.

Memory Structure

The memory structure of all Geodimeter memory units makes it is easy to check and identify the stored data after registration.

The memory is divided in two separate files which are called Job- and Area-file. Both these files are fully flexible according to number and size. The only limit is the total storing capacity available in the memory.

The memory can be used to store two types of data: survey measurements (Job-files) and known coordinates (Area-files). These Job- and Area-files consist of separate expansive memories which means that they can be updated individually at any time without affecting other Job- and Area-files. The total number of files is limited only to the total capacity of the memory. The more raw data stored in Job-files, the less known coordinate and elevation data can be stored in Area-files and vice versa.

Job Files

In order to permit later identification of Job files, they are given a numeric, alpha or alphanumeric title by the user. All survey data are stored in a Job file. Even field calculated coordinate and elevation data are stored in these files. When complete, these files can be transferred separately to

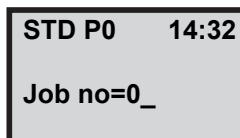
a computer while the unfinished files can remain in Geodimeter Internal Memory.

New Job file

F **5** **0**

When you run most of the field calculation programs in Geodimeter CU the program asks you to name the Job file in which you wish to store the measured data. Job no=0 does already exist. If you wish to create a new Job file outside the field programs you enter label 50 (F50) and key in the new Job number. As an alternative, Program 55 Job/Mem Setup can also be used to create a new job file.

The next time you register a measurement the data will be stored in this Job file.



Area Files

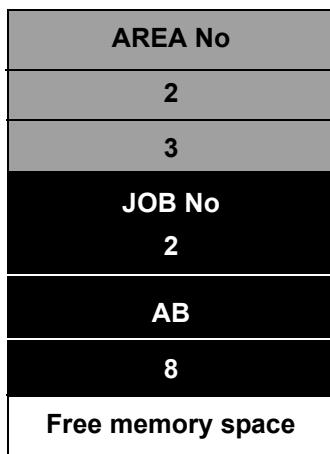
Known coordinates and elevations can be keyed in manually (P43), or transferred from a computer.

Area-files, which are used during setting out survey, can be accessed by giving the name/number of the file in which the set out data is stored. By doing this, the search for the point is limited to just that particular file. Several different Areafiles can be prepared in advance of the survey job e.g. surveyors often know that they will be working in more than one single area during the course of a week. All known

data for particular sites can therefore be stored in different Area files. This is especially advantageous if several points have the same numbers. Area no=0 does already exist.

Edit File

Any Area- or Job-file can be edited with the program Edit. With this program you can view and change the contents of the file after registration.



This is how the memory is structured. The more data that is stored in the Area file the more the Job file will be “pushed down in the memory” and the more the free memory space will decrease.

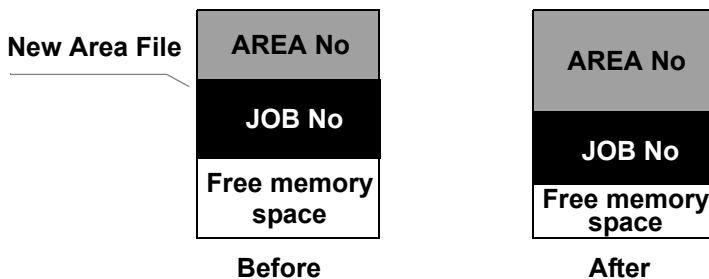
In the above example the three files 2, AB and 8 represent different survey jobs.

It is possible to continue in an existing Job file. If you return to the survey site to update the job 2 the new data will be appended on the old file and the files AB and 8 will be “pushed further down”.

File Transfer

When you transfer a Job file or an Area file the files are not erased from the device in which they were originally stored. They are copies of the data files which are transferred to the other device.

When using Program 54 (See Geodimeter CU User Guide Software) it is sometimes faster to transfer a Job file than an Area file. That is because when transferring an Area file all data in the Job file of the target unit must be pushed down first in order to create room for the new Area file.



The possibility also exists for deleting Job and Area files from a computer or a total-station. This would be done e.g. to create more room in the Geodimeter Memory Device, see Data Communication, Chapter 4.

The operation should be carried out only after a successful transfer to a computer or another device.

3 Memory Structure

4

Data Communication

Introduction	4-2
Data Transfer	4-2
Control Unit Personal Computer	4-2
Serial Communication	4-4
Description of the Command Instructions	4-4
Geodimeter Language (Geo/L) Syntax Structure	4-6
Protocol	4-8
Directory	4-10
Kill	4-11
Load	4-12
Memory	4-13
Mode	4-14
Output	4-15
Position	4-16
Read	4-17
Trig	4-20
Write	4-21
Status Description	4-22

Introduction

Geodimeter CU can be connected to an instrument. There is also possible to connect a computer to the CU directly. The data can thereafter be edited or used e.g. in a CAD-program.

This part of the manual will describe how to connect the control unit to a computer and how to transfer the data.

Data Transfer

Any Geodimeter CU can be connected to an external device via a built in serial interface. This part of the manual will describe how to transfer data from and to the Geodimeter CU.

Control Unit Personal Computer

Connect the Control unit to a computer and a power supply and turn on both units. There are two ways to transfer data between these units:

1. with Program 54

Enter program 54 at the control unit and choose (From Imem, To serial) to transfer files from the control unit 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 in Geodimeter CU User Guide Software.

2. with RS-232 commands

By sending the appropriate commands from the computer you can transfer data between the control unit and computer. Look at page 4-8 for more information about serial communication.

Serial Communication

This part of the manual describes the communication language that is used when the Geodimeter CU is communicating with a personal computer.

Description of the Command Instructions

This part of the manual describes the syntax for communication via the RS232 serial communication port in Geodimeter CU.

Not all commands apply to all devices, information about this is given in the command description. Some of the commands are new and other have additions which will not apply to older versions of the software in the devices.

Bold characters, **0**, must be written as given.

Text within hooks, <...>, is to be replaced with appropriate characters.

Items within square brackets, [...], is optional and need not to be entered.

Text within brackets, (...), is an ASCII control characters, e.g. (CR) is equal to ASCII 13 Carriage Return). The hooks and the brackets shall not be written.

All commands must be ended with a carriage return, the line feed is not necessary. Syntax for END of Command is: (CR) [(LF)]. In the following text this End of Command sequence is omitted. The instructions contains the following information:

Purpose: Description of what the command does.

Syntax: <The syntax> {devices for which the command is valid}

Comments:	Description of arguments etc.
Return:	Description of what is returned from the receiver of the command. <status> is equal to the messages given in the info list. Status is not always returned. However the prompt <eot> is always returned.
Details:	Special information.
Examples:	Some typical examples.

Abbreviations

<lbl>	Label, the tag which identifies the data.
<dta>	Data, the data itself
<cmd>	One character command
<dev>	One character device, which can be a directory in the memory or device.
<arg>	One or more arguments, all arguments are one character long. If two arguments are one character long. If two arguments are given which are contrary to each other the last one is taken.
<dir>	<dev>
<file>	Name of the file to be up- or down-loaded.
<etx>	End of text. Used to separate data posts from each other. When transfer from Stn, <etx>=(CRLF). When input to Stn, <etx>=(CR) or (CRLF).
<eot>	End of transmission. Tells the receiver that transfer is completed.

<status>	Message. Tells if an error condition occurs, or gives the status of requested system parameter.
,	Separates arguments from label.
=	Separate labels from data.
(CR)	Carriage return terminates the command.
(LF)	Line feed.

Devices

Stn	Station unit
CU	Control unit
Gdt	Geodat

Arguments

'I'	The Area directory
'M'	The Job directory
'U'	The U.D.S program directory
'*'	All directory (Geodat)

Geodimeter Language (Geo/L) Syntax Structure

The Geodimeter language is developed in order to create a standard for communication between devices in Geodimeter Systems. The basic Geodimeter data structure is data tagged with a label.

<lbl>=<dta>

e.g. 7=254.3496 Horizontal angle 254.3496

From this is the language developed by addition of commands and arguments in order to be able to direct data to and from a destination.

<cmd><dev><arg>...,<lbl>=<dta>(CR)[(LF)]

e.g. WG, 67=24572.358 Setout coordinate North set to
24572.358

Command types

There are two types of commands, one that requests data from the device, and one that sends data to set the device. Common for both types is that <eot> always is sent when the command is executed and the system is ready for a new command.

Sender: <complete command>(CR)

Receiver: [<status><etx>
<lbl>=<dta><etx>]...
<eot>

The status consists of 1 to 3 digits and is recognized in that no equal sign (=) is found before <etx>. A request type command always gives a response with status and/or data posts. While a set type command only responds with status when an error condition occurs. The meaning of the status number is equal to the normal messages given in the info list.

When files are transferred:

Sender: <cmd><dir>=<file>(CR)[(LF)]

Sender or receiver:<lbl>=<dta><etx>

-
<lbl>=<dta><etx>
<eot>

Commands when starting up the communication

Break <alt>to start the Geodimeter

PV, 20 to start compenstor calibration

PV,21 to switch off the Geodimeter

Return signals from the Geodimeter

@ the compensator is displayed

! Geodimeter awaits answer, Y(es) or N(o).

Protocol

Standard protocol for Station unit, Control unit and Geodat

Station unit From program 582-04

Control unit From program 588-01

Geodat From program 594-01

		Set	Meaning
Baud rate	(F78):	9600	
Parity	(F78):	0	None
Character length:	(F78):	8	8 bits
Stop bits	(F78):	1	1 bit
Time Out:		-	10 sec
Software flow control:		-	Always on (Geodat)

Xon character: - DC1(17)

Xoff - DC2 (19)

End of F(79): 62 >
transmission

Directory

Purpose: List of file catalogue in memory.

Syntax: O<dir>C {Stn, Gdt, CU}

Comments: <dir>

Is the dir argument. ‘I’, ‘M’, ‘U’ and ‘*’ are used. If <dir> is set to ‘*’ the file catalogue for all directories is output.

Return: <lbl>=<file><etx>

-

-

<lbl>=<dta><etx>

<eot>

or

<status><etx>

<eot>

Examples:

OMC File catalogue of all Job files in the JOB-directory.

O*C File catalogue off all files in the memory.

Kill

Purpose:	Delete files in memory.
Syntax:	K<dir>[=<file>] {Stn, Gdt, CU}
Comments:	<p><dir></p> <p>Valid directories for all devices are M, I and U. For Geodat is also D valid. If the file is omitted all files in the directory will be deleted. If the directory is given a wildcard * the entire memory will be deleted.</p>
	<file>
	The file entry is the name of the specific file to be deleted.
Return:	<eot>
	or
	<status><etx>
	<eot>
Examples:	
K*	Delete entire memory.
KI	Delete all area files.
KM=LOT	Delete JOB named LOT.

Load

Purpose: Load Memory. Data according to the standard format can be loaded into the memory device.

Syntax: L<dir>=<file> {Stn, Gtd, CU}
L<dir><prot>=<file> {Stn, CU}
LD {Gdt}

Comments:

<dir> Is the dir argument. ‘I’, ‘M’, and ‘U’ are used.
<file> Is the name of the file (max 15 characters). The file name is case sensitive.
<prot> Is the protocol number.

Return:

<*> When this is received transmission of data can start.

or

<status><eot> If an error occurs.

Details: The transmission can start after the command is sent and the prompt <*> is send back from the device. The data shall be in the Geodimeter standard format. The transmission is ended by the EOT character. The EOT is given in F79 for Geodimeter and CU, and as protocol parameter 16 in Geodat.

Examples:

- | | |
|---------|------------------------------------------------------------------------------------------------|
| LI=LOT6 | The area file LOT6 is created and can be loaded when the prompt * is received from the device. |
| LU=15 | U.D.S program 15 will be loaded into GDM or CU. |
| LD | Loads the protocol file into Geodat. |

Memory

- | | |
|-----------------|--------------------------------------|
| Purpose: | Check for free memory. |
| Syntax: | M[G] {Stn, Gdt}
M[R] {CU} |
| Return: | <number of bytes left><etx>
<eot> |
- or
- | |
|---------------|
| <status><etx> |
| <eot> |

Examples:

- | | |
|---------|----------------------------|
| Command | Return |
| M | 31654 Bytes left in memory |
| MG | 31654 |

Mode

Purpose: Change measuring mode.

Syntax: PG,3=<arg>{Stn}

Comments:

<arg> 0 STD-mode

1 TRK-mode

2 D-bar mode

3 FSTD-mode

4 D-bar mode, high resolution

Return:

<eot>

or

<status><etx>

<eot>

Details: The command will work whether the instrument is locked on a target or not.

Examples:

PG,3=0 Change to STD-mode

PG,3=1 Change to TRK-mode

PG,3=2 Change to D-bar mode

PG,3=3 Change to FSTD-mode

PG,3=4 Change to D-bar mode, high resolution

Output

Purpose: Output from memory.

Syntax:

O<dir>=<file> {Stn, Gdt,CU}

O<dir><arg> {Stn, Gdt, CU}

O<dir><prot>=<file>{Stn, CU}

OD {Gdt}

Comments:

<dir> Is the dir argument. ‘I’, ‘M’, and ‘U’ are used.

<file> Is the name of the file (max 15 characters). The file name is case sensitive.

<prot> Is the protocol number.

<arg> Is the argument field. One argument can be used, ‘C’. The ‘C’ argument will give an output of the file catalogue.

Return: <lbl>=<dta><etx>

-

-

<lbl>=<dta><etx>

<eot>

or

<status><etx>

<eot>

Examples:

OM=A45 Job file A45 is send out.

OU=3 U.D.S program no 3 is output.

Position

Purpose: Position the Station unit with servo.

Syntax: WS=<servo command>{Stn}

Comments: <servo command>

The servo command is divided in the following parts:

<cmd><ang><tol> [<ang><tol>]

<cmd> P Tells Geodimeter to perform a position task, to given angles in horizontal and/or vertical. The angles in horizontal and/or vertical. The angles can be given either via the instrument keyboard or by the serial command. Write (WG). Enter the labels 26 and 27 with the correct values and then use the WS command to perform the positioning.

<ang> H Horizontal positioning

V Vertical positioning

<tol> nn Positioning tolerance, given in cc (0-99). Tolerance=0 means no tolerance given, typical accuracy is 2cc if set to 0.

Return: <eot>

or

<status><etx>

<eot>

Examples:

- WS=Pho5V10 Position horizontal with 5cc accuracy and vertical with 10cc accuracy.
- WS=PH01 Position horizontal with 1cc accuracy.
- WS=PV15 Position vertical with 15cc accuracy.

Read

Purpose: Read Station unit or Control unit. Read of measured data or data in specific labels.

Syntax: RG=[<arg>][,<lbl>] {Stn}

RR=[<arg>][,<lbl>] {CU}

Comments:

<arg> [S] Standard output

N Name output

D Data output

V Numeric output item by item

T test if signal from target. 300 is returned if NO signal. 301 is returned if signal.

<lbl> If a label is given, the contents of that label is returned. When omitted measured data is returned.

Return: <status><etx> Standard output

<lbl>=<dta><etx>

e.t.c...

<eot>

or

<status><etx> Name output

<lbl name>=<dta><etx>

e.t.c...

<eot>

or

<status><etx> Data output

<dta><etx>

e.t.c...

<eot>

or

<status><etx> Numeric output

<lbl><etx>

<dta><etx>

e.t.c...

<eot>

or

<status><etx> Message or

<eot> Meas signal test

or

<lbl><dta> Specific label

<eot>

or

<lbl name><dta><etx>

Specific label with name

<eot>

or

<dta><etx>Specific label only data

<eot>

or

<lbl><etx>Specific label numeric

<dta><etx>

Details: When read of measure data, the output is dependent on how the computer table in the Geodimeter is set. See Geodimeter User Manual for detailed information.

Examples

Command	Return	Command	Return
RG	0	RGN,5	Pno=104
	7=10.2345		
	8=101.1005	RGN	0
	9=145.324		HA=10.2345
RGD	0		VA=101.1005
	10.2345		SD=145.324
	101.1005	RGV	0
	145.324		7
			10.2345
RGT	301		8
			101.1005
RG,5	5=104		9
			145.324

Trig

Purpose:	Start of distance measurement in Station unit.
Syntax:	TG[<arg>]{Stn}
Comments:	<arg> Is the argument for short range ‘<’ or long range ‘>’ measure. The ‘<’ is default and need not to be entered.
Return:	<eot> or <status><etx> <eot>
Examples:	TG or TG< Start of short range measure. TG> Start of long range measure.

Write

Purpose: Write data into the Station unit or Control unit. All labels that can be set by the function key in the system can be written.

Syntax: WG,<label>=<data> {Stn}

WR,<label>>=data> {CU}

Comments:

<label> 0-99

<data> Maximum 9 digits for numeric type labels, and maximum 16 characters for ASCII type labels.

Return: <eot>

or

<status><etx>

<eot>

Examples:

WG,5=10 Label 5 set to 10 in Station unit.

Status Description

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.
10	No device connected
20	Label error. This label cannot be handled by the instrument.
21	Parity error. this label cannot be handled by the instrument.
22	Bad or no connection, or wrong device connected.
23	Time Out
24	Illegal state to execute command. Occurs when trying to communicate in C2-position.
30	Syntax error.
35	Data error.

5

Pre-Measurement

Office Setup	5-2
Connecting the External Battery to the Control Unit	5-2
Turn on Power.....	5-2
Pre-Settings	5-5
Set Unit (e.g Metres, Feet, Grads, Degrees etc.)	5-6
Set Time & Date.....	5-8
Special Settings	5-13
Create & Select Display Tables.....	5-13
Create & Select a New Display.....	5-14
Number of Decimals	5-18
Switches.....	5-20
Standard Measure.....	5-26
Select Type of Language	5-27
Test Measurements	5-28
Measurement of Collimation & Tilt of Horizontal Axis ...	5-29
Tracker Coll – Calibration of the Tracker (Only for Trimble System 5600).....	5-35
Instrument Test	5-37

Office Setup

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

Connecting the External Battery to the Control Unit

When using the control unit detached from the instrument, e.g. when performing remote surveying or robotic surveying (see chapter.) or when connecting it to a computer it is necessary to connect the control unit to an external battery. Connect the external battery and the control unit with the standard battery cable.

Turn on Power

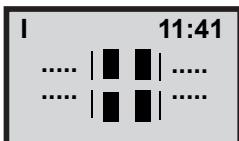
To turn the instrument on, press the On/Off key. A built in test sequence displays the following display tables.



A built in test sequence displays Geodimeter CU and type number followed by...

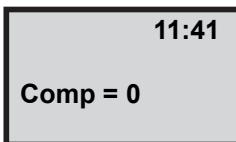


...display of the electronic level which indicates the level status of both axes of the instrument. As no measurements are to be made we will disconnect the dual axis compensator by setting function 22 to 0. Select function 22.



F **2** **2** **ENT**

Select 0 to disconnect the dual axis compensator and press ENT.



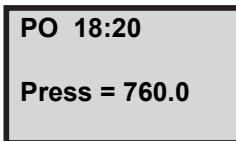
0 **ENT**

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



ENT

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



ENT

5 Pre-Measurement

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



ENT

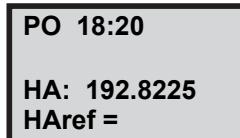
Note – This menu is shown only if “PPM Adv.” is activated in MNU6.1

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



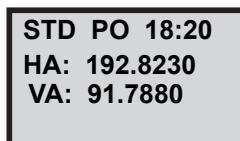
ENT

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



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

In this exercise you will need to access Appendix B at time to time to look at the main menu configuration. The subject Settings can be divided into three different categories:

- Measurement settings of PPM, Offset, Haref and Station data. These settings will be dealt with in the section “Start Procedure” on page 6-2.
- Special measurement settings – these range from the setting of decimal place and defining display tables to setting different switches. These settings will be dealt with on page 5-13“Special Settings”.
- Pre-Setting – settings which can be decided and executed in advance are the following: MNU 65 = Unit (i.e.metres, feet, grads, degrees, etc) and MNU 14 = Time & Date.

Note – Coordinate System

Start with checking your coordinate system setting with menu 67, see page 6-15.

Set Unit (e.g Metres, Feet, Grads, Degrees etc.)

MNU **6** **5**

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

STD PO 18:20
HA: 192.8230
VA: 91.7880

MNU

You are going to begin the CONFIG routine. Press 6.

Menu 18:20
1 Set
2 Editor
3 Coord

6

Step by pressing ENT.

Config. 18:21
1 Switches
2 Standard Meas
3 Decimals

ENT

Note – This is not needed. If you know the “code” for desired function just key in the entire code, in this case 65 in order to save key-strokes.

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

Press 5.

Config. 18:21
4 Display
5 Unit
6 Language

5

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

Here press ENT.

Config. 18:21
Metre?

ENT

Answer YES or ENT to accept, or NO if you want to change to degrees, decimal degrees or Mills.

Here press ENT.

Config. 18:21
Metre
Grads?

ENT

After you have answered YES or NO to the choice of temperature unit, the air pressure unit and Wet Temperature/Humidity, the program returns to Program 0.

Config. 18:21
Metre
Grads
Celsius?

Note – “Wet Temperature” must always be a lower figure than “Temp” otherwise you’ll get an error message in the display.

By pressing F23 you can see the units you have chosen according to the following: xxx1=Grads (400), xxx2=Degrees (360, min, sec), xxx3=Decimal Degrees (360), xxx4=Mills (6400), xx1x=Meter, xx2x=Feet, x1xx=Celsius, x2xx=Fahrenheit, 1xxx=mbar, 2xxx=mmHg, 3xxx= inchHg, 4xxx=hPa.

Example: F23 shows ‘3121’ means that inchHg, Celsius, Feet and grads have been choosen.

Set Time & Date

MNU **1** **4**

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

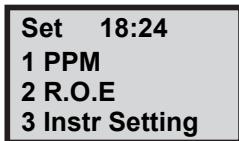
STD PO 18:24
HA: 192.8230
VA: 91.7880

MNU

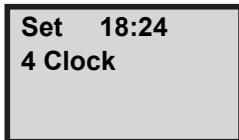
You are going to begin the SET routine, Press 1.



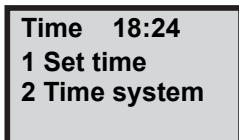
Step by pressing ENT or 4 directly.



You are going to set the clock, Press 4.



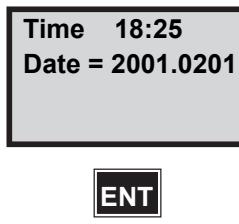
You wish to calibrate the clock. Press 1.



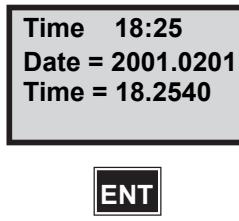
5 Pre-Measurement

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

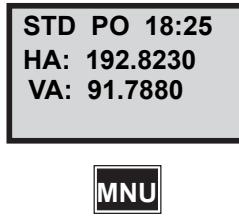
These values were in the instrument at the time it left the factory. Key in today's actual values and press ENT.



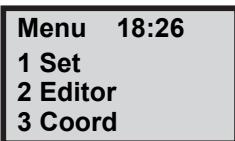
Key in your time. Press ENT when the time is synchronized.



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.

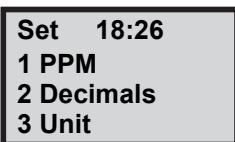


Choose Set by pressing 1.



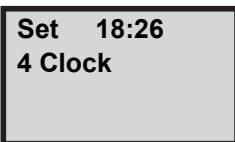
1

Press the ENT key or 4 direct to access the clock option.



ENT

Choose clock by pressing 4.



4

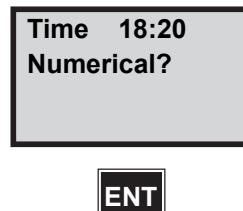
Choose Time system by pressing 2.



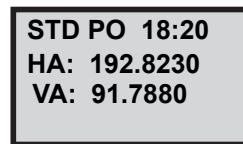
2

5 Pre-Measurement

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 – Check after service

If the instrument has been delivered for service you should check time & date as these parameters might have been changed.

Special Settings

The special measurement settings range from defining display tables, setting decimal place and setting different switches such as: Targ. Test, Pcode and Info ack.

Create & Select Display Tables

Various display combinations can be created by the operator. However, we consider the following 3 tables as standards and we have chosen them to be the default.

Table 0 (Standard)

STD PO 9:22
HA:
VA:
SD:

HA:Horizontal Angle
VA:Vertical Angle
SD:Slope Distance

ENT

STD PO 9:22
HA:
HD:
VD:

HA:Horizontal Angle
HD:Horizontal Distance
VD:Vertical Distance

ENT

STD PO 9:22
N:
E:
ELE:

N:Northing
E:Easting
ELE:Elevation

Other settings can be made with the help of the main menu using MNU 64 and option No. 2, Create Display e.g MNU 642.

MNU **6** **4** **2**

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

STD PO 9:22
HA:
VA:
SD:

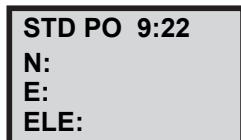
ENT

Page 2

STD PO 9:22
HA:
HD:
VD:

ENT

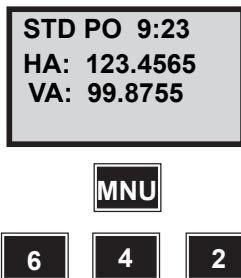
Page 3



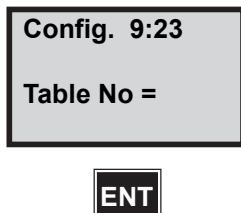
If for example you would like to display eastings before northing, you can change the display table according to the following example: (page 1 and 2 unchanged)

Create display

To be able to set your own display tables you have to access the main menu. Press MNU 642...



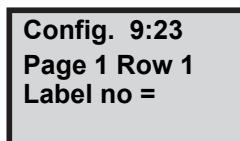
Choose, for example, 1. Press 1 ENT...



Note – Table 5 can not display distance measurements.

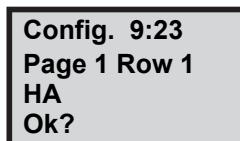
5 Pre-Measurement

Check the list of functions labels in Appendix A. Press 7 (HA) ENT...



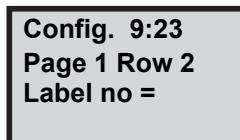
ENT

Press YES or ENT.



ENT

Continue with label 8 (VA) and 9 (SD).



ENT

Continue with label 7 (HA), 11 (HA), 11 (HD) and 49 (VD) using the same procedure as for page 1.

When you have come to page 3, key in the labels below in the following order:

- 38 Easting coordinate
- 37 Northing coordinate
- 39 Elevation coordinate

Config. 9:23
Page 2 Row 1
Label no =

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

Config. 9:23
Ready?

Select display

To be able to use your newly created display table, select MNU 64 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.

Display 9:23
Table no =

Display table no 5

With display table 5 you can not view any distances. For this reason this table is very useful for user instructions. You can combine e.g. table 0 with table 5 as follows:

1. Name e.g. label 90 and 91 with p41 to 'Aim' resp. "Press"
2. Define function 90, 91 as "to prism" resp. "A/M"
3. Create display table 5 and include label 90 and 91

4. Choose display table 0,5 (that is table 0 and table 5)
5. Before every measurement you will now see the following instruction: “Aim to prism” “Press A/M”. As soon as the prism is hit you will get the angles and distances in the display.

Note – If the data output is to be similar to your display table, then it also has to be set. See “Data Output”, page 17-4.

Number of Decimals

MNU **6** **3**

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

STD PO 10:16
HA: 234.5678
VA: 92.5545

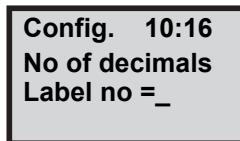
MNU

Select number 63 Set Decimals

Menu 10:16
1 Set
2 Editor
3 Coord

6 **3**

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



No of decimals

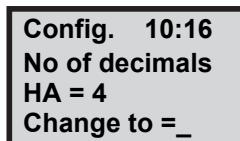
Label no =_

7

ENT

Note – A complete list of functions and labels can be found in App.A.

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



No of decimals

HA = 4

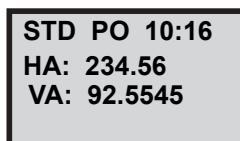
Change to =_

2

ENT

Note – When TRK-mode is active some labels will only work with 2 decimals even if they are set to more decimals by the user.

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



HA: 234.56

VA: 92.5545

Switches

(**Targ. Test on? Pcode on? Info ack off?**
HT meas on? Pow.save in? Key click on?
Prg-num.? PPM ADV.?)

MNU **6** **1**

Eight different switches can be set in the instrument, by using the menu's CONFIG function, Option 6, Set switches. You switch between on and off by pressing the NO key.

For activation/deactivation of the Target test; answer ENT/NO. For more informations see "yellow pages", page 12-8.

Config. 11:22
Targ.test on?

ENT

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

Config. 11:22
Targ.test on
Pcode on?

ENT

If you want to confirm any info message that may appear switch this label on. Any info message will then be followed by “Press any key”. The display returns to normal after 3s.

Config. 11:22
Targ.test on
Pcode on
Info ack. on?

ENT

If the station height has been established in e.g. P20 (Station Establishment) you can be entering menu 61 from P0 choose whether to include the station height or not.

Config. 11:22
HT_meas on?

ENT

Note – HT_meas will not be displayed if the station has been established.

Some distance meters can be set in power save mode, which means that the distance meter is only active during distance measurements. This is indicated in the display with an “s”. (only in STD and D-bar).

Config. 11:22
HT_meas on
Pow. save on?

ENT

Set keyclick on to hear a clicking sound every time you press a key.

Config. 11:22

HT_meas on
Pow. save on
Key click on?

ENT

If Prg-num is on, the current program number will be stored first in the jobfile when you start a program (P20-P29).

Config. 11:22

Prg_num on?

ENT

Enabling PPM Adv. means that you base the PPM correction factor also on user defined wet temperature or humidity. Select alternative using MNU65, Units. If disabled the system uses a standard humidity of 60% for the PPM calculation.

Config. 11:22

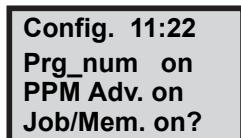
Prg_num on
PPM Adv. on?

ENT

Note – the Target Test is created for your 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

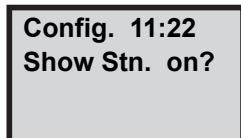
forget to measure a distance when measuring the following points.

If Job/Mem is on, the program will prompt the user to select job number and memory device when an application program is started.



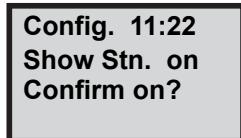
ENT

If Show station is on, the established station number will be displayed when an application program is started e.g. P23.



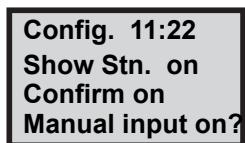
ENT

If Confirm is on, the coordinates for a selected point will be displayed when fetched from an areafile.



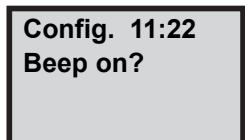
ENT

With Manual input on, the operator will be able to manually key in the Horizontal angle HA, Vertical angle VA and Slope distance SD.



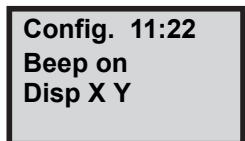
ENT

Turn on or switch off beep from CU.



ENT

Display XY shifts the order of X and Y in the display.
Display X before Y or Y before X.



ENT

Allows the operator to select if display illumination shall be on or off as default when the CU is started.

Config. 11:22
Beep on
Disp X Y
Illumination on?

ENT

2 hours stand by will keep the station establishment, made with P20, for two hours after the instrument has been switched off. If 2 hours stand by is not set the last made station establishment will be kept until a new station establishment is made.

Config. 11:22
2h Standby on?

ENT

Standard Measure

MNU **6** **2**

With this menu you can choose the standard measuring mode, STD (Standard) or FSTD (Fast standard). The Fast standard mode is not as accurate as the Standard mode but much faster.

Config. 11:22
1 Standard
2 Fast Standard

Select Type of Language

MNU **6** **6**

This function is used when you want to select special characters that might be unique for Your language. You have the opportunity to select between Swedish, Norwegian, Danish, German, Japanese, UK, US, Italian, French and Spanish. An instrument with an alpha-numeric control unit gives you the characters on the last row of the display when working in alpha mode. An instrument equipped with a numerical contrl unit and in ASCH mode displays the special characters by selecting the different values for different languages. See complete list on page 10-2.

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

1 **ENT**

Test Measurements

MNU 5

When the instrument arrives at your office, the horizontal and vertical collimation and horizontal axis error correction factors have been measured and stored in the memory of the instrument. These correction factors will allow you to measure as accurately in one face as you can in two faces. The instrument will correct, fully automatically, all horizontal and vertical angles there are measured in one face only.

Note – Test measurements should be carried out regularly, particularly when measuring during high temperature variations and where high accuracy is demanded in one face.

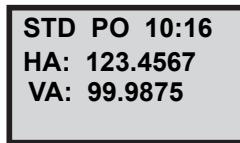
Note – Trimble System 5600 can be equipped with one or two keyboard units. Test measurements should be made with the same keyboard configuration as will be used during measurement to achieve maximum measurement accuracy.

A limit of 0.02grads is set to the Collimation and horizontal axis tilt correction factors. If the measured collimation and tilt of the horizontal axis correction factors prove to be greater than this limit the instrument gives the operator a warning and will not accept the correction. The instrument should then be mechanically adjusted at the nearest Trimble service shop.

Measurement of Collimation & Tilt of Horizontal Axis

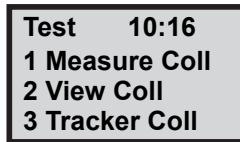
Set up the instrument in the normal way according to the start procedure instructions described in chapter 3 “Station Establishment”. This test is performed at the instrument.

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



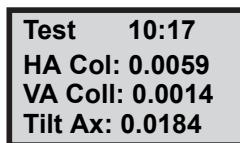
MNU 5

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



2

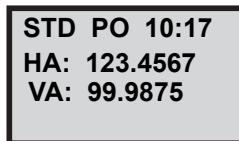
These are the values which are to be updated. Press ENT.



ENT

5 Pre-Measurement

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

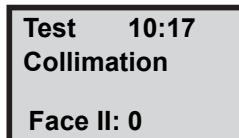


MNU **5** **1**

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.

Rotate the instrument to C2 (if you have servo this is done automatically). Wait for a beep and aim accurately at the point both horizontally and vertically.



Note – Minimum test distance=100m

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

Press  in front

Note – Press **A/M if you have a control unit at the front.**

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

Press  in front

Note – The same number of sightings must be made in both C2 and C1.

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

***Servo:** Rotate the instrument to C1 position by pressing the A/M key in front for approx 2 sec. and aim at the point.

Press  in front

Note – Press  if you have a control unit at the front.

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

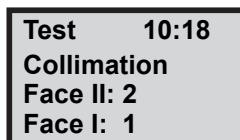
Test 10:18
Collimation
Face II: 2
Face I: 0

A/M

C1:I

5 Pre-Measurement

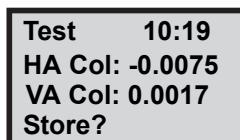
Make the second aiming, press A/M.



C1:II

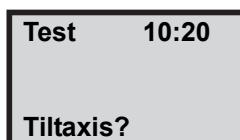
The second C1 angle measurement and indication of completion are very quickly shown on the display.

The display shows correction factors. Answer YES (ENT) or NO to the question Store? These values do not have to be zero in order for the instrument to be OK.



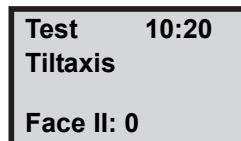
Note – If you are not sure about the accuracy of the displayed values, due to sighting errors for instance, you should answer No to the question Store? And repeat the measurements.

If you answered YES (ENT), the question for measurement of the tilt of the horiz. Axis appears. Press YES (ENT).

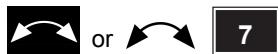


Note – If you consider it unnecessary to measure the tilt of the horizontal axil, you can avoid this by answering NO to the question.

Rotate the instrument to C2*, aim at a point which is at least 15grads above or below the horiz. plane. Press A/M in front after each sighting.



***Servo:** Rotate the instrument to C2. Wait for a beep and aim at a point which is at least 15grads above or below the horiz. plane. Press A/M in front after each sighting.



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

Press  in front

Note – Press  if you have a control unit at the front.

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

Press  in front

Note – The same number of sightings must be made in both C2 and C1.

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

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

Press  in front

Note – Press  if you have a control unit at the front.

Aim at the point, press A/M.

Test 10:21
Tiltaxis
Face II: 2
Face I: 0

A/M

Make the second aiming, press A/M.

Test 10:21
Tiltaxis
Face II: 2
Face I: 1

A/M

The second C1angle measurement and indication of completion are very quickly shown on the display.

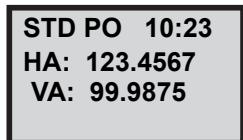
If satisfactory, answer YES or ENT. Press ENT.

Test 10:22
Tiltax: 0.0150
Store?

ENT

Note – If the horizontal axis tilt correction factor is greater than 0.02grads, a “Fail Re measure? Message will be shown on the display. This question should be answered by Yes and the measurement procedure repeated. If the factor is greater than 0.20grads and you answer NO to the re measurement question, the instrument will retain and use the correction factor which is presently stored in the instrument. However, if the factor proves to be greater than 0.20grads, then the instrument must be mechanically adjusted at the nearest authorized Trimble service shop.

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



Tracker Coll – Calibration of the Tracker (Only for Trimble System 5600)

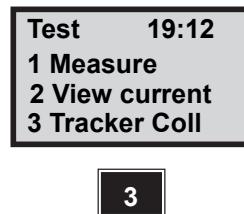
MNU 5 3

The tracker unit, which is directing the instrument when configured for auto lock, remote and robotic surveying, can obtain collimation errors in a similar way as for the optical system. Therefore test measurements should be done regularly and the new values stored. If possible perform the test over a distance as close as possible to the distance that you are going to work at, but at least 100m.

Note – Test measurements should be done at a distance of at least 100m.

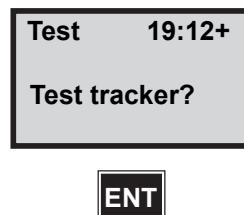
It is important that the RMT is held very still during the test (it is recommended to use a tripod) and that it is clear sight without any obstructing traffic. Calibration is initiated Menu 53. The instrument is calibrated with respect to Horizontal and Vertical collimation errors. These collimation errors can be stored and used to correct the measured points. The measured values are in effect until a new Test Measurement is done.

Switch on the RMT and aim the instrument towards the RMT. Enter menu 5 and start the Tracker calibration by pressing 3.



Note – The compensator has to be initiated during this routine.

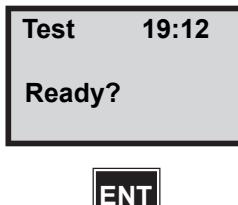
Press the YES or ENT to perform the calibration or press NO to cancel it.



The instrument is now measuring in both faces towards the RMT. Please wait.



The calibration is now ready. Press YES or ENT to return to P0 or NO to redo the calibration.



Instrument Test



Switch on the instrument and enter menu 5-4.

Choose either 1 - Instrument Ver., 2 - Memory Test or 3 - Radio version.



1 - If you press 1 you will be able to view the current program version installed in your instrument. (With a long press on the PRG-key you can also see the current program version installed in your keyboard, see page 1-17).

5 Pre-Measurement

- 2 - If you press 2, the program will make a quick test of the instrument memory.
- 3 - If you press 3 you will be able to view the current program version installed in your radio.

CHAPTER

6

Start Procedure

Start Procedure	6-2
Field Setup.....	6-2
Startup.....	6-3
Calibration of Dual-Axis Compensator With Servo	6-4
Calibration of Dual-Axis Compensator Without Servo	6-5
Pre-Setting of Temp., Press, Humidity, Offset & HRef ...	6-7
Station Data (Instr. Height, Signal Height, Stn. Coord.)	6-10
Coordinate System	6-15

Start Procedure

The start procedure for Trimble System 3600/5600 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 5 “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 (cord).

Field Setup

Mount the instrument on the tripod in the normal manner at a convenient working height and connect power.

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



Figure 6.1 Fitting the internal battery.



Figure 6.2 Connecting the external battery.

Startup

- Switch on the instrument and place the display of the instrument parallel to two of the foot screws of 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 the screw will move the cursor to the right. Levelling must be within 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” (see fig 3.3). “Fine mode” is achieved after calibration of the dual-axis compensator.

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 1-19.

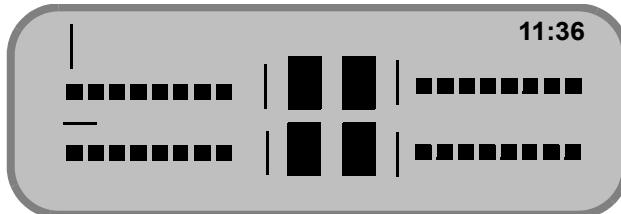
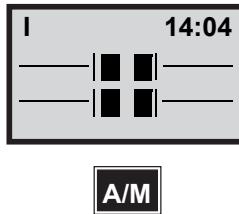


Figure 6.3 Display when level appears thus “coarse mode”

Calibration of Dual-Axis Compensator With Servo

This should be done to get full accuracy of the systems inherent intelligence.

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



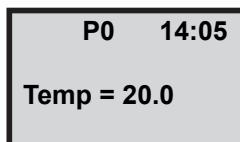
A beep is heard and the display will change to...

Note – Disconnect the compensator by setting function 22=0.

The instrument automatically turns 200 grads (180°) away from you. After a few seconds a beep is heard and the instrument turns back and the display will change to...



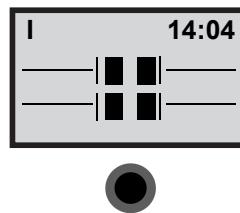
...program 0. The appearance of P0 indicates that the instrument is sufficiently well levelled and that the compensator is now engaged. It also means that the electronic level is in the “fine mode” in which each individual left or right movement of the cursor represents 20^{CC}.



Calibration of Dual-Axis Compensator Without Servo

This should be done to get full accuracy of the systems inherent intelligence.

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

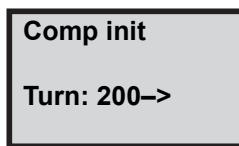


6 Start Procedure

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

Note – Disconnect the compensator by setting function 22=0.

Turn the instrument 200 grads (180°) and the display will change to...



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



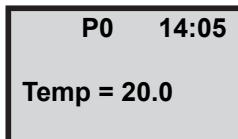
A beep is heard and the display will change to...

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



....program 0. The appearance of P0 indicates that the instrument is sufficiently well levelled and that the compensator is now engaged. It also means that the

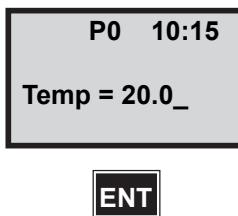
electronic level is in the “fine mode” in which each individual left or right movement of the cursor represents 20°C.



Pre-Setting of Temp., Press, Humidity, Offset & HRef

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 updated 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 HRef 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.



6 Start Procedure

Accept or key in a new value for pressure.

P0 10:16
Press = 760.0_

ENT

Key in Relative Humidity in percent. (If you have chosen Wet Temperature in MNU6.5 this will be shown instead.)

P0 10:16
RelHum = 60.0_

ENT

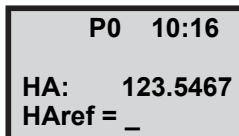
Note – This menu is shown only if “PPM Adv.” is activated in MNU6.1

Key in the distance correction offset or accept zero value (Default value= 0). See also prism constant, Chapter 10.

P0 10:16
Offset = 0.000_

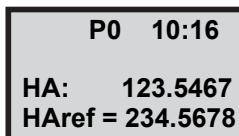
ENT

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



ENT

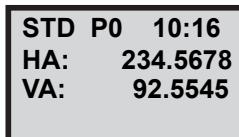
Aim instrument to R.O. (Reference Object) and press A/M or ENT.



ENT

Note – If you use F21 to preset the Haref angle, the instrument must be pointing at the R.O. before pressing the ENT key.

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). But 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 F39. 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

F 3

To inform instrument of the instrument height, we will select function by pressing F.

STD P0 10:16
HA: 234.5678
VA: 92.5545

F

Select function 3 and press ENT.

STD P0 10:16
Function = 3_

3 ENT

The previous value is shown. Accept or key in new lh.
Press ENT to return to P0.

STD P0 10:16
lh = 0.000_

ENT

Signal Height

F **6**

To inform instrument of the signal height, we will select function by pressing F.

STD P0 10:16
HA: 234.5678
VA: 92.5545

F

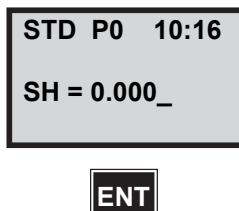
Select function 6 and press ENT.

STD P0 10:16
Function = 6_

6 **ENT**

6 Start Procedure

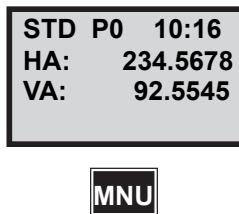
The previous value is shown. Accept or key in new SH.
Press ENT to return to P0.



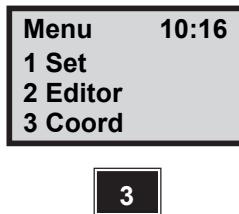
Station Coord



Press MNU.



Choose option No. 3 Coord...



Choose option No 1. Stn. Coord.

Coord 10:16
1 Stn Coord.
2 Setout Coord.
3 Fetch Stn data

1

Note – Keying in of SetOut Coords will be explained on page 7-22.

STN = XXXX

ENT

HT measure?

YES

IH = 0.000

ENT

6 Start Procedure

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

Coord	10:16
N = 100_	

ENT

Eastings, e.g., 200 and press ENT.

Coord	10:16
N = 100	
E = 200_	

ENT

Elevation, e.g., 50 and press ENT.

Coord	10:16
N = 100	
E = 200	
EL E = 50_	

ENT

HA: X.XXXX
HA ref:

ENT

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

STD P0	10:17
HA:	168.5400
VA:	92.1570

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 precalculated bearing (HArref) 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.

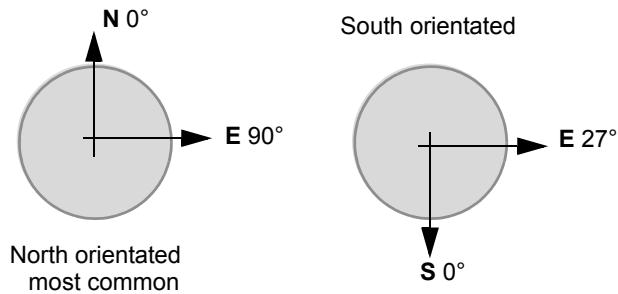
Coordinate System

MNU	6	7
------------	----------	----------

With menu 67, Coord system, you can choose if you wish to work with a north oriented coordinate system or with a south oriented coordinate system.

Config.	10:16
1	North Orient
2	South Orient

6 Start Procedure



CHAPTER

7

Carrying Out A Measurement

Distance & Angle Measurement.....	7-2
Standard Measurement (STD Mode)	7-2
Fast Standard Mode.....	7-9
D-bar Measurement (D-bar Mode).....	7-10
D-bar two-face Measurement (C1/C2).....	7-13
Collecting Detail & Tacheometry (TRK-Mode)	7-18
Setting Out (TRK Mode)	7-22
Measuring Differences Robotic Surveying (Servo)	7-35

Distance & Angle Measurement

Standard Measurement (STD Mode)

STD **1** or **STD**

This measurement mode is normally used during control surveys – e.g., small tachometric exercises, survey point accuracy control, etc. Measurement time for each point takes 3.5 sec.

The instrument carries out the measurement and display in PO of horizontal and vertical angles and slope distance (HA, VA & SD) with the possibility of also displaying horizontal distance and difference in height (HD & VD) and the northing, eastings and elevation of the point by pressing the ENT-key twice.

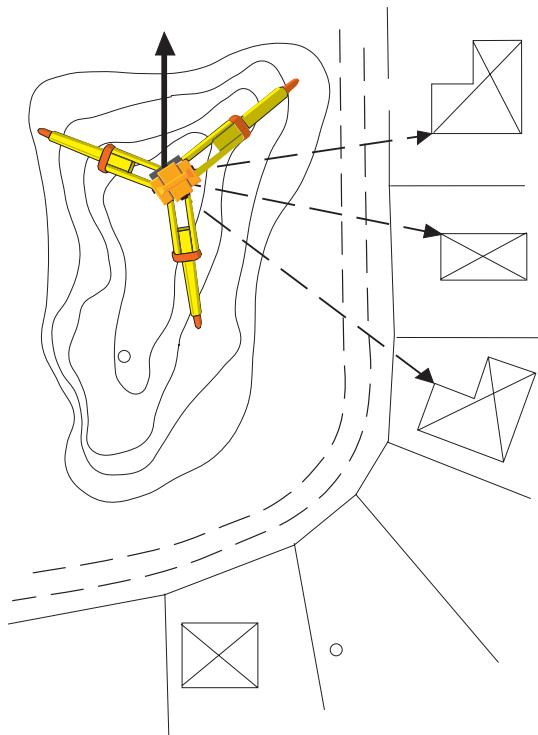


Figure 7.1

Aim instrument at the point. To measure a distance press the A/M key.

STD P0 10:17
HA: 137.2355
VA: 106.5505

A/M

Note – If you have activated Power Save you will not be able to hear a signal.

7 Carrying Out A Measurement

After 3.5 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....

STD P0 10:18*
HA: 137.2235
VA: 102.2240
SD: 37.225

ENT

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

STD P0 10:18*
HA: 137.2235
HD: 37.202
VD: -1.300

ENT

The VD and ELE 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 target and repeat the above instructions. If you measure to the next point in this mode, N, E and ELE will be displayed first.

STD P0 10:18*
N: 1234.567
E: 8910.123
ELE: 456.789

Note – R.O.E (Remote Object Elevation) is automatic in the display modes VD and ELE when the telescope is turned vertically. Use MNU 1.2 to preset R.O.E.

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

Two-Face Standard Measurement (C1/C2)

STD **1** or **STD**

This measurement mode is normally used during control surveys – e.g., traversing, survey point accuracy control, etc. It can only be used when using the instrument as a total station (not for robotic surveying).

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. The asterisks (*) beside the displayed differences between C2 & C1 positions, i.e., dH & dV, indicate that face 2 and face 1 differences are in excess of 100 (~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.

7 Carrying Out A Measurement

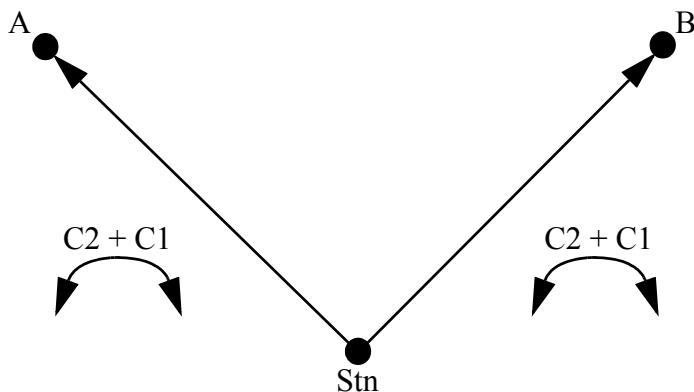


Figure 7.2

Rotate the instrument to the C2 position*.

STD P0 10:17
HA: 154.3598
VA: 106.3707

or 7

***Servo:** Rotate the instrument to the C2 position and wait for a beep.

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

Press in front

Note – Press if you have a keyboard unit at the front.

Both the horizontal and vertical angles at the time the A/M key is pressed are stored in the working memory of the keyboard unit. 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**. A signal is heard if the point is marked with a prism...

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

Press  in front

Note – Press   or  if you have a keyboard unit at the front.

The dH & dV values displayed are half the differences between the C2 & C1 angles values. To measure distance press A/M key.

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



7 Carrying Out A Measurement

After 3.5 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...

STD	P0	10:18*
HA:	154.3599	
VA:	106.3704	
SD:	98.473	

ENT

If you wish to see the cords and elev. Of the point, press ENT...

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

ENT

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

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

ENT

One more press of ENT returns you to the first display and you are ready to measure to the next point. Aim the

instrument horizontally and vertically at the prism target and repeat the above instructions.

STD P0 10:18
HAI: 354.3581
VAI: 293.6284

Note – The R.O.E feature also operates in this two face STD measurement mode exactly the same as in the once face STD measurement mode.

Fast Standard Mode

In those cases when faster measurements are preferred before high accuracy, you can choose the Fast mode that speeds up the measuring time in standard mode. The measuring time will now only be approx. 1.3 sec instead of 3.5 sec in normal standard mode and with 2 decimals in Tracking mode.

The fast standard mode is indicated in the display by “FSTD”.

FSTD P0 10:18
HA: 154.3581
VA: 106.6284

MNU
6
2

You switch between fast standard mode and normal standard mode in menu 6 2, Standard Measure (see Chapter 5). The measurement procedure is identical to the standard mode, except that 2 face measurements are not possible in Fast Standard mode, see page 7-2 to page 7-5.

Special function in U.D.S. (P1-P19)

When working in FSTD and U.D.S. you can measure and registrate with a single key press on the REG-key. You can of course measure with the A/M-key as usual and then registrate with the REG-key.

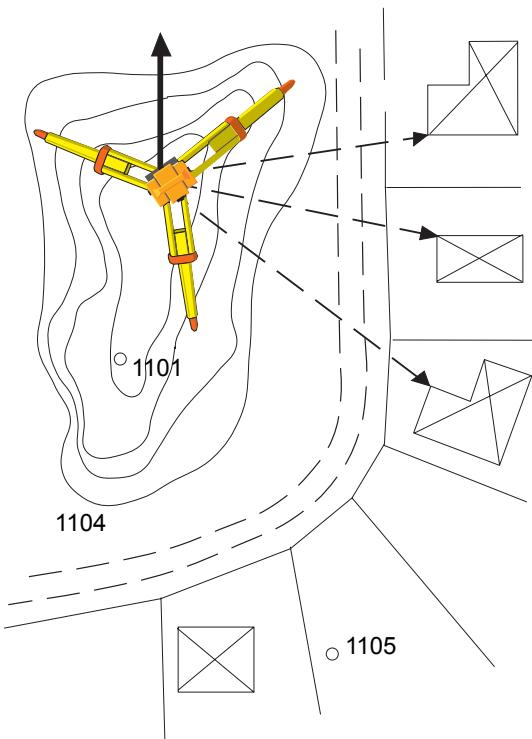
D-bar Measurement (D-bar Mode)

 3 or 

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, thus resulting in a greater degree of accuracy being achieved.

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 once 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.



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

STD	P0	10:18
HA:	399.9995	
VA:	104.8845	

D **3** or **Ȑ**

Note – In some instruments Hi-Res mode can be selected.

7 Carrying Out A Measurement

Aim towards point in the C1 position. If marked with a prism, a signal is heard. Press A/M. Note- If you have activated Power Save you will not be able to hear a signal.

D	P0	10:19
HA:	399.9995	
VA:	102.2205	

A/M

Note – If you have activated Power Save you will not be able to hear a signal.

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, i.e to view HD & VD to point press ENT...

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

ENT

Note – In Hi-Res mode HA and VA are shown with five decimals and SD with four.

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

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

ENT

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

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

ENT

Note – The amount of time you allow the instrument to measure and update the distance is completely 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)

This measurement mode is 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 cycle thus resulting in a greater degree of distance accuracy, and the mean horizontal and vertical angles of all measurements made in both C2 and c1 positions are automatically calculated and presented on the display.

Note – Automatic arithmetic mean value of both angles and distance.

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.

7 Carrying Out A Measurement

Collimation and horizontal axis tilt errors are fully compensated and operator error is minimized.

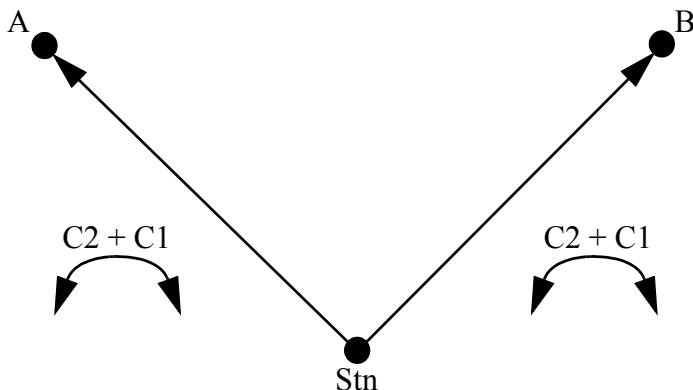


Figure 7.3

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

STD P0 10:17
HA: 154.3605
VA: 106.7301

D **3** or **–D**

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

D P0 10:19
HA: 154.3605
VA: 106.7301

* Servo: Rotate the instrument to the C2 position by pressing.



Wait for a beep and aim at the first point.

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

Press in front

*Note – Press **A/M** if you have a keyboard unit at the front.*

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 sightings in C2. Approach the point from the other direction and press A/M in front...

Press in front

*Note – Press **A/M** if you have a keyboard unit at the front.*

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

measuring angles in this mode the same number of sightings must be made in booth C2 and C1.

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

***Servo:** Rotate the instrument to C1 position by pressing the A/M key for approx. 2 s. and aim at the point. A signal is heard if the point is marked with a prism.

Note – Press ↗ or ↘ if you have a keyboard unit at the front.

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

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

A/M

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

However, the values now seen on 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...

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

A/M

Note – See General measurement hints Chapter 10 for more info. about dH and dV.

Distance is continually measured and updated while mean angular values are frozen.

To view the HD and VD to the point, press ENT.

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

ENT

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

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

ENT

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...

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

ENT

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

D	P0	10:21*
HAI:	354.3597	
VAI:	293.6278	

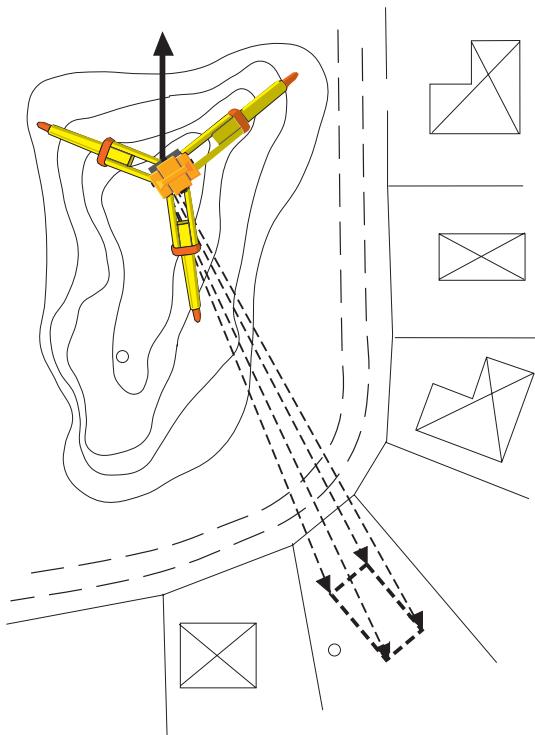
ENT

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

Collecting Detail & Tacheometry (TRK-Mode)

TRK **2** or **TRK**

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. 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. Note that as measurements are started automatically, there is a slight risk that measurements are made when the instrument is badly pointed towards the prism.



To engage tracking mode, press TRK key...

STD	P0	10:17
HA:	165.2355	
VA:	106.5505	

TRK **2** or **TRK**

7 Carrying Out A Measurement

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

TRK P0 10:17
HA: 165.2355
VA: 106.5505

HD & VD appear on the display. To view cords, and height of point, press ENT...

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

ENT

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

TRK P0 10:17*
N: 1234.567
E: 9101.112
ELE: 31.415

ENT

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

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

Note – R.O.E is automatic in the display modes VD & ELE when the telescope is turned vertically.

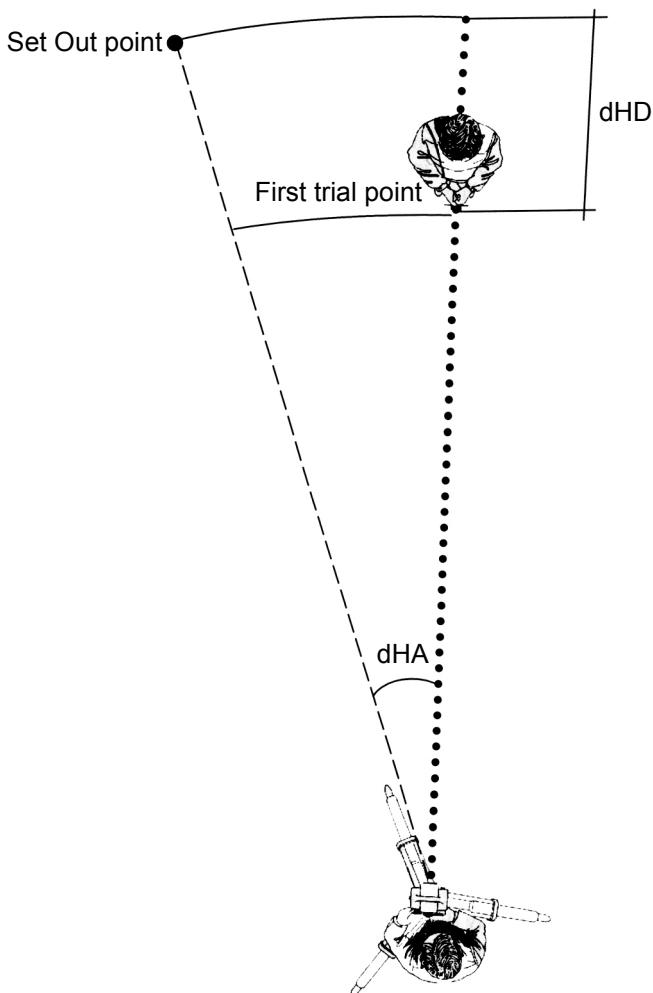


Figure 7.4 Setting Out using TRK mode

Setting Out (TRK Mode)

The tracking measurement mode is mainly intended for setting out, with the option of using countdown to zero of both the horizontal bearing (azimuth), distance and height 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 distance measured 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 ways. One way is to key in the SHA (setting out bearing), SHD (setting out horizontal distance) and SHT (setting out height) values. This is done after first calling up F27, F28 and F29 respectively. The point height is set out using the R.O.E feature.

The other way 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 cords 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.

Setting Out Using Pre-calc. Bearing & Horizontal Distances SHA &SHD

To engage tracking mode, press the TRK-key.

STD	P0	10:17
HA:	33.7965	
VA:	109.3960	

TRK **2** or **TRK**

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

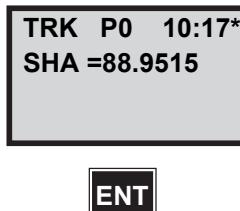
TRK	P0	10:17*
HA:	33.7965	
VA:	109.3960	

F **2** **7**

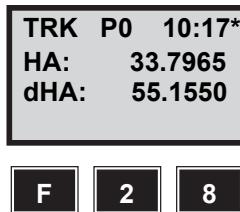
Note – F27 = SHA

7 Carrying Out A Measurement

Key in the bearing to setting out point for example, 88.9515, then ENT.

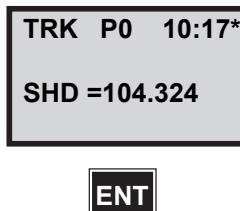


To key in horizontal distance to setting out point press F28 (F28=SHD).



Note – F28 = SHD

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



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

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.

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

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

 or 

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

 or 

***Servo:** When positioning in both horizontal and vertical direction, press this key.

 or 

Note – When using the RPU, use the CL-key to position the instrument.

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.

Note – Tracklight 

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

7 Carrying Out A Measurement

keyed in bearing (azimuth) of 88.9515 will also appear opposite HA in the display. The correct position of the point has now been set out. Height setting out can be carried out by keying in F29 SHT.

TRK	P0	10:17*
HA:	88.9515	
dHA:	0.0000	
dHD:	-7.25	

F **2** **9**

Note – F29 = SHT

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

TRK	P0	10:17*
SHT = 45.363		

ENT

Turn the telescope vertically until 0 is obtained on SHT.

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

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

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

ENT

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

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

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

Setting Out Using Coordinates

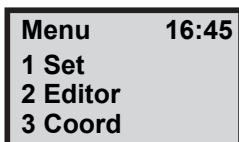
After having gone through the start procedure, enter the main menu by pressing MNU....

TRK P0 16:45
HA: 66.4565
VA: 101.2345

MNU

7 Carrying Out A Measurement

Choose options No 3...



3

Choose option No 1 (instrument station data).



1

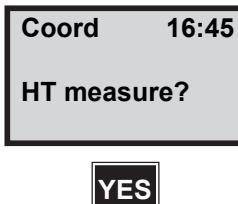
Key in the station number.



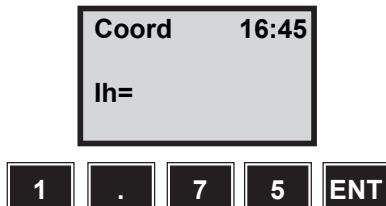
1 1 0 1 ENT

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

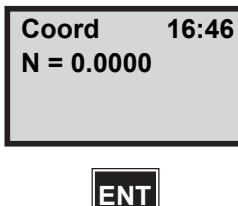
signal height (SH) will be ignored. In this example, we will be measuring heights. Press YES.



Key in the instrument height and press ENT.



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



7 Carrying Out A Measurement

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

Coord 16:46
N = 123456.789
E = 0.000

ENT

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

Coord 16:46
N = 123456.789
E = 455678.910
ELE = 45.355

ENT

Key in the horizontal reference angle and press ENT

Coord 16:45

HA :66.4565
HA ref=

ENT

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

TRK P0 16:47
HA: 66.4565
VA: 101.2345

MNU

Note – R.O.E

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.), can be marked directly on the marker pole or concrete shuttering, exactly at the point at which the centre of the reticle (horizontal crosshair) is pointing.

Press option No 3...

Menu 16:48
1 Set
2 Editor
3 Coord

3

Choose option No 2 (set out point data)

Coord 16:48
1 Stn Coord
2 Setout Coord
3 Fetch Stn data

2

7 Carrying Out A Measurement

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 (F27). Make a note of it and use it when setting the orientated bearing.

Key in “N” coordinate value of set out point: Press ENT.

Coord 16:48
SON=0.000

ENT

Key in “E” coordinate value of set out point. Press ENT.

Coord 16:49
SON=123556.789
SOE=0.000

ENT

Key in height value of set out point. Press ENT.

Coord 16:49
SON=123556.789
SOE=455778.910
SHT=40.500

ENT

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

*see note on previous page.

TRK	P0	16:49
HA:	66.4565	
VA:	101.2345	

ENT

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.

TRK	P0	16:50
HA:	29.5070	
dHA:	20.4930	

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

 or  **8**

Note – When using the RPU, use the CL-key to position the instrument.

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

 or  **9**

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.

Note – Tracklight



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.

TRK	P0	16:51*
HA:	50.000	
dHA:	0.0000	
dHD:	2.03	

ENT

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

TRK	P0	16:52*
HA:	50.0000	
HA:	141.142	
VD:	0.000	

ENT

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.

TRK	P0	16:52*
N:	123556.78	
E:	45778.91	
ELE:	40.500	

Measuring Differences Robotic Surveying (Servo)

Important information when measuring with high accuracy and using the instrument's tracker

To achieve the highest accuracy when measuring distances shorter than 200 meters and using the Tracker unit you need to be aware of the following:

If you use a large reflector like the Super Prism (Part no. 571 125 021), reflections from the Tracker unit may have influence on the measured distance. The error can vary from 0 to 3 mm. If you use the Miniature Prism (Part no 571 126 060) this error doesn't occur.

STD.mode measurement

When carrying out a STD-mode measurement in robotic surveying the measurement procedure is a little bit different from the total station; when pressing the A/M_key for a measurement the servo is first fine adjusting the instrument towards the target, the RMT. After that the measurement is initiated. The distance measurement is made during about 4 sec. Under that time the arithmetic mean value of a large number of angle measurements is also calculated and presented thus eliminating an effect of any instability of the

RMT during the measurement and resulting in higher accuracy.

D-mode measurement

When carrying out a D-mode measurement in robotic surveying the servo is first fine adjusting the instrument towards the target. Each single measurement of distance and angles is made in the same way as in STD-mode measurement and a continuously updated arithmetic mean value of the repeated measurement for both angles and distance are calculated. This is an improvement compared with the servo-assisted surveying where only the arithmetic value for distance is calculated.

TRK-mode measurement

When carrying out measurements in TRK-mode the servo is set to follow the moving target and very fast measurements can be carried out, but then without fine adjusting the instrument towards the target before the measurements when e.g. setting out. Whenever higher accuracy is demanded the operator can easily switch between the different measurement modes.

CHAPTER

8

Direct Reflex (only DR Instruments)

In General	8-2
Settings	8-4
Standard Deviation.....	8-4
Measuring method	8-5
Distance Interval	8-6
Pointer.....	8-8
Measuring Object.....	8-13
Distance C1/C2	8-14
STD DR Measurement.....	8-16
Problems to Reach the S_Dev.....	8-17

In General

Direct reflex measurement requires an instrument with long range because different materials have different reflector qualities. A white surface yields about 90% reflection, while a black surface yields only 5%. So the range is greatly reduced when you measure against a black surface.

Standard Deviation

This means that a requested accuracy can be keyed in. During the measurement the operator will be able to see the “count down” towards the keyed-in value. If the requested value is not achieved, the distance measurement can be stopped and the achieved standard deviation will be displayed.

Note – This function is not available on all DR instruments

Measuring method

The operator can select between two different measuring methods. Reflector mode when measuring against a reflector target and No reflector mode when measuring Direct Reflex measurements. Reflector mode is default.

Distance Interval

The distance interval makes it possible to select the measurement interval. The user can change these default values. If the object to be measured is more than 200 meters away, the value can be changed to 300 or 400 meters, for example. Another way to use this function is when the user wants to measure a small object at, for example 50 meters, and there is building 150 meters behind the object. To avoid

a result from the reflective building you can set the values from 2 to 100 meters.

Note – This function is not available on all DR instruments

Pointer

The Trimble 5600 DR Standard -series is equipped with a Laser Pointer. The Trimble 5600 DR200+ -series can be equipped with a Laser Pointer as an option. The operator can switch on or off the Laser Pointer via the menu. The Laser pointer can only be activated when the instrument is in No reflector mode.

Vertical & Horizontal guide

Note – Vertical & Horizontal guide is a function that will make it possible for the operator to measure a point with the Laser Pointer as a guide. The instrument will compensate for the 91 mm (0.3 ft) offset between the measuring and Laser Pointer aperture by repositioning the instrument. The operator will have to select if the measurements are carried out against a vertical or horizontal surface.

Note – This function is not available on all DR instruments

Measuring object

When the signal becomes too weak, the instrument will not present a result because the accuracy will not be within the specification. However, sometimes you need a result anyway. In that case the user can initiate the weak signal.

Note – This function is not available on all DR instruments

Distance C2

Distance C2 will allow the operator to do measurements in C2 position.

Settings

Standard Deviation

MNU **7** **1**

Note – This function is not available on all DR instruments

Select MNU 7, press 1 to set the Standard deviation.

Dir. Refl. 12:18
1 S_Dev
2 Meas.method
3 Dist.Int

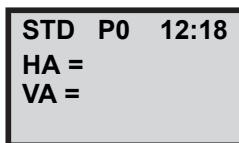
1

Default 0.003m (0.015 Ft). Max 0.999m (3 Ft) Min value 0.001m (0.004 Ft). Last used will stay default.

Dir. Refl. 12:18
S_Dev = 0.003

ENT

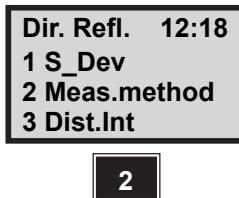
Back to the application.



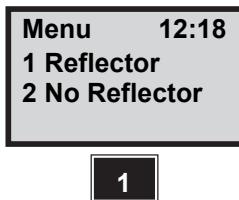
Measuring method



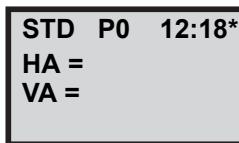
Select MNU 7, press 2 to set measuring method.



Press 1 to measure with Reflector.

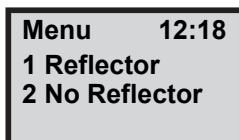


A "*" will be displayed to the right side of the time when reflected signal is received.



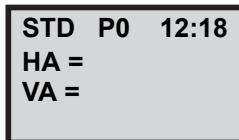
8 Direct Reflex (only DR Instruments)

Or press 2 to measure Direct Reflex (without reflector).



2

A "D" will be displayed to the right side of the time.



Reflector mode is default and will be set next time you start up the instrument.

Distance Interval

MNU **7** **3**

Note – This function is not available on all DR instruments

Select MNU 7, Press 3 to set the distance interval.



3

Key in the minimum distance value in the distance interval.
Min 2m (7FT) = default. It will be reset to 2 meters when
you start up the instrument.

Dir. Refl. 12:18
From = x
ENT

Key in the maximum distance value in the distance interval.
200m (656Ft) = default. It will be reset to 200 meters when
you start up the instrument.

Dir. Refl. 12:18
To = x
To = xxx
ENT

Back to the application

STD P0 12:18
HA =
VA =

Pointer

MNU 7 4

Laser Pointer

Note – This function is not a standard feature on all DR instruments

Select MNU 7, Press ENT.

Dir. Refl. 12:18
1 S_Dev
2 Meas.method
3 Dist.Int
ENT

Press 4 to select pointer.

Dir. Refl. 12:18
4 Pointer
5 Measuring Obj
6 Dist. C2
4

Note – This menu can only be accessed if the instrument is in Direct Reflex mode.

Press 1 to turn on the Laser Pointer or press 2 to switch the Laser Pointer off. An “L” will be shown in the display to indicate that the Laser pointer is switched on.

Select 8:21
1 Pointer on
2 Pointer off
3 Vertical guide

1 or 2

Note – The Laser Pointer will switch off automatically if reflector mode is selected.

Back to the application

STD P0 12:18
HA =
VA =

Vertical & Horizontal guide

Note – This function is not available on all DR instruments

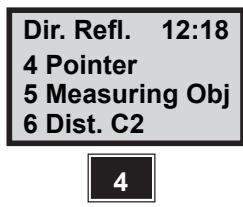
Select MNU 7, Press ENT.

Dir. Refl. 12:18
1 S_Dev
2 Meas.method
3 Dist.Int

ENT

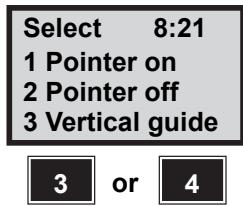
8 Direct Reflex (only DR Instruments)

Press 4 to select pointer.

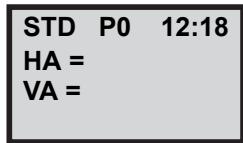


Note – This menu can only be accessed if the instrument is in Direct Reflex mode.

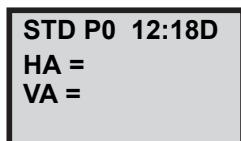
Select if the point to be measured is on a horizontal or vertical surface. Press 3 for vertical guide or 4 for Horizontal guide.



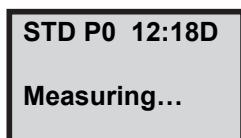
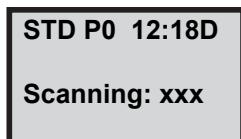
Back to the application



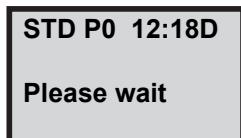
Aim with the laser dot at the point that is to be measured.
Press A/M to start the measurement.



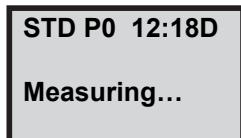
A/M



When the instrument has measured the distance it will reposition to compensate for the 91 mm (0.3 ft) offset between the measuring and laser aperture.



The instrument will measure the distance to the point.



The distance and angles to the point are displayed.

8 Direct Reflex (only DR Instruments)

STD P0 12:18
HA =
VA =
SD =

When a point is to be setout the calculated vertical angle will be adjusted for the vertical offset so that the laser dot will aim at the point that is to be set out. When a distance is measured dELE will be -0.091.

Measuring Object

MNU 7 5

Note – This function is not available on all DR instruments

Select MNU 7, Press ENT.

Dir. Refl. 12:18
1 S_Dev
2 Meas.method
3 Dist.Int
ENT

Press 5 to select Measuring Object.

Dir. Refl. 12:18
4 Pointer
5 Measuring Obj
6 Dist. C2
5

1 Weak signal on, means that measurements can be made using a weak signal. Accuracy will drop to \pm (10mm + 5 ppm).

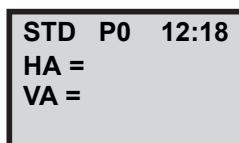
2 Weak signal off, is default.

Select 8:21
1 Weak sign. on
2 Weak sign. off
1 or **2**

Note – Use weak signal ON only when the object can not be measured in normal mode.

Note – When measuring with Weak signal ON there is a risk of getting incorrect distances if the signal is too weak.

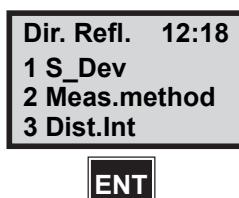
Back to the application



Distance C1/C2



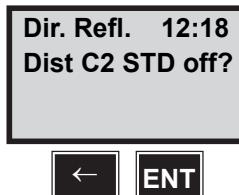
Select MNU 7, Press ENT.



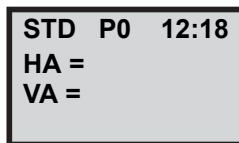
Press 6 to select Distance C2.



Press the clear key to select Distance C2 on or off, confirm with ENT.

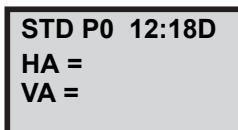


Back to the application

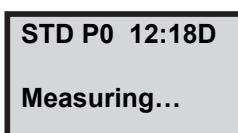
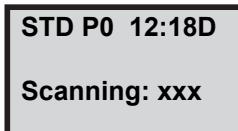


STD DR Measurement

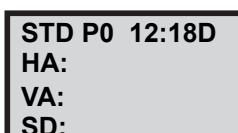
Select MNU 7.2. Press 2 to measure without reflector.
Press A/M to start a measurement.



A/M

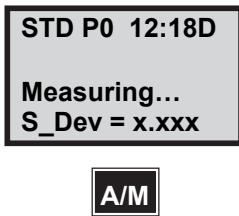


SD will be displayed automatically when the predefined S_Dev have been reached.



Problems to Reach the S_Dev

If the instrument has problems to reach the predefined S_Dev, the so far measured value of SD and S_Dev will be displayed. To stop the measurement press A/M.

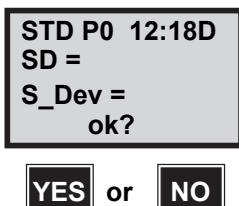


The preliminary distance SD will be displayed, but it has still not reached the S_Dev, that is predefined in setup, menu 7.1.

S_Dev is the calculated value of the so far measured distance.

Press Yes to accept.

Press NO to cancel.



8 Direct Reflex (only DR Instruments)

9

Surveying methods

In General (only servo).....	9-2
Conventional Surveying With Servo	9-2
Autolock (Only Servo)	9-3
Robotic Surveying (Only Servo).....	9-3
RMT Configuration	9-4
Conventional Surveying With Autolock (Only Servo).....	9-6
Important Information When Measuring With High Accuracy (and Using the Instrument's Tracker).....	9-6
How to Work With Autolock	9-7
Aiming	9-8
Robotic Surveying (Only Servo).....	9-10
Important Information When Measuring With High Accuracy (and Using the Instrument's Tracker).....	9-10
How to Work With Robotic Surveying	9-11
Search Window	9-13
Activation of the RPU.....	9-15
Aim & Measure	9-17
Establishing Contact From a Detached Control Unit.....	9-19
Switch to Measurement Towards an Ordinary Prism	9-20
Switch Back to Robotic Surveying	9-21
Search Functions in Robotic Surveying	9-23

In General (only servo)

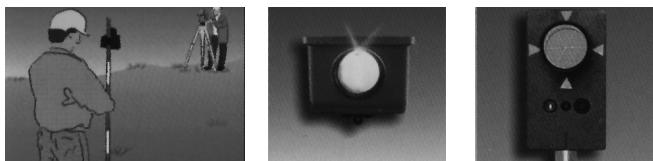
This chapter will describe the different ways of working with Trimble System 5600. First of all you can work conventionally with the system. Since the instrument is equipped with servo drive, you'll find that the system is very easy to handle, when setting out you can with a touch of a single key aim the instrument towards the set out point.

Conventional Surveying With Servo

If your instrument is equipped with servo drive, this means a lot of advantages:

- In e.g. setting out you only need to give the point number. The instrument will calculate and aim automatically towards the precalculated bearing with a single press of the positioning key .
- For angle measurements, just aim towards the different reflector stations once. The instrument remembers and repeats the aiming process how ever many times and in what ever order you want.
- During manual aiming, the servo assists the horizontal and vertical adjustments. All that's needed is a light circular movement of the adjustment screw with your finger tip.
- Thanks to servo-drive, adjustments screws have no end positions. That means no unnecessary interruptions, when aiming.

Autolock (Only Servo)



Secondly you can equip your instrument with a tracker unit and take full advantage of the feature we call Autolock™, this enables the instrument to lock on to a RMT and automatically follow it as it moves. This means that there is no need for fine adjustment or focusing.

Robotic Surveying (Only Servo)

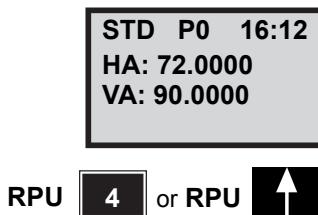


With both a tracker unit and a telemetric link you can work with robotic surveying. This means that you can take over the control of the whole measurement from the point, i.e. you have a one-person system. On the following pages we will describe the different measuring techniques with Trimble System 5600.

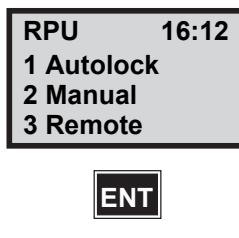
RMT Configuration

The type of RMT to be used is selected in the RMT configuration menu. If the RMT has multi channel capability the tracker channel must be set to the same channel Id as the RMT. If the RMT does not have multi channel capability then the tracker channel Id must be set to 4 (Standard).

Press the “RPU”-button on the instrument.



Press ENT



Press 4 to select the RMT configuration menu.



Press 1 to select Tiltable RMT if an RMT600TS is to be used, or if the RMT 602 is mounted in a tiltable holder.

Press 2 to select Vertical RMT if a non-tiltable RMT is to be used.

Press 3 to set the RMT id.



3

Press [NO] until the desired RMT Id is displayed. Then Press [YES]



YES

Note – If your instrument is not equipped with multi channel capability then the RMT Id will not change when you press NO. You can still use a multi channel RMT but the RMT's Id must be set to 4. The program version of the CU must be 632-08.01 or later.

Conventional Surveying With Autolock (Only Servo)

With the feature Autolock, you do no longer have to fine adjust or focus, since this is taken care of by the system.

- To upgrade a base unit to Autolock, you'll only need to add a Tracker unit and a RMT target. It is also possible to measure in a conventional way without Autolock using an ordinary reflector.
- When setting out, you'll only need to supply a pre-stored point and the system will calculate the necessary data for setting out. Then, position the instrument with the positioning key. When the rodman, guided by the built-in Tracklight enters the Tracker's field of view (2.5m/100m), the instrument locks onto the RMT automatically. You're now able to fully concentrate on the information in the display (radial/right angle offset) and direct the rodman to the setting out point.

Important Information When Measuring With High Accuracy (and Using the Instrument's Tracker)

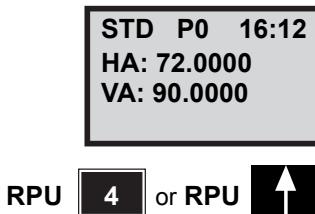
To achieve the highest accuracy when measuring distances shorter than 200 meters and using the Tracker unit you need to be aware of the following:

Always use the Miniature Prism (Part no. 571 126 060) mounted on your RMT. If you use a large reflector like the Super Prism (Part no. 571 125 021), reflections from the Tracker unit may have influence on the measured distance. The error can vary from 0 to 3 mm. This error doesn't occur using the Miniature Prism.

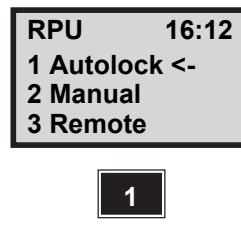
How to Work With Autolock

First switch on your instrument and make the necessary setup; activate compensator, enter PPM-parameters etc.

Then press the “RPU”-button on the instrument.

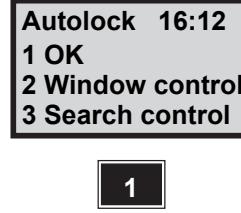


Choose 1. Autolock.



Press 1. to switch on the Autolock function. This display does only appear if you installed the search option.

Optional



The instrument is now setup for Autolock. A search function can be added as an option. With this option both

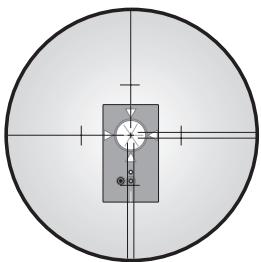
sector control and search control can be used. For more information, see Chapter 15.

Measuring towards an ordinary prism

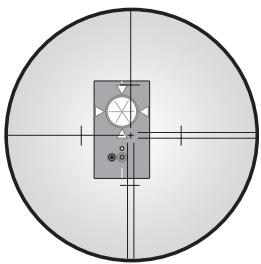
If you aim towards an ordinary prism with the Autolock option on and press the A/M-key, you will be prompted: “Measure OK?”. Press YES to proceed the measurement or press NO to cancel it. If you choose to measure and press the REG-key, you will be prompted: “Reg OK?”. Press YES to register the measurement or press NO to cancel it.

Aiming

The adjustment between the two optical axes, i.e. the Telescope and the Tracker, may differ. The difference will make it seem like the instrument does not point towards the centre of the prism, when using Autolock (see fig. Below). This is not a problem since the two axis have their own collimation data. It is however important to make collimation test for both axis



Without Autolock
Manual aiming



With Autolock

How to check

You can check how good the instrument is calibrated yourself, by measuring towards the same prism with and without Autolock and compare the displayed angles:

Without Autolock: The instrument shows the angles for the tube.

With Autolock: The instrument shows the angles for the tracker

If the angle deviations are large you should calibrate both the tube (MNU 5.1) and the tracker (MNU 5.3), see Chapter 5.

Robotic Surveying (Only Servo)

The robotics of the system are unique. By equipping the instrument with a tracker unit, even aiming can be done from the measuring point. The entire measurement is performed from the point, with the same access to all functions of the total station as if you were standing beside it.

Robotic surveying means higher production capacity. During setting-out, it's best with two people: one to handle the measuring with the RPU, and one to mark the points. Of course, the entire job can be performed by a single person. The unique search function makes robotics surveying extremely efficient 24 hours a day.

Important Information When Measuring With High Accuracy (and Using the Instrument's Tracker)

To achieve the highest accuracy when measuring distances shorter than 200 meters using the tracker unit you need to be aware of the following:

If you use a large reflector like the Super Prism (Part no. 571 125 021) on your RMT, reflections from the Tracker unit may have influence on the measured distance. The error can vary from 0 to 3 mm. If you use the Miniature Prism (Part no. 571 126 060) instead this error doesn't occur.

Equipment

To be able to work with robotic surveying you'll only need one control unit, which you after station establishment etc. disconnect from the instrument and bring to the point. You

will also need to equip your instrument with a radio side cover (see Chapter 1), a tracker unit, a RMT (Remote Target) and an external radio connected to the keyboard unit. The keyboard unit, the RMT and the external radio will hereafter be called, RPU.

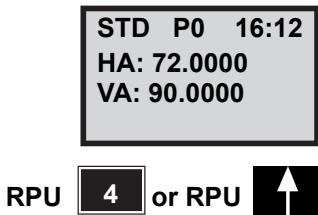
Radio Communication

In order for the instrument and the RPU to be able to communicate you will have to set the same radio channel at the instrument and at the RPU. Select a channel with regards to other radio systems that might be in operation in your immediate area. If radio disturbances occur, e.g. if Info 103 is displayed, try another channel.

How to Work With Robotic Surveying

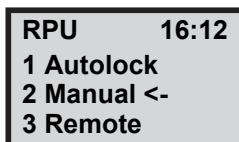
First turn on your instrument and make the necessary setup; activate compensator, enter PPM-parameters, perform station establishment etc. Then select radio channel in MNU1.5. In the following examples we will use a larger display appearance for the RPU.

First press the “RPU”-button on the instrument.



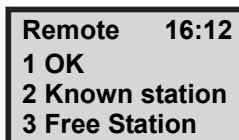
9 Surveying methods

Choose 3 Remote for robotic surveying.



3

Now choose method of station establishment: In this case we choose 1 OK = No station establishment.



1

Note – Station Establishment is described in Chapter 6. If you don't want to use the station or 4 Known Station+ you can choose 1 OK. In this case the horizontal angle (Haref) that was set in the station unit will be used.

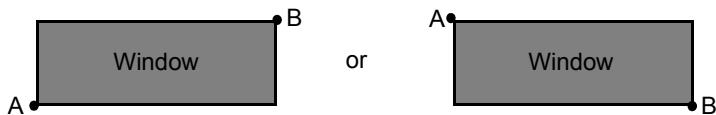
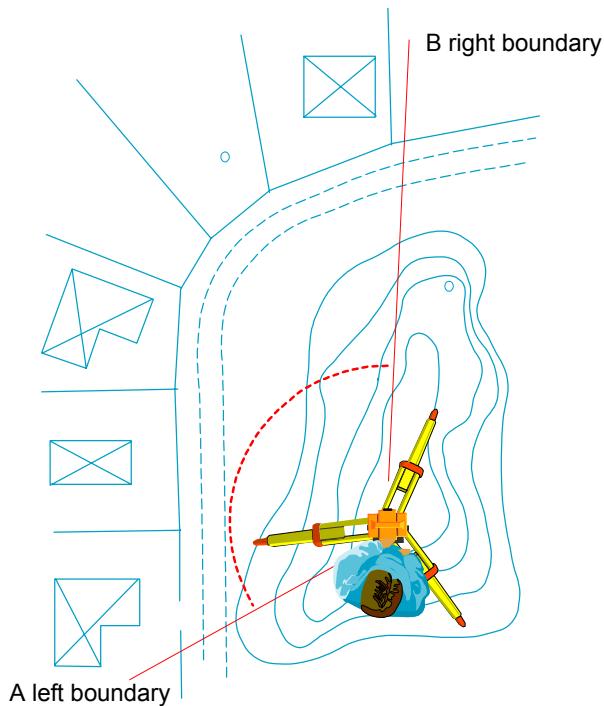
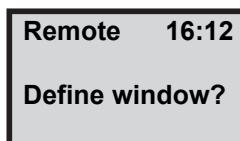


Figure 9.1 Set window. The sector window can be defined as described above.

Search Window

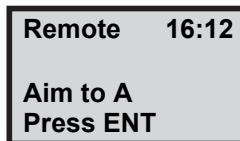
When Station Establishment has been carried out or 1. OK is selected the display will show “Define windows?”. Define

window gives you the possibility to set a window in which the instrument will search for the RPU. This will decrease the search time and will make you more efficient (it takes 10-12 sec for the instrument to search the complete circle). In this example we will show you how to use the function, answer YES.



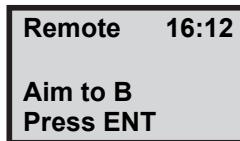
YES

Aim to the upper/lower left boundary and press ENT.



ENT

Aim to the upper/lower right boundary and press ENT.

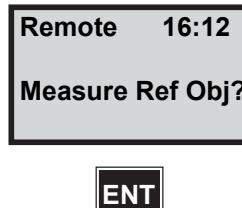


ENT

Note – Define window

The window can be relocated from the RPU menu, see Chapter 15.

Do you want a reference object? If so, press YES or ENT, otherwise press NO. The reference object doesn't have to be located at a known point, but should be located outside the search window where the sight is clear.



Note – The reference object must be a remote target (RMT).

Now it is time to take control of the measurement from the RPU, that is the detached keyboard unit at the measuring point. Press any key and detach the keyboard unit at the measuring point. Press and detach the keyboard unit from the station unit.



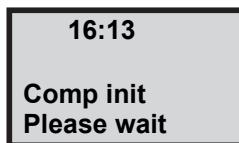
Activation of the RPU

Activate the RPU by pressing the PWR-key

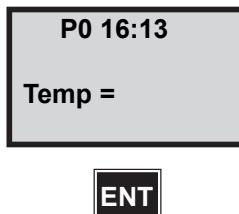


9 Surveying methods

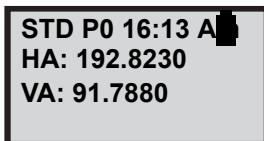
The compensator in the instrument is now calibrating,
please wait.



When the calibrating is ready you will step to program 0,
where you enter the PPM values, temp pressure,
(humidity), offset and Haref.

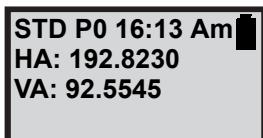


The display now switches to Standard Measurement mode.
You are now in control over the measurement from the
RPU. In the upper right display corner you can see the
battery status of the battery status of the battery connected
to the station unit and the function of the A/M-key (see
Chapter 15).

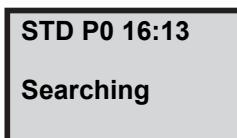


Aim & Measure

Aim the RMT towards the instrument and press the A/M-key.

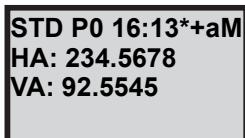


RPU is sending a signal to the instrument and the station starts to search in the sector.



The station has found the RMT and the system is ready to measure. This is indicated with*, + symbol (please refer to chapter 2.5 for explanation of the symbols).

Press A/M to measure.



9 Surveying methods

The display will show Horizontal angle (HA), Vertical Angle (VA) and Slope Distance (SD).

STD P0 16:13++Reg
HA: 234.5678
VA: 92.5545
SD: 73.409

Note – The A/M-key has two functions (Aim and Measure). In the right corner of the display the current function of the A/M-key is displayed, Am-Aim, aM-Measure. A long press on the A/M-key will give you a chance to step backward in the sequence Aim an Measure.

Establishing Contact From a Detached Control Unit

In addition to the methods described on the previous pages in this chapter, it is also possible to establish contact between the station unit and a detached control unit without having a control unit attached at the station unit.

Note – The previously described method is safer when it comes to radio channel selection. The instrument and control unit must be set to same radio channel to be able to communicate with each other.

Do as follow:

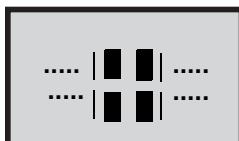
Press the A/M key on the backside of the station unit. 1 beep will be heard. Wait until 2 beeps are heard; this means that the telemetric link is on.



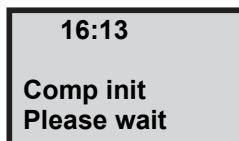
Press the PWR-key at the RPU.



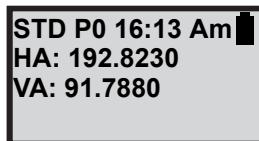
Level the instrument and press the A/M-key.



The compensator in the instrument is now calibrating,
please wait.



After having gone through program 0 you are now in the Standard Measuring mode. If you are about to perform robotic surveying, it is recommended that you set a search sector in the RPU menu, see Chapter 15.



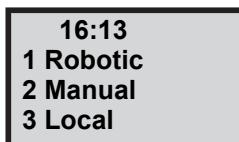
Switch to Measurement Towards an Ordinary Prism

If you, during a robotic measurement wish to measure towards an ordinary prism (e.g. when you wish to measure outside the range of the tracker), you can configure this in the RPU menu as follows:

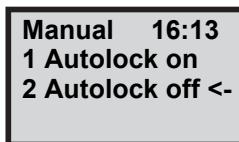
Press the RPU-key

RPU or RPU

Press 2 Manual



Press 2 to disconnect the Autolock function.



You are now able to measure towards an ordinary prism.

Switch Back to Robotic Surveying

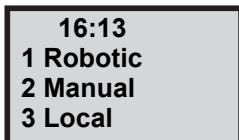
If you wish to switch back to robotic surveying from measuring towards an ordinary prism, do as follows:

Press the RPU-key



9 Surveying methods

Press 1 Robotic



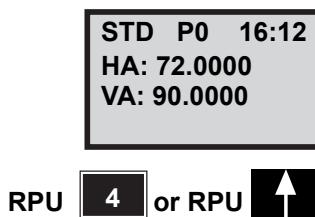
Press 1 OK if you wish to maintain the old settings.



Search Functions in Robotic Surveying

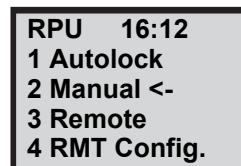
When you are surveying with Trimble 5600 in robotic mode there is a number of search functions that can be very useful depending on actual application. These functions are described below.

First press the “RPU”-button on the instrument.



RPU **4** or RPU

Choose 1. Autolock for robotic surveying.



1

Press 3 search control.



3

Here you can choose which function(s) you want to use. Switch between on and off by pressing the corresponding numeric key. Confirm by pressing ENT.

RPU 16:12
1 Automatic: on
2 Adv.lock: off
3 RMT600TS: off

ENT

Now you're taken back to PO and the selected search functions is activated. Below is described the different functions you can choose between.

STD P0 16:12 Am
HA: 72.0000
VA: 90.0000

Automatic: on (in Autolock or Robotic Mode)

Automatic search mode means that as soon as the instrument lose lock of the target (RMT) it will begin searching for the target 5 times in the same vertical plane (if you want to search the whole window you need to press the A/M key). As soon as the instrument finds the target it will lock on to it automatically. This function is very useful for ordinary surveying work.

Adv.lock: on (Only in Robotic Mode)

Advanced lock mode means that if the instrument lose lock of the target (RMT) it automatically locks on to the target as soon as it is visible again. This function is useful if you, for

example, are measuring in heavy traffic with cars temporarily blocking the measuring beam. This way you save time since the instrument usually (see “Search mode conflict” below) doesn’t start searching each time the measuring beam is being blocked.

Warning – When this switch is activated there is a risk that the instrument could lock on to a window etc. if the tracker signal should come as a reflex from RMT. After a normal search the instrument always locks on to the strongest tracker signal which, in every case, comes directly from the RMT itself.

RMT600TS: on (Only in Robotic Mode and With RMT600TS)

Sometimes it can be useful to let the instrument lock on to the RMT600TS without the RMT’s vertical sensor being active. This is useful if you must extend the range pole it isn’t possible for you to aim RMT600TS vertically towards the instrument.

Note – Search mode conflict

If both Automatic and Adv.lock are set to ‘on’ there is a conflict. In most cases the instrument will start searching for the RMT after a beam break.

Eccentric Point

Sometimes it is difficult to locate the prism at the point to be measured. This can be solved by considering the point as an eccentric point. Locate the prism at a known distance from the eccentric point, see figure 9.2. Works in STD, FSTD (not TRK or D-bar). Available in P0-P19.

9 Surveying methods

Choose menu 12, Preset.

STD P0 16:13 Am 
HA: 21.4108
VA: 93.0732
SD: 105.213

MNU **1** **2**

Choose 1 Eccentric pt.

Preset 16:13
1 Eccentric pt.
2 R.O.E.

1

Enter the radial offset and press ENT.

Eccentric 16:13
Radofs = 0.47

ENT

Note – Radofs can also be entered by pressing the function key and 70.

Enter the right angle offset and press ENT.

Eccentric 16:13
RT.ofs = 0.795

ENT

Note – RT.ofs can also be entered by pressing the function key and 71.

Are the offset values OK.

If so press YES, otherwise press NO.

Eccentric 16:13
Radofs = 0.47
RT.ofs = 0.795
OK?

YES

The values are now updated with the offset you've entered.
The new point will get the same height as the measured point. The next point will be measured without the offset if you do not enter menu 121 again.

STD P0 16:13 Am 
HA: 21.8643
VA: 93.0968
SD: 105.619

Stored as

0 = Eccentric pt 2
70 = 0.47
71 = 0.795
Updated measured values according to the U.D.S being used.

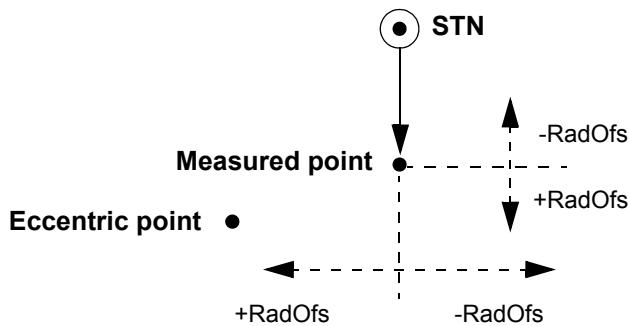


Figure 9.2 Eccentric point.

The RPU Menu

RPU  or RPU 

Instrument					
		1 OK			
1 Autolock*	2 Window control	1 Auto center	2 Center	3 Editor	4 Set
		5 Reset	6 Remove	7 Left	8 Right
	3 Search control	1 Automatic	2 Adv. lock***	3RMT600TS****	
2 Manual					
3 Remote	1 OK				
	2 Known Station				
	3 Free Station				
	4 Known Station+				
	5 Exce. station				
4 RMT Config	1 Tilttable RMT				
	2 Vertical RMT				
	3 RMT Id				

RPU					
		1 OK			
1 Robotic*	2 Window control**	1 Auto center	2 Center	3 Editor	4 Set
		5 Reset	6 Remove	7 Left	8 Right
	3 Search control	1 Automatic	2 Adv. lock***	3RMT600TS****	
2 Manual	1 Autolock on*				
	2 Autolock off*				
3 Local					

* Only available for servo instruments.

** For further description of Window control, see page 12-5.

*** Only in Robotic surveying.

**** Only in Robotic surveying using RMT600TS

9 Surveying methods

10

Important Pages

ASCII Table	10-2
General Measurement Hints	10-4
Backup of Memory	10-4
Reboot the Keyboard Unit.....	10-4
Collimation Errors	10-6
Tilt Axis.....	10-6
How to Combine Labels 26, 27, 28 and 29	10-6
Fetch Station Data (MNU 33).....	10-7
How to set out Using Autolock (Only Servo).....	10-7
Measuring Towards Corners Using Autolock	10-8
How to Check What is Installed in Your Keyboard Unit.	10-8
Temporary Horizontal Angle in P0	10-9
Description of Label 23	10-9
Info Codes.....	10-11

ASCII Table



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 (ASCII) key.

Table 1:

Value	ASCII Char.						
32	Space	56	8	80	P	104	h
33	!	57	9	81	Q	105	i
34	"	58	:	82	R	106	j
35	#	59	;	83	S	107	k
36	\$	60	<	84	T	108	l
37	%	61	=	85	U	109	m
38	&	62	>	86	V	110	n
39	'	63	?	87	W	111	o
40	(64	@	88	X	112	p
41)	65	A	89	Y	113	q
42	*	66	B	90	Z	114	r
43	+	67	C	91	[115	s
44	-	68	D	92	\	116	t
45	_	69	E	93]	117	u
46	.	70	F	94	^	118	v
47	/	71	G	95	_	119	w
48	0	72	H	96	-	120	x
49	1	73	I	97	a	121	y

Table 1:

50	2	74	J	98	b	122	z
51	3	75	K	99	c	123	{
52	4	76	L	100	d	124	
53	5	77	M	101	e	125	}
54	6	78	N	102	f	126	~
55	7	79	O	103	g		

MNU **6** **6**

The instrument also gives you the opportunity to select special characters for different languages. This can be done via Menu 66. The following languages and characters can be selected.

Table 2:

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

General 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 more than one place. Backup is easily done with Program 54 which enables you to transfer Job- and Area-files between the different Trimble units or to a PC, see 'Geodimeter CU software' for more information. You can also use the PC-program Terramodel Field Data Module, ask your local dealer for a demonstration.

Reboot the Keyboard Unit

Measurements will be stored in the memory of the keyboard unit attached to the instrument. The data system is designed to max. security with write protection of the data memory and a backup of the working area of the programs. If a lock up or an error of the program should occur which cannot be resolved by just a restart of the instrument, there is a new reboot action available:

1. Disconnect the keyboard unit from the instrument and connect it to an external battery.
2. Start the keyboard unit by keeping the **CON** and **PWR** key depressed at the same time.
3. In the display will 2 options be available.
4. Choose 2. Reboot and a reboot will occur.

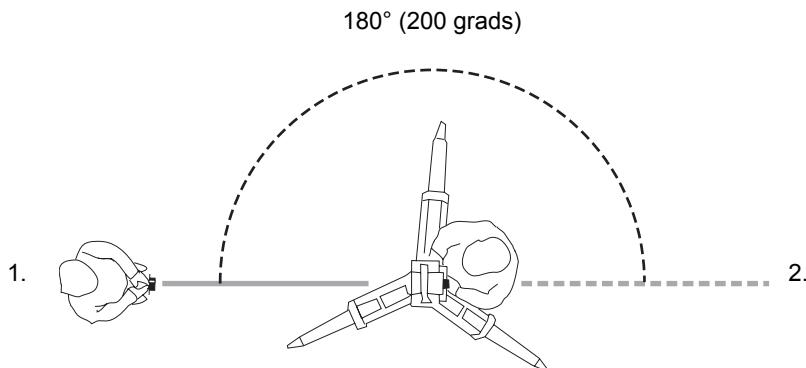
Note – in this case all functions will be reset and all self-made U.D.S. will be lost.

Fast check of the collimation errors (only Servo)

1. Aim at the point exactly.
2. Press the  button.
3. Look at reticle. The difference in aiming represents the value of the current collimation errors (dH and dV).
4. If you consider them too large we recommend you to perform a test measurement (MNU 5).

Extend the straight line (only servo and at the instrument)

When you wish to measure as shown in the illustration below, i.e. first measure towards a point and then rotate the instrument to a point that lies on a straight line from the first point, you should turn the instrument 180° , (200 grads) and not rotate the instrument to face 2. This is because in the second case the instrument will not correct any collimation errors. With a long press on the  key you will rotate the instrument 180° (200 grads).



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 pre-measured 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 regularly especially when measuring during high temperature variations and where high accuracy is demanded in one face.

Test measurements should be carried out with the keyboard configuration current for the measurement.

Tilt Axis

When measuring towards a point, the instrument will correct the measured angles as described above. If you tilt the telescope up/downwards you will find that the horizontal angle will change, this is an illustration of tilt axis and two-axis level compensator correction, which both are dependent of the vertical angle. However if you point the telescope to a vertical level string you will find that the horizontal angle will remain constant.

How to Combine Labels 26, 27, 28 and 29

1. Positioning of HA and VA

If you wish to aim at a point when you know HA and VA you should use label 26 and 27.

2. Set out points with bearing and distance

If you know the bearing and the distance to a point you should use label 27 and 28. With label 29 you can also set out the height.

Note – Do not use label 26 for positioning the height of the point. Use instead label 29 and let the instrument calculate the VA.

3. Set out points with known coordinates if the station is established (via program 20 or menu 3) you can use label 67 and 68. With label 69 you can also set out the height.

Note – If you use label 67, 68 or 69, this will also have effect on label 27 and 28.

4. Set out points in height with the servo control key to position the height use the  button. If the distance has not yet been measured, the instrument will be positioned in height based on the theoretical distance. If the distance has been measured the instrument will be positioned in height to the measured point, i.e. the height will always be correct even if you do not aim exactly at the correct point.

Fetch Station Data (MNU 33)

If you have established a station with program 20 and the station coordinates is somehow destroyed (e.g. with an overriding U.D.S. containing station, IH, Refobj.), you can retrieve the original station coordinates with menu 3.3.

Note – This does not work if label 21 has been changed.

How to set out Using Autolock (Only Servo)

1. Switch on Tracklight.
2. Select the point to set out.

3. Aim the instrument towards the point by pressing .
4. The prism holder looks for the white light from Tracklight without aiming the RMT towards the instrument.
5. When the prism holder is inside the white light, he/she turns the RMT towards the instrument.
6. At the prism, choose the display page that shows Radofs and RT.ofs and guide the prism holder to the right set out point.

Measuring Towards Corners Using Autolock

1. Choose FSTD, STD or D-bar.
2. Aim towards the RMT, press A/M and you will get frozen display values.
3. Turn the RMT away from the instrument.
4. Press the CON-key.
5. Aim the instrument towards the corner.
6. Press the REG-key to register the measurement

How to Check What is Installed in Your Keyboard Unit.

1. Make a long press on your PRG key.
2. Now you are in the UDS library. Press the corresponding key below DIR.
3. Now you are in the PRG library. Press the corresponding key below DIR.

4. Now you can see the options installed in your keyboard unit. Step between the installed options with the corresponding keys below the arrows(-and-).

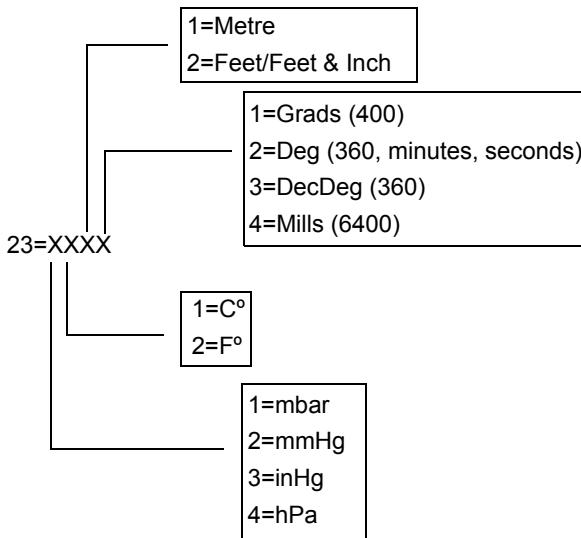
Temporary Horizontal Angle in P0

The temporary horizontal angle feature in Program 0 can be useful if you want to turn the instrument without affecting the original HA. This function is called HA_L, Horizontal Angle form a Line, and results in an extra line in the display showing HA_L=0.oooo. You activate the HA_L function by pressing key 5. Reset HA_L by pressing key 5 again. Exit HA_L with a long press on key 5. Note that this function only works in Program 0.

Description of Label 23

Label 23 can be used in an U.D.S. to log which units that where current during the measurement.

Note – You cannot change the value of this label with F 23, you must instead use MNU 6.5.



Ex. If 23=2111, means that the units are mmHg, C°, Metre and Grads.

The following pages will describe the different info codes that can appear in Your Geodimeter. If an error appears frequently the instrument should be left to authorized service.

In some cases the info code also includes a device code, e.g. 22.22. The most frequent codes are: 1=Serial, 2=Imem, 6=Radio, 7=Distance meter.

If a device code appears, check the info code description. If the code is not described the error is internal and the instrument should be left to authorized service.

Info Codes

Info 1 – Compensator out of range

- Cause: The instrument is tilted too much. The dual-axis compensator can not compensate for the inclination.
- Action: Leve the instrument or disconnect the dual-axis compensator.

Info 2 – Wrong face

- Cause: The operation was carried out while the instrument was in an illegal mode. E.g: Trying to measure in the wrong face.
- Action: Change to face 1, showing angles in the display and retry.

Info 3 – Distance already recorded

- Cause: The distance to the current object has already been registered.
- Action: If a new registration is required a new measurement must be carried out.

Info 4 - Invalid measurement

- Cause:
- The measurement is invalid, e.g. several measurements towards the same point or the measured points lies 200 grads from each other, P20, Free Station.
 - Trying to perform a calculation which is dependent from a distance without having measured any distance, P20 Free Station and Z/I_Z.
- Action:
- Check that the circumstances above does not occur and redo the measurement.

Info 5 - Undefined mode or table

- Cause: Tries to use a display – or output-table that does not exist.
- Action: Choose another table or create a new.

Info 6 - Vertical angle less than 15grads from horizontal angle

- Cause: The vertical angle is less than 15grads from the horizontal angle when performing a Tilt Axis Calibration.
- Action: Redo the calibration with an increased horizontal angle.

10 Important Pages

Info 7 - Distance not yet measured

Cause: Tries to register without having performed a distance measurement. E.g: when using an U.D.S. which includes labels that are dependent on a distance.

Action: Perform a distance measurement before registration.

Info 10 - No active device

Cause: Tries to register in an U.D.S. without having defined a storage unit.

Action: Check that the U.D.S. includes a logon procedure.
Restart the U.D.S. and choose a storage unit (IMEM or Serial).

Info 19 - Communication error

Cause: - The cables are not connected correctly or are damaged.
- The battery is drained.
- The data for transfer contains errors.

Action: - Check that the cables are connected properly.
- Check that the batteries are not drained.
- Run the transfer again and check if any error appears.

Info 20 - Label error

Cause: You have entered a wrong label number. The label does not exist, is not correct or does not contain any data.

Info 21

Cause: - Wrong communication parameters (label 78).
- The cables are not connected correctly or are damaged.
- The battery is drained.

Action: - Check that the same parameters are set in the target unit as in the source unit.
- Check that the cables are connected properly.
- Check that batteries are not drained.

Info 22 – No or wrong device connected

Cause: Tries to access a device that is not connected or working.

Info 23 -Time out

Cause: An error occurred during a communication session.

Action: - Check that the batteries are not drained.

- Check that the cables are connected properly.

Info 24 -Illegal communication mode

Cause: The operation was carried out while the instrument was in an illegal mode.

Action: Set the instrument in face 1 (P0), press STD, TRK or D_bar and retry.

Info 25 - Real time clock error

Action: Try to set date and time. If that does not help the instrument should be left to authorized service.

Info 26 - Change backup battery

Action: The instrument can be used but should be left to authorized service for replacement of the battery. There is a risk for total loss of memory.

Info 27 - Option not installed

Cause: Tries to select a program which is not installed in the instrument.

Action: Choose another program or contact Your local Trimble dealer for a program installation.

Info 29 - The current table can't be changed

Cause: Tries to modify the current display- or output-table.

Action: To be able to modify the current table, you must first select another table to be the current.

Info 30 - Syntax error

Cause: Tries to send a command with illegal syntax on the serial channel.

Action: Check the command and change the syntax. Note that only big letter commands are allowed.

10 Important Pages

Info 31 - Out of range

- Cause:
- Tries to choose an illegal display – or output-table.
 - Tries to choose a display – or output-table that does not exist.
 - Tries to create an illegal U.D.S.
 - Tries to measure too long a distance.

Info 32 - Not found

- Cause:
- Tries to access a Job- or Area-file that does not exist.
 - Tries to access an illegal program.

Info 33 - File record exist

- Cause: Illegal way of creating a Job- or Area-file

Info 34 - Illegal record separator

- Cause: Tries to insert a label in the editor when you have a Job No or Area No in the display.

Info 35 - Data error

- Cause: Wrong data input, e.g. value out of range or alpha sign in a numeric value.

Info 36 - Memory full

- Cause:
- Too many point codes in the point code library (Program 45) or too many characters in the point codes.
 - Too long display- or out output-table
 - Internal memory full.
- Action
- Use less characters in the point codes.
 - Shorten the tables or use fewer tables.
 - Install more memory at your local dealer or delete unused files.

Info 41 - Wrong label type

- Cause: This label type can not be attached to this specific label.
- Action. Choose another label or use another label type.

Info 42 - U.D.S. program memory full

Action: Delete unused U.D.S. programs or shorten the programs.

Info 43 - Calculation error

Action: Redo the procedure.

Info 44 - Not enough data for calculation

Cause: The program needs more points for the calculation, P20, Free Station.

Action: Measure more points and redo the calculation.

Info 46 - GDM power error

Cause: RPU can not switch on GDM

Action: Redo the procedure. If the error appears again leave the instrument to authorized service.

Info 47 - U.D.S. call stack error

Cause: You have used call in too many steps (max 4 steps).

Action: Check the U.D.S's and decrease the number of calls.

Info 48 - No or wrong station establishment

Cause: - The station labels has been changed since the station was established.

- The station is not established.

Action: Perform a station establishment. If using a RPU and if the station has been established earlier, fetch station data with menu 33.

Info 49 - RPU not logged on to GDM

Cause: Tries to perform an operation that demands a RPU.

Action: Log on the RPU to the GDM and redo the operation.

Info 51 - Memory lost

Action: Reboot the instrument /see page 10-4). If that does not help leave the instrument to authorized service.

Info 54 - Info 54 Memory lost

Action: Reboot the instrument (see page 10-4). If that does not help, leave the instrument to authorized service.

10 Important Pages

Info 103 - No carrier

Cause: Disturbance or no contact over the telemetry link.
Action Change channel or decrease the distance between the RPU and the instrument.

Info 107- Channel busy over the telemetry link

Action: Change channel.

Info 122.6 - Radio not connected (Can also show info 22.6)

Cause: - The radio is not connected to the geodimeter.
- The radio is not switched on.
- The battery in the radio is drained.
- The cables are not connected properly or are damaged.
Action: Connect the radio to the instrument and switch on the radio.

Info 123 - Time out (Can also show info 23.6)

Cause: - The battery in the radio is drained.
- The cables are not connected properly or are damaged.
Action: Check the cable connections and examine the radio battery.

Info 153 - Limit switch engaged

Cause: Tries to position the instrument to an illegal angle.

Info 155 - The horizontal positioning is not good enough

Action: If this appears frequently leave the instrument to authorized service.

Info 156 - The horizontal & vertical positioning isn't good enough

Action: If this error appears frequently leave the instrument to authorized service.

Info 158 - Can not find the target

- Cause:
- The aiming from the RPU is bad.
 - The measuring distance is too long.
 - The measuring beam was obstructed.
- Action:
- Try to aim the RPU towards the Station more accurately and remove any obstructing object. If possible try to reduce the measuring distance.

Info 161 - The target is lost

- Cause:
- The aiming from the RPU is bad.
 - The measuring beam is obstructed.
 - The target was moved too fast.
- Action:
- Try to aim the RPU towards the Station more accurately and remove any obstructing object. If not in tracking mode, it is important to hold the target still while measuring.

Info 162 - Syntax error (see Info 30)

Info 166 - No measuring signal from prism

- Cause:
- The distance meter in the instrument or the prism is obstructed.
- Action:
- Remove any obstructing object from the instrument and the prism.

Info 167 - Collimation error too large

- Cause:
- The collimation error during a test measurement was too large.
- Action:
- Increase the measuring distance. It is important to keep the RPU held still during the measurement. If the error does not disappear leave the instrument to authorized service.

Info 174.7 - Distance measurement error

- Action:
- Redo measurement.

10 Important Pages

Info 175.7 - Distance measurement error

- Cause: Especially in TRK mode when you start to measure a distance to one prism and end the measurement to another one.
- Action:
- Wait until the error message disappears. The next distance measurement will be correct.
 - Measure in FSTD (Fast Standard Mode).

Info 201 - Calculation error (see Info 43)

Info 207 - Process queue overflow

- Cause: Too many commands sent too fast on the serial channel.
- Action:
- Wait for the result of one command before you send the next one.
 - Switch off and restart if keyboard is attached on the instrument.

Info 217 - RS-232 Buffer Overflow

- Cause: Data was sent without an end sign.
- Action: Make sure that the command contains an end sign.

Info 218 - Input string too long

- Cause: A command that is too long was sent on the serial channel.
- Action: Send a shorter command.

11

Angle Measurement System

Overview	11-3
The Angle Measuring Technique.....	11-3
Dual Axis Compensator	11-3
Correction for Collimation Errors.....	11-4
Correction for Trunnion Axis Tilt.....	11-4
Calculation of the Horizontal Angle.....	11-5
Calculation of the Vertical Angle	11-5
Single-Face Angle Measurement.....	11-6
Two-Face Angle Measurement	11-6

11 Angle Measurement System

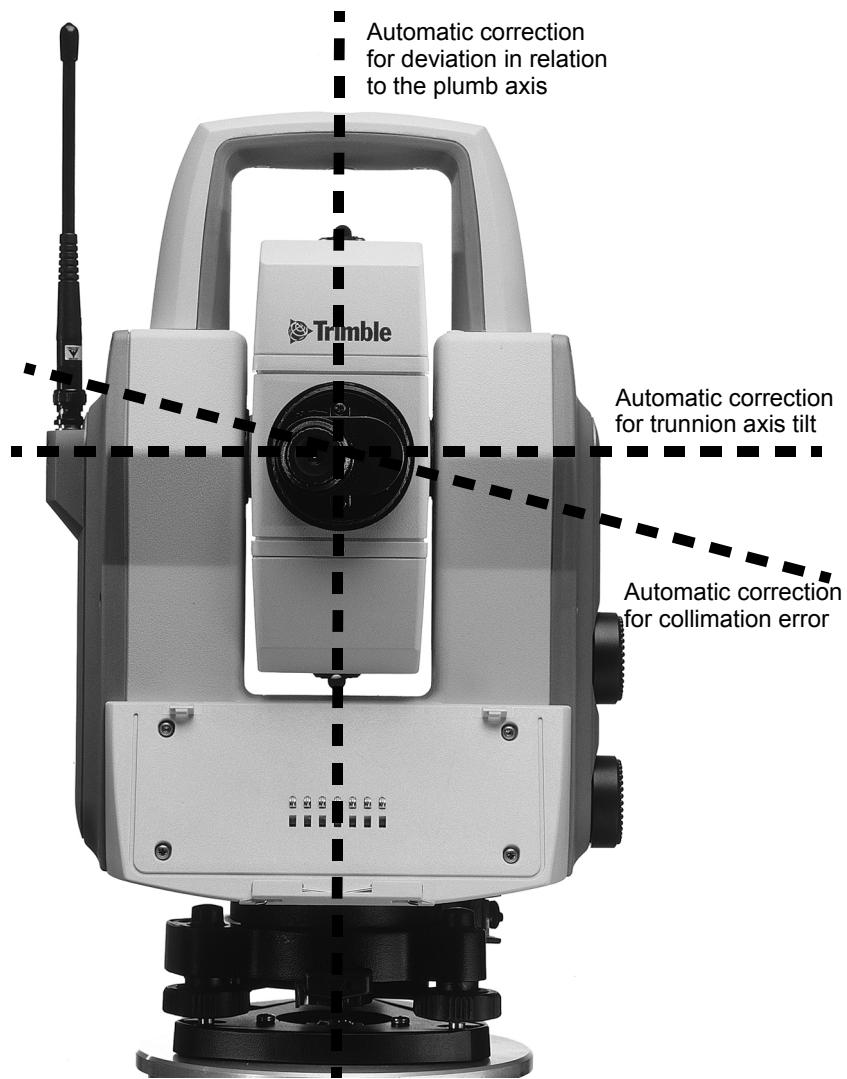


Figure 11.1 The Angle Measurement System

Overview

The Trimble System 5600 and 3600 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 measurement system gives you full compensation for the following:

- Automatic correction for angle sensor errors.
- Automatic correction for collimation error and trunnion Axis tilt.
- Automatic correction for tracker collimation error.
- Arithmetic averaging for elimination of pointing errors.

The Angle Measuring Technique

One of the strong features of the design of Trimble System 5600 is its electronic angle measurement system, which eliminates the angle errors that normally occur in conventional theodolites. The principle of measurement is based on reading an integrated signal over the whole surface of the angle sensor and producing a mean angular value. In this way, inaccuracies due to eccentricity and graduation are 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 system warns immediately of any alterations in excess of $\pm 10^c$ ($6'$).

Correction for Collimation Errors

By carrying out a simple pre-measurement test procedure both horizontal and vertical collimation of the instrument can be quickly measured and stored. All angles measured thereafter are automatically corrected. These collimation correction factors remain in the internal memory until they are measured again.

Correction for Trunnion Axis Tilt

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

When should these tests be carried out?

1. After transport where hard handling may have occurred.
2. When the temperature differs by $> 10\text{ C}$ from the previous application.
3. If you have changed the keyboard unit configuration since the latest calibration.(You can use one, two or none key board unit).
4. Immediately prior to high precision angle measurement.

How are these tests carried out?

See “Test Measurements”, Chapter 5, page 5-25.

Calculation of the Horizontal Angle

The formula below is used to calculate the horizontal angle:

$$HA = Has + Eh * 1 / \sin v + Yh * 1 / \tan v + U * 1 / \tan v$$

($\sin v$ = collimation

$\tan v$ = levelling

$\tan v$ =horizontal axis)

HAs = Horizontal angle measured by the electronic sensor.

Eh = Horizontal collimation error.

Yh = Levelling error at right angle to the telescope,
corrected by the automatic level compensator.

U = 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 sensor.

Ev = Vertical collimation error.

Yv = Deviation in the vertical axis, measured by the
automatic level compensator.

Single-Face Angle Measurement

The above described features admits efficient and accurate angle measurement in a single face, since the instruments errors are automatically corrected with constants which are stored during the test measurement.

During Single Face angular measurements, with the compensator 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.

Two-Face Angle Measurement

The instrument 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 hereafter be referred to as Circle 1 and Circle 2 positions. Two face measurements can be used for legal reasons, or when additional concern of accuracy and documentations is demanded.

When measuring in STD-mode you measure and store each angle value of the two faces and get a display value of the total collimation and sighting error.

When measuring in D-bar mode you can decrease the sighting error by repeating measurements and mean value calculation of each sighting. The number of repeated sightings can be chosen depending on the current measuring conditions. The final mean value calculated angles are displayed and stored in this mode. Angle values for each face are also available.

11 Angle Measurement System

CHAPTER

12

Distance Measurement System

Overview	12-3
Distance Measurement	12-3
Standard Measurement (STD Mode)	12-4
Fast Standard Measurement (STD mode)	12-5
Precision Measurement (D-bar).....	12-5
Tracking Measurement (Setting Out).....	12-6
Measurement Towards Moving Targets	12-7
Long Range Measurements.....	12-7
Target Data On/Off	12-8
Automatic Control of Signal Level.....	12-9
Measurement Beam Width	12-9
Measurement Range	12-9
Accuracy	12-10
Important Information When Measuring With High Accuracy	12-10
R.O.E (Remote Object Elevation)	12-10
UTM Scale Factor Corrected Distances.....	12-14

12 Distance Measurement System



12-2 Geodimeter CU General

Overview

The distance module of Trimble System 5600 and 3600 (Not DR instruments)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 an received signal is measured. The time measurement of the phase delay is converted and displayed as a distance with mm accuracy on the four-line LCD.

Note – When taking measurements with servo instruments and having the Tracker installed there may be a distance error if you use large prisms. See page 12-10 for further information!

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 four methods of distance measurement



Standard measurements towards stationary targets (standard mode)



Fast measurements towards stationary targets (fast standard mode)



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



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.

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 is 3.5 seconds. 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 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 (see page 12-10). 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 12-7).

Fast Standard Measurement (STD mode)

STD

This measurement mode is used when the object is stationary but the demands on precision are low. The measurement time is very short, approx. 1.3 seconds.

The measurement is performed in the same way as the standard measurement.

Switch Between Fast Standard and Standard Measurement Mode

MNU **6** **2**

You can configure the STD-key to work in Standard- or Fast Standard mode in menu 62.

Precision Measurement (D-bar)

D̄

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 3.5 seconds. 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 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 (see page 12-10).

Note that when using the R.O.E.-feature the distance measurement has to be interrupted by pressing the A/M-key. 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-key.

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. 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 distance measured and the required horizontal distance to the point. These differences are visible on 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 in the standard version of the instrument:

- Keying in of bearings (SHA), distances (SHD) and height (SHT) to the points, after first calling up F27 (SHA), F28 (SHD) and F29 (SHT) respectively.

MNU **3** **1**

- 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 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 7-26.

Measurement Towards Moving Targets

The TRK mode is fully automatic. All measured values will be updated every 0,4 sec. after making contact with the prism. No keys have to be pressed between measurements. 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.

Long Range Measurements

MNU **1** **6**

On some instruments you can enable/disable a special function called “Long Range” by accessing MNU 16. If Long Range is enabled you will see the “Long Range” text

in the display every time you press the A/M button in STD or D-bar mode. If you are unsure whether you have the option installed you can check that by making a long press on the PRG-key. In the first row you will find the characters "LR" or "MR" if you have the options installed.

Target Data On/Off

This allows measuring to points over which the prism range pole cannot be placed – e.g., 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 50mgrads rotation of the instrument for distances within 400mg. 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 1200m, the instrument can be re-directed to the correct point up to offset distance of 90 cm.

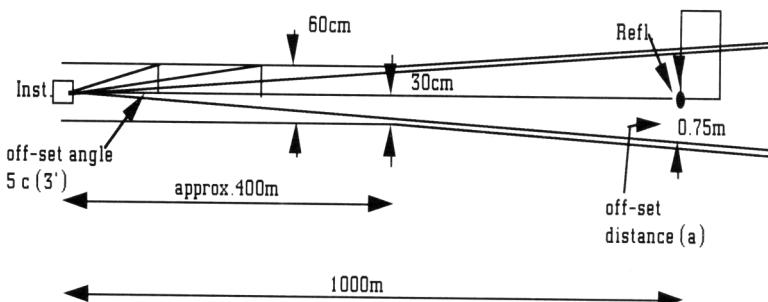


Figure 12.1 Measuring against eccentric point.

This +/-30 cm or 50mgrads limit can be deactivated in menu 6.1. Config 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 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 instruments have an automatic signal control which adjusts the measurement signal level for the optimal value of each distance measured.

Measurement Beam Width

The infrared measurement beam has a width of 16 cm/100m (~6inch/300 feet) (1.6 mrad). The wide measurement beam simplifies considerably both target/prism acquisition and setting out exercises. The DR 200+ instruments has a beam width of 8cm/100m.

Measurement Range

The instruments have an range capability of 0.2m to 5500m (depending on the type of instrument) with only one prism in normal weather conditions (Standard clear).

Accuracy

Since the instruments are constantly improved we refer to the Technical Specifications sheets for the up-to-date accuracy figures of the respective models.

Important Information When Measuring With High Accuracy

To achieve the highest accuracy when measuring distances shorter than 200 meters and having the Tracker unit installed on your instrument you need to be aware of the following:

If you use a large reflector like the Super Prism (Part no. 571 125 021) or the Tilttable Reflector (Part No. 571 126 110) you need to cover the tracker aperture before you measure the distance. Otherwise reflections from the Tracker unit may have influence on the measured distance. The error can vary from 0 to 3 mm. If you use a Miniature Prism (Part no. 571 126 060 or 571 126 100) this error does not occur.

R.O.E (Remote Object Elevation)

The R.O.E. measurement function is used to measure heights of objects where it is not practical or impossible 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 is in the same vertical plane as the point to be measured. 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. The height is calculated from the horizontal distance measured and the

vertical angle for the point at which the reticle of the telescope is pointed.

R.O.E. can be preset to 0 or any other value by using menu 1.2, R.O.E. preset. Note that you do not have to activate the R.O.E. function – it is always active as long as you are in Program 0.

MNU **1** **2**

An example: Let's say you want to measure the height of a building, from the ground to the top. Place the rod close to the building. Take a measurement to the prism, select a display that shows VD or ELE. Tilt the telescope to the bottom of the rod and select MNU 12, R.O.E. Preset, and key in 0.000. If you can't see the bottom of the rod you can aim to the prism and key in the height of the prism as R.O.E. Preset, e.g. 3.000. Now, when you tilt the telescope to the top of the building you can see the height in the display shown as VD or ELE.

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 by the choice of display mode of the instrument, it is also possible to work with and see immediately the northings, eastings and elevations of the points. This will allow you to work directly from the engineer's drawing without needing to pre-calculate bearings, distances and heights.

The R.O.E. is reset in STD and D-bar mode by a new measurement.

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 you do not key in either instrument or signal height, the vertical distance (VD) shown on the display is the difference between the horizontal of the instrument and the point at which the telescope reticle centre is pointing.

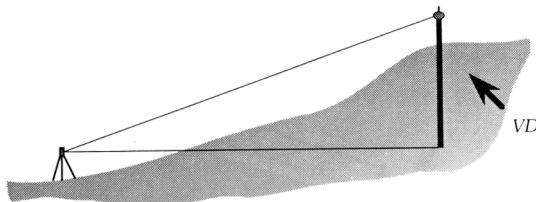


Figure 12.2

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 (SH) of the target to 0, the vertical distance (VD) shown on the display is the difference in height between the station ground 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 heights directly from the engineer's drawing, for example.

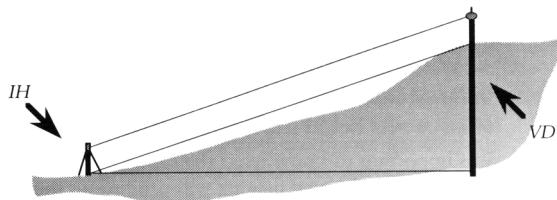


Figure 12.3

3. If you key in both the instrument and signal height, the vertical distance (VD) which is shown on 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 reflector is placed – i.e., the actual difference in elevation between the two ground points.

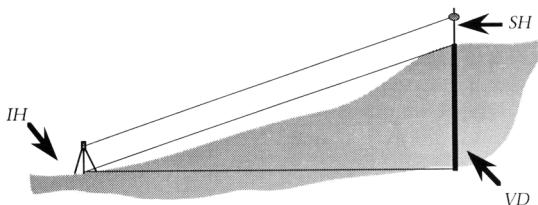
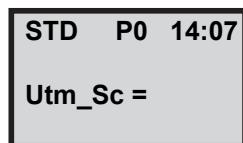


Figure 12.4

UTM Scale Factor Corrected Distances

In Trimble System 5600 and 3600 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 government 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 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: Know Stn./Free Stn.

P23: SetOut

P26: DistOb (Distance between 2 objects)

UDS which includes distance measurements.

UTM Example

F 4 3

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) with your scale factor. This routine will be carried out automatically when keying in a UTM Scale Factor using Function 43.

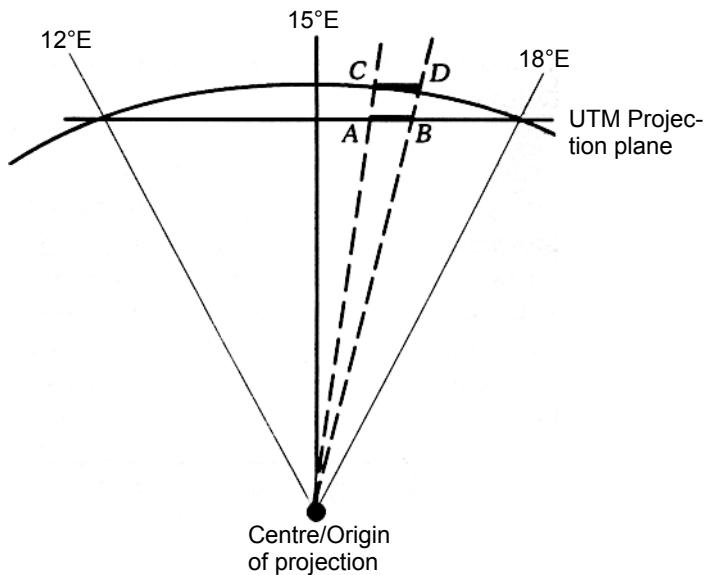


Figure 12.5 UTM Scale Factor.

12 Distance Measurement System

C H A P T E R

13

Tracklight

Overview	13-3
How to Activate Tracklight.....	13-4

13 Tracklight

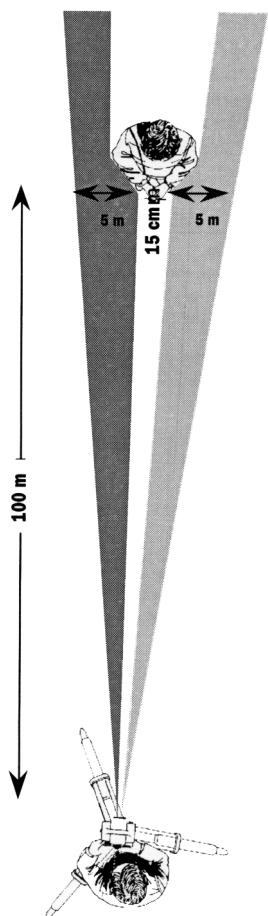


Figure 13.1 Tracklight emits a red, white and green sector of flashing light where the white light coincides with the measuring beam.

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 staffman 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 previous page, it can be seen that the instrument measuring beam width at 100 m is 15 cm. The width of the tracklight beam at the same distance is 10 m.

The tracklight unit slides onto the underside of the measuring unit (see fig figure 13.2) and it is activated from the keyboard.



Figure 13.2 The Tracklight unit slides onto the underside of the measuring unit.

How to Activate Tracklight



Tracklight is activated from the keyboard by pressing
 on the keyboard unit.

Tracklight RPU

MNU **6** **1**

The display now shows:

Tracklight 10:18
0=OFF
1=HIGH
2=NORM

Figure 13.3 Activation of Tracklight

- Key in 0 if you wish to switch off Tracklight during measurement.

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

Tracklight is switched off automatically when the instrument is powered off. It is worth noting that the life length of the tracklight 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.

13 Tracklight

CHAPTER

14

Servo

Servo Controls	14-2
Servo Control keys.....	14-2

Servo Controls

Servo Control keys

When you are about to position the instrument towards a point that are known, that is when the horizontal and vertical angle is known you can use the servo control keys  and  for positioning the instrument. Simply enter label 26 and 27 or SON and SOE and press the control key  for horizontal positioning and  for vertical positioning. As soon as the key has been pressed the servo will position the instrument at the right position. When measuring in two faces you can use control key  for switching between face 1 and face 2.

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



Key for horizontal positioning



Key for vertical positioning



Key for horizontal and vertical positioning



This key is used for switching between C1 and C2 when measuring in two faces. It is available on instruments with no keyboard unit attached at the front. A long press on this key switches the face.



14 Servo

15

Tracker (only for servo instruments)

Overview	15-3
Tracker Operation	15-3
Search Criteria (OPTIONAL for Autolock)	15-3
Lock on Target	15-4
Controlling the Tracker (OPTIONAL for Autolock)	15-5
Window Control.....	15-5
Search Control.....	15-7
Guidelines	15-9
Reference Control in Robotic Mode.....	15-10

15 Tracker (only for servo instruments)

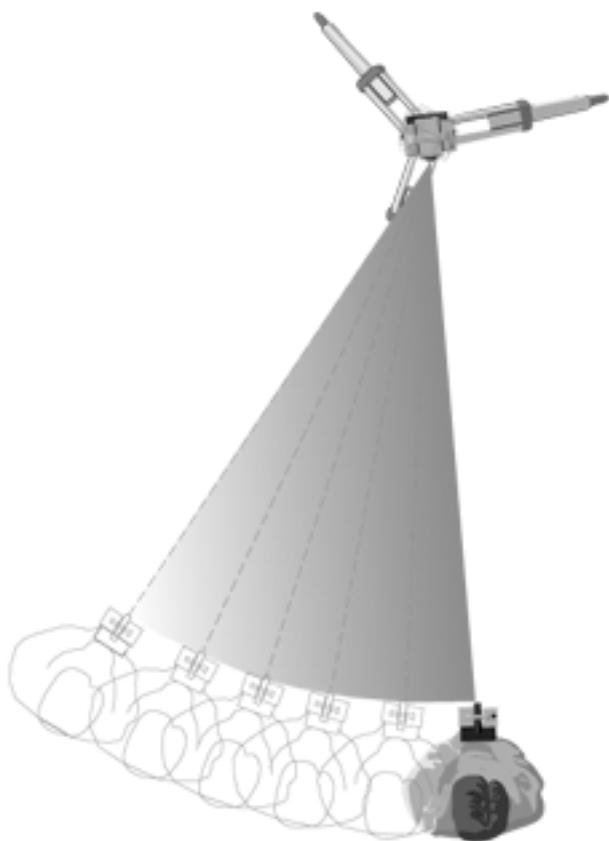


Figure 15.1 The Trimble 5600 series Tracking function.

Overview

Trimble System 5600 can be equipped with a Tracker unit which is needed when using the system for robotic surveying or when performing conventional surveying with Autolock.

The tracker has control over the instrument's servos and aims the instrument correctly towards the target, which in these cases must be an RMT (Remote Target). An automatic search function is optional.

Tracker Operation

Search Criteria (OPTIONAL for Autolock)

It is possible to let the tracker perform a search for the target, e.g. when measuring in dark or in heavy shrubbery where the sight is not so good or when having lost contact with the prism during a measurement.

The search is either started manually by pressing the A/M key or automatically in TRK-mode (if you have switched TRK Search ON):

The tracker seeks for the target in the following order:

1. ±30 degrees horizontally around the point at which the instrument is pointing.
2. In a three-dimensional search window*

***If no search window is set the search will be carried out 360 degrees around the instrument and ±15 degrees vertically.**

Note – If no target is found after the search Info 158 will be displayed. Reaim the RMT towards the instrument and press the A/M-key to start the search procedure.

Use the **NO** key to cancel the search.

Lock on Target

When the instrument is locked on the RMT this is indicated by a + on the display. When moving the RMT, still visible for the instrument, the instrument will automatically follow.

If losing contact with the instrument in STD-, FSTD or D-mode

If the instrument loose visible contact with the RMT, Info 161 (Target lost) will be displayed. Aim the RMT towards the instrument and press the A/M-key to start searching (optional) or use the servo controls to regain contact. The function “Advanced lock” can also be used in these measurement modes (see page 15-7 for further explanation).

If losing contact with the instrument in TRK-mode

If the instrument loose visible contact with the RMT, Info 161 (Target lost) will be displayed. Use the servo controls to regain contact.

With the search option:

The tracker can be set to automatically start to seek for the RMT in the search window. The instrument searches

through the whole search window, both horizontally and vertically. If the target isn't found the text “**Target lost**” appears. Press the A/M-key (optional) or use the servo controls to regain contact if you have changed the position much. The function “Advanced lock” can also be used in this measurement mode (see page 12-6).

Controlling the Tracker (OPTIONAL for Autolock)

To speed up the search routine, you can set a “window” in which the instrument should seek for the target. When setting up the instrument for remote or robotic surveying you automatically will be prompted to set a search window, but when performing conventional surveying with Autolock, you must enter the RPU menu and chose Window control to do the same.

Window Control

RPU  or RPU 

You can change the search window by choosing the RPU menu, 1 Autolock and 2 Window control. There are 8 different options on this menu:

1. **Auto centre** – to enable/disable the automatic centring function when the instrument loses contact with the RMT.
2. **Center** – to manually change the center of the current search window to the position where the instrument is pointing (also in height).
3. **Editor** – to manually key in the window boundaries:

15 Tracker (only for servo instruments)

The first line shows the horizontal angle of the left and the right boundary of the window. The second line shows the vertical angle of the upper and the lower boundary of the window.

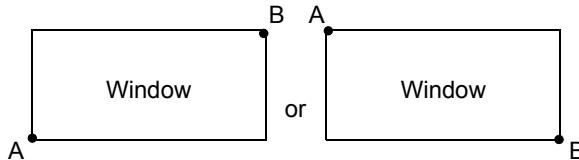
Window 14:32
Hor: L=308 R=27
Vert:U=89 D=99
Sel Exit

4. **Set** – to set a new search window:

Aim to the left boundary and press ENT.

Window 14:32
Aim to A
Press ENT

ENT



Aim to the right boundary and press ENT.

Window 14:32
Aim to B
Press ENT

5. **Reset** - to reactivate the last entered window (if you have used option 6. Remove).
6. **Remove** – to disable current search window.

7. **Left** – to change the left boundary of the current search window to the position at which the instrument is pointing.
8. **Right** – to change the right boundary of the current search window to the position at which the instrument is pointing.

Search Control

In TRK-mode there are three different search options when working in Robotic mode and one (Automatic) when working in Autolock. Choose the RPU menu, 1 Autolock and 3 Search control. The following menu appears:

Toggle between on and off by pressing the corresponding numeric key. Confirm your setup by pressing ENT.

Remote 14:32
1 Automatic: on
2 Adv.lock: off
3 RMT600TS: off

Automatic: on (in Autolock or Robotic mode)

Automatic search mode means that as soon as the instrument finds the target it will lock on to it automatically. This function is very useful for ordinary surveying work.

Adv.lock: on (only in Robotic mode)

Advanced lock mode means that if the instrument loses lock of the target (RMT) it remains in the same direction without starting to search for the target (if Automatic is set to “off”). The instrument automatically locks on to the target as soon as it is visible again. This function is useful if

you, for example, are measuring in heavy traffic with cars temporarily blocking the measuring beam in heavy traffic with cars temporarily blocking the measuring beam. This way you save time since the instrument doesn't start searching each time the measuring beam is being blocked.

Warning – When this switch is activated there is a risk that the instrument could lock on to a window etc. if the tracker signal should come as a reflex from the RMT. After a normal search the instrument always locks on to the strongest tracker signal which, in every case, comes directly from the RMT itself.

Note – Search mode conflict

If both Automatic and Adv.lock are set to 'on' there is a conflict. In most cases the instrument will start searching for the RMT after a beam break.

RMT600TS: on (only in Robotic mode and with RMT600TS)

Sometimes it can be useful to let the instrument lock on to the RMT600TS without the RMT's vertical sensor being active. This is useful if you must extend the range pole so it isn't possible for you to aim RMT600TS vertically towards the instrument.

Search routine



Press A/M and the instrument will first start to search 30 degrees horizontally around the last point, considered that the point is inside the search window. There after the instrument will start to search inside the window in the way illustrated below.

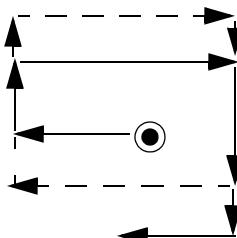
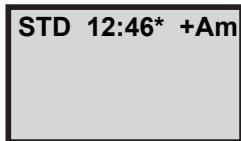


Figure 15.2 Search routine.

Note – Use the key to cancel search.

Guidelines

Some functions are unique when you use the tracker. The system guides you through the measurement by a number of indicators on the display:



Measurement information

- * the instrument has contact with the prism.
- + the tracker has locked on the target.
- ++ the tracker has locked on the target and the angle values are frozen (STD, FSTD and D-bar modes).
- T the tracker is activated. (If search option is installed Am will be seen instead).

A/M-key (optional for Autolock, standard for Robotic)



Am – If you press the A/M key at this moment, the tracker will start searching.

aM – If you press the A/M key at this moment, you will initiate a measurement.

A long press on the A/M-key will change between the two modes.

Reference Control in Robotic Mode

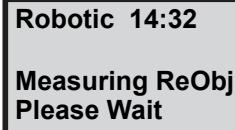
RPU or RPU

and

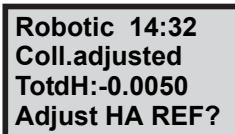
When setting up the instrument for robotic surveying (see Chapter 9) you can define a reference object which is marked with a remote target. By doing this you can eliminate angular errors caused by tripod turning. By using errors caused by tripod turning.

By using RPU menu 14 you can, whenever you want during the survey in robotic mode, check the reference object bearing and automatically compare the measured bearing with the original and if you want adjust it.

The instrument located the reference object and measures towards it 5 times in both faces.



The difference between the original Haref and the measured is presented as dH. Press YES or ENT to adjust the bearing or NO to ignore.



- The reference object does not have to be located at a known point but should be located outside the search sector and preferably at a distance longer than 100m.
- Don't change label 21 because this will also change the angle to the reference object.
- If you choose MNU33 (Fetch Station data) the original HA will be used, and a reference control measurement will be made automatically.
- If the reference object is obstructed when choosing RPU menu 14 you will get INFO 158 (Can't find the target).
- If the reference object is obstructed during the reference control you will get INFO 161 (The target is lost) and the measurement is cancelled.
- If the reference object is located inside the search sector it is possible that the instrument locks on the reference object instead of on the RMT. In that case the system will automatically continue to search after the correct RMT.

15 Tracker (only for servo instruments)

CHAPTER

16

Radio

Overview	16-2
Radio Controls	16-2
Select Radio Channel	16-2
Station Address	16-2
Radio License	16-3
Radio Contact	16-3
Range	16-4
Info Codes.....	16-4
External Radio	16-5

Overview

To be able to communicate between the instrument and the RPU the instrument must be equipped with a radio side cover and the keyboard unit must be connected to an external radio. The radio side cover consists of a built in radio and an antenna.

Radio Controls

MNU **1** **5**

Select Radio Channel

The radio channel is selected from menu 15. Up to 12 channels can be used depending on how many are supplied or permitted by authorities in each country. Select a channel using the <-(arrow) key when the keyboard unit is detached and connected to the external radio, this radio will automatically get the same channel as the instrument. The range of different channels makes it possible to work with more than one Trimble System 5600 at a working site. It is important though that each system has its own radio channel so that not any disturbances will occur.

Station Address

If disturbances occur on the radio channel from other systems in the same area, try to change channel. If that does not help the instrument and the RPU can be given an unique address. Choose menu 15, Radio with the keyboard unit attached to the instrument. Here you are prompted to enter a station address and a remote address between 0 and 99.

Radio License

Before using the system at your working site it is important to notify that in some countries it is necessary to have a user license. Make sure that your Trimble agent has informed you about the regulations in your country.

Radio Contact

RPU  or RPU 

You can establish contact between the RPU and the instrument in two ways.

1. Start the instrument with an attached keyboard unit
 - a. Choose a channel and an address with menu 15 if it's the first time you establish contact.
 - b. Press the RPU-key.
 - c. Choose 3. Remote and follow the instructions.
 - d. The instrument will prompt "Press any key, Remove keyboard".
 - e. Remove the keyboard, connect it to the external radio and press the PWR button.

Note – If you have powered off the system from the RPU, the system will store all parameters for 2 hours. Restart simply by pressing PWR at the keyboard.

2. Start the instrument with the A/M-button
With this method you don't have to attach the keyboard unit on the instrument.

- a. Press the A/M button on the backside of the station unit, one beep will be heard.
- b. 2 beeps will be heard when the radio is on.
- c. Press the PWR button at the detached keyboard unit.

Note – To be able to establish contact between the instrument and RPU by using method 2, you must have established contact using method 1 at least once before, since the external radio must get the correct radio channel from the instrument.

Range

The actual range in which the radio can work is depending on the conditions. Other radios that may be in operation in your area can decrease the range as well as when working in an area with many reflection object.

Info Codes

If the radio contact between the RPU and the instrument can not be established info code 103 will be displayed. If this appear, first check that both units are switched on and setup properly, that no other radio is working on the same channel, then restart both unit and retry. If still no radio contact can be established, contact your local Trimble Service shop for support.

If the radio contact between the RPU and the instrument is disturbed e.g. by another radio info code 30 or 107 may be displayed. If this appear, try to change channel.

Note – If the radio battery is in a bad condition when you start the system from RPU, the system might need to be

restarted, i.e. station establishment etc. might have to be done again.

External Radio

The external radio is connected to the keyboard unit with the system cable. The PWR button on the radio unit is not necessary to use since the keyboard unit automatically turns the radio unit on at startup. If you connect the keyboard unit to the wrong connector on the radio, the keyboard unit automatically obtains local mode.

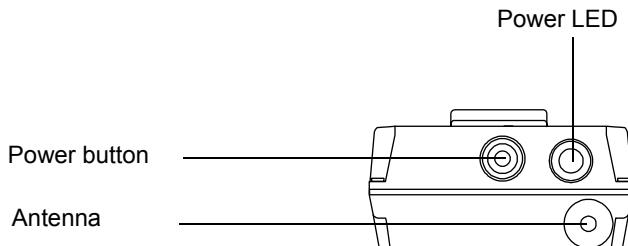


Figure 16.1 External radio – top view

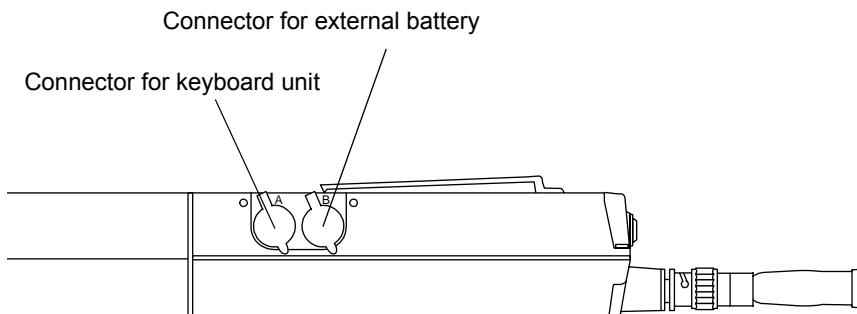


Figure 16.2 External radio – right view

16 Radio

17

Data Logging

Data Recording	17-2
Control of Data Registration.....	17-3
Data Output.....	17-4
Standard Output.....	17-4
User Defined Output	17-7
How to Create an Output Table.....	17-7
Type of Memory Device	17-9
1. Internal Memory	17-10
2. Serial Output	17-11
3 Xmem.....	17-17
Data Communication.....	17-19
CU PC.....	17-19
Instrument With CU PC.....	17-20
CU Instrument With CU	17-20
Instrument With CU Card Memory.....	17-21
Card Memory PC	17-22

Data Recording

The recording of data is based on the general system of labels and label numbers which describe the different data items. The systems has 109 different labels, which all can be registered as separate items directly from the keyboard of the instrument, or they can be recorded using the User Definable Sequences available in the additional software (UDS).

Angle registration can be carried out during both single and double face measurements.

The angle values are measured in face II by pressing the A/M-key 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 angle recording is carried out under separate labels for face I and face II. Instrument data can be recorded according to Table 17.1 (see below).

Data is always stored in the keyboard unit attached at the back, even if two keyboard units are attached.

If you wish to store data in both panels, you will have switch keyboard units. Data can also be transferred as a file between two keyboard units (Program 54).

Table 17.1 Data recording

Instrument Data	Prompt	Label
Horiz. Angle	HA	7
Vert. Angle	VA	8
Horiz. Angle C2	HA II	17
Vert. Angle C2	VA II	17
Horiz. Angle C1	HAI	24*
Vert. Angle C1	VAI	15*
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

*Only in D-bar. Normally C1 angles is read in label 7 and 8. But in D-bar label 7 and 8 is the all over mean value.

Control of Data Registration

The instrument checks that validity of data before recording. It checks, for instance, that the instrument is on target. This can be de-selected with Targ.test off? MNU 61 – i.e. that measured angles and distance is not recorded twice. For more information about eccentric objects, see page 12-7.

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 on the instrument or Serial for direct transfer via the tribrach contact to and from a computer – is done with MNU 41, Select device function.

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

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

Standard Output

Output of measured data 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 Table 17.2, page 17-5), is adapted to the function of the different modes of measurement, while a User Defined Table 1, 2, 3, 4 and 5 will be independent of choice of mode.

Table 17.2 Table 0 Standard mode, STD

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*

*Not available at the RPU

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 be made only in the face on 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 17.3 (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,

17 Data Logging

the mean angular value for angles 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.

Table 17.3

Table 0, D-bar

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

*Only at the instrument

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

MNU 4 2

To be able to create a new output table, you must first choose function 4 (“Data com”) of the menu.

STD P0 10:16
HA: 234.5678
VA: 92.5545

MNU 4

Select number 2, “Create table”.

Data com 10:16
1 Sel. device
2 Create table

2

17 Data Logging

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

Data com 10:16
Table no=

ENT

Select desired label – e.g., HA 0 label 7. Press ENT

Data com 10:16
Label no=

ENT

Note – Table 5!

No measured or calculated distances can be stored in table 5. A complete list of functions and labels can be found in Appendix A.

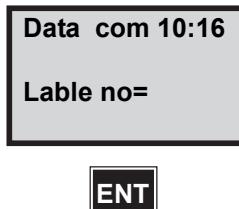
The label is confirmed or rejected with YES or NO. Press YES or ENT.

Data com 10:16
HA
Ok?

ENT

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 only pressing 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.

Output table 5 –when you wish to exclude distances

With output table 5 you can use a display table that contains angles or other labels that do not have distances or coordinates.

Type of Memory Device

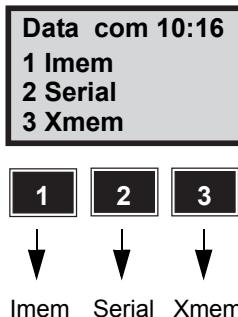


Selection of memory device can be made with menu function 4, option1, “Select device”.

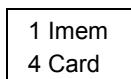
The following choices are available:

Press 1 to select the internal memory or 2 to select the serial interface connection. (This is the display that shows

when there is no card memory or when it is connected via the foot connector).



This is the display when the card memory is connected on the backside of the instrument.

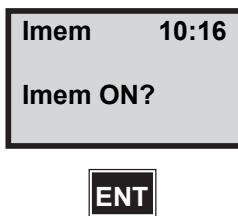


1. Internal Memory

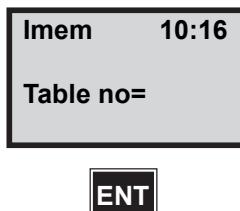


Select MNU 411, for recording to the Internal Memory. See more about the internal memory in the “Software Manual”. The setup procedure contains the following display instructions:

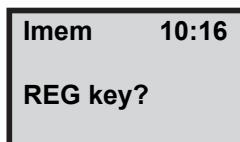
YES to continue, NO to interrupt. Press YES or ENT.



Select output table number = 0,1,2,3,4 or 5 and then press ENT.



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



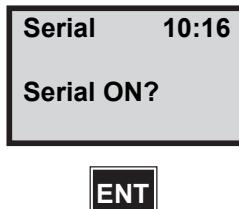
2. Serial Output



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.

17 Data Logging

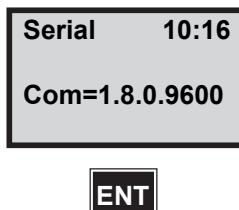
Connected device switched on or off? Press YES or ENT to continue.



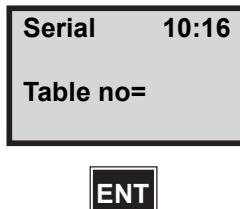
Transmission parameters. The parameter setting can be accepted by just pressing ENT, changed completely by over writing from the beginning, or changed by erasing each character using the <- key.

The four transmission parameters which are separated by decimal points can have the following values:

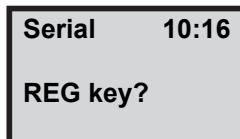
- | | |
|------|---------------------------------------------------------------------------------------|
| Pos. | 1: Number of stop bits = 1 |
| | 2: Number of data bits 7 or 8 |
| | 3: Parity: No parity = 0 |
| | Odd parity = 1 |
| | Even parity = 2 |
| Pos. | 4: Baud rate: 50-19200 baud standard rates
e.g 300, 1200, 2400, 4800, 9600, 19200. |



Select output table number = 0, 1, 2, 3, 4 or 5 and then press ENT.



Control of the output can be done 1) by the computer, 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: REG Key? or Slave?



Serial Commands

If neither REG-key or Slave is selected, data output is initiated from the computer by sending one of the following commands. The command is executed upon the carriage return. See the “Software and Data communication” manual for a complete list of the serial commands.

Load

Load Memory. Data according to the standard format can be loaded into the memory device.

Syntax: L<dir>=<file>

<dir>: 'I' The Area directory

‘M’ The Job directory

‘U’ The U.D.S. program directory

<file>: Is the name of the file (max 15 characters).
The file name is case sensitive.

Output

Output from memory

Syntax: 0<dir>=<file>

0<dir><arg>

<dir>: ‘I’ The Area directory
‘M’ The Job directory
‘U’ The U.D.S. program directory
<file>: Is the name of the file (max 15 characters).
The file name is case sensitive.
<arg>: ‘C’ Output of the file catalog

Read

Read instrument of measured data or data in specific labels

Syntax: RG=[<arg>][,<lbl>]

<arg>: [S] Standard output

N Name output

D Data output

V Numeric output item by item

T Test if signal from target. 300 is returned
if no signal. 301 is returned if signal.

Trig

Start of distance measurement in instrument.

Syntax: TG[<arg>]

<arg>: ‘<’ This is default and need not to be entered.

Write

Write data into instrument. All labels that can be set by the function key in the system can be written.

Syntax: WG,<label>=<data>

<label>: 0-109

<data>: Maximum 9 digits for numeric type labels and maximum 16 characters for ASCII type labels.

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)

Use the multi functional cable (Part no 571 202 188/216) together with the computer adapter (Part no 571 202 204) to

17 Data Logging

connect the Keyboard unit to a computer via the external battery (Part no 571 202 194) or power supply.

Table 17.4 Computer connection configuration

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

Table 17.5 Status Description

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	Lable error. This lable 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

Output format

The standard format of data from the interface is:

<Label>=<data>CRLF

Status

Status is a numeric value, transmitted before measurement data, and distance those values which are about to be transmitted. This status values is non-zero if an error is detected. See Table 17.5 for status description.

End of Transmission

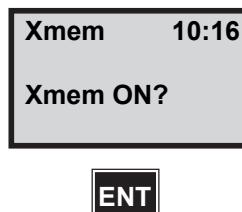
The end of transmission, EOT, character is set in label 79, where the equivalent ASCII number is set.
(Default is 62, e.g “>”). If set to 0 no EOT will be sent.

3 Xmem



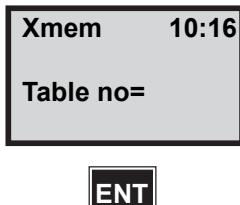
Select MNU 413 for output to the Geotronics card memory if it is attached to the panel on the back of the instrument. The setup procedure contains the following display instructions:

YES to continue, NO to interrupt. Press YES or ENT.



Select output table number=0,1,2,3,4 or 5 and then press ENT.

17 Data Logging

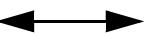


Control of the output can be done by pressing the REG key of the instrument (REG key?) or continuously (Slave?). Choice of method is made by answering YES or ENT to one of the questions.



Data Communication

Geodimeter CU can be connected to an external device via 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 Trimble System instruments.

CU  **PC**



Connect the Keyboard unit and the computer to a battery via the multi functional cable 571 202 188/216 and the computer adapter 571 202 204 and turn on both units. There are two ways to transfer data between these units:

1. Program 54 (not for Card Memory-PC)

Enter program 54 at the Keyboard unit and choose (From Imem, To Serial) 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 in the Geodimeter CU User Guide Software.

2. RS-232 commands

By sending the appropriate commands from the computer you can transfer data between the Keyboard unit and

computer. Look at page 17-13 for a list of serial commands or see the Geodimeter Software & Data communication manual for further information.

Instrument With CU ↔ PC



Connect the instrument tribrach contact and the computer to a battery via the multi functional cable 571 202 188/216 and the computer adapter 571 202 204 and turn on both units. Then follow the Keyboard unit-Personal Computer instructions for file transfer between the two units.

CU ↔ Instrument With CU



Connect the instruments tribrach contact and the Keyboard unit via the cables 571 202 188/216. Turn on both units and enter program 54. First choose (From Serial, To Imem) at the unit that are to receive data then choose (From Imem,

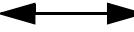
To Serial) at the unit that are to send data. See more information about program 54 in the Geodimeter CU User Guide Software.

Note – Do not connect the Keyboard unit to the External Radio (571 180 810) through the T-connector (571 202 312) when an external battery is already connected to the T-connector, as this will destroy the battery. When the Keyboard unit and the External Radio are to be connected, the internal battery inside the radio should be the only power source.

Instrument With CU \longleftrightarrow Card Memory



Connect the instruments tribrach contact and the Card Memory via the cable 571 202 188/216. Turn in the instrument and enter program 54. Choose (From Xmem, To Imem) if you are going to transfer data from the Card memory to the instrument or (From Imem, To Xmem) if you are going to transfer data from the instrument to the Card memory. See more information about program 54 in the Geodimeter CU User Guide Software.

Card Memory  **PC**



Connect the Card Memory and the computer to a battery via the multi functional cable 571 202 188/216 and the computer adapter 571 202 204 and turn on the computer. There is one way to transfer data between these units:

RS-232 commands

By sending the appropriate commands from the computer you can transfer data between the card Memory and computer. Look at page 17-13 for a list of serial commands or see Chapter 4 Data communication for further information.

C H A P T E R

18

Definitions & Formulas

Corrections for Refraction and Curvature	18-2
Correction for Difference in Height.....	18-4
Correction of Horizontal Distance	18-5
Instrument Height.....	18-5
Signal Height.....	18-6
Atmospheric Correction.....	18-6

Corrections for Refraction and Curvature

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 and refraction. The formulas which are used in the instrument for the automatic calculation of curvature and refraction 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 R_e and K will vary, depending on the geographical location of the survey area.

$$DHT = SD \cdot \cos Z + \frac{(SD)^2 \cdot \sin^2 Z}{2R_e} \cdot (1 - K)$$

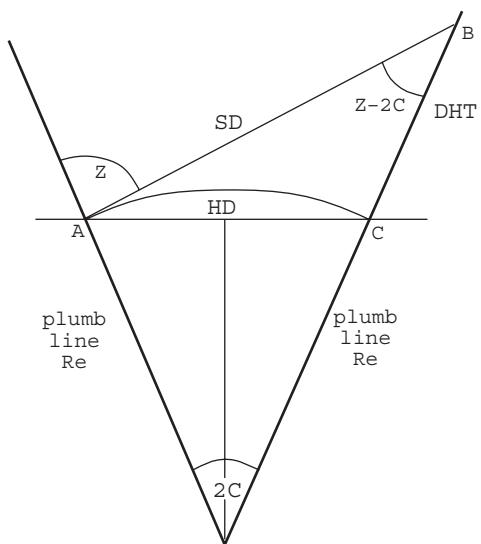
$$HD = SD \cdot \sin Z - \left(\frac{(SD)^2 \cdot \sin 2Z}{2R_e} \cdot (1 - K/2) \right)$$

HD = Horizontal Distance, DHT = Difference in Height,

SD = Slope Distance,

R_e = Earth radius mean value = 6372km

K = Refraction constant mean = 0.142



Correction for Difference in Height

Case 1:

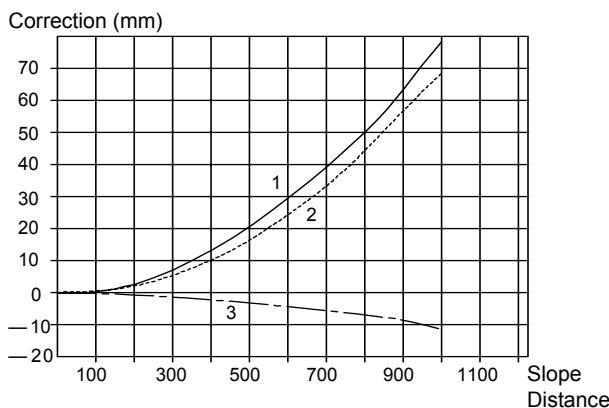
Slope distance has not been corrected when displayed or recorded.

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.



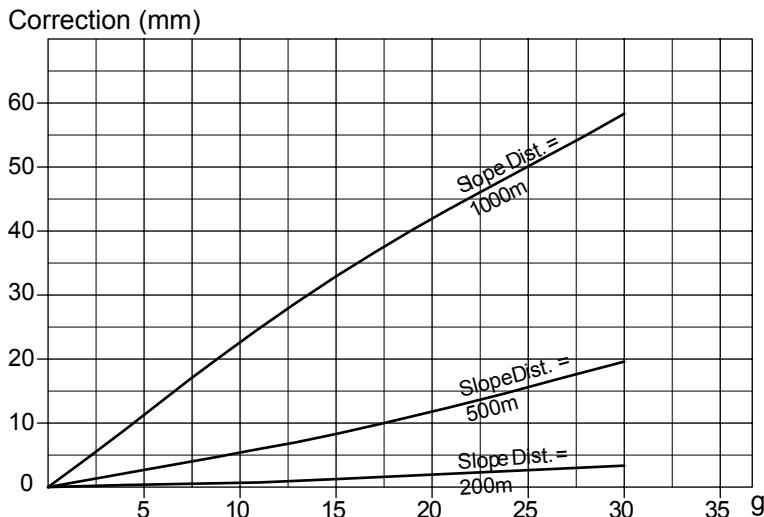
Curve 1 represents the earth's curvature. Curve 3 is the correction for refraction as a function of slope distance. Curve 2 is the resultant correction to be applied to the height obtained by multiplying the slope distance by $\cos z$. This correction changes relatively slowly in relation to the deviation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

Correction of Horizontal Distance

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 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

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

$$\text{ppm} = 274,41 - 79,39 \cdot \frac{p}{(273,15 + t)} + 11,27 \cdot \frac{p_w}{(273,15 + t)}$$

p = pressure in millibars

p_w = partial pressure of watervapour in millibars

t = dry air temperature in degrees centigrade (Celsius)

The partial pressure of watervapour (p_w) is calculated according to the following.

$$p_w = \frac{h}{100} \cdot 6,1078 \cdot e^{\left(\frac{17,269 \cdot t}{237,3 + t}\right)}$$

OR

$$p_w = 6,1078 \cdot e^{\left(\frac{17,269 \cdot t}{237,3 + t'}\right)} - (0,000662 \cdot p(t - t'))$$

p = pressure in millibars

p_w = partial pressure of watervapour in millibars

t = dry air temperature in degrees centigrade (Celsius)

t' = wet temperature in degrees centigrade (Celsius)

h = relative humidity in %

Trimble 5600 calculates and corrects for this automatically.
Please ensure that the instrument is working with the
correct units, MNU 65, Unit.

Examples:

To show the significance of the different units used for calculating the ppm factor let's take a look at the following:

At 20°C dry air temperature 0.1 ppm corresponds to an approximate change of:

- dry temperature: 0.1°C
- air pressure: 0.3 mbar
- relative humidity: 10%
- wet temperature: 1.3°C

At 40°C dry air temperature 0.1 ppm corresponds to an approximate change of:

- dry temperature: 0.1°C
- air pressure: 0.3 mbar
- relative humidity: 4%
- wet temperature: 0.8°C

As shown in the first example above relative humidity has quite a small influence on the ppm factor. It's much more important to be precise when it comes to dry temperature and air pressure. In hot regions relative humidity becomes more important, though.

Atmospheric correction is automatically applied to measured slope distance according to data input selected by the operator. Input of temperature, pressure and humidity

can be input via MNU 11, PPM. Local units can be set for temperature and pressure and humidity units can be set to relative humidity, h%, or to wet temperature, t', via MNU 65.

Full correction including input of all these parameters is selected in MNU 61, Switches, by setting PPM Adv on. If PPM Adv is set to off, then h is default set to 60% relative humidity. PPM=0 is obtained at temperature 20 °C, air pressure 1013.25 mbar and relative humidity h=0. When input of PPM=0 is made no atmospheric correction is applied to slope distance.

19

Appendix A

Label List F

No	Text	Description
		*Cleared when power OFF **Only Geodimeter Instrument
0	Info	Information
1	Data	Data used in INFO/DATA combination,
2	Stn	Station number
3	IH	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	Area of an surface (Result from Program 25)
13	Voume	Volume (Result from Program 25)
14	Grade	Percent of grade ((DHT/HD) *100)
15	Area	Area file

19 Appendix A

No	Text	Description
		*Cleared when power OFF **Only Geodimeter Instrument
16	dH	Difference between C1 and C2 horizontal angles *
17	HAll	Horizontal angle which was measured in C2 and stored *
18	VAll	Vertical angle which was measured in C2 and stored *
19	dV	Difference between C1 and C2 vertical angles *
20	Offset	Offset const. which can be added to or subtracted from the SD
21	HRef	Horizontal Reference Angle100
22	Comp	Compensator ON=1, OFF=0100
23	Units	Status of unit set, e.g. 3214=(Mills Meter Farhenheit 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	BMLE	Benchmark elevation
33	PrismC	Prism constant
34	HA.L	Horizontal angle
35	S	Info about Sections (Length tables) in P39 RoadLine
36	HtOfs	Height Offset
37	N	Northing coordinates. Cleared when power OFF
38	E	Easting coordinates. Cleared when power OFF
39	ELE	Elevation coord. Cleared when power OFF (39=49+STN HT)

No	Text	Description
		*Cleared when power OFF **Only Geodimeter Instrument
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
44	Slope	Slope inclination
45	dHA	Correction value of the calculated bearing in Program 20
46	S_dev	Standard deviation
47	Nr	Rel. North Coorde.
48	Er	Rel. East Coorde.
49	VD	Vertical distance (IH and SH included) (49=10+3-6)
50	JOBNo	Job No file for storage of raw and calculated data
51	Date	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	RefObj	Reference Object
63	Diam	Diameter
64	Radius	Radius

19 Appendix A

No	Text	Description
		*Cleared when power OFF **Only Geodimeter Instrument
65	h%	Relative humidity in%
66	t'	Wet temperature
67	SON	Northing Coordinate of setting out point
68	SOE	Easting Coordinate of setting out point
69	SHT	Elevation of setting out point
70	Radoffs	Keyed in Radial offset dimension
71	RT.offsets	Keyed in Right angle offset dimension
72	RADOffs	Calculated Radial offset dimension in setting out program
73	RT.Offs	Calculated Right angle offset dimension 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 and measured distance
77	dHA	Diff. between setting out bearing and 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	SecIncl	Section Interval
83	Cl.ofs	Center line offset
84	PCoeff	Parabola Coefficient
85	Pht	Point Height difference
86	Layer	Layer number
87	LayerH	Layer Height
88	Profil	Profile number
89	Dist.	Distance from def. point to Ref. point
90-109	-	Label which can be defined by the user

No	Text	Description
		*Cleared when power OFF **Only Geodimeter Instrument
110	WGS84X	WGS84 coordinate X
111	WGS84Y	WGS84 coordinate Y
112	WGS84Z	WGS84 coordinate Z
113	Lat.	Latitude
114	Long.	Longitude
115	PDOP	Position Dilution Of Precision
116	RefSat	Number of satellites at reference station
117	RovSat	Number of satellites at rover station
118	NumSat	Number of satellites at both stations
119	C/F	Cut and Fill for staking out
120	dx	Baseline component in x
121	dy	Baseline component in y
122	dz	Baseline component in z
123	RadofB	Radial offset to point B (Refile)
124	SD1	Slope distance face 1
125	SD2	Slope distance face 2
126	Res	Reserved
127	Random	Random
128	Res	Reserved
129	Sdev	Standard deviation of 3D position
130	Vernum	Software version number
131	CtrlUn	Serial number
132	TimSpn	Time span of observation
133	RadOfs	Calculated radial offset dimension in setting out program
134	RT.ofs	Calculated right angle offset dimension in setting out program
135	N-ofs	N offset for file handling
136	E-ofs	E offset for file handling
137	WGS84	Height above national grid ellipsoid

19 Appendix A

No	Text	Description
		*Cleared when power OFF
		**Only Geodimeter Instrument
138	Cov1,1	Cov 1,1
139	Cov 2,1	Cov 2,1
140	Cov 2,2	Cov 2,2
141	Cov 3,1	Cov 3,1
142	Cov 3,2	Cov 3,2
143	Cov 3,3	Cov 3,3
144	Res	Reserved
145	Res	Reserved
146	Res	Reserved
147	SD1	SD1
148	SD2	SD2
149	SD3	SD3
150	SD4	SD4

20

Appendix B

Main Menu Configuration

MNU				
1 Set	1 PPM	Temp	Press	PPM
	2 Preset	1 Exentric point	2 ROE	
	3 InstrSettings	Display Illumination on/off, Level adjust, Display Contrast adjust, Reticle on/off, Reflected signal volume adjust		
	4 Clock	1 Set Time	2 Time system	
	5 Radio	Channel	Station Address	Remote Adress
	6 Long Range **	(** Not available on all instruments)		
	7 Instr set. 2**	Laser plumb On/Off (** Not available on all instruments)		
2 Editor	1 Imem	(* The card memory device is named XMEM when it is attached to the instrument)		
	2 Xmem (Card *)			
3 Coord	1 Stn Coord	Point no.	Ih	Href
		N(X)	E(Y)	ELE(Z)
	2 SetOut Coord	SON	SOE	SHT
	3 Fetch Stn data	Fetch Station data		
	4 View stn coord.	View station coordinates		
4 Data com	1 Select device	1 Imem	2 Serial	3 Xmem
	2 Create table	Table no		
	3 Output format	1 Standard	2 APA format	3 NEN format
		4 GDM400/500		

20 Appendix B

MNU				
5 Test	1 Measure	Measure New	Collimation&Hor Axis Tilt	
	2 View current	H Collimation	V Collimation	Hor Axis Tilt
	3 Tracker Coll			
	4 Instrument	1 Inst.ver.	2 Mem.test	3 Radio ver.
	5 Battery check	Battery status		
	6 CU Status	Memory status		
6 Config	1 Switches	Targ. test on/off, Pcode on/off, Info ack. on/off, HT meas on/off, Power save on/off, Key click on/off, Prg_num on/off, PPM Adv on/off, Job/Mem on/off, Show Stn. on/off, Confirm on/off, Manual input on/off, Beep on/off, Display XY, Illumination, 2 hours stand by		
	2 Standard Meas.	1 Standard	2 fast Standard	
	3 Decimals	No of decimals		Label no
	4 Display	1 Select display	2 Create display	
	5 Unit	Metre, Feet, Feet/Inches, Grads, Degrees, DecDeg, Mills, Celsius, Fahr, mBar, mmHg, InHg, hPa, h%, Wet Temp		
	6 Language	Sw, No, De, Ge, Ja, Uk, Us, It, Fr, Sp		
	7 Coord System	1 North orient.	2 South orient.	
	8 Prism const	Prism constant		
	9 Dist. C2	Dist. C2 D_bar on/off, number of measurements.		
7 Direct Reflex	1 S_Dev.	Standard Deviation		
	2 Meas. method	1 Reflector	2 No reflector	
	3 Dist. int.	Distance interval		
	4 Pointer	1 Pointer on 2 Pointer off	3 Vertical guide 4 Horizontal guide	
	5 Measuring obj.	1 Weak signal on	2 Weak signal off	
	6 Dist. C2	Distance C2 std on/off		
8 Position		Left/Right	Up/Down	



Trimble Engineering and Construction Division
5475 Kellenburger Road
Dayton, Ohio 45424
U.S.A.

800-538-7800 (Toll Free in U.S.A.)
+ 1-937-233-8921 Phone
+ 1-937-233-9004 Fax

www.trimble.com