

Operating  
Instructions

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**ZEISS**

West Germany

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**REC 500 / 352k**

Elta - Version

Operating Instructions

Edition 06 / 88

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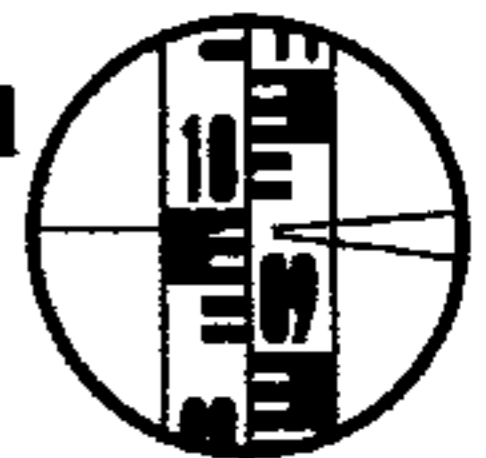
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REC 500

352k Elta Version

Operating Instructions

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**SURVEYORS-EXPRESS™ GmbH**



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## 1. General

The REC 500 is an intelligent electronic field book for

- automatic and manual data acquisition,
- data storage,
- data editing,
- data processing during measurement (on-line),
- computations with coordinates
- data transfer to peripheral units and computers,
- storage of data received from peripheral units or computers.

It can be connected to all Carl Zeiss data-recording surveying instruments for measuring and on-line processing through its RS 232 / V.24 interface. Data is stored and processed in records which, depending on the instrument type and the selected measuring mode, contain the measured distance, direction and zenith angle or computed data such as Y, X, Z coordinates. A 27-character alpha-numerical point identifier consisting of the point number and additional information is stored with each record. The REC 500/352k has a memory capacity of 2000 records.

The RS 232 / V.24 interface also serves to interchange data with peripheral units and computers. The REC 500 provides two standard data transfer procedures (see sections 8 and 9). Further procedures can be implemented on demand.

## 2. Scope of Delivery

The REC 500 is supplied in a case which also contains a battery charger and a connecting cable for connection to Carl Zeiss surveying instruments. There is sufficient space in the case for further connecting cables and spare batteries.

The REC 500 is supplied with the battery compartment cover not screwed in tightly as shown by the piece of screwed-in red plastic tape. This precaution is to ensure de-pressurization of the REC 500 in case it is shipped by air. We recommend you always use this precaution for air-shipment to prevent REC 500 damage.

## 3. Power Supply

The REC 500 is supplied with four commercially available rechargeable batteries which ensure up to 10 hours of operation at normal environmental temperatures when fully charged. With old batteries and low temperatures the operating time may be shorter.

To recharge the batteries, the battery charger can be connected to the rear of the REC 500. The batteries should be charged for 12 hours, e. g. overnight. If the battery voltage falls below the minimum operating voltage during measurement, an audible signal sounds, the message

\* WARNING BATTERIES ARE LOW \*

appears repeatedly, and the REC 500 becomes inoperable. Recharge the batteries or insert spare batteries in the battery compartment at the right-hand side of the REC 500 after screwing off the cover. Battery replacement does not adversely affect the programs and data stored in the REC 500 because an internal lithium battery is used for buffering.

Notes:

- Use only rechargeable type AA NiCd batteries (1.2 V, 500 mA) or non-rechargeable alkali-manganese dry cells.
- Check for proper polarity when inserting the batteries (refer to the red sticker at the REC 500).
- Do not store the REC 500 for extended periods of time without batteries being inserted.
- Check that the battery charger is designed for and set to the local power voltage.
- Do not charge the batteries for more than 12 hours to avoid capacity decrease over time (applies only to battery chargers of a type other than LG 10).
- Type LG 10 battery chargers automatically switch over to trickle-charging after the 12-hour charging period.
- If an LG 10 battery charger is in the trickle-charging mode, briefly disconnecting it from the power network returns it to the charging mode.
- Operate the REC 500 with line power only with inserted batteries.
- Never operate the REC 500 with line power when dry cells are inserted (risk of explosion) or if no batteries are inserted. Make the battery charger connector at the rear of the REC 500 inaccessible, e. g. with a sticker, if dry cells are inserted.

#### 4. REC 500 Operation

The REC 500 display has a capacity of 8 lines with 40 characters each. A blue humidity indicator is located in the lower left corner of the display; if it turns pink, the REC 500 has to be dried, checked and provided with new dessicant in our works.

The REC 500 has a typewriter-like keyboard. All keys are single-action keys if pressed briefly and repeat-function keys if kept depressed.

##### Key functions:

- Red HLP/PWR key                      Turns the REC 500 on and off
- Shift key                              Shifts from lower-case to upper-case characters or activates upper-case key functions
- A to Z                                 Lower-case letters; upper-case if the shift key is depressed
- 1 to 0                                 Digits; upper-case functions if the shift key is depressed
- Symbol keys                          Left bracket; right bracket if the shift key is depressed
- Unmarked key                         Space
- Arrow up  
              down  
              left  
              right keys                 Shift the cursor in the direction of the arrows. The flashing-dot cursor indicates where the next character will appear.
- BRK, ESC                             Ineffective
- INS, LBL                             Ineffective
- BS, DEL                              Move the cursor to the left; BS does not delete the character, DEL deletes it.
- TAB                                    Moves the cursor to the next tabulator stop
- ENTER                                 Terminates data entry or continues program execution
- CTL/FN                                Function keys used in conjunction with digits 1 to 8

##### Using the function keys:

Eight function blocks are marked on the black display mask of the REC 500 to which sometimes differing functions are assigned during operation. The functions are indicated by 3 or 4-character codes or words in the bottom line of the display. Functions can be activated by simultaneously pressing CTL/FN and then briefly pressing the appropriate digit key.

## General Information:

The REC 500 uses menus and prompts for operator guidance. Measuring and computing options as well as the required operator entries are displayed on the screen to enable you to select and activate the desired function. If an entry consists of a digit or a letter only, the relevant key need be pressed only briefly.

Letters may be entered in lower-case or in upper-case.

If the ENTER key has to be pressed to terminate an entry, this is indicated on the display. As far as possible, all entries are checked for plausibility, i. e. errored entries are rejected and have to be repeated.

You can manually turn off the REC 500 in any mode. It is turned off automatically after 5 minutes if you do not initiate a function within this period of time. When you turn it on again, the REC 500 is in the same mode as at turn-off, i. e. an initiated function can be continued.

In programming the REC 500, efforts have been made to allow for any conceivable entry, operator or other errors and to display appropriate messages. Should a system error occur anyway, which is indicated by ERROR messages, you can restart the REC 500 as follows:

- Turn it off.
- Turn it on. Display: 'HUSKY HUNTER press any key...'
- Press any key.
- Enter b a s and press ENTER.  
Display: 'Hunter Basic Interpreter'  
'Ready'
- Enter n e w and press ENTER.  
Display: 'NEW?: Are you sure (Y/N)'
- Enter y Display:  
'54613 bytes available'  
'READY'
- Enter s y s t e m and press ENTER.  
Display: 'Date and Time'  
'\*\* DEMOS 2.2.....'
- Enter r e c 5 0 0 and press ENTER.  
Display:  
'ZEISS REC 500.....'
- Press any key. The main menu appears.
- Press 0 key for normal power-down



This procedure is also mandatory if you used the REC 500 operating system or the BASIC interpreter and want to return to Zeiss program usage.

If REC 500 should be locked and no more function can be initiated or even if it is impossible to switch out REC 500 then do the following steps:

- Switch out REC 500 (if not possible remove batteries for a short time).
- Press simultaneously X and P keys and keep them pressed.
- Press PWR/HLP for a short moment and then release X and P.
- This should display "HUSKY HUNTER press any key.." IF not repeat the same steps.
- Continue as described above.

Warning: The Zeiss programs are stored on the RAM disk of the computer and are protected against normal access. The following programs are involved:

ELTA30/1.HBA	30	= program version
ELTA30/2.HBA	/1 etc.	= program part
REC500.COM		Startup program
ELTA30/3.HBA		
ELTA30/4.HBA		Open program part for user programming

Please note that any attempt to access any of the above program parts may in the worst case result in the computer operating system being destroyed and does not ensue any Zeiss liability.

The program part ELTA30/4.HBA is not protected and can be used to link your own programs to the Zeiss standard programs. This requires the

- ability to program in BASIC
- Husky Hunter Operating Manual (Order No. 708419)
- REC 500 software interface description (Order No. )

If you do your own programming, you must assume the exclusive responsibility.

## 5. Structure of the REC 500 Operating Program

The REC 500 operating program has three levels:

- Upper level: Control program with main menu for calling medium-level general functions
- Medium level: General functions:
- 1 Input and editing of project data
  - 2 Measurement and recording of data
  - 3 Input, display and editing of data
  - 4 Transfer of data
  - 5 Application programs ( on-line )
  - 6 Computation programs ( off-line )
  - 7 Formatting and setting of parameters
- Lower level: Utility functions called by the general functions and individual functions such as input, editing, deleting, point identifier setting, incrementing, measurement, storage, RAM searching etc.

When you turn the REC 500 on, the upper level (control program) comes on, i. e. you can select one of the seven general functions. Depending on your choice you will find a general function without submenus (1, 2, 3) or with submenus and individual functions (4, 5, 6, 7). The general function is processed step by step, if applicable after individual function selection in the submenu, with the lower-level utility functions being used as required. When an individual function is completed, control is returned to the submenu for selecting another individual function within the general function, if required. When the general function is completed, control is returned to the upper level and the main menu. Another general function can then be selected or measurement and storage terminated and the REC 500 turned off.

## 6. Preliminary Remarks on the Use of the REC 500

### - Measurement

A prompt to set the measuring mode and initiate measurement appears on the display of the REC 500. A general rule is that only the TH and TH+D modes are legal for on-line processing in the field, while any measuring mode may be used for measurement and recording without on-line processing. The surveying instrument and the REC 500 must be set to the same units for angle, distance and zenith angle measurement. The units settings are not checked. Measurements to be processed with the REC 500 may be made in both telescope positions as desired.

- Offset measurement

All measurement programs allow offset measurements and storage of the re-centered and reduced measured data. You can enter your own offset identifiers e. g. in the additional information field of the record.

To select and enter offsets, press the 'Ecc.' function key and proceed as follows:

- Display:           Target position   Ahead of point (A)  
  Behind point (B)  
  Left of point (L)  
  Right of point (R)

- Enter the position of target with A/B/L/R.  
  To clear target offset input 0 (zero).

- Enter the horizontal offset.

- Elevation computation:

At the beginning of all measurement functions the question appears if an elevation computation is to be made. If yes, enter the current instrument and reflector heights. If you omit this, no elevation computation is made.

- Point identifier:

Measurements or points can be identified and described by point identifiers with a length of up to 27 alphanumeric characters. The point identifiers consist of a point code and additional information. The point code can have a length of 3 to 24 characters with the remaining characters being available for the additional information. The term "point code" is used here instead of the term "point number" because the point code, unlike the point number, may be alphanumeric. In practical field use, the point identifier will contain the point number in numeric or alphanumeric form plus additional information defining the point.

- Point identifier entry:

The point identifier can be entered in full or in part using all (lower- and upper-case) letters, digits and symbols (including spaces) available on the REC 500 keyboard. If no entry is made, the point identifier will be blank.

To improve the legibility, the 27 characters can be broken down into randomly marked subsets (see 7.7.1).

Entries can be made in the desired places by positioning the cursor with the left/right keys, which move the cursor continuously through the point identifier in the direction of the arrows. The TAB key causes the cursor to move to the next tabulator stop. You can set tab stops in any desired locations (see 7.7.2).

- Automatic point code incrementation:

The point code can be incremented automatically during measurement to eliminate the need for individual point code entry. At the beginning of measurement, automatic incrementation is off and the relevant function block shows 'Ioff'. Pressing the relevant function key activates automatic point code incrementation 'Ion'. The right-most numerical part of the point code is incremented, and automatic incrementation is disabled automatically if incrementation is not possible because the point code does not contain any digits. Incrementation can be suspended and resumed.

The increment and the sign of the increment is selectable within - 9999 to +9999. It is recommended to set the point number that is to be incremented right justified to use all possibilities of incrementation.

- Storage

Data that is to be stored, i. e. measured and computed data from the surveying instrument, manual entries and computed data from the REC 500, or data entered in the REC 500 through the interface, is stored in the order of arrival. The storage mode is activated when a measuring mode is initiated, and can be deactivated ('Roff') with the associated function key.

The following storage options are available depending on the selected measurement program:

R-M Record measured data  
R-C Record computed data  
R-MC Record measured and computed data

- Recall

Data stored in the REC 500 can be accessed in one of three ways by specifying either

- the address or
- the point identifier or
- an identifier part.

- Recall with the point identifier

Enter a character string (mask) comprising up to 27 characters that is identical in layout and content with the wanted point identifier. The following rules apply:

- The search is based on the length and the content of the mask.
- Target fields not included in the mask are ignored.
- The mask always begins at column 1 and ends with the last used column.
- Mask fields can be suppressed both at the beginning and within the mask by entering the ? character.

If several records are found, they are all displayed on the screen together with their addresses so that a specific record can be selected by means of the address.

The screen can be scrolled up and down by pressing the shift and the appropriate vertical cursor key.

- Recall with an identifier part

This reading option is similar to reading with the point identifier. It mainly serves to find records with common identifier parts, e. g. a specific point type identified by the additional information.

- Manual entry of measured data and coordinates

A difference is made between manual measured data entry and manual coordinates entry. Point identifier entry is identical for both versions.

- Measured data ranges:

Distance	0 to 9 999 999.999	m (ft)
Horizontal direction	0 to 399.9999	grad (359 59'59'' DMS)
Zenith angle	0 to 399.9999	grad (359 59'59'' DMS)

- Coordinate ranges:

E coordinate	-999 999.999 to 9 999 999.999	m (ft)
N coordinate	-9 999 999.999 to 99 999 999.999	m (ft)
Z coordinate	-9 999.999 to 99 999.999	m (ft)

Set Z to zero if the Z coordinate is not known.

- Use of control points

The coordinates of points required for stationing, connection measurement, stake-out work or computations must be contained in the REC 500, i. e. must normally be entered beforehand either manually or through the interface. If a point is required during measurement or computation that has not been stored yet, it can be entered manually without the measurement or computing function having to be terminated. Points whose coordinates are computed during these operations can also be used.

- On-line measurement and processing, further options:

You can select one of the following for all measurement programs of the REC 500 (general functions 2 and 5) depending on the connected surveying instrument:

- Eltas: Automatic storage of all measured data
- ETH and Eldi: Automatic storage of all measured data
- ETH or Eldi: Automatic storage and manual entry
- Non-recording instruments: Manual entry

Manual entry can also be used to perform the application programs (measurement) of general function 5 independently of the surveying instrument.

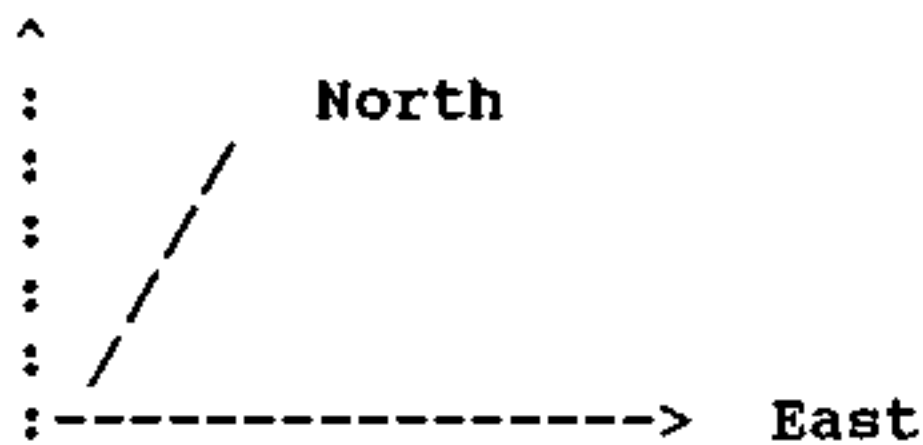
Stored coordinates and manual entries are used for the computation programs (off-line) of general function 6.

For measurement you must set the REC 500 properly to the Zeiss instrument you are using. Especially distinguish between Elta 2/20/3 with IF 2 interface and the new instruments with built in interfaces.

- Coordinate systems:

The coordinate system used in the REC 500 is always right-handed.

Elevation



North and East may differ depending on the selected system:

X = East, Y = North: Mathematical system  
Y = East, X = North: Geodetic system  
E = East, N = North: Geodetic system

The manual entry, interface entry and display sequence is always East, North and Elevation. The direction angle always refers to the North axis in all systems and is positive clockwise.

- Setting the optimum display angle

The following display appears when the REC 500 is turned on:

```
REC 500/352K          Z E I S S
Elta Version         R E C   5 0 0
Elta 46R/40/42
Elta E-Series
ft , DMS
zenith angle          Press any key to continue
```

The program selects the display angle so that the display is in an optimum viewing position if the REC 500 is suspended at the tripod. To change the display angle for some other viewing position, simultaneously press CTL/FN and the up or down cursor key preferably immediately after turning the REC 500 on.

## 7. Using the REC 500 Programs

A record containing the measurement program designation is stored when you call a measurement program in order to identify the stored data, i. e. all records can be assigned to the selected measurement program in the sequence in which they are stored.

### 7.1 Input and Editing of Project Data

Up to 7 lines are available for entering project data. Every line has 27 columns into which alphanumeric data can be entered.

The horizontal cursor keys (left and right) and the TABs are effective.

Terminate each entry in a line with ENTER. If you do not want to make an entry in a line, skip it by pressing ENTER.

All lines are displayed again after the 7th line has been used. You can confirm the project data with Y or recall the individual lines with N for making changes.

If you confirm the project data, the following question appears:

Record project data Y/N

If you enter Y, the content of the used lines is stored and control is returned to the main menu.

### 7.2 Measurement and Recording of Data

#### - Measurement and recording:

A prompt appears to turn on the instrument. Any measuring mode may be used and changed during measurement.

The recording mode is activated.

Confirm at the REC 500 by pressing ENTER.

#### - A prompt appears to enter the point identifier and to measure a point.

Function keys:

'ClrC'	Delete point code
'ClrI'	Delete additional information
'Ioff' (Ion )	Automatic incrementation off (on)
'R-M' (Roff)	Recording of measured values on (off)
'LAdr'	Read last used address
'Ecc.'	Enter target offset
'End'	Terminate measurement and return to main menu

#### - Measurement initiation at the instrument

The point identifier and the measured data are displayed in the upper two lines (together with the record address if the recording mode is on) after measurement.

### 7.3 Input, Display and Editing of Data

#### - Display and editing

An indication appears that scrolling in the field book with the up/down cursor keys is possible.

Function keys:

'Inpt'	Enter data
'Del.'	Delete record
'LAdr'	Read last used address
'Mark'	Mark record
'?Adr'	Read record specified by address
'?Pt.'	Read record specified by point identifier
'End'	Terminate program part and return to main menu

- The following function key become effective after record display with the up/down cursor keys or the function keys.

'Edit' Edit last record

You can scroll up in the field book with the up cursor key and down with the down cursor key after record display with the 'LAdr', '?Adr' and '?Pt.' function keys. Scrolling up from the last record returns you to the first record, and scrolling down from the first record returns you to the last record.

#### - 'Inpt' function key

- Measured data entry (M) or coordinates entry (C)
- Point identifier entry followed by ENTER or Enter mode termination with 'End' and return to the menu
- Entry of the slope distance D or the E coordinate depending on the selected mode (M or C) followed by ENTER
- Entry of the horizontal direction Hz or the N coordinate followed by ENTER
- Entry of the zenith angle V or the Z coordinate followed by ENTER
- Display of all entered data
- Is data correct? (Y/N)
  - N: Reenter all the data
  - Y: Data storage in the next available record

#### - 'Edit' function key

- Enter the password if required.
- The last record is displayed completely. If this is not the desired record, scroll with the up/down cursor keys until the desired record is displayed. Terminate editing with 'End'.
- The old point identifier is displayed for editing. Overwrite as required or press ENTER if OK.
- The complete record is displayed together with the new point identifier. The first old value can now be edited. Enter a new value and press ENTER or press ENTER only to retain the old value.



- The complete record is displayed together with the new value. The second old value can now be edited. Enter a new value and press ENTER or press ENTER only to retain the old value.
- Same procedure for the third value.
- The new record is displayed. Press N for further editing or Y to store the new record at the old address. A prompt appears to indicate that you can access further records with the up/down keys.
- The up key addresses the record above and the down key the record below. Terminate editing with 'End'.
- 'Del.' function key
  - Enter the password, if required.
  - Record selection with function keys
 

'All'	All records are selected
'Adr'	One record is selected
'A->A'	All records from start address to end address are selected
'Pt.'	A record is selected using the point identifier. If several records are found, you can select the desired one with the address.
'P->P'	All records from start point to end point are selected
'Part'	All records with the same identifier part are selected
'LAdr'	The last used record is selected
'End'	End of deletion mode
  - The selected records are displayed as follows:  
The first and the last selected record for 'All', 'A->A', 'P->P'  
The selected record for 'Adr', 'Pt.', 'LAdr'.
  - If a selection error occurred, you can repeat record selection with the function keys or scroll with the up/down cursor keys until the desired record is displayed.
  - Press ENTER to delete the selected record. The letters DEL are inserted in the last three point identifier columns. The record is marked as deleted but not actually deleted yet.
  - A prompt appears to continue record selection for deletion.
  - Terminate the delete mode with 'End'. The message 'Renumbering line addresses' appears. The records marked for deletion are deleted and the remaining records are renumbered.
  - Use the 'All' function key to delete all records. The display then shows:
 

```
'DELETE ALL DATA ????? Y/N'.
```

If you press Y, the display shows:

```
'ALL DATA TO BE DELETED: ARE YOU SURE ????? Y/N'
```

If you press Y, all records are deleted. If you press N, the

data is retained.

#### 7.4 Transfer of Data

The data transfer menu offers:

- 1 Standard interface printer etc.
- 2 Standard interface computer
- (3) Optional interface
- (4) Optional interface disk drive
- 5 Set parameters of standard interfaces

Make your choice or enter 0 (zero) to return to the main menu.

Interfaces (3) and (4) are optional. All interfaces are handled in the same way.

After selecting an interface,

- a prompt appears to switch on the peripheral device. Confirm with ENTER.
- a decision is requested on data transfer from (F) or to (T) the peripheral device or to terminate data transfer with 0.
- T: Data transfer to the peripheral device

Record selection with the function keys:

'All'	All records are selected
'Adr '	Only one record is selected
'A->A'	All records from start address to end address are selected
'Pt.'	The record with the entered point identifier is selected. If several records are found, the desired one can be selected with the address.
'P->P'	All records from begin point to end point are selected.
'Part'	All records with identical part identifier are selected.
'LAdr'	The last record is selected.
'End'	Terminate data transfer and return to data transfer menu

- The following records are displayed after selection:
- The first and last selected record for 'All', 'A->A', 'P->P'.
- The selected record for 'Adr', 'Pt.', 'LAdr'.
- To recover selection errors, use the function keys, or for individual records the up/down cursor keys, to repeat record selection.
- If the selected records are displayed, start data transfer with ENTER.
- Data transfer can be aborted with the B key.

- A message appears or the program returns to the data transfer menu if data transfer does not take place or is interrupted for 60 seconds.
- F: Data transfer from the peripheral device
  - A prompt appears to start data transfer at the peripheral device.
  - A message appears or the program returns to the data transfer menu if data transfer does not take place or is interrupted for 60 seconds.
- 5: Set parameters of standard interfaces
  - Display: 1 standard interface printer etc.  
           Selected baud rate  
           Selected parity
  - Enter Y if the displayed parameters are OK or N if not.
  - N: A table is displayed for baud rate selection.  
       A table is displayed for parity selection.  
  
       Standard interface 1 is then displayed with the new parameters. Enter Y or N depending on whether the parameters are OK or not.  
  
       N: Repeat parameter selection  
  
       Y: Display standard interface 2
- Set up standard interface 2 in the same way as standard interface 1.

## 7.5. Application Programs ( On-line )

The application programs menu offers:

Measuring and computation (on-line)

/- Stationing -/

1 Occupied point	2 Resection
3 Side shots	4 Stake-out
5 Connecting distances	6 Station and offset
7 Traverse	8 User programs

The stationing results - station coordinates, scale, orientation angle and instrument height - are retained in the REC 500 until they are deleted or overwritten by other station data.

Stationing on an occupied point or by resection is required before modes 4 and 6 can be used. Modes 3 and 5 can be used either in an existing coordinate system or in an assumed coordinate system with station coordinates  $Y(E)=0$  and  $X(N)=0$  and with the zero direction of the instrument as north axis as selected in the measurement program.

Mode 7, traverse, does not require prior stationing.

Mode 8, user programs, is an open program part, which can be used to combine an user program with the Zeiss standard programs.

- Mode selection

- Exit from this general function with 0 (zero) after measurement completion. The program returns to the main menu.



- Effective function keys:

'Del.' Delete direction  
'Mnew' Repeat whole measurement  
'Madd' Measure further directions  
'Comp' Recompute orientation, e. g. after deletions  
'End' Accept residuals and stationing results and return to application programs menu.

'Del.' key:

The first residuals are displayed. A prompt appears to scroll the residuals with the up/down cursor keys. Press the 'Del.' key when you have found the residuals whose data is to be deleted. Terminate deletion with 'End'. Continue measurement or initiate orientation recomputation.

### 7.5.2 Stationing by Resection (on Unknown Point)

There are three free planimetric stationing methods:

- Single point adjustment
- Helmert transformation with free scale (4-parameter transf.)
- Helmert transformation with scale 1.00 (3-parameter transf.)

The single point adjustment method uses directions or directions and distances in random combination. The Y (E) and X (N) station coordinates, the scale factor M and the orientation unknown Omega are computed. Measured directions are given the weight 1 and measured distances the weight 0.01 during adjustment. An adjustment of intermediate observations with different weights is done.

Directions and distances are always used for Helmert transformations. The same unknowns are computed as during single point adjustment. Identical direction and distance weights are used. Using the scale 1.000 is optional.

The single point adjustment is always used for station elevation computation, but as usual the weight of measured elevations is made inversely proportional to the square of the distances.

During stationing, provisional station parameters are computed as soon as this is geometrically feasible, either after two measurements in the TH+D mode by transformation, or after three measurements by resection. The station elevation Z is computed similarly.

- Select the free stationing method.
- Enter the point identifier of the unknown station and press ENTER. No check is made to see whether the point data is stored. Terminate free stationing with 'End'.
- Enter a provisional scale, if applicable, and press ENTER.
- Enter Y or N for elevation computation. If Y, enter the instrument height in m (ft) and press ENTER.
- Recall the first backsight point and, if applicable, enter the reflector height with the 'RefH' key, and press ENTER.
- If the point data is not found, you can enter it manually or specify another point.
- Sight the point.
- Recall the next point and sight it. Terminate stationing with 'End'.

The 'Srch' function key (search) becomes effective as soon as the provisional station coordinates Y (E), X (N) and, if applicable, Z have been computed so that further points can be located by measurement.

The longitudinal and lateral deviations  $d_l$  and  $d_q$  are computed after each additional measurement. The longitudinal deviation is the difference in distance and the lateral deviation the perpendicular measurement beam deviation from the point. If you activated elevation measurement, the vertical deviation  $d_h$  is the elevation deviation of the measurement beam from the point. If one of these residuals is greater than 0.1 m (0.3 ft), you can accept it with Y or reject it with N. If you enter Y, the data is used. If you enter N, you can call up the point again and repeat the measurement.

Up to 20 measurements can be made. Points can be measured repeatedly as soon as the provisional station coordinates have been computed, i. e. after two measurements in the TH+D mode or else after 3 measurements.

- Terminate stationing with 'End'. The station data is computed by adjustment.

#### Single point adjustment

Display after each iteration:

dy, dx	Provisional station coordinate shifts
dm	Provisional scale correction
do	Orientation unknown correction
Shift	Resultant of dy and dx

as well as the computed station data Y (E), X (N), M, Omega.

- Enter Y to initiate another iteration or enter N.

N Terminate adjustment. Use this option if the shift is sufficiently small (e. g. less than 0.001 m (ft) ) and if do is sufficiently small (e.g. less than 0.0001 grad (DMS) ) . The backsight point residuals are computed.

Y Compute the next iteration.

#### Helmert transformation

Result display:

Transformation factor o  
 Transformation factor a  
 Y direction shift  
 X direction shift  
 Scale M  
 Rotation angle Epsilon

- The backsight point residuals are displayed in m (ft) together with the record numbers (Adr) and the point identifiers.

The single point adjustment residuals indicate the longitudinal and lateral deviations and the Helmert transformation residuals the coordinate differences.



Effective function keys:

'Del.' Delete stationing measurements  
'Mnew' Repeat whole stationing procedure  
'Madd' Measure further directions or distances  
'Comp' Recompute station data, e. g. after deletions  
'End' Accept deviations and terminate planimetric stationing.

'Del.' key:

The first residuals are displayed. A prompt appears to scroll to further residuals with the up/down cursor keys. Press 'Del.' when you have found the residuals whose data is to be deleted. Terminate deletion with 'End'. You can then continue stationing or initiate station data recomputation.

- Answer Y to store the planimetric residuals for stationing documentation or N for not storing them.
- If you selected elevation computation and elevation computation is geometrically feasible, the Z data is computed by single point adjustment and the deviations  $dh$  at the backsight points are displayed in m (ft) together with the consecutive numbers (Adr) and the point identifiers.

Effective function keys:

'Del.' Delete measurements  
'Mnew' Repeat whole stationing procedure and elevation computation  
'Madd' Measure further zenith angles  
'Comp' Recompute Z stationing, e. g. after deletions  
'End' Accept elevation deviations and terminate Z stationing.

- Answer Y to store the elevation residuals for stationing documentation or N for not storing them.
- The adjusted Y (E), X (N) and Z coordinates, the standard deviations of coordinates  $m_y$ ,  $m_x$  and  $m_z$  and the adjusted scale are displayed when free stationing is terminated.
- Enter Y to store and use the new point or N to delete it.  
N The measured data and the computed result is deleted.  
Y The point identifier, the adjusted station coordinates, the standard deviations of coordinates as well as the new scale, the orientation unknown and the instrument height are stored in three records for use in further computations. Return to the application programs menu.

### 7.5.3 Sideshots

- A request appears to specify stationing in the assumed coordinate system (A) or in the existing coordinate system (C).
- If you enter C and stationing has been omitted, a prompt appears. Press ENTER to return to the application programs menu.
- You can now enter the scale and specify elevation computation.
- If you entered C, the station data determined last, i. e. the point identifier, station coordinates, scale and the instrument height if the elevation was computed, are displayed.
- Enter Y or N to accept or reject the stationing data.  
N: Return to the application programs menu.
- Display: 

Sideshots
Switch on instrument and set the TH+D mode
Recording in REC 500 activated
- Confirm with ENTER.
- A prompt appears to enter the identifier and measure the next point.

#### Effective function keys:

'ClrC'	Delete point code C
'ClrI'	Delete additional information I
'Ioff' (Ion)	Automatic incrementation off (on)
'R-C' (R-MC)	Recording mode on
(R-M)	Recording mode on
(Roff)	Recording mode off
'RefH'	Enter reflector height (elevation computation only)
'Ecc.'	Enter target offset
'?off' (?on)	Compare redundant observations
'End'	Terminate sideshot measurement and return to application programs menu

#### 'Ecc.' function key:

- Display: 

Target position	ahead of point (A)
	behind point (B)
	left of point (L)
	right of point (R)
- Enter offset location as A/B/L/R  
Enter 0 to delete any existing offset.
- Enter the horizontal offset and press ENTER.

#### '?off' function key

If this key is set to '?on', the point code (not the additional information) is used after every sideshot measurement to check if this point is already stored. If yes, the coordinate differences are displayed. No other action occurs.

- A prompt appears to enter and measure another point. The current entries appear in the display if an offset and/or elevation computation have been selected. They remain valid until they are changed or deleted.

Initiate measurement at the Elta. A message appears if the TH+D mode is not set and a slope distance is not measured.

- The identifier and the coordinates of the measured point are displayed together with the memory address if the recording mode is active. A prompt appears to enter and measure the next point.
- Terminate sideshot measurement with 'End'; return to the application programs menu.

#### 7.5.4 Stake-Out

- A check for stationing data is made.
  - The scale factor can be entered and elevation computation requested.
  - The stationing data determined last is displayed and a decision is requested to accept or reject the data.  
N: Return to application programs menu.  
Y: Display: Stake-out  
Switch on the instrument and set the TH mode
- Confirm with ENTER.
- Enter the point identifier or address to recall the data of the point to be set out. Enter the reflector height with 'RefH' if the elevation is to be computed. Terminate stake-out with 'End'; return to the application programs menu.
  - The point data can be entered manually if it is not found, or another point can be specified.
  - The nominal direction and the horizontal distance to the point (polar coordinates referred to the station) are displayed. Set the nominal direction with the tracking mode, direct the assistant, and confirm with ENTER.
  - The nominal direction and the horizontal distance to the point are displayed; a prompt appears to set the TH+D mode at the instrument and to initiate measurement to the approximate point.
  - Display: Nominal direction and horizontal distance  
dY, dX, (dZ) Coordinate deviations of measured point from true point location  
dl, dq Longitudinal, perpendicular deviation  
An, dr Polar deviation of measured point from true point
- dl positive: Measured distance too short  
dq positive: Measured point is to the left of true point location  
dr = linear deviation  
An = angle on measured point between instrument and true point
- Record measured data: R  
Enter Y to accept or N to reject stake-out.
- R: Store the data of the last stake-out measurement if the point is set out properly, and read the data for the next point.  
N: Prompt to measure again in the TH+D mode.  
Y: Prompt to read the data of the next point or to terminate with 'End'; return to application programs menu.

### 7.5.5 Connecting Distances

- Specify measurement in the assumed coordinate system (A) or in the existing coordinate system (C).
- A message appears if you entered C and stationing has not been performed yet. Confirm with ENTER. Return to the applications program menu.
- The scale factor can now be entered and elevation measurement specified.
- If you entered C, the stationing data determined last is displayed.  
Enter Y to accept or N to reject the data.  
N: Return to application programs menu.  
Y: Specify the first point and press ENTER.
- If you entered A, the following display appears:

```
Connecting Distances      First Point
Switch on the instrument and set the TH+D mode
Recording in REC 500 activated
```

Confirm with ENTER.

- Display: Connecting Distances  
Switch on the instrument and set the TH+D mode  
Recording in REC 500 activated

Confirm with ENTER.

- Prompt to enter the point identifier and measure the next point.

Effective function keys:

'ClrC'	Delete point code
'ClrI'	Delete additional information
'Ioff' (Ion)	Automatic incrementation off (on)
'R-C' (R-MC)	Recording mode on
(R-M)	Recording mode on
(Roff)	Recording mode off
'RefH'	Enter reflector height (elevation computation only)
'Ecc.'	Enter target offset
'P1-P' (P-P)	Connecting distance reference point
'End'	Terminate connecting distance measurement and return to application programs menu

'P1-P' (P-P) key:

'P1-P': All connecting distances are referred to the first point.

'P-P' : A connecting distance is referred to the preceding point.

Switchover from 'P1-P' to 'P-P' and vice-versa is possible at any time during measurement.

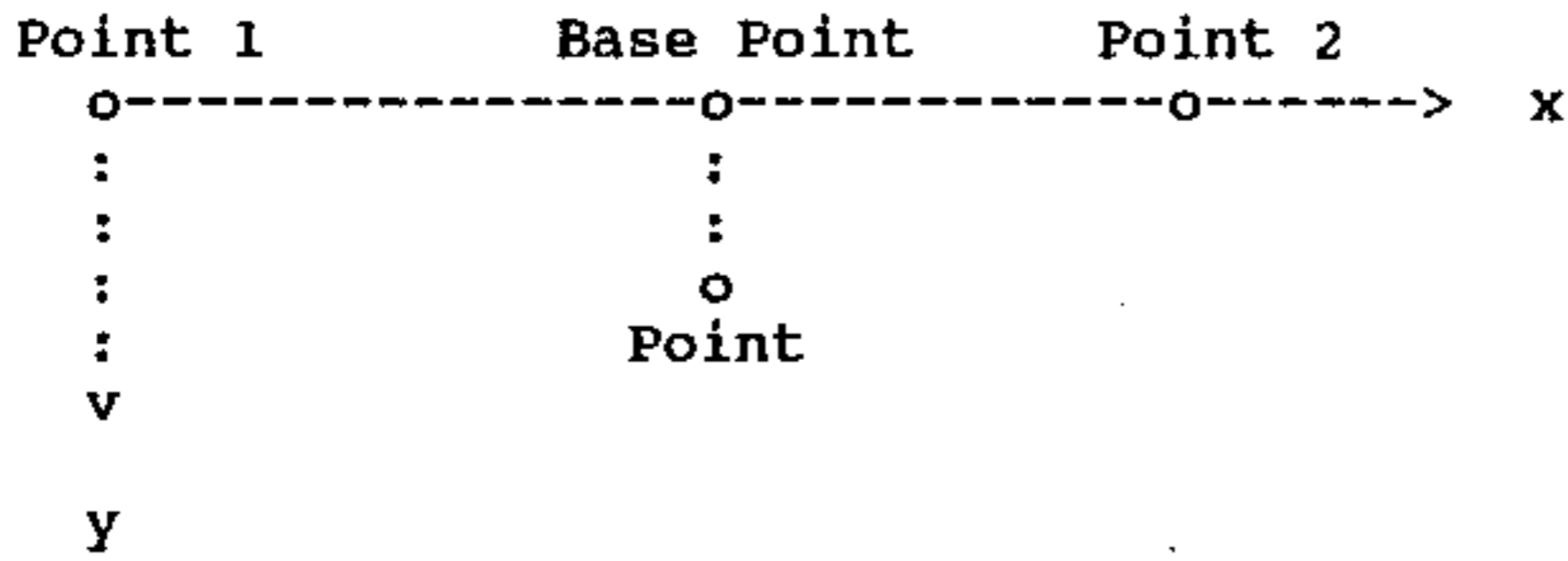
- Prompt to enter and measure the next point. Initiate measurement at the instrument. A message appears if a slope distance is not measured.
- Connecting distance display:
  - D = Spatial connecting distance
  - E = Horizontal connecting distance
  - h = Difference in elevation

Spatial connecting distances and the difference in elevation are computed only if elevation measurement has been selected and the elevation of the connecting distance reference point is not 0.

Prompt to enter and measure the next point. Terminate connecting distance measurement with 'End'; return to the application programs menu.



The first two line points form a local x, y coordinates system:



If y is positive, the measured point 'Point' is to the right of the line connecting points 1 and 2.

If x is positive, the plumb line base point is in the positive area of the x axis.

The Z coordinate refers to the higher-level Y, X, Z coordinates system.



### 7.5.7 Traverse

The traversing program supports on-line measurement of different types of traverses.

The traversing menu offers the following options:

- 1 Measurement on P.O.B. (Point of Beginning)
- 2 Measurement on T.P. (Traverse Point)
- 3 Measurement on P.O.E. (Point of Ending)
- 4 Measurement of sideshots
- 5 Traverse status
- 6 Balancing

Select one of options 1 to 6 or return to the application programs menu (measurement) by entering 0 (zero).

A warning appears before the traversing menu is displayed if there is not enough memory space for at least 100 records.

The traversing procedure is as follows:

1. Measurement on P.O.B. (option 1)
  - e. g. with stationing on occupied (known) point
  - Foresight measurement (F.S.) to first traverse point T.P. 1
2. Measurement of sideshots on P.O.B. (option 4)
3. Measurement on traverse point 1 (option 2)
  - Backsight (B.S.) to P.O.B.
  - Foresight (F.S.) to T.P. 2
4. Measurement of sideshots on traverse point 1 (option 4)
5. Measurement on traverse point 2 (option 2)
  - Backsight to T.P. 1
  - Foresight to T.P. 3
- .....
8. Measurement on P.O.E. (option 3)
  - e. g. with stationing on occupied (known) point
  - Backsight measurement to last traverse point
9. Traverse balancing (option 6)

You can display the current traverse status (list of coordinates and measured data) at any time with option 5.

The following table contains a survey of the measurement and recording conditions of the different program parts.

	Measurement	Recording	Incrementation	Offsets
Station on P.O.B./P.O.E	TH/TH+D	R-M	No	Possible
Traverse point	TH+D	R-M	No	No
Sideshots	TH+D	R-C	Possible	Possible
New orientation for sideshots	TH/TH+D	R-M	No	No
Intermediate check	TH/TH+D	R-M	No	No

The recording modes are preset as shown above, but can be changed with a function key.

#### 7.5.7.1 Measurement on Point of Beginning (P.O.B.)

Options:

- 1 Stationing by Resection (Unknown point and directions)
- 2 Stationing on Occupied Point (Known point and directions)
- 3 No Backsight Points (Free point)

Select one of the options or return to the traversing menu by entering 0.

- You can select any of the three options if the traverse is closed.

##### 7.5.7.1.1 Stationing by Resection (Unknown Point and Directions)

In this case the P.O.B. is determined by free stationing as described in 7.5.2 provided there are sufficient directions. Foresight measurement is activated automatically after stationing.

Particularity:

In step "Recall backsight point i, ENTER" there is an additional function key 'F.S.' (foresight measurement), which allows foresight measurement to traverse point 1 also during stationing (refer also to 7.5.7.2). You can return to stationing with the 'Stat' function key.

##### 7.5.7.1.2 Stationing on Occupied Point (Known Point and Directions)

Stationing as described in 7.5.1, foresight measurement and return as described in 7.5.7.1.1. Refer also to 7.5.7.2.

### 7.5.7.1.3 No Backsight Points (Free Point)

- (a) Display:
- Trav.: P.O.B., no B.S. point  
(is also stored as a comment)
  - Local system: X axis in direction of first traverse leg
  - Switch on the instrument, TH+D mode
  - The default recording mode R-M is displayed
  - Continue with ENTER
- (b) Entries
- Point identifier and P.O.B. coordinates. The default values Y=10000, X=10000 and Z=1000 are displayed. You can change or use them.
- (c) The current scale is displayed
- You can change it or accept it with ENTER.
- (d) Prompt to select elevation computation, if applicable.
- If Y, enter the instrument height in m or ft and press ENTER.
- (e) Foresight measurement to traverse point 1; refer to 7.5.7.2 (g).

### 7.5.7.2 Measurement on T.P. (Traverse Point)

- Measurement on a traverse point consists in backsight measurements (to the last traverse point or the P.O.B.) and in foresight measurements (to the next traverse point or the P.O.E.).
- Several foresight and backsight measurements may be made in sequence or in alternation.
- The numbers of foresight and backsight measurements may differ.
- Intervening circle setting changes are not allowed.
- On the P.O.B. (7.5.7.1), only foresight measurement is activated automatically after stationing, and on the P.O.E. (7.5.7.3) only backsight measurement.

### Traversing procedure:

- (a) Display:
- Trav.: Measurement on TP i  
(is also stored as a comment)
  - Switch on the instrument, TH+D mode
  - The default recording mode R-M is displayed
  - Continue with ENTER
- (b) Display:
- Measurement on T.P. i
  - Address, point identifier  
Y, X, Z coordinates
  - Continue with ENTER  
or return to traversing menu with 'End'
- (c) If elevation computation selected:
- The instrument height is displayed. The reflector height used during foresight measurement on last T.P. is used automatically.
  - Confirm with ENTER  
or change the instrument height.

- (d) Display:
- Backsight (B.S.) measurement to traverse point i-1 (or to the P.O.B.)
  - Current instrument height
  - Current reflector height (same as instrument height at TP i-1)
  - Identifier of TP i-1
  - Prompt to initiate the jth measurement.

Effective function keys:

'ClrC'	Delete point code C
'ClrI'	Delete additional information I
'R-M'	Default recording mode, can be changed to 'R-C', 'R-MC' or 'Roff'
'RefH'	Enter/change the reflector height (elevation computation only)
'F.S.'	Activate foresight measurement (g)
'End'	Terminate traversing on TP i and start computing (j)

The reflector (target) height should not be changed during measurement. Elevation computation would still be correct but only the last reflector height would be stored.

- (e) Initiate measurement at the instrument or press ENTER and enter the D, Hz and V data manually.

(f) Display:

1st backsight measurement:

- Difference in distance (and elevation) from mean of foresight measurements on last TP i-1.

Later backsight measurements:

- Difference in distance (and elevation) and perpendicular deviation to 1st backsight measurement.

Continue with ENTER and (d) or delete (ignore) the measurement with 'End' and continue with (d).

- (g) Display: Foresight (F.S.) measurement to TP i+1

All further displays are identical to those for backsight measurement except for the following:

- Elevation computation only: The reflector height is preset to 0.000 and has to be entered before the first foresight measurement with the 'RefH' function key.
- The point identifier must be entered before the first foresight measurement.
- Function key 'F.S.' becomes function key 'B.S.' for backsight measurement (d).

- (h) Initiate measurement at the instrument or press ENTER and enter the D, Hz and V data manually.

- (i) Display as of 2nd foresight measurement:
  - Difference in distance (and elevation) and perpendicular deviation to 1st foresight measurement.
  - Continue with ENTER and (g) or delete (ignore) the measurement with 'End' and continue with (g).
  
- (j) Display:
  - Differences (distance and elevation) of the mean foresight (TP i-1) and backsight (TP i) measurements.
  - Continue with ENTER or remeasure on TP i with 'End' and return to traversing menu.
  
- (k) Display:
  - Corrected TP i
  - Address, point identifier (TP i)  
Y, X, Z coordinates
  - Address, point identifier (TP i)  
Backsight reflector height (tr), foresight reflector height (tv), instrument height (ih)
  - Continue with ENTER

Note: TP i has already been measured in the foresight direction from TP i-1 and stored. This data and the TP i backsight measurement data is used for a recomputation. The corrected coordinates are stored at the same address (refer also to (l)).

- (l) Display:
  - Next T.P. i+1
  - Address, point identifier,  
Y, X, Z coordinates
  - Address, point identifier,  
tr, tv, iv
  - Continue with ENTER; return to traversing menu.

### 7.5.7.3 Measurement on P.O.E. (Point of Ending)

If the P.O.E. has been measured in the foresight direction from the last traverse point, select the P.O.E. measurement option in the traversing menu.

Options:

- 1 Stationing on occupied Point  
(Known point with F.S. direction(s))
- 2 Known point , but no F.S. direction
- 3 Stationing by resection  
(Unknown point with F.S. directions)
- 4 End of a random traverse  
(Unknown point without F.S. direction)

Select one of options 1 to 4 or return to the traversing menu by entering 0 (zero).

- If a closed polygon is involved, only options 1 and 2 can be selected. For option 1 at least the direction to TP 1 has to be measured as the foresight direction.
- The applicable stationing routines are activated again for options 1 and 3.  
Backsight measurements are possible during stationing and later as described in 7.5.7.1.1 and 7.5.7.2. Return to 7.5.7.3.5 after foresight measurement.

### 7.5.7.3.2 Known Point, but no F.S. Direction and 7.5.7.3.4 End of a Random Traverse (Unknown Point without F.S. Direction)

- (a) Display:
- Trav.: P.O.E., no F.S. point  
(is also stored as a comment)
  - Switch on the instrument, TH+D mode
  - The default recording mode (R-M) is displayed
  - Continue with ENTER
- (b) Only for 7.5.7.3.2: Recall the known P.O.E. using
- the point identifier or
  - the address
- (c) Enter the instrument height or confirm the current height.
- (d) Backsight measurement to last traverse point  
(refer to 7.5.7.2 (d)).  
Continue with 7.5.7.3.5.

#### 7.5.7.3.5 Display and Storage the Errors of Closure (E.C.)

- Coordinate closing errors  $dy$ ,  $dx$ ,  $dz$
- Longitudinal, lateral deviation  $d_l$ ,  $d_q$  and closing angle (C.A.)  $db$ .

The errors of closure are computed and displayed only to the extent that this is possible with the chosen P.O.B. and P.O.E.

Continue with ENTER; return to the traversing menu.

#### 7.5.7.4 Sideshots (Polar Point Measurement)

Sideshots can be measured after stationing and/or foresight and backsight measurement on the P.O.B, P.O.E. resp. traverse points. Redundancy checks and traversing checks by intermediate measurements to known stations are possible.

Display:

- Measurement on TP  $i$  (or P.O.B. or P.O.E.)
- Address, point identifier, Y, X, Z coordinates
- Continue with ENTER

Options:

- 1 New orientation of the circle
- 2 Measurement of sideshots

Select one of the options or enter 0 to return to the traversing menu.

##### 7.5.7.4.1 New Orientation of the Circle

If the circle orientation has changed after traverse point measurement on the current station, you have to reorient it before you can initiate sideshot measurement. You can do this by backsight measurement, or by foresight measurement on the P.O.B.

(a) Display:

- Trav.: New orientation (is also stored as a comment)
- Switch on the instrument, TH/TH+D mode
- The default recording mode is displayed (R-M)
- Continue with ENTER

(b) Enter the new instrument height and press ENTER or confirm the current height with ENTER.

(c) Display:

- New orientation to TP  $i-1$
- Instrument height, reflector height
- Target point identifier
- Prompt to initiate measurement

Effective function keys: 'ClrC', 'ClrI', 'R-M', 'RefH', 'End'  
Refer to 7.5.7.2 (d)

Only 1 reorientation measurement is provided for. You can use the TH or the TH+D mode.

Return to the sideshot measurement menu.

#### 7.5.7.4.2 Measurement of Sideshots

(a) Display:

- Trav.: Sideshots  
(is also stored as a comment)
- Switch on the instrument, TH+D mode
- The default recording mode is displayed (R-C)
- Continue with ENTER

(b) Display:

- Sideshots on TP i (or P.O.B. or P.O.E.)
- (Offset), instrument height, (last reflector height)
- Prompt to enter the reflector height and the point identifier and to initiate measurement

Effective function keys:

- 'ClrC' Clear point code C
- 'ClrI' Clear additional information I
- 'Ioff' Automatic incrementation off  
'Ion' Incrementation on
- 'RefH' Enter reflector height (elevation computation only)
- 'Ecc.' Enter target point offset
- '?off' No search  
'?on' Search point with same code  
Display differences dy, dx, dz to new point
- 'Chck' Same as '?on' plus  
Display longitudinal and lateral deviations dl and dq, relative to the direction of traverse (P.O.B. -> P.O.E.).  
This function key is effective only if any stationing on P.O.B is done (occupied point or resection).  
The search with '?on' or 'Chck' is aborted when the first point with the same point code is found. Further points with the same code are not located.
- 'End' Return to sideshot measurement menu

Measure intermediate sightings to known stations ('Chck') without offset in the TH or TH+D mode.



### 7.5.7.5 Traverse Status

Each time you return to the traversing menu you can request the current traverse status up to the current station. A list containing the following data is then displayed:

Pt	Y (E)	X (N)	Z	Pt	Dist. F.S./B.S.	Bearing	Traverse Angle	dz(F.S.) B.S.
B	Y(B), X(B), Z(B)			B	d(B-1) (1-B)	b(B-1)		dz(B-1) (1-B)
1	Y(1), X(1), Z(1)			1	d(1-2) (2-1)	b(1-2)	B(1)	dz(1-2) (2-1)
.....								
E	Y(E), X(E), Z(E)			E	S(E-i)			dz(E-i)
<----- Left-hand side ---->				<----- Right-hand side ----->				

- Three points are always displayed.
- You can scroll up and down with the vertical cursor keys.
- Select the left-hand or right-hand side with the left/right cursor keys.
- The distances and differences in elevation are the mean of the F.S. and B.S. measurements.
- Return to the traversing menu with 0 (zero).

### 7.5.7.6 Traverse Balancing

#### 7.5.7.6.1 Planimetric Balancing

- If possible, the traverse is automatically adjusted in plan by means of a similarity transformation.
- The closing angle (C.A.) is not attributed to the traverse angles beforehand.
- Normal (extended) traverses are transformed from the "P.O.B. - Current P.O.E." axis to the "P.O.B. - Nominal P.O.E." axis.
- For closed traverses the point that is common to both axes can be assigned freely to any of the traverse points. The transformation is then made with the axis "T.P. i - Current P.O.E." and the axis "T.P. i - Nominal P.O.E. (= P.O.B.)", i. e. the coordinates of T.P. i are not corrected.

#### 7.5.7.6.2 Elevation Balancing (if elevation computation selected)

The elevation error of closure is assigned to the traverse point elevations in proportion to the distances. Sideshots on a T.P. are corrected with the same value.

### 7.5.7.6.3 Balancing Procedure

- The comment "Trav.: Balancing" is stored
- Planimetric and elevation balancing are performed simultaneously and all sideshots are also transformed simultaneously if their coordinates have been stored ('R-C' or 'R-MC' recording mode).
- The transformed traverse and sideshots and their addresses are displayed. Return to the traversing menu.
- At this stage, only the traverse status option can be selected in the traversing menu. The adjusted coordinates are then displayed on one side and the unadjusted mean sightings on the other side.

Special procedure for planimetric balancing of closed traverses:

- (a) Display:
  - Balancing of closed traverse by transformation of the line T.P.(i) - P.O.E. to the line T.P.(i) - P.O.B.
  - Select (enter) the consecutive number i of the traverse point. Confirm with ENTER.
- (b) The comment "Transf line: TP(i) - (C.P.)" is stored.
- (c) Traverse and sideshot transformation.  
Return to traversing menu.

## 7.6 Computation Programs ( Off-line )

This menu provides programs for performing some computations in the field. The purpose is not to do all computations in the field but only those that are required for checking the measured data and those that provide intermediate results for some measurement programs in order to speed up the field work.

The coordinates application programs menu offers the following options:

- |                                  |                        |
|----------------------------------|------------------------|
| 1 P -> R, R -> P                 | 2 Transformation       |
| 3 Intersection of straight lines | 4 Intersection of arcs |
| 5 Area computation               | 6 Curve solution       |

- Select one of options 1 to 6.  
The required records must be stored, of course.
- Return to the main menu by entering 0 (zero).

### 7.6.1 Polar - Rectangular Coordinate Conversions

The submenu offers the following options:

- |  |
|--|
| 1 R -> P: Y,X (E,N) --> Bearing, distance<br>(vertical distance) |
| 2 P -> R: Bearing, distance --> Y,X (E,N)                        |

Select an option or return to the coordinates application programs menu by entering 0.

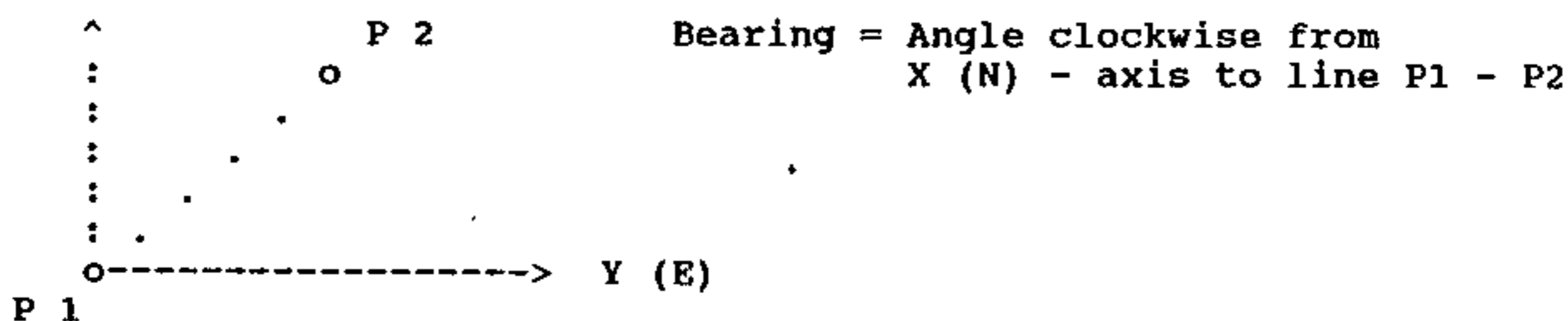
#### 7.6.1.1 R -> P: Bearing, Distance (and vertical distance) from P1 to P2

- Enter the point identifier of point P1 and press ENTER.  
A message appears if the specified point is not found. Press ENTER and repeat the entry or terminate the program with 'End'.
- The coordinates of the specified point are displayed.  
If there are several points, you can select one of them by means of the address. Yes/No decision on point selection. Enter N to repeat point entry.
- Enter the point identifier of the next point P2 and press ENTER or return to the basic tasks menu with 'End'.  
Proceed as for point P1.
- Display: Bearing, horizontal distance from P1 to P2 and, if both elevations are known, the vertical distance (difference in elevation)  $Z(2)-Z(1)$ .  
Press ENTER to return to (c) for the next computation with the same start point P1.

### 7.6.1.2 P -> R: Rectangular Coordinates Y,X (E,N) for P2

- (a) Enter the identifier of point P1 and press ENTER. Proceed as described in 7.6.1.1.
- (b) Enter the bearing from P1 to P2 and press ENTER.
- (c) Enter the horizontal distance from P1 to P2 and press ENTER.
- (d) The bearing and the distance are displayed and a confirmation is requested that the entries are correct. Enter Y if they are or N to repeat entry.
- (e) Enter the identifier of another point P2 and press ENTER or return to the coordinate conversion menu with 'End'.
- (f) Storage is confirmed by briefly displaying the computed coordinates.
- (g) A prompt appears to compute the next polar point from the same start point. Enter Y to return to (b) or N to return to the coordinate conversion menu.

X (N)



### 7.6.2 Transformation

There is a choice between

- 1 Helmert transformation with scale = 1.0 (3-parameter transf.)
- 2 Helmert transformation with free scale (4-parameter transf.)

Select option 1 or 2 or enter 0 (zero) to return to the coordinates application programs menu.

Operator control of the two programs is identical.

- (a) Display: Recall of the identical points in the grid system Y/X (E,N) and press ENTER.

Select the records with the function keys.

- 'All' All records are selected
- 'Adr' One record is selected
- 'A->A' All records from start address to end address
- 'Pt.' Record selection with point identifier. If there are several records, select the desired one with its address
- 'P->P' All records from start point to end point
- 'Part' All records with the same point identifier part
- 'LAdr' The last record is selected
- 'End' End of selection mode

- The selected records are displayed as follows:  
 'All', 'A->A' and 'P->P': The first and last records are displayed.
- 'Adr', 'Pt.' and 'LAdr': The specified record is displayed.
- If a selection error occurred, you can repeat selection with the function keys or, for individual records, with the cursor keys.
- If no selection error occurred, confirm record selection with ENTER. Consecutive selection/entry passes are possible, but only up to 20 records are transferred to the program.
- Terminate the selection phase with 'End' after record selection and transfer to the program.
- The transferred records are displayed for checking purposes.
- Enter Y or N depending on whether the wanted records have been transferred or not.  
 N Return to (a).  
 Y Continue with (b).

(b) Display: Recall of the identical points in the local system y/x (e,n)

- Proceed as described in (a).
- Take care to enter the points in the same sequence as in (a).

(c) The transformation factors o, a, Y and X shifts, scale and rotation angle are displayed. Continue with ENTER.

(d) The Y and X residuals and the standard deviation m0 are displayed.

If there are only 2 identical points, the distance difference  $ds = S(Y/X) - s(y/x)$  is displayed.

Effective function keys:

- 'Pdel' Delete points
- 'Tnew' Repeat whole transformation
- 'Padd' Add further identical points
- 'Comp' Compute the transformation parameters again, e. g. after deletions
- 'End' Accept transformation results

'Pdel' key:

The residuals of the first point are displayed and a prompt appears to locate the other residuals with the cursor. Press the 'Pdel' key when you have found the residuals whose coordinates you want to delete. Terminate the delete mode with 'End'.

'Padd' key:

Select additional identical points as described in (a) both in the grid and local system. The additional points are displayed together with the original points and the question whether the proper points have been transferred appears again. Return to (c).

- (e) Prompt to store the transformation parameters or to return the the transformation menu with 'End'.  
Y: Continue with (f).  
N: Continue with (g).
- (f) Parameter storage is confirmed by briefly displaying the stored records.
- (g) Display: Recall of the non-identical points in local system y/x (e,n).  
Continue with ENTER or return to the transformation menu with 'End'.
- Proceed as in (a).
- (h) Prompt (Y/N) to perform a transformation with consideration of the weighted best fit or to return to the transformation menu with 'End'.  
Y: The residuals of the identical points are made zero. The transformed non-identical points are corrected with the weighted averages of the residuals of the identical points.  
Weight:  $p = 1/s * \text{sqr}(s)$ , where  $s$  is the distance between the identical point and the non-identical point.
- (i) The transformed points are displayed together with their addresses, point identifiers, coordinates and the corrections from the bestfitting adjustment (if selected) are displayed.
- The old point identifiers are used. The type codes (YT, YT, Z) of the coordinates indicate transformation.  
- Prompt to transform further non-identical points.  
Y: Return to (g)  
N: Return to transformation menu

### 7.6.3 Intersections of Straight Lines

The following options are available:

- 1 Two lines
- 2 Parallel lines through 2 points
- 3 Parallel lines with offset
- 4 Perpendicular Intersection
- 5 Perpendicular Intersection from 2 reference lines

- All lines must be defined by two coordinated points. If only 1 point and the bearing are available, an auxiliary point has to be computed first as a polar point (coordinate conversion program).
- Entry is facilitated by a graph of the selected intersection. This graph can be displayed at any time during entry with the 'Grph' function key.

Select one of options 1 to 5 or return to the coordinates application programs menu by entering 0 (zero).

- (a) The graph for the selected option is displayed together with the first point P1 to be selected. Continue with ENTER.
- (b) Enter the point identifier or the address of point P1 and press ENTER. Continue entry as described in the coordinate conversion program.

Effective function keys:

- 'Grph Display the graph of the selected intersection.  
Press ENTER to return to (b).
- 'End' Return to the menu for the intersections of straight lines

- (c) Enter the point identifier or the address of the next point.

- The following have to be entered:

- Option 1: 4 points: P1, P2 for line 1, P3, P4 for line 2
- Option 2: 6 points: P1 to P4 as for option 1; P11 defines the parallel to P1-P2 and P33 the parallel to P3-P4
- Option 3: 4 points: As option 1
- Option 4: 3 points: P1, P2 for line 1; the perpendicular to P1-P2 is dropped from P3
- Option 5: 6 points: P1 to P4 as for option 1; P11 defines the vertical to P1-P2 and P33 the vertical to P3-P4

- The entry sequence and the required number of points are indicated by the program.
- Several intersections can be computed with the selected option after the first line has been entered, i. e. only line 2 and other required data has to be entered.
- Terminating and returning to the line intersections menu is generally possible with 'End'.

(d) Additional entries for option 3

- Enter the offset to line 1-2 and press ENTER.
- Enter the offset to line 3-4 and press ENTER.

The distances are positive if, seen from P1 (P3) towards P2 (P4), they are on the right-hand side.

(e) The results are displayed, i. e. the coordinates of the point of intersection and the line segments between the line points and the point of intersection (where appropriate).

(f) Prompt Y/N to store the coordinates.

Y: Enter the point identifier and press ENTER.

The stored record is displayed briefly. Return to entry of line 2 and other data.

N: Return to entry of line 2 and other data.



#### 7.6.4 Intersections of Arcs

The following options are available:

- 1 Distance - Distance
- 2 Distance - Line
- 3 Distance - Parallel through a point
- 4 Distance - Parallel with offset
- 5 Distance - Perpendicular line

Enter the lines as described in the straight line intersection program.

The circles can be defined as follows:

- 0 Radius point and radius
- 1 Radius point and point on circle
- 2 Radius point, point on circle and delta radius dR
- 3 Two points on circle and radius
- 4 Two points on circle, radius and delta radius dR

The delta radius dR allows computing intersections with parallel curves to the given circles.

dR is positive if outwards seen from the radius point.  
dR is negative if inwards seen from the radius point.

Observe the following point definition and entry conventions to ensure unambiguous solutions:

- Circle definition: If 2 points on the circle are given, they have to be defined so that, seen from P11 (P21) to P12 (P22) the radius point C1 (C2) is at the right.
- Distance-distance intersection: The intersection that is to the right of the line from C1 to C2 is computed.
- Dist.-line inters.,  
Dist.-parallel inters.: That intersection is computed that, seen from the perpendicular base point (C on P1-P2), is located in the direction of P1.
- Dist.-perp. line inters.:
- C left of P1-P2: Seen from the perpendicular base point (C on perpendicular line), I is in the direction towards line P1-P2 (point F).
  - C right of P1-P2: Seen from the perpendicular base point (C on perpendicular line), I is in the direction away from line P1-P2
  - C on P1-P2: I is on the right seen from P1-P2.

Operation:

Select one of options 1 to 5 or return to the coordinates application programs menu with 0 (zero).

- (a) Define circle 1 as required.  
Define circle 2 if distance-distance intersection selected.
- (b) The graph for the selected option is displayed as well as the first point C1 to be read. Continue with ENTER.
- (c) Enter the point identifier of radius point C1 and press ENTER. Continue as described in the coordinate conversion program.

Effective function keys:

- 'Grph' Display the graph for the selected intersection.  
Press ENTER to return to (c).
- 'End' Return to arc intersections menu.

- (d) Enter the identifier of the next point or enter the radius, delta radius distance dR or line offset ol and press ENTER.
  - The entry sequence is indicated by the program in accordance with the selected option.
  - Several intersections can be computed with the selected option after the first circle has been entered, i. e. only intersection element 2 has to be entered.
  - Terminating and returning to the arc intersections menu is generally possible with 'End'.
- (e) The results are displayed, i. e. the coordinates of the point of intersection, radii, distance between the radius points, line segments etc. depending on the selected option.
- (f) Prompt Y/N to store the coordinates of the point of intersection.
  - Y: Enter the point identifier and press ENTER.  
The stored record is displayed briefly. Return to entry of the 2nd intersection element (circle 2, line etc.).
  - N: Return to entry of second intersection element.

### 7.6.5 Area Computation

There are two options:

- 1 Area bounded by straight lines
- 2 Area partly bounded by arcs

For option 2, the angle point coordinates must include the point of curvature (P.C.) and the point of tangency (P.T.) and the radius must be known.

Select option 1 or 2 or return to the coordinates application programs menu with 0 (zero).

(a) Display: Recall the angles points  
Right or left direction

- If you selected option 2, the angle point polygon must include the P.C. followed by the P.T.
- Continue with ENTER or return to the area computation menu with 'End'.

(b) Select the records  
as described in the transformation program.

(c) Display: Area computation result for the selected polygon, i. e.  
area in square meters (sqft) and number of angle  
points.

Effective function keys:

'Pdel' Delete angle points  
'Anew' New area (return to area computation menu)  
'Padd' Add points to angle polygon  
'Comp' Compute area again, e. g. after deletions  
'End' Area computation OK

'Pdel' function key:

Displays the address and the point identifier of the first corner and the message that the desired point can be selected with the cursor keys.

Function keys that are effective in this context:

'Del.' The displayed point is deleted completely.  
'Repl' Replace the displayed point by another one that has to be read in. Return to (a) for this purpose.  
Replacement must not be followed by deletions.  
'End' Terminate the delete function.

'Padd' function key:

- Only 1 point can be added at a time. Attempts to add several points result in point sequence errors. Another point can be added after the next area computation.
- Take care to add the point to the polygon in the chosen following direction.
- Add the point by entering the sequence number of the angle polygon point that precedes the point to be added in the following direction. The sequence number depends on the entry sequence in (b).
- Return to (a) to read in the additional point.

(c) Enter the P.C. sequence number  
Enter the P.T. sequence number

The sequence numbers depend on the entry sequence in (b).

(d) Display: P.C. and P.T. and point identifiers.

- Prompt to decide (Y/N) if the proper points have been entered.  
Y: Continue with (e)  
N: Return to (c)

(e) Enter the arc radius (corrections are possible)

(f) Display: Result of arc segment area computation, i. e. radius, chord and area.

- Prompt to decide whether the area is to be added to (P) or subtracted from (N) the total area.  
0 (zero): Recompute the arc segment area. Return to (c).

(g) Prompt (Y/N) to compute further arc segments.  
Y: Return to (c).

(h) Display: Result, i. e. total area, number of angle points, number of arc segments and area in square meters (sqft).

- Prompt (Y/N) to store the area.  
N: Return to area computation menu.

(i) Enter the area description (up to 27 characters) and press ENTER.

(j) The stored record is displayed briefly and control is returned to the area computation menu.

### 7.6.6 Curve Solution and Stationing

The curve solution menu offers the following field computation options:

- 1 Horizontal curve solution
- 2 Stationing along an arc
- 3 Stationing along a line
- 4 Stationing along a spiral
- 5 Stationing along portion of a spiral

- The results (coordinates of the arc points (1) and the stations (2 - 5) along the center-line of the chosen curve) are computed and stored.
- Options 2 to 5 offer the additional options to measure cross-sections at the stations.
- The point data can be read from the memory for setting out from a near traverse, for example.

#### 7.6.6.1 Horizontal Curve Solution

(a) Recall the known points of arc

Options:

- |                                |                            |
|--------------------------------|----------------------------|
| 1 Point of curvature (P.C.)    | 2 Point of tangency (P.T.) |
| 3 Point of intersection (P.I.) | 4 Radius point R           |

- Any combination of points 1 to 4 can be entered.
- At least 2 points must be known to enable coordination.
- If only one of points 1 to 3 is known, another point P1 located on a tangent may be entered for clarification. A prompt to do so appears automatically in step (f).
- If none of points 1 to 4 is known, only the arc geometry can be calculated. Coordinate computation is not possible in this case.

Select one of options 1 to 4 and continue with (b), or press ENTER to continue with (c), or 'End' to return to the curve solution menu.

(b) Enter the identifier of the selected point and press ENTER.

Effective function keys:

- 'Grph' Display graph and explanations. Continue with ENTER.  
'End' Return to curve solution menu

- Return to (a) and display the entered points.

(c) Curve data computation and display:

- |                  |                              |
|------------------|------------------------------|
| 1 Tangent length | 5 Chord                      |
| 2 Radius         | 6 External                   |
| 3 Arc length     | 7 Mid ordinate               |
| 4 Delta          | 8 Tangent intersection angle |

- All elements that can be derived from the known curve points are computed and displayed.
- A sensible combination of two elements is required to compute all curve data completely.
- If the arc geometry has not been computed yet, two of the above elements are required, and only one if the geometry has not yet been computed completely.
- Only angles located in the first and second quadrant (interior angles) may be entered.

Enter - the number of the known element and continue with (d), or  
 - ENTER if the arc has been computed completely and continue with (e).

Effective function keys: 'Grph' and 'End' (see (b)).

(d) Enter the known element (correction is possible) and press ENTER. Return to (c).

(e) Differentiation:   R Curve right  
                           L Curve left

- This information is required for proper computation of the unknown arc points.
- Enter the code or return to the curve solution menu with 'End'.

(f) Alternatives:

- If at least 2 arc points are known, continue with (h).
- If no point is known, a message appears that the arc cannot be coordinated. Return to the curve solution menu.
- If only 1 point of the tangent through P.C. or P.T. is known, a message appears that an additional point P1 is required on the tangent at P.C. resp. P.T.. Continue with ENTER.

Effective function keys: 'Grph' and 'End' as in (b).

- If the P.C. or the tangent intersection point P.I. is known, P1 must be located on the tangent through P.C.. If the P.T. of the arc is known, it must be on the tangent through P.T..

(g) Indicate the location of P1 as follows:

- 1 P1 lies in the direction of the tangent intersection (P.I.) as seen from P.C. (P.T.).
- 2 P1 lies in the opposite direction.

Enter 1 or 2 or 0 to return to the curve solution menu.

(h) Display: Coordinates of all arc points.

- The middle point of curve (MPOC) is computed and displayed in addition to the points listed in (a). Continue with ENTER.

Effective function keys: 'Grph' and 'End' as in (b).

- (i) Brief display: The newly computed arc points and curve data are stored.  
(only the initially unknown points)
- (j) Enter the identifier of the (next) arc point to be stored.
  - The record is displayed briefly. Continue with (j).
  - Effective function keys: 'Grph' and 'End' as in (b).
- (k) Enter the discription of the curve (up to 27 characters) and press ENTER.
  - The record is displayed briefly: Radius, arc length and the code for curve right (1) or curve left (-1).
- (l) Return to curve solution menu

#### 7.6.6.2 Stationing along an Arc

This program can be performed only if the arc points and the curve data are known and stored. If these have just been computed, the program can be started immediately.

If not, there are the following options:

- 1 Compute now
- 2 Recall the computed data
- (a) Enter 1 or 2 or 0 to return to the curve solution menu.
  - Option 1: The horizontal curve solution program is started.
  - Option 2: Continue with (b).
- (b) Enter the point identifiers of the P.C. and P.T., the radius point and the MPOC, or return to the curve solution menu with 'End'.
  - The specified points are read from the memory.
- (c) Enter the curve description, press ENTER and read the curve data, or return to the curve solution menu.
- (d) Stationing data entry
  - Enter the total distance for the P.C. in m (ft) and press ENTER. The entered distance is displayed. Confirm it with ENTER or enter it again and press ENTER.
  - Enter the stationing interval and press ENTER. Displays as above.
- (e) Prompt (Y/N) to compute cross-section points.
  - Y: 1 point each left and right of the center-line and normal thereto can be computed. Continue with (f).
  - N: Continue with (h).
- (f) Enter the distance of the left cross-section point and press ENTER or enter zero for no left point.

- (g) Enter the distance of the right cross-section point and press ENTER or enter zero for no right point.
- (h) The P.C. and its total distance are stored again.
- The total distance is stored in the additional information field in the form 12+345.123 (= 12345.123 m resp. ft).
  - Cross-section points (if selected) are assigned the same point number and station, but either an L or an R is stored in the first position of the additional information field.
- (i) Enter the point code of the 1st station and press ENTER.

Effective function keys:

'Crss' Return to (f) and (g) for cross-section modification, followed by a return to (i).

'End' Return to curve solution menu.

- (j) The station and cross-section point records are displayed and stored.

Effective function keys: 'Crss' and 'End' as above.

- The next station is computed. Continue with (j).
- The MPOC and the P.T. are also stored together with their total distance and cross-section points.

- (k) Return to the curve solution menu after the P.T. storage.

#### 7.6.6.3 Stationing along a Line

- (a) Recall the point of beginning (POB) of the line and press ENTER.
- (b) Recall the point of ending (POE) of the line and press ENTER.

Effective function keys in (a) and (b):

'?Adr' Point reading with address

'End' Return to curve solution menu

- (c) Proceed as described in Stationing along an Arc.



#### 7.6.6.4 Stationing along a Spiral

- (a) Recall the tangent spiral point (T.S.) and press ENTER.
- (b) Recall the spiral curve point (S.C.) and press ENTER.

Effective function keys in (a) and (b):

'?Adr' Point reading with address  
'End' Return to curve solution menu

- (c) Spiral data computation and display.

- 1 Parameter A
- 2 Arc length L
- 3 Radius R
- 4 Angle delta (tangent intersection)

- Enter a combination of 2 parameters.
- The other two parameters are computed and displayed.
- If the stationing direction is from the spiral curve point (S.C.) to the tangent spiral point (T.S.), parameter A must be negative.

Enter: - Number of the known element and continue with (d), or  
ENTER if all elements are known. Continue with (e).

Effective function keys:

'Dnew' Restart data entry, e. g. after errors. Return to (c).  
'End' Return to curve solution menu.

- (d) Enter the known element (correction is possible) and press ENTER. Return to (c).

- (e) Differentiation: R Curve right  
L Curve left

- as seen from the tangent spiral point (T.S.) to the spiral curve point (S.C.). This information is required for proper computation of the stations along the center-line.
- Enter the code or return to the curve solution menu with 'End'.

- (f) Proceed as described in Stationing along an Arc (7.6.6.2 as of (d)).

#### 7.6.6.5 Stationing along Portion of a Spiral

This program is similar to Stationing along a Spiral.

Particularities:

(a) and (b): The point of beginning for the portion is the curve spiral point (C.S.) with the greater radius R2.  
The point of ending is the spiral curve point (S.C.) with the smaller radius.

(c): The following parameters must be entered:

1	Parameter	A
2	Radius (large)	R1
3	Radius (small)	R2



### 7.7.3 Selection of the Coordinate System

- The coordinate system used last is displayed. Accept it with Y or reject it with N.

N: Another system is displayed. The coordinate systems are described in section 6.

### 7.7.4 Selection of the Measuring Units

- The units used last are displayed.  
Angle measurement: grad or DMS  
Distance measurement: m or ft  
Accept with Y or reject with N.

### 7.7.5 Selection of the Measuring Instrument / Manual Input

- The measuring instrument used last is displayed. Accept it with Y or reject it with N.

N: Different options are displayed:

- Elta 46R/40/42 Elta ETh/Eldi E-Series
- Elta 2/20/3 with IF2 Online Interface
- Manual input
- Eldi or ETh and manual input.

- Select the instrument

### 7.7.6 Selection of Password for Editing and Deletion

- If no password specified:

- Prompt Y/N to enter a password

Y: Enter a random string with up to 5 characters and press ENTER.

!!! Please do not forget your password !!!

- If password specified:

- Prompt Y/N to change the password

Y: Enter the existing password and press ENTER. Enter the new password or delete the old password with ENTER.

## 8. REC 500 V.24/RS 232 Interface

The REC 500 data transfer program offers two standard input/output routines for interchanging data with non-intelligent peripherals such as printers or cassette recorders or with intelligent units such as computers over the interface. Data transfer with non-intelligent units is synchronized by interface control lines and with intelligent units by software interaction.

Standard interface cable 708177-9010 is available from Carl Zeiss for connecting peripheral units to the REC 500.

The interfacing cost for units not using the Zeiss standards will have to be charged.

### Control lines

The RTS, CTS and DTR lines are used for control using the pin assignment shown below.

Pin	Signal	In/Out	Meaning
1	PC	-	Protective ground
2	TD	Out	Transmitted data
3	RD	In	Received data
4	RTS	Out	RTS = 1: REC 500 ready to receive RTS = 0: REC 500 not ready
5	CTS	In	CTS = 1: Peripheral ready to receive CTS = 0: Peripheral not ready
7	CC	-	Ground
20	DTR	Out	DTR = 1: Transfer mode selected DTR = 0: Transfer mode not selected

Non-connected lines are in the 1 state for the REC 500, i. e. data is put out also if no cable is connected. This means that at least the TD, CTS and CC lines have to be used if a printer is connected.

END CR LF is transferred at the end of transmission.

### Software control

The RTS, CTS and DTR control lines are not used. The above pin assignment table applies in all other respects.

Data transfer is controlled by software using the following control words:

A CR LF = Request to send  
B CR LF = Ready to receive  
Z CR LF = End of transmission

The records are also terminated with CR and LF.

Data transfer from the REC 500 to the unit

Software dialog:

REC 500: A CR LF            DATA CR LF            DATA CR LF            Z CR LF

Computer:            B CR LF            B CR LF            B CR LF \*)

\*) If the computer wants to terminate data transfer, e. g. because the buffer is full, it should transmit Z CR LF.

Data transfer from the unit to the REC 500

Software dialog:

REC 500:            B CR LF            B CR LF            B CR LF \*\*)

Computer: A CR LF            DATA CR LF            DATA CR LF            Z CR LF

\*\* ) If the REC 500 cannot accept any more data, e. g. because the memory is full, it should transmit Z CR LF instead.

General

The baud rate (75 to 4800) and the parity (odd, even, none) can be set for both standard data transfer routines by means of a menu.

The number of bits per byte can be set to either  
7 bits + even or odd parity bit or to  
8 bits without parity bit.

## 9. REC 500 Standard Record Content and Format

The records stored in the REC 500 have the following content:

L	Blank	1 position
ADR	Address	4 positions, numeric; consecutive record number
P	Point ID	27 positions, alphanumeric, point code C and additional information I
T1	Type code 1st value	2 positions, alphanumeric, e. g. D = slope distance, E = horizontal distance, Y = coordinate
W1	1st value	12 positions, numeric
T2	Type code 2nd value	2 positions, alphanumeric, e. g. Hz = horizontal distance, X = coordinate
W2	2nd value	13 positions, numeric
T3	Type code 3rd value	2 positions, alphanumeric, e. g. V = zenith angle, Z = coordinate
W3	3rd value	9 positions, numeric
CR	CARRIAGE RETURN	Control character
LF	LINE FEED	Control character

### REC 500 Standard Record Format

Content	:	L	ADR	L	P=C+I	L	T1	W1	L	T2	W2	L	T3	W3	CR	LF
Positions:		3	4	1	27	1	2	12	1	2	13	1	2	9	1	1

#### Example:

Position:	1	.	10	20	30	40	50	
	:		:	:	:	:	:	
Fields:	<-->	<--->	----->				<-->	<----->
Example:		1122	12345678901234	ASDFGHJKLZ	XCV D		2500.941	
Blanks:	LLL	L				L		
Content:		ADDR	Code C		Add. Infor. I	T1	Distance	

Position:	50	60	70	80
	:	:	:	:
Fields:	<-->	----->		<-->
Example:	Hz	256.5224	V1	102.1234
Blanks:	L		L	xy
Content:	T2	Hor.Direct.	T3	Zen.Ang.

x=CR, y=LF



REC 500: Hardware-Modification since September 1988

Since 15.09.88 REC 500 is delivered in a slightly modified hardware. There are some differences to the previous model

- \* Larger screen  
The number of lines (8) and the number characters per line (40) is identical.
- \* The color of characters is blue, the color of the screen is grey, the characters are larger.
- \* The humidity indicator is in the left upper corner.

The REC 500 is delivered with a BACKLIGHT for the screen.

The backlight can be switched on and off for a moment or permanently.

Switching on for a moment is done by pressing simultaneously CTR/FN and SHIFT. After releasing both buttons backlight is off again.

Switching on permanently is done by pressing simultaneously CTR/FN and SPACE. Pressing these buttons again will switch off the backlight.

WARNING: The backlight cannot be seen in normal daylight. To reduce power consumption switch on the backlight only in bad daylight. Be also sure to switch off the backlight before switching off the REC 500.