Geotracer® GPS and GLONASS receivers

L1/L2 User Manual - 2

ver. 1.04c Part. No. 571 701 161

RADIO FREQUENCY INTERFERENCE

This equipment generates and uses radio frequency energy but may not cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B digital device in accordance with the specification in Subpart J of Part 15 FCC Rules and the EMC directive as stated in 89/336/EEC, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by switching the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures.

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

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commisions helpful: 'How To Identify And Resolve Radio-TV Interference Problems'.
This booklet is available from the US Government Printing Office, Washington, DC 20402, Stock No. 004-000-00345-4.

Modifications resulting from technical developments may be in the interest of our customers. Illustrations and specifications are therefore not binding, and are subject to change without prior notice.

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3rd EDITION

Printed in Sweden 06.98 Publ.No. 571 701 161, Larserics DIGITAL PRINT AB.

Chapter 10.

Programming the System

10.1 Data Interfaces

10.1.1 Data Export to Job Files

The Geotracer® RTK System offers the opportunity to store the results in job files with name `*.JOB`. Results are automatically written to the `*.JOB` files in a simple structure defined by a label system.

The structure of a job file is defined by the label system. This allows you to control its contents very easily. In a simple case the file would look like the following example.

2=REFERENCE	Reference station
110=4185261.959	WGS84 Coordinate X [m]
111=868327.996	WGS84 Coordinate Y [m]
112=4719089.073	WGS84 Coordinate Z [m]
5=1000	Point number
110=4185268.737	WGS84 Coordinate X [m]
111=868321.004	WGS84 Coordinate Y [m]
112=4719089.754	WGS84 Coordinate Z [m]
5=1001	Point number
110=4185265.121	WGS84 Coordinate X [m]
111=868325.765	WGS84 Coordinate Y [m]
112=4719089.835	WGS84 Coordinate Z [m]
...	

Label defined structure of job (and area) files

The first number in each line is the label ID followed by the information this label provides. The meaning of all labels used by the Geotracer® RTK System is listed in the following chapter 10.2.

Of course you may store more than WGS84 coordinates. You can use of the following point information to represent the point position:

Point information

- Horizontal angle, Vertical angle and Slope distance (Labels 7, 8, 9)
- National Grid Coordinates (N, E, Ele) (Labels 37, 38, 39)
- WGS84 Coordinates (X, Y, Z) (Labels 110, 111, 112)
- Ellipsoidal coordinates within the national grid datum (Latitude, Longitude, Height) (Labels 113, 114, 137)
- •) Relative N, E coordinate and vertical distance (Labels 47, 48, 49)
- •) Baseline components in x, y, z [m] (Labels 120, 121, 122)

or all other labels mentioned in chapter 10.2.

The last two sets cannot be used before the reference station position is known exactly. Therefore note:

Relative coordinates and distances or baseline components are not allowed for reference station position initialization.

Reference station information always at the beginning

To simplify processing and network adjustment with Geotracer® GPS a `*.JOB` file created by the RTK system contains information on the reference station at the beginning. The results of the determined points follow.

You may, of course, store more information for each point.

Use U.D.S. to create a job file according to your special needs!

The kind of information stored in a job file is controlled by User Defined Sequences (U.D.S.). A default U.D.S. is part of the RTK software. You may, however, create your own U.D.S. as an `*.UDS` file (see chapter 10.2) using the easily to manage Geotronics system of labels and label types.

A typical `*.JOB` file may look as follows:

A typical job file

2=reference	Station number = Reference
51=03-10-95	Date
52=13:38:15	Time
23=1400	Units used
110=4185261.959	WGS84 coordinate X
111=868327.996	WGS84 coordinate Y
112=4719089.073	WGS84 coordinate Z
37=5320489.865	Northing coordinate
38=479297.498	Easting coordinate
39=703.628	Elevation coordinate
5=1	**New Point**: Station number
37=5320491.148	.
38=479284.123	.
39=703.372	.
47=1.283	Relative North coordinate
48=-13.375	Relative East coordinate
49=-0.256	Vertical distance
120=1.652	Baseline component in x
121=-13.323	Baseline component in y
122=0.635	Baseline component in z
138=0.0000239427176583	Elements of variance/
139=0.0000076238064381	covariance matrix
140=0.0000148327480290	"
141=0.0000189936490934	"
142=0.0000101352123581	"
143=0.0000362934342069	"
4=1	Point code
0=Lamp post	Point info
6=1.500	Signal height
118=7	No. of sat. at both stations
115=2.12	PDOP
132=2.00	Time span of measurement

5=1	**New Point:** same point again!
37=5320491.147	.
38=479284.125	.
39=703.369	.
47=1.283	.
48=-13.374	.
49=-0.259	.
120=1.650	.
121=-13.322	.
122=0.633	.
138=0.0000239037751034	.
139=0.0000076645015711	.
140=0.0000148944782960	.
141=0.0000189152282543	.
142=0.0000101874547272	.
143=0.0000361639089006	.
4=1	.
0=Lamp post	.
6=1.500	.
118=7	.
115=2.12	.
132=2.00	.
5=1	**New Point**: same point again!
99=MEAN	Weighted Mean: The RTK system
37=5320491.148	automatically computes
38=479284.124	the weighted mean of
39=703.371	all measurements of the
47=1.283	same point!
48=-13.374	.
49=-0.257	.
120=1.651	.
121=-13.323	.
122=0.634	.
138=0.0000007490217054	.
139=0.0000002393338729	.
140=0.0000004653707310	.
141=0.0000005934486343	.
142=0.0000003181454132	.
143=0.0000011342935762	.
4=	.
0=	.
6=1.500	.
118=7	.
115=2.12	.
132=2.00	.
...	

10.1.2 Data Import to RTK from Area or Job Files

When initializing or staking out, you may want to use previously stored or processed points. Files in the Geotronics format and with the extension `*.ARE` or `*.JOB` can be read automatically by the system.

No reference station information necessary

In principle, job and area files have the same structure. However, the reference station position information is not necessary in an area file.

The minimum information an area file must contain are point number and point information in the chosen coordinate system. In this case the file would look like the following example.

5=1000	Point number
110=4185268.737	WGS84 Coordinate X [m]
111=868321.004	WGS84 Coordinate Y [m]
112=4719089.754	WGS84 Coordinate Z [m]
5=1001	Point number
110=4185265.121	WGS84 Coordinate X [m]
111=868325.765	WGS84 Coordinate Y [m]
112=4719089.835	WGS84 Coordinate Z [m]
...	

Of course, a lot more information for each point may be stored in the file.

Use the labels listed in chapter 10.2.1 to format your area files! Otherwise the Geotracer® RTK system can not identify the point information.

10.2 Programming the System

The Geotracer® 2000 RTK System is completely programmable with User Defined program Sequences (U.D.S.).

A default U.D.S. is implemented in the program, but you may replace it with your own `*.UDS` files. This offers you the opportunity to instruct the Geotracer® 2000 RTK System to carry out the survey and store data exactly the way you want. All the information you need - but not more - is sampled and displayed according to your User Defined Sequences.

If your needs change - simply create a new U.D.S.!

Creating a U.D.S. as an `*.UDS` file is very easy. You may
- use your own PC at the office and upload the file to the ACU (see Appendix A) or
- create a file directly on the handheld computer using the alphanumeric keys and an ASCII editor running under MSDOS.

A `*.UDS` file consists of an unlimited number of lines, which all have the same structure. An equal sign separates the label type on the left side from the label on the right part of the line. An example of a line is:

label type → `5=79` ← label

Labels are used to denote various types of data within the Geotracer® or Geodimeter systems. Sometimes the data is the result of measurement, or point positioning, sometimes it is keyed in survey point code information, sometimes it is information the system provides, such as number of satellites. Inside a U.D.S, a label type is assigned for each label, which, e.g., could be an instruction to duplicate a value, auto-increment a point number, or repeat a sequence.

Your choice of labels will be more easily understood when you start to create your own U.D.S. Your mapping system may dictate the choice of U.D.S .

10.2.1 Usage of Labels

Available labels in file LABEL.INI

The following table gives a complete list of all available labels. They are stored in the file `LABEL.INI` of your ACU.

No.	Text	Description
0	Info	Information
2	Stn	Station No
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
15	Area	Area file
23	Units	Status of unit set
26	SVA	Setting out vertical angle
27	SHA	Setting out horizontal angle
28	SHD	Setting out horizontal distance
29	SHT	Setting out height
37	N	Northing coordinates
38	E	Easting coordinates
39	ELE	Elevation coordinates
40	dN	Relative to stored X (N) coord of set out point
41	dE	Relative to stored Y (E) coord of set out point
42	dELE	Rel. to stored Z (ELE) coord of set out point
47	Nr	Rel. North Coord.
48	Er	Rel. East Coord.
49	VD	Vertical distance
50	JOB No	Job No file for storage of raw and calculated data.
51	Date	Date
52	Time	Time
53	Operat	Operator identification
54	Proj	Project identification

No.	Text	Description
55	Instno	Instrument Number
58	EA Rad	Earth Radius
67	SON	Northing Coordinate of setting out point
68	SOE	Easting Coordinate of setting out point
69	SHT	Elevation of setting out point
72	Radofs	Calculated Radial offset dimension in setting out program - orientated to reference station
73	RT.ofs	Calculated Right angle offset dimension in setting out program - orientated to ref.stat.
75	dHT	Difference between ELE and SHT
76	dHD	Diff. between setting out distance and measured distance
77	dHA	Diff. betw. setting out bearing and the present instr. pointing
99		comment
110	WGS84X	WGS84 Coordinate X [m]
111	WGS84Y	WGS84 Coordinate Y [m]
112	WGS84Z	WGS84 Coordinate Z [m]
113	Lat	Latitude [degrees]
114	Long	Longitude [degrees]
115	PDOP	PDOP
116	RefSAt	No. of Satellites at Reference station
117	RovSat	No. of Satellites at Rover
118	NumSat	No. of Satellites at both stations
119	C/F	Cut/Fill for staking out
120	dx	Baseline component in x [m]
121	dy	Baseline component in y [m]
122	dz	Baseline component in z [m]
129	Sdev	Standard deviation of 3D Pos [m]
130	VerNum	Software Version No.
131	CtrlUn	Serial No.
132	TimSpn	Time Span of observations [seconds]
133	Radofs	Calculated Radial offset dimension in setting out program - user defined direction
134	RT.ofs	Calculated Right angle offset dimension in setting out program - user defined direction

No.	Text	Description
135	N-offs	N offset for file handling
136	E-offs	E offset for file handling
137	Ele	Height above national grid ellipsoid
138	Cov1,1	Element of variance/covariance matrix
139	Cov2,1	Element of variance/covariance matrix
140	Cov2,2	Element of variance/covariance matrix
141	Cov3,1	Element of variance/covariance matrix
142	Cov3,2	Element of variance/covariance matrix
143	Cov3,3	Element of variance/covariance matrix
144	Week	GPS week
145	Sec	GPS second
146	Crc	Cyclic redundancy check

The text displayed can be changed, but the meaning of it can not be changed. Please consider the length of the text, which must not exceed 6 digits.

Using labels not listed

In addition, you may use labels, that are not mentioned in the file `LABEL.INI`. You may define a new label in your `LABEL.LAB` or `*.UDS` file, entering a number, that does not exist in `LABEL.INI`. That label will automatically be of the ASCII - type. When measuring or staking out, the new label will be displayed and registered as `Labxxx`, where xxx stands for a number less or equal 150, e.g., `Lab21`. These user-defined labels allow you to define standard comments, that you can use repeatedly.

User defined LABEL.LAB file: labels for display

The labels in the file `LABEL.LAB` on your ACU are used for display during system operation. You may change the `LABEL.LAB` file and configure your RTK system for your individual needs. The `LABEL.LAB` file contains a block of labels to be displayed during kinematic movements (normal display), during stake out movements and stake out measurements. The block of labels for stake out measurements also controls the labels stored in your job file when staking out. The labels are given in blocks which have headers indicated by "#" in the first column. An example is given in the following figure.

```
#KINEMATIC
37
38
39
47
48
49
7
8
9
11
10
110
111
112
120
121
122
113
114
39
116
117
129
```

```
#Staking out
133
134
75
5
119
129
40
41
42
67
68
69
75
76
77
27
28
29

#Measure Staking out
133
134
75
5
72
73
40
41
42
4
76
129
```

Please note that each line of a block contains a number for the desired label. The first labels will be displayed first. Depending on the setting in the parameter menu 3 or 6 labels may be displayed simultaneously (see chapter 7, line `Num lab`). Use the **PG↓** or PG↑ key to page through the block of labels.

10.2.2 Usage of User Defined Sequences (U.D.S.)

U.D.S. allow to register and duplicate measurement, coding and administrative data according to your needs

U.D.S. must be stored in directory RTK/ USERPROG !

U.D.S. allow you to create own User Defined Sequences for the registration and display of measurement, coding and administrative data. They are stored in `*.UDS` files.

You may create `*.UDS` files on an external device and transfer them via the serial port to the ACU. They must be stored in directory `RTK\USERPROG`.

What advantages can be gained with U.D.S.?

- It is possible to store different U.D.S.´s in the instrument. The number of U.D.S. is limited only by the available card memory.
- Measurement status is always under complete operator control with the help of the automatic display of program prompts in the instrument.
- All labels and values can be duplicated or incremented automatically. This means that the values of the labels can be stored on a PCMCIA card without even seeing them in the display and without the need to press the **YES** key for duplicating and incrementing.

U.D.S. Generating

ASCII editor necessary

Each line contains a single U.D.S.

The U.D.S. sequence must be generated with an ASCII editor as `*.UDS` file. Different U.D.S. labels are used to control, display and store Geotracer® results. Each line of the file has to contain a single Geotracer® label text. An example is shown below.

```
4=5
3=4
3=0
3=6
0=115
0=40
0=41
0=42
0=110
0=111
0=112
5=79
```

The part left of the equals sign - the label type - determines the function of the label, which is the part on the right side.

In this example the last line 5=79 stands for a repeat loop, i.e., the U.D.S. restarts at line 4=5.

A description of all labels is given in the previous chapter 10.2.1. On the next page follows a list of the U.D.S. label types.

Label Types

The label type determines the function of the label.

No	Label Type	Description
0	**Registration**	Collect values directly from the receiver.
1	**Prompting label**	Enter data manually.
2	**Set** *	Set values directly in the receiver without storing.
3	**Duplicating**	Use the value of the last measurement that is already stored
4	**Incrementing**	Increment the previously stored value automatically.
5	**Loop/repeat END** *	Return the U.D.S. to the first program step.
6	**Single Program END** *	End the U.D.S.
7	**Link Program END** *	End the present U.D.S. and start another U.D.S.
8	**View label** *	View a value without storing.
10	**Logon** *	Choose job file name

*** Can not be stored**

Description of label types

Description of Label Types

0 - Register
Register raw and/or calculated values from the Geotracer®. Choose this type of label when measured and calculated values can be collected directly from the Geotracer®, e.g. HA, VA, SD, N, E, ELE, HD, VD.

1 - Prompting label
Enter data manually after the prompt. The default value of the label will not be displayed. Without entry the RTK system will not go on.

2 - Set
These pre-set values, e.g. Label 50 = job file name, can be set directly in the instrument.

3 - Duplicating
This label type is used for displaying both the prompt and the last registered value (e.g. SH=0.75). This value can be changed by overwriting or accepted by pressing YES.

4 - Incrementing
The previously stored value belonging to the same label, e.g. Pno=3, is automatically incremented and can be accepted and stored. Displayed values can be overwritten and/or accepted.

5 - Loop/repeat END
Choice of this label type will automatically return the U.D.S. to the first program step after registration of the last data items in the measurement sequence.

6 - Single Program END
Choice of this label type will return the U.D.S. to the mode selection menu after registration of the last data items in the measurement sequence.

7 - Link Program END

Choice of this label type will end the present U.D.S. and start another U.D.S. of your choice, allowing the field operation to be registered as one complete sequence. Type the name of the next U.D.S. as file name without extension.

8 - View Label

This label type is used when you wish to look at certain values. The label will not be stored to the PCMCIA card.

10 - Logon

Choose a job file you want to store the data in when you make a registration.

Default U.D.S.

The default U.D.S. is implemented in the RTK system. It allows the input of information on point number, point code, point information and instrument height. It has the following structure:

0=37	North
0=38	East
0=39	Elevation
0=47	Relative North with respect to reference station
0=48	Relative East with respect to reference station
0=49	Relative Elevation with respect to reference station
0=120	Baseline component X (WGS84)
0=121	Baseline component Y (WGS84)
0=122	Baseline component Z (WGS84)
0=138	Covariance matrix element (1,1) of baseline
0=139	Covariance matrix element (1,2) of baseline
0=140	Covariance matrix element (2,2) of baseline
0=141	Covariance matrix element (1,3) of baseline
0=142	Covariance matrix element (2,3) of baseline
0=143	Covariance matrix element (3,3) of baseline
0=118	Satellites tracked
0=115	PDOP
0=132	Time span of static measurement [seconds]
0=129	Standard deviation of three-dimensional position
4=5	Point number (increment)
3=4	Point code (duplicate)
3=0	Point info (duplicate)
3=6	Signal height (duplicate)
5=79	Repeat sequence

In the default U.D.S. you will enter point code information after the measurement is complete. All lines starting with `0=` instruct the system to register data according to the labels. The default U.D.S. stores North, East, Elevation absolute and relative components for each point, baseline components in WGS84 with associated covariance matrix. Also number of satellites tracked (118), the PDOP (115), the time span of measurement in seconds (132) and the standard deviation will be stored. Displayed and prompted labels (label type 3) are point code (4), point info (0) and signal height (6). Point number (5) will be incremented, displayed and prompted (label type 4). The last line `5=79` instructs the system to repeat the sequence. The next point will be measured.

Examples of U.D.S.

In the following we will compare several U.D.S. First example: file `TOPO.UDS`

```
4=5
3=4
0=37
0=38
0=39
0=7
0=8
0=9
0=10
0=11
0=47
0=48
0=49
0=115
0=116
0=117
5=79
```

File `TOPO.UDS` instructs the program to increment the Point Number(4=5), to duplicate the Point Code and to collect data (0=) for Northing, Easting, Elevation coordinates (37, 38, 39), for horizontal and vertical angle and slope distance (7,8,9), for the vertical distance (instrument height and signal height not included, 10), for the horizontal distance (11), for relative north, east coordinates and vertical distance (47,48,49), for PDOP (115), as well as for the number of Satellites at Reference Station (116) and Rover (117). Finally the RTK system is instructed to loop to the beginning of the file.

Another example:

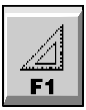
Compare the following two `*.UDS` files called `PO-FIRST.UDS` and `PO-LAST.UDS`. The labels and label types are completely the same, only the succession differs:

PO-FIRST.UDS	PO-LAST.UDS
4=5	0=37
3=0	0=38
3=4	0=39
3=6	0=110
0=37	0=111
0=38	0=112
0=39	4=6
0=110	3=0
0=111	3=4
0=112	3=6
5=79	5=79

In both cases the Northing, Easting and Elevation coordinates as well as WGS84 coordinates will be collected from the receiver (0=...). The Point Number will be incremented automatically (4=5), and values for Point Info (3=0), Point Code (3=4) and Signal Height (3=6) will be duplicated automatically. You are allowed to make changes and an entry is not necessary. The files end with the command to loop to the first step (5=79).

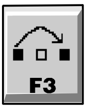
But: the sequence of the files differs.

If you use `PO-FIRST.UDS` the first display when entering the RTK surveying or stake out mode will be the following:



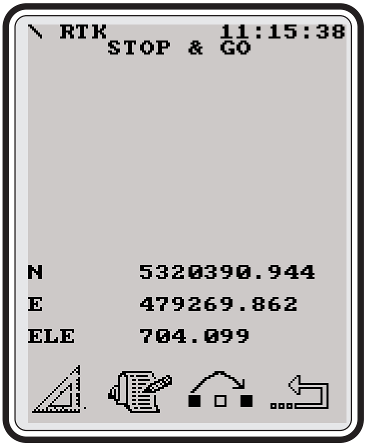
You may now enter the information asked for and go on measuring. When measurement has finished, the same display reappears, with the only difference, that the point coordinates displayed in the lower part of the screen do not change any more. They are measurement results.

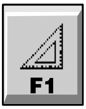
If you register now, the next display will have the point number increased by 1 and constantly updating point coordinates again. You may change the point infomation values.



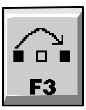
If you skip the measurement instead of storing, the point number will stay the same. Coordinate values are updating again.

If you use PO-LAST.UDS the first display when entering the RTK mode will be slightly different:





Point coordinates are changing. You can not enter point information until you have measured the point. Press F1 to measure and now the display for point information pops up.



Now you may enter Point Number, Point Info, Code or Signal Height. As soon as you register the measurement or skip it the "blank" display will show up again.
Note: It depends on your preferences alone, which kind of succession you choose.

Another example:

You may have stored the following two files:

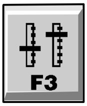
USER.UDS	TOPO.UDS
10=79	4=5
1=53	3=4
3=51	0=37
3=52	0=38
7=topo	0=39
	0=7
	0=8
	0=9
	0=10
	0=11
	0=47
	0=48
	0=49
	0=115
	0=116
	0=117
	5=79

F3

Go to the parameter settings menu(F3) and install `USER.UDS` in line `UDS`. `USER.UDS` is the current `*.UDS` file now. When first entering the RTK mode a display will pop up asking for the name of the job file to store in data (10=79). The next display asks for the name of the operator (1=53). **Since the label type is 1 you must provide a name**! Date and Time of the following measurements are not obligatory (3=52, 3=51). The last sequence `7=` instructs the RTK system to use file `TOPO.UDS` in the following measurements until the first time you leave the surveying or stake out mode (F4). If you reenter, `USER.UDS` is the valid `*.UDS` file again. You may enter a new or the same jobfile, operator´s name and so on.

F4

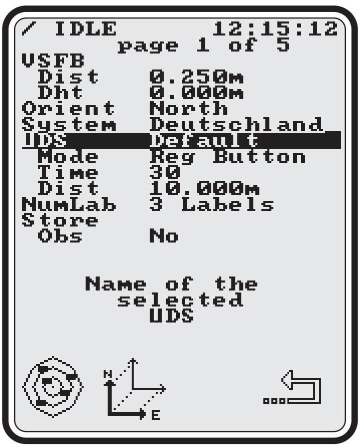
Requesting an *.UDS File



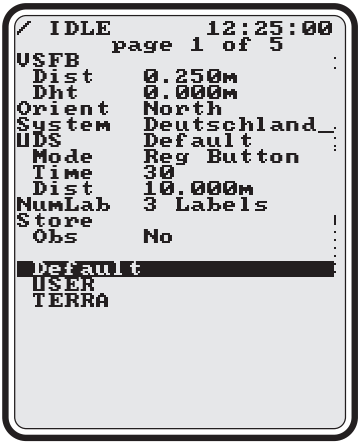
If you have generated your own U.D.S. and want to use it, you should select it from the parameter menu. In most displays it is possible to press function key **F3** . If not, you can use at any time the hotkey combination **Shift** + **P**.

*Change *.UDS file in line UDS of Parameter Settings Menu*

The Parameter Settings Menu pops up. Use the **▼** arrow to highlight the line UDS and accept with **YES**.



Now a list of all available (i.e., stored in directory `RTK/USERPROG`) U.D.S.´s is displayed and you may choose the one you need. Move the highlight to the name of your `*.UDS` file and press the **YES** button.



Even easier is the direct access to the list of `*.UDS` files using the hot key combination Shift + U at any time.

In lines `Mode`, `Time` and `Dist` you may define when your U.D.S. shall be used and, if in automatical storing mode, what time and/or distance intervals have to elapse before the next measuring event takes place (see chapter 5.2).

10.3 Serial Data Output

You may want to send the survey results to a serial port. This may be done instead of storing to a job file or simultaneously with storage to a job, or only as a continuous output.

If you want to use serial output, two requirements have to be fulfilled. You have to define the structure of the data that will be output and you have to set the necessary parameters in the parameter menu, pages 4 to 5.

10.3.1 Structure of Serial Output Data

The structure of your serial output data is defined via output tables. These are similar to the User Defined program Sequences, but in contrast to them you only have to define which labels shall be sent to the serial port.

The output tables are stored in a `*.OUT` file. You may create as many `*.OUT` files as you need, store them in directory `RTK/USERPROG` and select one of them in the parameter menu.

Default serial output setting

A simple `*.OUT` file (which at the same time is the default serial output setting) may look as follows:

7	Horizontal angle
8	Vertical angle
9	Slope distance

Another `*.OUT` file may look as follows:

5	(Point Number)
37	(Northing)
38	(Easting)
39	(Elevation)

Labels for registration of U.D.S.

Additionally, you may use the labels of the current U.D.S. as selected in the parameter menu, page 1, line `U.D.S.` If one of these U.D.S.s is selected, only labels to be stored will be considered. Please refer to chapter 10.2 for more information on programming U.D.S.

Structure of output

What will be sent to the serial port?

- A status value precedes the measured data.
- Measured data follow.
- The serial output may contain a cyclic redundancy check (CRC).
- The last value of the serial output settings can be the ASCII text character number assigned to label 79.

•) The **status value** is a numeric character sent before the measured data.

0: System operating correctly, all required data available. Either RTK solution has been found and is being used, or DGPS mode has been selected.

4: Measurement is invalid (the measurement has failed to reach the accuracy required, because of, e.g., bad PDOP or not enough satellites).

•) The **measured data** follow according to the serial output settings. You may choose which format shall be used for output (see chapter 7, line `Serial output Format`). Following formats are selectable (the default table is used here):

RG (Read Geotracer) will generate a response of

0	(Status)
7=123.1212	(Horizontal angle)
8=89.1212	(Vertical angle)
9=123.456	(Slope distance)
>	(End of table)

RGN will generate a response of

0	(Status)
HA=123.1212	(Horizontal angle)
VA=89.1212	(Vertical angle)
SD=123.456	(Slope distance)
>	(End of table)

RGD will generate a response of

0	(Status)
123.1212	(Horizontal angle)
89.1212	(Vertical angle)
123.456	(Slope distance)
>	(End of table)

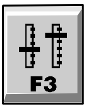
RGV will generate a response of

0	(Status)
7	
123.1212	(Horizontal angle)
8	
89.1212	(Vertical angle)
9	
123.456	(Slope distance)
>	(End of table)

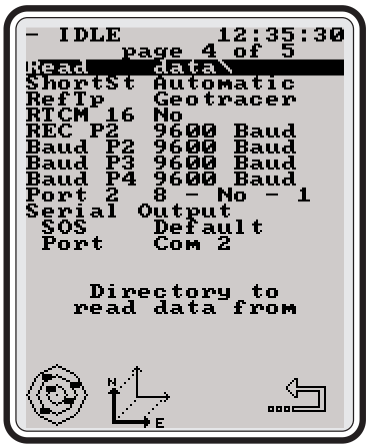
•) To check possible problems with data transmission, the system offers the opportunity to add a **cyclic redundancy check** (CRC) to the output sequence. Thisis done by adding label 146 to your `*.OUT` file. The system will then compute a cyclic redundancy check value, started with the status up to the line before the CRC.

•) Each data measurement could be finished with an end of sequence character stored in **label 79** as an ASCII value. If label 79 is set to 0, no end of sequence message will be sent. As default, the label is set to ASCII 62 (>).
You may set labels using the hot key combination [Shift] + [L] (see App. B.3).

10.3.2 Set Parameters to Send Serial Output Data

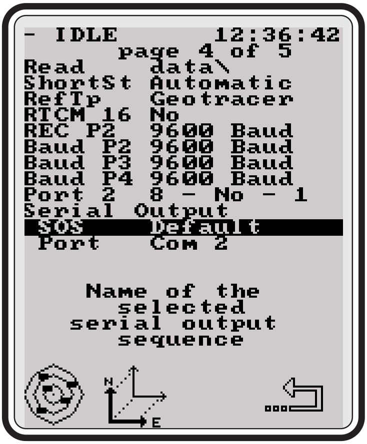


If you want the PC or your ACU to send data to the serial port, you have to set several parameters which are located together in the parameter menu. They are found on pages 4 and 5 under the header `Serial Output`. Press [F3] if available or [Shift] + [P] and move to page 4 using [4] or the [PG ↓] and [PG ↑] arrow keys.



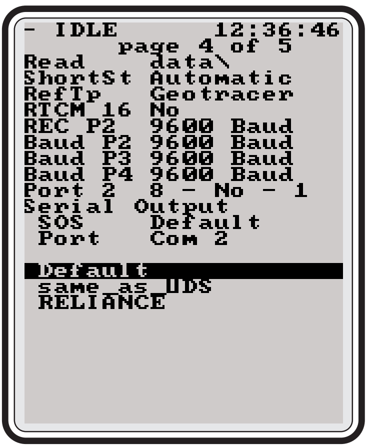
SOS

Using the ▼ and ▲ arrow keys highlight the line `SOS` (Serial Output Sequences) below `Serial Output`.



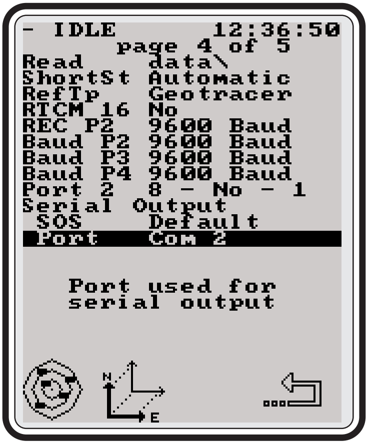
Here you may choose, whether you want to use

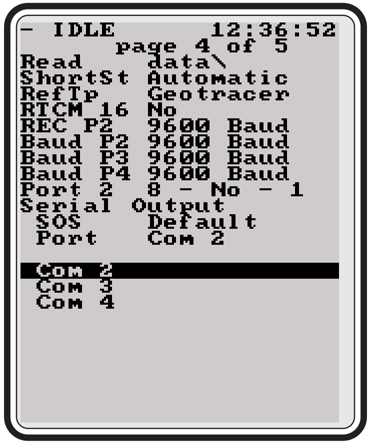
- the labels from the default serial output setting,
- the labels from the current U.D.S. , or
- the labels according to one of your `*.OUT` files, stored in directory RTK/USERPROG.



`Port`

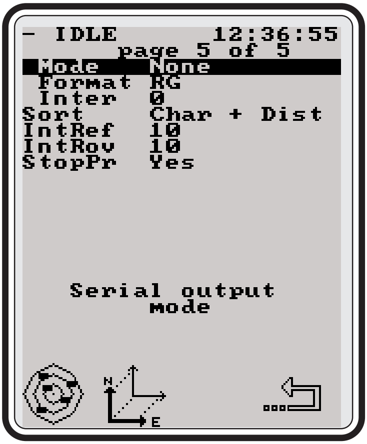
Next, choose the port to which the data is to be sent in the line `Port`. The program offers you a list of all ports available.

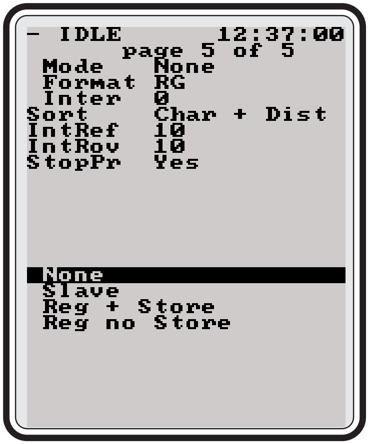




Mode

Line Mode allows to set the output mode, whether and when to send data to the serial port. Four modes are available:

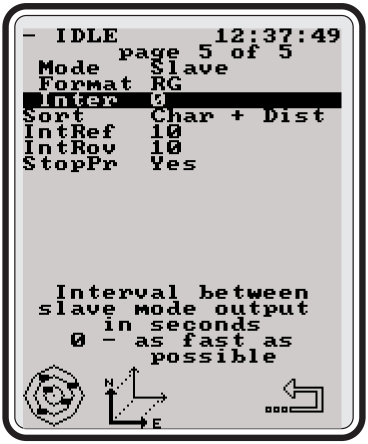


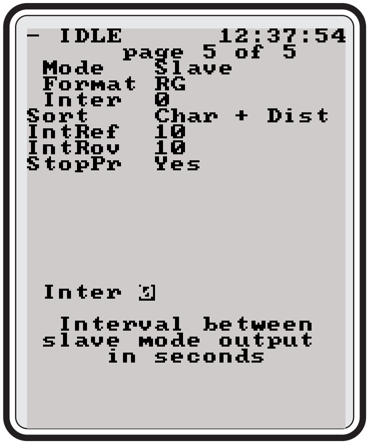


None	No serial output. Default mode.
Slave	Serial output at predefined time intervals, which can be every epoch or determined using the parameter Inter.
Reg + Store	Serial output each time measurements will be registered automatically or manually. Additionally, the measurements will be written to a job file.
Reg no Store	Serial output each time measurements will be registered automatically or manually. No entry into a job file.

`Inter`

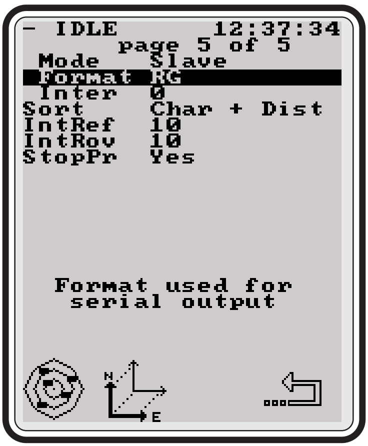
If you have chosen the slave mode, you may decide how often measurement data shall be sent. The default value is 0, which defines that output shall be sent as fast as possible, depending on the type of receiver and its update rate. Move the highlight to the line `Inter` , if you want to change the time interval between two measurement transfers.

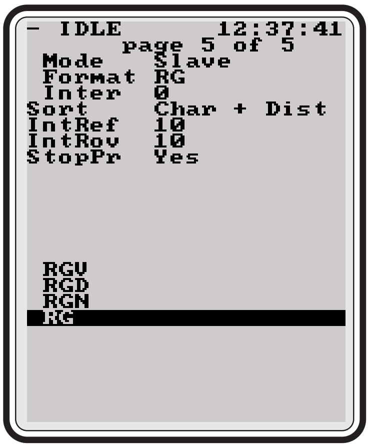




`Format`

The format (see chapter 10.3.1) of the resulting data flow is selected in the line `Format`.





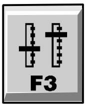
10.3.3 Examples of Serial Output Configurations

The following are some examples of serial output configurations.

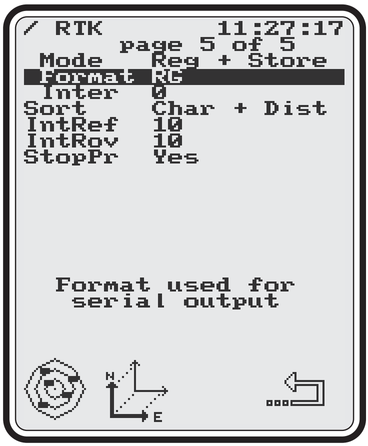
Example 1

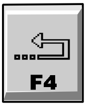
First example:

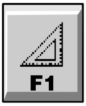
You want to use the system Serial Output Setting, send data in RG format to port 2 with a baud rate of 9600 baud. Data should be sent only if data is registered (manually or automatically) to a job file. Therefore, the value at line `Inter` is of no interest.



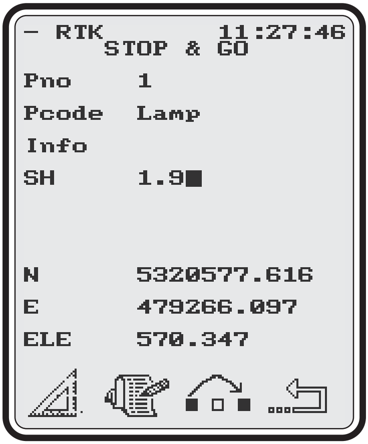
Pages 4 and 5 of the parameter menu should be set as in the following example:







Leaving the parameter menu with F4, measuring with F1 and entering the values for Pcode and SH will forward the following display:

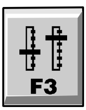


Now, you may register with F2 . At the same time, the following will be sent to port 2 of your ACU:

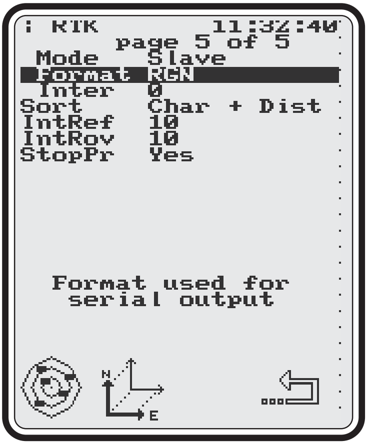
```
0
7=159.1608
8=94.1719
9=25.005
>
```

You may now repeat measuring and registering.

Example 2



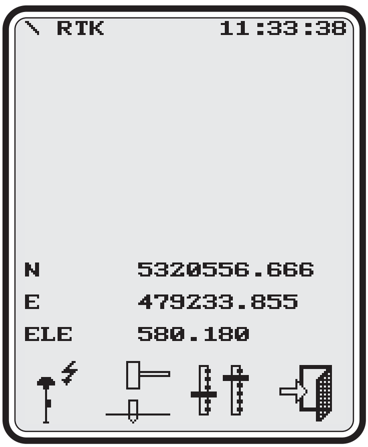
The second example lets the system send data automatically to port 2 as fast as possible. The baud rate for Port 2 is raised to 19 200 baud and the format changed to RGN. Data are sent according to a `*.OUT` file called `SLAVE.OUT` .



`SLAVE.OUT` contains the following labels:

```
145
37
38
39
146
```

As soon as you leave the parameter menu, you will be shown the following display, depending on your LABEL.LAB.

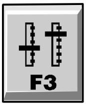


The device connected to port 2 of your ACU will receive data of the following kind:

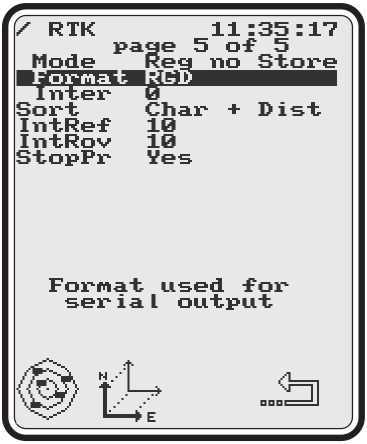
```
0
Sec=293634.00
N=5320556.665
E=479233.852
ELE=580.171
CRC=d099
>
0
Sec=293634.50
N=5320556.656
E=479233.846
ELE=580.174
CRC=9dbd
>
0
Sec=293635.00
N=5320556.655
E=479233.847
ELE=580.173
CRC=24e2
>
0
Sec=293635.50
N=5320556.657
E=479233.848
ELE=580.164
CRC=46f6
>
...
```

Notice the GPS-Time, which shows, that data are sent with two hertz, which is as fast as possible for a Geotracer® 2200!

Example 3

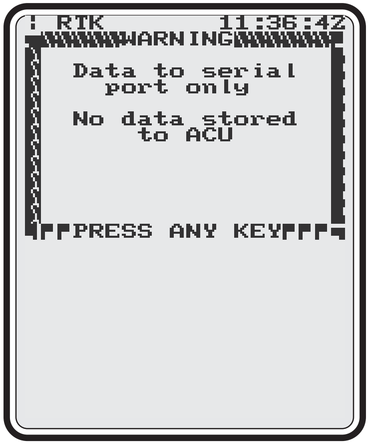


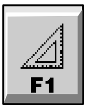
As third example, we will use the Serial Output Setting `Same_as_UDS` , lower the baud rate to 4800 baud and use the format RGD. This time, no data shall be registered to the ACU.



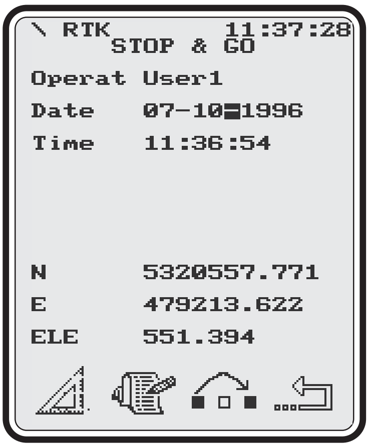
Next, we make sure, that the U.D.S. in use is `USER.UDS`, which we introduced in chapter 10.2.2.

Starting the point collecting menu results in a warning message, that no data will be saved on the ACU:





Accept the message using any key and start to measure with F1 . First, the following display will appear, allowing you to enter some labels.



As soon as you have registered, the device connected to port 2 of your ACU will receive data of the following kind

```
0
User1
07-10-1996
11:36:54
>
```

and simultaneously, the next display will appear at the ACU, which is the result of file `TOPO.UDS`, because it is linked to `USER.UDS`.

Each time, you register now using **F2** , a set of data according `TOPO.UDS` will be sent to port 2 of your ACU.

In the following you will see an output example for two registrations, containing parts of the labels of `TOPO.UDS`.

```
0
User1
07-10-1996
11:36:54
>
0
1
Lamp1
5320557.780
479213.625
551.392
162.2771
85.8753
25.006
2.41
7
7
>
0
2
Lamp1
5320554.981
479219.734
554.591
151.1340
96.1121
28.786
2.41
7
7
>
```

Chapter 11.

RTK Files

This chapter describes the files used by the RTK system.

When delivered from Geotronics the Advanced Control Unit contains all the files necessary for data recording, registration and processing. These are stored on a 5 MByte PCMCIA card in the ACU.

You may add other files, typically, these are `*.JOB`, `*.ARE`, `*.UDS`, `*.LCS` or `*.OUT` files.

The Advanced Control Unit (ACU) used for the Geotracer® RTK System contains a PCMCIA memory card in slot `A:\` which has the following directory structure:

Directory structure

A:\
A:\CU
A:\CUL2
A:\CUPLUS
A:\RTK
A:\RTK\USERPROG
A:\DBS
A:\START
A:\DATA

The following files should be stored on the PCMCIA card. Should you suspect a problem with your RTK system, you should check that all files are located in the correct place.

ACUCOMM.EXE
AUTOEXEC.BAT
CHARBACK.EXE
COM2SET.EXE
COMM.EXE
COMMAND.COM
COMMCHAR.EXE
COMMS.CFG
GEOGPS.EXE

```
CU\800201PD.ENG
CU\800201PH.ENG
CU\800201PT.ENG
CU\CU.CFG
CU\CU.EXE
CU\READ.ME
CU\WAYPOINT.TXT

CUL2\AREA.DBS
CUL2\CUCHAR.EXE
CUL2\CUL2.EXE
CUL2\DATUM.DBS
CUL2\ELLIPS.DBS
CUL2\FX.EXE
CUL2\PROJ.DBS
CUL2\TZONE.INI
CUL2\ZONE.DBS

CUPLUS\CUPLUS.EXE

RTK\ALMANAC.ALM
RTK\CHAR.EXE
RTK\CONFIG.DAT
RTK\LABEL.INI
RTK\LABEL.LAB
RTK\RTK.EXE
RTK\RTK_STAT.PAR

RTK\USERPROG\

DBS\AREA.DBS
DBS\DATUM.DBS
DBS\ELLIPS.DBS
DBS\PROJ.DBS
DBS\ZONE.DBS
```

```
START\ASSIGN.COM
START\AUTOEXEC.BAT
START\CONFIG.SYS
START\MMBFLAG.COM
START\NGENATA.SYS
SSTART\PW6.EXE
START\PCMCIAON.COM
START\RESET.EXE
START\SETIDLE.EXE

DATA\
```

The `A:\DATA` directory is used to store observed data. It is the normal directory used for the storage of results, `*.JOB` and `*.ARE` files. You can create and use other directories.

Only use A:\DATA or your own created directories for storing data. Never store data files in the program directories A:\, A:\CU, A:\CUL2 or A:\CUPLUS, A:\RTK and A:\START.

Directory `A:\CU` contains the Control Unit program files for the L1 receiver, directories `A:\CUL2` and A:\CUPLUS contain Control Unit Programs for the L1/L2 receiver.

All your `*.UDS`, `*.OUT` and `*.LCS` files have to be stored in directory `A:\RTK\USERPROG`!

The file ALMANAC.ALM

The RTK system uses the Geotracer® standard almanac format. When starting the RTK program, the receiver automatically loads almanac data and stores them in the `ALMANAC.ALM` file.

When the Geotracer® RTK system is delivered, an `ALMANAC.ALM` file will already be stored (directory `A:\RTK`). This allows you to use the skyplot function even when you have no receiver connected.

The almanac file contains the following information (see following pages):

The parameters in each column are:

PRN	Satellite PRN number
health	Health code
e	Eccentricity
$\sqrt{a}$	Square root of semimajor axis [$\sqrt{m}$]
Ω	Right ascension of ascending node [°]
ω	Argument of perigee [°]
M	Mean anomaly [°]
toa	Time of almanac in GPS seconds [sec]
i	Inclination offset to 54°
$d\Omega/dt$	Rate of right ascension [°/sec]
a_0	Satellite clock offset
a_1	Satellite clock drift
week	GPS week

PRN	1	2	4	5	6	7
health	0	0	0	0	0	0
e	0.003548	0.014520	0.003486	0.001820	0.006310	0.007247
√a	5153.6	5153.6	5153.5	5153.5	5153.7	5153.6
Ω	-117.290	6.714	129.089	7.560	69.937	67.910
ω	-77.040	-145.682	-63.782	-116.621	-164.554	-146.580
M	-24.986	124.258	-101.331	-6.981	-56.168	59.551
toa	32768	552960	552960	552960	552960	552960
i	0.6612	0.4343	1.4540	0.5830	1.0622	1.2336
dΩ/dt	-0.0004558	-0.0004636	-0.0004446	-0.0004623	-0.0004636	-0.0004617
a_0	304222.1	-176429.7	30517.6	114440.9	-7629.4	701904.3
a_1	0.05	0.00	0.00	0.00	0.00	0.00
week	811	810	810	810	810	810

PRN	9	12	14	15	16	17
health	0	0	0	0	0	0
e	0.003817	0.015578	0.002429	0.006959	0.001259	0.008258
√a	5153.6	5153.4	5153.7	5153.7	5153.6	5153.6
Ω	-51.455	-35.106	-176.439	124.121	-175.902	126.151
ω	-14.659	-5.086	178.724	99.057	-57.632	121.849
M	-48.554	-51.370	34.946	-174.743	140.444	-72.580
toa	552960	32768	32768	32768	32768	32768
i	0.3049	8.1536	1.2243	1.7245	1.0331	1.7884
dΩ/dt	-0.0004512	-0.0003654	-0.0004446	-0.0004407	-0.0004453	-0.0004381
a_0	-7629.4	591278.1	7629.4	206947.3	-100135.8	-91552.7
a_1	0.00	-0.04	0.00	0.00	0.00	0.00
week	810	811	811	811	811	811

PRN	18	19	20	21	22	23
health	0	0	0	0	0	0
e	0.005873	0.001265	0.004972	0.011899	0.008072	0.009689
√a	5153.5	5153.7	5153.6	5153.6	5153.5	5153.5
Ω	-120.025	-60.201	0.408	-171.355	7.569	-169.367
ω	82.622	-171.733	79.977	172.943	-4.880	-130.380
M	44.325	-131.063	107.528	155.538	114.701	128.722
toa	32768	32768	32768	552960	552960	552960
i	0.0051	21.8539	0.7848	0.8655	0.4412	1.0646
dΩ/dt	-0.0004643	-0.0004584	-0.0004564	-0.0004505	-0.0004643	-0.0004499
a_0	-7629.4	323295.6	236511.2	-22888.2	229835.5	7629.4
a_1	0.00	-0.02	0.00	0.00	0.00	0.00
week	811	811	811	810	810	810

PRN	24	25	26	27	28	29
health	0	0	0	0	0	0
e	0.006256	0.005953	0.008824	0.011299	0.003915	0.005107
√a	5153.6	5153.5	5153.6	5153.6	5153.6	5153.6
Ω	128.764	-53.026	-111.540	-52.233	68.512	-112.843
ω	-118.620	-177.235	-45.019	151.921	171.219	-106.051
M	-74.237	9.035	58.657	-107.828	-126.515	-92.837
toa	552960	552960	552960	552960	552960	552960
i	2.0194	22.4042	0.8312	0.1318	1.6981	0.6097
dΩ/dt	-0.0004381	-0.0004545	-0.0004525	-0.0004505	-0.0004577	-0.0004551
a_0	81062.3	0.0	-953.7	38147.0	23841.9	7629.4
a_1	0.05	0.00	0.00	0.00	0.00	0.00
week	810	810	810	810	810	810

PRN	31
health	0
e	0.005872
√a	5153.5
Ω	68.064
ω	38.911
M	-30.110
toa	552960
i	1.1996
dΩ/dt	-0.0004630
a_0	341415.4
a_1	0.05
week	810

CHAPTER 12.

CLASSICAL GPS SURVEYING WITH GEOTRACER® 2200 L1/L2 RECEIVER

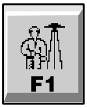
Setting Up In The Field

The Geotracer® System is very easy to use. The GPS Surveying System was designed so that inexperienced users can survey easily with the Global Positioning System. In order to set up the survey system in the field, connect the GPS receiver system to the control unit via a serial interface cable, further connect the antenna to the receiver and provide the receiver system with battery power. For more information on the hardware refer to chapter 1. After switching on the receiver, the control unit (ACU) should also be switched on. When the control unit is first switched on, it will boot up, then the following screen will be displayed.

The CU program is easy to handle using function keys, symbolized by icons just on top of them. The following description of the functions of the CUL2 program follows the order of the icons. Therefore, a separate description of function keys and their meaning is not necessary.

12.1 Enter CU L2 Program

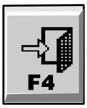
There are four basic function keys:



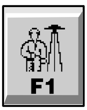
Classical GPS surveying options (Postprocessing)
(a description follows in this chapter 12)

Real-time kinematic options
(see chapters 2-11)

Communication options
(see App. A)

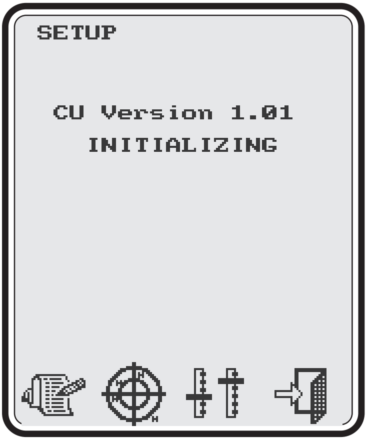


Exit to DOS

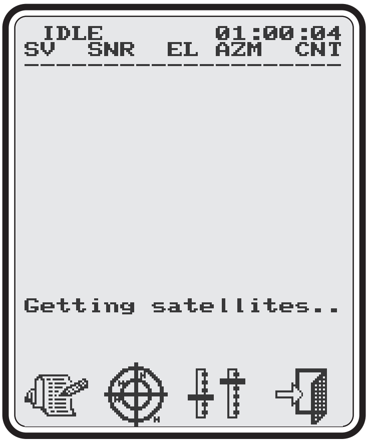


In order to survey with the receiver press the F1 key. The control unit will test the type of receiver connected and, if on a L1/L2 receiver, will start the CUL2 program (described in this chapter). If you have a L1 receiver the corresponding program (CU L1) will be started. By default, the unit starts the CUL2 program, and you can use the program even, if no receiver is attached. If your ACU also contains the CU/L2 Plus program, the CU/L2 Plus program will be started automatically. For more information on CU/L2 Plus refer to chapter 13.

Once the CUL2 program is started, the control unit initializes the receiver with the default parameters or with the last parameters you saved. The message "`INITIALIZING`" along with the program version will appear on the screen.

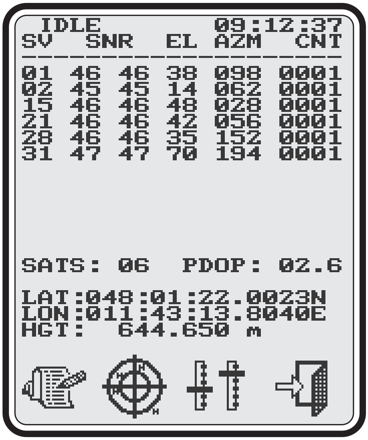


After receiving a correct acknowledgement from the receiver, the display will change to the following



indicating, that the system is working and that the control unit is waiting for the receiver to track satellites. If you did not have a receiver attached to the control unit (ACU) , you will not get this screen, but you will still be able to use the other functions of the CU program, such as the changing of parameters.

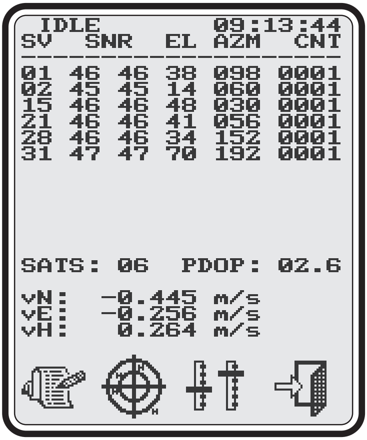
After a few seconds, information about the satellites will appear on the main display of the control unit. Generally, the mode "IDLE" will be displayed on the top line. A differ-



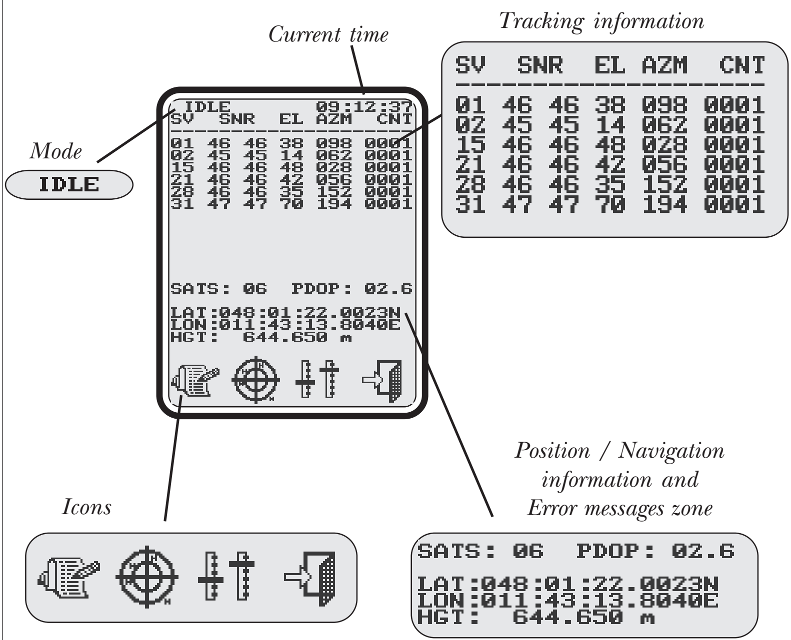
ent mode can occur when making use of the "Autotimed Survey" option (see Chapter 12.5.12) or when the receiver is in "Stand Alone" mode (see Chapter 12.7).

12.2 Main CU Control

The main control display will be shown when entering the program. It consists of an overview of the satellites currently being tracked and navigation information. The top line is a comment line which identifies the mode in which the receiver is working, as well as the current time. When the system is shipped to the customer, the time displayed is GPS-time, which is only a few seconds different to Greenwich Mean Time (GMT). In order to switch to different time zones you can use the parameter menu which will be described in section 12.5. The main part of the display consists of satellite tracking information. Up to 12 satellites can be tracked. Each tracked satellite occupies one line of the display. Below the satellite tracking information there is position and navigation information. Pressing **V** will display your current velocity instead of showing the position. Pressing **P** will display the position again. At the bottom, there are icons representing the different functions of the four function keys .



The display contains information on:



Receiver modes may be:

`IDLE`	The receiver tracks satellites but does not record any data on the PCMCIA card.
`RECORD`	When RECORD is activated the system records observational data on the PCMCIA card. It also stores all available ephemeris and almanac data.
`ST.ALONE`	In stand alone mode, the receiver (not the control unit) stores data on its internal PCMCIA card. For more details on this mode refer to section 12.7 of this chapter.

Displayed tracking information is:

SV	Satellite PRN number
SNR	Signal to noise ratios in dB for L1 and L2 If SNR = 00 the satellite is tracked but the quality of the data is not acceptable. If SNR = "- -" the satellite was tracked, but is not tracked currently.
EL	Elevation angle in degrees
AZM	Azimuth in degrees
CNT	A counter for the number of epochs tracked without a loss of lock. During startup the default epoch interval will be used for storing data, then you may define the epoch interval.

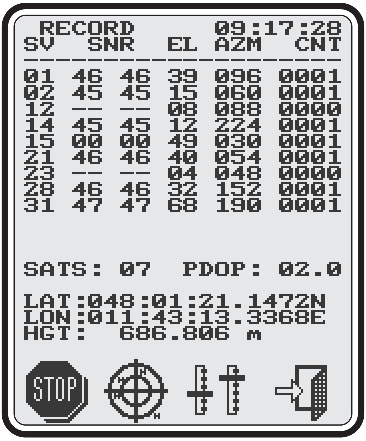
Each time the system enters the RECORD mode the CNT counter for all satellites will be reset. It will also be reset when a loss of lock occurs.

If you ignore a satellite during the tracking, e.g., because it does not track well, the satellite to be ignored will be displayed for another five minutes marked by a minus and will then disappear.

The position/navigation information includes the amount of satellites tracked, the PDOP (Position Dilution of Precision) and the latitude, longitude and height information for the receiver (single point positioning estimate). This position is given in the chosen reference system. When shipped, this system will be WGS84 but you have the freedom to change the reference system datum in the parameter menu. You will find more details on that in App. D ("Coordinate Systems"). You will find, that the position/velocity is updated with the frequency of the observation interval you have chosen in the parameter menu.

12.3 Record

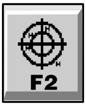
A GPS survey with the Geotracer® 2000 can be started by pressing the F1 key. You will see that the icon for F1 changes to the STOP sign. The mode displayed on the header line is now "RECORD". The CNT recounter will be reset.



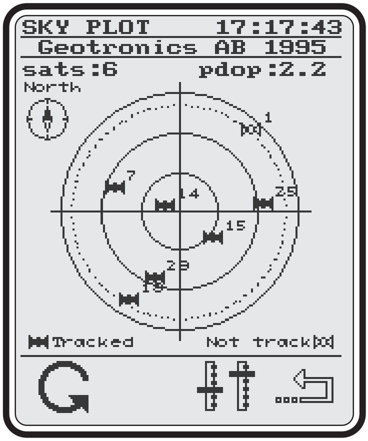
After pressing the F1 key, the system will automatically record observational data. The survey parameters used for recording these data are the parameters which were used last time you turned off the system. (However, you can change all survey parameters at any time. These include observation interval, point number, antenna height etc. For detailed information see section 12.5) The receiver is now in GPS surveying mode and you can view the main control display showing the tracked satellites.

In order to stop the survey, press the F1 key again. This puts the system to IDLE mode in which no data is recorded onto the PCMCIA card.

12.4 Sky Plot



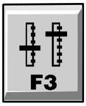
The Sky Plot is used to show the satellite locations in the form of a polar plot. It is available from most menus. All visible satellites are drawn on the polar plot. The visibility (azimuth and elevation) is computed from the almanac information stored in the ACU. Visible satellites which are tracked are drawn in black. Visible satellites not tracked are drawn in white.



Satellites at the center of the cross have an elevation of 90 degrees. Satellites near the outer circle have a low elevation down to 0 degrees. The dashed line indicates the current elevation mask setting.

By default the upward vertical axis is pointing to North indicated by the text "North" above the compass needle. You may rotate the reference direction to the sun or moon by using the **F1** key. The sun is indicated by "Sun" and the moon by "Moon". When either the sun or moon are not visible from your location the system will not offer this orientation, i.e. it will offer only the reference orientations which are visible.

12.5 Survey Parameters



Enter the parameter menu from the main display or the sky plot via the F3 key. It allows you to define all survey parameters.

In order to edit parameters, use the cursor ▲ and ▼ keys. While moving the cursor a comment is displayed in the comment area, describing the current parameter.

Edit the highlighted parameter by pressing the YES key on the control unit. You will then move to the editing area where the parameter you want to edit is displayed again. If your first keystroke is ◀ or ▶, the old value will be preserved, allowing you to make minor modifications to the old parameter. By pressing any other key, the old value will disappear and you may enter the new one.

For some of the parameters a text or number can be entered or edited. Some, such as "Ant.type", are selected from a list of predefined values. You can move through the list using [▲] and [▼], [PG↑] and [PG↓]. When the required value is highlighted, press the [YES] key and it will become the new value for the parameter.

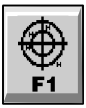
If you press the [No] key while editing a parameter you will get back the previous value of the parameter you are editing.

Pressing the [No] key while you are in the upper window will recover the old parameters values before you start making changes.

There are three pages of parameters you can select from. Pressing the [F2] key toggles between the pages.

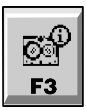
Please note that no parameter is set until you leave the parameter menu.

The icons on the bottom of the screen have the following meaning:

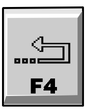


Move to the sky plot (see section 12.4.)

Browse parameter pages



Move to File Handling Menu (see section 12.6)



Return back to main screen

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12.5.1 Point Definitions

In this block you can enter those parameters which will allow you to differentiate between general surveying sessions. They are only used as identifiers in the files when storing data and are required for postprocessing (see display p. 12.12).

Point: 8 character point number. The name of the files, where the observation data will be recorded is derived from it (see section 12.5.11) - Default value: STATION
Pcode: 16 character point code - Default value: CODE
Pinfo: 15 character point info - Default value: INFO

12.5.2 Elevation Mask And Observation Interval

These parameters instruct the receiver when to track a satellite and with which frequency it should provide the control unit with the received data (see display p.12.12).

ELEV Mask: Elevation mask in degrees, no satellites are tracked below the given elevation angle (default value 10°) (minimum: 0°, maximum: 90°).
OBS.INT: Observation interval (Recording interval) for static observations. The minimum value is 0.5 sec and the maximum 999 sec for the dual-frequency receiver (default 10 sec).

12.5.3 Instrument Eccentricities

These instrument eccentricities represent the position difference between the antenna and the point on the ground you are currently measuring.

H ecc: Displacement in height. Default value: 1,545 m. (min: -99.99, max: 99.999)
see also section 12.5.4

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N ecc: North displacement: Default value: 0
(min: -99.999, max: 99.999)
E ecc: East displacement, Default value: 0
(min: -99.999, max: 99.999)

12.5.4 Antenna Definition

In this block you define the way you measure the height of the antenna (see 12.5.3: height eccentricity parameter) and the type of antenna in use.

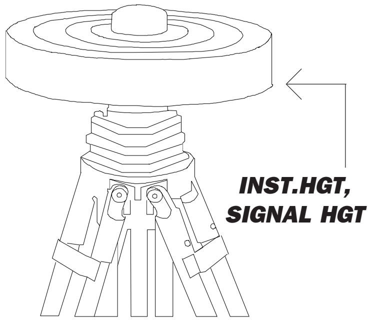
Hgt. mode: The antenna height can be measured in different ways:

1. `INST.HGT`: As an instrument height from the survey mark to the mark on the antenna mounting.
2. `SLOPE`: As a Slope distance from the survey mark to the outer edge of the antenna ground plane.
3. `TRUE VERT`:As a true vertical from the survey mark to the antenna phase center.

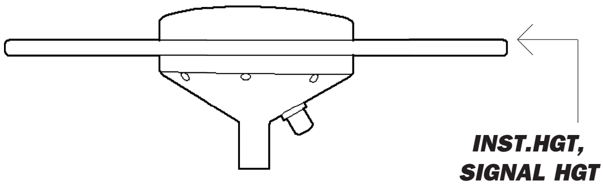
Default value: `INST.HGT`.

FIRST PAGE Ant. type: Antenna types could be

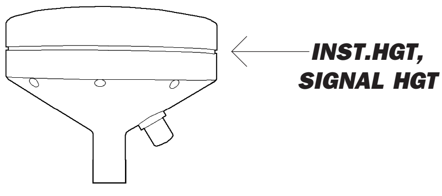
1. Choke ring antenna



2. Geodetic antenna with ground plane



3. Compact antenna



Default value: Choke ring

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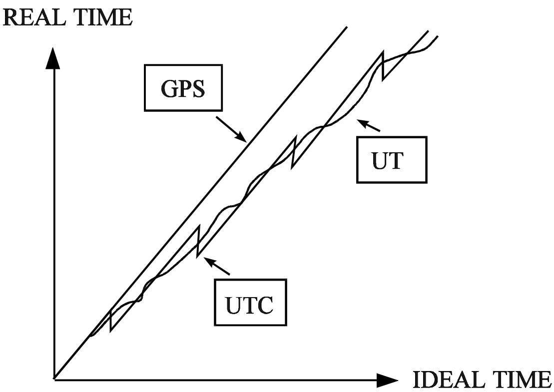
12.5.5 Time Definition

The second parameter menu allows you to set the Time Zone and the difference between UTC and GPS time in seconds. The UTC and GPS times differ by full seconds. This is due to the fact that the GPS time is a continuous time whereas UTC is using leap seconds.
The current (June 15, 1995) UTC-GPS time difference is UTC-GPS = -10 seconds. The time difference between atomic time and GPS is TAI-GPS = + 19 seconds.



UT: time derived from astronomical observations

In order to select a time zone move the highlighted line to `Time Zone` and press **YES**. The following will be displayed:

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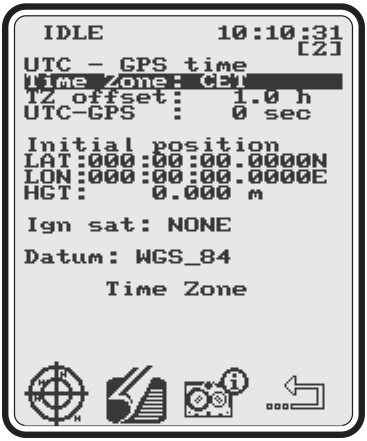
Use the cursor ▲ and ▼ keys to select your time zone. Please note that the system automatically switches from summer to winter time, so you will not have to take care of that. Summer time is indicated by the abbreviation DST which stands for Daylight Saving Time (e.g. CETDST for Central European Time Daylight Saving Time).



You may also enter the Time Zone offset manually. In this case the time zone field will change to default, indicating that you are not using any standard time zone.

Defaults: No time zone selected
TZ offset: 0
UTC-GPS: -10

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12.5.6 Position Definition

In some cases it might be necessary to provide an initial position to the receiver. This can help to reduce the time to first fix if you were using the receiver in different regions. Please use the "Initial Position" block to provide latitude, longitude, height information. To edit for example the latitude, move the highlighted line to LAT and press **YES**. An edit line will then appear at the bottom part of the display allowing you to enter latitude information.

Enter **N** or **S** for North and South. **E** and **W** for East and West. Use the colon to separate degrees, minutes and seconds.

Default values: LAT 0, LON 0, HGT 0.

This position is sent to the receiver only when the CU unit detects, that it has changed from the last time you used it.

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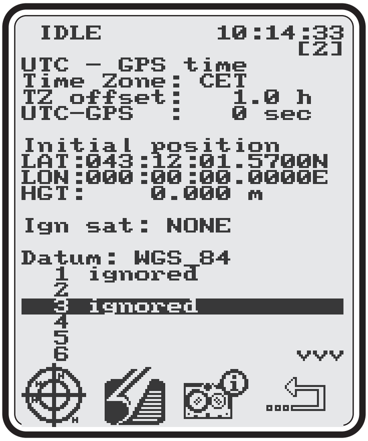
12.5.7 Satellite Definition

The "ignore satellite" function allows you to disable satellites which you do not want to track or record. When you move the highlighted line to "`Ign sat`" and press the **YES** key you will find

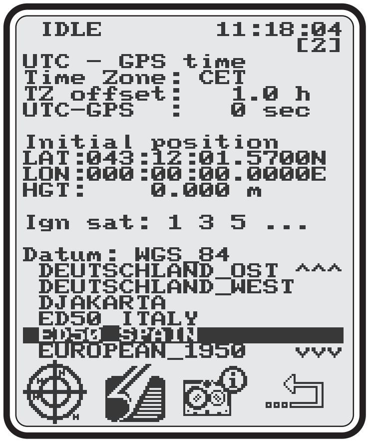


that a movable selection menu is displayed below. Use the **SP** key to mark and unmark individual satellites. Use **YES** key to accept your selection. The disabled satellite numbers will then be listed in the "Ignore satellite" field. Default value: NONE (disabled).

SECOND PAGE

12.5.8 Datum Definition

To change the datum in which the position on the main display is shown, move the cursor to the datum line and press YES. You will then be displayed with a selection of available datums on the lower part of the screen.



Select your datum and press YES for acknowledgment. For more detailed information on available datums refer to App. D. Default value: WGS 84

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12.5.9 Version Number - Info Only

The first two lines of the screen display the number of the CU software version and the firmware version of your receiver. These are the version numbers you should mention to your provider whenever having any problems or troubleshooting with your system.

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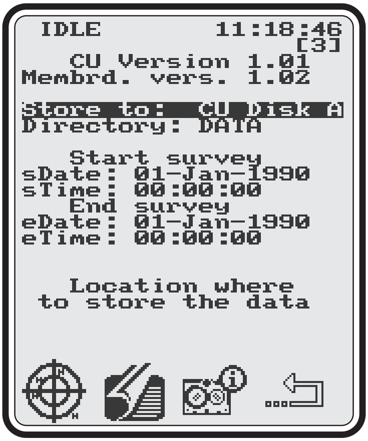
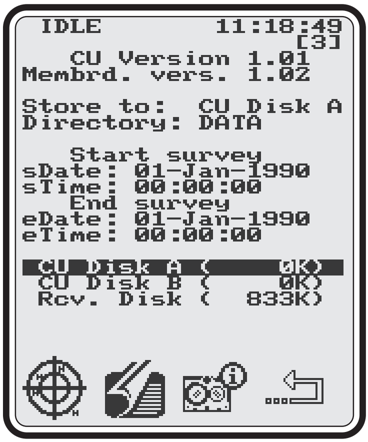
12.5.10 Drive and Directory Definition



In order to select the device where you want to store the data, move the highlighted line to "`Store to`" and press **YES**. The following display will appear.



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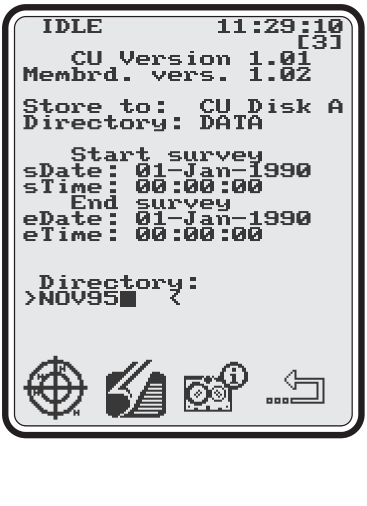
You can store data on any of the local devices (CU disk A and B) or on the receiver disk. During storage to any particular device, you still have the possibility to examine, delete or display the contents of the other devices and directories with the file handling menu. (See more information on this subject later on in this chapter). Together with the device name, the free space available in KBytes is displayed. This can help you to decide, where to store data. If there is no PCMCIA card inserted in one of the devices or if the inserted card is full, a free space of 0 KBytes will be displayed.

You also have the possibility to define the directory in which the data shall be stored. If the directory does not exist it will be created. The drive and directory definitions are set in the file handling menu (see section 12.6). Default directory: DATA.



12.5.11 Result Files

During a survey the receiver records raw observational code and carrier data in a file with the extension `*.OBS`.

In general the file name consists of eight characters composed to a string `siteddds` with

site	4 significant characters of the point number, normally the last 4 characters
ddd	the day of the year (range 1 ... 366)
s	session identifier (A...Z)

Note: you may create up to 26 session files with the same site and day identification.

In addition, for each survey an ephemeris and almanac file is recorded.

The ephemeris information will have the extension based on the current year, for example "95N". The "N" stands for navigation file.

The almanac information is saved in a file. The extension of this file is also based on the current year, e.g. "95A". The "A" stands for almanac information.

Ephemeris data is stored in the RINEX convention which is described in the following table.

NAVIGATION MESSAGE FILE - DATA RECORD DESCRIPTION		
OBS. RECORD	DESCRIPTION	FORMAT
PRN / EPOCH / SV CLK	- Satellite PRN number - Epoch: Toc - Time of Clock year (2 digits) month day hour minute second - SV clock bias (seconds) - SV clock drift (sec/sec) - SV clock drift rate (sec/sec2)	I2, 5I3, F5.1, 3D19.12
BROADCAST ORBIT - 1	- IODE Issue of Data, Ephemeris - Crs (meters) - Delta n (radians/sec) - M0 (radians)	3X,4D19.12
BROADCAST ORBIT - 2	- Cuc (radians) - e Eccentricity - Cus (radians) - sqrt(A) (sqrt(m))	3X,4D19.12
BROADCAST ORBIT - 3	- Toe Time of Ephemeris (sec of GPS week) - Cic (radians) - OMEGA (radians) - CIS (radians)	3X,4D19.12
BROADCAST ORBIT - 4	- i0 (radians) - Crc (meters) - omega (radians) - OMEGA DOT (radians/sec)	3X,4D19.12
BROADCAST ORBIT - 5	- IDOT (radians/sec) - Codes on L2 channel - GPS Week # (to go with TOE) - L2 P data flag	3X,4D19.12
BROADCAST ORBIT - 6	- SV accuracy (meters) - SV health (MSB only) - TGD (seconds) - IODC Issue of Data, Clock	3X,4D19.12
BROADCAST ORBIT - 7	- Transmission time of message (sec of GPS week, derived e.g. from Z-count in Hand Over Word (HOW) - spare - spare - spare	3X,4D19.12

Almanac information is stored in the Geotracer® GPS format. The almanac file conforms to the following example:

```
        1         2         4         5         6         7
        0         0         0         0         0         0
 0.003548  0.014520  0.003486  0.001820  0.006310  0.007247
   5153.6    5153.6    5153.5    5153.5    5153.7    5153.6
 -117.290     6.714   129.089     7.560    69.937    67.910
  -77.040  -145.682   -63.782  -116.621  -164.554  -146.580
  -24.986   124.258  -101.331    -6.981   -56.168    59.551
    32768    552960    552960    552960    552960    552960
   0.6612    0.4343    1.4540    0.5830    1.0622    1.2336
-0.0004558-0.0004636-0.0004446-0.0004623-0.0004636-0.0004617
 304222.1 -176429.7   30517.6  114440.9   -7629.4  701904.3
     0.05      0.00      0.00      0.00      0.00      0.00
      811       810       810       810       810       810

        9        12        14        15        16        17
        0         0         0         0         0         0
 0.003817  0.015578  0.002429  0.006959  0.001259  0.008258
   5153.6    5153.4    5153.7    5153.7    5153.6    5153.6
  -51.455   -35.106  -176.439   124.121  -175.902   126.151
  -14.659    -5.086   178.724    99.057   -57.632   121.849
  -48.554   -51.370    34.946  -174.743   140.444   -72.580
   552960     32768     32768     32768     32768     32768
   0.3049    8.1536    1.2243    1.7245    1.0331    1.7884
-0.0004512-0.0003654-0.0004446-0.0004407-0.0004453-0.0004381
  -7629.4  591278.1    7629.4  206947.3 -100135.8  -91552.7
     0.00     -0.04      0.00      0.00      0.00      0.00
      810       811       811       811       811       811

       18        19        20        21        22        23
        0         0         0         0         0         0
 0.005873  0.001265  0.004972  0.011899  0.008072  0.009689
   5153.5    5153.7    5153.6    5153.6    5153.5    5153.5
 -120.025   -60.201     0.408  -171.355     7.569  -169.367
   82.622  -171.733    79.977   172.943    -4.880  -130.380
   44.325  -131.063   107.528   155.538   114.701   128.722
    32768     32768     32768    552960    552960    552960
   0.0051   21.8539    0.7848    0.8655    0.4412    1.0646
-0.0004643-0.0004584-0.0004564-0.0004505-0.0004643-0.0004499
  -7629.4  323295.6  236511.2  -22888.2  229835.5    7629.4
     0.00     -0.02      0.00      0.00      0.00      0.00
      811       811       811       810       810       810
```

24	25	26	27	28	29
0	0	0	0	0	0
0.006256	0.005953	0.008824	0.011299	0.003915	0.005107
5153.6	5153.5	5153.6	5153.6	5153.6	5153.6
128.764	-53.026	-111.540	-52.233	68.512	-112.843
-118.620	-177.235	-45.019	151.921	171.219	-106.051
-74.237	9.035	58.657	-107.828	-126.515	-92.837
552960	552960	552960	552960	552960	552960
2.0194	22.4042	0.8312	0.1318	1.6981	0.6097
-0.0004381	-0.0004545	-0.0004525	-0.0004505	-0.0004577	-0.0004551
81062.3	0.0	-953.7	38147.0	23841.9	7629.4
0.05	0.00	0.00	0.00	0.00	0.00
810	810	810	810	810	810

31
0
0.005872
5153.5
68.064
38.911
-30.110
552960
1.1996
-0.0004630
341415.4
0.05
810

The parameters in each column are

PRN	Satellite PRN number
health	Health code
e	Eccentricity
$\sqrt{a}$	Square root of semimajor axis [$\sqrt{m}$]
Ω	Right ascension of ascending node [°]
ω	Argument of perigee [°]
M	Mean anomaly [°]
toa	Time of almanac in GPS seconds [sec]
i	Inclination offset to 54°
Ω	Rate of right ascension [°]
a_0	Satellite clock offset
a_1	Satellite clock drift
week	GPS week

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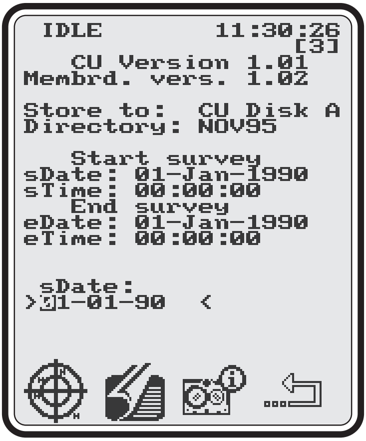
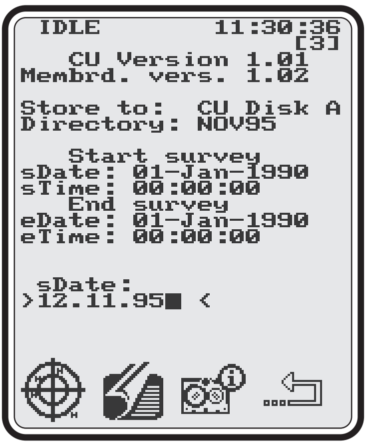
12.5.12 Autotimed Survey

With your CU software you have the capability of recording data at predefined times you specify with this option. You simply enter the date and time the software should start recording data, and the date and time it should stop. The software has to be left running for it to start an automatic survey after your specifications.



You can use almost any separator character (/ . - :) between day, month and year, as well as between hours, minutes and seconds. If you do not give a value for minutes and/or seconds, the program will interpret this as being zero.



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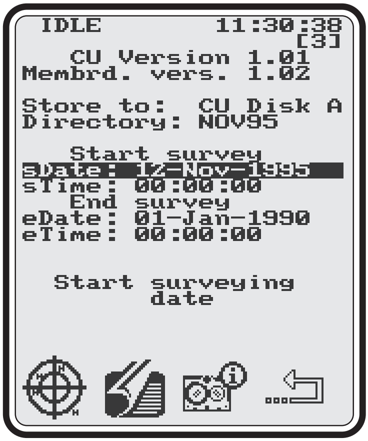
If the end time you entered is previous to the start time the program will not start recording data at all.

The program creates a report file (`AUTOTIME.RPT`). This file will list any problems encountered during the survey and will be stored in the same directory as the observation files.

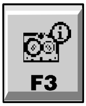


The file has the following format:

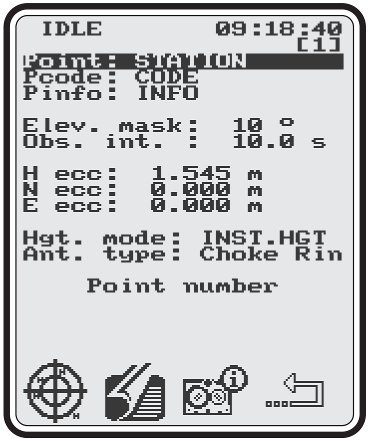
```
817::374760.0 REPORT CREATED
817::375147.0 Can not find receiver
817::375150.0 Retrieving satellites...
817::376200.0 REPORT CLOSED
```

The first two numbers of each line indicate the time (GPS time) at which the event described occurred. The number before the double colon indicates the GPS week and the number after it the seconds of the week.

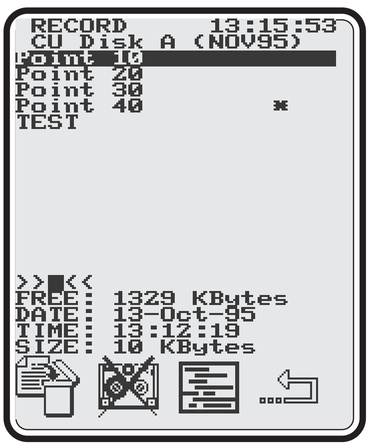
12.6 File Handling



Enter this menu by pressing the **F3** key in the "Getting Parameters" menu.



A scrolling list of the point numbers of each survey session will be displayed. These represent the files stored on the device you have defined in the Parameter Menu. You may change the directory during recording. This will not influence the observation files or their location.



In the second line of the header, the device name and directory you are examining is displayed. This is not necessarily the one you are storing the data in (if you are in RECORD mode).

The information displayed is derived from the binary observation files with the extension `*.OBS`. You may scroll through the individual file selection with the cursor ▲ and ▼ keys or you can enter the initial character to find the specific point number directly. You will find, that, by moving the highlighted line up and down, the information section in the lower part of the display changes. The information section includes information about the available memory on the memory card. It writes information on date and time of the data set. In the file selection menu you will find an asterisk after the point number for the file which is currently being used for survey.

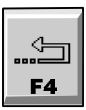
If you are examining a "STOP & GO" observation file, the acronym "`S&G`" will be displayed behind the point number.

The icons on the bottom of the screen have the following meaning:

Delete a file (see section 12.6.1),

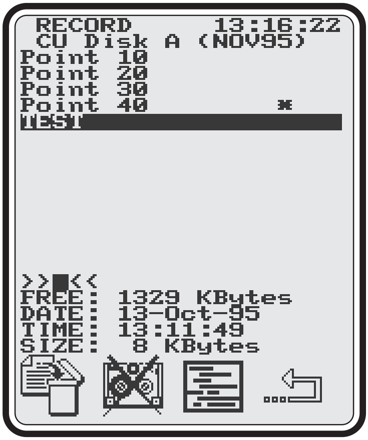
Clear a directory (see 12.6.2),

View data graphically (see section 12.6.4),

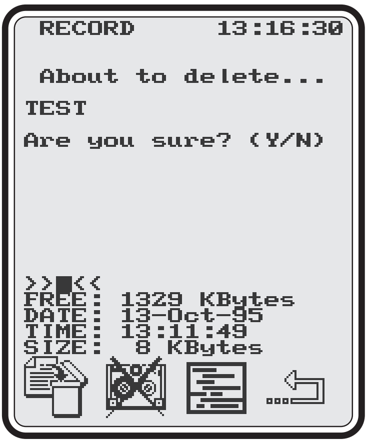


Return back to main screen.

12.6.1 Delete a file

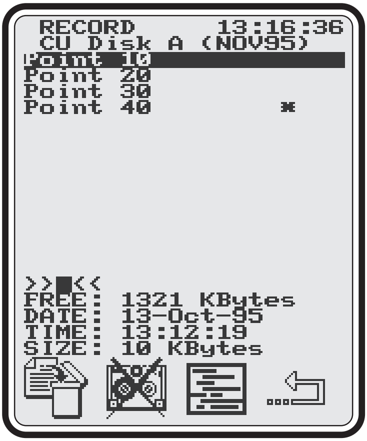


You can delete some or several data sets. A data set consists of an *.OBS file as well as its corresponding ephemeris and almanac file. In order to delete a dataset move the cursor with the ▲ and ▼ keys to the dataset you want to delete and press the **F1** key. You will then be asked for an acknowledgement before the data is deleted.



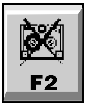
If you acknowledge with **YES** or **Y** the data set will be removed from the PCMCIA card. Any other key used will cause the program to return to the file handling menu.

Acknowledge with **YES** or **Y** and the resulting display will be:



If you delete the file in which data is currently being recorded, you will clear the data stored up to this moment and continue recording from there on.

12.6.2 Clear A Directory



To delete all observational data and associated ephemeris and almanac data in a directory use the **F2** key. You must first acknowledge that the files should be deleted and are prompted with the following question:

Acknowledging the request with **YES** deletes all files on the directory selected.

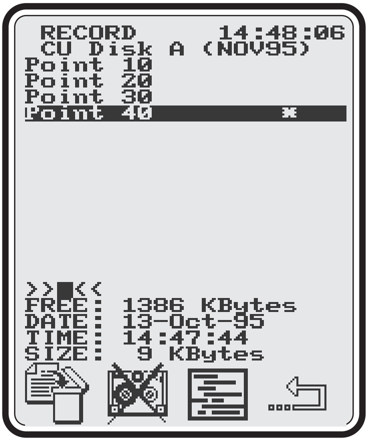
12.6.3 Memory

The amount of memory used by each file, date of the file and the total amount of free memory on the PCMCIA card, is always displayed in the information area.

12.6.4 View Data Graphically

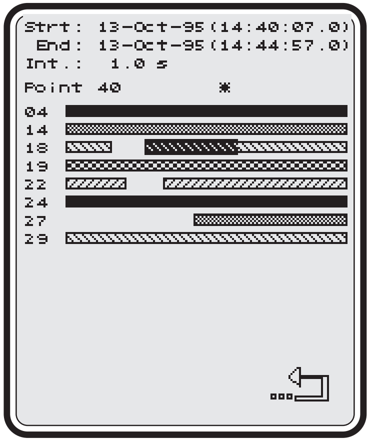
Graphic information on recorded data is available for all observation datasets.

You can view the data stored on the card by pressing the F3 key after selecting an observation with the cursor ▲ and ▼ keys.



Horizontal bars will appear on the screen showing the satellites tracked during this observation period as a function of time. Satellites are ordered by their PRN number. These are displayed on the left side of the graphic.

The two first lines in the header of the screen show the beginning and end times (using the time format you have defined in the parameter menu) of the observation period. This is the lapse of time covered by the graph. The third line indicates the observation interval or minimum time elapsed between two consecutive epochs. On the fourth line the point number is displayed. As in the file menu, an asterisk after the point number indicates, that this file is the currently open and that data is currently being stored there.



Please note, that the graph shown on the screen is a snapshot of the state of the file at the moment you selected this function.

Successive calls to the function can give you an idea of the progress of the file being recorded. Losses of lock during the tracking of a satellite (which appear in the main display as “SNR: 00”) will be represented by a thin line crossing the bar at the time the loss of lock occurred. Continuing losses of lock will cause the bar to look thicker in this zone and the filling pattern will invert.

F4

To return to the file handling menu, press the F4 key.

12.7 Stand Alone Mode

In the stand alone mode, the receiver records data in its internal PCMCIA card independently of the CU unit. You can enter this mode either

- by pressing the receiver switch-on button for longer when turning it on,
- by starting a record session with the CU unit specifying storage to the receiver or
- by programming an autotime survey session and saving it in the receiver.

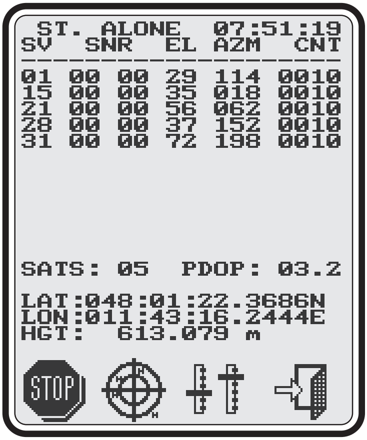
If the receiver is in stand alone mode, the operation and display of the CU program is different to that previously described. This section is dedicated to explain the differences.

12.7.1 Using A Receiver In Stand Alone Mode

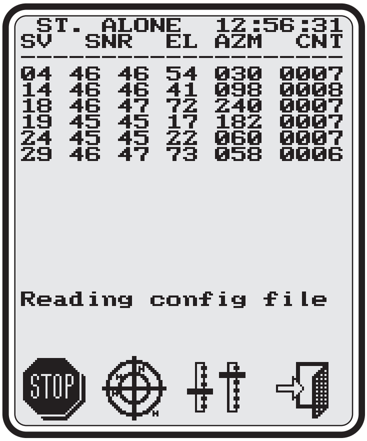
You can start a stand-alone survey without the ACU. Press the switch-on button of the receiver and hold it until the LED becomes red. The receiver will automatically be in stand alone mode and will begin to save data using its default parameters.

You can check the data being stored or change the default options by means of the ACU. To do this, just attach the unit to the receiver and start the program as usual (see section 12.1). If the receiver is in stand alone mode, the message "`ST.ALONE`" will appear in the header line of the screen.

In this mode, any configuration saved on your ACU is deactivated, i.e. the observation interval, elevation mask, disabled satellites etc., are the ones saved in the receiver.



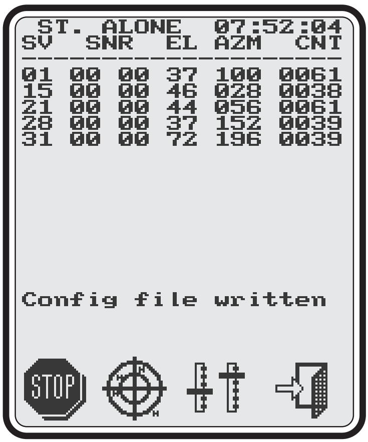
To read the receiver´s configuration parameters, press the combination of the **Shift** + **R** key while in the main display. The following message will appear.



The stand alone mode is designed in such a way that it can not be accidently interfered with. Changes in the configuration of a stand alone receiver must be made intentionally.

To do this press the combination of the **Shift** + **W** key while in the main screen and the following message will appear:

asking you to confirm the overwriting of the receiver´s configuration. If you acknowledge by pressing the **YES** or **Y** key, the parameters you are working with will be stored in the receiver and it will start using them immediately.



Cancel by pressing any other key.

12.7.2 Stopping A Stand Alone Session

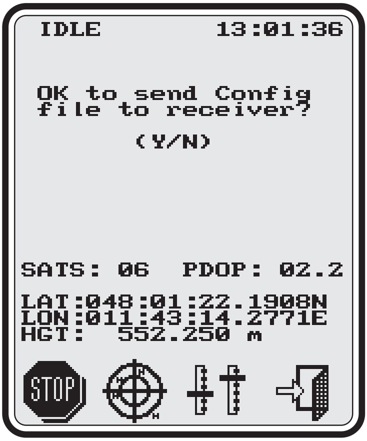
To stop a stand alone session just press the **F1** key. The CU unit will ask you to confirm your decision.

Acknowledging with the **YES** or **Y** key, will cause the session to stop. Press any other key to cancel.

To stop a stand alone survey without an ACU, just switch off the receiver. All files will be closed immediately.

12.7.3 Starting A Stand Alone Session With The ACU

To start a stand alone session select "`Rcv.Disk`" in the third page of the Survey Parameters menu (see section 12.5.11)as storing device. Then go back to the main menu and press the **F1** key for "Start Recording". The program will ask you, whether to use the ACU configuration parameters.



Pressing the **YES** or **Y** key will send the ACU parameters to the receiver, overwriting the parameters in the receiver. If you want the receiver parameters to remain unchanged, just skip the option by pressing the **NO** key.

Next, acknowledge the starting of the stand alone session.

Press the **YES** key to start recording data to the receiver, press the **NO** key to cancel the command.

12.7.4 Programming An Autotimed Stand Alone Survey Session

To program an autotimed session in stand alone mode set the ACU Survey Parameters with the values you wish to use in the stand alone session (see section 12.5 "Survey Parameters"). Specify storage in the receiver disk and the start and end times for the timespan for the survey, then send them to the receiver by pressing the combination of the **Shift** and **W** key.

The new parameters are then stored in the receiver and it will begin to save data at the predefined time even if no ACU is attached to it at that moment.

The receiver must remain switched on during the time before the survey should start.

12.8 Messages

12.8.1 System messages

`Check the antenna`
The Control Unit has detected, that although a receiver is attached, it still does not receive satellite data with the required frequency. Probably you forgot to connect the antenna, but it could also be, that the elevation mask is set higher than the highest tracked satellite or all visible satellites are disabled. Another possibility is, that the receiver battery is low. This message is disabled when in Stand Alone mode.

`Cannot find receiver`
The Control Unit was at one stage able to communicaten with the receiver, but can no longer do so. Check the connections and the operation of the receiver (check the LED).

`Getting satellites...`
This message is given when the Control Unit is waiting for the receiver to send satellite data.

`Getting almanac...`
Usually, the Control Unit requests an almanac when the program starts. But, if for some reason the receiver did not send it, you will get this message when you try to view a Sky Plot. Give the Control Unit a few seconds to get a new almanac and try again.

`Retrieving satellites...`
This message is given when the Control Unit is waiting for the receiver to send satellite data after having lost it for some reason.

`Invalid input`

The entry you specified for a parameter value has an invalid format. Enter the value again with a format that conforms to the one expected by the program.

`Memboard time-out`

A time-out occurred while expecting an answer from the receiver.

- If you get the message "`Still trying ...`" immediately afterwards, it just means, that the traffic driven through the serial link is reaching is maximal value. Don´t worry!
- If you do not get the message "`Still trying ...`" or the system does not behave correctly the serial link is overloaded and you will have to reduce the volume of data that passes through it: Store your data on one of the ACU devices, or reduce the number of satellites tracked by increasing the elevation mask or change to a lower update rate.

`Battery low`

The receiver battery is low. You have 30 seconds to replace it before the system closes down.

12.8.2 File messages

`Getting directory`
You get this message while the Control Unit is reading a directory structure.

`Disk write-protected`
You have tried to save data in a write-protected card. Remove the write-protection and try again.

`No space left on dev`
The card is full. You can not save any more data on it, unless you remove some of the files.

`Drive not ready`
You have tried to write in a device where no card is inserted. Insert a card and try again or select another device.

`No card in receiver`
An attempt has been made to read from or write to the receiver card when it was not inserted, or you have removed the card and put it in again without turning the receiver OFF and ON.

`Change point name`
You have attempted to create more than 26 observation files with the a point name using the same site and day specification.
You will either have to change the point name (some of the last four characters) so that the new file name derived from it also changes or specify another directory where to save the data.

`Memboard Bad CRC`

Three attempts have been made to get correct data from the receiver, but all failed. It may signify that the serial link is overloaded or that the electrical environment conditions are not as good as they should be. Check whether your serial link is built-up correctly. If the problem persists, reduce the volume of data being driven through the serial link: Store your data in the ACU if possible, reduce the number of satellites by increasing the elevation mask or reduce the update rate.

`Memboard bad command`

The receiver did not recognize a command sent by the Control Unit after three attempts made. It may signify that the serial link is overloaded or that the electrical environment conditions are not as good as they should be. Check whether your serial link is built-up correctly. If the problem persists, reduce the volume of data being driven through the serial link: Store your data in the ACU if possible, reduce the number of satellites by increasing the elevation mask or reduce the update rate.

`Sector not found`

A general failure while trying to read a card has occurred. Check for the integrity of the card.

`Inconsistent struct.`

Inconsistent data on the receiver card. The data structures are inconsistent with each other. This is most likely the result of a crash while writing to the volume.

`Directory not found`

The directory name you specified for reading could not be found. Check, whether drive and directory specified in your parameter set are correct.

`Illegal path name`
The path name specified is illegal. Possibilities for this error are:
- File name exceeds 12 characters.
- Illegal character in a file name.
- Illegal first character in a file name.
- Incorrect path name syntax.
Check whether the drive and directory specified in your parameter set are right.

`Directory expected`
Directory file expected. The file name specified is not a directory file. Enter the right name in your parameter menu.

`File already exists`
The file name specified already exists. You tried to create a file and a directory with the same name. Change one of them.

`Too many files`
Too many files on card. You attempted to create more than ~ 170 observation files in the root directory.
Specify an other directory name in your parameter menu. Other directories have no limit to the number of observation files to be stored.

12.9 Time Zones Supported

The Geotracer® system works with different time zones which can be defined in the parameter menu. The following table defines the time zones supported:

TIME ZONE	ABBREVIATION		TIME OFFSET WINTER [h]
	Winter	Summer	
Central European	CET	CETDST	-1.0
Greenwich Mean	GMT	BST	0.0
Pazific Standard	PST	PDT	8.0
Eastern Standard	EST	EDT	5.0
Central Standard	CST	CDT	6.0
Mountain Standard	MST	MDT	7.0
Atlantic Standard	AST	ADT	4.0
Newfoundland Std	NST	NDT	3.5
Eastern Std US:Indiana	EST	CDT	5.0
Aleutian Standard	AST	ADT	10.0
Yukon Standard	YST	YDT	9.0
Western European	WET	WETDST	0.0
Portuguese Winter	PWT	PST	0.0
South Africa Std	SAST	SADT	-2.0
Australian Central	CST	CDT	-9.5
Australian Eastern	EST	EDT	-10.0
New Zealand Standard	NZST	NZDT	-12.0
Australian East (Tasmania)	EST	EDT#Tasmania	-10.0

The given time offset is used in the relation

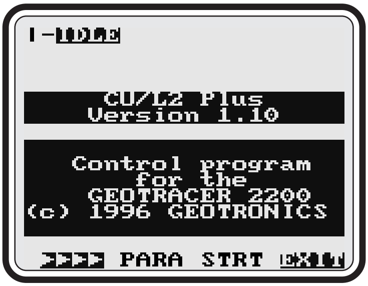
Local time = UTC - Time offset

UTC .. Universal Time Coordinated which differs only by a few seconds from GPS time.

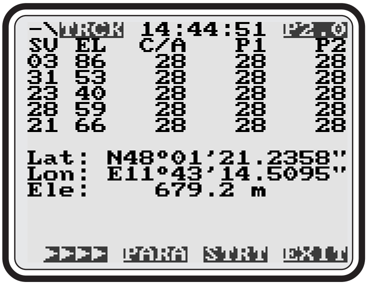
CLASSICAL GPS SURVEYING WITH GEOTRACER® 2200 and 2204 L1/L2 RECEIVER - CU Plus

13.1 Overview of CU Plus

You are using a Geotracer® System 2200 or 2204 , which is very easy to use. The GPS Surveying System was designed so that you, even as inexperienced user, can survey easily with the Global Positioning System. In order to set up the survey system in the field, simply connect the GPS receiver system to the control unit via a serial interface cable, further connect the antenna to the receiver and provide the receiver system with battery power. For more information on the hardware refer to chapter 1. After switching on the receiver, the control unit should also be switched on with a press on **FUNC** + **ESC**. When the control unit is first switched on, it will boot up and start the CU Plus program (even if the CU/L2 program is also installed), then the following screen will be displayed.



The CU Plus program is easy to handle using function keys, the function of which is symbolized by an acronym (abbreviation) just on top of them.



If the receiver is already running and was connected to the control unit before, information about the satellites will appear on the main display of the control unit after a few seconds. Otherwise, the mode "WAKE" will be displayed on the top line. The control unit builds up a connection to the receiver, switches it on and initializes.

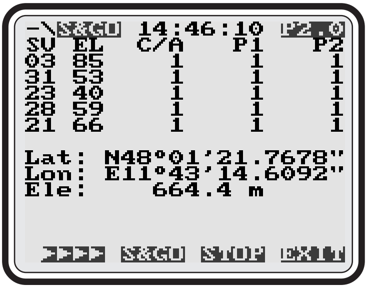
As soon as a sufficient number of satellites can be tracked, the mode changes to "TRCK". This means, that satellites are tracked, but no data are recorded onto the internal PCMCIA card of the receiver.

The bottom line of the screen is reserved for a short description of the four function keys (F1 ... F3 , ESC). The description consists of an 4-character acronym of the related function, just above the function key. Generally the characters are white on black (symbolizing a key of the keyboard). If, however, a function is deactivated, you will see the characters in black on white. If you press a key and the execution of the action takes a little bit longer, the acronym begins to flash.

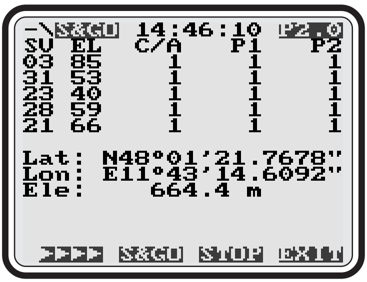
A full description of the functionality follows in the next sections.

13.2 Main CU Control

The main control display will be shown when the program is started. It consists of an overview of the satellites currently being tracked and of navigation information. The top line identifies the mode in which the receiver is working, the current time and the PDOP value. When the system is delivered, the time displayed is GPS-time corrected by 11 seconds, which currently (September, 1996) corresponds to Universal Time Coordinated (UTC) and Greenwich Mean Time (GMT). In order to switch to different time zones you can use the parameter menu which will be described in section 5.

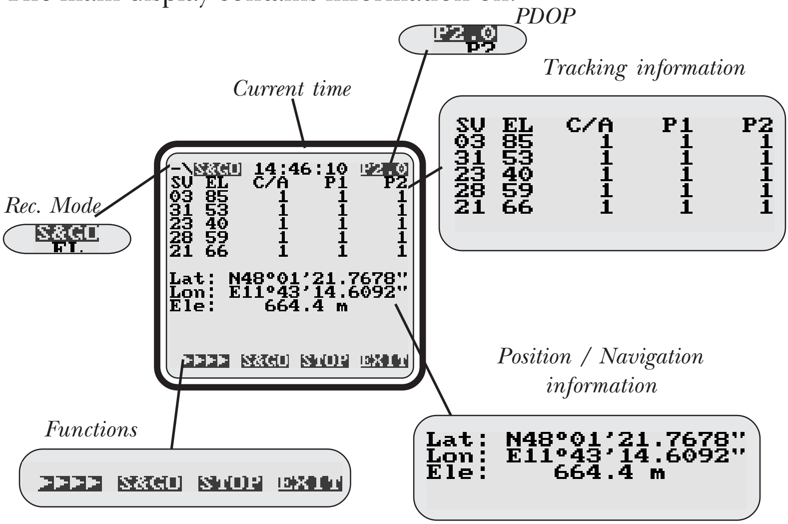


The main part of the display consists of satellite tracking information. Up to 12 satellites can be tracked. Each tracked satellite occupies one line of the display. If enough space remains on the screen, position and navigation information are displayed below the satellite tracking information.



You may use the ▲ and ▼ arrow keys to change between this page and following pages of the main screen.

The main display contains information on:



Receiver modes may be:

IDLE	No satellites are tracked currently.
UNKN	No information available yet.
WAKE	The control unit starts tracking, but has not yet received enough satellites. The receiver may be switched off. The program will try to switch it on.
IDNT	The control unit tries to identify which Geotracer® is connected.
TRCK	The receiver tracks satellites but does not record any data on the PCMCIA card.
REC	When REC is displayed the system is recording observational data of a static measurement on the PCMCIA card. It also stores all available ephemeris and almanac data.
KIN	The receiver is recording observational data of a kinematic measurement.
RTK	The Geotracer® 2204 is in RTK mode.
S&GO	The receiver is recording observational data of a Stop&Go measurement.
OFF	The receiver has been switched off by pressing the on/off button or on low battery condition. You can switch it on via the receiver power button.

The functions of the main control display

The bottom line of the display is always reserved for the description of the function related to the function key.

▶▶▶▶ F1 Changes the function of **F2**

PARA F2 Opens the parameter settings menu (see section 5)

SESS F2 Opens the file handling menu (see section 6)

SKYP F2 Enters the sky plot facility (see section 4)

RADI F2 Opens the radio configuration menu (see section 7)

STRT F3 Starts the data collecting and recording to the receiver´s PCMCIA card (see section 3)

STOP F3 Stops the data collecting and recording to the receiver´s PCMCIA card (see section 3)

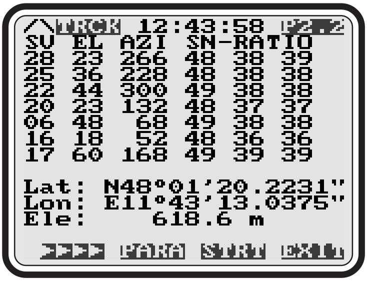
EXIT ESC Leaves the program (see page 11)

Additional functions may be available on **F2**, depending on your recording mode (see section 13.3). In the following chapters you will find further information on the submenus.

Displayed **tracking information** on the first page is:

SV	Satellite PRN number
EL	Elevation angle in degrees
C/A	Number of epochs of C/A-code data. A counter for the number of epochs tracked without a loss of lock. During start-up, the default epoch interval will be used for storing data, you may define a different epoch interval later.
P1	Number of epochs of P-code data on L1
P2	Number of epochs of P-code data on L2

You may display more tracking information using the cursor key ▶. (To scroll back, press ◀).

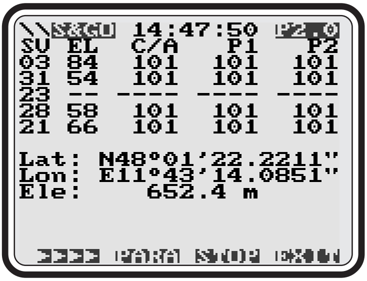


The following will then be displayed:

SV	Satellite PRN number
EL	Elevation angle in degrees
AZM	Azimuth in degrees
SN-Ratio	Signal to noise ratios in dB for C/A, P1, P2. If SNR = 00 the satellite is tracked but the quality of the data is not acceptable. If SNR = "- -" the satellite was tracked, but is not tracked currently.

Each time the system enters one of the recording modes the counter for all satellites will be reset. It will also be reset when a loss of lock occurs for a satellite measurement.

If the receiver stops tracking a satellite, the satellite number will remain displayed for one minute more, marked by a dashed line and will then disappear.



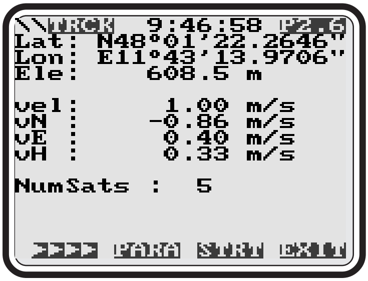
If measurements in C/A, P1 or P2 are not good enough for cm-level positioning, the counter for them will be marked with one dash.

The position/navigation information includes the latitude, longitude and elevation information for the receiver (navigation solution estimate). This position is given in the WGS84 System. The position/velocity is updated with the frequency of the observation interval you have chosen in the parameter menu.

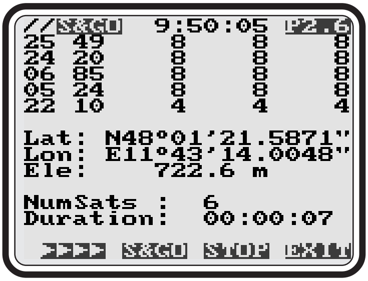
The pages of the main screen

You may use the ▲ and ▼ arrow keys to change between the first page and following pages of the main screen.

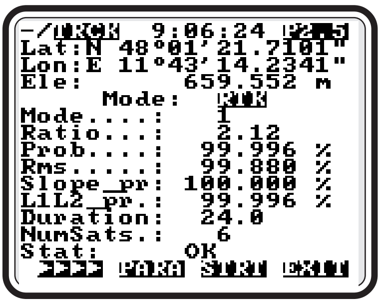
The **second** page will always display position and navigation information. Velocity is not only given in N, E, and height components but also as the absolute value. The number of satellites tracked is also given on that page.



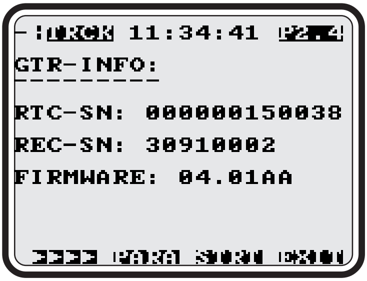
If you have already started recording, the duration of the survey so far is displayed in the last line of that display.



If you are in RTK mode, an additional **third** page will display one of several output tables of RTK positions (RTK output tables). You may switch between these tables using **SFT** + **F1** and **SFT** + **F2** . (If you use the ACU, you may use the PG↓ and PG↑ keys for to toggle the tables). During initialization, the third page also displays status information or error messages.

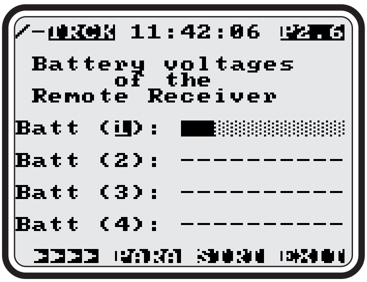


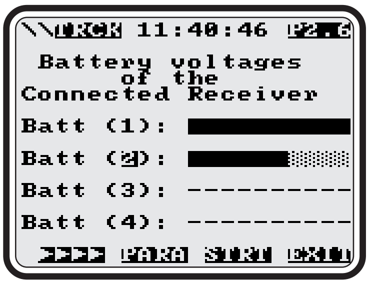
The **following four pages** of display information on the **hardware and software configuration** are available, if you are using the Geotracer® 2204.



First, you will find the "Geotracer - Info" section. This section displays hardware information:

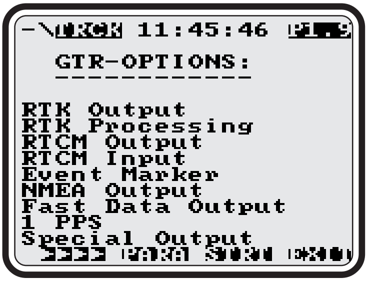
`RTC-SN:`	Serial number of the Real Time Clock.
`REC-SN:`	Serial number of the connected receiver, as shown on the receiver.
`Firmware:`	Firmware version within the receiver.





The next two pages help you to view the voltage status of the batteries of the remote and the connected receiver. Up to four batteries for each receiver may be connected. A connected battery is represented by a bar, a port that is not connected to a battery is represented by a dashed line. The battery in use is indicated with the port flashing.

The bars indicate the voltage of the respective battery. The more of the bar is filled, the better the remaining capacity.



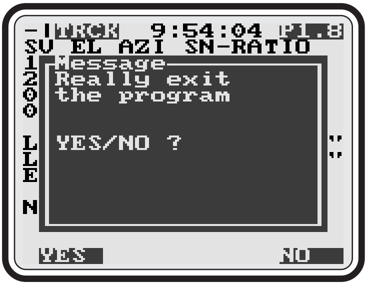
The **last** page summarizes information on your software options. Up to nine options are currently available:

`RTK Output`	Reference mode enabled
`RTK Processing`	RTK mode enabled
`RTCM Output`	RTCM output enabled
`RTCM Input`	RTCM input enabled
`Event Marker`	Event records enabled
`NMEA output`	NMEA enabled
`Fast data output`	Fast operate enabled `(>2Hz)`
`1 PPS`	1 PPS output enabled
`Special output`	Special data output.

Leaving the Program

EXIT
ESC

To leave the program just press the ESC key. The program will ask you to confirm your decision.



YES
F1

Acknowledging with the F1 key will exit the program.

NO
ESC

Press ESC to cancel.

13.3 Recording Modes

The receiver records data onto its internal PCMCIA card independently of the control unit. You can start recording either

- by pressing and holding down the receiver switch-on button for a few seconds when turning it on (long-press),
- by starting a record session with the control unit, or
- by programming an autotimed survey session.

Surveying With The Receiver

You can start a survey without the control unit. Press the ON/OFF button of the receiver and hold it until the LED becomes red. The receiver will automatically start to collect data and store it on the PCMCIA card **using its default parameters** or the parameters set by CU Plus the last time the receiver was used. This is explained in more detail in chapter 1 or the release notes of Geotracer ® 2204.

You can check the data being stored or change the default options by means of the control unit. To do this, attach the unit to the receiver and start the program.

To stop a survey without a control unit, just switch off the receiver. All files will be closed immediately.

For further information on your receiver, please check the respective manual.

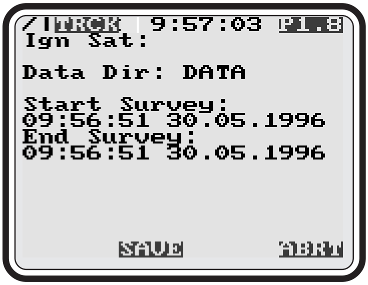
LED
On/Off button

Example: 2200 L1/L2 Reciever

Programming An Autotimed Survey Session

PARA F2

To program an autotimed session, first key in the necessary survey parameters (see section 5.12). Specify the start and end times for the survey, then send them to the receiver by pressing **F2**.



The new parameters are then stored in the receiver and it will begin to save data at the predefined time even if no control unit is attached to it at that moment.

The receiver must remain switched on during the time before the survey should start.

If the receiver is already storing data at the start time of the autotimed survey, it will not stop at the end time, but wait for you to manually stop the session.

Starting and Stopping With The Control Unit Program

STRT F3

You can start a GPS survey with the Geotracer ® 2200 by pressing the **F3** key from most displays. The survey parameters set in the parameter settings menu will be used. You may wish to check these parameters before starting the survey (see section 5).

If the **F3** button is disabled (black on white), then the connection between receiver and control unit has not been established. If the receiver is already recording data, when you start the control unit, the control unit will display the recording mode immediately (function of **F3** will be `STOP`).

STRT F3

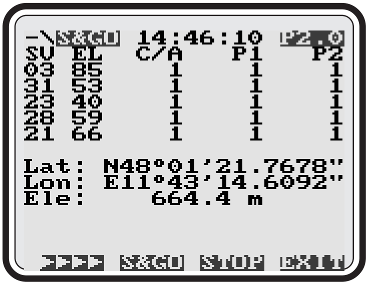
After pressing **F3** you will notice, that the function symbol begins to flash. This indicates, that the system is starting, but not yet recording data. As soon as data is being recorded, and the survey has begun, the flashing will stop.

STOP F3

The function of **F3** changes to `STOP`, which means, that you can stop the recording any time now.

The mode displayed on the header line will now be `REC`, if you first started the program with its default parameters. `REC` stands for recording in static mode. Other recording modes are kinematic (`KIN`) or Stop&Go (`S&GO`), depending on the mode selected in the parameter menu. The epoch counters will be reset to zero.

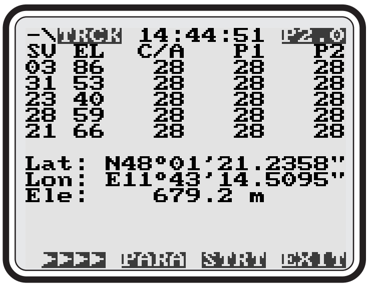
STRT F3



Working in one of the recording modes, the system automatically records observational data onto the PCMCIA card of the receiver. It selects the directory specified in the parameter settings menu for storing data files. The survey parameters used for recording the data are the parameters which were used last time you turned off the system. However, you can change all survey parameters at any time. The recorded data will respond to the parameters, as soon as the settings are saved. These include observation interval, station name, point number, antenna height, etc. For detailed information see section 5. The receiver will now be in GPS surveying mode and you can view the main control display showing the tracked satellites.

STOP F3

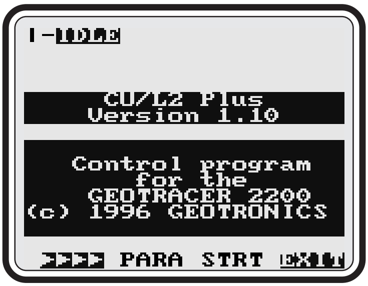
In order to stop the survey, press the **F3** key again. This puts the system to the tracking mode (`TRCK`) in which no data is recorded onto the PCMCIA card of the receiver.



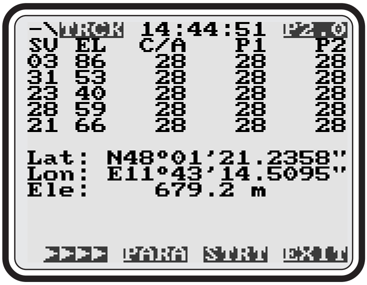
CLASSICAL GPS SURVEYING WITH GEOTRACER® 2200 and 2204 L1/L2 RECEIVER - CU Plus

13.1 Overview of CU Plus

You are using a Geotracer® System 2200 or 2204 , which is very easy to use. The GPS Surveying System was designed so that you, even as inexperienced user, can survey easily with the Global Positioning System. In order to set up the survey system in the field, simply connect the GPS receiver system to the control unit via a serial interface cable, further connect the antenna to the receiver and provide the receiver system with battery power. For more information on the hardware refer to chapter 1. After switching on the receiver, the control unit should also be switched on with a press on **FUNC** + **ESC**. When the control unit is first switched on, it will boot up and start the CU Plus program (even if the CU/L2 program is also installed), then the following screen will be displayed.



The CU Plus program is easy to handle using function keys, the function of which is symbolized by an acronym (abbreviation) just on top of them.



If the receiver is already running and was connected to the control unit before, information about the satellites will appear on the main display of the control unit after a few seconds. Otherwise, the mode "WAKE" will be displayed on the top line. The control unit builds up a connection to the receiver, switches it on and initializes.

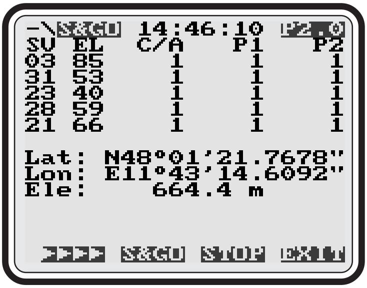
As soon as a sufficient number of satellites can be tracked, the mode changes to "TRCK". This means, that satellites are tracked, but no data are recorded onto the internal PCMCIA card of the receiver.

The bottom line of the screen is reserved for a short description of the four function keys (F1 ... F3 , ESC). The description consists of an 4-character acronym of the related function, just above the function key. Generally the characters are white on black (symbolizing a key of the keyboard). If, however, a function is deactivated, you will see the characters in black on white. If you press a key and the execution of the action takes a little bit longer, the acronym begins to flash.

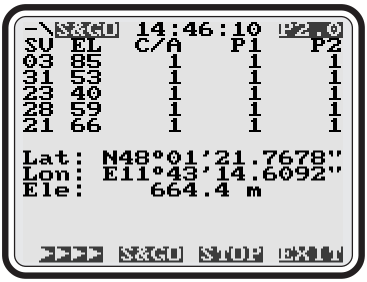
A full description of the functionality follows in the next sections.

13.2 Main CU Control

The main control display will be shown when the program is started. It consists of an overview of the satellites currently being tracked and of navigation information. The top line identifies the mode in which the receiver is working, the current time and the PDOP value. When the system is delivered, the time displayed is GPS-time corrected by 11 seconds, which currently (September, 1996) corresponds to Universal Time Coordinated (UTC) and Greenwich Mean Time (GMT). In order to switch to different time zones you can use the parameter menu which will be described in section 5.

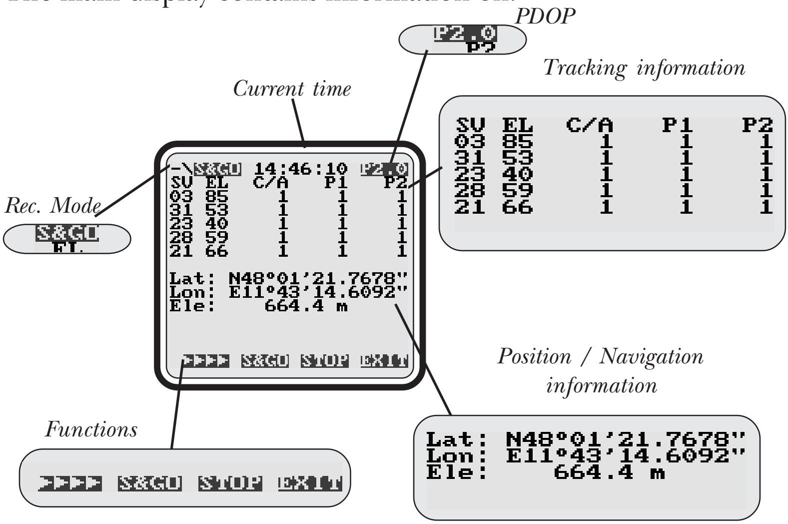


The main part of the display consists of satellite tracking information. Up to 12 satellites can be tracked. Each tracked satellite occupies one line of the display. If enough space remains on the screen, position and navigation information are displayed below the satellite tracking information.



You may use the ▲ and ▼ arrow keys to change between this page and following pages of the main screen.

The main display contains information on:



Receiver modes may be:

IDLE	No satellites are tracked currently.
UNKN	No information available yet.
WAKE	The control unit starts tracking, but has not yet received enough satellites. The receiver may be switched off. The program will try to switch it on.
IDNT	The control unit tries to identify which Geotracer® is connected.
TRCK	The receiver tracks satellites but does not record any data on the PCMCIA card.
REC	When REC is displayed the system is recording observational data of a static measurement on the PCMCIA card. It also stores all available ephemeris and almanac data.
KIN	The receiver is recording observational data of a kinematic measurement.
RTK	The Geotracer® 2204 is in RTK mode.
S&GO	The receiver is recording observational data of a Stop&Go measurement.
OFF	The receiver has been switched off by pressing the on/off button or on low battery condition. You can switch it on via the receiver power button.

The functions of the main control display

The bottom line of the display is always reserved for the description of the function related to the function key.

▶▶▶▶ F1 Changes the function of **F2**

PARA F2 Opens the parameter settings menu (see section 5)

SESS F2 Opens the file handling menu (see section 6)

SKYP F2 Enters the sky plot facility (see section 4)

RADI F2 Opens the radio configuration menu (see section 7)

STRT F3 Starts the data collecting and recording to the receiver´s PCMCIA card (see section 3)

STOP F3 Stops the data collecting and recording to the receiver´s PCMCIA card (see section 3)

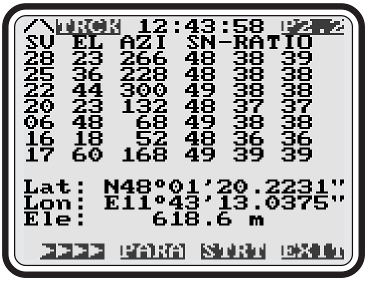
EXIT ESC Leaves the program (see page 11)

Additional functions may be available on **F2**, depending on your recording mode (see section 13.3). In the following chapters you will find further information on the submenus.

Displayed **tracking information** on the first page is:

SV	Satellite PRN number
EL	Elevation angle in degrees
C/A	Number of epochs of C/A-code data. A counter for the number of epochs tracked without a loss of lock. During start-up, the default epoch interval will be used for storing data, you may define a different epoch interval later.
P1	Number of epochs of P-code data on L1
P2	Number of epochs of P-code data on L2

You may display more tracking information using the cursor key ▶. (To scroll back, press ◀).

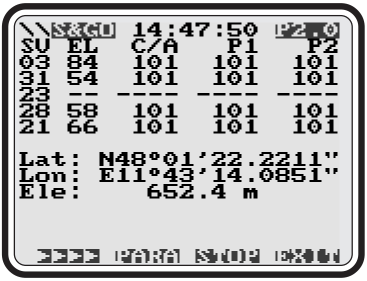


The following will then be displayed:

SV	Satellite PRN number
EL	Elevation angle in degrees
AZM	Azimuth in degrees
SN-Ratio	Signal to noise ratios in dB for C/A, P1, P2. If SNR = 00 the satellite is tracked but the quality of the data is not acceptable. If SNR = "- -" the satellite was tracked, but is not tracked currently.

Each time the system enters one of the recording modes the counter for all satellites will be reset. It will also be reset when a loss of lock occurs for a satellite measurement.

If the receiver stops tracking a satellite, the satellite number will remain displayed for one minute more, marked by a dashed line and will then disappear.



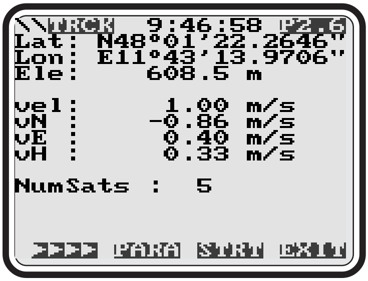
If measurements in C/A, P1 or P2 are not good enough for cm-level positioning, the counter for them will be marked with one dash.

The position/navigation information includes the latitude, longitude and elevation information for the receiver (navigation solution estimate). This position is given in the WGS84 System. The position/velocity is updated with the frequency of the observation interval you have chosen in the parameter menu.

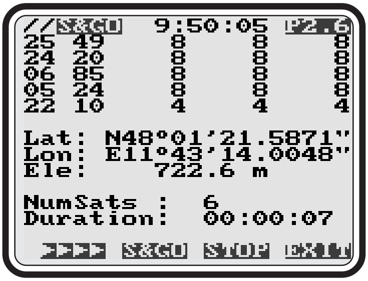
The pages of the main screen

You may use the ▲ and ▼ arrow keys to change between the first page and following pages of the main screen.

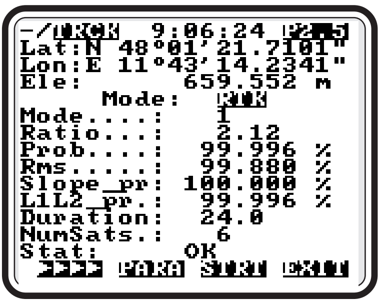
The **second** page will always display position and navigation information. Velocity is not only given in N, E, and height components but also as the absolute value. The number of satellites tracked is also given on that page.



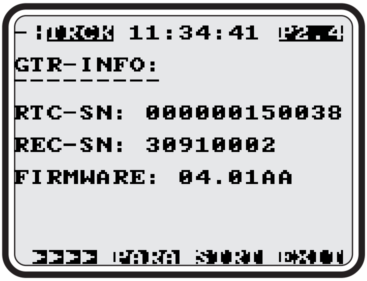
If you have already started recording, the duration of the survey so far is displayed in the last line of that display.



If you are in RTK mode, an additional **third** page will display one of several output tables of RTK positions (RTK output tables). You may switch between these tables using **SFT** + **F1** and **SFT** + **F2** . (If you use the ACU, you may use the PG↓ and PG↑ keys for to toggle the tables). During initialization, the third page also displays status information or error messages.

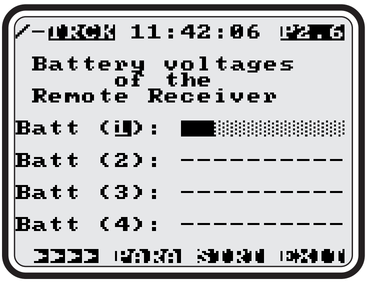


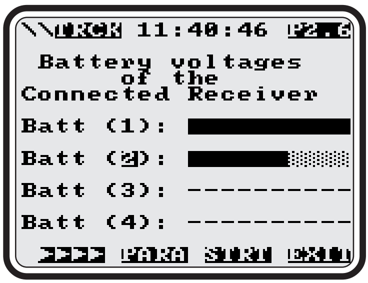
The **following four pages** of display information on the **hardware and software configuration** are available, if you are using the Geotracer® 2204.



First, you will find the "Geotracer - Info" section. This section displays hardware information:

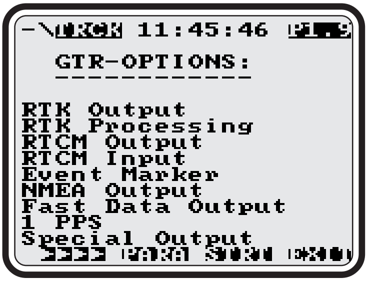
RTC-SN:	Serial number of the Real Time Clock.
REC-SN:	Serial number of the connected receiver, as shown on the receiver.
Firmware:	Firmware version within the receiver.





The next two pages help you to view the voltage status of the batteries of the remote and the connected receiver. Up to four batteries for each receiver may be connected. A connected battery is represented by a bar, a port that is not connected to a battery is represented by a dashed line. The battery in use is indicated with the port flashing.

The bars indicate the voltage of the respective battery. The more of the bar is filled, the better the remaining capacity.



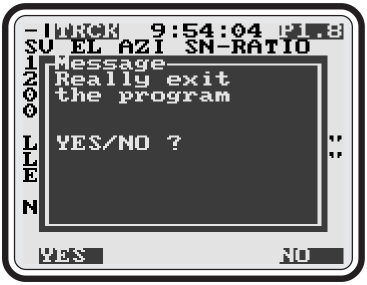
The **last** page summarizes information on your software options. Up to nine options are currently available:

`RTK Output`	Reference mode enabled
`RTK Processing`	RTK mode enabled
`RTCM Output`	RTCM output enabled
`RTCM Input`	RTCM input enabled
`Event Marker`	Event records enabled
`NMEA output`	NMEA enabled
`Fast data output`	Fast operate enabled `(>2Hz)`
`1 PPS`	1 PPS output enabled
`Special output`	Special data output.

Leaving the Program

EXIT ESC

To leave the program just press the ESC key. The program will ask you to confirm your decision.



YES F1

Acknowledging with the F1 key will exit the program.

NO ESC

Press ESC to cancel.

13.3 Recording Modes

The receiver records data onto its internal PCMCIA card independently of the control unit. You can start recording either

- by pressing and holding down the receiver switch-on button for a few seconds when turning it on (long-press),
- by starting a record session with the control unit, or
- by programming an autotimed survey session.

Surveying With The Receiver

You can start a survey without the control unit. Press the ON/OFF button of the receiver and hold it until the LED becomes red. The receiver will automatically start to collect data and store it on the PCMCIA card **using its default parameters** or the parameters set by CU Plus the last time the receiver was used. This is explained in more detail in chapter 1 or the release notes of Geotracer ® 2204.

You can check the data being stored or change the default options by means of the control unit. To do this, attach the unit to the receiver and start the program.

To stop a survey without a control unit, just switch off the receiver. All files will be closed immediately.

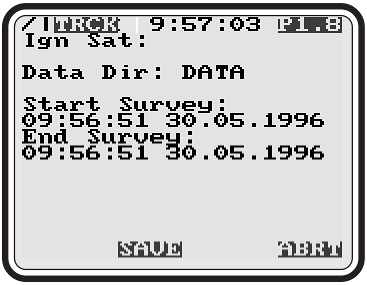
For further information on your receiver, please check the respective manual.

Example: 2200 L1/L2 Reciever

Programming An Autotimed Survey Session

PARA
F2

To program an autotimed session, first key in the necessary survey parameters (see section 5.12). Specify the start and end times for the survey, then send them to the receiver by pressing **F2**.



The new parameters are then stored in the receiver and it will begin to save data at the predefined time even if no control unit is attached to it at that moment.

The receiver must remain switched on during the time before the survey should start.

If the receiver is already storing data at the start time of the autotimed survey, it will not stop at the end time, but wait for you to manually stop the session.

Starting and Stopping With The Control Unit Program

STRT F3

You can start a GPS survey with the Geotracer ® 2200 by pressing the **F3** key from most displays. The survey parameters set in the parameter settings menu will be used. You may wish to check these parameters before starting the survey (see section 5).

If the **F3** button is disabled (black on white), then the connection between receiver and control unit has not been established. If the receiver is already recording data, when you start the control unit, the control unit will display the recording mode immediately (function of **F3** will be `STOP`).

STRT F3

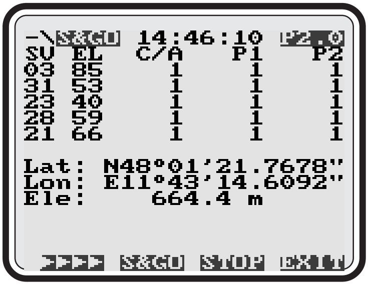
After pressing **F3** you will notice, that the function symbol begins to flash. This indicates, that the system is starting, but not yet recording data. As soon as data is being recorded, and the survey has begun, the flashing will stop.

STOP F3

The function of **F3** changes to `STOP`, which means, that you can stop the recording any time now.

The mode displayed on the header line will now be `REC`, if you first started the program with its default parameters. `REC` stands for recording in static mode. Other recording modes are kinematic (`KIN`) or Stop&Go (`S&GO`), depending on the mode selected in the parameter menu. The epoch counters will be reset to zero.

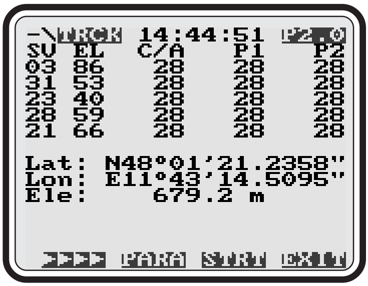
STRT F3



Working in one of the recording modes, the system automatically records observational data onto the PCMCIA card of the receiver. It selects the directory specified in the parameter settings menu for storing data files. The survey parameters used for recording the data are the parameters which were used last time you turned off the system. However, you can change all survey parameters at any time. The recorded data will respond to the parameters, as soon as the settings are saved. These include observation interval, station name, point number, antenna height, etc. For detailed information see section 5. The receiver will now be in GPS surveying mode and you can view the main control display showing the tracked satellites.

STOP F3

In order to stop the survey, press the **F3** key again. This puts the system to the tracking mode (`TRCK`) in which no data is recorded onto the PCMCIA card of the receiver.



13.3.1 Static Mode

Using the parameter settings menu you may choose the mode of data recording.

STRT F3

To make a static survey, just position the antenna over a point and press **F3**. The symbol STRT will begin to flash, indicating that the system is initializing and the measurement will start as soon as the flash has stopped. The function of **F3** will change to STOP. Now **F3** allows you to stop the measurement of the point whenever you want.

STOP F3

Pressing **F3** stops the measurement and the observation file will be completed. Point parameters as saved in the parameter menu are also saved in the observation file (point information, antenna information, etc.).

STOP F3

During measurement, you may use the file handling options (deleting the current recording session deletes all measurements up to the moment of deleting!), the parameter settings menu, the sky plot function or the radio configuration menu.

13.3.2 Kinematic Mode

A kinematic survey is made in the same way as a static survey.

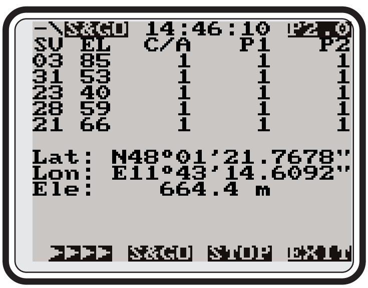
Setting the parameter `Mode` to `Kinematic` allows you to move the antenna during measurement. The procedure to start and stop surveys are the same as in static mode. You will notice a difference from the static mode only when post-processing the data.

13.3.3 Stop&Go Mode

This mode should be selected, if you want to survey more than one point in succession, and for initialization of the system to the high precision mode. After initialization you will be in the cm-accuracy level. Using Stop&Go mode, the duration of stop point occupation is system defined, but may be modified by you. Ths system is able to automatically measure and store point positions by only one keystroke!

STRT F3

Press **F3** to start the Stop&Go measurement. The name of the result file will depend on the entry to line `Point` of the parameter settings menu (4 last characters), the current day of the year and a session identifier. The session identifier is `A...Z, 0...9`. The system selects the first unused letter for the current point and day of the year during measurement. All stop points measurements will be collected in this file.



You will notice, that new functions are presented on **F2**.

These new functions are

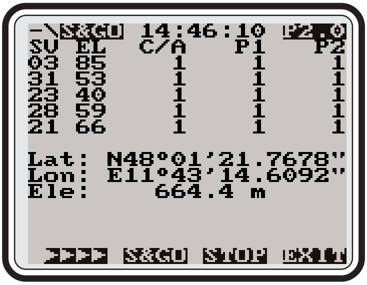
S&GO F2	Stop&Go Measurement of a stop point,
VSFB F2	VSFB Initialization,
KNPT F2	Known Point Initialization,
SHST F2	Short Static Initialization.

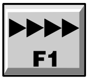
The previously introduced functions (parameter setting, skyplot, file handling, radio configuration) are still available (see section 2).

By using Stop&Go mode you can get cm-accurate point measurements after initialization. Therefore, the system should be initialized before point measurement starts. A complete description of the initialization features is given in chapter 4 of the RTK manuals. Please refer to that chapter for information on the differences of initialization methods and the accuracies that can be reached using them. Here, we will concentrate on the handling of the software.

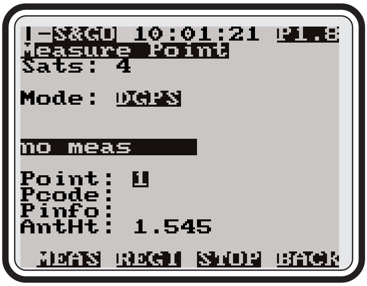
Even though the aims of initialization and measurement are rather different, the display and the handling of the software are very much alike. Therefore, this section concentrates on the description of the measurement function itself, and the next sections explain the differences for the three initialization methods.

Point Measurement





To carry out a Stop&Go survey scroll through the F2 functions with F1 until `S&Go` is displayed. Then press F2 . The following display will be shown.



The header will show `Measure Point`. Below this, you will see information on the number of satellites tracked and the precision estimate by the software (`Mode`). This can either be `DGPS`, which indicates meter-level accuracies or `PREC` for accuracies in the cm level.

Precision indicators DGPS or PREC are only estimates! Only after postprocessing will you definitely know the precision of your survey. Therefore, to be on the safe side, you should never forget to carry out initializations after loss of lock! Reoccupation of previously measured points at various times during the survey is strongly recommended. You should ALWAYS end the survey at a reliable known point or at the VSFB.

Four lines are used for point information. You may enter the following:

• Point point number of up to 8 characters. The point number will be incremented automatically after registration, but you may change the number any time.

• Pcode: The Point Code may consist of up to 16 characters. After registration it will remain unchanged, and so is duplicated for the next point. You may change the value manually.

• Pinfo: The Point Information may consist of up to 15 characters. After registration it will remain unchanged, and so is duplicated for the next point. You may change the value manually.

• AntHt: The signal height of the antenna. It may have three decimals. After registration it will remain unchanged, and so is duplicated for the next point. You may change the value manually.

The stop point information can be accepted or changed for every stop point before registration. Due to the nature of GPS data, they cannot be changed later.

The function keys now have the following functions:

MEAS F1 measure a stop point,

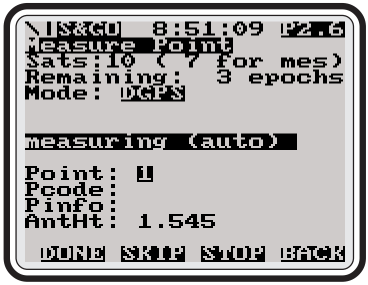
REGI F2 register the measurement manually when finished or measure and register,

STOP F3 stop the recording of data,

BACK ESC return to the Main Control Display.

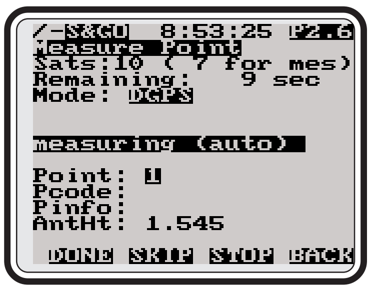
Start of stop point measurement

Pressing F1 starts the stop point measurement.



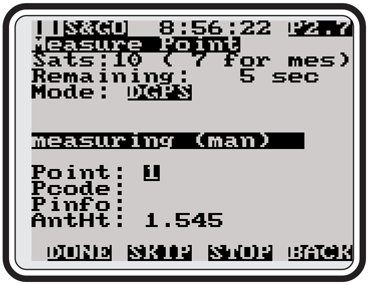
New information is displayed:

• Remaining: The minimum number of epochs and the minimum time in seconds that are necessary to measure the stop point positions are displayed. These values are user defined in the parameter menu. The number of epochs counts down to zero, and so does the time. The measurement is accepted as being completed when both, epochs and time, have been counted down to zero.



DONE
F1

• Duration: If line `AutoMode` of the parameter settings menu is set to `Never`, measurement will continue until you stop it using **F1**. When the "Remaining" epochs and time have finished, the duration of measurement is shown instead, starting from the first epoch.



The bottom line of the information block gives you the current status. The status may be:

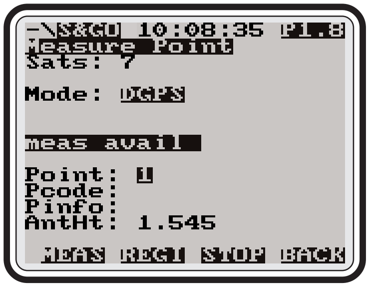
- • no meas — No stop point measurement available for registration. If a measurement existed, it has been skipped.
- • measuring — Measurement is being made, either in automatic stop mode `(auto)` or to be stopped manually `(man)`.
- • meas avail — Measurement is available for registration,
- • meas stored — The last measurement has already been registered and can not be registered again.

The functions of **F1** and **F2** are now:

DONE F1 Finish measurement

SKIP F2 Skip measurement

While measuring the stop point the status line displays `measuring`. When the measurement has finished, the computer or control unit will beep, and the display will change to `meas avail`, while the functions of the function keys will be revised.

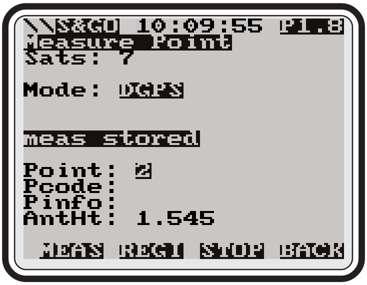


MEAS F1

You now can decide whether you want to register that point measurement, or measure another stop point without registration of that measurement (e.g., because you noticed, that you did not hold the rod with the antenna steady). Skip the storage of that measurement by remeasuring. Press **F1**.

REGI F2

Generally, however, you will want to register the measurement with F2. The measurement will not be stored in the observation file until you have registered with F2.



REGI F2

MEAS F1

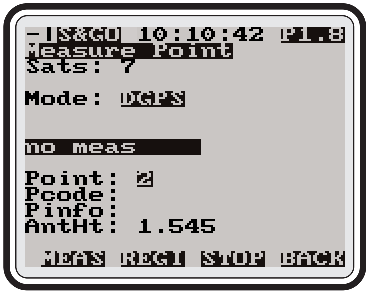
Having registered using F2 the status line will change to `meas stored`. Now you may move the antenna to a new stop point and measure again using F1.

DONE F1

If you think to have sufficient measurements you may finish the measurement with F1. However, a certain number of epochs is necessary for good estimation of the precision in postprocessing. Therefore, it may take some time before you are allowed to register or measure.

SKIP F2

If you want to skip a measurement (e.g., you noticed, that the antenna was not held steady during measurement), press F2 . No measurement data will be available for registration and the point number will not be incremented.



REGI F2

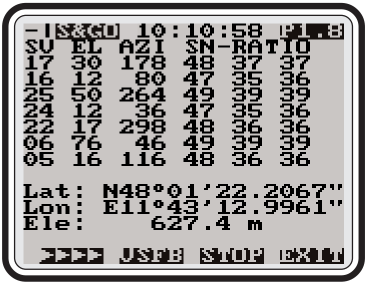
A "one key" measure and store function exists: press F2 without first pressing F1. This means, that data is measured and registered immediately. The display shows `no meas` or `meas stored`. You should choose the "one key" mode only when you are sure that **no skipping of measurement** will be necessary, and **after** entering point information `Pcode` or `AntHt`. The "one key" mode is of great use if the Autostop parameter is set to `Always` or, in case of point measurements, to `MeasOnly`.

BACK ESC

STOP F3

If you want to initialize or use some of the other functions of F2, press ESC to return to the Main Measurement Display. If you want to stop the recording of data, press F3.

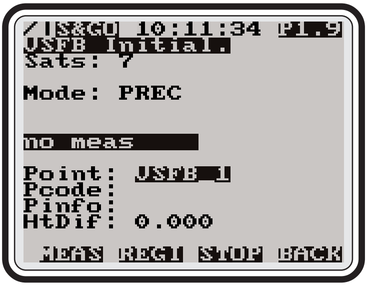
VSFB Initialization



▶▶▶▶ F1

VSFB F2

First, select the Stop&Go Mode, then scroll through the functions of F2 using F1. When `VSFB` is shown, press F2 to select the VSFB initialization mode.



The VSFB display is very similar to the Main Measuring Mode display. The header line, however, indicates the initialization mode `VSFB Initial`. Another difference is seen in the bottom line of the point information block, where any antenna height difference between the two antennas may be entered (`HtDif`).

The point number will automatically be set to `VSFB_1`, but it may be changed to any value. Since more than one VSFB measurement is possible, the point number will be incremented automatically.

All other features are the same as in the Stop&Go point measuring mode. You may measure, register, interrupt or skip the measurement.

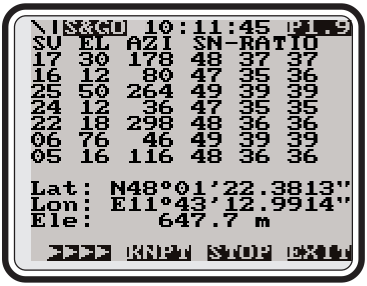
After successful VSFB initialization, i.e., if the measurement was not skipped, the measurement precision mode automatically switches from `DGPS` to `PREC` .

BACK ESC

STOP F3

If you want to start measuring stop points or to use some of the other functions of **F2** , press **ESC** to return to the Main Measurement Display. If you want to stop the recording of data, press **F3**.

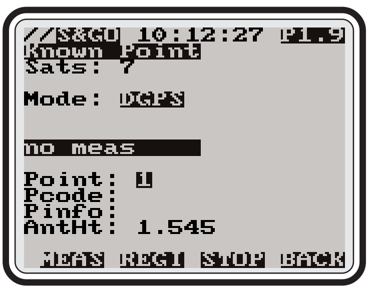
Known Point Initialization



►►►► F1

KNPT F2

First, select the Stop&Go Mode, then scroll through the functions of **F2** using **F1**. When `KNPT` is shown, press **F2** to select the known point initialization mode.



The display is very similar to the Main Stop &Go Measuring Display. The header line, however, indicates the initialization mode, `Known Point`.

All other features are the same as in the measuring mode. Move the antenna to a point, whose coordinates are known very accurately. This may be a point you have surveyed with GPS from the same reference point or a point you already measured in precise mode (PREC) in this session. You now may measure, register, interrupt or skip the measurement.

After successful known point initialization, i.e., if the measurement was not skipped, the measurement precision mode automatically switches from `DGPS` to `PREC` .

BACK ESC

STOP F3

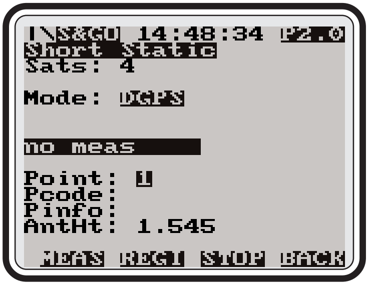
If you want to make some stop point measurement or to use some of the other functions of **F2** , press **ESC** to return to the Main Measurement Display. If you want to stop the recording of data, press **F3**.

Short Static Initialization

▶▶▶▶ F1

SHST F2

From the main Measurement Display scroll through the functions of **F2** using **F1**. When `SHST` is shown, press **F2** to select the short static initialization mode.



The short static display is very similar to the Main Measuring Display. The header line, however, indicates the `Short Static` initialization mode.

All other features are the same as in the Stop&Go measuring mode. Move the antenna to a point which should be well defined and marked so that it can be reoccupied. You now may measure, register, interrupt or skip the measurement. In short static mode measurement should go on for some minutes. You can specify a user defined default in the parameter menu `(Short Static)`.

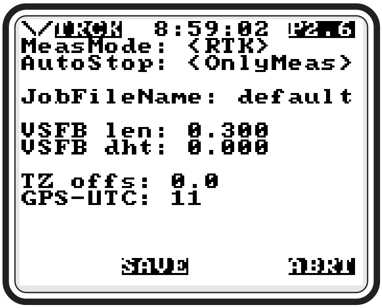
After a successful short static initialization, i.e., if the measurement was not skipped, the measurement precision mode automatically switches from `DGPS` to `PREC` .

BACK ESC

STOP F3

If you want to make some more stop point measurements or to use some of the other functions of **F2**, press **ESC** to return to the Main Measurement Display. If you want to stop the recording of data, press **F3**.

13.3.4 RTK Mode



The Geotracer® 2204 has the additional option of surveying in high precision real-time kinematic mode. The RTK mode allows you to retrieve positions in real time and to write results into a job file, which needs no postprocessing.

In the RTK mode, positions can be stored to a chosen accuracy. RTK has an accuracy of a few centimeters, DGPS has an accuracy of approximately one meter.

Choose RTK mode
The RTK processing mode can be entered by two ways. Either with a second press of the 2204 receiver On/Off button, or by selecting RTK mode from the Parameter menu.

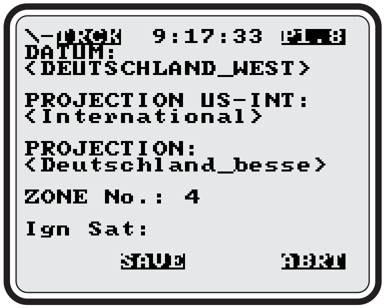
PARA F2

SAVE F2

By default, the receiver is _not_ in RTK processing mode when it is switched on, even if RTK mode is set in the parameter menu. RTK calculation mode must be reset by a short press of the On/Off button or, by saving the parameters once. (Select F2 and then F2). (Be careful that the reference station coordinate is correct for its current location!)

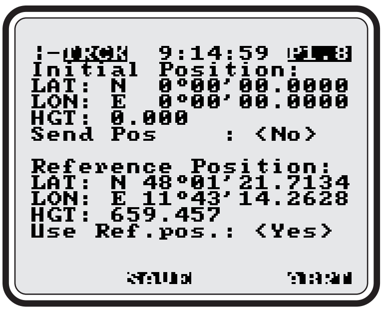
Selecting a System

You can choose the datum and projection for national grid / state plane coordinates from the parameter menu. The projections are divided into two lists to accelerate the search for a projection. The list `United States` contains the US state plane projections, while the list `International` contains all other projections found in the ACU/RTK system.



Reference Station Coordinates

For the RTK mode, the receiver must first establish a coordinate for the Base Station (Reference). You can enter a Reference position in WGS84 Lat, Long Height in the Parameter menu line Reference Position (see section 13.5), and flag that it should be used by the Receiver (line `Use Ref.Pos.`). This is the most reliable way to start. If no reference is entered, or the flag is set to `No` (do not send the reference to the receiver), the RTK calculator will make a single point average over a period of 150 seconds, before starting calculations.



Combining Precision Modes

In RTK mode you may choose the precision or may combine the DGPS and RTK precision modes. The following precision modes are available in the parameter menu:

DGPS mode: will output and allow recording of points at all times that base station data is received. Accuracy is typically sub-meter; Reliable even without initialization.

RTK mode: will output and allow recording of points when base station data is received and RTK accuracy is achieved. Accuracy is typically +/- 1..3 cm; initialization is necessary.

DGPS + RTK mode: This allows you to combine the reliability of DGPS data and the precision of RTK data. During initialization and re-initialization phases, the system automatically chooses the DGPS mode in order to provide positions. When the initialization has finished and RTK positions are available, CU Plus automatically switches to the RTK precision mode.

Single point mode: will allow positioning and output whether data is received from the base station or not. The receiver creates a single point position for every epoch (accuracy +/- 100m). No point measurement is possible.

Recording in RTK mode

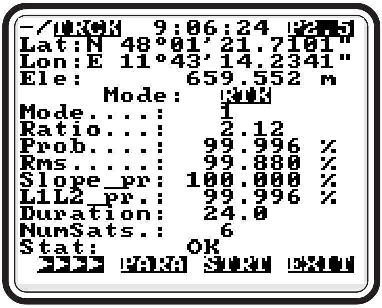
The method of recording points in RTK mode is almost identical to the method described already for Stop&Go. However, you should first go to the parameter menu, define a job file name and enter all labels that should be recorded. Please refer to chapter 10 of the ACU/RTK manual for more information on labels. An updated list on labels is appended to this chapter 13.

There are two label lists that should be entered. The first is the job file header information (line `Job-file Header`). We suggest that you include at least station name (label 2), instrument height (3), and administration data. The second is the list of labels stored at each point (line `Stop Point Measure`). This can be a point number (label 5), code (4), and coordinates (37,38,39), or the more comprehensive list of default labels from the ACU/RTK system. The labels available include most of those supported by Geodimeter® Total Stations.

When RTK mode has been selected, the same point measurement option as in the Stop&Go mode is available. The only difference is, that you may additionally view RTK results on the main and the Stop&Go screen.

Viewing Results

The main display will continuously show three lines of RTK results on its third page (output tables). During initialization phases additional status information is displayed. To toggle the pages of the main display press the ▲ and ▼ arrow keys.



Seven different types of RTK output tables are available. These are listed in the following:

N,E,H	North, East, Elevation (Default)
Nr,Er,VD	Rel. North, Rel. East, Vertical Distance
HA,VA,SD	Hor. Angle, Vert. Angle, Slope Distance
HD,DHT	Hor. Distance, Delta Height
84X,84Y,84Z	WGS84 X, Y, Z
d_X,d_Y,d_Z	Delta x, Delta y, Delta z
Lat,Lon,Ele	Latitude, Longitude, Elevation

To switch between the seven tables press the SFT + F1 and the SFT + F2 keys. (If you use the ACU, you may use the PG↓ and PG↑ keys for to toggle the tables).

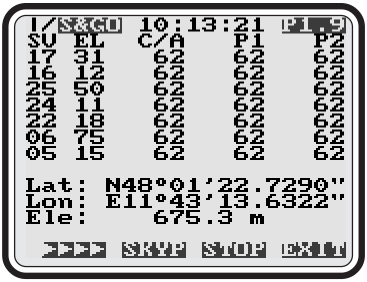
If no tables are available in RTK mode, the RTK page shows an error message instead (refer to the Appendix to this chapter).

13.4 Sky Plot

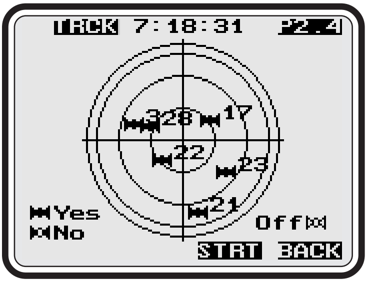
►►►► F1

SKYP F2

Enter the sky plot facility from the main control display using function keys **F1** and **F2**.



The sky plot is used to show the satellite locations in the form of a polar plot. All visible satellites are drawn on the polar plot. The visibility (azimuth and elevation) is computed from the almanac information stored in the control unit or field computer. Visible satellites which are tracked are drawn in black (`YES`). Visible satellites not tracked consist of a light-coloured body and black wings (`NO`), while satellites disabled via parameter menu are drawn as light-coloured (`OFF`).



Satellites at the center of the cross have an elevation of 90 degrees, circles mark 60 and 30 degrees. Satellites near the outer circle have a low elevation down to 0 degrees. The 4th circle indicates the current elevation mask setting. The orientation of the plot is to the North.

STRT F3

BACK ESC

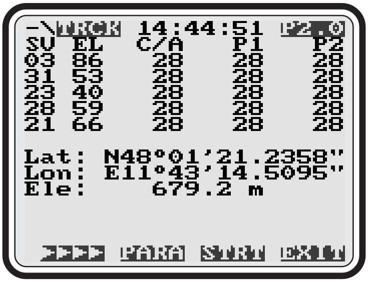
You may start/stop recording data with **F3** or exit to the main control menu with **ESC**.

▶▶▶▶ F1

PARA F2

13.5 Survey Parameters

Enter the parameter settings menu from the main display via the F1 and F2 keys.



The parameter settings menu allows you to define all survey parameters.

In order to position the cursor, use the ▲ and ▼ keys. Pressing ▼ at the bottom line shifts the display to the next page. In the same way, a press of ▲ at a top line changes to the previous page. A long press on ▲ or ▼ allows a fast scroll through the pages of the menu.

For some of the parameters, a text or number can be entered or edited. Some, such as "Ant.", are selected from a list of predefined values. You can move through the list using ▶ and ◀ . A > sign right of the value indicates, that more values follow when pressing ▶, < indicates the same for ◀ .

If you want to delete a character left of the cursor, then press ←, FUNC + ← deletes the character under the cursor.

Generally, the software detects, whether numerical or alpha characters are expected and inserts the correct character automatically. E.g., for `Elev` an angle is expected, expressed in a numerical value. If, however, alpha and numerical values are allowed as, e.g., for `Point`, you have to use the ALPH NUM (or similar) toggle switch to change the keyboard function. With the Geotronics control unit, a press on ALPH NUM changes from the numerical function of the keys to capital letters, and vice versa. If you want to display lowercase letters, press SFT each time a letter shall be displayed.

ABRT ESC

Pressing the ESC key while you are in the parameter settings menu will recover the old parameters values before you started making changes.

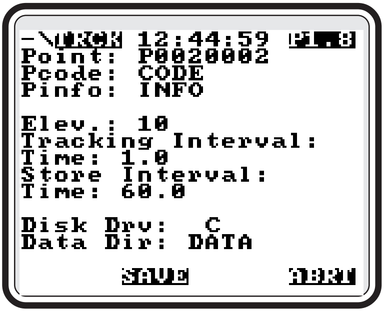
SAVE F2

Please note, that no parameter is set until you save the parameter menu using F2.

The functions related to the screen have the following meaning:

SAVE F2 — Set parameters according to the new entries. Parameters are set, as soon as the flashing of the symbol stops.

ABRT ESC — Leave the parameter settings menu without making any changes.



13.5.1 Point Definitions

On this page you can enter the point information for each station. They are only used as identifiers in the files when storing data and are required for postprocessing .

Point: 16 character point number. The names of the files, where the observation data will be recorded, are derived from it (refer to the appendix) - Default value: P00XYYYY where X starts at 1, YYYY are the last four digits of the receiver serial number.

Pcode: 16 character point code - Default value: CODE

Pinfo: 15 character point info - Default value: INFO

13.5.2 Elevation Mask And Observation Interval

These parameters control which elevation mask and tracking or observation interval are used by the receiver.

Elev: Elevation mask in degrees, no satellites are tracked below the displayed elevation angle (default value 10°) (minimum: 0°, maximum: 90°).

Note: An elevation angle below 10 ° will not be used when estimating the duration of initialization and stop point measurement. In this case, the system will only consider satellites with a higher elevation.

Tracking Interval Time: Data output rate for RTK observations and reference station data. The minimum value is 0.5 sec and the maximum 999 sec (default 1 sec). On Geotracer® 2200, this rate is fixed to be the same as the observation interval.

Store Interval Time: Recording interval for static/kinematic observations. The value must be a multiple (up to 3600) of the tracking interval. For example, the minimum is 1 second and the maximum is 3600 seconds, if the tracking interval is 1 second. Default: the same as the tracking interval (1 second).

13.5.3 Drive and Directory Definition

Disk Drv: defines the drive of the PCMCIA card. A 2204 receiver has two PCMCIA slots. Press ▶ and ◀ to select one of the drives (`C:\` or `D:\`).

Data Dir: Define the directory in which the data shouldbe stored. If the directory does not exist, it will be created. Default directory: DATA.

The drive and directory can not be changed during recording data. If you want to manuipulate already stored files during recording, you may change the drive and directory in the parameter menu. This change will not affect the data recording!

13.5.4 Instrument Eccentricities

These instrument eccentricities represent the position difference between the antenna and the point on the ground you are currently measuring. You may enter these values for the connected antenna and for the reference station antenna.

H ecc: Displacement in height. Default value: 1,545 m. (min: -99.999, max: 99.999) see also section 5.4 !

N ecc: North displacement: Default value: 0 (min: -99.999, max: 99.999)

E ecc: East displacement, Default value: 0 (min: -99.999, max: 99.999)

13.5.5 Antenna Definition

Here you define the way you measure the height of the antenna (see 5.3: height eccentricity parameter) and the type of antenna in use.

Hgt.: The antenna height can be measured in different ways:

1. `Instrument`: As an instrument height from the survey mark to the mark on the antenna.
2. `Slope`: As a Slope distance from the survey mark to the outer edge of the antenna ground plane (not supported for S&Go point occupations!).
3. `True Vert`: As a true vertical from the survey mark to the antenna phase center.

Default value: Instrument.

Geotracer® Processing Software includes a file called GPS.INI. This contains information on antenna dimensions used to correct for the different measurement types.

The line concerning the antenna has the following meaning:

```
Instrument Height Corrections: name type a b c1 c2
```

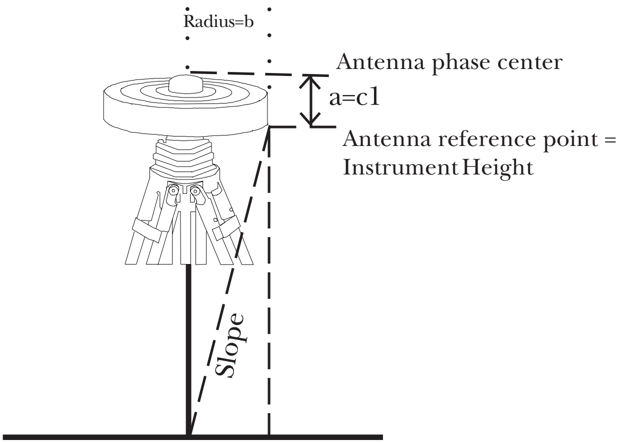
Units in file GPS.INI are 0.1 mm !

The geometrical meaning of the parameters a, b, c are described in the following pictures. The parameter "a" in file GPS.INI stands for the distance between the antenna reference point and the antenna phase center. The parameter b stands for the radius of the antenna, which is important for to reduce from slope to vertical. "c1" stands for the L1 phase center, "c2" for the L2 antenna phase center.

For Geotracer® antennas we generally do not refer the antenna reference point to the lowest surface of the antenna, we refer it to specified points for our different antenna types. Please note, that for all Geotracer ® antenna types, the parameter "a" is equal to the parameter "c1". Both parameters stand for the difference between the antenna reference point and the antenna phase center.

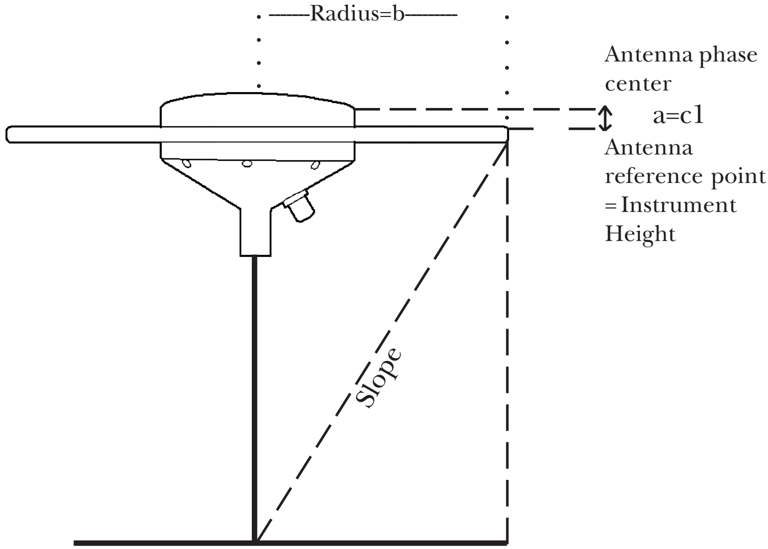
Choke_Ring_L2:

Antenna reference point: Lower edge of ground plane
Antenna eccentricities: L1: a = c1: 0.098m L2: c2: 0.093m



Geodetic_with_GP_L2:

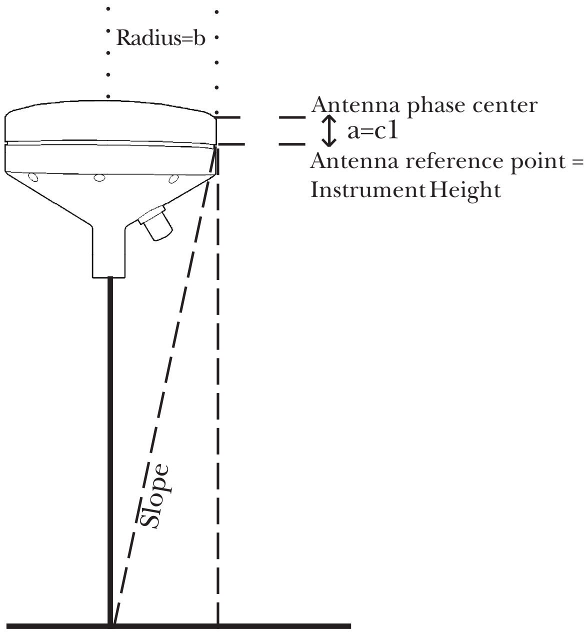
Antenna reference point: Top edge of ground plane
Antenna eccentricities: L1: a = c1:0.028m L2 : c2: -0.003m

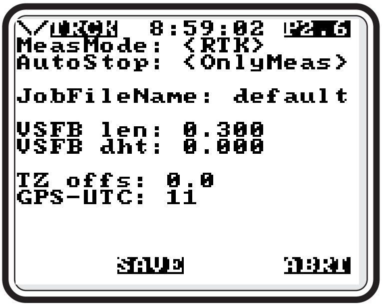


Compact_L2:

Antenna reference point: Connection of the white plastic top to the orange body

Antenna eccentricities: L1: a = c1: 0.037m L2 : c: 0.010m





13.5.6 Mode Definition

This allows you to define the mode in which the receiver records data. You will find an additional parameter for Stop&Go mode.

MeasMode: You may choose whether the receiver collects data in `Static`, `Kinematic`, `Stop&Go` or `RTK` mode. Press ▶ and ◀ to select the mode. Default: `Static`

AutoStop: Here you may choose whether the measurement will be stopped automatically or not. If set to one of the automatic modes, the measurement will stop when the criteria defined in the parameter settings menu for point measurement or initialization are fulfilled.
`MeasOnly`: Point measurements will be stopped automatically when the values set in the parameter menu have been reached. Initialization, however, will continue until you press **F1** or **F2**.
`Always`: Point measurements and initialization measurements will be stopped automatically when the values set in the parameter menu have been reached. You can still stop the measurement manually using **F1** or **F2**.

DONE F1

SKIP F2

DONE F1

SKIP F2

`Never:` You have to press F1 or F2 for point measurements and initialization measurements to stop measurement.

Default: `MeasOnly.`

13.5.7 RTK - Jobfile Name Definition

This option is only valid, if you have chosen the RTK option with an 2204 receiver.

You may enter a name for the job file of up to eight alphanumeric characters. The system automatically appends the suffix `*.JOB`.

The entry `Default` results in the name `DEFAULT.JOB.`

13.5.8 VSFB Initialization Parameters

The VSFB initialization is a method that is used to get cm-accurate positions in postprocessing especially when using the system without the OTF option. In order to perform a VSFB (Very Short Fixed Baseline) measurement you have to position two receiver antennas, separated by a very short and accurately known distance. You have to provide the two parameters `VSFB length` and `difference in height` for the postprocessing. The system calculates the azimuth of the VSFB automatically.

VSFB len: You may choose the horizontal distance between the phase centers of the two antennas when initializing with VSFB. The default value of 30 cm refers to the Geotracer® VSFB device.

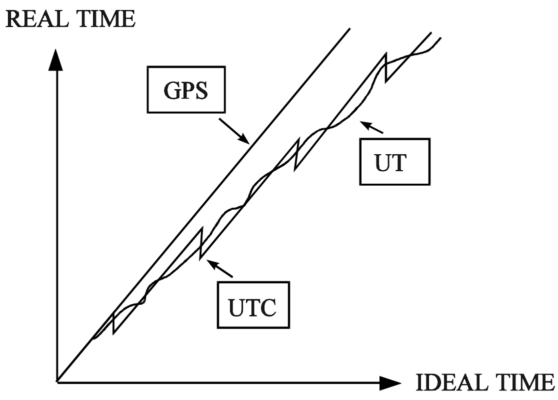
If you want to use your own device enter the horizontal distance between the phase centers of both antennas. An accuracy of ±1 cm is sufficient to initialize the system.

VSFB dht: You may enter the difference in height between the phase centers of the two antennas. An accuracy of ±1 cm is sufficient to initialize the system. This improves speed and accuracy of the initialization. The most convenient way is to set the rod so that the height difference is within one centimeter and to enter a height difference value of 0 cm.

The height difference value has a positive sign if the rover is higher than the reference antenna, a negative sign if the rover antenna is lower than the reference antenna!

13.5.9 Time Definition

Here you may define a time zone offset and the difference between UTC (Universal Time Coordinated) and GPS time in seconds. The UTC and GPS times differ by full seconds. This is due to the fact that the GPS time is a continuous time whereas UTC is using leap seconds.
The current (September 1, 1996) GPS-UTC time difference is GPS-UTC = +11 seconds. The time difference between International Atomic Time and GPS is IAT-GPS = +19 seconds.



UT: time derived from astronomical observations (Universal Time)

`TZ offset:` You may enter the time zone offset between UTC and the desired time zone manually.

`GPS-UTC:` Change this parameter, when a change in the leap seconds is announced by the GPS specific press.

Defaults: TZ offset: 0
GPS-UTC: 11

13.5.10 Position Definition

Initial Position (Connected Receiver)
In some cases it might be necessary to provide an initial position of the connected receiver to the receiver. This can help to reduce the time to first fix if the receiver was last used in a different location. Please use the " `Initial Position`" section to provide latitude, longitude, height information in geographical coordiantes.

Default values: LAT 0, LON 0, HGT 0.

Line `Send Pos` allows you to define whether the initial position should be used.

Reference Station Position (Remote Receiver)
The "`Reference Position`" section allows you to enter the latitude, longitude, height coordinates of the reference station. This is recommended, if you are surveying in RTK mode. If you do not enter a reference position, the system will calculate a single point position. If you are surveying with several sessions, a reference position is mandatory.

Line `Use Ref.pos.` makes the reference position coordinates available to the system if it is set to `Yes`. Press ▶ and ◀ to toggle `Yes` or `No`.

13.5.11 System Definition

For data output in RTK mode the system needs information on the geodetic system. Chapter 8 of the ACU/RTK manual provides complete information on Coordinate Systems.

A block of system parameters allows you to choose the datum, the projection and to enter zone information, if necessary. To search for an item in the lists enter its initial character and then use ▶ and ◀. Please refer to Appendix D of the ACU/RTK manual for complete lists of datums, ellipsoids and projections.

`Datum:`	List of datums
`Projection US-Int:`	Toggles two lists of projections.
`United States:`	contains the US state plane projections
`International:`	contains all other national grids found in the ACU/RTK system.
`Projection:`	projections of the list selected above.
`Zone:`	Enter zone information manually, if necessary. If you enter a zone that is not available for the projection or if you enter the zone definition `0`, CU Plus will automatically set the value to `Not Used`.

13.5.12 Satellite Definition

The "`ignore satellite`" function allows you to disable satellites which you do not want to track or record.

`Ign Sat:` Enter the PRN numbers of the satellites to be disabled, separated by a blank character. Default: No satellite PRN number.

13.5.13 Autotimed Survey

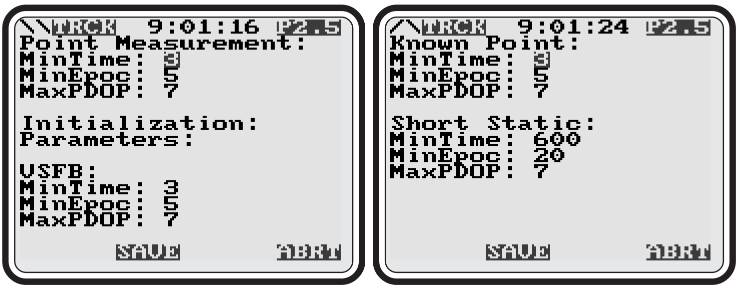
With your CU software you have the capability of recording data at predefined times. You simply enter the date and time the software should start recording data, and the date and time it should stop. The software has to be left running for it to start an autotimed survey.

Below the line `Start Survey` you may first enter the time, then the date, at which the survey shall be started. Default: `current time and date.` Use the following outline: `hh:mm:ss dd.mm.yy`

Enter end time and date in the same way below line `End Survey.`

If the end time you entered preceeds the start time the program will not start recording data at all.

13.5.14 Stop&Go Occupation Duration



This set of parameters is related to all kinds of measurements in the Stop&Go mode, i.e. to point measurement as well as to the initialization measurements. These parameters are only valid, **if the measurement is to be finished automatically** (see `AutoStop`).

For each point you may determine

- `MinTime` The minimum time, after which a point measurement or initialization shall automatically be finished.

- `MinEpoc` The minimum amount of epochs, after which a point measurement or initialization shall automatically be finished.

Both values must be exceeded before measurement stops automatically.

- `MaxPDOP` The maximum PDOP value, which shall be considered for measurement. If the PDOP exceeds this value, the time and epoch counters will be reset to zero. Measurement will go on until the minimum epochs and time of measurement having a better PDOP have passed. You may of course, always finish the measurement manually.

Default values:

`Point Measurement:`
`MinTime` 8 sec
`MinEpoc` 10
`MaxPDOP` 7

`Initialization Parameters:`

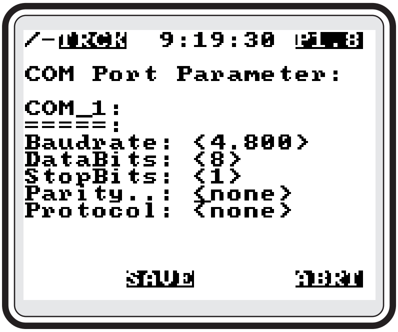
`VSFB:`
`MinTime` 3 sec
`MinEpoc` 20
`MaxPDOP` 7

`Known Point:`
`MinTime` 3 sec
`MinEpoc` 10
`MaxPDOP` 7

`Short Static:`
`MinTime` 600 sec
`MinEpoc` 10
`MaxPDOP` 7

The following parameters are only of interest, if you have purchased the On-the-Fly Option for your postprocessing software. In this case, you do not have to initialize manually, but the system initializes automatically. If you can not use the On-the-Fly initialization, you should set `On-the-Fly MinTime` to the value `3600` in order to prevent misleading display of mode `PREC`.

`On-The-Fly:`
`MinTime` 300 sec
`MinEpoc` 20
`MaxPDOP` 7



13.5.15 COM Port Parameters

The COM Port parameters consists of five options for each of the four ports of the 2204 receiver.

Baudrate: Press ◀ or ▶ to select a baudrate between *300 Baud* and *115.200 Baud*.

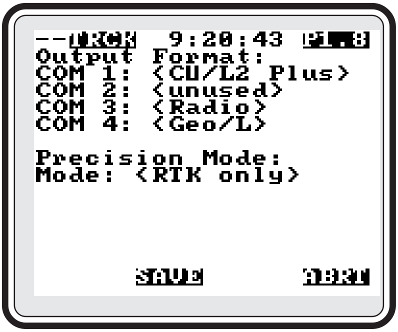
DataBits: Press ◀ or ▶ to select the number of DataBits (from *5* up to *8*)

StopBits: Press ◀ or ▶ to select the number of StopBits (possible are *0*, *1* and *2*)

Parity: Press ◀ or ▶ to select the parity mode (possible are *none*, *even* or *odd*)

Protocol: Press ◀ or ▶ to select the protocol type (possible are *Xon/Xoff*, *hardware* or *none*)

Using the next block `Output Format` you can choose the input or output format for each of the four COM ports of the 2204 receiver. The receiver can in/output data in each format to/from one port only. Therefore, you may choose a format once only. Press ◀ or ▶ to choose between the formats `CU Plus`, `Radio`, `RTCM out`, `NMEA`, `Geo/L`, or to set the port to `unused`. *Radio* is the input/output in Geotronics RTK format. We recommend you to use COM 1 for the CU Plus input.



13.5.16 Precision mode selection

The `Precision Mode` parameter allows you to choose the precision accepted for coordinate calculation when in the RTK mode. The following precision modes are available:

DGPS only: will output and allow recording of points at all times if base station data is received. Accuracy is typically sub meter; Reliable even without initialization.

DGPS & RTK: This allows you to combine the availability of DGPS data and the precision of RTK data. During initialization and re-initialization phases, the system automatically chooses the DGPS mode in order to provide positions. When the initialization has finished and RTK positions are available, CU Plus automatically switches to the RTK precision mode.

RTK only: will output and allow recording of points when base station data is received and RTK accuracy is achieved. Accuracy in the cm-level; initialization necessary.

Single Point: will allow positioning and output whether data is received from the base station or not. The receiver creates a single point position for every epoch (accuracy +/- 100m). No point measurement is possible.

Press ◀ or ▶ to select the precicion mode.

13.5.17 NMEA Output Selection

The 2204 receiver allows NMEA input and output. There are five NMEA messages, which can be switched on or off by pressing ◀ or ▶. For more information on NMEA please refer to the Appendix NMEA of this CU Plus manual.

The currently available messages are

GGA includes Latitude and Longitude, UTC time of fix, number of satellites, horizontal DOP and an GPS quality indicator.

GGK special message derived from the GGA message, no standard format!

GLL includes latitude and longitude

GXP includes latitude and longitude with UTC time of fix

ZDA includes UTC time, Day, Month, Year, time zone.

13.5.18 RTCM messages

CU Plus allows you to send RTCM messages using a 2204 receiver. You may enable/disable individual message types seperately by pressing ◀ or ▶ in the respective `RTCM Support` line. You can also insert a time interval for each RTCM message, independently of the refering switch (refer to Appendix - RTCM).

Currently, you may use the following RTCM messages:

```
#1
#2
#3
#16
#18
#19
#20
#21
```

The Messages Type 18,19,20 and 21 could be generated for L1, L2 or for both L1 & L2. Here you select which subtypes of this messages should be generated. You can switch between

L1,
L2,
CA,
L1& L2

by pressing ◀ or ▶ .

For RTCM message output, a station identification for the receiver is necessary. Station_ID allows you to supply the reference station identification during installation. It can be any number from 0 to 1,023.

A reference station health indicator is given with the staleness of data sent. You may select one of the following options in line `Stn_Data_Age`:

`Stale <12 sec`
`<18 sec`
`<24 sec`
`<48 sec`
`<96 sec`
`>95 sec`
`sends # 16 MSG` (see chapter 4.1 of the RTK/ACU manual)
`not working`

13.5.19 Job File Label Lists

When surveying in the RTK mode with a Geotracer ® 2204 you can specify which data is to be stored by defining a list of labels. You may enter up to 40 labels in each of the tables, separated by space characters. Please refer to chapter 10 of the ACU/RTK manual for more information on labels. A full list of available labels is appended to this chapter 13.

There are two label lists that should be entered. The first is the job file header information. The second is the list of labels stored at each point.

`Job-File Header:` The labels of this table will be written into the header of the job file. The information is of interest when postprocessing job files. We suggest that you enter at least station name (label 2), instrument height (3), and administration data.

`Stop Point Measure`: When measuring a stop point, the system will store the information according to the labels of this list. For example, you may decide to store a point number (label 5), a code (4), and north, east, height coordinates (37,38,39), or perhaps the more comprehensive list of default labels from the ACU/RTK system.

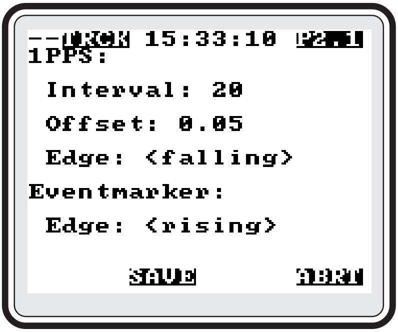
13.5.20 Geo/L Output

With a Geotracer® 2204, you have the opportunity to send surveying data in the Geotronics® Geo/L format to one of the Com ports. This format uses labels (register numbers) in the same way as they are used in a job file. For a complete label list please refer to the Appendix of this manual. Two parameters allow you to define the used labels and the mode defining when to send data.

`Geo/L Output Labels`: You can enter up to forty labels for the Geo/L output table, seperated by a blank character.

`Geo/L Mode`:

`Request`	Positions are sent on external Geo/L command.
`Slave`	Geo/L output at predefined time intervals, which can be every epoch. (Default mode.)
`Reg + Store`	Output each time measurements are registered manually or automatically. Additionally, the measurements will be written to a job file.
`Reg, NoStore`	Serial output each time measurements are registered manually or automatically. No entry into a job file.



13.5.21 PPS and Events

For some purposes, such as photogrammetric flights, it is necessary to mark the kinematically derived positions with time markers. With a Geotracer ® 2204, you can set the receiver to generate pulses (PPS) at predefined times with its rising or falling edge synchronized to GPS time. These pulses are TTL-compatible pulses given continuously with given intervals. Set the following three parameters in the Section 1 PPS to define the PPS:

`Interval:` Defines the interval time between two PPS pulses. Range 0.5 ... 60.0 secs in units of 0.5 secs.

`Offset:` Defines the offset between PPS signal and GPS time. Range -999.99 ... + 999.99 msecs.

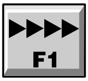
`Edge:` Synchronizes the rising edge (`rising`) or the falling edge (`falling`) of the pulse with GPS time.

If your Geotracer® 2204 is connected via the "Event" input connector to an instrument which itself generates TTL-compatible event pulses, these events will be marked automatically in the observation files with a time resolution of 1 µsec. Define one parameter in section Event marker:

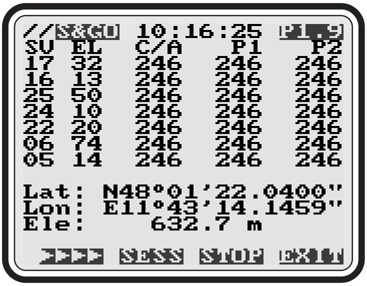
`Edge:` Uses the rising edge (`rising`) or the falling (`falling`) edge of the event pulse to measure the time. `Disabled` allows you to ignore the event pulses.

You can switch the edges by pressing ◀ or ▶.

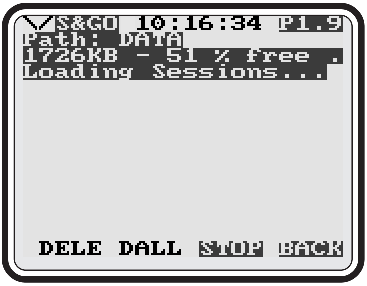
13.6 File Handling



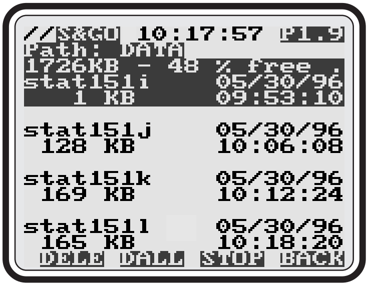
Function SESS on **F2** enters a menu, which shows the file handling possibilities. Enter this menu from the main control screen by pressing the **F1** key repeatedly, until the function for **F2** becomes SESS.



Messages on the loading process appear for a short time,



then a scrolling list of the station numbers for each survey session will be displayed. These represent the station related files stored on the device you have defined in the Parameter Settings Menu. Each station name stands for three files: An observation file, an almanac file and an ephemeris file.



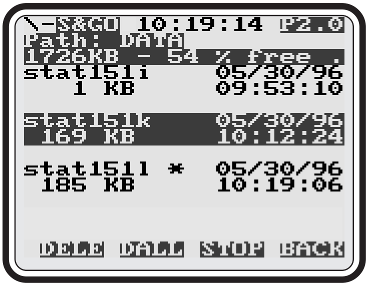
In the second line of the header, the path of the directory you are examining is displayed. The third line includes information on the total space of the card and the amount of available memory in percent of total memory space.

You may scroll through the individual file selection with the cursor ▲ and ▼ keys. On the first line of each information set, is information on the name of the file and the recording date. The second line gives information on the space used and the end time of recording. You will find an asterisk after the point number at the file which is currently being used for survey.

The new functions of this menu have the following meaning:

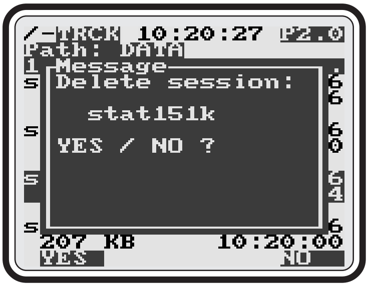
DELE F1	Delete a data set (see section 6.1),
DALL F2	Clear a directory (see section 6.2),
BACK ESC	Back to main control menu.

13.6.1 Delete a data set



You can delete some or several files. A data set consists of an *.OBS file as well as its corresponding ephemeris and almanac file. In order to delete a data set move the cursor with the ▲ and ▼ keys to the data set you want to delete and press the **F1** key. You will then be asked for an acknowledgement before the data is deleted.

DELE F1



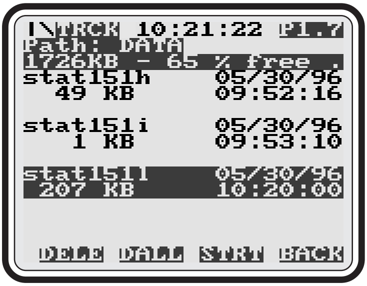
YES F1

NO ESC

If you acknowledge with **F1** or **Y** the data set will be removed from the PCMCIA card. Pressing **ESC** or **N** will cause the program to return to the file handling menu.

YES F1

Acknowledge with **F1** or **Y** and the resulting display will be:

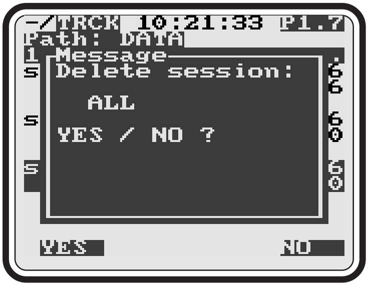


If you delete the file in which data is currently being recorded, you will clear the data stored up to that moment and continue recording from there on. The session name will be displayed as: CURRENT.

13.6.2 Clear A Directory

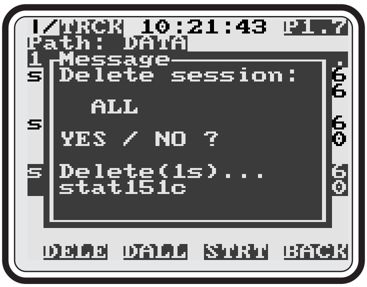
DALL F2

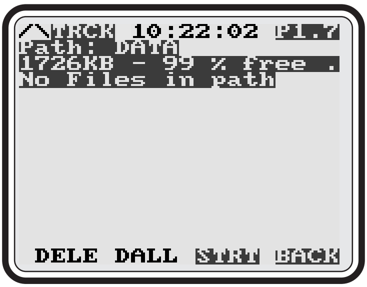
To delete all observational data and associated ephemeris and almanac data in a directory use the **F2** key. You must first acknowledge that the file should be deleted and are prompted with the following question:



YES F1

Acknowledging the request with **F1** or **Y** deletes this file as well as all following file(s) of the directory.





The file in which data is currently recorded will not be deleted.

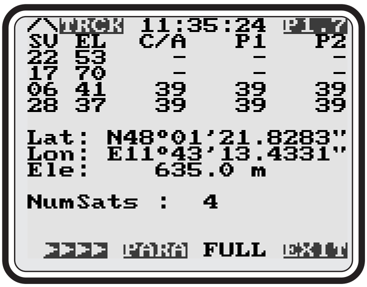
13.6.3 Memory

The amount of disk space and free space in percent is always displayed in the third line of the screen. You will find information on the amount of memory used by each file in the second line of the file information block.

The program updates the display every several seconds, as well as the size of the current observation file.

FULL F3

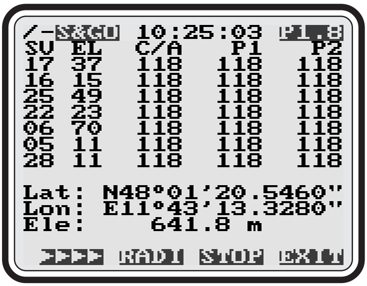
If the PCMCIA card is full, a warning message appears at the screen and you can not record any more. **F3** has no function any more and, instead, shows `FULL`.

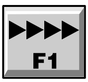


13.7 Radio Configuration

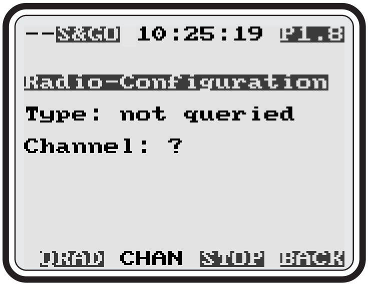
Reference and rover receiver exchange information during operation. Two radio devices delivered together with the RTK system take charge of the information exchange. During measurement the reference receiver transfers data via the telemetry to the rover receiver. For detailed information on the hardware part please check chapter 1. Please note, that different telemetry devices are part of the Geotracer® 2200 system, depending on the country of purchase. The system automatically recognizes the type of telemetry, as soon as you query for detection.

Be sure you turn on the radio AFTER having connected its serial port to the ACU. Unless you follow this recommendation, serious electrical interferences inside the device will make it impossible to change channel.





Use F1 to scroll through the functions of F2, until F2 gets the radio configuration function. Then press F2.



The message appears: Radio not queried. As the detection process takes some time (1 to 10 seconds, depending on the type of radio connected) no data can be transmitted during that time. Therefore, if you, e.g., are using the CU Plus software for a reference station receiver in RTK mode, you must be aware of a loss of data during request for the radio type.

While the system queries for the type of telemetry, no data transmission is possible for up to 10 seconds! For that reason, you have to query the radio type manually.

QRAD F1

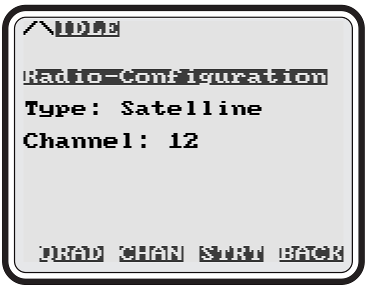
Start the recognition process by pressing F1.

The control unit starts trying to identify the radio channel in use. If no telemetry should be connected to the receiver, the message "not connected" will be displayed. You are not allowed to change the radio channel. In rare cases, the system may not recognize the radio connected at the first attempt. If you have connected a radio, and if it is switched on, try again. If the system still does not recognize the radio connected, you should disconnect the GPS antenna and then try again.

If a radio is connected, the system is able to recognize different radio types:

- Satelline radio (e.g., used in Europe, except France)
- Georadio (e.g., used in France)
- Pacific Crest (Baby Blue) radio (e.g., used in U.S.A.)

When finished, the correct type of radio will be displayed.



Depending on the radio type the currently used channel is shown. If the radio channel is characterized by a question mark, CU Plus can not figure the channel. Nevertheless, you can select a new channel.

CHAN
F2

You may now scroll through the channels to choose the channel you want to use with the ◀ and ▶ arrow keys. The channel numbers offered depend on the telemetry system in use and the channels that are allowed for them. Press F2 in order to accept the choice. The symbol for F2 will flash, until the process has finished.

For Pacific Crest Users Only:
Be aware of the options for further channels that you have purchased. If you select one of the channels 5..15 and if that channel is not an option for your radio, the radio system may crash. To prevent you from accidently crashing the radio, the optional channels appear flashing.

STRT
F3

STOP
F3

or

BACK
ESC

You may start/stop a survey with F3 or exit to the main screen with ESC.

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13.8 Appendix
Messages

No Receiver found
No receiver is detected by the program. This might be caused by a missing data link to the Geotracer ® 2200/2204 or a bad power supply.

Wait for receiver
The program is waiting for a first response from the receiver. This message will disappear after contact is established.

Power up receiver
CU Plus is switching on the receiver via the connection. This is equivalent to manually switching on the receiver using the power button.

No Satellites tracked.
Currently, the receiver tracks no satellites. This may be due to a missing connection to the antenna, bad placement of the antenna or that the receiver has been switched on for less than 2 minutes.

Lost contact to the receiver. Check cabling and power. Press YES to continue
The receiver was successfully detected and initialized. Now, the receiver does not send any data or respond to commands. Possible reasons: the cable connection to the receiver was removed, the power was removed.
If none of these reasons applies, you can switch the receiver off, then on again. Be careful not to interrupt an important survey (checking the status LED of the receiver) or a running RTK survey which may be using this receiver as reference station.

PCMCIA card is full.
Delete sessions or replace card.
Press YES to continue
The PCMCIA card is full. The current survey is stopped. Please delete unused sessions on this card or replace with another card. Note, that there might be sessions stored on the card in a different storing directory.
Make sure that the data interruption doesn't cause problems. If you are in doubt, repeat the survey. You might want to change the update rate setting and/or the elevation mask to be able to record longer time spans on the same card.

PCMCIA card is missing.
Replace card.
Press YES to continue
The PCMCIA card is missing or was just removed. The current survey is stopped.
Please replace the card or insert another one. Check that the card is properly inserted in the receiver. Please check the orientation of the card. Removing and inserting it again can solve these problems.

Battery is almost empty.
Replace battery.
Press YES to continue
Battery low. The battery supplying the receiver with power is almost empty. The receiver will switch off in 30 seconds to prevent damaging the battery. The current survey will be stopped. Please make sure that you are using fully charged batteries to avoid interrupted sessions.

Receiver is switched off.
Press YES to continue
The receiver was switched off either by the operator (power button on the receiver) or automatically following a low battery condition.
CU Plus will not try to switch it on again. Nevertheless, it will detect, when the receiver is switched on again manually.

Appendix.
Result Files

During a survey the receiver records raw observational code and carrier data in a file with the extension `*.OBS`.

In general the file name consists of eight characters composed to a string `ptnoddds` with

`ptno`	4 significant characters of the point number, normally the last 4 characters
`ddd`	the day of the year (range 1 ... 366)
`s`	session identifier (A...Z, 0...9)

Note: you may create up to 36 session files with the same point and day identification.

In addition, for each survey an ephemeris and almanac file is recorded.

The ephemeris information will have the extension based on the current year, for example "95N". The "N" stands for navigation file.

The almanac information is saved in a file. The extension of this file is also based on the current year, e.g. "97A". The "A" stands for almanac information.

Ephemeris data is stored in the RINEX convention which is described in the following table.

NAVIGATION MESSAGE FILE - DATA RECORD DESCRIPTION		
OBS. RECORD	DESCRIPTION	FORMAT
PRN / EPOCH / SV CLK	- Satellite PRN number - Epoch: Toc - Time of Clock year (2 digits) month day hour minute second - SV clock bias (seconds) - SV clock drift (sec/sec) - SV clock drift rate (sec/sec2)	I2, 5I3, F5.1, 3D19.12
BROADCAST ORBIT - 1	- IODE Issue of Data, Ephemeris - Crs (meters) - Delta n (radians/sec) - M0 (radians)	3X,4D19.12
BROADCAST ORBIT - 2	- Cuc (radians) - e Eccentricity - Cus (radians) - sqrt(A) (sqrt(m))	3X,4D19.12
BROADCAST ORBIT - 3	- Toe Time of Ephemeris (sec of GPS week) - Cic (radians) - OMEGA (radians) - CIS (radians)	3X,4D19.12
BROADCAST ORBIT - 4	- i0 (radians) - Crc (meters) - omega (radians) - OMEGA DOT (radians/sec)	3X,4D19.12
BROADCAST ORBIT - 5	- IDOT (radians/sec) - Codes on L2 channel - GPS Week # (to go with TOE) - L2 P data flag	3X,4D19.12
BROADCAST ORBIT - 6	- SV accuracy (meters) - SV health (MSB only) - TGD (seconds) - IODC Issue of Data, Clock	3X,4D19.12
BROADCAST ORBIT - 7	- Transmission time of message (sec of GPS week, derived e.g. from Z-count in Hand Over Word (HOW) - spare - spare - spare	3X,4D19.12

Appendix.
Result Files

During a survey the receiver records raw observational code and carrier data in a file with the extension `*.OBS`.

In general the file name consists of eight characters composed to a string `ptnoddds` with

`ptno`	4 significant characters of the point number, normally the last 4 characters
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Note: you may create up to 36 session files with the same point and day identification.

In addition, for each survey an ephemeris and almanac file is recorded.

The ephemeris information will have the extension based on the current year, for example "95N". The "N" stands for navigation file.

The almanac information is saved in a file. The extension of this file is also based on the current year, e.g. "97A". The "A" stands for almanac information.

Ephemeris data is stored in the RINEX convention which is described in the following table.

NAVIGATION MESSAGE FILE - DATA RECORD DESCRIPTION		
OBS. RECORD	DESCRIPTION	FORMAT
PRN / EPOCH / SV CLK	- Satellite PRN number - Epoch: Toc - Time of Clock year (2 digits) month day hour minute second - SV clock bias (seconds) - SV clock drift (sec/sec) - SV clock drift rate (sec/sec2)	I2, 5I3, F5.1, 3D19.12
BROADCAST ORBIT - 1	- IODE Issue of Data, Ephemeris - Crs (meters) - Delta n (radians/sec) - M0 (radians)	3X,4D19.12
BROADCAST ORBIT - 2	- Cuc (radians) - e Eccentricity - Cus (radians) - sqrt(A) (sqrt(m))	3X,4D19.12
BROADCAST ORBIT - 3	- Toe Time of Ephemeris (sec of GPS week) - Cic (radians) - OMEGA (radians) - CIS (radians)	3X,4D19.12
BROADCAST ORBIT - 4	- i0 (radians) - Crc (meters) - omega (radians) - OMEGA DOT (radians/sec)	3X,4D19.12
BROADCAST ORBIT - 5	- IDOT (radians/sec) - Codes on L2 channel - GPS Week # (to go with TOE) - L2 P data flag	3X,4D19.12
BROADCAST ORBIT - 6	- SV accuracy (meters) - SV health (MSB only) - TGD (seconds) - IODC Issue of Data, Clock	3X,4D19.12
BROADCAST ORBIT - 7	- Transmission time of message (sec of GPS week, derived e.g. from Z-count in Hand Over Word (HOW) - spare - spare - spare	3X,4D19.12

Appendix

Keyboard functions for the control unit (Grid field computer)

FUNC	+	▶	End
FUNC	+	◀	Home
SFT	+	▲	PgUp
SFT	+	▼	PgDn
FUNC	+	←	Delete
FUNC	+	▲	Increase the screen contrast
FUNC	+	▼	Decrease the screen contrast

Appendix

NMEA Standard

With a Geotracer® 2204, CU Plus allows you to send data in the NMEA protocol format. If your receiver is no 2204, choosing NMEA for a port has no effect.

The NMEA (= National Marine Electronics Association) is dedicated to the education and advancement of the marine electronics industry and the market which it serves.

The NMEA standard defines an electrical interface and data protocol for communications between marine instrumentation.

Under the NMEA-0183 standard, all characters used are printable ASCII text (plus carriage return and line feed).

The data is transmitted in the form of "sentences". Each sentence starts with a "$", a two letter "talker ID", a three letter "sentence ID", followed by a number of data fields separated by commas, and terminated by an optional checksum, and a carriage return/line feed. A sentence may contain up to 82 characters including the "$" and CR/LF.

If data for a field is not available, the field is simply omitted, but the commas that would delimit it are still sent, with no space between them. Since some fields are variable width, or may be omitted as above, the receiver locates desired data fields by counting commas, rather than by character position within the sentence.

The optional checksum field consists of a "*" and two hex digits representing the exclusive OR of all characters between, but not including, the "$" and "*". A checksum is required on some sentences.

The supported messages are:

1. GXP - Latitude and Longitude with UTC of fix
2. GGA - Latitude and Longitude, UTC of fix, Number of satellites, and Horizontal DOP. GPS quality identifier.
3. GLL - Latitude and Longitude
4. ZDA - UTC, Day, Month, Year, Time zone

5. GGK - special message derived from the GGA message

For more information refer to the NMEA-0183 standard

NB. The latitude and longitude will be in the chosen datum and ellipsoid.

GGA - Global Positioning System Fix Data

Time, Position and fix related data for a GPS receiver.

```
       1         2       3 4        5 6 7  8   9  10 11 12 13  14   15
       |         |       | |        | | |  |   |   | |  | |   |    |
$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>
```

1) Universal Time Coordinated (UTC) [hhmmss.ss]
2) Latitude in [DDMM.MMMMMM]
3) N or S (North or South)
4) Longitude in [DDDMM.MMMMMM]
5) E or W (East or West)
6) GPS Quality Indicator
   0 = fix not available,
   1 = GPS fix,
   2 = Differential GPS fix
7) Number of GPS satellites being used [0 - 12]
8) Horizontal Dilution of precision
9) Antenna Altitude above/below mean-sea-level (geoid)
10) Units of antenna altitude [= M] = meters
11) Geoidal separation, the difference between the WGS-84 earth ellipsoid and mean-sea-level (geoid), "-" means mean-sea-level below ellipsoid

12) Units of geoidal separation [= M] = meters
13) Age of differential GPS data, time in seconds since last SC104 type 1 or 9 update, null field when DGPS is not used
14) Differential reference station ID, [0000-1023]
15) Checksum [00 - FF]

GGK - NOT A STANDARD FORMAT

```
     1         2             3 4               5 6 7  8   9  10 11 12   13
     |         |             | |               | | |  |   |   |   | |    |
$—GGA,hhmmss.ss,llll.llllllll,N,yyyyy.yyyyyyyy,E,x,xx,x.x,EHTx.x,M,xxxx*hh<CR><LF>
```

1) Universal Time Coordinated (UTC) [hhmmss.ss]
2) Latitude in [DDMM.MMMMMMMM]
3) N or S (North or South)
4) Longitude in [DDDMM.MMMMMMMM]
5) E or W (East or West)
6) GPS Quality Indicator
   0 = fix not available or invalid
   1 = autonomous GPS fix
   2 = differential GPS fix
   3 = RTK GPS fix
7) Number of GPS satellites being used [0 - 12]
8) DOP of fix
9) EHT (= ellipsoidal height ??)
10) Ellipsoidal height of fix
11) Units of ellipsoidal height [= M] = meters
12) Differential reference station ID, [0000-1023]
13) Checksum [00 - FF]

GLL - Geographic Position - Latitude/Longitude

```
        1         2 3          4 5           6 7
        |         | |          | |           | |
$—GLL,llll.ll,a,yyyyy.yy,a,hhmmss.ss,A*hh<CR><LF>
```

1) Latitude in [degree, decimal minutes]
2) N or S (North or South)
3) Longitude in [degree, decimal minutes]
4) E or W (East or West)
5) Universal Time Coordinated (UTC) [hhmmss.ss]
6) Status A - Data Valid, V - Data Invalid
7) Checksum [00 - FF]

GXP - Present Position with Time of Fix

```
        1           2         3 4          5 6
        |           |         | |          | |
$—GXP,hhmmss.ss,llll.ll,a,yyyyy.yy,a*hh<CR><LF>
```

1) Universal Time Coordinated (UTC) [hhmmss.ss]
2) Latitude in [degree, decimal minutes]
3) N or S (North or South)
4) Longitude in [degree, decimal minutes]
5) E or W (East or West)
6) Checksum [00 - FF]

ZDA - Time & Date

```
        1           2  3  4     5  6
        |           |  |  |     |  |
$—ZDA,hhmmss.ss,xx,xx,xxxx,xx*hh<CR><LF>
```

1) Universal Time Coordinated (UTC) [hhmmss.ss]
2) Day of the month [01 - 31]
3) Month of the year [01 - 12]
4) Year
5) Offset from Greenwich Mean Time [-13 ... +13]
6) Checksum [00 - FF]

Appendix:
List of Labels Used for RTK Positioning and Geo/L Output

No.	Text	Description
0	Info	Information
2	Stn	Station No
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
15	Area	Area file
23	Units	Status of unit set
26	SVA	Setting out vertical angle
27	SHA	Setting out horizontal angle
28	SHD	Setting out horizontal distance
29	SHT	Setting out height
37	N	Northing coordinates
38	E	Easting coordinates
39	ELE	Elevation coordinates
40	dN	Relative to stored X (N) coord of set out point
41	dE	Relative to stored Y (E) coord of set out point
42	dELE	Rel. to stored Z (ELE) coord of set out point
47	Nr	Rel. North Coord.
48	Er	Rel. East Coord.
49	VD	Vertical distance
50	JOB No	Job No file for storage of raw and calculated data.
51	Date	Date
52	Time	Time
53	Operat	Operator identification
54	Proj	Project identification

No.	Text	Description
55	Instno	Instrument Number
58	EA Rad	Earth Radius
67	SON	Northing Coordinate of setting out point
68	SOE	Easting Coordinate of setting out point
69	SHT	Elevation of setting out point
72	Radofs	Calculated Radial offset dimension in setting out program - orientated to reference station
73	RT.ofs	Calculated Right angle offset dimension in setting out program - orientated to ref.stat.
75	dHT	Difference between ELE and SHT
76	dHD	Diff. between setting out distance and measured distance
77	dHA	Diff. betw. setting out bearing and the present instr. pointing
78	COM	Settings of the current Com Port
79	EOT	End of Text Sign
99		comment
110	WGS84X	WGS84 Coordinate X [m]
111	WGS84Y	WGS84 Coordinate Y [m]
112	WGS84Z	WGS84 Coordinate Z [m]
113	Lat	Latitude [degrees]
114	Long	Longitude [degrees]
115	PDOP	PDOP
116	RefSAt	No. of Satellites at Reference station
117	RovSat	No. of Satellites at Rover
118	NumSat	No. of Satellites at both stations
119	C/F	Cut/Fill for staking out
120	dx	Baseline component in x [m]
121	dy	Baseline component in y [m]
122	dz	Baseline component in z [m]
129	Sdev	Standard deviation of 3D Pos [m]
130	VerNum	Software Version No.
131	CtrlUn	Serial No.
132	TimSpn	Time Span of observations [seconds]
133	Radofs	Calculated Radial offset dimension in setting out program - user defined direction
134	RT.ofs	Calculated Right angle offset dimension in setting out program - user defined direction

No.	Text	Description
135	N-offs	N offset for file handling
136	E-offs	E offset for file handling
137	Ele	Height above national grid ellipsoid
138	Cov1,1	Element of variance/covariance matrix
139	Cov2,1	Element of variance/covariance matrix
140	Cov2,2	Element of variance/covariance matrix
141	Cov3,1	Element of variance/covariance matrix
142	Cov3,2	Element of variance/covariance matrix
143	Cov3,3	Element of variance/covariance matrix
144	Week	GPS week
145	Sec	GPS second
146	Crc	Cyclic redundancy check
527	interval	Tracking interval (seconds)
625	cutoff	Elevation cutoff (degree)
665	gps_utc	Time difference GPS - UTC
800	ZONE	Number of used zone
806	DATUM	name of used datum
807	PROJEC TION	name of used projection
808	ELLIPS	name of used ellipsoid
2000	STATIC	mode of the current measurement 0 = SPP (Single Point Precision) 1 = DGPS 2 = RTK
2001	PRECI SION	real mode (current) while RTK 0 = SPP (Single Point Precision) 1 = DGPS 2 = RTK
2002	PREC_ WANTED	maximum used mode while RTK 0 = SPP (Single Point Precision) 1 = DGPS 2 = RTK
2003	PREC_ NEEDED	minimum used mode while RTK 0 = SPP (Single Point Precision) 1 = DGPS 2 = RTK
2050	TABLE_ GEOL	Geo/L output table as defined in the CU/ Plus program (max 40 entries, separated

No.	Text	Description
		by a space character) *Example: "144 145 47 48 49 115 2001"*
2051	TABLE_ JOB	Job file table as defined in the CU/Plus program (max. 40 entries) *Example: "144 145 118 129 146"*
2052	TABLE_ JOB_HEAD	Job file header table as defined in the CU/ Plus program (max. 20 entries) *Example: "47 48 49 118 129"*
2060	ENABLE _NMEA	Bitmask for the NMEA output message *Example: see end of this table, page 96*
2061	GEOL_ MODE	Geo/L mode selection 0 = slave 1 = register, but not store 2 = register and store 3 = request
2100	CMD_ SERIAL	Serial number of the receiver
2101	RTC_ SERIAL	Serial numer of the real time clock
2103	OPTION_ SET	Options for the receiver • Bytemask, 32 byte, each byte for an-other option • byte =1 : option is set • byte =0 : option is not set byte 1: Reference mode byte 2: RTK mode byte 3: RTCM in byte 4: RTCM out byte 5: Event records byte 6: Special NMEA byte 7: Fast operate (< 2Hz) byte 8... byte 32. not yet used
2110	WGS84_ PC1_X	part 1 of table #5 of the seven position output RTK Tables
2111	WGS84_ PC1_Y	part 2 of table #5 of the seven position output RTK Tables
2112	WGS84_ PC1_Z	part 3 of table #5 of the seven position output RTK Tables

No.	Text	Description
2138	WGSA84_ Cov1_1	Element of variance/covariance matrix for the WGS84 position
2139	WGSA84_ Cov2_1	Element of variance/covariance matrix for the WGS84 position
2140	WGSA84_ Cov2_2	Element of variance/covariance matrix for the WGS84 position
2141	WGSA84_ Cov3_1	Element of variance/covariance matrix for the WGS84 position
2142	WGSA84_ Cov3_2	Element of variance/covariance matrix for the WGS84 position
2143	WGSA84_ Cov3_3	Element of variance/covariance matrix for the WGS84 position
2200	REF_ WGS84_X	RTK reference position, calculated from the latitude, longitude and height input of the CU/Plus program (without antenna offset)
2201	REF_ WGS84_Y	RTK reference position, calculated from the latitude, longitude and height input of the CU/Plus program (without antenna offset)
2202	REF_ WGS84_Z	RTK reference position, calculated from the latitude, longitude and height input of the CU/Plus program (without antenna offset)
2203	REF_ WGS84 PC1_X	RTK reference position, calculated from the latitude, longitude and height input of the CU/Plus program (antenna offset included)
2204	REF_ WGS84 PC1_Y	RTK reference position, calculated from the latitude, longitude and height input of the CU/Plus program (antenna offset included)
2205	REF_ WGS84 PC1_Y	RTK reference position, calculated from the latitude, longitude and height input of the CU/Plus program (antenna offset included)
2206	PC1_DX	Part 1 of table #6 of the seven position output RTK Tables (baseline phase center)
2207	PC1_DY	Part 2 of table #6 of the seven position output RTK Tables (baseline phase center)
2208	PC1_DZ	Part 3 of table #6 of the seven position output RTK Tables (baseline phase center)

No.	Text	Description
2300	RTK_ STATUS	Information about the progress of the OTF process → OK *“all succeeded”* → BAD_ARGS *“some arguments are bad”* → BAD_DATA *“GPS data bad”* → BAD_KNOWN_SATS *“not all known ambiguities found”* → NO_TRIPLE_SOLUTION *“could not get triple diff solution”* → NO_FLOAT_SOLUTION *“could not get floating solution”* → NO_CON_SOLUTION *“could not get constrained solution”* → SEARCH_SPACE_TO_BIG *“the search space was too big”* → NO_SETS_TESTED *“could not find any set”* → BAD_RESIDUALS_RMS *“after estimate RMS too bad”* → BAD_RESIDUALS_SLOPE *“after esti-mate slope too bad”* → BAD_RESIDUALS_L1L2 *“L1/L2 con-sistency too bad”* → BAD_RESIDUALS_SECOND *“second candidate too small”* → BAD_RATIO *“residual ratio too small”* → LOW_PROBABILITY *“result probability too low”* → USER_ABORT *“user abort processing”* → TOO_MANY_SATS *“more satellites than possible”*
2301	RTK_RATIO	Ratio of the OTF process (must be more than 2,0)
2302	RTK_PROB _RATIO	RTK probability ratio (must be more than 99,99 %)
2303	RTK_PROB _RMS	Quality of the solution (must be more than 95 %)

No.	Text	Description
2304	RTK_PROB_SLOPE	RTK probability slope (must be more than 95 %)
2305	RTK_PROB_L1_L2	RTK probability L1 L2 (must be more than 95 %)
2306	RTK_SECONDS	Duration of the data, needed for OTF solution
2307	RTK_NUMSAT	Number of satellites used for OTF solution
2308	RTK_MODE	Mode of the OTF solution
2309	RTK_STATUS_NR	String value with the status number of the OTF process
2333	RTK_LOOSE	Set this register to loose the ambiguities
2350	DECO_STATUS	State (text-string) of the decoder task → *OK* → *NO DATA RECEIVED* → *NO REFERENCE DATA* → *NO ROVER DATA* → *NO REFERENCE POSITION* → *GOT REFERENCE POSITION* → *SOME EPH MISSING* → *ALL EPH MISSING* → *MULTIPLE REFERENCES*
2351	SYNC_STATUS	State (text string) of the synchronizer task → *OK* → *NO DATA RECEIVED* → *NO REFERENCE DATA* → *NO ROVER DATA* → *NO REFERENCE POSITION* → *GOT REFERENCE POSITION* → *SOME EPH MISSING* → *ALL EPH MISSING* → *MULTIPLE REFERENCES*

No.	Text	Description
2352	SING-STATUS	State (text string) of the Single Point task → *OK* → *NO DATA RECEIVED* → *NO REFERENCE DATA* → *NO ROVER DATA* → *NO REFERENCE POSITION* → *GOT REFERENCE POSITION* → *SOME EPH MISSING* → *ALL EPH MISSING* → *MULTIPLE REFERENCES*
2353	DGPS_STATUS	State (text string) of the DGPS task → *OK* → *NO DATA RECEIVED* → *NO REFERENCE DATA* → *NO ROVER DATA* → *NO REFERENCE POSITION* → *GOT REFERENCE POSITION* → *SOME EPH MISSING* → *ALL EPH MISSING* → *MULTIPLE REFERENCES*
2354	PHASE_STATUS	State (text string) of the phase task → *OK* → *NO DATA RECEIVED* → *NO REFERENCE DATA* → *NO ROVER DATA* → *NO REFERENCE POSITION* → *GOT REFERENCE POSITION* → *SOME EPH MISSING* → *ALL EPH MISSING* → *MULTIPLE REFERENCES*

No.	Text	Description
2360	DECO-STATUS_NR	State number (string) of the decoder → *0x100 OK* → *0x101 no data received* → *0x102 no reference data* → *0x103 no rover data* → *0x104 no reference position* → *0x105 got reference position* → *0x106 some ephemeris missing* → *0x107 all ephemeris missing* → *0x108 multiple references*
2361	SYNC_STATUS_NR	State number (string) of the synchronizer → *0x200 OK* → *0x201 no data received* → *0x202 no reference data* → *0x203 no rover data* → *0x204 no reference position* → *0x205 got reference position* → *0x206 some ephemeris missing* → *0x207 all ephemeris missing* → *0x208 multiple references*
2362	SING_STATUS_NR	State number (string) of the Single Point task → *0x300 OK*
2363	DGSP_STATUS_NR	State number (string) of the DGPS task → *0x400 OK*
2364	PHASE_STATUS_NR	State number (string) → *0x500 OK*
2400	TIME_ZONE_OFFS	Time zone offset [h]
2401	INI_POS_HEIGHT	Initial position height [m]
2402	INI_POS_LATI	Initial position latitude [degree]
2403	INI_POS_LONGI	Initial position longitude [degree]

No.	Text	Description
2404	INI_POS_ SEND	Send position to receiver 0 = No 1 = Yes
2405	DISABLED_ SATS	Disabled satellites bitmask bit 0 → Sat 32 ... ... bit 31 → Sat 1 bit = 0 = Sat enabled bit = 1 = Sat disabled
2406	VSFB_ LENGTH	VSFB arm length [m]
2407	VSFB_ HEIGHT_ DIFF	VSFB antenna base height difference [m]
2408	MEASURE MENT_ MODE	Measurement mode: 0 = Static 1 = Kinematik 2 = Stop&Go 3 = RTK
?	geol_ mode	Geo/L mode selection 0 = slave 1 = register, but not store 2 = register and store 3 = request
2409	STORING_ DEVICE	Storing device (0 = Cu A) (1 = Cu B) 2...9 = Geotracer 2204 Disk C...J (if available)
2410	STORING_ DIR	Storing directory path with “0”-termination
2412	ROV_ ECCEN_H	Rover antenna eccentricities: height [m]
2413	ROV_ ECCEN_N	Rover antenna eccentricities: north [m]
2414	ROV_ ECCEN_E	Rover antenna eccentricities: east [m]

No.	Text	Description
2415	ROV_ HEIGHT_ MODE	Rover antenna height mode: 0 = Instrument height 1 = Slope 2 = True Vertical
2416	ROV_ ANTENNA _TYPE	Rover antenna type: 0 = Choke Ring 1 = Geodetic GP 2 = Compact
2417	REF_ ECCEN_H	Reference antenna eccentricities: height [m]
2418	REF_ ECCEN_N	Reference antenna eccentricities: north [m]
2419	REF_ ECCEN_E	Reference antenna eccentricities: east [m]
2420	REF_ HEIGHT_ MODE	Reference antenna height mode: 0 = Instrument height 1 = Slope 2 = True Vertical
2421	REF_ ANTENNA _TYPE	Reference antenna type: 0 = Choke Ring 1 = Geodetic GP 2 = Compact
2422	REF_POS_ HEIGHT	Reference position height [m]
2423	REF_POS_ LATI	Reference position latitude [degree]
2424	REF_POS_ LONGI	Reference position longitude [degree]
2325	REF_POS_ USE	Use the reference position: 0 = No 1 = Yes
2326	AUTO_ START _WEEK	Autosurvey start week
2427	AUTO_ START _SECS	Autosurvey start seconds [sec]

No.	Text	Description
2428	AUTO_END _WEEK	Autosurvey end week
2529	AUTO_END _SECS	Autosurvey end seconds [sec]
2430	COM_ SETTINGS_1	Settings of COM 1 format: a.b.c.ddddd with: a = number of stopbits {0, 1, 2} b = number of data bits {5, 6, 7, 8} c = number of parity bits {0, 1, 2} d = baudrate {300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200}
2431	COM_ SETTINGS_2	Settings of COM 2 (see COM1)
2432	COM_ SETTINGS_3	Settings of COM 3 (see COM1)
2433	COM_ SETTINGS_4	Settings of COM 4 (see COM1)
2434	COM_ FORMAT_1	Output format of port COM 1 0 = unused 1 = Geo/L 2 = NMEA 3 = RTCM OUT 4 = Radio 5 = CU/L2 Plus
2435	COM_ FORMAT_2	Output format of port COM 2 (see COM 1)
2436	COM_ FORMAT_3	Output format of port COM 3 (see COM 1)
2437	COM_ FORMAT_4	Output format of port COM 4 (see COM 1)

No.	Text	Description
2438	RTCM_ ENABLE	Bitmask for to switch on the RTCM messages number 1 to 32 bit 1 = RTCM message no. 1 ... bit 32 = RTCM message no. 32 bit = 1 = message is on bit = 0 = message is off
2439	RTCM_01_ SECS	RTCM message no. 1 interval [sec]
2440	RTCM_02_ MIN	RTCM message no. 2 interval [min]
2441	RTCM_03_ SECS	RTCM message no. 3 interval [sec]
2442	RTCM_16_ SECS	RTCM message no. 16 interval [sec]
2443	RTCM_18_ SECS	RTCM message no. 18 interval [sec]
2444	RTCM_19_ SECS	RTCM message no. 19 interval [sec]
2445	RTCM_20_ SECS	RTCM message no. 20 interval [sec]
2446	RTCM_21_ SECS	RTCM message no. 21 interval [sec]
2447	RTCM_ CODE	Type of the RTCM code 0 = L1 & L2 1 = L1 2 = L2 3 = CA
2448	RTCM_STA TION_ID	RTCM station ID {0...1024}

No.	Text	Description
2449	RTCM_ WELL NESS	RTCM wellness 0 = Stale << 12 sec 1 = Stale << 18 sec 2 = Stale << 24 sec 3 = Stale << 48 sec 4 = Stale << 96 sec 5 = Stale >> 95 sec 6 = sends # 16 MSG 7 = not working

EXAMPLES

Examples for registers # 2001, 2002, 2003

a) mode selected = DGPS & RTK
→ 2002 = RTK
2003 = DGPS
2001 could be either DGPS or RTK

b) mode selected = RTK only
→ 2002 = RTK
2003 = RTK
2001 has to be RTK

Structure of register # 2060:

binary 32 bit value:

```
32          24          16          8       1    <— bit number
|           |           |           |       |
xxxx xxxx   xxxx xxxx   Xxxx xXxx   xxXX Xxxx
                        |||| ||||   |||| ||||
                        |||| ||||   |||| |||+— ALM  (1,      not yet implemented)
                        |||| ||||   |||| ||+—— APA  (2,      not yet implemented)
                        |||| ||||   |||| |+——— BWC  (4,      not yet implemented)
                        |||| ||||   |||| +———— GGA  (8,      implemented)
                        |||| ||||   ||||
                        |||| ||||   |||+——————— GGK  (16,     implemented)
                        |||| ||||   ||+———————— GLL  (32,     implemented)
                        |||| ||||   |+————————— GRS  (64,     not yet implemented)
                        |||| ||||   +—————————— GSA  (128,    not yet implemented)
                        |||| ||||
                        |||| |||+——————————————— GSN  (256,    not yet implemented)
                        |||| ||+———————————————— GSV  (512,    not yet implemented)
                        |||| |+————————————————— GXP  (1024,   implemented)
                        |||| +—————————————————— RRE  (2048,   not yet implemented)
                        ||||
                        |||+———————————————————— TSS  (4096,   not yet implemented)
                        ||+————————————————————— VTG  (8192,   not yet implemented)
                        |+—————————————————————— XTE  (16384,  not yet implemented)
                        +——————————————————————— ZDA  (32768,  implemented)

bit = 0    refering NMEA message output is switched off
bit = 1    refering NMEA message output is switched on
```

Example: *if you want to activate the GGK, the GLL and the ZDA message, the register # 2060 must be set to 32816 (= 16 + 32 + 32768)*

RTCM for reference station

Appendix
RTCM IN/Output

General

RTCM (Radio Technical Commission For Maritime Services) has established a standard for differential GNSS applications, which allows to send out standardized differential messages to differentially correct mobile receivers. The Geotracer® 2204 receiver supports this standard.

If you do not have a reference station or want to minimize your cost by using a fixed reference station, whose positions are known accurately, you may use one of the RTCM Reference Stations instead.

The following information refers to the RTCM data transmission used with the 2204. For more details concerning RTCM structure please consult:

- RTCM special committee 15-96/SC104-139. The document has the title ***RTCM Recommended Standards for Differential GNSS Service (Version 2.2)***.
- ICD GPS 200.

Characteristics for RTCM transmission

All messages are transmitted by words containing 30 bits. The first 2 words are the header that is present in all the messages. All the words that refer to every message follow.

In the header, several types of data are broadcasted, including
- the preamble that is used for detection and synchronization
- the station identification
- the time that corresponds to the message
- the sequence number of the message,
- the number of words belonging to that message,

*• the message type, to identify what kind of information is contained in the message, and
• the "health" of the broadcasting site.

There is a second header for the message types 18 to 21 that includes better time definitions important for RTK applications.

Supported Messages

The CU Plus system with the Geotracer® 2204 supports the following types of messages. The type of message decoded depends on the RTCM version selected.

Type 1 Differential GPS corrections. This message is used to transmit C/A-code corrections.

Type 2 Delta GPS corrections. This message is used to bridge between old and new ephemeris. The user must set the duration of the transmission in minutes here. After the arrival of new ephemeris for a satellite this message is generated during this duration.

Type 3 Reference Station Parameters. This messages is used to send the coordinates of the reference station to the user. This is required for messages 18 and 19.

Type 16 Special Message. This message is used to send up to 90 chars to the user.

Type 18 Uncorrected carrier phase. It's used to transmit the measured carrier phase of each tracked satellite by the receiver.

Type 19 Uncorrected pseudo range. It's used to transmit the measured pseudo range of each tracked satellite by the receiver.

Type 20 Carrier phase corrections. It's used to transmit the carrier phase corrections of each tracked satellite by the receiver.

Type 21 Pseudo range corrections. It's used to transmit the pseudo range corrections of each tracked satellite by the receiver.

Using RTCM Input

In order to activate RTCM

- select a port and the baud rate of the port in the parameter menu (default 9600),
- connect the RTCM telemetry to the selected port of the receiver,
- The Geotracer® 2204 automatically uses the RTCM data as reference station data.

Start-up of the rover receiver, using RTCM

The reference station position will be received via RTCM message type 3 from the RTCM Reference Station. Therefore, you do not have to take care of any reference station coordinates. (If the receiver receives no type 3 messages, you may enter a Reference Position and set line Use to Yes, or may use a Single Point Position (only valid if RTCM 2.1 corr messages type 19 are available).

After decoding message type 3 (reference station coordinates) the system starts to use the RTCM messages for positioning according to the positioning mode you selected.

During all of your DGPS or RTK measurements the RTK system will receive and decode the different RTCM messages.

Supported Versions

The Geotracer® 2204 with CU Plus supports the following RTCM versions:

Version:	RTCM 2.0	RTCM 2.1 corr	RTCM 2.1 full
Messages necessary	1,(3)	3,20,21	3,18,19
Message also supported	2,16	2,16	16
Processing mode	DGPS	DGPS	DGPS, RTK
Update rate RTCM	< 20 sec	< 6 sec	< 6 sec

Annotation

1) For calculating the corrections for each satellite the reference station uses the ephemeris data for that satellite. Therefore, it is necessary to use the same set of ephemeris data for all further processing in the RTK system. To ensure that, all corrections contain also an identification of the used set of ephemeris data. If the ephemeris data used at the reference station are not available at the rover, the RTK system can not use that satellite. This may happen, when the reference station receives and uses a new set of ephemeris data, but not the rover. The message type 2 contains the corrections to continue working with the old set of ephemeris data and the code corrections generated with a different set of ephemeris data.
It is possible to work with the system without message type 2, but in this case there might occur time spans without usable RTCM corrections.

2) If you are using RTCM 2.1 corr and you are working in RTK mode, there could arise a time span without usable data for positioning. The reason for that is, that in RTCM 2.1 no equivalent exists for message type 2 concerning phase corrections.

RTCM Output

▶▶▶▶ F1

PARA F2

CU Plus allows you to configure a Geotracer® 2204 for use as a RTCM reference station. You may define all necessary parameters in the parameter menu. From the main display choose F1 - F2 .

To select the COM port for RTCM output go to the block Output Format and choose the output format RTCM out for the port which is to send RTCM data. Make sure, that you did not previously choose this format for another port, otherwise this option will not be available for the selected COM port.

You may also set some parameters for the selected port (baudrate, databits, stopbits, parity and protocol). Refer to section 13.5.

Go to the RTCM Support lines. Here you may enable/ disable the individual RTCM messages. You may set output rates or the duration (Type 2) here as well. The lines Code allows you to choose the code for the messages type 18, 19, 20, 21. Enter a station identifier in line Station_ID and set the station health (see also section 13.5).

Appendix
RTK Output Tables - Messages

If you are recording in RTK mode, you will receive RTK results on the main display (output tables). During initialization and re-initialization phases these output tables additionally display status information. The last information line `STAT` indicates, whether the fixing process is working trouble-free (`OK`), or whether some (temporary) problems occur. Several problems may slow down the initialization or may make it fail. Line `STAT` indicates the reason for it. Typically, you just have to wait until sufficient data is collected for the ambiguity fixing. If the initialization was still not successful after a long data sampling time, you should consider turning the receiver off and on again. In the following you will find a list of possible status messages (which you will probably never see) and, additional hints how to overcome the problem.

No Triple Solu
Up till now the receiver data is too bad to process a triple difference solution. This message should disappear within some minutes, otherwise turn the receiver off/on.

No Float Solu
Up till now the receiver data is too bad to process a double difference float solution. This message should disappear within some minutes, otherwise turn the receiver off/on.

No Con Solu
Up till now the receiver data is too bad to process a double difference fixed solution. This message should disappear within some minutes, otherwise turn the receiver off/on.

S-Space to big
There are too many possible solutions. Possible reasons: multipath effects, wrong antenna definition. Check the antenna settings!

Bad Resi RMS
Bad Resi Slope
Bad Resi Sec's

The residuals for the best solutions are worse than expected. The possible reason may be multipath effects. These messages should disappear within some minutes, otherwise turn the receiver off/on.

Bad Resi L1L2

The best solution shows a big discrepancy between L1 and L2 data. The possible reason may be multipath effects or wrong antenna definition. Check the antenna! If this messages does not disappear within some minutes, turn the receiver off/on.

Bad Ratio

The ratio is lower than the limit of 2. A possible reason may be multipath effects or too few data. This message should disappear within some minutes, otherwise turn the receiver off/on.

Low Probabili

The processed probability is worse than the limit of 99.99%. The receiver has still too little data. This message should disappear within some minutes, otherwise turn the receiver off/on.

Time Too Short

Up till now the receiver has not collected enough data to fix the ambiguities. This message should disappear within some minutes, otherwise turn the receiver off/on.

Too Few Sats

The receiver needs at least 4 satellites to initialize in the static mode, 5 satellites to initialize in OTF mode. Up till now the receiver has not received enough satellites for the current purpose. This message should disappear within some minutes, otherwise check the surrounding for obstructions or turn the receiver off/on.

Initialization Failure Messages

If the initialization failed, no RTK output table will be displayed. Instead, one of the following messages indicates the reason for failure.

NO_DATA_RECEIVED
Neither reference nor rover data were received. Check the connections.

NO_REFERENCE_DATA
The telemetry is sending no reference station data. Check the telemetry and the reference station receiver.

NO_ROVER_DATA
The local receiver gets no satellite data. Check the GPS antenna connection!

NO_REFERENCE_POSITION
The position of the reference antenna has not be determined. The system received neither a manual entry of reference coordinates, nor RTCM message 3 data, nor could it determine a single point position from RTCM message19 or the Geotracer® Reference Format.

GOT_REFERENCE_POS
Confirmation of determination of reference position

SOME_EPH_MISSING
ALL_EPH_MISSING
The local receiver misses some or all of the ephemeris data (navigation messages). It will continue to try to get the data.

Some RTCM Eph miss
some RTCM & STD Eph
all STD some RTCM E
all RTCM Eph miss
some STD all RTCM E
all RTCM & STD Eph
These messages indicate that ephemeris data are missing either from RTCM messages or from the local (STD) receiver or from both of them. Several combinations of miss-

ing ephemeris data are possible. From each source some or all ephemeris may be missing.

Multiple References

The telemetry transfers reference station data of more than one station. Choose another channel to avoid receiving multiple reference station signals.

Appendix A.

Communication Control

This chapters contains the description of three tools.

1. Part A1 describes the control of the radio channels for the telemetry used in the Geotracer® RTK System.

2. Part A2 gives details about file transfer between different computers in the Geotracer® RTK System. It provides a detailed description of the Geotracer® Communication software.

3. Part A3 describes in detail the Geotracer® RTK File Exchange Tool. Concerning a L1 receiver, it allows to check and delete files of the ACU card. Concerning a L1/L2 receiver, it additionally allows file exchange between ACU and receiver.

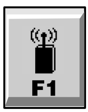
A.1 Telemetry Control

Reference and rover receiver exchange information during operation. Two radio devices delivered together with the system take charge of the information exchange. During measurement the reference receiver transfers data via the telemetry to the rover receiver. For detailed information on the hardware part please check chapter 1. Please note, that different telemetry devices are part of the Geotracer® 2000 system, depending on the country of purchase. The system automatically recognizes the type of telemetry.

The ACU controls the telemetry devices. Switch it on and the Geotracer® Main Control Display shows up.

Now you may choose communication control by pressing the F3 key. The Communication Control display shows up.

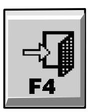
The function keys and their icons have the following meaning:



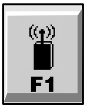
Control of telemetry

Start the Geotracer® Communication Software

Start the File Exchange Tool



Exit to main menu



Press F1 to open the Telemetry Control Display.

The control unit starts trying to identify the radio channel in use. It is able to recognize three different radio types:

- Satelline radio (e.g., used in Europe, except France)
- Georadio (e.g., used in France)
- Pacific Crest (Baby Blue) radio (e.g., used in U.S.A.)

The display shows the name of the device being tested. This process may take 10 to 15 seconds, depending on the radio type.

As soon as the program has identified your radio, a display pops up allowing you to change the working channel (if the radio was not identified the system exits automatically to the main menu). The display of the Channel Selector depends on the radio device.

The next chapter describes the features for the Satelline radio, while the following chapter informs on Georadio and Pacific Crest radio.

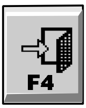
A1.1 Changing Channel on Satelline Radio

Be sure you turn on the radio AFTER having connected its serial port to port 2 of the receiver. Unless you follow this recommendation, serious electrical interferences inside the device will make it impossible to change channel.

F1

If you want to change the radio channel press the **YES** button. At first the control unit checks for the baud rate for communication between ACU and radio automatically. Then the following display appears:

You now may change the channel number. Enter the numerals and accept with **YES**. The control unit will now try to change channel. The message "Changing channel ... " appears on the screen.



Next you will receive the message: Channel changed. Pressing the **F4** button allows you to exit to the Main Screen.

In some cases, however, the change may not be executed. There may be different reasons:

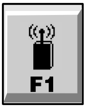
- No radio is connected.
- Other telemetry devices are being used nearby, causing interferences.

The following display will appear:

For the first case, make sure that your radio device is connected to the receiver or to the ACU.

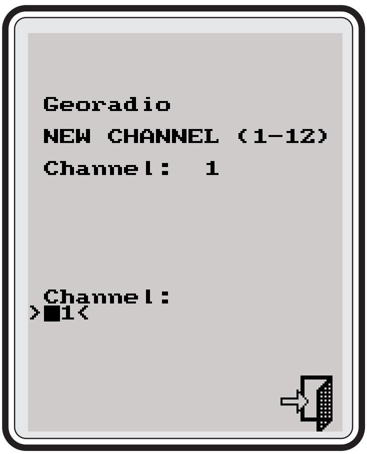
If there is interference from other telemetry devices in the neighborhood, disconnect the antenna from the radio. This will reduce the interference. Try again to change the channel by entering the correct numerals and pressing YES. If the interference was removed, the channel will now be changed.

A1.2 Changing Georadio or Pacific Crest (Baby Blue) Radio Channel

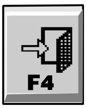


Enter telemetry control by pressing **F1**. One of the following two displays will appear:

If you want to change the radio channel press the **YES** key. The following display appears:



You now may change the channel number. Enter the number and accept with **YES**. The unit will now try to change channel and the message "Changing channel ... " appears on the screen.



Now you will receive the message: Channel changed. Pressing the **F4** button allows you to exit to the Main Screen.

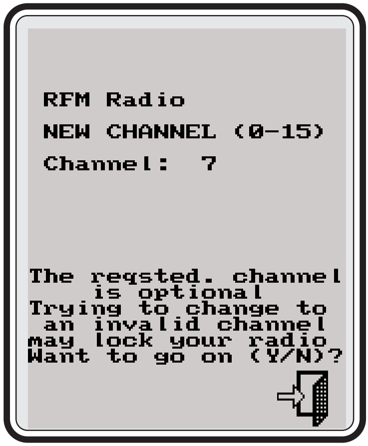
Attention! You can only change to previously initialized channels. The manufacturer of the telemetry devices will preset the frequencies of the radio to specific channels. Only properly licensed frequencies are programmed into the radio modem. Please check with your local Geotronics office or dealer which radio channels are initialized for your country.

If you try to change to a channel that is not initialized, you will get the error message "`Invalid channel`"

Try again and choose a valid radio channel.

The following concerns the Pacific Crest Radio only!

If you try to change your Pacific Crest Radio to one of the optional, but not licensed channels (licences may be purchased from your provider), the following warning will show up:



Press **YES** to go ahead and change the radio channel, any other key to abort the process.

Changing to an invalid channel may cause your radio to lock up. If that occurs, you will get the following message:

Please, turn the power of your radio off, then on again to reset and restart it.

A.2 Control of File Transfer by the Geotracer® Communication Software

The Geotracer® RTK System contains a powerful stand alone utility for data transfer between computers via serial RS232. All standard file operations such as copying and renaming are supported.

If you want to transfer area files, job files or observational data files between your handheld computer and your PC, connect with the Geotronics system cable and communications adaptor and run the Geotracer® communication software.

Geotracer® Communication runs under Microsoft WINDOWS 3.1, WINDOWS 95 or WINDOWS NT.

This chapter provides a detailed description of the Geotracer® Communication software. The first chapters describe how to establish serial communications between the computers, the later chapters describe each function of the program.

A2.1 Installation of the Geotracer® Communication Program on the PC

A setup disk named **GeoCom** is delivered together with the RTK system. Insert the disk into the 3.5" disk drive of your PC.

Installation on a MS WINDOWS 3.1 or MS WINDOWS NT system

1. Open either the Program Manager or the File Manager.

2a. If you opened the Program Manager, choose `Run` from the `File` menu and type the following command line:

```
[drive]:\setup
```

2b. If you opened the File Manager, open the drive containing the Disk **GeoCom** and double-click on the file `SETUP.EXE.`

3. Follow the installation prompts that guide you completely through the installation process.

Installation on a MS WINDOWS 95 system

1. Click on the Add/Remove Programs icon in the Control Panel window. Follow the installation prompts that guide you through the installation process. Alternatively

1a. From a DOS prompt, type the line shown below, assuming that disk **GeoCom** is in the `A:` drive:

```
A:\setup
```

1b. From the Start menu, choose `Run` and type the line below, assuming that disk **GeoCom** is in the `A:` drive:

```
A:\setup
```

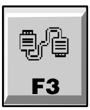
1c. From the Windows Explorer, open the drive containing the disk **GeoCom** and double-click on the file `SETUP.EXE` .

A2.2 Start of File Transfer Control Program on Control Unit

To start the file transfer control program both computers have to be connected with the Geotronics system cable and communications adaptor and switched on.

If you use an L1/L2 receiver, be sure that no antenna is connected to it, when you connect the receiver to the PC!

First start the ACU. The Main Screen appears.



Press **F3** to start the communication program. The Main Communication Program display will appear.

Now start the file transfer program with the F2 function key.

The connection to the main computer is now running and all operations will be controlled from your main computer.

You may quit the communication program using key Q.

A2.3 Starting the Geotracer® Communication Program on your PC

The Geotracer® PC Communication Program is a Microsoft WINDOWS program. Start MS WINDOWS and open the Geotracer® group.

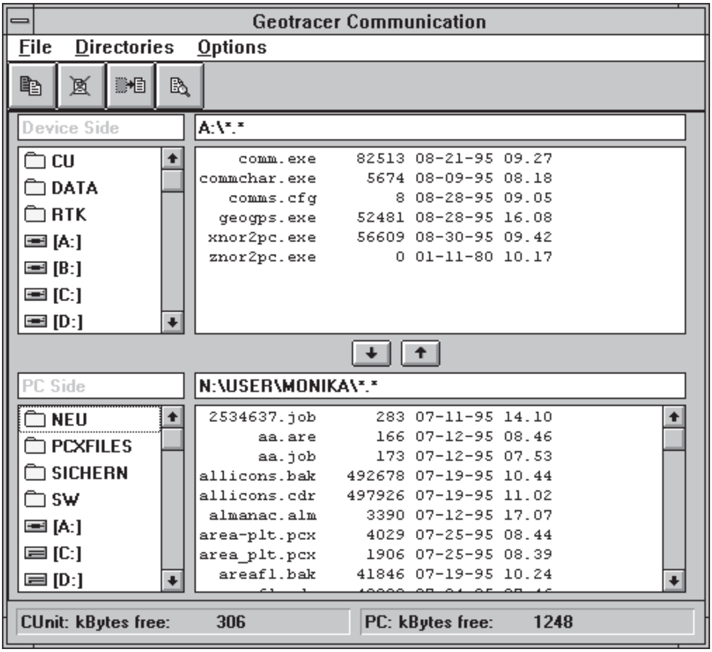
Double-click on the Geotracer® Communication Program icon to start the program. This window appears.

You are asked to indicate which communication port to use for the ACU (or L1/L2 receiver) to the PC. Enter the port and accept with OK or leave the program with Exit.

As soon as you have selected the communication port the baud rate of communication will be checked by the program. The message `Finding correct baudrate ...` shows up, until the program has successfully communicated with the control unit.

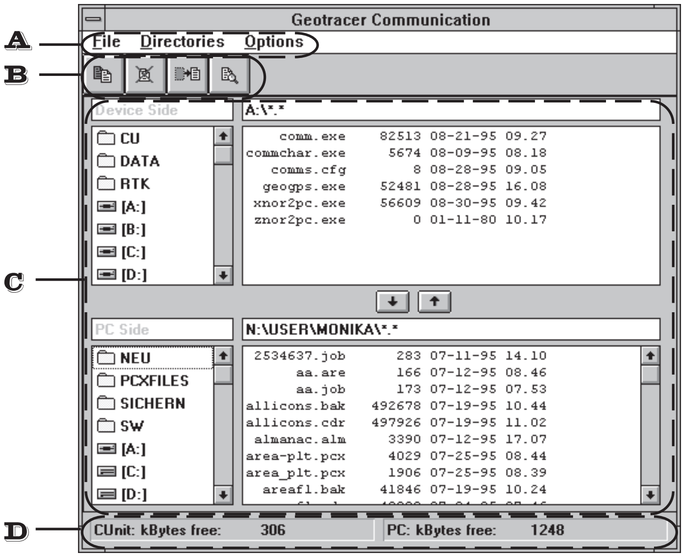
The message `Establish protocol ...` follows.

When the check is completed successfully, the Main Window shows up (otherwise the program is terminated).



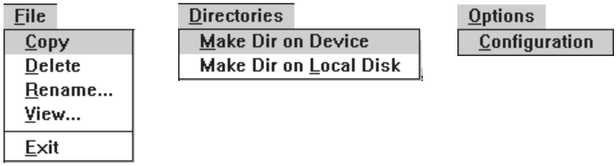
A2.4 Description of the Main Window

The Geotracer® Communication Main Window is subdivided into 4 main parts:

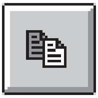
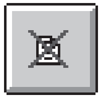


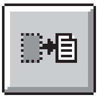
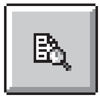
A A menu bar,
B A toolbar, providing shortcuts to some of the standard operations,
C A display to the actual drive and directory contents of the remote device and of the PC, separated by the up- and download arrow , displays,
D A status bar.

A The menu bar offers three choices:



B Buttons on the toolbar offer easy and quick access to standard file operations:

 Copy  Delete

 Rename  View

C The upper half of the file display relates to the ACU computer (or L1/L2 receiver), the lower part relates to the PC. On the lefthand side you see the current directory tree of each computer, on the right, the current directory and its contents. ↑ and ↓ keys make a fast transfer of data.

Please note, that the two arrows correspond to the use of the terms "upload" and "download" !

D A status bar at the bottom of the screen tells you how much free disk space is available.

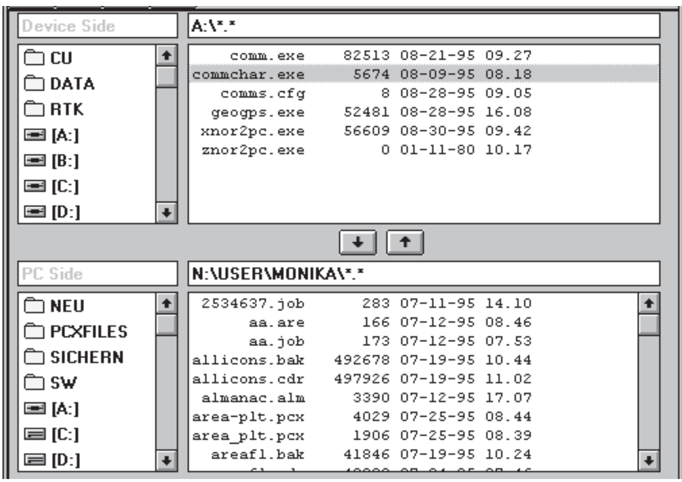
The amount of available disk space in the ACU (L1/L2 receiver) is shown on the left side and the amount of available space of the PC´s current drive on the right side of the status bar.

A2.5 Functions of the Geotracer® Communication Program

Change Directory

You can easily change directories:

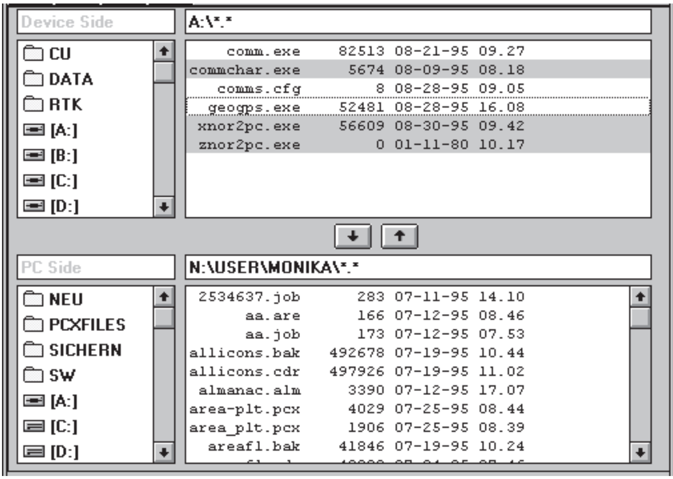
.	The current directory as defined in the top line
..	The directory above the current directory tree,
<NAME>	Subdirectories of current directory,
[a:], [c:], ...	Symbols for available drives.



To change a directory double-click with the left mouse button on the desired directory. The files contained in that directory will appear in the righthand box. The path to the directory is printed at the top of the list and the new subdirectory tree is printed in the lefthand box.

The Geotracer® Communication program works on selected files. We will now describe how to select or deselect files.

Select File(s)
To select a file simply move the cursor and click on the desired file with the left mouse button. You may select as many files as you like. Seleted files are highlighted.



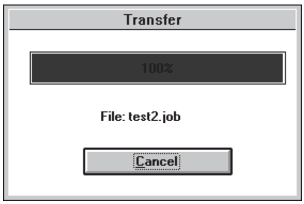
Deselect File(s)
To deselect a selected file simply click on it again. You will see, that the highlight disappears. The file is now deselected.

Copy File(s)

You may copy files from one device to the other. Simply select the desired directory, select the file(s) you want to copy, then ...

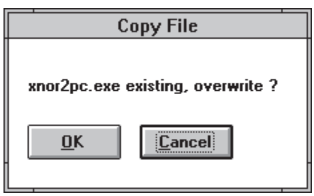
- enter the menu "Files" and choose "Copy"
  or
- click on the Copy button 
  or
- use the ↑ or the ↓ arrow, depending on the direction you want to copy the file(s).

A progress indicator shows the progress of the file transfer procedure.



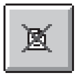
The name of the copied file shows up in the destination directory when the transfer has been completed. You may interrupt the transfer process at any time by pressing Cancel.

If the file name already exists in the destination directory a dialog window pops up, asking you whether or not you want to overwrite the file. Press OK if you want to overwrite the file. Press Cancel to cancel the copy process for the current file.



Delete File(s)

The Geotracer® Communication program provides an easy method to delete files. To delete file(s) change to the desired directory and select the file(s) you want to delete. You now may either

- enter the menu "Files" and choose "Delete"
  or
- click on the Delete button  .

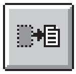
A window shows up asking whether you really want to delete the file. This protects you against unintentionally deleting files.

Press  if you want to delete the current file, the file will be removed from the current directory.

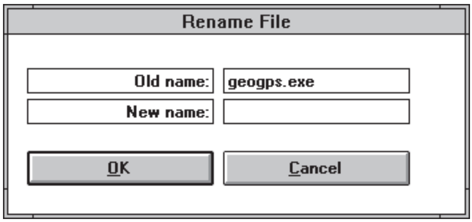
Press  to cancel the delete process for the current file. If you had selected more files you will be prompted for the next one.

Rename File

Change to the desired directory and select the file you want to rename. You now may either:

- enter the menu "Files" and choose "Rename"
  or
- click on the Rename button  .

The following window shows up.



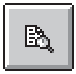
Enter the new name in the second line and accept by pressing the  . The file will be renamed in the current directory.

If you do not want to rename the file cancel the action by pressing  .

If you have selected more than one file to be renamed the renaming window offers only the file selected last.

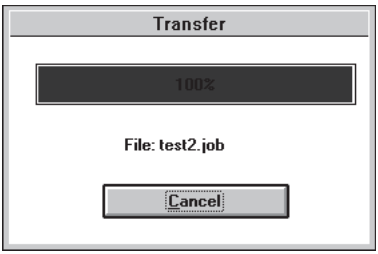
View File

The Geotracer® Communication system allows you to use any editor you have installed. This powerful option allows you to control or edit your files in a very easy way. To view a file change to the desired directory and select the file you want to view. You now may either

- enter the menu "Files" and to choose "View"
  or
- click on the View button  .

If you wanted to view a file on the remote device (ACU or L1/L2 receiver), the selected file will first of all be transferred to the PC. This transfer is only temporary and reversed when the viewing process has finished. You may interrupt it at any time by pressing 

.

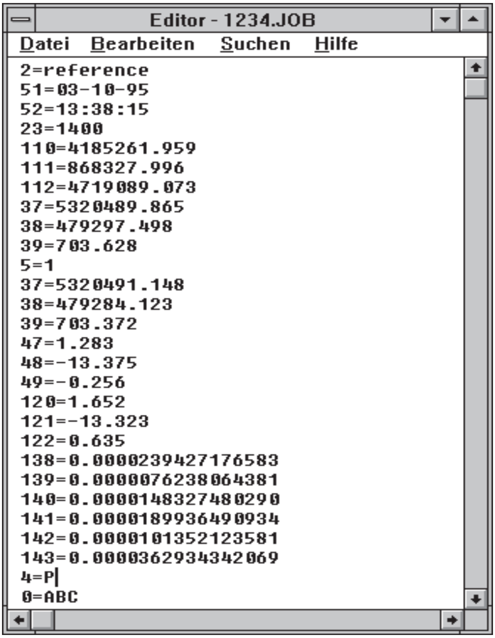


By default, the WINDOWS editor **Notepad** is used.

If you want to use another editor, you can do so. Go to menu Options and select Configuration. Change the entry "Editor" giving the full path and name for the editor of your choice.

**When using WINDOWS version 3.1 the Notepad editor only allows you to open files of less than 64 kBytes.
To view files larger than 64kByte use another editor and change the path to the editor in menu Options.**

You may use all the functions of your chosen editor. If you have edited a file you must save the change then and transfer the changed file back to the control unit or L1/L2 receiver.

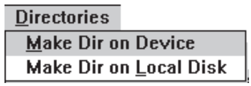


Above you see an example of a job file displayed by the German Version of WINDOWS **Notepad** editor. You may scroll through files, change them, etc.

The file structure depends on the structure of the User Defined Sequences described in chapter 10.

Create Directory

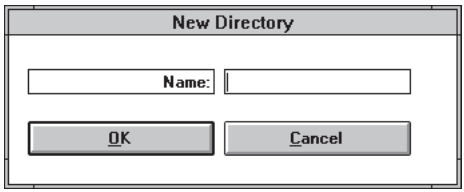
Creating a directory is a very simple task. Go to the directory, or root of the drive, then open the menu "Directories".



You may choose where you want to make a new directory:

- Make Dir on Device: New directory on the control unit or L1/L2 receiver,
- Make Dir on Local Disk: New directory on PC.

A window shows up and you can enter the name of the new directory.



Press 

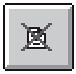
if you want to make the new directory. The new directory will be created as a subdirectory of the current directory or drive.

Press 

if you want to cancel the action.

Remove Directory

Removing directories is as simple as deleting files. If you want to remove a directory it must be empty. Choose the desired directory, then

- enter the menu "Files" and to choose "Delete"
  or
- click on the Delete button  .

A box shows up asking whether you really want to remove the directory. This prevents you from accidently removing directories.

Press 

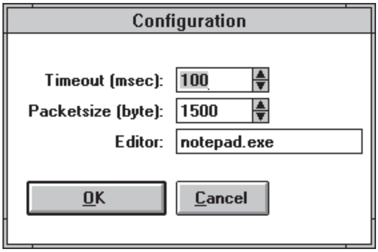
if you want to delete the current directory.

Press 

to cancel the delete process.

Options

When clicking on Configuration in the menu, the Configuration Window pops up.



You find three options for changes:

- Timeout - only to be changed by an experienced user!
- Packetsize - only to be changed by an experienced user!
- Editor

Timeout:

If the WINDOWS-computer is too slow and transmission errors occur, the duration of timeout could be increased. The value is given in milliseconds.

Packetsize:

The best packetsize depends on the quality of the serial link. Usually, you should accept the value suggested by the program. The value is in bytes.

Editor:

You may want to use a different editor or select a different path to the editor´s directory. This is commonly done, if the files are bigger than 64 kByte. In this case, you have to use a different editor than WINDOWS **Notepad**.

In order to change the editor or the path, enter the new path and name in the right field. There is no limit to the number of alphanumeric characters.

A3 File Exchange Tool

A3.1 Properties

Exchange files between ACU and L1/L2 receiver
-
Delete files
-
Several surveying teams

The main purpose of the File Exchange Tool is to move files from the ACU to a L1/L2 receiver and vice versa. In addition, you will also be able to view all the directories of both units and remove files. Using this tool you will have access to all your measurements stored in the ACU very easily by just copying the files from the ACU to the PCMCIA card of the receiver. The system also offers the opportunity to plug a card containing job or area files with known points into the receiver, transfer them to the ACU and use the points within your RTK session. Another option is to exchange measurements between different surveying teams out in the field, no matter whether they are using RTK or a total station.

L1 receiver: stand-alone

With a L1 receiver, the File Exchange Tool works as stand-alone tool and allows to check and/or delete the files of the PCMCIA card of the ACU.

A3.2 Start and Main File Exchange Display

To start the File Exchange Tool just switch on the ACU and the Geotracer® Main Control Display will welcome you.

Press **F3** to choose the Communication Display

F3 starts the File Exchange Tool. It will immediately establish the connection to a receiver on port 1 of the ACU and the Main File Exchange Display will appear.

Header and title line

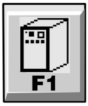
In the top line you will find the unit whose files are listed, either ACU or receiver. The second line displays the path to the current directory, followed by all subdirectories and files of that directory. When working with the receiver, the title line shows "`Receiver`", followed by the root directory and the path if you changed the working directory.

Information display

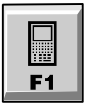
The lower part of the display contains additional information concerning the highlighted file or directory. For each file this will be time and date of creation and size of the file, if you select a directory, you will find the time and date of creation and the free space left on the disk.

All functions of File Exchange Tool

Depending on the system configuration you will find the following functions and related icons:



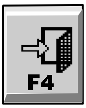
Show path and directory of receiver card.



Show path and directory of ACU card.

Copy the marked file(s) to the unit displayed on F1.

Reconnect the system to a receiver, if you have decided to connect a receiver during a session or if you have loaded a new PCMCIA card.



Exit the program and return to the Communication Menu.

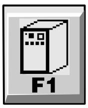
Depending on the current configuration different sets of these functions will be available.

Stand-alone: Check or delete files

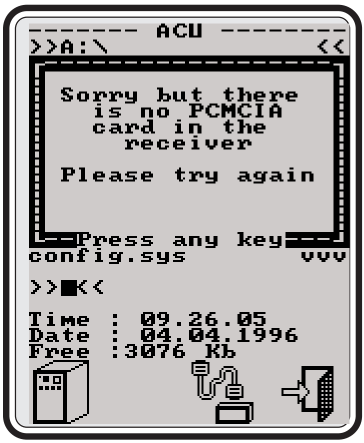
If no receiver is connected to the ACU or if the receiver is a one-frequency receiver, a warning message will pop up and offer the opportunity to work in stand-alone mode.

Using this stand-alone mode you can check all the directories of the ACU and delete files to get more free space on the disk. The display shows only two functions:

If a receiver is connected, but no PCMCIA card is plugged in, the following display will be shown.



If you now press F1, a warning message appears to inform you, that no PCMCIA card is plugged into the receiver.

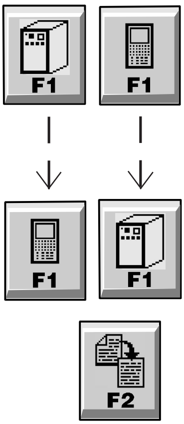


Using F3 you may reconnect after having inserted a PCMCIA card.

A3.3 Working with the File Exchange Tool

The File Exchange Tool will always work in the following way.

To copy a file :



- Change to the target unit by pressing **F1** until the directory of the target unit is displayed.
- Select the target directory by moving through the file system.
- Return to the source unit by pressing **F1**.
- To copy one file move the highlighted bar onto that file, to copy more files mark all files you want beforehand.

- Press **F2** to copy the files.
- Confirm the copying.

To delete a file:

- Change to the unit containing the file you want to delete.
- To delete one file move the highlighted bar onto that file or mark all files you want to delete.
- Press **Shift** + **←Sp** to delete the files.
- Confirm the deletion.

Change directory

Move the highlighted bar with the ▼ and ▲, PG↓ and PG↑ keys to a subdirectory and press YES. The program will then change to that directory and display all subdirectories and files. In addition, the path shown in the title line will be updated to the new subdirectory.

If you use line “ . . ” to change the directory the system will move up one directory.

Select Files

The currently selected file will be highlighted. If you want to select more than one file, you have to mark the files. To mark a file move the highlighted bar onto the file and press **Sp**.

If the file was unmarked, it will now be marked with an asterisk (*), if the file was marked, it will now be unmarked.

To mark all files of that directory press **Shift** + **M**.

To unmark all marked files of that directory press **Shift** + **U**.

Delete a File

To delete a file move the highlighted bar onto that file name and press **Del** (**Shift** + **←Sp**). A message will appear and you will have to confirm the deletion.

Any other key than **YES** will cancel the deletion.

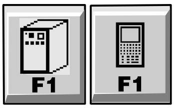
If one or more files are marked the system will delete all marked files.

The confirmation message will then differ from that for one file.

You will be able to follow the process with a small window appearing.

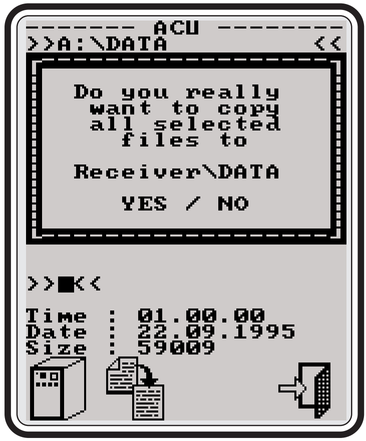
If a highlighted file is not marked, but other files are, only the marked files will be deleted!

Copy a File



To copy a file move the highlighted bar onto the file and press F2 or first select all the files you want to be copied. The file(s) will be copied to the current directory of the target as shown on the icon of F1. To change the target directory switch to the target unit and change to the required directory.

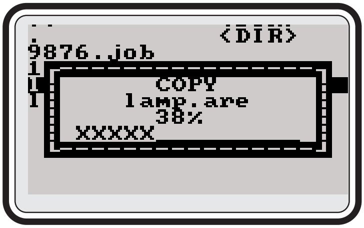
Switch back to the source directory and press F2 . A message will appear and you will have the opportunity to confirm the copying of the file(s). Any other key than YES will cancel the copying.



If the file already exists, another message will pop up to inform you about this. You will have to confirm that you really want to overwrite the file.

If one or more files are marked the system will copy all marked files. The message to confirm overwriting of existing files will appear for each duplicate file found.

You will be able to follow the copying process via a small information window displayed during the copying process.



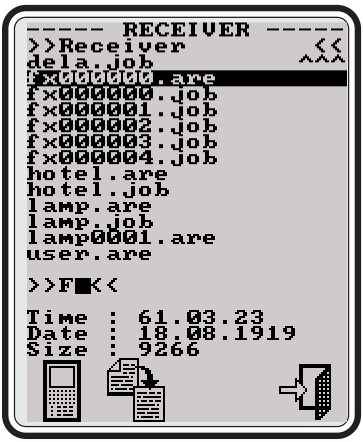
There you will find the current file name and the percentage of already copied data together with a bar indicating the progress.

Find a File

After selecting a new directory you will find the subdirectories at the beginning of the list followed by all files. The order of the files is the same as found on the PCMCIA card. If there are more files than lines on the display the system shows some arrows to make clear that there are more files up “^^^” or down “vvv”. Please use the ▼ and ▲ , PG↓ and PG↑ keys to scroll through the list of files.

If a subdirectory contains too many files to be found using the arrow keys, the system offers the opportunity to use an intelligent file search utility. At the end of a file list you will find two brackets “>> ■ <<“ .

If you start to key in the first character of the file or subdirectory to be found, the display will be rearranged and all files and subdirectories will be displayed in alphabetical order. The first file starting with that character will be highlighted.



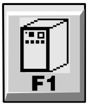
If you key in the second character, the first file matching both characters will be highlighted. Using this utility it will be very easy to find the file either by keying in characters until the required file is highlighted or by using the ▲ and ▼ keys, if the file is close to the highlighted file.

If you key in some characters for which there is no matching file, no file will be highlighted. You can use the ←Sp key to change the characters you are searching for. If you use the ▲ or ▼ key, all characters which do not match the new file are removed from the bracket.

Change of the PCMCIA card

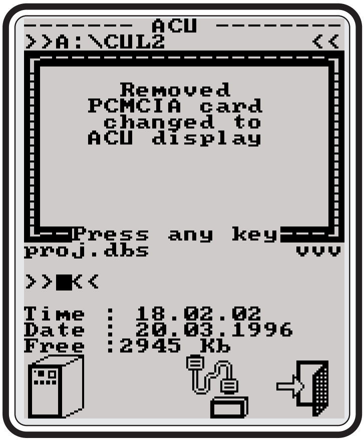
If you want to change the PCMCIA card while using the File Exchange Tool, just remove the card and plug in the new one.

If the display shows the ACU directory, the icons will change to F1, F3 and F4 after removing the card and change back to F1, F2 and F4 if you plug in the

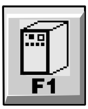


new one. Pressing the **F1** button will now display the directory of the new card.

If, however, the display shows the receiver directory while removing the card, a warning will come up and the icons will change to **F1**, **F3** and **F4**



If you accept the message by pressing any key and the display will switch to the ACU directory. As soon as you plug in the new card the icons will change back again and pressing the **F1** button will result in the display of the directory of the new card. Alternatively, you can just plug in the new card. The warning will then disappear and the directory of the new PCMCIA card will be displayed.



Warning

Do not use the File Exchange Tool during stand-alone recording of data to the internal PCMCIA card of the receiver. The transfer program switches off the receiver during a session to get the full bandwidth of data transmission for file handling. You would therefore find "gaps" (periods without data) in your observation files for the time the File Exchange Tool was running.

Appendix B.

Function Keys and Other Shortcuts

Function Keys and Other Shortcuts

F1
·
·
F4

Working with the Geotracer® 2000 System is very easy. During survey you can control any procedure of the program with only four function buttons and accept or cancel with the YES and NO button. Easy-to-identify icons placed directly above the function key indicate the function of the key. One look at the display tells you the current options.

Chapter B1 lists all the icons used in the RTK system and in data communication. Chapter B2 summarizes the respective functions and the steps that follow.

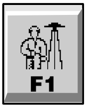
In chapter B3, the effects of some other keystrokes and keystroke combinations are given.

Functions on **F1**

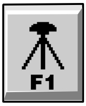
B1 List of Functions

On this and the following two pages you will find a complete list of all the functions connected with the four function keys, symbolized by icons on the bottom line of the display.

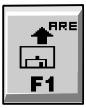
F1 :



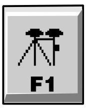
Classical Surveying Options (B.8)



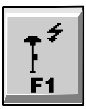
Start-up of Reference Receiver (B.9)



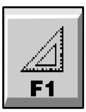
Read Coordinates from a Job or Area File (B.10)



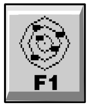
RTK Initialization by Measuring the Very Short Fixed Baseline (B.11)



Point Positioning Mode / Survey Mode (B.12)



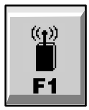
Measure a Point (B.13)



View the Sky Plot (B.14)

Zoom Function (B.15)

Stop (B.16)

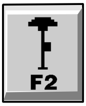


Control of Telemetry (B.17)

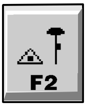
Functions on F2

F2 :

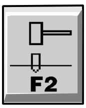
Enter the Real Time Kinematic Geotracer® RTK System (B.18)



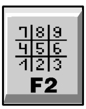
Initialization of Rover Receiver (B.19)



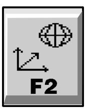
Known Point Initialization (B.20)



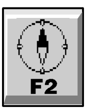
Stake out (Set out) Points Mode (B.21)



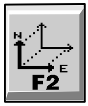
Manually Enter Coordinates (B.22)



Definition of Coordinate System (Toggle Switch) (B.23)



Definition of Orientation of Reference (B.24)



Definition of Local Coordinate System (B.25)

Register Measured Point Information or Measure and Register (B.26)

Control of File Operation (B.27)

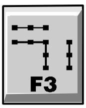
Functions on **F3** *and* **F4**

F3 :

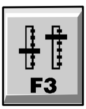
Start the Communication Program (B.28)

Short Static System Initialization (B.29)

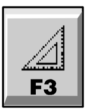
Skip Measured Point Information (B.30)



Sketch Survey Plot (B.31)



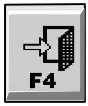
Parameter Settings (B.32)



Measure a Point to Define Local Coordinate System or for Single Point Positioning of Reference Position (B.33)

F4 :

Return to Previous Menu (B.34)

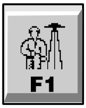


Exit to Main Menu or DOS (B.35)

B2 Detailed Description of Function Keys

The following pages provide a detailed description of each function. When you are not quite sure of the meaning of an icon, have a quick look at this chapter. What happens when you choose the related function key is described here. You will see the display where the icon appears as well as the display which follows when you press that respective function key.

We have listed the icons and function keys (F1 ... F4) in the same order as they appear in the program (RTK, Communication Control).

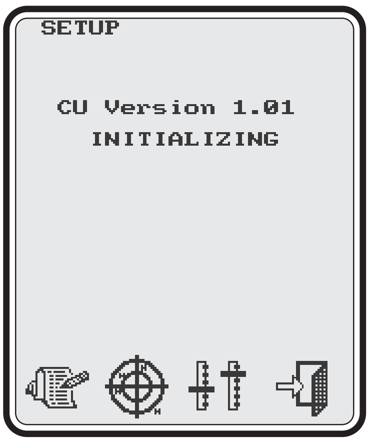


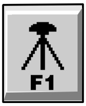
Definition:
Classical Surveying Options

Current display:
Geotracer® Main Control Display

Action:
The receiver control menu tests the type of receiver connected, and starts the relevant control unit program. You can set various parameters including elevation cutoff, sampling rate etc. For further information please check the L1 receiver manual or the L1/ L2 receiver manual, chapter 12.

Following display:
Main CU Display (in this example, we show the L1/ L2 receiver display).





Definition:
Start-up of Reference Receiver

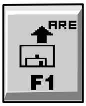
Current display:
Main RTK Display

Action:
Before starting with a survey it is necessary to determine the reference station. A Geotracer® receiver can be made to function as a reference station. This function key gives the Geotracer® L1 reference receiver all its parameters for RTK survey. These include:

- a sampling interval of 1 sec.
- a cutoff elevation angle of 10°

When initialized as reference station, the reference receiver sends RTK data to the port connected.

Following display:
Receiver Start-up Display

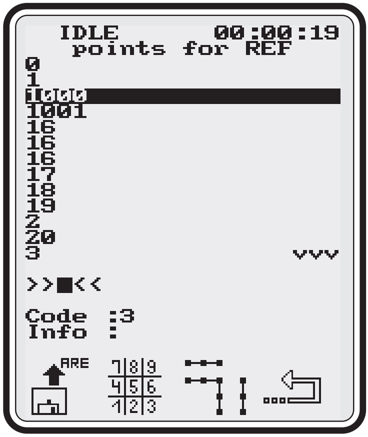


Definition:

Read Coordinates from a Job or Area File.

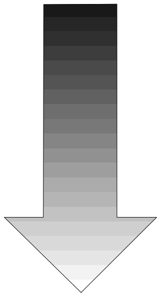
Current display:

The file selector is available from various places in the RTK program, e.g., at the Point Selection Display

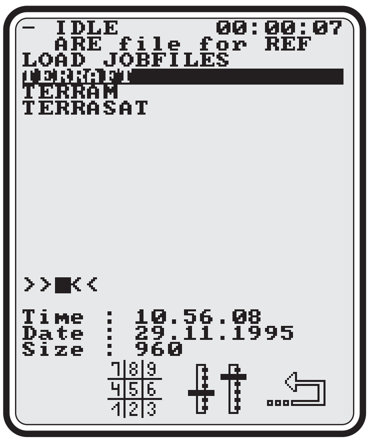


Action:

Area and job files are point position information files which are used in the Geodimeter and in the Geotracer® product lines. You should create these files for points you wish to stake out (set out) or use as known points. Job files are created by the RTK system and may or may not contain coordinates. Their content depends on your U.D.S.

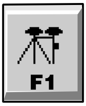


When you have pressed the key all available area files will be listed. The first option is to load all job files. You can select a file using the ▲ and ▼ arrow keys, then pressing YES.



Following display:

Area File Selection Display



Definition:
RTK Initialization by Measuring the Very Short Fixed Baseline

Current display:
Initialization Menu Display

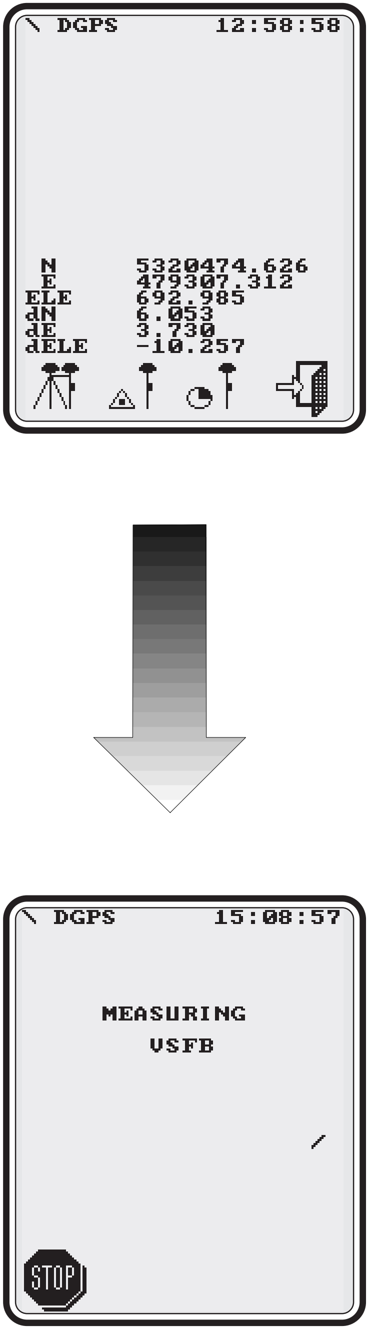
Action:
System initialization with a VSFB. When successful, the mode is changed to RTK giving centimeter accurate positions.

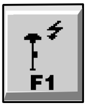
The Very Short Fixed Baseline may involve the use of the VSFB accessory provided by the Geotracer® RTK system or you may use your own and enter its parameters in the parameter menu.

If you always use the same VSFB and guarantee a height difference of 0 no changes in the default parameter setup are necessary.

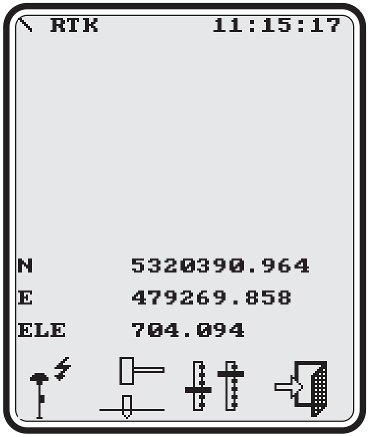
If you change any of the height or length parameters a change of the parameter setup is necessary as described in chapters 4.2 & 7 .

Following display:
Measuring VSFB Display





Definition:
Point Positioning Mode / Survey Mode

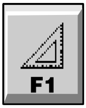


Current display:
Mode Selection Display

Action:
The Geotracer® RTK system allows you to measure the position of points in Real Time Kinematic Mode. Measurement takes a few seconds only.

Press this key to enter survey mode.

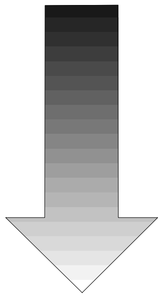
Following display:
Survey Mode Display



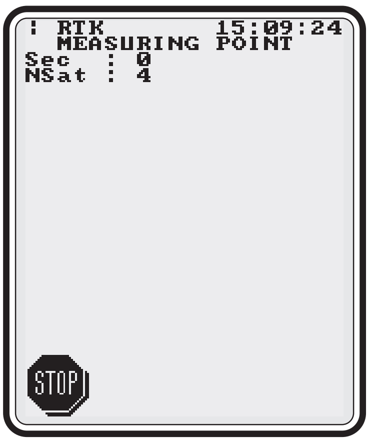
Definition:
Measure a Point

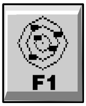
Current display:
Available at several places in the Geotracer® RTK program

Action:
Move to a point you want to survey and position the rod at the point. Hold it vertical and steady. Check with the bubble. Press the key to measure.



Following display:
Measuring Point Display





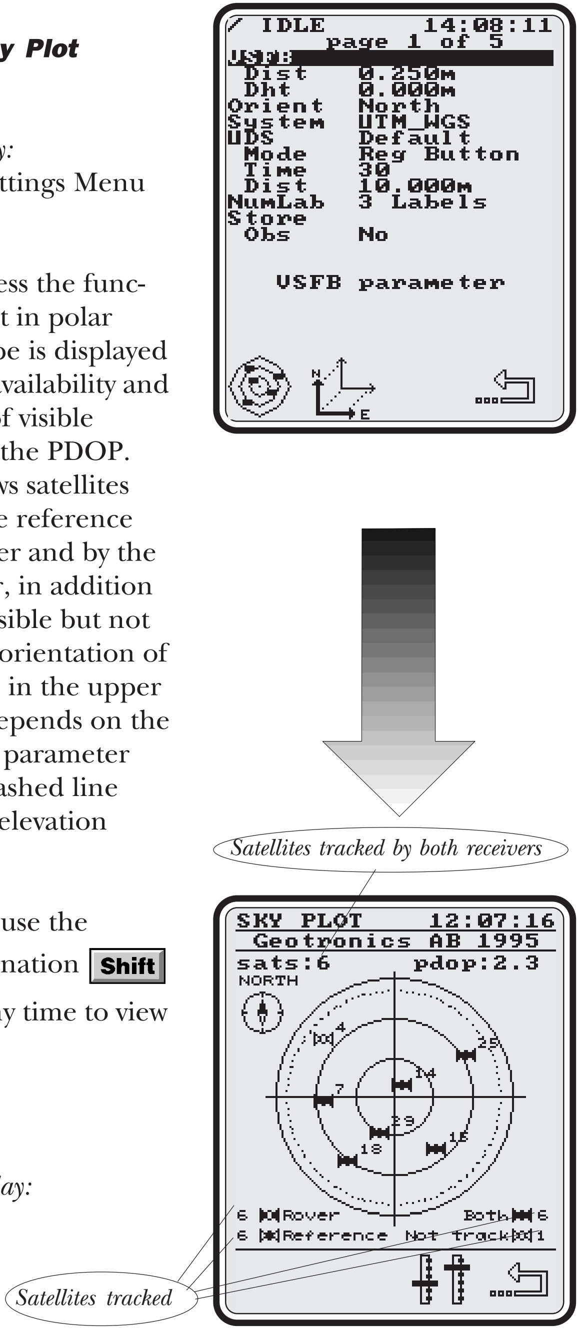
Definition:
View the Sky Plot

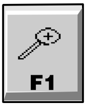
Current display:
Parameter Settings Menu

Action:
When you press the function key a plot in polar projection type is displayed showing the availability and distribution of visible satellites and the PDOP. The plot shows satellites tracked by the reference station receiver and by the rover receiver, in addition to satellites visible but not tracked. The orientation of the plot, seen in the upper left corner, depends on the setting in the parameter menu. The dashed line indicates the elevation cutoff angle.

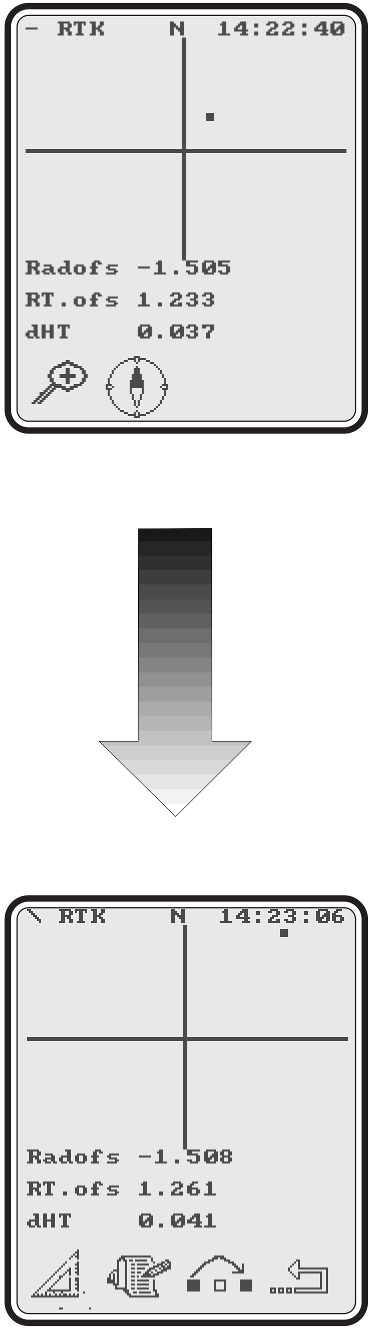
You may also use the hotkey combination **Shift** + **S** at any time to view the Sky Plot.

Following display:
Sky Plot





Definition:
Zoom Function



Current display:
Graphic Staking out Display
Important: These icons will only appear if you press the YES key. Press YES again to switch back!

Action:
In graphic stake out mode the system distinguishes between different scales for the map shown. By default the system zooms in automatically. If, however, you want to zoom manually you may use the zoom function. When selected, the square, indicating the point to be staked out, jumps to the outer edge of the screen and the main icon list shows up again.

Exception: the largest scale is already in use.

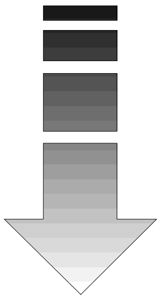
Following display:
Graphic Staking out Display, zoomed in.

Note: The main functions and their icons reappear automatically.

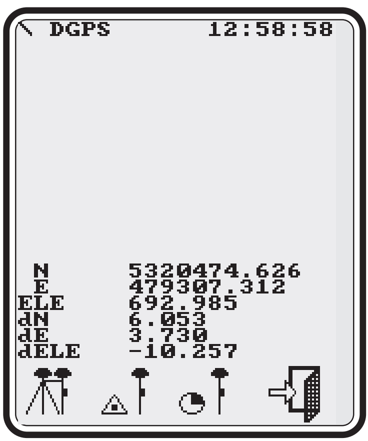
Definition:
Stop

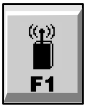
Current display:
Available at several parts of the RTK program

Action:
Press the key and any procedure in progress will be interrupted.



Following display:
When you have pressed the key the previous display reappears, depending on what function you interrupted. In this example, the Initialization Menu reappears. Sometimes, you will have to confirm, whether the process is to be interrupted or not.

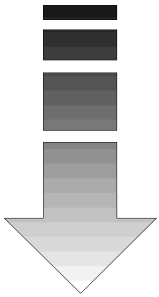




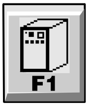
Definition:
Control of Telemetry

Current display:
Main Communication Control Display

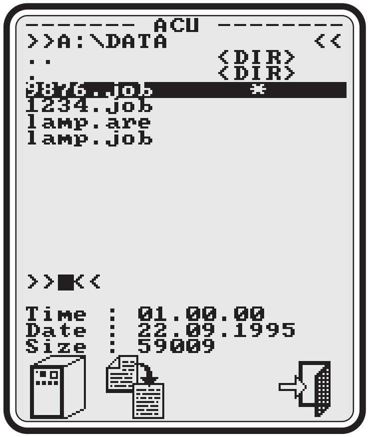
Action:
This controls the telemetry devices, which take the information from the reference to the rover receiver. You can select the radio channel. For details, see Appendix A1.



Following display:
Telemetry Control Display, depending on the telemetry in use.

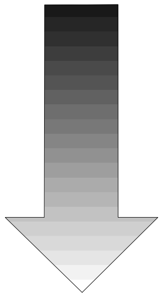


Definition:
Show Contents of Receiver Card

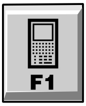


Current display:
File Exchange Tool Display, 2200 series only!

Action:
Using the File Exchange Tool with a L1/L2 receiver this key changes to the current drive of the receiver. The icon also indicates the target device for copying files by pressing **F2** .



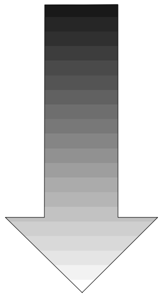
Following display:
File Exchange Tool Display for receiver



Definition:
Show Contents of ACU Card

Current display:
File Exchange Tool Display, 2200 series only!

Action:
Using the File Exchange Tool with a L1/L2 receiver this key changes to the current drive of the ACU. The icon also indicates the target device for copying files by pressing F2 .



Following display:
File Exchange Tool Display for ACU

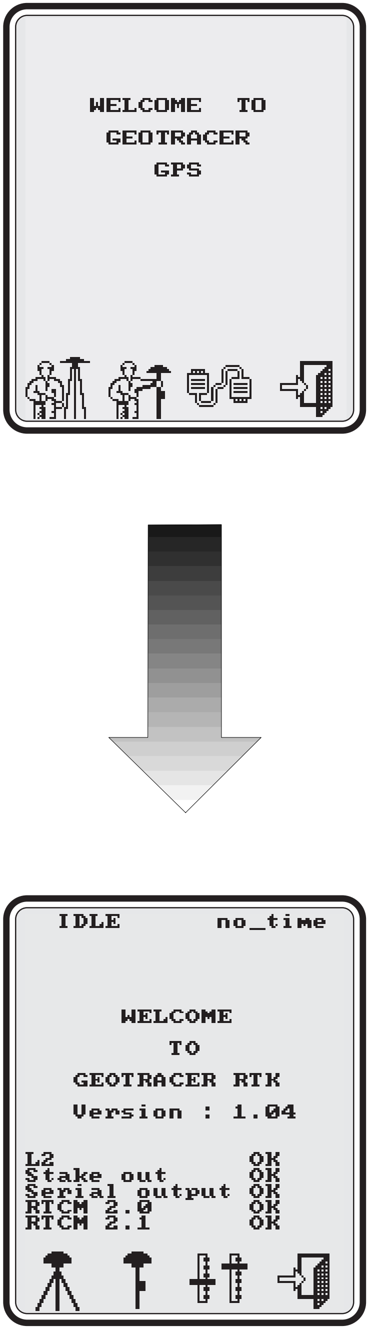
Definition:
Enter the Real Time Kinematic Geotracer® RTK System

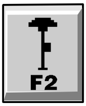
Current display:
Geotracer® Main Control Menu

Action:
In order to start the RTK program, connect the GPS receiver system to the ACU, provide the receiver system with power and switch on the receiver and ACU. The control will "boot up". You can now start the RTK program by pressing the key.

The RTK program starts the receivers and measurement system, ready to measure positions of points in real time kinematic mode or to stake out points.

Following display:
Main RTK Display



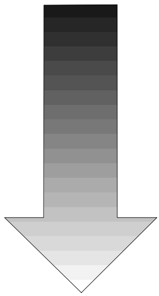


Definition:
Initialization of Rover Receiver

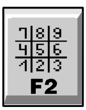
Current display:
Main RTK Display

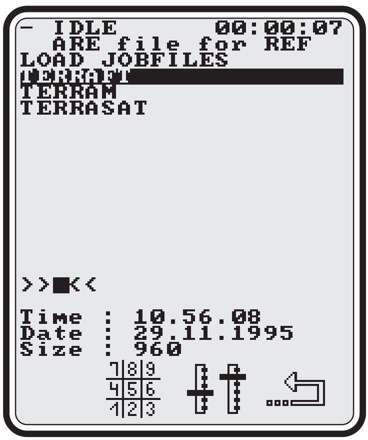
Action:
When you have connected the rover receiver to the ACU and switched on power to both units, the RTK system has to be initialized. In order to initialize the system, supply coordinates of the receiver at the reference station. This information can be read from the receiver, input manually or read from an area file.
This function key instructs the rover receiver to set up all parameters to RTK values. These are in detail:

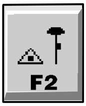
- a sampling interval of 0.25 sec (L1) or 0.5 sec (L1/L2)
- a cutoff elevation angle of 10°



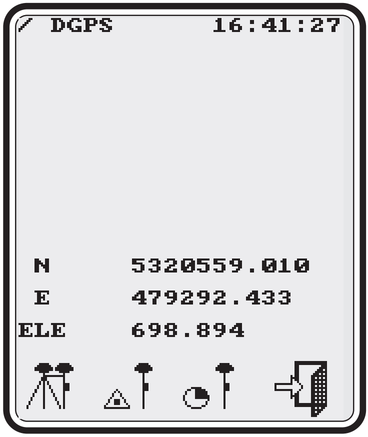
Following display:
Area File Selector
Select a file. You will see the Point Selector Box and chould choose "reference". Other possibilities are to use **F2** to manually input coordinates or else to take the single point position from the receiver.







Definition:
Known Point Initialization

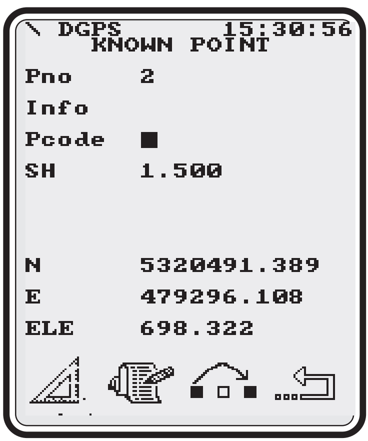


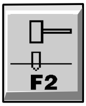
Current display:
Initialization Menu Display

Action:
Initialization of the RTK system with the help of an accurately known point (see chapter 4.2.2).

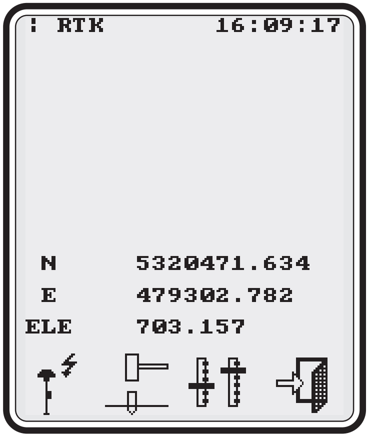
You can select the Known Point from a list of points already measured in the current survey, from area files, or enter coordinates manually via the keyboard.

Following display:
Known Point Measurement Display



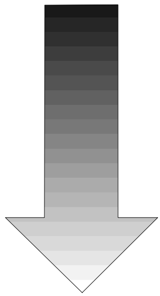


Definition:
Stake out (Set out) Points Mode

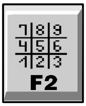


Current display:
Mode Selection Display

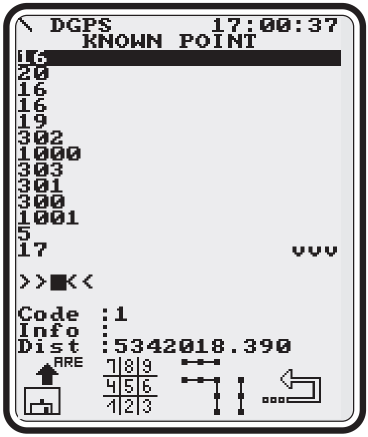
Action:
Switches the system to the stake out (set out) mode in which you are able to set out points from a job file, an area file, or manually input from the keypad.



Following display:
Request for Jobfile Name Display



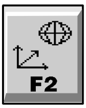
Definition:
Manually Enter Coordinates



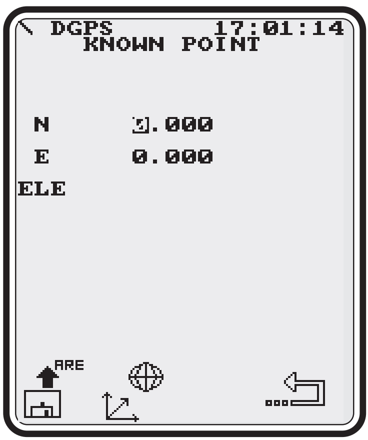
Current display:
Point Selection Display

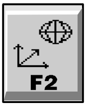
Action:
You may enter the coordinates of points manually using the F2 key.

You may enter coordinates in different coordinate systems. You may choose a coordinate system via toggle switch F2.



Following display:
Coordinate System Menu Display





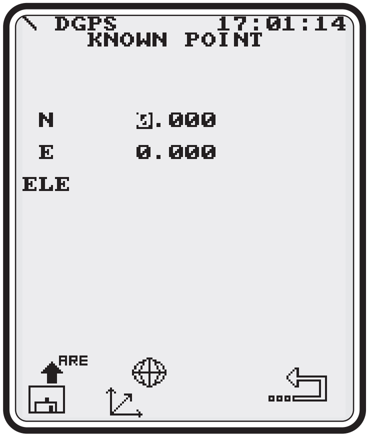
Definition:
Definition of Coordinate System (Toggle Switch)

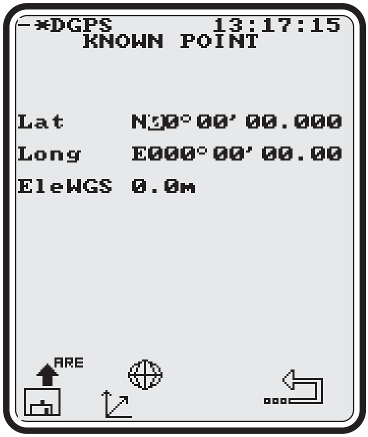
Current display:
Coordinate System Menu Display

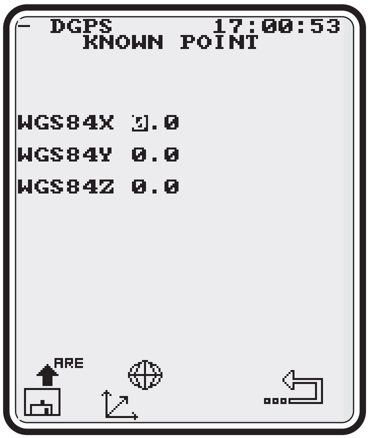
Action:
You may enter coordinates in different coordinate systems. The program offers the opportunity to choose one of the following coordinate systems by repeatedly pressing the key:

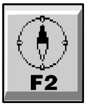
- National grid coordinates north, east and height component (N, E, Ele)
- Ellipsoidal coordinates within the national grid datum (Lat, Long, Ele)
- WGS84 coordinates (X,Y,Z)

Following displays:
Using the key toggles between these displays.



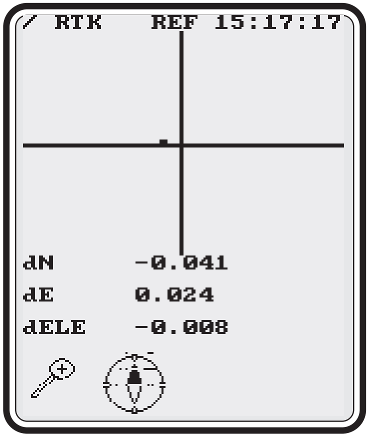






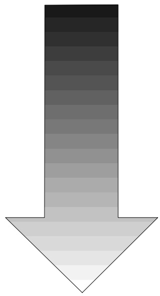
Definition:

Definition of Orientation of Reference



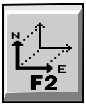
Current display:
Graphic Staking out Display
Important: Press the YES key first. The icons will change.

Action:
Different graphics in the RTK system offer a user defined orientation of the display. The orientation definition key allows you to change the orientation of the stake out graphic or the sky plot.



The orientation direction can also be defined in the Parameter Settings Menu (Use the hotkey combination Shift + P at any time during system operation to access the Parameter Settings Menu and select the line `Orient`).

Following display:
Orientation Selection Menu

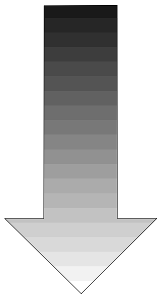


Definition:
Definition of Local Coordinate System

Current display:
Parameter Settings Menu

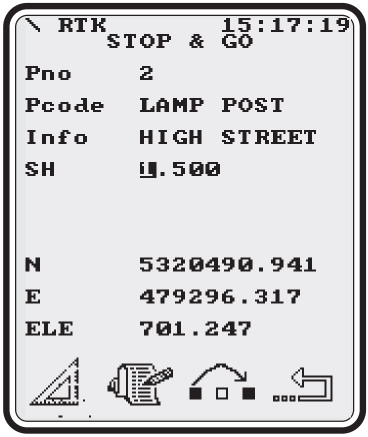
Action:
Allows you to control the system in which your local coordinates are based.

You can select the same option, if you select the `System` line of the Parameter Settings Menu and choose `Local Trans.` in the following display.



Following display:
Local Coordinate System Selector

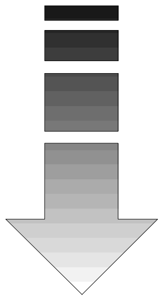
Definition:
Register Measured Point Information or Measure and Register



Current display:
This function is offered at several points in the program.

Action:
When you press F2, the program will store the coordinates of the point you have just measured and any of the labels defined in your U.D.S.

If you have not measured a point, it will first measure the point before storing the data.

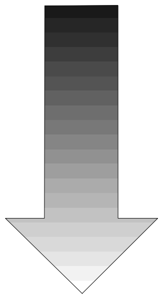


Following display:
Usually, the position display shows continuously updating positions (kinematic mode).
Exception: **The first time** you have selected this function the Enter Jobfile Name Display is shown and you must enter the name for a job file.

Definition:
Control of File Operation

Current display:
Main Communication Control Display

Action:
Start the utility for data transfer between ACU and a computer via serial links. All standard file operations are supported.



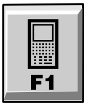
Following display:
File Operation Display

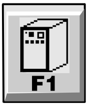
Definition:
Copy Files

Current display:
File Exchange Tool

Action:

If you press **F2** , all marked files of the current directory of the chosen device (L1/L2 receiver or ACU) will be copied to the current drive of the device shown on the icon above the function key **F1**.

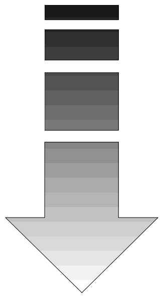




The function is not available, if

a) no receiver is connected to the ACU
b) a L1 receiver is connected to the ACU
b) a L1/L2 receiver is connected, but no PCMCIA card inserted

Following display:
Message display

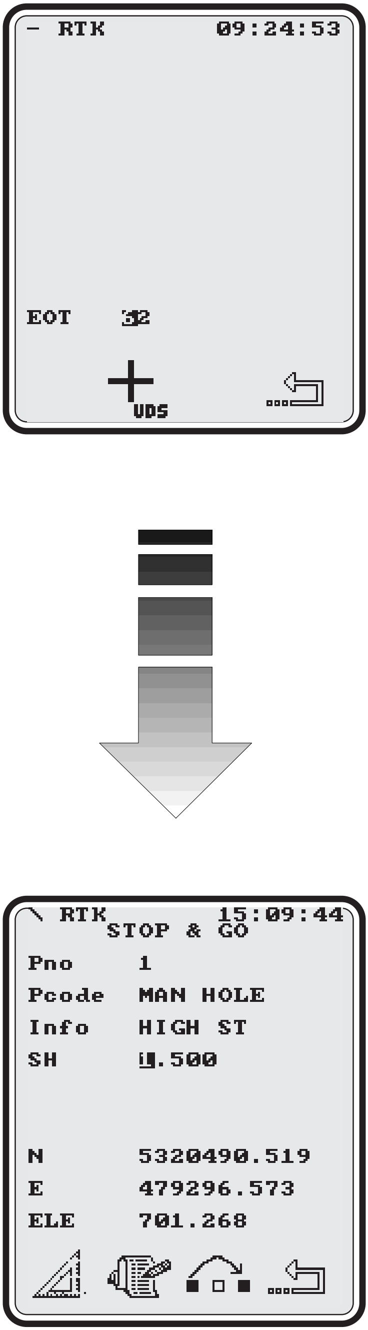


Definition:
Add Label Once

Current display:
Label Definition Display

Action:
You may change the value of a label using the hotkey combination **Shift** + **L** . You then may add **once** a newly defined label value to the following stop point measurement. E.g., using label 99 you may add some comments to the measurement results (either in measuring mode or in stake out mode) of one stop point of your survey. If you want to append the respective information to more than one measurement, you will have to repeat the procedure for each stop point.

Following display:
The display which was shown before using the **Shift** + **L** combination will appear again.

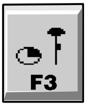


Definition:
Start the Communication Program

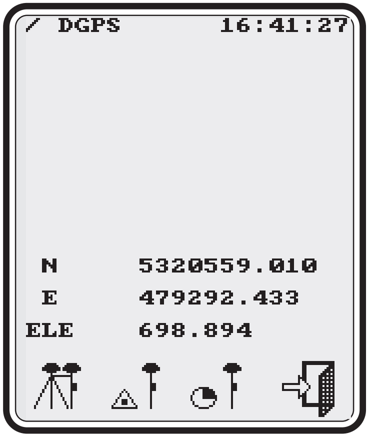
Current display:
Geotracer® Main Control Menu

Action:
When you press **F3** , the communication module which allows you to change radio channel and to communicate with a PC via serial cable is started.

Following display:
Main Communication Control Display



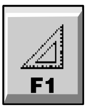
Definition:
Short Static System Initialization



Current display:
Initialization Menu Display

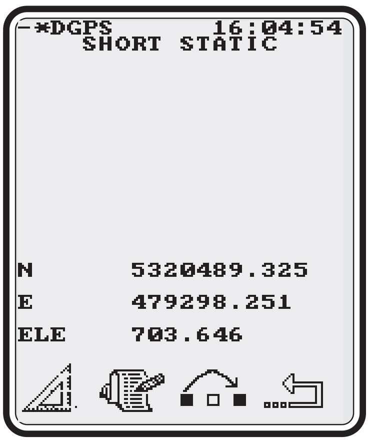
Action:
You may perform a short static system initialization if neither VSFB initialization is possible nor known point information can be provided. Also, if you want to measure positions with very high precision, this would be the preferable method.

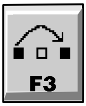
It is necessary to position the rover receiver at a point, hold the rod vertical and steady, and measure with F1.



Short static initialization will take up to several minutes, depending on the required accuracy and reliability.

Following display:
Short Static Initialization Menu

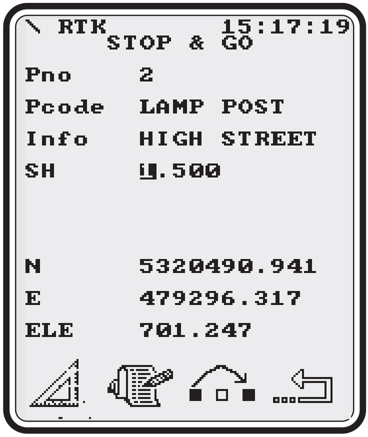




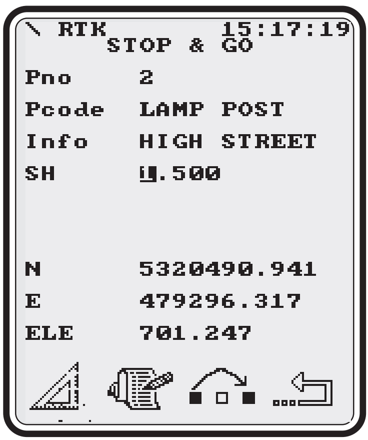
Definition:
Skip Measured Point Information

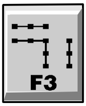
Current display:
This option is offered at several points in the RTK program.

Action:
If you do not want to store measured point information, skip the information by using this key (instead of storing the results).

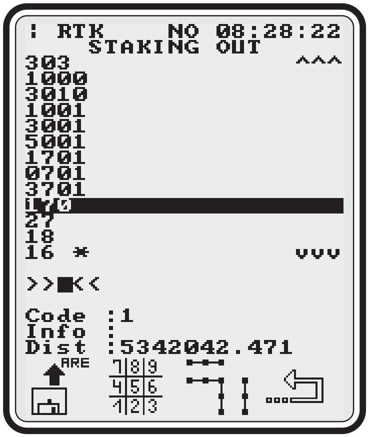


Following display:
Position display shows continuously updating positions.





Definition:
Sketch Survey Plot



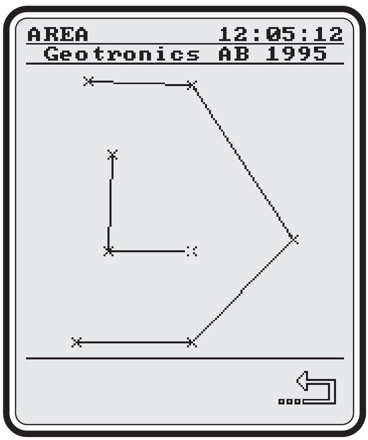
Current display:
Point Selection Display

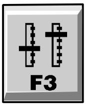
Action:
You can view a two-dimensional plot of the points of your chosen job or area file.

The plot is - like a map - always orientated to the north. Lines connect points with the same PointCode.

You may also view a plot display by using **Shift** + **M** . This displays measured points of your current job file together with the current position of the rover.

Following display:
Survey Plot





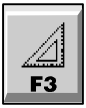
Definition:
Parameter Settings

Current display:
Different displays

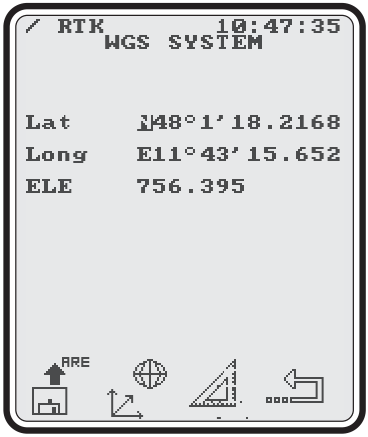
Action:
Press the key and the Parameter Settings Menu, offering you 5 pages of changable parameters, is shown. Scroll through the pages using the PG ↓ and PG ↑ or the 1 ... 9 keys and through lines using the ▲ and ▼ keys.

You may also use the hotkey combination Shift + P at any time during system operation to access the Parameter Settings Menu.

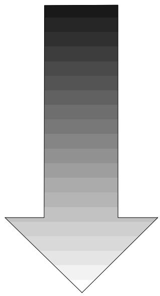
Following display:
Parameter Settings Menu



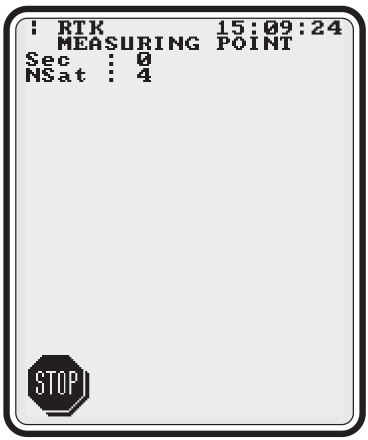
Definition:
Measure New Point to Define Local Coordinate System or for Single Point Positioning of Reference Position



Current display:
a)Available in the local coordinate system program part whenever you want to add a new point.
b) When initializing the rover with reference position.



Action:
a) You may define a local coordinate system by measuring one or more points with known coordinates. Move to a point you want to survey and position the rod above the point. Hold the rod vertical and steady. You can check this with the bubble. Press this key to measure.
b) If you want to initialize a rover with the reference station position, you can define the position using this key for a single point positioning (see chapter 4.1.1).

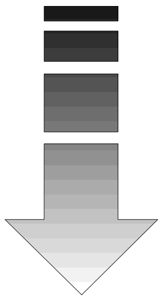


Following display:
Measuring Point Display

Definition:
Start the File Exchange Tool

Current display:
Main Communication Control Display

Action:
This key starts the File Exchange Tool. With a L1 receiver, the File Exchange Tool works as a stand-alone tool and allows to check and/or delete the files of your ACU. With a 2200 series receiver files can also be exchanged between receiver and the ACU.

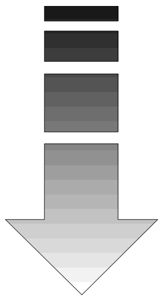


Following display:
File Exchange Tool Display

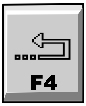
Definition:
Connection to L1/L2 Receiver

Current display:
File Exchange Tool Display

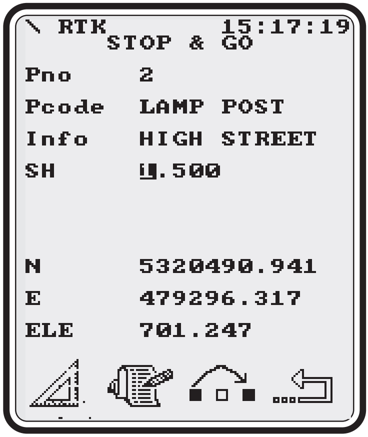
Action:
If the File Exchange Tool did not yet recognize a connection to a L1/L2 receiver or if its PCMCIA card was still missing, the program will try again, if you press the key.



Following display:
Message display, then
File Exchange Tool Display of the receiver card, if the connection was built-up successfully.

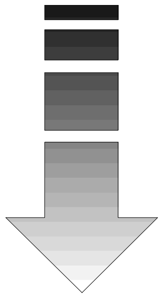


Definition:
Return to Previous Menu

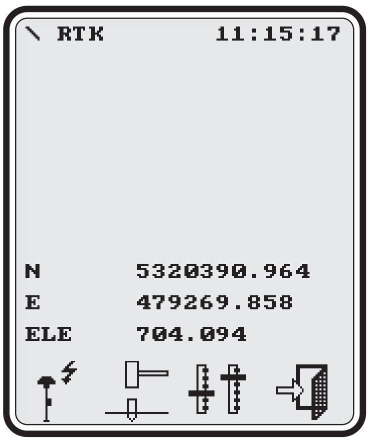


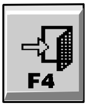
Current display:
This option is offered at several parts of the RTK program.

Action:
At any time you may leave the current program part by using the key.



Following display:
The display of the previously executed operation. In this example the Mode Selection Menu will reappear.

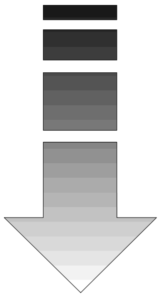


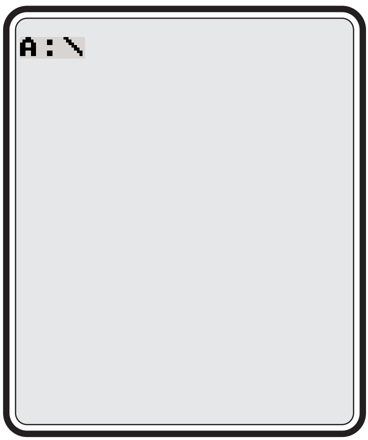


Definition:
Exit to Main Menu or MSDOS

Current display:
This option is offered at several places in the RTK program, e.g., at the Geotracer® Main Control display.

Action:
Allows you to exit to the Main Control display or to leave the Geotracer® Software for MSDOS.





Following display:
e.g., MSDOS Display

B3 List of Other Keystrokes and Hotkey Combinations

The following is a list of frequently used keystrokes.

YES	Open a menu, Accept a line or entry In Graphic Stake out Mode: Toggle between 2 function lists (icons change!)
NO	Cancel: Leave the menu without making changes
▲	Change to the next line above the current line
▼	Change to the next line below the current line
▶	Change to the next character right of the cursor
◀	Change to the next character left of the cursor
PG ↑	Change the screen or position window to the previous page
PG ↓	Change the screen or position window to the next page
←Sp	Delete the next sign to the left of the cursor
Shift + **←Sp**	Delete the sign under the cursor (**Del**)

Hotkey combinations make working with the Geotracer® 2000 system even easier and faster. Instead of scrolling through menus you only have to click on one or two keys to enter the desired menu.

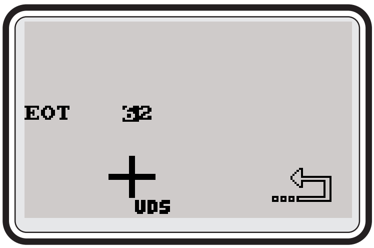
Shift + **L**	Change Label Setting
Shift + **M**	View the Survey Plot
Shift + **P**	Enter Parameter Settings Menu
Shift + **R**	Edit Projection Systems or Reset Telemetry Header
Shift + **S**	View the Sky Plot
Shift + **T**	Telemetry Header
Shift + **U**	Enter Menu UDS Sequences

Shift **L**

Change Label Settings

This hotkey combination allows you to change the settings of some labels at any time. If, e.g., you do not want an end of sequence label to finish your serial output messages, you may set the label 79 to ASCII 48.

Enter the label number. A display will show up allowing you to check the settings of this label.



F4 **VDS F2**

If you want to make changes, enter the new value and accept it with **YES** . If not, return to the last display pressing **F4** . Pressing **F2** appends the new value once to the next measurement.

Shift

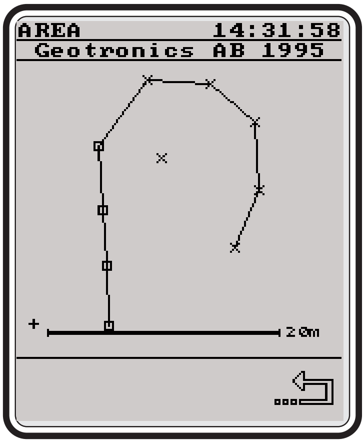
M

View the Survey Plot

At any time you may want to view the location and distribution of your surveyed (**M**easured) points. The plot offers a great opportunity for an overview of your survey.

A quick method to view a sketch plot display of your measured or staked out points at any time is to use the hotkey combination **Shift** + **M** .

The location of the measured points is displayed as a map. The orientation of the map is - independent of the orientation for staking out or sky plot - always to the north. Lines connect points with the same point code. The position of the rover receiver is indicated by a (moving) + sign, all staked out points by inactive □ signs and all points not yet staked out by inactive x signs.



F4

Leave the area plot display by pressing **F4** . The screen returns to the previous display.

Shift

P

Enter Parameter Settings Menu

The Parameter Settings Menu allows you to change most of the default parameters. See chapter 7 for detailed information on each parameter.

You may use the hotkey combination Shift + P at any time during system operation to access the Parameter Settings Menu.

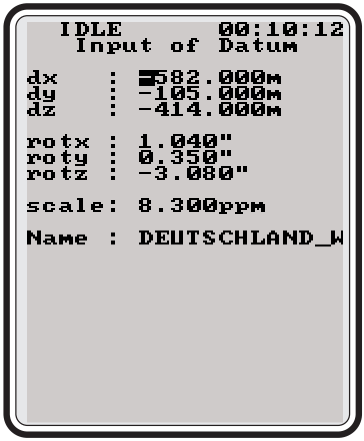
Shift

R

Edit Projection System or Reset Telemetry Header

This hotkey combination has two different functions, depending on the part of the program you are in.

a) When setting the `System` parameter:
Allows you to edit data stored in binary files. These include transformation parameters for datums, ellipsoids, projections.



b) When a telemetry header (see Shift + T) is shown:
Reset the values of the telemetry header and restart counting.

Shift

S

View the Sky Plot

The sky plot is very useful to check the availability of satellites. The Geotracer® 2000 system offers a plot of polar projection type, showing the availability and distribution of satellites visible and the PDOP. The plot shows satellites tracked by the reference receiver and by the rover receiver, resp. It also shows satellites visible but not tracked. You may change the orientation of the plot - as is shown in the upper left corner - in the parameter settings menu (use F3 or Shift + P). The dashed line indicates the elevation cutoff angle.

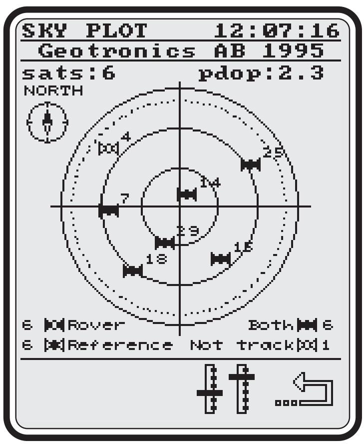
F3

F4

To leave the sky plot display press function key F4. The previously active display reappears.

F4

Note! If there are not enough satellites available for survey, the sky plot appears automatically. In this case you will leave the program using F4.



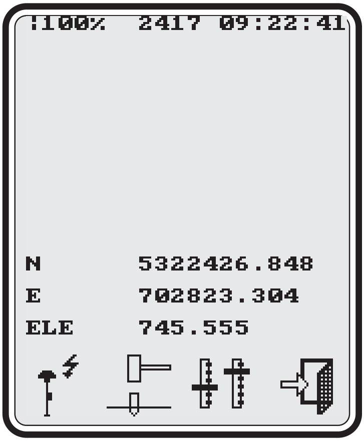
Shift

T

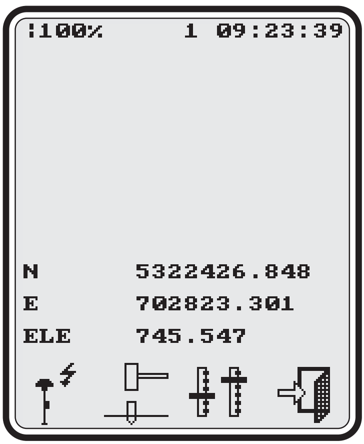
Telemetry Header

This hotkey toggle switch helps you to debug telemetry problems. It is only available in standard display.

Pressing the hotkey combination once changes the header line to the telemetry header (and vice versa). The new telemetry header contains the percentage of reference records received to reference records expected as well as a counter for all reference records decoded.



You may reset the values of the telemetry header using the hotkey combination **Shift** + **R** .



Shift

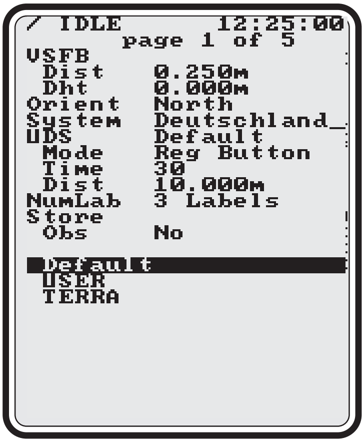
U

Enter Menu UDS Sequences

If you want to execute different kinds of surveys you may want to store more than one `*.UDS` file on your ACU. You may choose a new `*.UDS` at any time. The entries in the job file change according to the labels set in your selected U.D.S.

You may select an `*.UDS` file in the `UDS` line of the Parameter Settings Menu.

An alternative is to use the hotkey combination Shift + U . A list of all available *.UDS files pops up.



Choose one by moving the ▲ and ▼ keys and accept with YES or cancel with NO. The previously active display reappears.

Appendix C.

Warning Messages and Trouble Shooting

Warning messages follow each other in alphabetical order.

Battery low warning for reference. Status x
The battery of the reference station is running out of power. The range of the status is between 5 for full and 0 for empty.

- Change the battery of the reference station.

Battery low warning for rover. Status x
The battery of the rover is running out of power. The range of the status is between 5 for full and 0 for empty.

- Change the battery of the rover.

Can't compute transformation parameter. Please check last point again.
You tried to setup a local coordinate system but the last point does not match the other one and causes mathematical errors.

- Check the coordinates of the last point

Can't compute transformation parameter. Points too close together. Please select another point.
You tried to setup a local coordinate system using two points which are too close together. This will result in an unstable projection system.

- Select a different point

Can´t find the correct Receiver type for incoming data Please check
The ACU is receiving data in an unknown format.

- Check the connected receiver.

Could not initialize the port for RTCM input. Port occupied by serial output

- Select a different port for serial output.

Could not initialize the port for serial output. Please select a different port number
The port number is not available in your computer or the port is occupied by another system.

- Select a different port number

Data to serial port only. No data stored to ACU
You selected the mode to send all measurements to the serial port but not to the PCMCIA card.
- Only information

Distance to the reference x<unit>. VSFB not possible
You are too far away from the reference station to be able to perform a VSFB initialization.
- Select a different way to initialize the system to RTK

Error opening following UDS file. Please select another one.
Your U.D.S. is linked to another U.D.S. The second U.D.S. is not available on the PCMCIA card.
- Copy the U.D.S. or select another one

Error opening POS file, no storing
The system has problems writing a position file to the PCMCIA card.
- Check for free disk space

Error opening UDS file
Using default
The U.D.S. file selected in the parameter menu is not available on the card. The system will use the default U.D.S.

Error reading SOS for serial output. Using default SOS.
Reading a file containing a Serial Output Sequence failed. The system will continue using the default SOS.
- Check your `*.OUT` file in the `USERPROG` subdirectory.

Error reading UDS for serial output. Using default UDS.
Reading a `*.UDS` file for serial output failed. The system will continue using the default U.D.S.
- Check your `*.UDS` file in the `USERPROG` subdirectory.

Error setting receiver labels
Please check receiver

An error occurred while setting the parameter in the receiver during start up.

Please check:

- Connection between rover receiver and control unit.
- Is the receiver switched on and working?

Try again.

Error starting receiver

The receiver is not responding to the start up command.

Please check:

- Connection between rover receiver and control unit.
- Is the receiver switched on and working?

Try again.

File contains no point coordinates.
Please continue with first point

You tried to add a new point to a local coordinate system file that contains only transformation parameters, but no points.

- If you go on, the program will recalculate the transformation parameters of the local coordinate system using the points that you will add. The old parameters will be lost!
- If you want to keep the transformation parameters, but want to define a new local coordinate system, select `Measure new`.

File not valid as local coordinate system.
Please select another one

You tried to load a local coordinate system from a file, but the file does not have a valid format.

- Select another file

Memory device out of free space. Stopped writing data.
The memory card is out of free space. The storage of data to the card is stopped.
- Delete some data from the card or select the second card if available.

More than 30 labels found. Using only the first 30 labels.
Your `*.UDS` or `*.OUT` file contains more than 30 labels. The number of labels for serial output is limited to 30. All following labels will be ignored.
- Only information.

Need port 2 for reference input. Disabled serial output
You selected RTCM input and serial output both on port two. Serial output will be disabled.
- Select another port for serial output

New reference position arrived from RTCM generator. Now using the new reference position.
This message is only available if the system is working with RTCM as reference data format. A message type 3 containing reference station coordinates is received and the position differs from the reference coordinates the system is currently working on. From now on all RTK positions are based on the new reference position.
- Only information

No ambiguities fixed. Please check your position and start again
Performing a known point initialization failed. Check
- the coordinates you selected,
- your position,
- the antenna height,
- antenna levelled correctly ?

No data from the ROVER since xx s
The processing unit has not received any data from the roving receiver for at least the time specified in the parameter menu, page 5, line `IntRov`. Please check:
- Connection between rover receiver and control unit.
- Is the receiver switched on and working?
- Is the radio out of range?

No Data from the Telemetry. No position available.
You are trying to use a single point measurement for reference coordinates and there are no reference data from the telemetry.
- Check the telemetry
- Try again

No data from the telemetry since xx s
The system has not received data from the telemetry for at least the time specified in the parameter menu, page 5, line `IntRef`. Please check the following:
- Cable connection between rover telemetry and rover receiver
- Is the rover telemetry switched on?
- Cable connection between reference telemetry and reference receiver
- Is the reference telemetry switched on?
- Is the reference receiver switched on?
- Is the reference receiver working in reference mode (LED: permanent red)?
- Did you select the same channel for both radios?
- Switch reference receiver off and on again.

No DGPS solution
There is no DGPS solution during short static measurement. Possible reasons are too few satellites or bad PDOP.
- Set-up the system in an area with better conditions or make a break to wait for better conditions and then try again.

No File datum.dbs. Please check database

There is no DATUM.DBS file in the DBS directory. The system will continue working based on the WGS84 default datum.

- Check the DBS directory

No File ellips.dbs. Please check database

There is no ELLIPS.DBS file in the DBS directory. The system will continue working based on the WGS84 default ellipsoid.

- Check the DBS directory

No File proj.dbs. Please check database

There is no PROJ.DBS file in the DBS directory. The system will continue working based on the UTM-WGS default projection.

- Check the DBS directory

No link to the receiver -
Please check connection

The ACU can not find a receiver during start up.
Please check:

- Connection between rover receiver and control unit.

No Static Point. Ambiguities lost.

The system lost ambiguities during stop point measurement.

- Run a new initialization of the system to RTK mode and measure the point again.

No valid parameter in datum.dbs. File may be corrupted.

There is a DATUM.DBS file in the DBS directory but its contents is invalid. The system will continue working based on the WGS84 default datum.

- Check the DBS directory for file consistency.

No valid parameter in ellips.dbs. File may be corrupted.
There is a `ELLIPS.DBS` file in the `DBS` directory but its contents is invalid. The system will continue working based on the WGS84 default ellipsoid.

- Check the `DBS` directory for file consistency.

No valid parameter in proj.dbs. File may be corrupted.
There is a `PROJ.DBS` file in the `DBS` directory but its contents is invalid. The system will continue working based on the UTM-WGS default projection.

- Check the `DBS` directory for file consistency.

Position format is not valid for reference coordinates. Please select another one
The job or area file chosen for reference position input only contains local coordinates such as baseline components (labels 120, 121, 122), horizontal angles, etc.

- Reference positions must be absolute, e.g., WGS84 (labels 110, 111, 112) or ellipsoid coordinates (labels 113, 114, 137) or N, E, ele (label 37, 38, 39).

Position format not valid for known point initialization
Data read from an area or job file are not in a valid format or the position information is incomplete like a position without height component.

You can not use this point for known point initialization.

Problems with memory device. Please check card
The system failed to check the memory device for free space.

- Please check your card for corrupted clusters

Problems writing job file
Please check card for free space
The card to store job files on is out of disk space. The current point measurement is not stored.

- Delete old data files from card.
- If you have two cards in the ACU switch to the other card to continue data storage.

Single Point not successful
Bad PDOP
The single point determination of the reference position was not successful, because the PDOP is too high. Possible reasons:
- Unfavorable set-up of the receiver if covered up (houses, trees)
- Elevation cutoff angle set too high
- Satellites were disabled

Try again

Sorry, but the L2 option is not set. Please contact your local Geotronics provider
Your system is not licensed for dual frequency receivers.
- Please contact your local Geotronics provider to get more information on available options for the RTK system.

Sorry, but the RTCM option is not set. Please contact your local Geotronics provider
The option to use RTCM data as reference is not set in your system.
- Please contact your local Geotronics provider to get more information on available options for the RTK system.

Sorry, but the SERIAL OUTPUT option is not set. Please contact your local Geotronics provider
You tried to activate the serial output but the concerning option is not set in the configuration file.
- Please contact your local Geotronics provider to get more information on available options for the RTK system.

Sorry, but the STAKING OUT option is not set. Please contact your local Geotronics provider
You tried to start the stake out subsystem but the concerning option is not set in the configuration file.
- Please contact your local Geotronics provider to get more information on available options for the RTK system.

Sorry, but you have to fill the label <x>
You tried to store a set of UDS labels, you have not keyed in a value for label <x>. According to your U.D.S., you have to key in information for the label <x>.
All labels with the label ID 1 require the user to input a value.

Sorry, you are trying to use the same port for RTCM and serial output. Please select a different port number.
It is not possible to receive RTCM data and send serial output data via the same port.
- Please select a different port for serial output.

STATIC POINT FAILED
Measurement of a static point failed
Reasons might be:
- Bad standard deviation
- Bad PDOP
- Too few satellites
- You moved the antenna during measurement
- Levelling of the antenna correct?

Try again

STOPPED KNOWN POINT INITIALIZATION
No DGPS solution
The system has no code position, so the Known Point processing is interrupted.
Possible reasons can be:
- Too few satellites
- Bad PDOP
- Large time gap to the telemetry

Stopped Staking out. Ambiguities lost. Please run a new initialization to proceed staking out.
You lost ambiguities during stake out. The system will switch back to the initialization menu.
- Perform a new initialization to RTK mode

STOPPED VSFB
No DGPS solution
The system has no code position, so the VSFB processing is interrupted.
Possible reasons can be:
- Too few satellites
- Bad PDOP
- Large time gap to the telemetry

There are two points with the same name but the coordinates differ <x [unit]>
Please select an other point number
You tried to store points with the same point number, but the positions differ more than the maximum difference from the parameter menu .
- Check parameter `dist`.

The system is not in the accuracy mode you selected. The position coordinates might differ.
You tried to measure a point to setup a local coordinate system but the system is not in the accuracy you selected. E.g., the system is still in DGPS mode while you selected RTK as processing mode.
- Initialize the system to RTK and then try again to setup a local coordinate system.

VSFB FAILED
The VSFB initialization failed. Please check
- Set-up of the VSFB beam correct?
- Levelling of the antenna correct?
- VSFB parameters in Parameter Settings Menu (see chapter 7)

VSFB FAILED <x [unit]> from VSFB slope
Please check and start again
Calculated distance between reference and rover differs more than 1 cm from the distance set in the parameter menu (parameter `VSFB dist`).

Writing of local coordinate system to disk not successful. Please check disk for free space

Your local memory device is full, the local transformation parameters are not stored to the card.

- Delete some files to get more free space on the card

You are not allowed to work with RTCM corr. in RTK mode. Accuracy mode is changed to DGPS.

Your selected processing mode -RTK- does not function with your selected type of reference data. RTK solution is not possible with RTCM 2.0.

- Only information.

You are working with a virtual reference station and the selected point has only relative coordinates.

If you are working with RTCM 2.0 without reference coordinates the system is based on virtual reference coordinates which are calculated from rover data. If you want to use points for stake out which are based on relative coordinates like labels 7,8,9, the point coordinates of course differ from the expected results.

- Only information

You can´t create a local system without reference coordinates.
Please select a reference !

You tried to define a local coordinate system (you have chosen `Measure new`), but have not selected a reference station previously.

- Accept the warning. The screen will still show the coordinate system selector. You may now choose a previously defined local coordinate system.

If you want to define a new coordinate system, you should return to the main RTK menu and define the reference station first.

Your antenna height seems to be out of range. Please check.
The antenna height you are using seems to be out of range. The antenna height is valid and will be used for further processing, but please make sure that it is correct.
- Only information

Your ARE/JOB File contains unknown unit information. Please check
While reading a job or area file a label 23 containing unit information with unknown value was found.
- Check your area / job files for valid unit information

Your position seems to have bad conditions for OTF. Please move to an open area.
The system tried to perform an OTF initialization but your position has too much multipath or your position is shaded.
- Move to an unshadowed area.

Your projection parameters do not fit your position. Your position will be wrong
The projection system you selected is not valid for your position. The resulting position might be wrong.
- Check the projection system and use a fitting one.

Your selected projection is not available in the database. Using default UTM_WGS
The selected projection is not available in the database. The system continues working with UTM_WGS projection.
- Check the projection setup and select a valid one.

Your selected reference position differs x <unit> from the real position. We suggest the following as reference.

The system checks the selected reference position with the data received via telemetry. If the position differs more than a limit this message will come up. After accepting the warning you will find the reference position selector on the screen again, in order to select the correct position or accept the suggested measurement.

Working with a wrong reference position will result in degraded performance and bad positioning

- Select a new reference position

Your selected zone does not fit your selected projection. Please check your parameter settings.

The zone you are using together with the projection is not valid for your position. The resulting position might be wrong.

- Check the zone in the projection setup and use a fitting one

Appendix D.

Coordinate Systems Supported

Datum Systems

The datum parameters available within the system are the following:

Datum	Δx[m]	Δy[m]	Δz[m]	εx["]	εy["]	εz["]	Scale factor [ppm] m
WGS_84	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ARGENTINA_CAMPO_INCH	148.000	-136.000	-90.000	0.000	0.000	0.000	0.000
ARGENTINA_GRS67	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ADINDAN	162.000	12.000	-206.000	0.000	0.000	0.000	0.000
ARAMCO	130.000	232.000	-10.000	0.000	0.000	0.000	0.000
ARC_1950	143.000	90.000	294.000	0.000	0.000	0.000	0.000
AUSTRALIAN_GEODETIC_1966	133.000	48.000	-148.000	0.000	0.000	0.000	0.000
AUSTRALIAN_GEODETIC_1984	116.000	50.470	-141.690	0.230	0.390	0.344	0.098
ATS77	0.000	0.000	-4.500	0.000	0.000	0.000	0.000
BELGIUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BUKIT_RIMPAH	384.000	-664.000	48.000	0.000	0.000	0.000	0.000
CAMP_AREA_ASTRO	104.000	129.000	-239.000	0.000	0.000	0.000	0.000
CAPE_DATUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CZECH_SLOVAKIA_BESSEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DEUTSCHLAND_OST	-24.000	123.000	94.000	0.020	-0.250	-0.130	1.100
DEUTSCHLAND_WEST	-582.000	-105.000	-414.000	1.040	0.350	-3.080	8.300
DJAKARTA	377.000	-681.000	50.000	0.000	0.000	0.000	0.000
ED50_ITALY	181.100	85.800	23.600	0.384	-1.560	-0.524	0.000
ED50_SPAIN	-231.000	-196.000	482.000	0.000	0.000	0.000	0.000
EUROPEAN_1950	87.000	98.000	121.000	0.000	0.000	0.000	0.000
FINLAND	78.000	231.000	77.000	0.000	0.000	0.000	0.000
FRANCE	66.000	170.000	-311.000	0.000	0.000	0.000	0.000
G._SEGARA	403.000	-684.000	-41.000	0.000	0.000	0.000	0.000
G._SERINDUNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GEODETIC_DATUM_1949	-84.000	22.000	-209.000	0.000	0.000	0.000	0.000
GHANA	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GREAT_BRITAIN_1936	-375.000	111.000	-431.000	0.000	0.000	0.000	0.000
GUAM_1963	100.000	248.000	-259.000	0.000	0.000	0.000	0.000
HERAT_NORTH	333.000	222.000	-114.000	0.000	0.000	0.000	0.000
HJORSEY_1955	73.000	-46.000	86.000	0.000	0.000	0.000	0.000
HU-TZU-SHAN	634.000	549.000	201.000	0.000	0.000	0.000	0.000
ICELAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000
INDIAN	-173.000	-750.000	-264.000	0.000	0.000	0.000	0.000
IRELAND_1965	-506.000	122.000	-611.000	0.000	0.000	0.000	0.000
ITALIAN_1940	-225.000	-65.000	9.000	0.000	0.000	0.000	0.000
KERTAU	11.000	-851.000	-5.000	0.000	0.000	0.000	0.000
LIBERIA_1964	90.000	-40.000	-88.000	0.000	0.000	0.000	0.000
LITHUANIA_1942	40.597	18.550	69.339	1.832	-2.611	2.508	-4.299
LUZON	133.000	77.000	54.000	0.000	0.000	0.000	0.000
LUZON_PRS92	127.622	67.245	47.043	3.068	-4.903	-1.578	-1.060
MERCHICH	-31.000	-146.000	-47.000	0.000	0.000	0.000	0.000
MONTJONG_LOWE	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MRT_(KERTAU)	379.776	-775.383	86.609	2.597	2.102	-12.114	0.000
NAD83	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NARHWAN	-231.000	-196.000	482.000	0.000	0.000	0.000	0.000
NIGERIA_MINNA	92.000	93.000	-122.000	0.000	0.000	0.000	0.000
NORTH_AMERICAN_1927_CANADA	9.000	-151.000	-185.000	0.000	0.000	0.000	0.000
NORTH_AMERICAN_1927_CONUS	8.000	-160.000	-176.000	0.000	0.000	0.000	0.000
OLD_HAWAIIN_KAUAI	-190.000	230.000	341.000	0.000	0.000	0.000	0.000
OLD_HAWAIIN_MAUI	-210.000	230.000	357.000	0.000	0.000	0.000	0.000
OLD_HAWAIIN_OAHU	-201.000	224.000	349.000	0.000	0.000	0.000	0.000
ÖSTERREICH	128.000	-481.000	-664.000	0.000	0.000	0.000	0.000
PORTUGAL_ED73	241.731	-73.287	-27.971	-0.237	0.098	1.408	2.600
PSAD_56	288.000	-175.000	375.000	0.000	0.000	0.000	0.000
QORNOQ	-164.000	-138.000	189.000	0.000	0.000	0.000	0.000
RD	-577.570	-14.450	-458.650	-1.304	-0.103	-1.144	4.077
RD_ZONDER_GEOIDE	-565.040	-49.910	-465.840	-0.409	0.360	1.868	4.077
RT90	-424.300	80.500	-613.100	-4.396	1.987	-5.185	0.000
RR92	-419.375	-99.352	-591.349	0.850	1.817	-7.862	-0.995
SD_LUZON_SPECIAL	133.000	77.000	54.000	0.000	0.000	0.000	0.000
SD_MGRS-RELATED_INDIAN-SD	-173.000	-750.000	-264.000	0.000	0.000	0.000	0.000
SD_TOKYO_SPECIAL	128.000	-481.000	-664.000	0.000	0.000	0.000	0.000
SD_WGS_84_SPECIAL	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SIERRA_LEONE_1960	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Datum	Δ_X[m]	Δ_Y[m]	Δ_Z[m]	ε_X["]	ε_Y["]	ε_Z["]	Scale factor [ppm] m
SOUTH_AMERICAN_CAMPO_INCH	148.000	-136.000	-90.000	0.000	0.000	0.000	0.000
SOUTH_AMERICAN_CHUA_ASTRO	134.000	-229.000	29.000	0.000	0.000	0.000	0.000
SOUTH_AMERICAN_CORREGO_AL	206.000	-172.000	6.000	0.000	0.000	0.000	0.000
SOUTH_AMERICAN_PROVISIONAL	288.000	-175.000	375.000	0.000	0.000	0.000	0.000
SOUTH_AMERICAN_YACARE	155.000	-171.000	-37.000	0.000	0.000	0.000	0.000
TAIWAN	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TANANARIVE_OBSERVAT_1925	189.000	242.000	91.000	0.000	0.000	0.000	0.000
TIMBALAI	639.000	-583.000	55.000	0.000	0.000	0.000	0.000
TIMBALAY_BORNEO	689.000	-691.000	46.000	0.000	0.000	0.000	0.000
TOKYO	128.000	-481.000	-664.000	0.000	0.000	0.000	0.000
UTM_ED50	189.000	242.000	91.000	0.000	0.000	0.000	0.000
UTM_MARTINIQUE	-126.930	-547.940	-130.410	-2.787	5.161	-0.858	13.823
UTM_WGS	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VOIROL	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WGS_72	0.000	0.000	-4.500	0.000	0.000	0.000	0.000
CORREGO_ALEGRE	205.570	-168.770	4.120	0.000	0.000	0.000	0.000
SAD69	66.870	-4.370	38.520	0.000	0.000	0.000	0.000

Ellipsoids

The datum systems use the following ellipsoids:

Datum	Ellipsoid
WGS_84	WGS_84
ARGENTINA_CAMPO_INCH	INTERNATIONAL
ARGENTINA_GRS67	INTERNATIONAL_1967
ADINDAN	CLARKE_1880
ARAMCO	INTERNATIONAL
ARC_1950	CLARKE_1880
AUSTRALIAN_GEODETIC_1966	AUSTRALIAN_NATIONAL
AUSTRALIAN_GEODETIC_1984	AUSTRALIAN_NATIONAL
ATS77	WGS_84
BELGIUM	INTERNATIONAL
BUKIT_RIMPAH	BESSEL
CAMP_AREA_ASTRO	INTERNATIONAL
CAPE_DATUM	MOD_CLARKE_1880
CZECH_SLOVAKIA_BESSEL	BESSEL
DEUTSCHLAND_OST	KRASSOWSKY
DEUTSCHLAND_WEST	BESSEL
DJAKARTA	BESSEL
ED50_ITALY	INTERNATIONAL
ED50_SPAIN	INTERNATIONAL
EUROPEAN_1950	INTERNATIONAL
FINLAND	INTERNATIONAL
FRANCE	CLARKE_1880_IGN
G._SEGARA	BESSEL
G._SERINDUNG	WGS_84
GEODETIC_DATUM_1949	INTERNATIONAL
GHANA	WGS_84
GREAT_BRITAIN_1936	AIRY
GUAM_1963	CLARKE_1866
HERAT_NORTH	INTERNATIONAL
HJORSEY_1955	INTERNATIONAL
HU-TZU-SHAN	INTERNATIONAL
ICELAND	INTERNATIONAL
INDIAN	EVEREST
IRELAND_1965	MODIFIED_AIRY
ITALIAN_1940	INTERNATIONAL
KERTAU	MODIFIED_EVEREST
LIBERIA_1964	CLARKE_1880
LUZON	CLARKE_1866
MERCHICH	CLARKE_1880
MONTJONG_LOWE	WGS_84
NAD83	WGS_84
NARHWAN	CLARKE_1880
NIGERIA_MINNA	CLARKE_1880
NORTH_AMERICAN_1927_CANADA	CLARKE_1866
NORTH_AMERICAN_1927_CONUS	CLARKE_1886
OLD_HAWAIIN_KAUAI	INTERNATIONAL
OLD_HAWAIIN_MAUI	INTERNATIONAL
OLD_HAWAIIN_OAHU	INTERNATIONAL
ÖSTERREICH	BESSEL
PORTUGAL_ED73	INTERNATIONAL
QORNOQ	INTERNATIONAL

Datum	Ellipsoid
RD	BESSEL
RD_ZONDER_GEOIDE	BESSEL
RT90	BESSEL_1841
RR92	BESSEL_1841
SD_LUZON_SPECIAL	CLARKE_1866
SD_MGRS-RELATED_INDIAN-SD	EVEREST
SD_TOKYO_SPECIAL	BESSEL
SD_WGS_84_SPECIAL	WGS_84
SIERRA_LEONE_1960	WGS_84
SOUTH_AMERICAN_CAMPO_INCH	INTERNATIONAL
SOUTH_AMERICAN_CHUA_ASTRO	INTERNATIONAL
SOUTH_AMERICAN_CORREGO_AL	INTERNATIONAL
SOUTH_AMERICAN_PROVISIONAL	INTERNATIONAL
SOUTH_AMERICAN_YACARE	INTERNATIONAL
TAIWAN	INTERNATIONAL_1967
TANANARIVE_OBSERVAT_1925	INTERNATIONAL
TIMBALAI	BESSEL
TOKYO	BESSEL
UTM_ED50	INTERNATIONAL
UTM_MARTINIQUE	INTERNATIONAL
UTM_WGS	WGS_84
VOIROL	WGS_84
WGS_72	WGS_72
CORREGO_ALEGRE	HAYFORD
SAD69	SAD69

The ellipsoidal parameters used within the system are:

ELLIPSOID	Semimajor axis [m]	Inverse Flattening
WGS_84	6378137.000	298.2572235630001
INTERNATIONAL	6378388.000	297.0000000225716
INTERNATIONAL_1967	6378160.000	298.2500000435636
CLARKE_1880	6378249.145	293.4649999958536
AUSTRALIAN_NATIONAL	6378160.000	298.2500000435636
BESSEL	6377397.155	299.1528128283983
MOD_CLARKE_1880	6378249.145	293.4663076736678
KRASSOWSKY	6378245.000	298.3000046726388
CLARKE_1880_IGN	6378249.200	293.4660209980696
AIRY	6377563.396	299.3249645775651
CLARKE_1866	6378206.400	294.9786982296745
EVEREST	6377276.345	300.8016999923457
MODIFIED_AIRY	6377340.189	299.3249645775651
MODIFIED_EVEREST	6377304.063	300.8016999923457
CLARKE_1886	6378206.400	294.9786982296745
BESSEL_1841	6377397.155	299.1528125697652
WGS_72	6378135.000	298.2600000373650
HAYFORD	6378388.000	297.0000000225716
SAD69	6378160.000	298.2500000435636

The ellipsoidal shape is defined by the semimajor axis and the inverse flattening of the local ellipsoid.

$$x_{local} = \Delta x + (1+m) \begin{pmatrix} 0 & -\varepsilon_Z & \varepsilon_Y \\ \varepsilon_Z & 0 & -\varepsilon_X \\ -\varepsilon_Y & \varepsilon_X & 0 \end{pmatrix} X_{WGS84}$$

Translations Δx, Δy, Δz are given in meters and rotations ε_X, ε_Y, ε_Z in arcseconds.

Projections

The following projections are supported by Geotracer®. In the table below you find their names, their projection type and the datum and ellipsoid used by them.

Abbreviations:
TM Transverse Mercator
OM Oblique Mercator
LT Lambert conformal conic tangential
LS Lambert conformal conic secant
SD Stereographic double projection
BP Belgium projection
NP Netherland projection
CP Czechian projection
HP Hungarian projection
SP Swiss projection
RS Rectified skew orthomorphic projection

Argentina	TM	ARGENTINA_CAMPO_INCH	INTERNATIONAL
Belgium	BP	BELGIUM	INTERNATIONAL
Borneo_RSO	RS	TIMBALAY_BORNEO	EVEREST_BORNEO
Canada_Edmonton	TM	NAD83	WGS_84
Canada_New_Brunswick	SD	ATS77_NEW_BRUNSWICK	ATS77
Canada_Nova_Scotia	TM	ATS77	WGS_84
Canada_Quebec	TM	NAD83	WGS_84
Czech_Slovakia_Krovak	CP	CZECH_SLOV._BESSEL	BESSEL
Deutschland_bessel	TM	DEUTSCHLAND_WEST	BESSEL
Deutschland_krass	TM	DEUTSCHLAND_OST	KRASSOWSKY
Finland	TM	FINLAND	INTERNATIONAL
France_centre	LT	FRANCE	CLARKE_1880_IGN
France_corse	LT	FRANCE	CLARKE_1880_IGN
France_nord	LT	FRANCE	CLARKE_1880_IGN
France_sud	LT	FRANCE	CLARKE_1880_IGN
Hungary	HP	WGS_84	WGS_84
Iceland_1	TM	ICELAND	INTERNATIONAL
Iceland_2	LT	ICELAND	INTERNATIONAL
Iceland_3	TM	ICELAND	INTERNATIONAL
Ireland	TM	IRELAND_1965	MODIFIED_AIRY
Italy_1	TM	ED50_ITALY	INTERNATIONAL
Italy_2_1	TM	ITALIAN_1940	INTERNATIONAL
Italy_2_2	TM	ITALIAN_1940	INTERNATIONAL
Lithuania_1942	TM	LITHUANIA_1942	KRASSOWSKY
Malayan_RSO	RS	MRT_(KERTAU)	MODIFIED_EVEREST
Netherlands	NP	RD	BESSEL
Philippines	TM	LUZON_PRS92	CLARKE_1866
Portugal	TM	PORTUGAL_ED73	INTERNATIONAL
SOUTH_AFRICA	TM	CAPE_DATUM	MOD_CLARKE_1880
Sweden	TM	RT90	BESSEL_1841
Sweden_92	TM	RR92	BESSEL_1841
Switzerland	SP	CH_1903_(SWITZ.)	BESSEL
Taiwan	TM	TAIWAN	INTERNATIONAL_1967

US_AK10_5010	LS	NAD83	WGS_84
US_AK_1_5001	OM	NAD83	WGS_84
US_AK_2_5002	TM	NAD83	WGS_84
US_AK_3_5003	TM	NAD83	WGS_84
US_AK_4_5004	TM	NAD83	WGS_84
US_AK_5_5005	TM	NAD83	WGS_84
US_AK_6_5006	TM	NAD83	WGS_84
US_AK_7_5007	TM	NAD83	WGS_84
US_AK_8_5008	TM	NAD83	WGS_84
US_AK_9_5009	TM	NAD83	WGS_84
US_AL_E_0101	TM	NAD83	WGS_84
US_AL_W_0102	TM	NAD83	WGS_84
US_AR_N_0301	LS	NAD83	WGS_84
US_AR_S_0302	LS	NAD83	WGS_84
US_AZ_C_0202	TM	NAD83	WGS_84
US_AZ_E_0201	TM	NAD83	WGS_84
US_AZ_W_0203	TM	NAD83	WGS_84
US_CA_1_0401	LS	NAD83	WGS_84
US_CA_2_0402	LS	NAD83	WGS_84
US_CA_3_0403	LS	NAD83	WGS_84
US_CA_4_0404	LS	NAD83	WGS_84
US_CA_5_0405	LS	NAD83	WGS_84
US_CA_6_0406	LS	NAD83	WGS_84
US_CO_C_0502	LS	NAD83	WGS_84
US_CO_N_0501	LS	NAD83	WGS_84
US_CO_S_0503	LS	NAD83	WGS_84
US_CT___0600	LS	NAD83	WGS_84
US_DE___0700	TM	NAD83	WGS_84
US_FL_E_0901	TM	NAD83	WGS_84
US_FL_N_0903	LS	NAD83	WGS_84
US_FL_W_0902	TM	NAD83	WGS_84
US_GA_E_1001	TM	NAD83	WGS_84
US_GA_W_1002	TM	NAD83	WGS_84
US_GU___5400	TM	NAD83	WGS_84
US_HI_1_5101	TM	NAD83	WGS_84
US_HI_2_5102	TM	NAD83	WGS_84
US_HI_3_5103	TM	NAD83	WGS_84
US_HI_4_5104	TM	NAD83	WGS_84
US_HI_5_5105	TM	NAD83	WGS_84
US_IA_N_1401	LS	NAD83	WGS_84
US_IA_S_1402	LS	NAD83	WGS_84
US_ID_C_1102	TM	NAD83	WGS_84
US_ID_E_1101	TM	NAD83	WGS_84
US_ID_W_1103	TM	NAD83	WGS_84
US_IL_E_1201	TM	NAD83	WGS_84
US_IL_W_1202	TM	NAD83	WGS_84
US_IN_E_1301	TM	NAD83	WGS_84
US_IN_W_1302	TM	NAD83	WGS_84
US_KS_N_1501	LS	NAD83	WGS_84
US_KS_S_1502	LS	NAD83	WGS_84

US_KY_N_1601	LS	NAD83	WGS_84
US_KY_S_1602	LS	NAD83	WGS_84
US_LASH_1703	LS	NAD83	WGS_84
US_LA_N_1701	LS	NAD83	WGS_84
US_LA_S_1702	LS	NAD83	WGS_84
US_MA_I_2002	LS	NAD83	WGS_84
US_MA_M_2001	LS	NAD83	WGS_84
US_MD___1900	LS	NAD83	WGS_84
US_ME_E_1801	TM	NAD83	WGS_84
US_ME_W_1802	TM	NAD83	WGS_84
US_MI_C_2112	LS	NAD83	WGS_84
US_MI_N_2111	LS	NAD83	WGS_84
US_MI_S_2113	LS	NAD83	WGS_84
US_MN_C_2202	LS	NAD83	WGS_84
US_MN_N_2201	LS	NAD83	WGS_84
US_MN_S_2203	LS	NAD83	WGS_84
US_MO_C_2402	TM	NAD83	WGS_84
US_MO_E_2401	TM	NAD83	WGS_84
US_MO_W_2403	TM	NAD83	WGS_84
US_MS_E_2301	TM	NAD83	WGS_84
US_MS_W_2302	TM	NAD83	WGS_84
US_MT___2500	LS	NAD83	WGS_84
US_NC___3200	LS	NAD83	WGS_84
US_ND_N_3301	LS	NAD83	WGS_84
US_ND_S_3302	LS	NAD83	WGS_84
US_NE___2600	LS	NAD83	WGS_84
US_NH___2800	TM	NAD83	WGS_84
US_NJ___2900	TM	NAD83	WGS_84
US_NM_C_3002	TM	NAD83	WGS_84
US_NM_E_3001	TM	NAD83	WGS_84
US_NM_W_3003	TM	NAD83	WGS_84
US_NV_C_2702	TM	NAD83	WGS_84
US_NV_E_2701	TM	NAD83	WGS_84
US_NV_W_2703	TM	NAD83	WGS_84
US_NY_C_3102	TM	NAD83	WGS_84
US_NY_E_3101	TM	NAD83	WGS_84
US_NY_L_3104	LS	NAD83	WGS_84
US_NY_W_3103	TM	NAD83	WGS_84
US_OH_N_3401	LS	NAD83	WGS_84
US_OH_S_3402	LS	NAD83	WGS_84
US_OK_N_3501	LS	NAD83	WGS_84
US_OK_S_3502	LS	NAD83	WGS_84
US_OR_N_3601	LS	NAD83	WGS_84
US_OR_S_3602	LS	NAD83	WGS_84
US_PA_N_3701	LS	NAD83	WGS_84
US_PA_S_3702	LS	NAD83	WGS_84
US_PRVI_5200	LS	NAD83	WGS_84
US_RI___3800	TM	NAD83	WGS_84
US_SC___3900	LS	NAD83	WGS_84
US_SD_N_4001	LS	NAD83	WGS_84
US_SD_S_4002	LS	NAD83	WGS_84

US_TN___4100	LS	NAD83	WGS_84
US_TXNC_4202	LS	NAD83	WGS_84
US_TXSC_4204	LS	NAD83	WGS_84
US_TX_C_4203	LS	NAD83	WGS_84
US_TX_N_4201	LS	NAD83	WGS_84
US_TX_S_4205	LS	NAD83	WGS_84
US_UT_C_4302	LS	NAD83	WGS_84
US_UT_N_4301	LS	NAD83	WGS_84
US_UT_S_4303	LS	NAD83	WGS_84
US_VA_N_4501	LS	NAD83	WGS_84
US_VA_S_4502	LS	NAD83	WGS_84
US_VT___4400	TM	NAD83	WGS_84
US_WA_N_4601	LS	NAD83	WGS_84
US_WA_S_4602	LS	NAD83	WGS_84
US_WI_C_4802	LS	NAD83	WGS_84
US_WI_N_4801	LS	NAD83	WGS_84
US_WI_S_4803	LS	NAD83	WGS_84
US_WV_N_4701	LS	NAD83	WGS_84
US_WV_S_4702	LS	NAD83	WGS_84
US_WYEC_4902	TM	NAD83	WGS_84
US_WYWC_4903	TM	NAD83	WGS_84
US_WY_E_4901	TM	NAD83	WGS_84
US_WY_W_4904	TM	NAD83	WGS_84

UTM_AUSTRALIA	TM	AUSTRAL._GEODETIC_1984	AUSTRAL._NATION.
UTM_Argentina_67	TM	ARGENTINA_GRS67	INTERNATIONAL_1967
UTM_Argentina_Hayford	TM	ARGENTINA_CAMPO_INCH	INTERNATIONAL
UTM_BRAZIL_1	TM	SAD69	SAD69
UTM_BRAZIL_2	TM	CORREGO_ALEGRE	HAYFORD
UTM_Denmark	TM	EUROPEAN_1950	INTERNATIONAL
UTM_ECUADOR	TM	PSAD_56	INTERNATIONAL
UTM_ED50	TM	UTM_ED50	INTERNATIONAL
UTM_MARTINIQUE	TM	UTM_MARTINIQUE	INTERNATIONAL
UTM_Saudi_Arabia_1	TM	NARHWAN	CLARKE_1880
UTM_Saudi_Arabia_2	TM	ARAMCO	INTERNATIONAL
UTM_Spain	TM	ED50_SPAIN	INTERNATIONAL
UTM_WGS	TM	WGS_84	WGS_84
United_Kingdom	TM	GREAT_BRITAIN_1936	AIRY

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