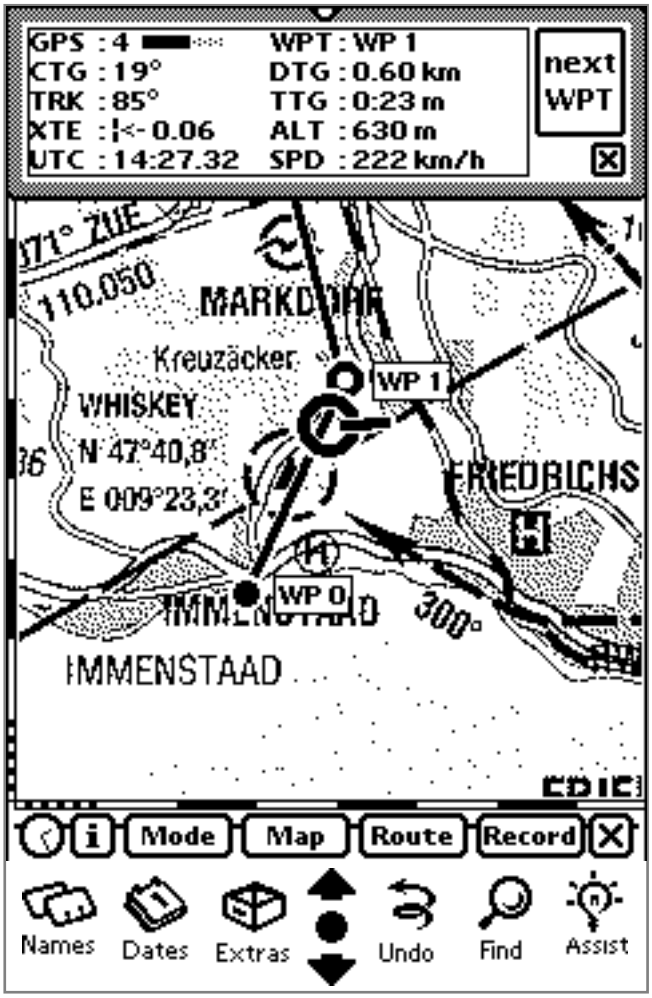
GPS Map

Demo Version 1.6

Users Manual



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For latest informationand the latest demo version you should check out the *GPS Map* home page at:

<http://www.segelflug.de/gps/GPS_Map.html>.

August 1996

Contents

1. Introduction

GPS Map makes your *Apple Newton* or compatible PDA in combination with almost every GPS receiver to a simple to operate navigation system with digital map display. The power of this system was formerly available only with special developed hardware or with powerful PCs, both much more expensive. Compared to the specialised hardware which may be used for navigation purposes only and to PCs which are unmanageable and heavy, your PDA is handy, has almost the same features and still can be used for your daily work.

GPS Map is able to work with both bitmap type maps and vector based maps and supports all popular cartographic map projection methods. You could even draw your own map with either *MacDraw* like applications or *MacPaint* like applications. The new vector feature of version 1.5 is important for better support of nautical maps (with wide areas of pure water) or desert maps (with some oasis only). Because the vector format is PICT format based you can even combine both types of maps and use small bitmap regions (such as islands) within a vector based map.

Having only a black and white display on actual PDAs needs not to be a disadvantage, because a colour display always needs background illumination, much more energy, and has a very bad readability at day light. A colour PDA would be much more unmanageable and much more heavy. Because of the storage size of colour maps it would need a micro hard disk and even more energy. It would be nearly equal to a portable PC.

The *GPS Map* demo version has all functionality of the full version but there is no GPS interface included. Instead a circle flight above Friedrichshafen at Germany will be simulated. The demo Map Container contains aviation maps in various scales for that region.

2. PDA Requirements

GPS Map runs on all *Apple Newton* compatible PDAs. Your PDA must have an operating system version of 1.3 or greater (*GPS Map* is NOS 2.0 compatible)..

I commend to using a PDA with large internal memory and large battery capacity such as *Apple MP120* or even better *MP130* and advise against upgraded *MP100.*

Because the internal memory may contain small map regions only you will need an additional PCMCIA 2.0 compatible storage card. Memory cards are currently available in a range of one megabyte up to 40 megabytes.

Unfortunately memory cards are still expensive. The needed size depends on the size of the map region and number of scales you permanently need. You can calculate as follows: one average paper map sheet (55 * 80 centimeters) in two scales needs about 1,8 megabytes of memory.

3. GPS Requirements

NOTE: For running the demo version you don't need a GPS receiver!

There are no special requirements to the GPS receiver used because it will be used only as a position sensor.

The receiver must have a serial interface with the following specifications:

- TTL, RS232 or RS422 level, 4800 baud, 8 bits, 1 stop bit
- NMEA 183 software protocol

The popular NMEA protocol has many different implementations, but *GPS Map* will adapt to them automatically.

GPS Map supports the following NMEA message combinations:

1. $GPGGA and $GPVTG
2. $GPGGA and $GPRMC
3. $GPGLL and $GPVTG
4. $GPRMC only

If the receiver sends additional messages they will be suppressed automatically.

Because the NMEA protcol doesn't support any handshale the receiver should not send too many messages per second to avoid input overflows on the PDA. Most receivers dont make problems except the *Trimble Personal Locator*, which is not compatible with *GPS Map*.

Because of nearly each GPS receiver manufacturer seems to invent his own private connector *GPS Map* comes with a free Newton connector to be soldered to the data cable supplied by your GPS receiver's manufacturor.

4. Installing the demo version

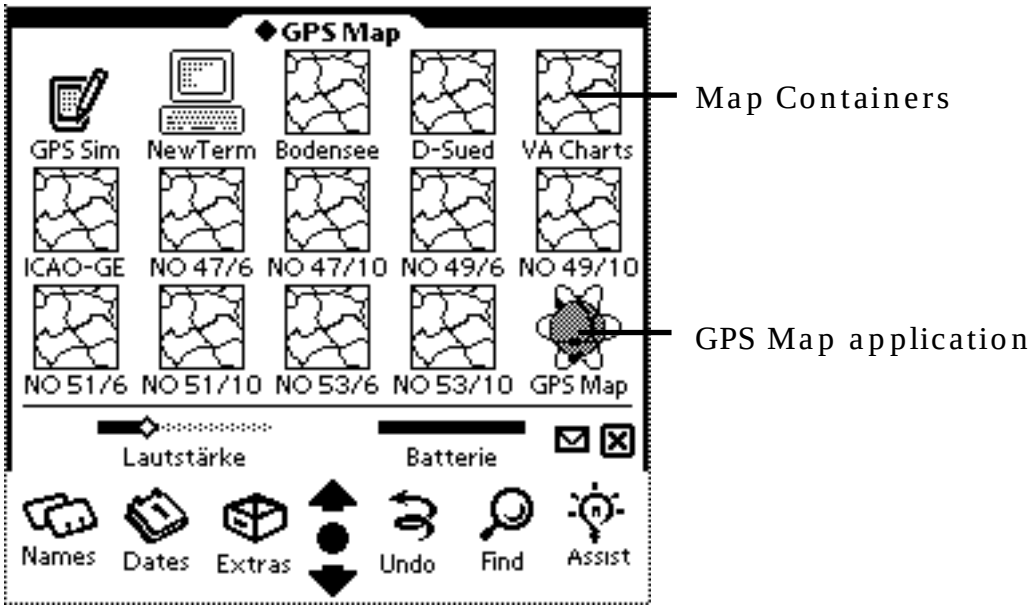
- Decide where to store the applications and check the storage settings within the built in PDA application “Card”. Map Containers should be stored on a PCMCIA card
- Download *GPS_MapD.pkg* and *Map .pkg* by using any installer application or the *Newton Backup Utility*

5. Starting-up *GPS Map*

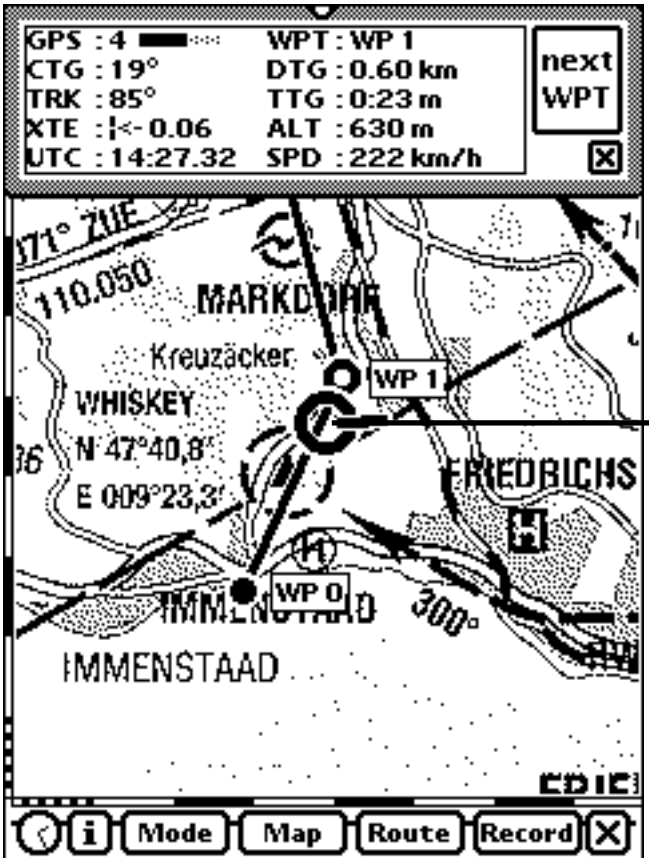
Tap onto your PDA’s *Extras* s ymbol. Dependant of the map containers installed you should see your *Extras* folder similar to the following picture.

Start *GPS Map* by tapping onto its symbol. Please don’t get impatient because of it can need more than 10 seconds until the start-up process has finished.

GPS Map is a very complex application which needs a maximum of free working memory (heap). If you get an error message during starting up *GPS Map* please remove all unused applications from your PDA, freeze them, or archive them by using shareware tools such as *ScrollEx* (1.3 units) because they also need heap memory even if they do not run. Don’t run other applications in parallel to *GPS Map* for the same reason. If there are still problems the system heap may be fragmented and the PDA must be reset.



After initialising you should see a screen like this:



the actual position is at the center of the circle, the pointer shows to the movement direction

As soon as simulated GPS data is available, *GPS Map* will react a bit slacky to your inputs. That is normal and is a result of background processing and of the limited performance of the PDA processor

6. Screen Layout

Almost all the usable screen area is used for displaying the map. If the upper screen part is not covered by the NAV information window you will see the application name in the centre, the name of the active route (if any) at the left side and the scale of the current map at the right side. The value in brackets shows the map magnification in relation to the original paper based map.

At the lower end of the screen there are menu buttons for operating the system.

At the left and bottom side of the map there are rulers for distance estimation similar to those found on paper maps. The unit used depends on the selection made for distance within the “Preferences” window. The smallest division represents (depending on unit) 100 meters, 0,1 nautical miles, or 0,1 statute miles. Each ten

divisions the divisions will be 10 times larger and so on. If the smallest division can not be shown because of a high map scale the system retries with the next higher value (times ten).

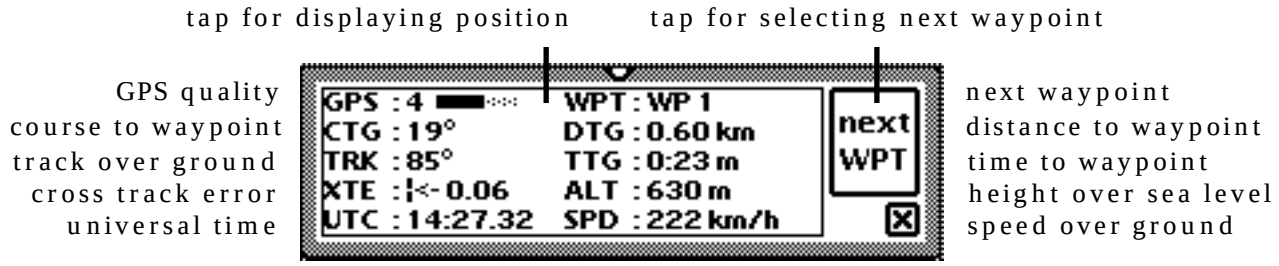
6.1 More Details about Windows

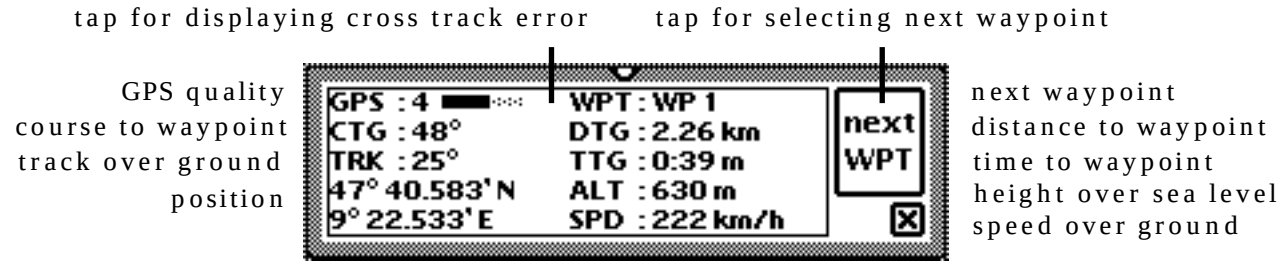
All windows within *GPS Map* may be moved freely. Tap at the boarder of a window and drag it away without releasing the pen.

Each window has a Close button ⊠. After tapping the window will be closed and inputs made by the user will be executed. Some windows have an additional Cancel button ⊡. Tapping this button will also close the window, but all inputs will be rejected.

6.2 NAV Information Window

The upper screen area is normally covered by a window showing navigational information. All navigational calculations are based on great circle formulae.





The GPS bar display at the top left side shows the quality of the actual GPS data (PDOP dependant). It depends on the number of satellites available and their relative positions at the firmament. GPS satellites are not at a fixed position but are orbiting, and therefore the quality will change permanently. The GPS position should be usable as far as the black bar covers more than half of the maximum sized grey bar.

The “TRK” field shows the track over ground relative to geographic north (true track). Please don’t mistake this value with your compass course, because of the compass course is magnetic north relative and does not regard the drift f.e. because of wind influence. “TRK” is calculated from the relative position change per measuring cycle and is only valid if you are moving faster than approximately 2 knots!

The “ALT” field shows the current height over sea level. Please remember that this value is not exact enough for relying on. This value will be shown only if the GPS receiver is in 3D mode (if it is tracking more than 3 satellites).

The “SPD” field shows the speed over ground. Similar to “TRK” it is not the speed displayed by your speed measuring system because that is adulterated by drifting.

The “XTE” field (cross track error) shows the distance between your position and the route. The vertical line shows the route and may be either on the left or right side of the distance value. The unit used is the same as for the distance to the next waypoint. In the example below your position is 0.06 kilometres right of the route.

The “UTC” field shows the satellites time as universal time. Please don’t confuse with your local time, there is usually an offset of some hours.

If a route has been activated the name of the next way point will be displayed in the “WPT” field (WAY POINT). The field “CTG” (COURSE TO GOAL) will show the direction to, the field “DTG” (DISTANCE TO GOAL) will show the distance to, and the field “TTG” (TIME TO GOAL) will show the estimated time until the selected way point.

The time shown at “TTG” is displayed as hours and minutes if the time is more than one hour (p. e. 01:32h) or as minutes and seconds if the time is less (p. e. 01:12m).

Only the converge part of the speed vector is used for calculating “TTG”.

Use the button “Next” for selecting the next waypoint within the current route. If the last way point of the route is currently selected and you press “Next” the first way point will be selected.

7. *GPS Map* Operation Modes

The application distinguishes among three user selectable operation modes:

7.1 NAV Mode

This mode is the standard mode for navigation. The map is under control of the GPS receiver and will move in relation to your position change. The present position will be always in the centre of the screen and be marked with the PPOS (Present Position). The pointer out of the symbol represents your current track.

The map may be moved limited by the user for a better orientation, and jumps back to the real position after some seconds. For moving the map with the pen, tap onto the map and then drag it in the desired direction. Don't release the pen until the originally tapped position is below the pen again.

If the PPOS symbol reaches the border of a map region *GPS Map* will load a new map region with same scale and magnification automatically (if one exists).

You may enforce a premature map change by dragging the map in the movement direction.

7.2 PLAN Mode

This mode supports both navigation and planning. Map positioning is controlled totally by the user. In contrast to NAV mode the map will stay fixed and the PPOS symbol will move. Use PLAN mode for defining routes or displaying maps of other regions without loosing the present position.

The map may be moved either with the pen as in NAV mode or by using the scroll compass at the lower left edge.

If you scroll over the map boarder the next map region will be loaded as in NAV mode.

7.3 OFFLINE Mode

This mode is nearly identical to PLAN mode, but GPS data will not be displayed. Therefore all processor performance is available for doing the user interface and the system will not be as slacky as in the other modes. If the mission recorder is running

recording will continue during OFFLINE mode. This mode should be preferred for doing mission planning with or without connected GPS receiver.

8. Defining a Reference Position

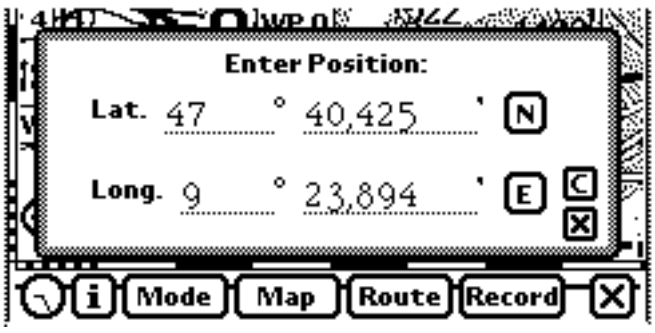
Many *GPS Map* functions (such as setting waypoints) depend on reference positions entered by the user. A reference position may be defined by three different methods and will then be shown within the map as a small circle:

8.1 Defining Positions by Tapping onto the Map

The map may be dragged with the pen in each operation mode (limited in NAV mode). To define a reference position drag the map until the desired position is visible and then tap onto the position. *GPS Map* will mark the position with a small circle and then calculate and store the geographic position for later use.

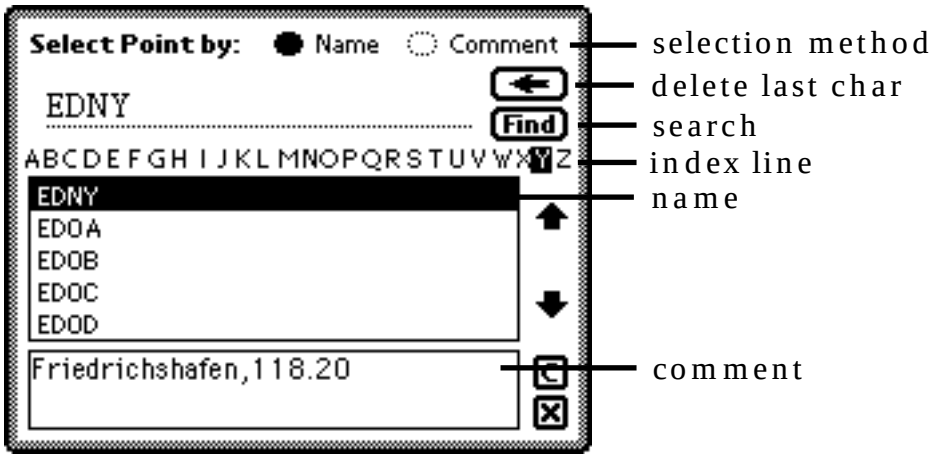
8.2 Defining by Numerical Entry

Use “Go to Position” within the “Map” menu for entering the desired position as longitude and latitude. Dependent of the “Preferences...” settings positions may be entered as decimal degrees or as degrees and decimal minutes. You can also decide if the entered values will be interpreted as WGS84 or ED50 reference co-ordinates. If there is already a reference position it will be pre-entered as default value. Tap onto the N and E buttons for changing the quadrant.



8.3 Defining Positions by using predefined NAV Points

Use “Go to NAV Point” within the menu “Map” to select an entry from within a database containing stored positions. You may define NAV points from within *GPS Map* or load them from an external database by using the *Newton Connection Kit*.



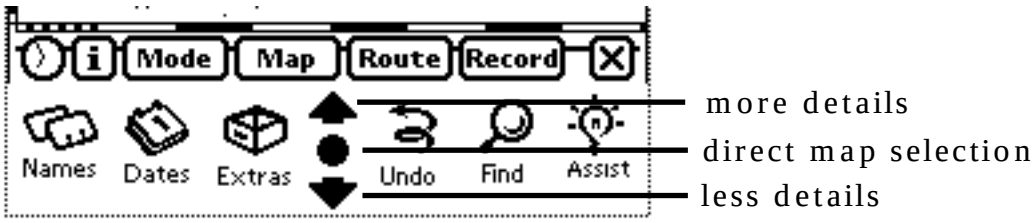
You may select an entry by entering a part of its short name by handwriting, by tapping the characters within the index line or by entering a part of its comment. After each entered key the list will be scrolled to the first matching item. You may use the arrow keys for scrolling the list manually.

For finally selecting an entry tap on its short name within the list and then onto the Close button. Use the Cancel button for leaving the window without selection.

9. Loading a Map and Changing the Scale

The arrow buttons below the screen may be used for a quick scale change. If an adequate map region is available the upper button will load a map with more details and the lower button will load a map with fewer details.

Changing scale is dependent on the current operation mode. In NAV mode the new map will be loaded in such a way that the Present Position is in the centre of the screen.



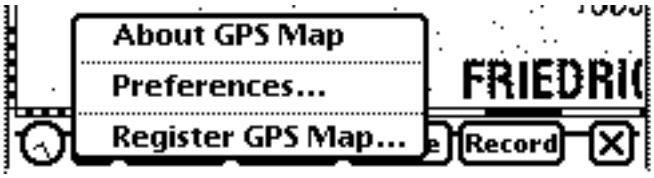
In PLAN and OFFLINE mode the map will be loaded in such a way that a defined reference position shows up at the centre of the screen. If there is no reference position the map will load in such a way that the old screen centre position will be conserved. Press the overview button for directly selecting a map within a map list window.

Note: If you try to load a map in NAV mode only maps covering the Present Position will be displayed.

10. Menus

10.1 "Info" Menu

Tap onto ⓘ for displaying the following menu:.



About *GPS Map*

Tap onto "About GPS Map" to see the program version and copyright information. The window may be closed by tapping onto it.

Preferences

Tap onto "Preferences..." to get a window for changing default settings for your special needs.

GPS Driver

GPS Map is able to support nearly all thinkable navigation receivers with different interface protocols. Each specific protocol needs a special driver software for handling.

If you have purchased *GPS Map* with an extra interface option you may select that option instead of NMEA 183 by tapping onto the "GPS Driver" line.

You may get a *GPS Driver Developers Kit* to support your special receiver.

Sleep Mode

The PDA supports a "sleep mode" setting in its standard configurations. If you define a specific time there the PDA will shut down itself after this time has expired. That is useful for daily work but not for navigation. Therefore you may prevent the PDA from going to sleep mode while GPS Map is running by selecting the "Disable Sleep Mode" box.

Prepare the Removing of *GPS Map*

If you intend to delete *GPS Map* you should first check the "Prep. removing GPS Map" box. During quitting *GPS Map* will remove all preferences, defaults, routes, NAV points and mission log soups from the PDA memory. Then you may delete the application as described in the PDA's user manual.

10.2 "Mode" Menu

Tap onto Mode to check the current operation mode, select a new mode or show or hide the NAV information window.

10.3 "Map" Menu

Tap onto Map to get a menu with map functions.

Load Map

Use this item will open a list window for directly loading a specific map. While in NAV mode only maps covering the present position will be displayed. The function is identical to tapping the “overview” button below the screen.

Go to PPOS

Tapping this item while in PLAN mode will scroll the map to the present position. The PPOS symbol will be in the centre of the screen afterwards. If the present position is not within the current map a new map covering the position will be loaded. In addition the present position will be stored as current reference position

Go to NAV Point

Use this item to position the map to a pre-defined position and for defining that position as reference position. If the desired position is not covered by the current map a new map containing that position will be loaded (if available). If this item will be selected while in NAV mode the map will not move but the selected position will be stored as reference position.

You may define NAV points from within *GPS Map* or load them from an external data base by using the *Newton Connection Kit*.

Go to Position

Use this item to move the map to a position entered by longitude and latitude and for defining that position as reference position. In “Preferences...” you can change the entry format to decimal degrees or degrees and decimal minutes and chose the WGS84 or ED50 reference system. You may use the keyboard for entry by double tapping into an input field.
If the desired position is not covered by the current map a new map containing that position will be loaded (if available).
If this item will be selected while in NAV mode the map will not move but the selected position will be stored as reference position.

Define NAV Point

Tap this item to store the current reference position by name and comment for later use as NAV point. You will see a window opening for entering a NAV point name. The name may be up to 25 characters in length. Double tap into the input field for using the keyboard.

In addition to the name you may enter a comment with up to 60 characters.

NAV point names don't need to be unique as long as the comments are different.

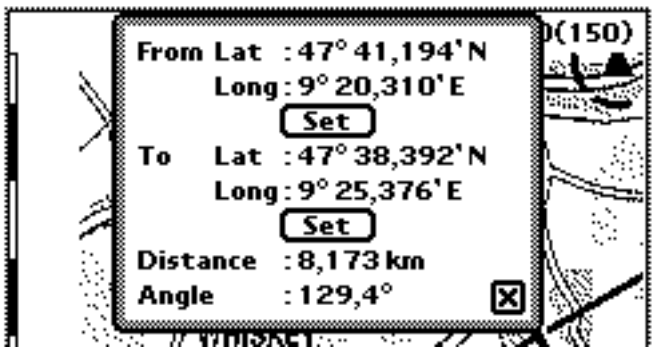
You may decide if the NAV point shall be stored in internal PDA memory or on the PCMCIA card by checking the "store objects on card" button in the standard application "Card".

Delete NAV Point

Use this item to delete a previously defined NAV point that is wrong or not longer needed. The selection will be done by using a similar window like that of the "Go to NAV Point" command.

NAV Calculations

This item opens a geographic calculator window for getting the distance and course between two points. All navigational calculations are based on great circle formulae.



The calculator will need two reference positions which you can enter while this window is open. After entering the first position tap onto the upper Set button and the reference position will be displayed. Then define the second reference position and press the lower Set button. The calculator will show the second reference position and the distance and course (geographic north relative) between both positions.

10.4 "Route" Menu

Tap onto Route to get a menu with route planning functions.

Load Route

This item opens a list window for selecting a pre-defined route. You may use the arrow buttons for manually scrolling the list or select the first character of the desired route by tapping it within the index line.

The name of a loaded route will be displayed at the upper left side of the map window.

New Route

If you want to define a new route tap onto this item. If a route is already loaded it will be removed from screen. A window will appear for entering a route name. Route names may be up to 25 characters in length. You may use the keyboard by double tapping into the input field.

If you don't enter a route name a temporary route will be created. This route will not be stored permanently and will be lost after a reset or PCMCIA memory card change.

You may decide if the NAV point shall be stored within internal PDA memory or on the PCMCIA card by checking the "store objects on card" button in the standard application "Card".

Direct Route

This is the fastest way for defining a simple route with two way points and works only in NAV and PLAN mode. First define a reference position with one of the methods described and then tap onto the "Direct Route" item. You will get a route where "WP 0" is the Present Position and "WP 1" is the reference position. Please remember that this route is created temporary only!

Clone Route

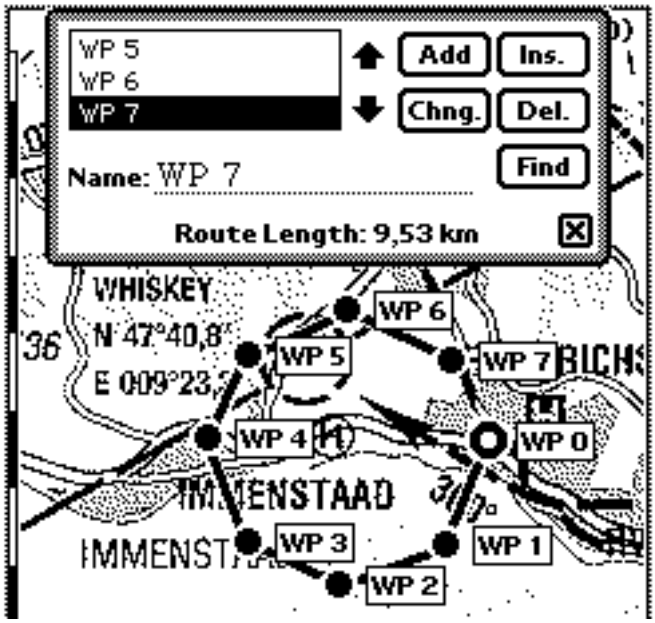
If you want to copy an existing and loaded route for modifying that copy or if you want to change a temporary route into a permanently stored route tap onto this item. You will get the same window for entering a route name like you already know from “New Route”. If you tap Cancel there will be no new route and the old one will remain unchanged.

Delete Route

If you want to permanently delete a stored route tap onto this item to get a selection window.

Edit Route

Tapping this item opens the route editor window.



If a route is loaded its way points will be displayed in the list. To enter a new way point first define a reference position for the waypoint and then tap **Add** for appending the new waypoint or **Ins.** for inserting the way point before the way point currently selected in the list.

To change an existing way point’s position first define a new reference position, then select the way point to change in the list by tapping it and then tap onto **Chng.**.

To change an existing way point's name first select the way point to change in the list by tapping it, enter the new name and then tap onto Chng..

For deleting a way point select it in the list and then tap onto Del..

You can also use the route editor for finding way points. Select a way point within the list and tap the Find button. The map will be positioned for seeing the way point in the centre of the screen. If the way point is not covered by the current map an adequate map will be loaded if available.

A route may contain up to 100 way points but you may then see some limitations with other functions due to a lack of heap memory. A usual route has up to 20 way points.

During entering way points will be named automatically starting with "WP 0" and then incrementing. These automatic names will be renumbered automatically if way points will be inserted appended or deleted.

If you have chosen a NAV point as a reference position for a way point the NAV point name will be taken as way point name.

If necessary you may enter your own names for way points directly before pressing one of the buttons. Your own names will be not affected by renumbering. way point names may be up to 8 characters in length. You may use the keyboard for input by double tapping into the input field.

All manipulations on the route will be automatically saved (will be temporary for temporary routes). If you want to use an existing route as a template for a new route use "Clone Route" to make a copy first.

The two last executed functions may be cancelled by tapping the "Undo" button below the PDA screen while the editor window is open.

Invert Route

Use this item to invert the actual route. The first waypoint will become the last one, and the last one the first one.

Set next Way Point

Use this item to select the next way point from a list window. This function is only needed if you want to select a way point in the middle of the route because of normally you will use the “Next” button found in the NAV information window.

Position Line Functions

In addition to routes you may define a position line to a reference position or to a way point. The position line works similar to a rubber thread connecting your Present Position with the selected reference position.

Free Pos. Line

First define a reference position and then tap onto this item to define the position line.

Pos. Line to WP

Tapping onto this item will open a list window to select a way point as target for the position line. This function works only if a route is currently loaded.
If a position line has been already defined there will be more selectable items in the menu:

Remove Pos. Line

Tapping this item will remove the position line from the screen.

Change Pos. Line

For changing an existing free position line first define a new reference position and then tap onto this item.

Pos. Line as Route

This function works similar to “Direct Route” and changes an existing position line to a route with two way points. It may be a good help for emergency procedures. Please remember that this route will be a temporary route and must be stored with “Clone Route” to get a permanently stored route.

10.5 "Record" Menu

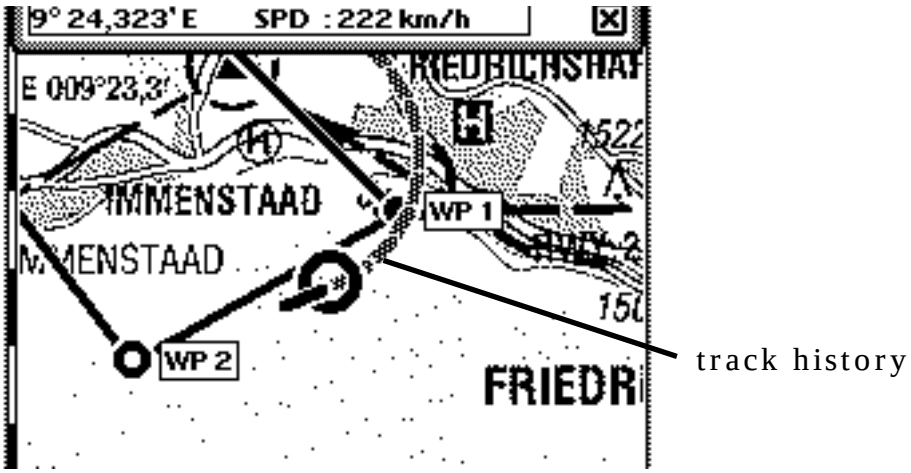
Tap onto Record to get a menu with mission recorder specific functions.

Emergency

This function is for storing of an emergency position. The Present Position will be saved as both a reference position and as a NAV point named "EMERGENCY". Then a position line to that position will be defined.

Show / Hide Track History

A very interesting feature is available through this item. After selection *GPS Map* will plot your movement as a tail fitted at the PPOS symbol. The tail will grow up to a maximum length of some minutes history. It may be a big aid for staying on course or curving back into the route.



Because of the stored history depends of the actual map and scale it will be erased during a map change, either manual or automatic. The function needs much storage space and performance. You should stop it by tapping onto the meanwhile changed item "Hide Track History" if it is not longer needed.

Start / Stop Mission Recorder

Another very interesting feature is available through the remaining items. You may store your mission for later displaying it as a curve within a map. The actual position will be saved about all 15 seconds. After selecting the "Start Recorder" item there

will be an input box for entering the mission name. You may enter up to 25 characters there, and you may use the keyboard by double tapping into the input field.

To stop recording simply select the item again which has changed its text to “Stop Recorder”.

Stored missions need a lot of memory! Please delete missions if you will no longer need them.

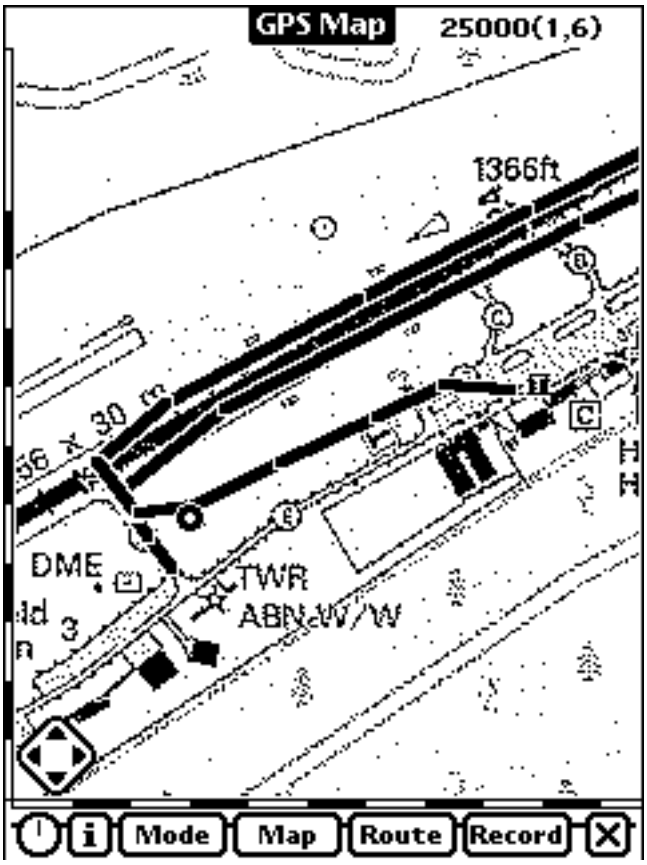
Show / Hide a Mission

Use this item for displaying a stored mission as a curve within the current map. This function needs much memory and calculation time because it has to check for each stored point if it is covered by the current map and then has to clip the connection vectors. It should be used in OFFLINE mode only and it is disabled in NAV mode. It may take up to several minutes until the curve will show-up within the map. When finished the map will be positioned in that way that the start point of the mission will be in the centre of the screen.

If you do a scale change you will have to wait the same time again because of all points have to be recalculated for the new map.

For cancelling the mission display tap onto the meanwhile changed item “Hide Mission”.

You may decide if the mission shall be stored in internal PDA memory or on the PCMCIA card by checking the “store objects on card” button in the standard application “Card”.



Start and landing shown on the air field map of Friedrichshafen at Germany

Save Window

Tapping onto this item will either save the NAV information window (if open) or the NAV calculator window (if open) to the notebook. You may append a header with up to 25 characters in length.

11. Map Support

Most users will buy *GPS Map* together with map material. Ask your dealer or distributor for more maps and different scales.

With adequate tools you will be able to produce your own maps, but please acknowledge the copyright conditions of the map suppliers! You may purchase paper maps and produce Map Packages only for your private needs. For making commercial Map Packages you will need the written permission of the map supplier and you will have to pay a royalty fee to him.

12. Short Intro into Map Preparation

12.1 Hard- and Software Conditions

You will need the following equipment for creating *Map Container Packages* :

- a fast *Apple Macintosh* or *Windows* computer with at least 8 megabytes of RAM (sufficient only for small map regions) and a big hard disk with at least 80 megabytes of free space.
- image processing software like *Adobe Photoshop* (the “light” version will be sufficient) or vector based drawing software such as *Claris MacDraw*
- the development system *Newton Toolkit* from *Apple*
- the *Map Preparation Package*
- access to a big format scanner, if possible it should be big enough to scan your paper map in one piece (scanning is offered by DTP studios, too)

12.2 Overview of the Map Preparation Process

Creating *Map Container Packages* consists of the following steps:

“Real” maps:

- Search for a suitable map, both for navigation purposes and for displaying on a b/w PDA screen.
- Scan the map (or get it in electronic form)

- Do the optical preparation of the raw image with image processing software (*Photoshop*) and reduce the result to a b/w PICT resource file

Synthetic vector maps:

- Draw your map by using a vector oriented drawing application such as *Claris MacDraw (Pro)* or similar.

- If supported by your drawing application store your map directly as a PICT resource filer, or create it within *Apple's ResEdit* by copying the map as PICT resource into a new created file.

Common for both:

- If your map image exceeds a maximum of about 10 000 000 pixels you should consider dividing the map into two or more smaller parts, overlapping each other for about 100 pixels at the borders because of PDA performance limitations.

- Find map locations (calibration points) for generating the geographic reference. You will need 3 locations for maps with a rectangular type projection or 9 locations for maps with cone type projection

- Calculate the map description parameters by entering the selected locations into a *Macintosh* or *Windows* application (*RectMap, QuadrantMap* or *ConeMap*) comming with the *Map Preparation Package*

- Copy the map description parameters into a NTK project template, compile it and load it into your PDA

- Check the *Map Container Package* by entering the locations used for calibration into the "Go to Position" window of *GPS Map*

12.3 Map Projection Methods

It is not necessary to be a cartographer for making *Map Container Packages,* but you will need a little base knowledge.

Putting a map onto a screen is not as simple as showing a photography. Along with the map image *GPS Map* will need supplementary information for finding just that image pixel corresponding to a given geographic position.

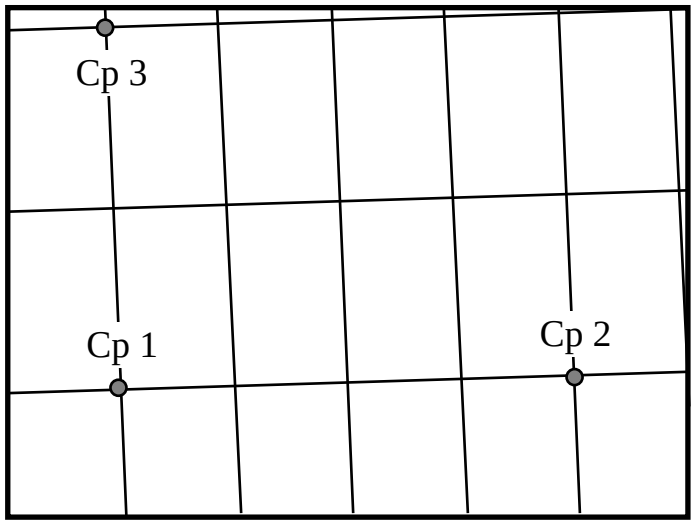
A globe surface may be projected to a flat surface only with some difficulties because of its curvature. For solving this problem cartography has developed several projection methods, each with both advantages and disadvantages.

Rectangular Type Projections

This projection method is especially used for topographic maps with scales between 1:1 and approx. 1:100000. Examples are town maps, walking maps or airfield maps for aviation.

If you have a map where both latitude and longitude lines are straight, all latitude lines as all longitude lines are running in parallel and all latitude lines are crossing the longitude lines with a 90° angle it is a rectangular type projection.

There is a projection error because of the decreasing distance between longitude lines in pole direction, but this error can be neglected with small map scales and therefore small regions.



The advantage of this method is the simple handling. You may determine distances and angles simply by using a ruler and setsquare.

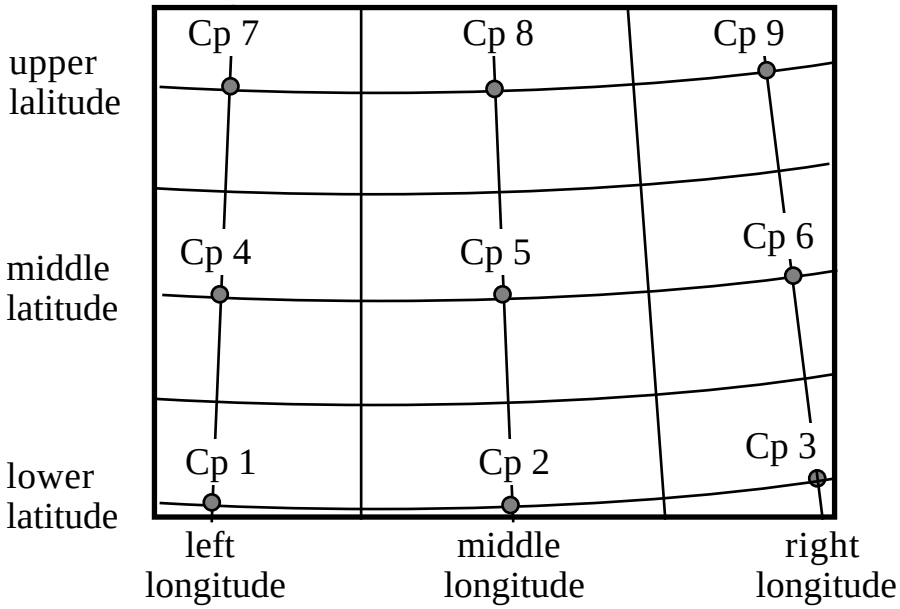
GPS Map uses a transformation method that describes a rectangular type projection map by three special calibration points and which is able to eliminate little twist or warp of the scanned map image.

Cone Type Projections

This projection method has many variations. It is used for maps with high scale up to world wide maps.

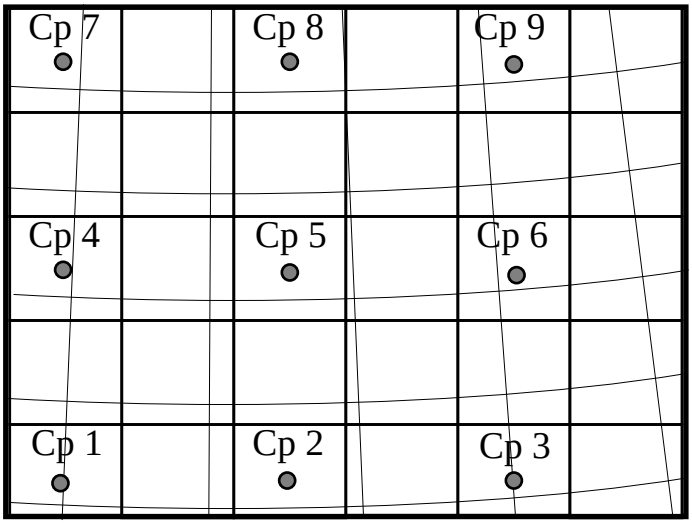
If you have a map where latitude or both latitude and longitude lines are curved it is handled as a cone type projection.

It is much more difficult to extract positions out of these maps because you must remember the actual curving of the latitude and longitude lines at each map point.



A widely available road map in US comes from Thomas Bros. and an alteration is available through *Trimble,* called the *Trimble Atlas*. These maps are also cone type maps, but without geographical grid. You can use them only if you have a possibility to convert between their grid format and the geographical WGS84 latitude / longitude format. Some GPS receivers (e.g. the *Trimble ScoutMaster*) are able to convert the grid.

GPS Map uses a transformation method which describes almost any cone type map by nine special calibration points with sufficient exactness.



13. Distribution

GPS Map is offered both as a bundle including maps and as a bundle including the *Map Preparation Package*. and *GPS Driver Development Package*. Documentation is available both in English and German language.

The price for the first bundle depends on the maps included. The price for the second bundle is DM 685,- plus self costs for mailing.

Included is six months free support by phone or e-mail, and free updates up to the next major revision.

All distributors are also offering a map preparation service. Customers can send in paper based or digitized maps. The price depends on the map source, size (square centimeters) and the expense for optical preparation and calibration. Please ask for a special offer and specify the desired map.

For an actual list of distributors please take a look to the *GPS Map* home page at <http://www.segelflug.de/gps/GPS_Map.html> or send e-mail to the address below.

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