

GPS Navigation on LONDON TO DAKAR



1970 6 2005
WORLD CUP
London to Dakar

GPS Navigation on the London to Dakar Rally

Sending rally crews across a desert is not risk free. The Organisers must make the London to Dakar rally as safe as possible for those taking part and this involves training crews in GPS navigation.

These GPS (Global Positioning System) navigation notes are written specifically for the London to Dakar rally. They concentrate on the most important features and methods necessary for the rally rather than general GPS theory.

For those wanting a broader knowledge there are many books and web sites devoted to the theory and practice of GPS navigation. Some recommended sources are listed in the Appendix at the end of these notes.

The Desert is a big place.

For an impression of the scale of the task consider one section of the rally across part of Mauritania.

Between Nouadhibou (Naddy-boo) and Nouakchott (Nak-shot) the rally crosses a desert region of over 20,000 sq kms. This is about the same size as Wales with little in the way of natural features to guide the way. No road signs, no clear tracks, few distinctive natural features and lots of sand.... Your rally task is to follow a route across this desert, locating control points on the way and keeping to a time schedule.

There may be a temptation to say that many overlanders make the journey to Dakar so what's the big deal. There are some crucial differences between an overland adventurer and a rally crew.

- Overlanders usually travel in groups, probably with a local guide.
- Overlanders don't have a rally time schedule.
- Overlanders don't have to visit specific control point locations.

GPS is the tool that makes the London to Dakar possible. It is essential that all crews are equipped with GPS and know how to use it. When you know how to use your GPS it will tell where you are; where you should be – and much more besides.

Your ability with GPS is crucial.

Selecting a GPS

Every crew on the London to Dakar must have one of the following Garmin GPS receivers.

Garmin III+

Garmin V

Garmin GPSmap 176

Some crews may already own a GPS other than those listed and wonder why it is not suitable. There are a few other Garmin units that might be suitable for experienced users but new users must select one of the above units.

GPS Navigation on the London to Dakar Rally

The GPS receiver that you use on London to Dakar must be one of the recommended Garmin models unless you have specific clearance in writing from the Rally Office to use an alternative model.

We have to limit the choice of GPS units for a couple of critical reasons.

- A large amount of route data must be loaded in each GPS. Entering the data manually would be a massive task and prone to errors. An error of 1 minute could have you nearly 2kms off course or an error of 1 degree could have you over 100kms off course. To avoid errors the data must be uploaded electronically.
- Our instructions must apply to all the units used.

Garmin make a very large range of receivers. Take care not to be swayed by an eager salesman who might claim that the unit he wants to sell you is 'as good' or even 'better' than the ones we have listed.

Garmin III+ - Garmin III Plus

For some years the Garmin III+ has been one of the most popular units on the market. It contains all the features needed for the London to Dakar and is the unit used for the route surveys. These notes are based on the G-III+. The small screen size is thought by some to be restrictive. Some suppliers suggest that the G-III+ is obsolete but it still seems to be readily available. The older Garmin III can also be used but is only recommended for those who already have this unit and don't wish to buy a newer GPS

Garmin V

The Garmin V is physically the same as the G-III+ but has more features, increased memory and modifications to some of the operating procedures. It has a higher screen resolution – although the screen is the same physical size. The G-V has features such as “road lock” and “auto routing” that enable it to lock-on to the nearest road and display turn-by-turn route instructions. It will also recalculate routes if you miss a turn. This may be clever to get across town back home but will be no use in Mauritania! The G-V operates differently to the G-III+ in some respects. The G-V is fine if you already have one; or if you want the extra features when you return home; or if the G-III+ supply dries up.

Garmin GPSmap 176

This is regarded as nautical unit but is also suitable for land use. The significant difference is the larger screen. It has most of the same operating features as the G-III+ with extra capacity for storage of waypoints, routes and tracklogs. The GPSmap-176 operates differently to the G-III+ in some respects and may require extra learning to adapt methods to our route instructions. The G-176 is somewhat more expensive than the G-III and G-V units and also has no built in memory for extra maps, requiring a data card to store additional map data. (This is not an issue for the desert sections of London to Dakar.)

GPS Navigation on the London to Dakar Rally

Colour – Other versions – Buying notes

Restrict your choice to one of the above listed units. If you already have another Garmin unit it may be suitable but contact me before making any assumptions. There is a colour screen version of the G-176 designated GPSmap 176C. There are suggestions that the colour screen has a tendency to “wash out” in bright sunlight. For this reason we recommend the mono screen version.

Another very popular Garmin GPS is the Streetpilot III range. Although this is a very sophisticated GPS it does not have some track facilities that we will be using and is not regarded as suitable for the London to Dakar.

All the suggested GPS receivers have a built in ‘basemap’ that cannot be changed. The basemap relates to the original intended sales area. American units have an ‘Americas basemap’ – European units have an ‘Atlantic basemap’ – there is also a rarer ‘Pacific basemap’ version for Australia. The preferred choice is the ‘Atlantic basemap’ version that contains local data specific to Europe. The actual basemap in your unit is NOT critical for our purposes but you should be aware that many cheaper units from sources such as Ebay may have the Americas basemap.

Check which basemap comes with any unit you are about to purchase.
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Accessories

You will need the following essential accessories to fit your GPS in your car.

- An external aerial – When a GPS is mounted in a car the roof panel will obstruct the satellite signal and although the GPS will often still work through the windscreen an external roof aerial is essential to get the most accurate fix. Your Garmin dealer will charge approx £70 for the genuine Garmin external aerial although reliable aftermarket aerials are readily available for considerably less.
- A power supply lead. – Garmin GPS units can run off internal batteries but to avoid constant battery renewal you should wire the GPS to your car electrical supply. GPS vendors can supply a suitable power lead.
- A suitable GPS fixing system – Your GPS needs to be securely fitted so as to avoid vibration and to be clear for the navigator to see. It will also need to be quickly removable.

Installing your GPS

I do not intend to give precise details on fitting your GPS but the following suggestions may be useful.

Do consider the position of your GPS in the car to make it most clearly visible and to avoid direct sunlight on the display screen. The screen will be much harder to read if bathed in bright sunlight.

Many of us simply use Velcro to mount a GPS on the dashboard but bear in mind that the road to Dakar is not all smooth tarmac. For something better Garmin offer a range of mounting brackets although some of these are a little flimsy. For a more substantial solution you should check out the range of Ram or Touratech specialist mounts. More details on these in the Appendix.

GPS Navigation on the London to Dakar Rally

When navigating at speed, especially with the smaller screen units, I found it very useful to be able to hand hold the GPS to enable easier button pressing and a closer view of the screen. With a Velcro mounting, and enough slack in the wiring, I was able to grab the GPS from the dash and replace it very easily.

Velcro is not perfect. The adhesive tends to get soft at higher temperatures and when you use heavy duty Velcro – as you should – it can be the glue that separates rather than the Velcro. The Ram and Touratech mounts are both very well engineered but don't allow for repeated and quick removal and refitting, although I believe Ram can supply a quick release adapter. Garmin do an adjustable Auto Mounting Bracket (part 010-10329-00 – for G-III & G-V GPS) that is quite versatile and allows for fairly quick release although it might seem a little flimsy and possibly prone to vibration.

Power Connection

Most power leads come ready to plug into the car cigarette lighter socket. This is not a good solution as vibration or touching the lead will invariably break the connection. If a Garmin unit loses its external power it will show a message that power is lost and will turn off after 30 seconds. The G-V does have an audible alarm but the chance is that you will miss the warning and your GPS will be off just when you need it.

Connect your GPS with a fused direct connection power lead to avoid unwanted GPS switch off.
Ensure your GPS is quickly removable and has good batteries to make it available for data uploads during the event.
Leave enough slack in the power and aerial leads to enable hand holding for close work.

Fitting an External Aerial

The usual way to fit the external aerial is with Velcro or double sided tape. Position the aerial on the roof avoiding any obstructions – just behind the front screen above the co-drivers seat is usually good. Run the cable across the roof and through the door shut. Protect the cable from being trapped when the door closes and secure with gaffer tape. Those wanting something more sophisticated, and perhaps less prone being tampered with, should check out specialist suppliers. I believe that GPS Warehouse can supply a suitable bolt-through tamper proof aerial.

See the Appendix for GPS suppliers and sources.

GPS Navigation on the London to Dakar Rally

Some GPS basics

Latitude & Longitude

Positions on the surface of the earth can be defined in a number of ways such as the Ordnance Survey grid references in the UK. On London to Dakar we will use latitude and longitude.

Lines of Latitude run parallel to each other both north and south of the equator.
Lines of Longitude run from pole to pole dividing the earth into segments like those of an orange.

Each degree of latitude is about 110kms apart (or 60 nautical miles). One minute of latitude is 1.83km (or 1 nautical mile). At the equator each degree of longitude is also about 110kms but reduces as ones position moves towards the poles.

Garmin GPS receivers display positions to 1/1000th of a minute. At the equator 1/1000th of a minute represents 1.83 metres.

Be aware that resolution to 1/1000th of a minute is better than the position accuracy of your GPS. Do not expect your recorded position to match the given position exactly to the third decimal place.

There are three ways to express latitude and longitude. The difference is when you stop dividing into units of 60 and just use the decimal portion. Minutes and seconds work just like in time with each degree being divided into 60 minutes and each minute being divided into 60 seconds.

Here are the co-ordinates for the same location in all three formats – it's for the finish of London to Dakar beside Lac Rose, Dakar.

Degrees, Minutes and Seconds		
ddd° mm' ss.s"	N 14° 49' 55.4"	W 017° 14' 37.3"
Degrees and decimal fractions of degrees		
ddd.ddddd°	N 14.78207°	W 017.24368°
Degrees, Minutes and decimal fractions of minutes		
ddd° mm.mmm'	N 14° 49.924'	W 017° 14.621'

On London to Dakar we use the ddd° mm.mmm' format.

Datum

Any system of measurement needs a base-line or point of reference to measure from. Map makers over centuries have defined their map measurements according to differing datums. Although Garmin GPS units can operate according to approximately 100 different datum definitions the world wide datum for GPS is WGS-84.

GPS Navigation on the London to Dakar Rally

On London to Dakar we use the WGS-84 datum.

WAAS and other terms

There are a ton of other terms you will come across when learning GPS navigation. WAAS (Wide Area Augmentation System) is touted as a feature to make GPS more accurate. It relies on extra earth stations to add corrections to the GPS signals. These earth stations are not active where we are going. If your GPS is WAAS enabled you should turn the feature off to avoid possibly degrading accuracy.

I will deal with others terms as they arise.

Working your GPS

These notes are not a substitute for the user manual. Only the features most significant to the London to Dakar rally are included. If anything is not clear please refer to the manual and try to work things out. Find my contact details in the Appendix if you need to reach me with questions or comments.

The examples and procedures are based on the Garmin III+. Users of Garmin-V or Garmin-176 will have to adapt the exact methods but the essential points remain the same.

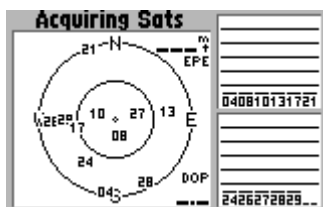
GPS Setup

Many Garmin features can be set for individual requirements. Some settings are essential while others are optional depending on user preferences.

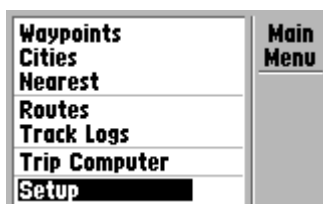
Checking the essentials.

I will assume you are indoors with no clear view off the sky – this is not a problem at this stage.

- Press the power button to turn on your G-III+
- Press Enter to pass the warning screens and display the Acquiring Sats screen as below.

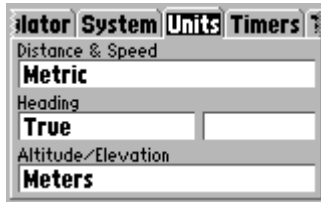


- Press Menu twice to reach the Main Menu then use the rocker switch to highlight Setup as below



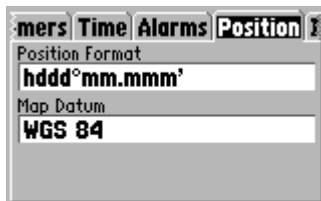
GPS Navigation on the London to Dakar Rally

- Press Enter and use the rocker switch to highlight the Units page as below



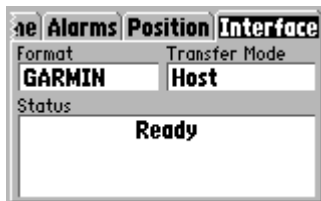
Ensure the three items on the Units page are showing Metric – True and Meters as above. If they are not use the rocker switch to highlight each item and press Enter to change the values. Try changing the values to become familiar with this method but ensure the values are as above before leaving this page.

- Use the rocker switch to move on to the Position page as below



Ensure the two items on the Position page are showing as above. If they are not use the rocker switch to highlight each item and press Enter to change the values. Ensure the values are as above before leaving this page.

- Use the rocker switch to move to the Interface page as below.



Ensure the Interface page items are showing as above. If they are not use the rocker switch to highlight each item and press Enter to change the values. Ensure the values are as above before leaving this page. This interface format enables the GPS to communicate with a PC for data transfer when connected by data cable.

Track Recording

When the GPS is recording a Track Log it can display a 'breadcrumb' trail of the route you have taken. This should be setup for reasons we will come to later.



Setup logging as follows:

- Press the Quit button to return to the Main Menu and scroll up two items to Track Logs as shown in the left screen shot above.

GPS Navigation on the London to Dakar Rally

- Press Enter and from the Active Log page press Menu and scroll to Setup Logging as in the centre screen shot.
- Press Enter to display the right screen shot as above.
- Ensure that the Record Mode – Interval and Interval Value are showing Wrap- Resolution and 50mt as shown above.
- Highlight any item that needs changing and press Enter to change it as required.
- When the items show the required values Press Quit – maybe several times – to back up to the Acquiring Sats screen.

Orientation

I strongly advise using your GPS in North Up mode so that Map screens are displayed with the map orientated with North upwards. The alternate choice is Track Up that displays the map with your current direction of travel uppermost.

Experienced navigators do not turn their maps upside down to face their direction of travel. Map orientation is changed from the initial menu screen that is reached by pressing Menu once from the Acquiring Sats / Satellite Status page. If the second item is showing “Track Up” this is how we want it as it means that the current setting is “North Up”. If it’s showing “North Up” then highlight this item and press enter & select “Yes” to change the map orientation to "North Up”

That is the end of the essential set-up values but you may want to have a look at some of the other pages in the Setup menu and experiment with making changes until you are familiar with the procedure.

Non Essential Set-Up Items

- Press Quit to return to the Main Menu then use the rocker to highlight Trip Computer menu item and press Enter to display the Trip Computer page as below.

Trip Computer	
Trip Odometer	Average Speed
1872 ^k _m	40.5 ^k _h
Trip Timer	Maximum Speed
--:--:--	179.6 ^k _h
Odometer	
16981.5 ^k _m	

This is a handy page where you will find various trip details as shown. You can't edit the items directly but pressing Menu will allow you to reset chosen values. (Did our route survey Land Cruiser really reach 179.6 k/h?). Be aware there is a glitch in the maximum speed feature that can give unreal values when satellite coverage is lost for brief periods.

You may want to explore other items on the Main Menu. For instance the Cities item gives access to a large database of stored places. Try and use the rocker switch with the Spell 'n Find feature to locate Dakar in the database as shown below. You may need the manual if working Spell 'n Find does not come intuitively.

GPS Navigation on the London to Dakar Rally



Getting a Fix

At this stage it's probably time to find out where you are so return to the Acquiring Sats page and take the GPS outside to get a clear view of the sky. If you have had the GPS on for some time indoors you may see the message shown below.



If you see this message, press Enter and choose Use Map or AutoLocate to initialise your position.

If your GPS has not previously been used at your current location it may take some time to calculate and display the position. The GPS has to locate and receive a lot of data from the satellites then sort out which satellites it is seeing before doing the maths to work out where it is. You can leave it to its own devices or select AutoLocate and it will sort things out after a few minutes or you can select UseMap to give it a little help. If you select UseMap you use the rocker switch to move the cursor over the map display until it is close to your current position. The position does not have to be precise but you can use the zoom In and Out buttons to position the pointer more accurately. Press Enter when the pointer is close to your current position.

Next time you use your GPS it will remember much of the initial set-up data and providing you have not moved position significantly since its last use, it will calculate and display the position much more quickly.

Garmin III+ display screens

In this section we will look at the different screens of information that can be displayed on the Garmin III+. Garmin V and 176 models arrange things differently but most of the principals remain the same.

The G-III+ has six primary display screens that can be shown in rotation by repeated presses of the Page button. Pressing the Quit button shows the same screens in reverse order rotation. This is useful to flip back and forth between adjacent screens.

GPS Navigation on the London to Dakar Rally

Map Screen

Once the GPS establishes its position it will switch to the Map screen to show the current location.

To set up the display screen examples I have created a situation for a position just after leaving the London to Dakar office in Blewbury having activated a Goto to my next destination – Brighton on the south coast.



Zoom Levels

The Map screen shots above show the same location in Blewbury at three different zoom levels. Notice in the large scale shot on the left that the position is shown some way north of the road. This sort of discrepancy is quite common with GPS and is more likely an error of the built in basemap than the positional accuracy of the GPS.

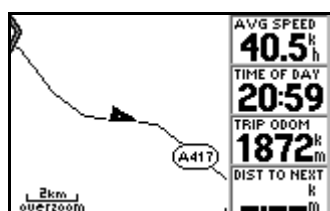
The Map screen and especially the range of zoom level is a very important feature of your GPS and one that you should become familiar with. A characteristic of experienced navigators when using conventional maps is their ability to relate to the scale of map that they are working with and their speed across the page whether the map scale is 1:25,000 or 1:4,000,000. The G-III+ can display the Map screen at 23 different scale resolutions between 30 metres and 800 kilometres.

It's important to be familiar with the large range of different Zoom levels and to get a feel for your speed across the screen as you approach Waypoints on your route. More on this later.

On the route survey I used two GPS units displaying different zoom levels enabling a simultaneous big-picture and close-up view – a bit of a luxury but very useful.

Map screen with data fields.

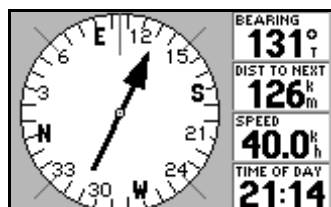
The map screen can be set to display additional data fields as in the example below. Personally I think this reduces the map display too much and the information can be displayed on another screen but the choice is yours. Press Menu while the Map screen is showing to access the data field display options.



GPS Navigation on the London to Dakar Rally

Compass Screen

From the Map screen press Page once to display the Compass screen similar to that shown below. Pressing Menu from the Compass screen allows changes to be made to the compass display size and the selected data fields.



The Garmin receivers we are using do not have a built in magnetic compass but once on the move they can calculate and display the direction of travel.

The Compass screen shows the speed and heading as well as the distance and bearing towards the destination. The compass ring (not the Pointer) shows the direction of travel as a little bit south of due east on a heading of 105°. The Pointer shows the course in a straight-line to the destination – Brighton, in this example. The data fields show the destination is 126km away at a Bearing of 131°. Obviously it's impossible to follow the Pointer in a perfect straight line from Blewbury to Brighton but in the desert this pointer will be very useful, as we will come to shortly.

The pointer is not a compass needle. It shows the direction of travel to reach the next Waypoint. When the needle points straight up you are travelling straight towards the next Waypoint.
If the pointer points right – go right. If it points left – go left.

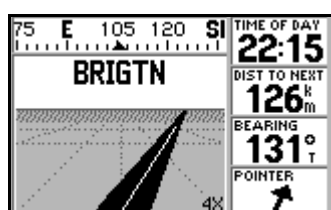
It is worth stating the difference between Bearing, Track and Heading.

- Bearing – is the compass direction from a position to a destination. In a GPS receiver, bearing usually refers to the direction to a waypoint.
- Track (or Course Over Ground) – is your current direction of travel relative to the ground. A Track Log is something different as we will see later.
- Heading – is the direction in which a vehicle is moving. For air and sea operations, this may differ from actual Course Over Ground (COG) due to winds, currents, etc.

Be aware that as you get close to a destination the Pointer will swing rapidly as you pass over or close by the Waypoint.

Navigation or Highway Screen

From the Compass screen press Page once to display the Navigation screen similar to that shown below. Pressing Menu from the Navigation screen allows changes to be made to the navigation screen setup.



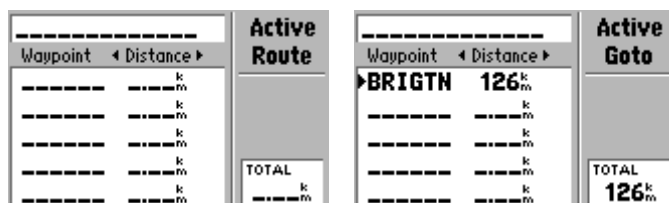
GPS Navigation on the London to Dakar Rally

The Navigation screen shows a representation of a road to the next destination. The small pointer and the representation of the road show that we need to go a little to the right, similar to the information we got from the Compass screen. The Zoom buttons can be used to stretch or compress the scale of the road representation. The compass bar and data fields echo information we saw on the Compass screen.

This can be a useful page under normal navigating conditions such as sailing or walking but under rally conditions with closely spaced waypoints I consider that the rapidly changing screen display becomes confusing. I will be recommending a navigation scheme that does not use this display but you are welcome to explore the possibilities of the Highway screen.

Active Route / Goto Screen

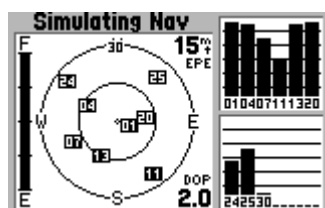
You know the technique now, so next in sequence is the Active Route or Active Goto screen similar to those shown below – probably blank like the left example on your GPS. Pressing Menu from the Active Route / Goto screen offers various Goto and Route options.



We will return to this screen when dealing with Routes and navigation techniques.

Satellite Status Screen

Next in sequence is the Satellite Status screen. This is the screen shown earlier as the Acquiring Sats screen.

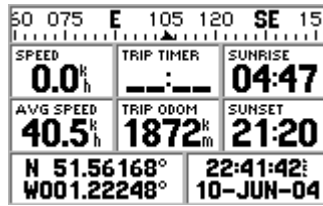


Enough to say here that the solid bars on the right indicate signal strength of the satellites providing current position data. Hollow signal strength bars indicate satellites being seen but not yet providing complete data communication. Refer to the manual for more on this screen if you wish.

Position Screen

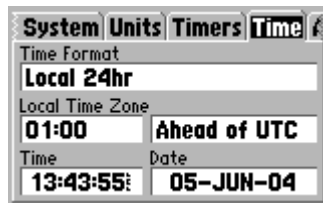
The final screen in sequence is the Position screen similar to that shown below. Pressing Menu from the Position screen allows changes to be made to the data fields.

GPS Navigation on the London to Dakar Rally



The compass bar at the top of the screen shows the direction of travel as 105°. The fields below the compass heading indicate six items of information that may be selected from the available data fields. Press Menu from this screen to change the selected fields.

The lower part of the screen displays the current position in Latitude and Longitude (providing the position format is set to Lat/Lon). Lower right is the time and date. The time displayed is very accurate being synchronised with the satellite signal but the actual hour shown will depend on the Time Zone setting on the Time page on the Setup pages as shown below.



In my job as rally timekeeper I always use satellite time to set the rally clocks so you should be able to get current rally time from this display. This is not a guarantee but rally time should be close to satellite time, and remember to reset for time zone changes

That completes our run through of screen displays. Next comes the techniques we will use to navigate on London to Dakar.


GPS Navigation on the London to Dakar Rally


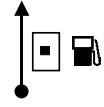

Waypoints, Routes, Track Logs and Navigation

Waypoints

Waypoints are locations or landmarks worth recording and storing in your GPS. These are locations you may later want to return to. They may be checkpoints on a route or significant ground features. Waypoints may be defined and stored in the unit manually by taking co-ordinates from a map or other reference. More usually, waypoints are entered directly by taking a reading with the unit at the location itself, giving it a name, and then saving the point.

To provide crews with additional GPS experience before we reach the serious desert sections a lot of earlier locations on the route will be defined by Waypoints that we will upload to your GPS.

 **The London to Dakar World Cup Rally 2005**
Leg 12: Agadir to Laayoune
Section Length 324.83 Kms

Inter	Total	Direction	Information	To Go
108.50	306.55		Province of Tan Tan Possible police check	18.28
18.28	324.83		<i>WP031 - N28° 26.038' W011° 04.723'</i>  TC1.6 Time Control Tan Tan Petromin Fuel	0.00

In the sample route book section shown above you will see WP031 above the details for a possible Time Control at Tan Tan. This Time control would be very easy to find without GPS as there is only one main road into Tan Tan. However to encourage crews to think GPS we will upload Waypoints to your GPS for most of the significant route points.

To have your GPS guide you to this Waypoint you should follow this sequence

- Press the GoTo button while displaying any of the main GPS screens.
- Use the rocker to highlight WP031 from the waypoint list
- Press enter to Activate the GoTo

The GPS will calculate the straight line distance and bearing to WP031 from your current position. You can use the various screens to follow your progress towards the point.

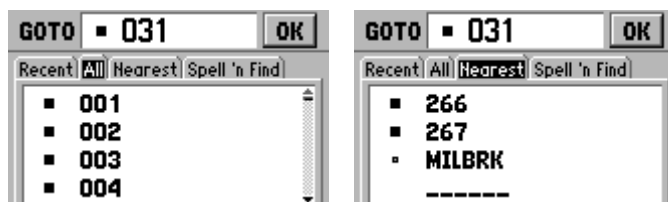
Note that the GPS draws a line on the Map screen from the position where you activate the GoTo to the chosen Waypoint. Although the distance and bearing to the point updates as you move, the drawn line does not change. Across open ground, at sea or in the air this is useful as you can see how far off course you are but it may be confusing when you are following a winding road. You can re-draw the line at any time by re-activating the GoTo as follows.

- Press GoTo – the previous waypoint should still be active with OK highlighted
- Press Enter to re-activate the GoTo.

GPS Navigation on the London to Dakar Rally

Waypoint selection page

It is likely that there may be upwards of 200-300 waypoints loaded to your GPS for the London to Dakar. The following note may ease the task of locating your next waypoint. When you press GoTo the Goto page is displayed as shown in the examples below.



In the left example the All tab is highlighted. This gives access to all the available waypoints but starts at the top of the list each time. If you want Waypoint 031 you must scroll from 001 to 031 before pressing Enter. It takes even longer if you want Waypoint 266 – and once you have used 266 and want to move on to Waypoint 267 you have to scroll from 001 again. Annoying.

In the right hand example the Nearest tab is highlighted. From this tab you have access to the nearest waypoints to your current position. This can reduce the amount of scrolling required.

Routes

A sequence of Waypoints may be combined into a group and designated as a Route. The Garmin III+ is able to store up to 20 pre-defined routes each one comprising a maximum of 30 Waypoints. The G-V and G-176 have a larger Route storage capacity.

Once a Route is loaded in the GPS it can be 'activated' and the GPS will guide you from point to point. When the Route is activated while at, or close to, the first point on the route the GPS will automatically lock to the next point on the route and indicate the bearing and distance to the next point. As each point is reached the GPS will automatically switch to the next point in the route sequence.

A Route is not usually activated until you are close to or at the first point on the Route so you will probably have to use the GoTo routines mentioned above to reach the start of a Route section. It may also be worth noting that if you activate a Route from a position some way along the course of the Route the GPS will calculate the quickest way to join the route and continue along the remainder of the Route. It will not re-direct you to the start of the Route.

Follow these steps to select and activate a stored Route:-

- Press Menu twice to reach the main menu
- Select Routes from the menu options and press Enter.
- Select the required Route from the stored routes and press Enter.
The display page will change to show details of the selected Route.
- Press Menu and highlight Activate from the options.
- Press Enter to activate the chosen route.

GPS Navigation on the London to Dakar Rally

The desert test sections on the London to Dakar will be defined by Routes uploaded to competitors GPS units.

To illustrate how we will use a Route on London to Dakar let's consider a possible test section of 160kms across Mauritania. Your Route may be defined by up to 30 individual points between the start and finish of the section. This would mean that each point might be 5.5kms apart. In fact we will probably use fewer points so the distance between points will be larger in some cases.

From the above you will see that the route across Mauritania is defined by a sequence of straight lines. This will provide part of the challenge in that, although there are few natural features in this part of Mauritania there are some and it is unlikely that you will be able to follow the route in a series of precise straight lines. A dune or rock outcrop in your path may require a diversion to the left or right. The skill is in reading the terrain and deciding the best and fastest way to reach the next point on the route.

It is important to grasp an idea of the scale of the desert.

If you are travelling across a vast and barren open space between two points 15 to 20 kms apart the fact that you are maybe 1 or 2 kms to the left or right of the straight line between the points may be of little consequence. This is especially true if you are on a good smooth and firm track while the direct line between the points crosses dunes and soft sand.

A feature of an active Route is that if you pass a point without actually reaching it and the GPS detects that you are now moving away from the point but towards a subsequent point it will switch to that next point. This is fine providing there is not a route check at the point that you have passed by.

Track Log

A GPS track log is a collection of track points along the course of a route. It's essentially a "breadcrumb" trail of the path of the navigated route. Track logs can tell us where we have been and therefore how to get back to where we started. More importantly, if prepared in advance, a track log can tell us where we need to go.

The track points comprising a track log are similar to waypoints but only the position is recorded without each point being given individual names that are usually given to waypoints. On our route survey between Agadir and Dakar earlier this year we recorded over 77,000 track points that produced individual track logs for each day of our route.

Most of these track logs will not serve any useful purpose but they could provide possibilities in more remote regions. As already seen, a Route is a combination of points joined by straight lines so the exact route between each point is not defined. In contrast a Track Log has the points much more closely spaced. By displaying a Track Log on the map screen we would effectively have a precise and detailed route to follow. Just keep the location pointer on the Track line and you would be on course. However there are some factors that make this solution less than ideal.

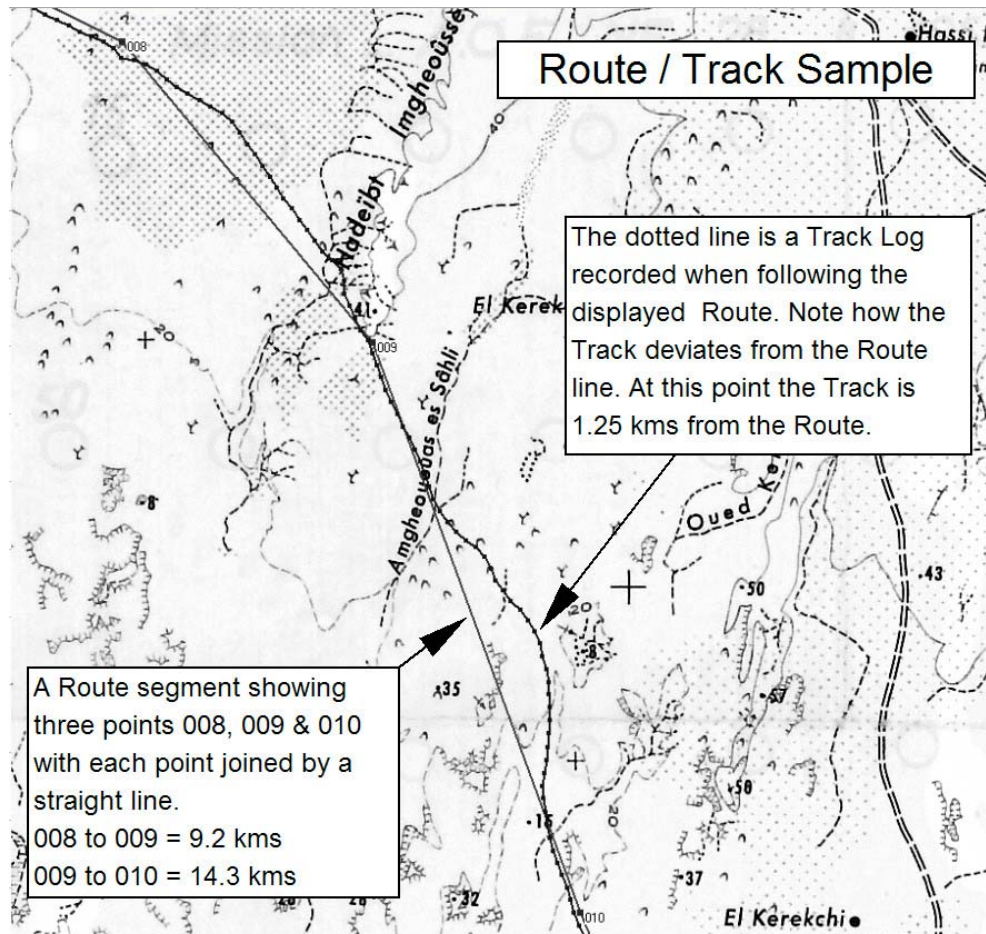
GPS Navigation on the London to Dakar Rally

It is unlikely that we will provide Track Logs for crews to use on the London to Dakar.

- The G-III+ can record up to 1900 points in its active track log but its stored track logs are limited to 250 points each.
- Loading track logs back to a G-III+ is a bit long winded as they cannot be loaded directly to a stored track log but must be loaded to the Active Log then saved within each GPS as a stored log.
- From a purely practical point of view the desert is constantly changing so, although the significant Waypoints on our route are chosen for permanence, the precise route between each point may vary significantly. We may have passed left of a sand dune on our route survey while subsequent changes mean that the locals are now passing to the right of the same dune. Blindly following a Track Log route to the left of the dune where all the current tracks on the ground indicate passage to the right would probably not be a good idea.

Route / Track Sample

Reproduced below is a sample from Mauritania showing part of a Route including three Waypoints and the Track Log points of the actual course taken. This should illustrate how you cannot expect to follow a Route in precise straight lines. (The map detail shown below is not provided in your GPS receiver but is shown to enhance the illustration)



GPS Navigation on the London to Dakar Rally

Following a Route

Let's consider some of the practicalities of following a Route under rally conditions. It will be up to you to develop your own technique but these notes gained from my own experience may be valuable.

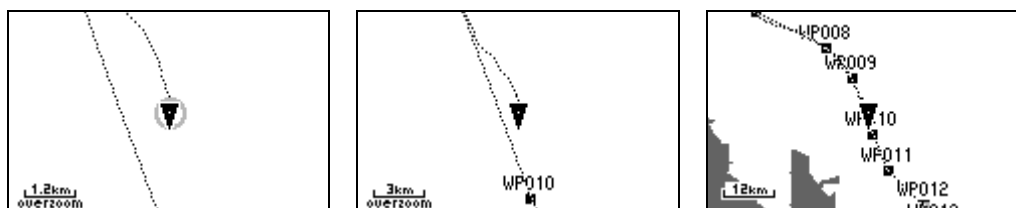
From reading various books on GPS navigation and from the user manual it may seem that using the Navigation screen is the most appropriate way of following a Route but this is not my preferred method.

I recommend concentrating on the Map and Compass screens to achieve the most efficient rally navigation.

Below are some screen examples to illustrate the technique. The example is based on the Mauritania Route / Track sample shown on the previous page. They show what you will be able to see on your GPS and illustrate that there is no background detail on the GPS for this part of the desert, although the coastline is just visible in the right hand screen shot.

The Map screen shots show a position as we approach WP010 while following a Route that is loaded in the GPS. The same screen shots are taken at scale levels of 1.2km, 3km and 12km – see the scale bar on the bottom left of each screen. Each screen provides valuable information.

Map Screen



Above: Map screens at three scale resolutions for the same position.

The left Map screen shot (1.2km scale)

- The arrow head shows our present position heading almost due south
- The dotted curved line behind the arrowhead shows the active Track Log. This is the 'breadcrumb' trail of our course to our present position.
- The oblique straight line to the on-screen-left of our current position shows the section of Route we are following.
- We can see that we are about 1.2km east of the Route but heading back towards it.
- You may notice a circle round the pointer on your GPS, as shown in the left example above. It is called the Accuracy Circle and represents the calculated positional accuracy of the GPS. The Accuracy Circle is yet another of the features that can be turned off if so desired.

The centre Map screen shot (3km scale)

- The same information as the first screen shot but our next Route point WP010 is in view so we get a feeling for our speed and direction of approach towards the next Waypoint.
- Having a view of the next Waypoint and the route beyond is important as it enables you to see any required change of direction before reaching the

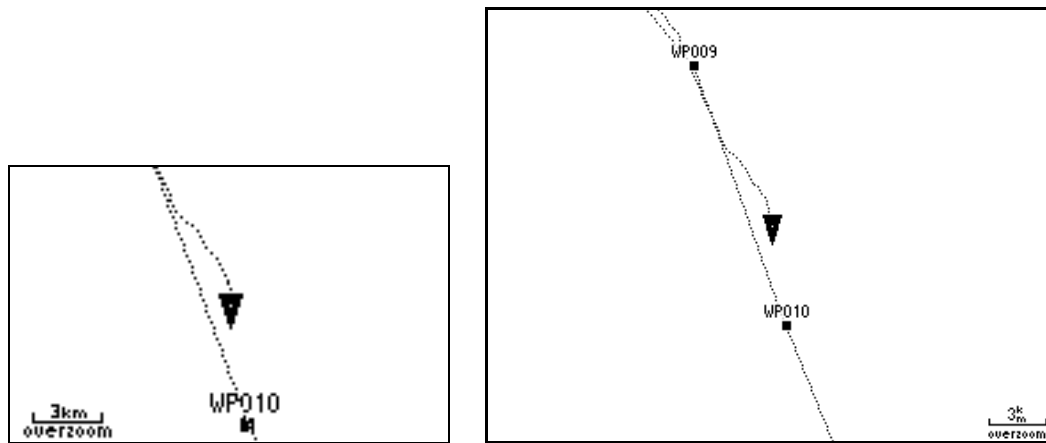
GPS Navigation on the London to Dakar Rally

That completes the features that I recommend to navigate a Route under rally conditions. Don't take the suggestions as the only method available. Consider the other information that your GPS can provide and whether it may be valuable to you and how you can locate that information under rally conditions.

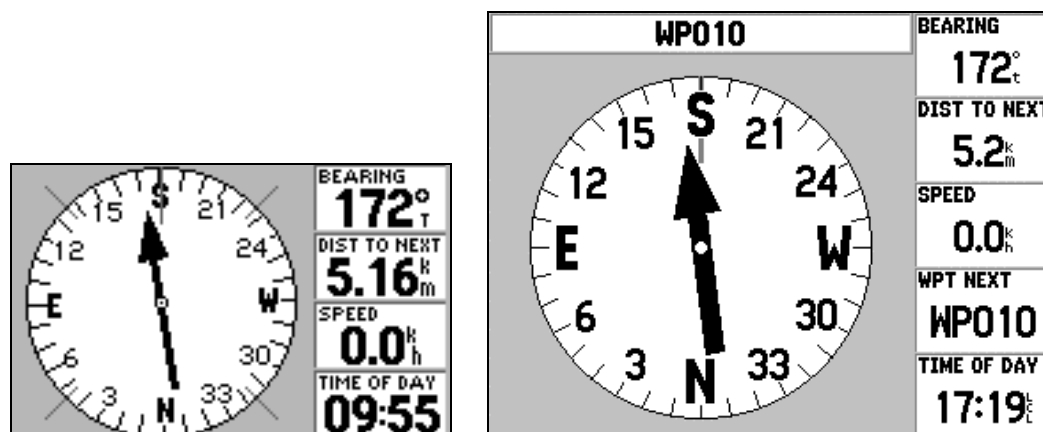
Other Stuff

Screen Comparisons

The screen shots below show a comparison between the Garmin III+ on the left and the Garmin 176 on the right illustrating the same position as used in our navigation example. They have been adjusted to be close to the actual size of the screen on each instrument. Besides the obvious size difference you will see that the G-176 detail is finer than the lower resolution G-III+ screen. Maybe it's because I am more familiar with the G-III+ but I sometimes find the G-III+ screen easier to read with its coarser lines although at smaller map scales the G-III+ becomes more cluttered.



Actual size comparison of G-III+ and GPSmap 176 Map screens.



Actual size comparisons of G-III+ and G-176 compass screens.

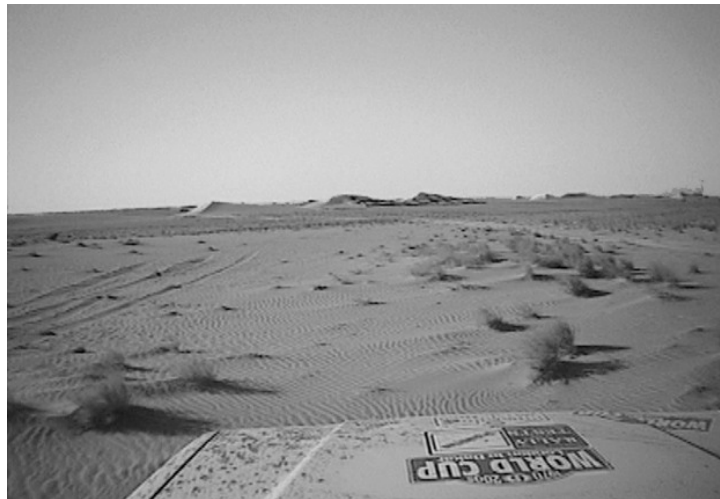
Screen Text Size

The Waypoint name text size, showing as WP010 in the above examples, is one of the many options you can change if desired. Find this on the G-III+ under Map Setup on the menu accessed by pressing Menu from the Map screen. Check your manual for more.

GPS Navigation on the London to Dakar Rally

The Road Ahead

Below is a typical view taken at a position similar to that used in our navigation example. Unless you are a native Mauritanian guide your GPS provides more essential guidance to your destination than the view through the window.



Above: A typical view of the way ahead.

Your GPS is your guiding hand across the desert. Your success depends on your ability to use it effectively.

Driving a straight course

Once the navigator has the driver heading in the correct direction it's useful if the driver can continue on a straight course without needing constant 'left-a-bit' 'right-a-bit' corrections. In our example, once the driver is heading 172° he needs to be able to hold this course while negotiating, for instance, a 10metre high dune 300mtrs dead ahead. It is the driver's job to decide which way to go round the dune (although the navigator will probably think the opposite way would be better). Once round the dune the driver needs to resume the heading of 172° . The best directional reference is to know where the sun is or to remember a feature on the horizon that may be just a small bump or dip in the far distance.

Rather than relying on constant left / right course corrections from the navigator it is much more efficient that the driver develops the ability to follow a direct course while missing the big bumps and soft sand patches.

Long Button pushes

The business of brief or longer button presses has been mentioned before and is a feature that crops up quite often on Garmin units. Here are a few examples – check the manual for more or just discover them from experience.

GPS Navigation on the London to Dakar Rally

- When the GPS is on, a long press of the Power button turns the unit off.
- A long press of the Page button switches the screen between landscape & portrait mode (Not G-176).
- A long press on either of the Zoom buttons sequences through the zoom levels.
- A long press on the GoTo button activates Man Overboard.

MOB (man overboard)

The MOB feature can be used for a quick trip distance meter. For example if you see a sign that says Tan Tan 15kms you can set MOB and then notice that the distance to MOB will be steadily increasing until you get there. Learn how to activate MOB from the manual if required although you may already have found it if you have pressed GoTo for too long and wondered where the new 'MOB' waypoint came from. I have never used MOB but you may as well know about it.

Trackback

Trackback is a feature that reverses an active Track Log and guides you back over your route. Besides the fact that I don't like going back I don't recommend this feature as I find it cumbersome and there is a better way.

In the section on essential setup I suggested settings for track recording. With these settings you will always be recording a Track Log that will leave a 'breadcrumb' trail of dots on screen to indicate the way you have come. In the Garmin III+ the Track Log has a capacity of about 1900 points which will pretty soon become full on London to Dakar. Having set the track log Record Mode to Wrap this means that when the log is full recording starts to overwrite the earlier records so your breadcrumb trail will always be 1900 points leading to your current position.

If you activate Trackback the Garmin takes the current Track Log and reduces it to 30 most significant points. It then reverse the points to create a reverse route. This takes time and 30 random points over the previous 500kms is not much use.

For Trackback to be effective you need to clear the active log regularly before any section where you may need to Trackback.

The better way is to go to the Map screen and set the zoom level to clearly see the breadcrumb trail and just keep the map pointer on the trail as you retrace your path.

Mark a Waypoint

Mostly on London to Dakar you will be navigating to Waypoints that we provide but you may want to record a Waypoint of your own for future use.

Follow these steps to record a new Waypoint:

- Press and hold the Enter / Mark button until the page changes to the Mark Waypoint page as shown below.

Mark Waypoint	
■ 268	Done
Comment	Reference
CRTD 19:02	-----
05-JUN-04	Bearing
Position	305°
N 21°02.571'	Distance
W 016°38.401'	0.62 ^k _m

GPS Navigation on the London to Dakar Rally

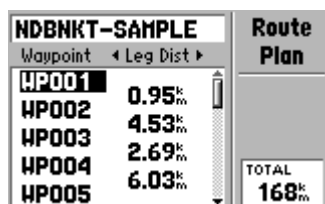
- Press the Enter button again briefly to store the Waypoint under the name 268.

When the GPS records the Waypoint position it assigns a numerical 'name' for the new Waypoint – in the above example it is 268. Note that 'Done' is highlighted by default on the Mark Waypoint screen so, for speed, you can accept this name and press the Enter button again briefly to store the Waypoint. The briefly is important. If you press and hold Enter at this point it will confirm and store Waypoint 268 AND immediately create another new Waypoint.

To give the Waypoint a more individual name such as 'HOME' you can edit the name before confirming completion of the recorded Waypoint. See your GPS manual for this procedure.

Route Plan Page

Having selected a Route that is stored in your GPS you can display various information about the route.



The screenshot shows a GPS screen titled 'NDBNKT-SAMPLE' with a 'Route Plan' section. It lists five waypoints (WP001 to WP005) with their respective distances in kilometers. WP001 is highlighted, and its distance (0.95 km) is shown in the right-hand column. A 'TOTAL' distance of 16.8 km is also displayed.

Waypoint	Leg Dist	
WP001	0.95 ^{km}	
WP002	4.53 ^{km}	
WP003	2.69 ^{km}	
WP004	6.03 ^{km}	
WP005		
TOTAL		16.8 ^{km}

In the Route plan page shown above we see – The name given to the route – The Waypoints that make up the Route – The distance between each Waypoint and the overall length of the Route. With one of the waypoints highlighted, as shown, the sideways rocker key will show alternative data in the right-hand column. Maybe you don't need to know the sunset time at every Waypoint but it all goes to illustrate some of what your GPS can tell you.

Backlight

The built in backlight is something you would obviously use at night but it can also enhance readability during the day. Set the backlight by briefly pressing the Power button while the GPS is on. Check the manual for more detail.

Simulation Mode

Most of the examples in these notes were created using Garmin's built in simulation mode. I have never found this mode very intuitive but it is certainly useful for getting a feel for your GPS from the comfort of your home.

On entering simulation mode you will find that the GPS simulates a lock on satellites as can be seen on the satellite status page and everything works similarly to the way it works when you actually have a fix.

In simulation mode you can:

- Setup your initial position.
- Set your speed and direction of travel.
- Activate and follow a Route
- Probably much more besides but, once again, check your manual for details.

GPS Navigation on the London to Dakar Rally

Practice Ideas

There's no substitute for practice and this doesn't mean just sticking the GPS on the dash and looking at it.

A simple practice routine might be as follows:

- Think up a simple route whether by car or on foot is not important but select a route with a start and a finish and several significant points on the way.
- Follow the route recording a Waypoint at the start and finish and at each significant point on the way.
- Return home and combine the recorded Waypoints into a Route.
- Put the GPS into Simulation Mode and set it to follow the Route while you watch the pointer on the screen.

You can work variations on the above but the important thing is to use the various GPS features until you no longer need to refer to the instructions.

Geocaching

Another good practice opportunity is offered by Geocaching. Geocaching can get you out and about on a little adventure and most importantly will require that you use your GPS.

Quoting from the Geocaching website. "The basic idea is that individuals and organisations have set up caches all over the world and have shared the locations of these caches on the internet. GPS users can then use the location coordinates to find the caches. Once found, a cache may provide the visitor with a wide variety of rewards. All the visitor is asked to do is if they get something they should try to leave something for the cache."

In practice this means that people are out there hiding Tupperware boxes all over the place containing treasure and messages. The idea is to find a cache and the hidden treasure. Being good souls you are expected to leave some more treasure before removing anything.

Find Geocaching on the web at <http://www.geocaching.com/>

You'll find more details on the web site. To give it a try you just need to enter your postcode and select United Kingdom from the country list (if that's where you are). You'll then get a list of caches near you.

No registering or joining is required to get started so give it a try at least once to get some GPS practice.

If you do give geocaching a try please read and respect the etiquette and avoid others seeing you discover or hiding the cache – you know they'll pull it out and spread the bits all over the place.

That's It

I hope these notes have not been too daunting and that they provide enough detail to get you working your GPS confidently. You'll have enough to do on London to Dakar without spending time reading a GPS instruction manual.

GPS Navigation on the London to Dakar Rally

Appendix

About the Author

I'm Chris Bruce. Peter and Betty Banham and I carried out the route survey for London to Dakar earlier this year so we have first hand experience of where you are going.

I've always been a fan of long distance rallies and did the London to Sydney rally in 1977. After that event I competed in several more long distance events, notably in Morocco, Algeria and Tunisia as well the Paris Dakar in 1986.

Always a bit of a techie I completed my first crossing of the Sahara using GPS in 1991. At that time my GPS was the size of a large book. It was a type used in the first Gulf war, it cost £1200 and provided only a fraction of the information that today's hand held units offer. I'm not an expert navigator but I do have considerable experience using GPS to find my way and I know how much you'll be relying on GPS during the London to Dakar rally.

Contact

Please feel free to contact me through the Rally Office or direct by e-mail at freewaycb@aol.com with any questions or comments. I don't claim to have all the answers but your contact might raise issues that could benefit us all.

***NOTE:** If sending email please mention London to Dakar in the subject line as I delete e-mails from unknown senders.*

Sources of Information

The internet is a huge source of information about GPS equipment, theory and practice.

Regarded by many as the GPS portal on the net is <http://www.gpsinformation.net/> where you can find information and links to the whole world of GPS.

Trimble is the company that made that £1200 GPS I used back in '91 and although they have largely abandoned the consumer market they have a pretty good tutorial on the theory of GPS at <http://www.trimble.com/gps/>

Of course Garmin themselves have a comprehensive site at <http://www.garmin.com/>

High street stores such as Maplins or good outdoor and camping equipment stores are regular suppliers of Garmin GPS receivers although their prices are not usually as keen as the specialist suppliers. And, it has to be said, their staff are not usually very knowledgeable in this specialist area.

Specialist UK GPS suppliers

Probably most notable among the UK suppliers of GPS kit are:

GPS Warehouse at <http://www.gpsw.co.uk/> or phone +44 (0) 20 8893 9393

and Global Positioning Systems at <http://www.globalpositioningsystems.co.uk/> or phone +44 (0) 8453 45 42 45

GPS Navigation on the London to Dakar Rally

GPS Mounting systems

As mentioned in the text Touratech <http://touratech.co.uk/> and Ram mounts <http://www.ram-mount.com> both make specialist mounts suitable for fixing a GPS.

Touratech is a German company that make special and sophisticated mounts developed primarily for motorcycle use. The web link above is to the UK division where you will find an on-line shop for their products.

Ram mounts are American. The link above is to their US site where you will find a baffling array of different models. Both GPS Warehouse and Global Positioning Systems sell Ram products in the UK.

GPS Warehouse have a special Ram mount site at <http://www.ram-mount-uk.com/>.

The following may be useful to help you sort out the huge variety of Ram Mounts. On the web site you'll see that these mounts comprise a universal clamp that tightens on a hard rubber ball at each end. One ball end is fixed to the car and the other fixed to the GPS. I have not used the system under rally conditions in the desert but the brackets are well made. The metal bits are good and strong and the rubber ball parts are properly engineered to do the job.

There is a suction Ram mount for fitting to glass. This does hold on well but would probably vibrate too much for rally use and might come off at high temperatures.

To make up a suitable Ram mount to fit your GPS you need the basic clamp and ball assembly plus a holding bracket for your particular GPS.

A clamp assembly with a flat base for bolting through a dash or instrument panel is RAM-B-138. A similar clamp assembly but with a base suitable for clamping to a tube such as a front roll cage pillar is RAM-B-108U-GP1

To hold your GPS you'll need RAM-HOL-GA2 for Garmin III+ or G-V.

See holder and clamps for G-III & G-V at <http://www.ram-mount-uk.com/ram-hol-ga2.htm>

or

RAM-HOL-GA7 is the holder for a Garmin-176 .

See holder and clamps for G-176 at <http://www.ram-mount-uk.com/ram-hol-ga7.htm>

If the flat plate or tube clamp base is not suitable for your needs you may find a ball with a single stud fixing more suitable.

A couple of single-bolt fixing ball ends are RAM-B-237 or RAM-B-273

See alternative ball mounts at <http://www.ram-mount-uk.com/handlebar-mounts.htm>

Ram also do a quick release fitting that I suspect would need two parts RAP-271ST and RAP-272 fitted between the universal clamp and the GPS holding bracket.

IMPORTANT – I have not used all these bits so please satisfy yourself that any chosen solution is what you need before spending your money.