ap*MK12 Navigation System*

Operation & Installation Manual

ap *MK12 Operator's Manual*

MK12 Navigation System

MK12 GPS

MK12 DGPS

Product Information

The model and serial number of your instrument are given on the instrument. Enter the model and serial number in the spaces provided below. Always refer to this information when you contact your dealer.

MK12 CDU Serial No.:_____

MX421 GPS Antenna S/N: _____

Doc. P/N 726226 July, 2001

Symbols Used In This Manual

Danger

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

Warning

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

Caution

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury and/or appreciable material, financial and environmental damage. This symbol is also used to alert against unsafe practices.

Important paragraphs which must be adhered to in practice, as they enable the product to be used in a technically correct and efficient manner.

This manual contains important safety directions as well as instructions for setting up the instrument and operating it. Read carefully through the *Operator's Manual*, *Options Manual*, and *Installation & Service Manual* before you switch on the instrument.

Scope Of This Manual

This manual reflects the software capabilities in version 1.5 software.

We have attempted to take care and develop manuals which provide in-depth information. Where possible, we have attempted not only to describe what you see on the screen, but how to understand and use it as well. Obviously, we can't teach you how to navigate, but we can help make your work more thorough and enjoyable. Throughout the manual, you will find helpful hints about the interaction of various functions. In a piece of equipment that has the many capabilities of this receiver, important details can sometimes become obscured in one or two lines of text. In our effort to ensure you get the most out of this documentation, and to protect against important details becoming lost, don't be surprised if you see the same or similar information more than once.

This manual is organized by describing the special front panel features first. The sections that follow detail each primary function as it is presented on the front panel (i.e. NAV, RTE, WPT, PLOT, ...CFG). The appedixes describe important details about special functions.

Appendix F talks about the installation and wiring interface between the MK12 and the MX421 antenna.

We hope you find the manual enjoyable and informative reading. As always, we welcome your comments on improving our products or manuals. We wouldn't mind if you wrote to tell us that we did the job right the first time either. You can find a Reader Comment Card at the back of the manual.

Related Documents

MK12 Operator's Quick Guide (726227)

How To Contact Us

For Installation, Service and Technical Support:

Contact your local Leica dealer

For Sales of Accessories:

Contact your local Leica dealer

For Hardware and Software Upgrades:

Contact your local Leica dealer

Unlike many other consumer electronics industries that only sell consumer electronic devices, your marine dealer is often your best advisor for installation and service of your new GPS receiver. Leica strongly encourages you to utilize the knowledge and experience of your sales and service dealer.

Should you need to contact us directly, we can be reached at the following for new sales, upgrades, repair service, or technical support:

International:

Leica Geosystems
GPS
23868 Hawthorne Blvd.
Torrance, California 90505
USA

+01-310-791-5300 Telephone (International)
1-800-97-LEICA (1-800-975-3422) Telephone (USA)
+01-310-791-6108 Fax
support@leica-gps.com

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About GPS Navigation

This GPS receiver is a precision navigation instrument utilizing the latest technology available today to provide optimum performance from the GPS satellite and Beacon land signals received. As with all other forms of radio signals, the ultimate navigation result is dependent upon the quality of these signals. Radio signals may, on occasion, be distorted, jammed, or otherwise incorrect. As a result, your position accuracy may occasionally be less than that which can normally be expected.

The Navstar Global Positioning System, commonly referred to as GPS, is a satellite navigation system developed by the U.S. Department of Defense to provide both military and civilian users with highly accurate, worldwide, three dimensional navigation and time. By receiving signals from orbiting GPS satellites, authorized users are able to continuously navigate with an accuracy on the order of 16 meters or better, while civilian users are limited to accuracy's of approximately 30 meters 2D RMS.

A technique referred to as Differential GPS (DGPS), allows users to obtain maximum accuracy from the GPS system. DGPS requires the use of two GPS receivers. One receiver, known as the *Reference Station*, is placed at a surveyed location, the coordinates of which are precisely known. The purpose of the differential GPS system is to use the reference station to measure the errors in the GPS signals and to compute corrections to remove the errors. The corrections are then communicated in real-time to the navigators, where they are combined with the satellite signals received by the navigators, thereby improving their navigation or positioning. The geographic validity of these corrections decreases with distance from the reference station, but the corrections are valid for navigators hundreds of kilometers from the reference station.

Marine radio beacons operating in the 283.5 to 325.0 KHz frequency range are in widespread use for direction finding in coastal navigation. Because the beacon system has been in place and widely used for many years, it provides an effective means for the transmission of DGPS signals. Depending on their local environment and power output, their signals may be usable to several hundred miles. Marine beacons provide an economical means of obtaining DGPS accuracy for coastal navigators. GPS receivers with built-in beacon receivers are designed to provide low cost reception of DGPS corrections broadcast (normally free of charge) by coastal authorities.

Special Notes

GPS

Never rely solely on any single navigational aid. Always use whatever information is available, and cross-check information when possible. GPS expected position accuracy is better than 30 meters (95% of the time) but may be up to 100 meters occasionally. The derived speed and course readings may be hampered accordingly. The GPS system was declared operational in 1994; however, the system's availability and accuracy are subject to change at the discretion of the US Department of Defense.

DGPS

This GPS receiver's position accuracy is improved to 5 meters or better for 95% of the time, subject to the availability, accuracy, and control of the DGPS correction transmission from the Beacon Station, or other reference station connected at the time of usage.

The differential GPS position is that of the navigator GPS antenna, and not that of the beacon antenna, if a separate beacon antenna is in use. In addition, the beacon radio signal which carries the DGPS corrections may be hampered by weather conditions such as heavy rain, snow, and thunder storms. The beacon radio signal may also be interrupted by powerful radio transmitters operating in long wavelength bands.

Charts and Navigational Aids

Positions obtained from charts are not always as accurate as your navigator (due to environmental changes, the dates of charts, and datum offsets if the datum differs from the one in use by the navigator). The position of a floating aid can differ due to tide, set and drift.

Functional Description

MK12 Configurations

The MK12 Navigation System is available in two basic configurations. Described below are the MK12 configurations and their differences.

MK12 GPS

This is a basic MK12 Control and Display Unit (CDU) model with two (2) bidirectional user NMEA ports. This model is supplied with an MX421 GPS only smart antenna. The MX421 antenna can achieve autonomous GPS accuracy better than 3 meters.

MK12 DGPS

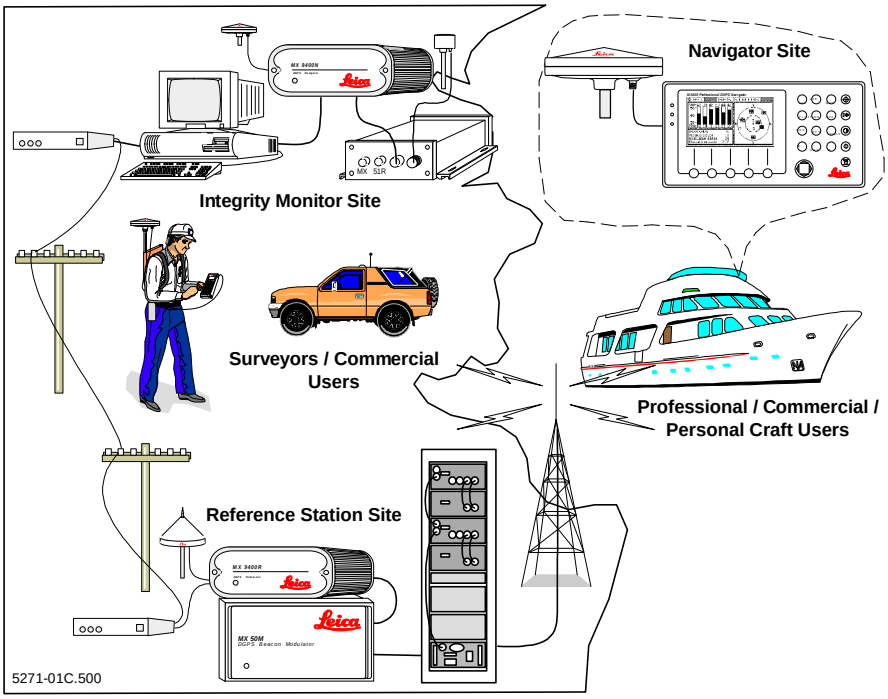
This is a basic MK12 CDU supplied with a combined GPS and Beacon smart antenna (MX421B). The MX421B DGPS unit can achieve sub-meter accuracy in areas with good beacon differential coverage.

Note: In general, this manual will refer to all versions of this product line simply as the MK12 CDU, CDU or navigator. Where distinction between models is necessary, the particular model type will be indicated.

DGPS Beacon System

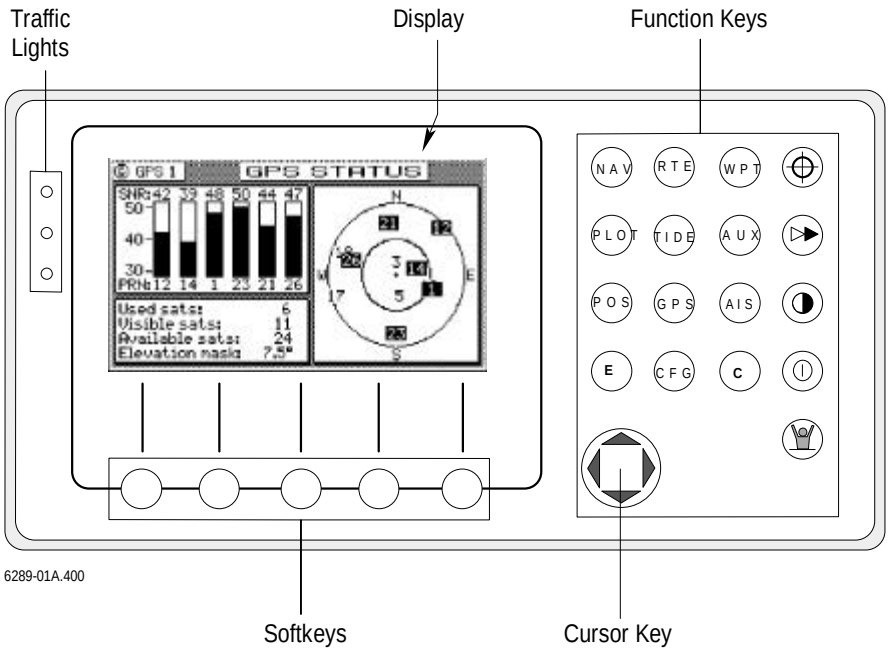
As Maritime Safety Administrations, Navy, and Coast Guard Organizations realize the limitations of standard GPS positioning, many have begun installing DGPS Beacon Stations. While an understanding of this system is not necessary for operating receivers with internal beacon receivers, you may want to read on to have a better understanding of how your receiver is capable of achieving the high levels of accuracy made possible by this network of transmitters.

The DGPS Beacon System is comprised of three segments: the reference station, Integrity Monitor (IM) equipment located at the beacon site, and the Navigator equipment located on board the user's boat or vehicle. The DGPS beacon system design is illustrated below.



Because of the limited range of the beacon transmitters, typically 150 to 400 km, the corrections generated by the reference station are always valid for users who can receive the correction signals and maintain a 5 meter or better accuracy figure.

Keypad & Display Description

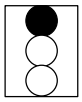


Refer to the illustration above. The **Traffic Lights** on the left side of the display will tell you how your navigator is operating.

Note: You need to take care in reading the traffic light indications, as there are overlapping possibilities between the GPS and DGPS modes. If you are unsure of the current operating mode, select the CFG function key and scroll down to the DGPS selection. If the DGPS mode is selected to anything other than Off, then follow the Differential GPS Traffic Light Operation. If the DGPS mode is selected to Off, then follow the GPS Traffic Light Operation.

Differential GPS Traffic Light Operation:

Red Flashing



Not tracking satellites (no position update). This is normal for the first 2 minutes or so when turning the unit on. The very first time you turn the unit on, or if the memory is reset or lost, this condition is also normal. Allow the receiver to run for at least 30 minutes under these circumstances. If it still does not change to Red Solid, refer to the troubleshooting section of the *Installation & Service Manual*. An icon similar to the one at left will be displayed in the upper left corner of screen.

Red/Yellow Solid

Dead Reckoning . When normal GPS or DGPS operation is not available, this LED sequence is provided to quickly identify the DR navigation mode. A DR indicator is also displayed on all screens.

Red Solid

Tracking one or more satellites (no position update). This is also normal for the first 2 minutes or so when turning the unit on. The very first time you turn the unit on, allow the receiver to run for at least 20 minutes after changing to Red Solid to collect an almanac from the satellites, regardless of whether a position update has been calculated or not. This is also a normal indication if the HDOP is greater than 10, if the receiver is tracking too few satellites, or for other reasons as well. Read the **GPS** and **DGPS** function screens for more information.

Yellow/Green Solid

GPS position update; DGPS corrections are not being received. You may see this from time to time during normal operation. It usually occurs when the beacon signal is not available (either it is being blocked by terrain or a local object or you are out of range of the transmitter) and/or you are tracking 3, 4, or 5 satellites, and the satellites have poor geometry relative to your position. The condition will normally go back to green solid, when it picks up another beacon station. The factory default level for dropping DGPS corrections is 60 seconds. During this period, your positioning information is less than optimal, and position accuracy may be off by as much as 3 to 5 meters. Press the GPS function key and refer to the *DGPS* section in this manual for guidance if this light condition occurs.

Yellow Solid

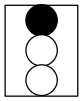
DGPS position update with poor HDOP value. You may see this from time to time during normal operation. It usually occurs when you are tracking 3, 4, or 5 satellites, and the satellites have poor geometry relative to your position. The condition will normally go back to Green Solid when it picks up another satellite or the geometry of the existing satellites improves. The factory default level for this indication is with an HDOP of 4 to 10. During this period, your positioning information is less than optimal, and position accuracy may be off by as much as 5 to 10 meters. You can press the **GPS** function key and refer to the *GPS* section in this manual for guidance if this light condition occurs.

Green Solid

DGPS position update with HDOP value less than 4. This is the normal operating condition. Position accuracy is normally better than 3 meters. Keep in mind that position accuracy is always only as good as the corrections received, their age, your distance from the reference station, and the geometry of the satellites. This is the normal operating condition and no icon will be displayed.

GPS Traffic Light Operation:

Red Flashing



Not tracking satellites (no position update). This is normal for the first 2 minutes or so when turning the unit on. The very first time you turn the unit on, or if the memory is reset or lost, this condition is also normal. Allow the receiver to run for at least 30 minutes under these circumstances. If it still does not change to Red Solid, refer to the troubleshooting section of the *Installation & Service Manual*. An icon similar to the one at left will be displayed in the upper left corner of the screen.

Red/Yellow Solid

Dead Reckoning . When normal GPS or DGPS operation is not available, this LED sequence is provided to quickly identify the DR navigation mode. A DR indicator is also displayed on all screens in the upper left hand corner of the display.

Red Solid

Tracking one or more satellites (no position update). This is also normal for the first 2 minutes or so when turning the unit on. The very first time you turn the unit on, allow the receiver to run for at least 20

minutes after changing to Red Solid to collect an almanac from the satellites, regardless of whether a position update has been calculated or not. This is also a normal indication if the HDOP is greater than 10. The HDOP value can be read in the **GPS** function screens.

Yellow Solid

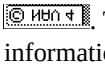
GPS position update has a poor HDOP value. You may see this from time to time during normal operation. It usually occurs when you are tracking 3, 4, or 5 satellites, and the satellites have poor geometry relative to your position. If you are patient, the condition will normally go back to Green Solid when you pick up another satellite or the geometry of the existing satellites improves. The factory default level for this indication is with an HDOP of 4 to 10. During this period, your positioning information is less than optimal, and position accuracy may be off by as much as 10 to 30 meters. You can press the **GPS** function key and refer to the *GPS* section in this manual for guidance if this light condition occurs.

Green Solid

GPS position update with HDOP value less than 4. This is the normal operating condition. Position accuracy is normally between 3 to 5 meters, but can be out as much as 30 meters. Keep in mind that position accuracy is always only as good as the geometry of the satellites and the navigation information provided by the satellites. This is the normal operating condition and no icon will be displayed.

The Display:

The CDU uses a *Transflective LCD* display screen. It provides optimum viewing in virtually all lighting conditions. To change the display contrast or backlight condition, select the **CFG** function key and scroll down to the *Lighting* menu choice. Refer to the **CFG** section of the manual for a complete description of menu options. The function key (◑) just above the Power On/Off key allows you to quickly change between daytime and night time screen settings.

Information displayed on the screen is normally divided into windows, similar to what you might see on a normal computer. Each screen has a page number in the upper left hand corner  . These page numbers are there to help you quickly find the information you need, and to help us guide you on the rare occasion that you might request our assistance.

With the exception of a portion of the **PLOT** and **MOB** screens which use two softkeys to change the view scale, all of the screens require that you press the **E** (Edit Mode) function key before you are allowed to change data on the screen. You can use the cursor key (the big key with the arrows pointing in four directions) to move between edit fields or menu choices on most screens when in the edit mode. When you are not in the edit mode, you can use the cursor to scroll between screens (i.e. NAV1, NAV2, NAV3, ...) or to move up and down on screens (like the menu bar in the **CFG** screen).

The Softkeys:

The five softkeys under the display are so named because their purpose changes from one menu or screen to the next. With the exception of a portion of the **PLOT** screens and the **MOB** screens, all of the screens require that you press the **E** (Edit Mode) function key before the softkeys can be accessed. Don't forget to press the **E** function key when you have finished editing a screen.

The Function Keys:

The Function Keys are the keys to the right of the display. There are 18 function keys in all. Eleven of the function keys access various screen and editing displays. Three of these keys are used for editing or moving within the screens. One key is used to mark your present position, another is used strictly for Man Over Board alarms. One switches between two display lighting options, and finally there is the power on/off key.

The ten function keys with alpha abbreviations on them are described in the ensuing chapters. The eight function keys with symbols are described below.

The function keys are also used in the edit mode to enter alphanumeric information into screen data fields.

Mark Position

This function key stores your present position, date and time at the next available waypoint location in the Waypoint Bank. A window pops up on the screen to confirm your key depression, and to tell you where the mark position is being stored. You can go into the **WPT** menu and edit the coordinates or description later.

GOTO

This function key allows you to quickly create a route from your present position to one other waypoint. This single waypoint route can use an existing waypoint from the Waypoint Bank, or you can quickly create one by either defining the appropriate coordinates or specifying a range and bearing.

Be careful when you use this selection, as it will erase your current active route when it creates the new one. Read through the *ROUTE* and *PLOT* sections of this manual to find other ways to use this key within an active route.

LIGHT

This function key allows you to quickly switch between two predetermined display lighting conditions. You can have two daytime settings, two night time settings, or a daytime/night time setting. Select the **CFG** function key and scroll down to the *Lighting* menu choice to make the desired adjustments. Refer to the *Configuration* section of the manual for a complete description of the *Lighting* menu options.

POWER ON/OFF

This function key turns the unit on and off. When depressed while the unit is on, you will be prompted to select a *YES* or *NO* softkey to confirm your action. This is known as a *software power off*.

If the operating program should hang up for any reason, you can also perform a *hardware power off* by continuing to depress the power on/off function key for about 5 seconds. When the GPS is turned off using this technique, you can not reapply power for 10 seconds.

Note: An occasion may arise when you need to reset the memory back to the factory default values. Doing this will cause the CDU to lose all of your defined settings, as well as all 2,000 of your waypoints and routes. If you hold down the fifth (right most) softkey when power is applied for about two seconds, until you hear a key click, then the memory will be reset.

MAN OVER BOARD (MOB)

This dedicated function key is located at the bottom right hand corner of the front panel. When depressed for a few seconds, it activates a number of automatic functions:

- Most obviously, it brings up an **MOB1** (Plot) screen. This is an automatic scaling screen which selects the best zoom level to display your present position and the MOB position. In addition, the MOB position is displayed in the upper left corner, so that you can quickly read the coordinates to others who may be available to render assistance. This plot screen also provides the vital bearing and distance back to the MOB position, as well as your present course over ground.
- The MOB position, date and time are stored in the Waypoint Bank for future reference (e.g. log book entries).
- Navigation data output on the NMEA ports (i.e. BWC and BWR), are changed to reflect the current crisis situation. This way, other interfaced equipment can also help guide you back to the MOB position. When the MOB condition is canceled via a MOB screen softkey, the NMEA sentences will automatically revert to the active route information. *Don't forget to cancel the MOB so your interfaced equipment will read the correct data!*

- The MOB function key and remote MOB input are disabled from subsequent activation, until the *MOB Cancel* softkey is selected.
- Other functions such as Position and Navigate can still be accessed; however, the screen will revert to the MOB Plot screen after 30 seconds. Bearing and distance information in these other screens relate to the MOB position, not the next waypoint in the active route, until MOB is canceled.

To cancel a MOB condition, make sure you are in the MOB Plot screen. Press the **E** function key, then select the *Cancel MOB* softkey.

E (EDIT)

This function key activates or deactivates the softkeys and edit fields within any screen where editing is appropriate. You will quickly learn that this is an important operating feature in the unit. Press the **E** key when you want to start editing a screen and again when you have

finished editing. If after editing you press a function key and nothing seems to happen, check to make sure you didn't accidentally alter your information and press the **E** key to end editing. Most edit screens provides an *Escape* softkey. If you decide for some reason that you don't want to use the changes you have made, pressing the *Escape* softkey will restore the original information. However, once you press the **E** key, all changes are accepted and the original data is lost.

C (CLEAR)

This function key is probably the least used of all the function keys; however, it can save you some otherwise frustrating editing time. This key allows you to erase or clear one character at a time. If you hold it down, it will erase the entire line that the cursor is currently on.

CURSOR

This function key is the most used of all the function keys. As its name suggests, this key is used to move between edit fields. It also allows you to move between function screen pages (by pressing left or right). In addition, many of the edit fields allow you to use either the cursor key or the *Change* softkey to scroll through or select from predetermined choices.

FUNCTION

You might have noticed that above and below each primary function key there are numbers and letters. These numbers and letters are used when you are in the edit mode. You will find that they are most often used in the **RTE**, **WPT**, and **CFG** screens, but they are used in other screens as well. If you are trying to enter text, simply locate the desired letter and press the appropriate key repeatedly until the appropriate letter or number appears. If you accidentally go past the desired letter, repeat pressing the key and the letter will come up again. You can toggle between upper and lower case characters by pressing the key for a long period.

You will also find that some screens allow you to input symbols into the text fields. These symbols are selected through a softkey selection where symbols are allowed. *Don't forget to press the 'E' key to get out of the edit mode!*

Another helpful feature on this CDU is that successive depressions on the function key (when not in the edit mode) allow you to page through all of the screens available for that particular function. You can accomplish the same thing by selecting a function and using the left and right arrows on the cursor key (which is sometimes faster). Whichever method you choose, it is impossible to get lost between function screens. In addition, the software remembers which screen you used last for each function. Each time you reenter a function (e.g. you go from **PLOT** to **NAV**), you will enter the last screen you viewed for that function. You can change this setting in the **CFG 1** *Operation*.

Use the associated function key to access the international character desired (i.e. *A* for *Æ*). The international characters supported are:

ABC = Ä, Å, Æ, À, Ç

DEF = É, È

GHI = Í

MNO = Ñ, Ó, Ö

STU = Ú, Ü

Use the **CFG** key when in the edit mode to cycle through these other optional characters.

‘ “ $ & ! ( ) ? / + - ° . , :

Note: The AIS key is not functional in the MK12 model. When this key is pressed the message “AIS Not Available on this Version” will be displayed.

Navigate

There are four basic **NAV** screens. **NAV4** only provides data if appropriate sensors (e.g. wind speed/direction logs, NMEA compass, etc.) are interfaced and activated on the CDU. The **NAV** functions are highly interactive with the **RTE1** screen, and a number of **CFG** menu selections.

The **RTE1** screen provides the active route for the **NAV** screens. It also maintains a waypoint pass log for you. One other important feature in the **RTE1** screen that you need to be aware of is that the *up* and *down* arrow softkeys control which waypoints are skipped (down arrow) and which are restored (up arrow) for your current route. The ETA information is configured in the RTE 1 screen. Refer to the *Route* section of the manual for a full description.

The following **CFG** menus directly impact the **NAV** functions:

- COG SOG - sets the filtering time for the displayed values.
- Datum - sets the reference datum for your present position and waypoints in the active route.
- GPS Offset - sets an offset for calculating the GPS antenna position if you can't physically locate the antenna exactly where you want it (e.g. over the centerline of the boat).
- Navigation - sets a variety of important functions and alarms
    - ⇨ Rhumb line or Great Circle navigation
    - ⇨ Range units: nautical miles, nautical miles and meters (when under 1000 meters), nautical miles and feet (when under 1000 feet), statute miles, statute miles and meters (when under 1000 meters), statute miles and feet (when under 1000 feet), kilometers, or kilometers and meters (when under 1000 meters)
    - ⇨ Cross-track error limit and alarm control
    - ⇨ Waypoint pass criterion and distance: bisector line, perpendicular line, complex (combination of bisector line and perpendicular line), distance to waypoint, or manual
    - ⇨ Waypoint Approach distance
    - ⇨ Autopilot alarm control
- Position - sets 2D or 3D mode, antenna height, Lat/Lon, Loran or

UTM, and some alarm limits. There is an optional software package available to setup a user grid as well. The option is explained in the *Position*, and *CFG Position* sections of this manual.

- Time - sets appropriate offsets, and 12 or 24 hour clock mode.
- Various NMEA input controls for sensors (i.e. speed log, wind instruments, etc).

You have probably already figured out that you will need to pay close attention to the configuration screens. The good news is that you should only have to setup one time. Keep in mind, though, that you may need to revisit these and other configuration screens from time to time to get the CDU to do exactly what you want it to.

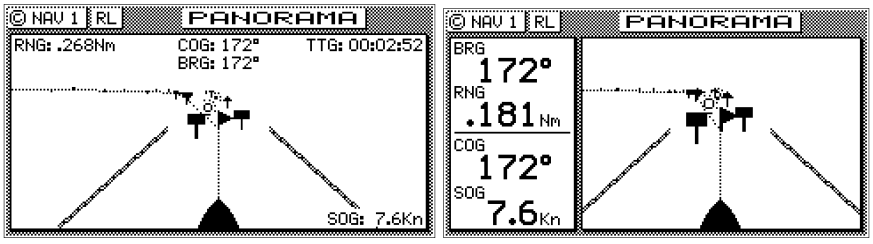
Dead Reckoning

The MK12 CDU is capable of Dead Reckoning (DR) calculation when appropriate compass/heading and speed log sensors are connected and activated. Refer to the *NAV4* and *CFG* sections of this document.

When the CDU is in the DR mode a DR icon is displayed in the upper left portion of the screen.

NAV1 - The Panorama Screen

This screen is designed to give you a unique 3 dimensional look at the active route you are to follow. It is typically referred to as a *runway view* because you can see navigation markers, your course line, the cross-track error lines, and waypoint flags as you pass them. Take a look at the example below.



If you don't see the information described below on your screen, you will need to create a route in **RTE1** first.

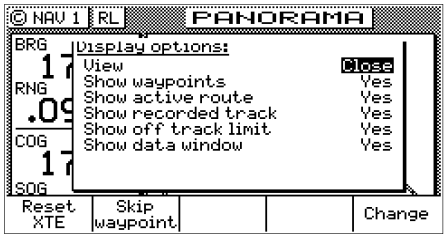
The somewhat triangular shape at the bottom center of the screen represents the bow of the boat. Icons on the screen are always related

to this object. The two dash lines extending from the bottom of the screen towards the center of the screen represent your cross-track error limits. The dotted line extending from the bow of the boat icon represents your course line. The course line changes direction at the flags, which represent your waypoints, and continues through to the end of the active route you entered in **RTE1**. Notice that the cross-track error lines end at the first flag. As you pass the flag and start the next leg of your course, these lines will be redrawn to reflect the course change. Icons that you see left and right of your course are navigation markers that you define in the Waypoint Bank (**WPT1**) where a symbol is used as the first character of the waypoint description. The Panorama and Plot screens will automatically place these navigation markers on the screen as you approach them.

The degree values that you see are your Course Over Ground (COG), as calculated by the GPS receiver's position fix to position fix, and Bearing (BRG) from your present position to the waypoint. The speed value is your Speed Over Ground (SOG) as calculated by the GPS. The distance value displayed as the Range (RNG) is calculated from your present position to the waypoint. The Time-To-Go (TTG) is the calculated time it will take you to reach the waypoint, based on your Waypoint Closure Velocity (see **NAV4** description).

To keep the screen from jumping around when you are stopped, the screen freezes the graphic representation when your speed is under 0.5 Kn in DGPS mode or 2.0 Kn in GPS mode. Once you get underway, your course details will update appropriately.

You will see a *RL* or *GC* symbol in the upper right corner of the display indicating whether you are navigating under Rhumb Line or Great Circle. This is set in the **CFG** *Navigate* menu.



If you press the **E** key, the Panorama Display Option screen will allow you to customize the information presented.

- *View* - allows you to adjust the display for a *Close* (zoomed-in) or a *Far* (zoomed-out) representation of your route.
- *Show Waypoints* - allows you to turn waypoints which are not part of the active route on and off.
- *Show Active Route* - allows you to turn the course line on or off on the display (assuming a symbol is entered for the first character of the waypoint name).
- *Show Off Track Limit* - allows you to turn the cross-track error limit lines on or off on the display.
- *Show Data Window* - allows you to select between the two NAV 1 display types depicted at the beginning of this section, one in which the data is displayed in various parts of the graphic screen, the other in which the data is displayed in a separate window to the left of the graphic screen.

If you drift outside of your cross-track error limit and you decide not to return to your original course line, you can reset your course line from your present position to the waypoint by selecting *Reset XTE* from the display.

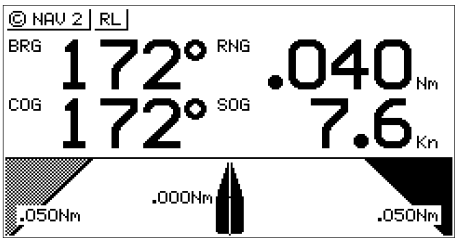
The *Skip Waypoint* softkey allows you to skip the waypoint you are presently going to, and advance to the next waypoint. For example, if you were under way and nearing waypoint 5 and you decide you want to go on to waypoint 6 now, press *Skip Waypoint*. If you make a mistake and you want to go back (unskip) to waypoint 5, you can do this by the following:

1. Go into the **RTE1** screen.
2. Press **E** in the **RTE1** screen.
3. Select the *Route Control* softkey.
4. Press the up arrow softkey (fourth from the left) once.
5. Press the **E** key again.

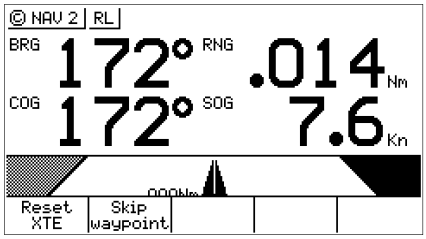
Refer to the *Route* section of this manual for more details about skipping and unskipping waypoints.

NAV2 - Basic Steering Information

Navigate screen 2 provides the bearing (BRG) and range (RNG) to the waypoint you are approaching in large easily viewed characters. Below these, you will see your actual Course Over Ground (COG) and Speed Over Ground (SOG). The bottom portion of the screen provides cross-track error information. Again, if you don't see the information described here on your screen, you will need to create a route in **RTE1** first (refer to the *Route* section of the manual).



In the bottom half of the window, the vertical line in the center represents your course line. The checkered area on the left and right side of this area represents the out of bounds or beyond the cross-track error limit area. Whenever the boat is left or right of the course line, the corresponding checkered area changes to solid black, indicating the side of the course line that you are on. The number next to the course line is your calculated cross-track error. The numbers in the lower left and right hand corners indicate the cross-track limit you set in the **CFG1** menu under *Navigation*. You will notice that the cross-track error limit lines are slanted, just as they were in the Panorama screen. So if the boat is off to the right of the course, and the bow is pointing straight up, you are actually traveling away from the course line. Keep the bow pointed toward the top of the course line, and you should be able to maintain your course without a lot of drift. The BRG and COG values will confirm this for you, when executed properly.



From time to time, you might drift off course and decide not to return to your original course line. If you drift outside of your cross-track error limit, you can reset your course line from your present position to the waypoint by pressing the **E** key and selecting *Reset XTE* from the display. This will save your autopilot from having to work hard to get you back on course. Press the **E** key again to get back into normal display mode.

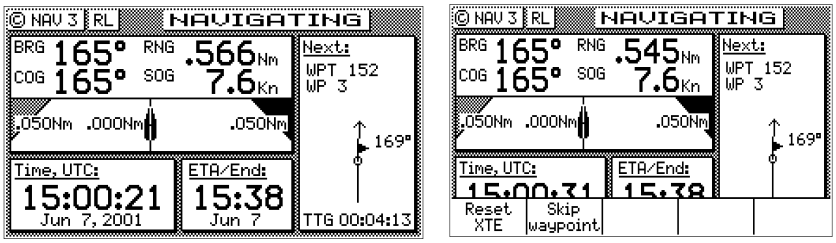
In addition, if you decide you want to skip this waypoint, and go on to the next one, Press the **E** key, and the *Skip Waypoint* softkey one time. Press the **E** key to end this procedure. If you skip one waypoint manually, and the CDU starts skipping more waypoints by itself, you probably need to change your *Waypoint Pass Criteria* in the **CFG1** *Navigate* menu. Refer to the *Route* section of this manual for more details about skipping waypoints.

Just as in NAV1, you will see an *RL* or *GC* symbol in the upper right corner of the display indicating whether you are navigating under Rhumb Line or Great Circle. This is set in the **CFG1** *Navigate* menu.

NAV 3 - Expanded Navigation Information

Navigate screen 3 has four windows. The upper left window is a smaller version of **NAV2**. Please read the previous section for a detailed description of this window. The two windows below this one indicate the current date, time and the ETA to the end of your route for the time zone currently entered. The date and time format is set in the **CFG1** *Time* menu. The ETA and TTG (in the right hand window) are filtered over time, so allow the filtering to settle when you first make a course or speed change. The filter time is controlled in the *RTE1 ETA Setup* screen. The Time-To-Go (TTG) value on the bottom of the right hand window expands from HH:MM:SS to HHHH:MM:SS when the

time to go is greater than 99:59:59. Also, these values are calculated by using your Waypoint Closure Velocity (WCV), not your SOG. WCV is described in short detail in the *NAV4* section which follows.



You will find the right hand window to be a helpful tool. In addition to identifying the waypoint you are currently approaching, it identifies the waypoint at the end of the next leg. The really unique feature of this screen is the graphical representation of your actual course line approach angle relative to the next leg of your course. This approach angle is continuously updated in real time and will help you setup for course changes.

Reset XTE and *Skip Waypoint*, described at the end of **NAV2,** is also available in **NAV3**.

NAV4 - Sensor Input Navigation

The *NAV 4* screen applies the wind instruments, speed log, compass, and depth sounder inputs from external sensors to your active route, as appropriate. You can setup the sensors in the **CFG1** screen. The *Installation & Service Manual* will guide you through the interfacing capabilities of the CDU.

Use the following **CFG1** menus to set this screen up:

Compass - Sets the input port number, compass type (true or magnetic), compass deviation table, and the input NMEA 0183 record from which to derive the compass information. The NMEA 0183 record should be specified by the user, because several NMEA 0183 records may contain compass information. This provides you the capability of knowing the compass source exactly. The CDU only accepts NMEA 0183 formatted data for the compass input. Synchro or stepper gyro compasses are not compatible.

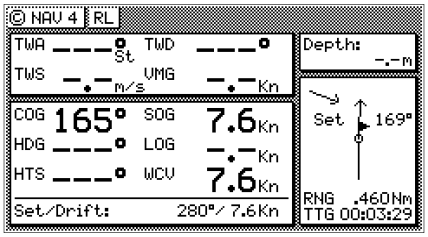
Depth - Sets the input port number, units of measure for depths and

tide data, sensor offset, alarms, and the input NMEA 0183 record from which to derive the depth information. The NMEA 0183 record should be specified by the user, because several NMEA 0183 records may contain depth information. This provides you the capability of knowing the depth source exactly.

Log - Sets the input port number, sensor type (pulse or NMEA 0183), sensor offset, alarms, and a correction factor (if needed).

Set & Drift - Sets the mode to manual or automatic (derived from GPS). Sets the time-out before applying calculated values. GPS calculated values are used prior to the time-out period.

Wind - Sets the input port number, units of measure, sensor offset, alarms, and the input NMEA 0183 record from which to derive the wind information. The NMEA 0183 record should be specified by the user, because several NMEA 0183 records may contain wind information. This provides you the capability of knowing the wind source exactly.

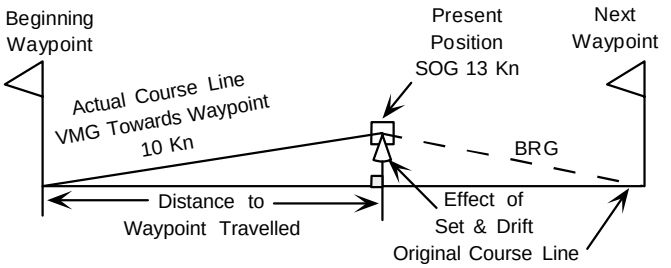


This screen is divided into four windows. The window on the top left provides details relating to the *True Wind Angle* (TWA), *True Wind Speed* (TWS) and *True Wind Direction* (TWD), which are taken from the NMEA 0183 record of MWV or VWR. If the wind information is given in relative terms, the CDU calculates true values using available GPS course and speed information to make the necessary adjustments. Refer to the *Glossary* for definitions on Apparent/True Wind Angle/ Speed/Direction. To the right of the wind information is your *Velocity Made Good* (VMG) towards the waypoint. The VMG data is filtered to show the average speed from the last waypoint to your present position towards the next waypoint. VMG is calculated from GPS data. The CDU will also use the above data to calculate your speed parallel to wind and can output the VPW NMEA 0183 data sentence to other on-board instruments.

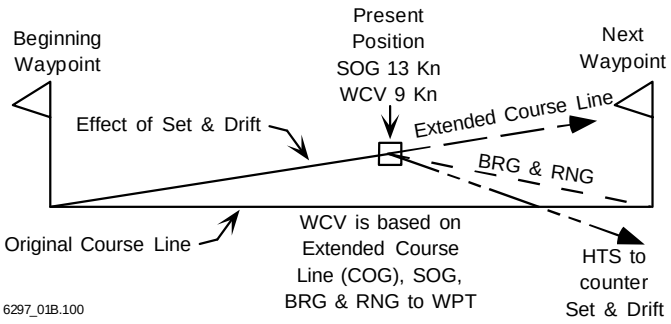
The window below the wind data provides information relating to your course and speed. You will find the *Course Over Ground* (COG calculated by the MX421 smart GPS antenna), *Heading* (HDG, your NMEA 0183 compass input), *and Heading To Steer* (HTS) data on the left side of the window. HTS data is calculated by considering your Heading, minus COG and adding BRG to the waypoint. In doing so, the software considers any Set to be included in the HDG value. If there is no Set, your HDG should be equal to COG. Set and Drift is calculated from GPS and your Speed Log (NMEA 0183 VHW record or Pulse input) and Compass (NMEA 0183 HDM, HDT, or VHW) input or an operator manual input.

On the right side of the lower left window you will find the *Speed Over Ground* (SOG, calculated by MX421 smart GPS antenna), *Speed Log* (LOG, the NMEA 0183 or pulse speed input), and the *Waypoint Closure Velocity* (WCV). WCV reflects the real time velocity from your present position and course towards the next waypoint. The VMG and WCV are calculated from GPS data. Refer to the diagram below to see a graphical representation between VMG and WCV.

Velocity Made Good:



Waypoint Closure Velocity:



Below this information, you will find your Set and Drift data, which is calculated using GPS and your compass and speed sensor inputs.

Reset XTE and Skip Waypoint, described at the end of **NAV2**, is also available in **NAV4**.

The window on the right displays depth information coming from the depth sounder unit using the NMEA 0183 record of DPT, DBS, DBT, or DBK. These are setup in the **CFG1** *Depth* screen, refer to the *Configuration* section of the manual and the *Installation & Service Manual* for full details on depth data.

Below the depth data you will find the next route leg vector, the *Range* to the waypoint and *Time To Go* data, explained in the **NAV3** section.

Route

There are two **RTE** screens. The **NAV** functions are highly interactive with the **RTE1** screen. The **RTE2** screen allows you to create a pool of predetermined routes that you might use often, so you need only create the route one time. Routes are created from waypoints. All waypoints are stored in the Waypoint Bank, regardless of which function is used to create them. Waypoints are either created in the Waypoint Bank (**WPT1**), created by the **GOTO** function, selected from the **PLOT** screens in conjunction with the **GOTO** function, or from New Waypoints that can be defined in the *Route Insert* menu (and simultaneously stored in the route and the Waypoint Bank).

We recognize the diverse needs of professional users. We have designed the route features to be very flexible to meet a wide range of users' requirements by allowing up to 2000 waypoints to be stored between all of the routes. You can create up to 100 routes, with any number of waypoints, providing the maximum number of 2000 waypoints between all routes is not exceeded.

The Route (**RTE**) function serves two purposes:

1. The *RTE1* screen provides all of the current, or active waypoint navigation data to the *Navigate* and *Plot* screens and is referred to as the *Active Route*. Therefore, whenever you begin a new trip or voyage, you should erase the previous voyage's waypoints in this screen, then insert the new waypoints or routes (from *RTE2*) for the new voyage. If you want to store the waypoints from the previous active route for future use, you can copy these waypoints in the order in which they were entered to the *Route Bank* in the *RTE2* screen. This is described in the *RTE2 - The Route Bank* section of this manual. If you do not clear the *RTE1* screen (refer to *Erasing an Existing Route* section of this manual), the *RTE1* screen will grow each time you add new waypoints to the route. The route function can hold a maximum of 2,000 waypoints between the routes stored in *RTE1* and *RTE2*.

2. The *RTE2* screen provides storage space for up to 100 user defined routes. You can pre-define routes, or copy new routes from the *RTE1* (active route) screen. Later you can choose individual routes or link two or more routes in the *RTE1* screen (refer to *Creating a Multi-Waypoint Active Route* section of this manual). When you are finished using the copied route in *RTE1*, you can erase the route from the *RTE1* screen and the original stored route will re-

main intact in the *RTE2* screen.

The following **CFG1** menus directly impact the **RTE** functions:

- Navigation - sets a variety of important functions and alarms.
  - ⇨ Rhumb line or Great Circle navigation
  - ⇨ Range units: nautical miles, nautical miles and meters (when under 1,000 meters), nautical miles and feet (when under 1,000 feet), statute miles, statute miles and meters (when under 1,000 meters), statute miles and feet (when under 1,000 feet), kilometers, or kilometers and meters (when under 1,000 meters)
  - ⇨ Waypoint pass criterion and distance: bisector line, perpendicular line, complex (combination of bisector line and perpendicular line), distance to waypoint, or manual.
  - ⇨ Waypoint Approach distance
  - ⇨ Autopilot alarm control
- Position - sets 2D or 3D mode, antenna height, Lat/Lon, Loran, UTM, or User Grid (optional), and some alarm limits.
- Time - sets time offsets and 12 or 24 hour clock mode (for ETA calculation, and waypoint passed time stamp).

RTE1 - The Active Route

The **RTE1** screen provides the active route data for the **NAV** and **PLOT** screens. It also maintains a waypoint pass log for you. Another important feature in the **RTE1** screen that you need to be aware of is that the *up (↑)* and *down (↓) arrow softkeys*, displayed when you are in the edit mode under the *Route Control* softkey, control which waypoints are skipped (down arrow - ↓) and which are restored (up arrow - ↑) for your current route.

Note: The CDU will recalculate the route when a navigation mode, either Rhumb Line or Great Circle is selected.

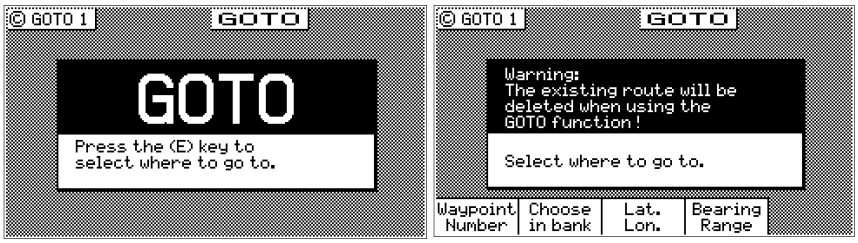
You can enter waypoints using different datums into the route

The **RTE1** screen is where you are likely to do most of your trip preparation. There are several methods you can use to create routes. You are sure to find one or more methods which meet your needs in the following sections.

Creating a Route Using the GOTO Key:

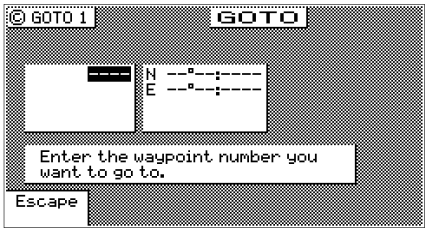
Using the **GOTO** function key is the fastest way to create a single leg route. Using this method will cause the existing active route to be erased and overwritten with the new position you define.

1. From any screen, press the **GOTO** key.
2. Press the **E** key.

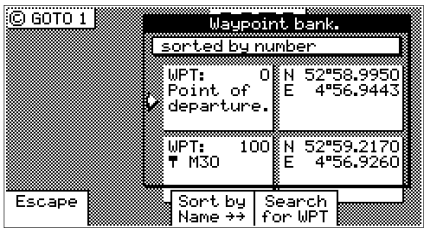


3. Select the waypoint determination method you want:

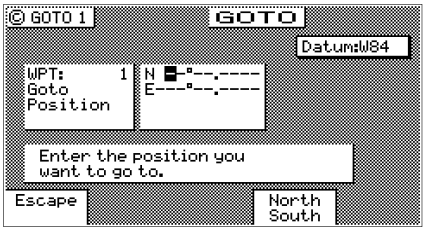
Waypoint Number - allows you to choose a waypoint stored in the Waypoint Bank. This feature is nice to use if you already know the waypoint number that you want to go to and you don't want to waste time scrolling through the available waypoints. Enter the number of the waypoint, verify that the coordinates are correct, and press the **E** key to copy the waypoint to the active route.



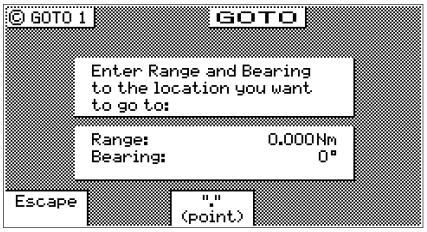
Choose In Bank - allows you to scroll through the Waypoint Bank. Align the cursor with the desired waypoint and press the **E** key. The waypoint is automatically inserted into the active route and the unit will revert to the NAV screens, displaying bearing and distance to this waypoint.



Lat. Lon., Grid Point, Loran C TD's - allows you to define a coordinate and description, which is also stored at the next available waypoint location in the Waypoint Bank. Once the coordinates are defined, press the **E** key to copy the waypoint to the active route.



Bearing Range - allows you to define a coordinate by specifying the bearing and range from your present position, which is also stored at the next available waypoint location in the Waypoint Bank. After entering the desired bearing and range, press the **E** key. The newly defined waypoint is copied to the active route automatically.



If you make a mistake, you can use the cursor key to position the cursor over the mistake and overwrite the error.

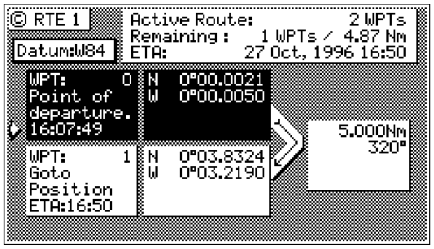
Use the **9** key to insert a space in the description, if needed.

Use the **0** key to select a special character, if needed.

International characters are available by selecting the associated function key. Refer to the *Keypad & Display Description* section at the front of the manual.

If you decide you don't want to continue with this function, press the *Escape* softkey, then press the **E** key. Make another function key selection (e.g. **NAV**) and your original route will have been left intact.

3. Press the **RTE** function key. You will see two waypoints defined in the center of the screen.



Waypoint 0, the first waypoint, is your *Point of Departure*, or the position you were at when you created the route. Waypoint 0 is a unique waypoint, in that the CDU internally constantly changes the position of Waypoint 0 to your present position. However, the CDU saves and displays the original coordinates entered when you created the route.

Waypoint 0 is displayed in *Inverse Video*, that is, white characters on a black background (when in the normal Daylight display mode; see **CFG1** *Lighting*). This indicates that you have already passed this coordinate. The time stamp at the lower portion of the description window indicates when the route was created. If you want to adjust your point of departure position, you can edit Waypoint 0 in the **WPT** function.

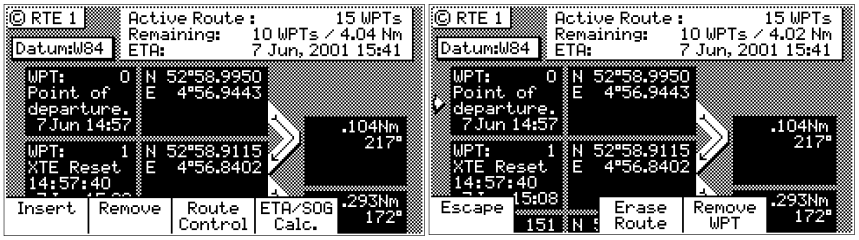
To the right of the coordinate window of Waypoint 0 is a bent arrow. The bend in the arrow is adjacent to the range and bearing between the waypoint you just passed and the waypoint you are approaching. Keep in mind that these are the fixed calculated values between these two coordinates and not the real time changing values that you will see in the navigate screens between your present position and your next waypoint during normal navigation.

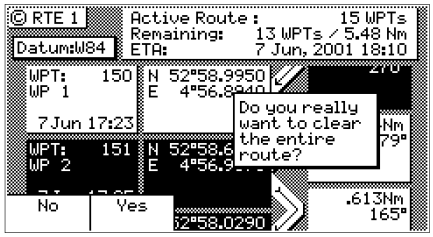
Below Waypoint 0 is the waypoint you defined in the **GOTO** function. Notice that this information is in standard video, black characters on a white background, and that an ETA time is displayed in the same position as the waypoint passed time in Waypoint 0. This indicates that the waypoint has not yet been passed. Remember that the ETA time is filtered over time, so allow a few minutes for the filter to settle when you first get underway or make course and speed changes.

Erasing an Existing Route

To completely erase the active route:

1. Select the **RTE** key until the **RTE1** screen is displayed.
2. Press the **E** key.
3. Press the *Remove* softkey.
4. Press the *Erase Route* softkey.





5. Press the *Yes* (confirmation) softkey.

The active route is now empty and ready for new input. If you want to work in other areas of the CDU first, you will need to press the **E** key to exit the edit mode.

Creating a Multi-Waypoint Active Route

There are four methods to create a multi-waypoint route:

- *Insert By Number* - allows you to type in or scroll through in numerical order using the cursor key, waypoints that you previously stored in the Waypoint Bank (see **WPT** later in this manual).
- *Choose In Bank* - allows you to sort and scroll through the waypoints stored in the Waypoint Bank (**WPT**) by various techniques (symbol, date, distance from present position, numerical order, alphabetical order, or search by user defined string). This is a great tool if you can't remember where you stored the waypoints you want to use.
- *Insert New Waypoint* - allows you to define new waypoint coordinates, define a waypoint by using Bearing and Distance from an existing waypoint, and enter them into the route and the Waypoint Bank at the same time.
- *Insert Route* - allows you to copy a previously defined route in the **RTE2** screen to the active route. This choice is only displayed when one or more routes are defined in the **RTE2** screen.

Our experience has shown that you are likely to choose several of these methods at any given time to create a route. You can mix any of these routines to create routes, amend routes, or insert waypoints in the middle of existing routes. The software is designed to be as flexible as possible to meet your changing needs.

Be sure to take a few minutes to read through the *Plotter* section to find out how you can modify the active route using the **Plotter** and **GOTO** functions.

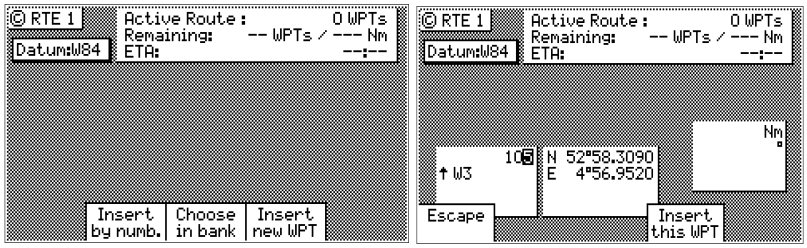
The following four sections are examples of how to use each of the four basic functions outlined above. We encourage you to experiment using all of the methods available to find the one (or two, or three) that best meets your needs. As long as you are working in the **RTE1** screen and sitting at the dock, you are not going to do any damage (e.g. erase waypoints in the Waypoint Bank or routes in the Route Bank), so have some fun *and find out how helpful this GPS receiver really is*.

If you are already comfortable with setting up a basic route, you might want to skip the examples which follow and jump ahead to the *Maneuvering Within the Route* section later in this section to understand some of the more advanced features of the software.

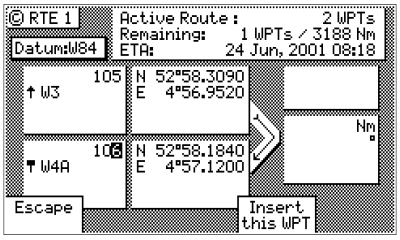
Insert By Number

The following example assumes **RTE1** is empty. Follow the directions in the *Erasing an Existing Route* section to start with an empty route if you have waypoints in the **RTE1** screen.

1. Select the **RTE** key until the **RTE1** screen is displayed.
2. Press the **E** key to enter the edit mode.
3. Select *Insert* from the display. Skip to the next step if RTE1 is empty.
4. Select *Insert by Number* from the display.



5. Use the keypad to type in the number you want or the beginning number of a range you would like to select from, or use the cursor key to scroll through the previously stored waypoints in numerical order.

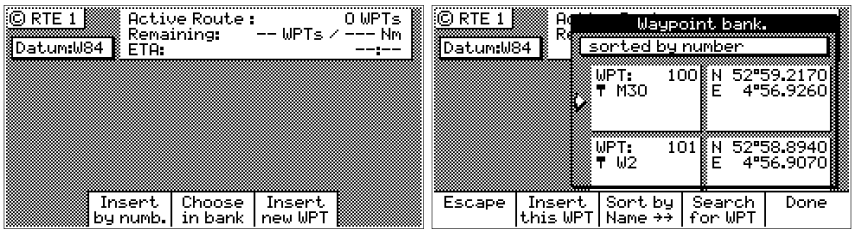


6. When you have found the waypoint you want, press the *Insert this WPT* softkey.
7. You can then choose to select another waypoint using the same method, select *Escape* to go back one level and use another method to enter waypoints, or select *Done* to go back to the main menu.
8. Don't forget to press the **E** key to end your editing.

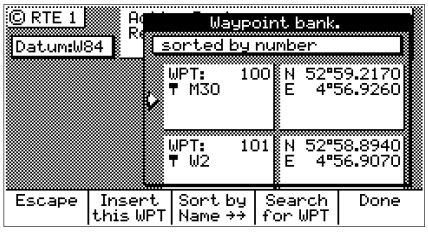
Choose in Bank

The following example assumes **RTE1** is empty. Follow the directions in the *Erasing an Existing Route* section to start with an empty route if you have waypoints in the **RTE1** screen.

1. Select the **RTE** key until the **RTE1** screen is displayed.
2. Press the **E** key to enter the edit mode.
3. Select *Insert* from the display. Skip to the next step if RTE1 is empty.
4. Select *Choose in Bank* from the display.



5. Select a waypoint by:
   A. Pressing the *Sort By* softkey to arrange the waypoints by number, name, type, distance, or age (refer to the *Waypoint* section for a full description), then using the cursor key to scroll through the previously stored waypoints in the Waypoint Bank.
   B. Pressing the *Search for WPT* softkey. When using this selection you actually spell out the name and or symbols of the waypoints you are looking for and the software will display any waypoint containing that combination of characters or symbols. Refer to the *Waypoint* section for a full description.



6. When you have found the waypoint you want, press the *Insert*

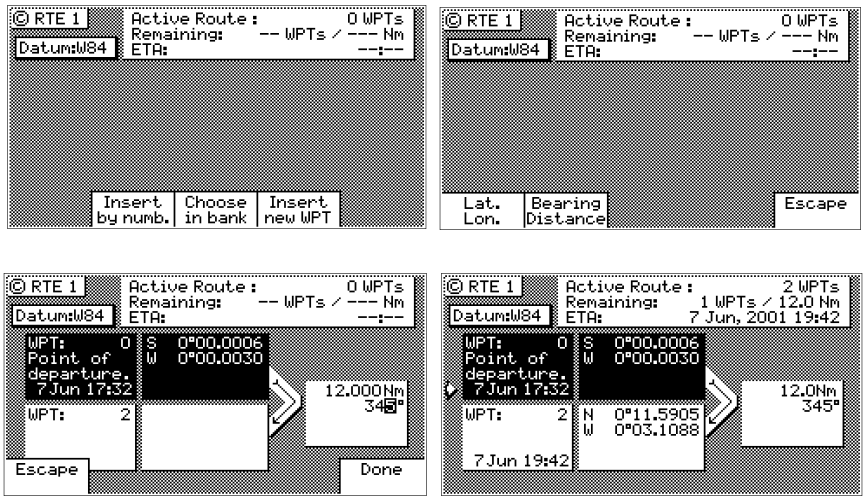
this WPT softkey.

7. When you are finished, press the *Done* softkey to get back to the main menu.
8. You can then choose to select another waypoint using the same method, select *Escape* to go back one level and use another method to enter waypoints, or select *Done* do go back to the main menu.
9. Don't forget to press the **E** key to end your editing.

Insert New Waypoint

The following example assumes **RTE1** is empty. Follow the directions in the *Erasing an Existing Route* section to start with an empty route if you have waypoints in the **RTE1** screen.

1. Select the **RTE** key until the **RTE1** screen is displayed.
2. Press the **E** key to enter the edit mode.
3. Select *Insert* from the display. Skip to the next step if RTE1 is empty.
4. Select *Insert new Waypoint* from the display.



5. Choose either *Bearing, Distance* or *Lat/Lon* (Grid Point, or TD if you are using other coordinate systems). Use the keypad to type in the range and bearing from the previous waypoint (or present position in the case of the first waypoint) or the coordinates you want and their appropriate description.

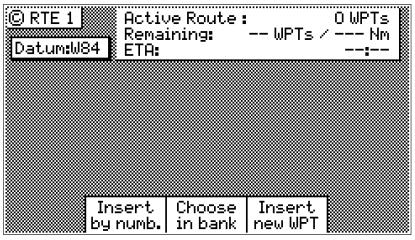
6. When the information is correct, press the *Done* softkey.
7. You can then choose to enter another waypoint using the same method, select *Escape* to go back one level and use another method to enter waypoints, or select *Done* to go back to the main menu.
8. Don't forget to press the **E** key to end your editing.

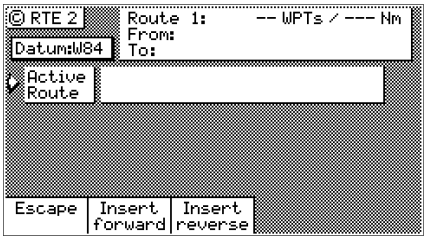
Insert Route

The following example assumes **RTE1** is empty. Follow the directions in the *Erasing an Existing Route* section to start with an empty route if you have waypoints in the **RTE1** screen.

To perform this function, you must also have defined a route in the **RTE2** screen. The **RTE2** description follows later in the *Route* section.

1. Select the **RTE** key until the **RTE1** screen is displayed.
2. Press the **E** key to enter the edit mode.
3. Select *Insert* from the display. Skip to the next step if RTE1 is empty.
4. Select *Insert Route* from the display.





5. Use the cursor key to scroll through the available defined routes, which are created in the *RTE 2* screen, in numerical order.
6. When you have found the route you want, press the *Insert Fwd* or the *Insert Reverse* softkey. *Insert Fwd* enters the route from the top of the defined list into the active route. *Insert Reverse* enters the route from the bottom of the defined list into the active route so that you can travel down the route in the reverse direction.
7. You can then choose to select another route using the same method or select another method to enter waypoints.
8. Don't forget to press the **E** key to end your editing.

Maneuvering Within the Route

Scrolling

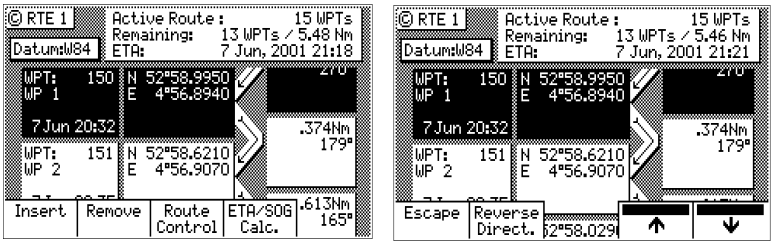
You can use the cursor key to scroll up and down the active route. You will probably want to do this when you update your log book to indicate when you passed a given waypoint, or when you want to know the ETA to a waypoint other than the one you are currently traveling towards. It is also a good idea to set the cursor at the correct waypoint before entering the edit mode to insert and delete waypoints from the route.

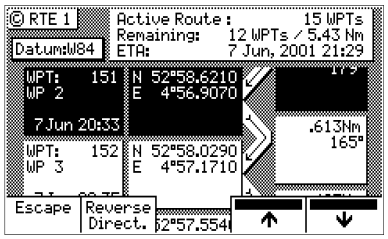
Skipping and Unpassing Waypoints

You are likely to run into an occasional circumstance where you accidentally skipped a waypoint (due to your waypoint pass criteria selection in the **CFG1** *Navigation* screen, or a manual skip in the **NAV** screens), and you want to switch back to a previous waypoint in the active route. You may also decide at some point that you want to skip the current or subsequent waypoints in the route. The software has a very simple design to accomplish both of these tasks.

The easiest way to accomplish either of these tasks is to scroll through the route with the cursor key until the cursor arrow is at the bottom of the last waypoint you want designated as *passed* (that is, white characters on a black background), whether this waypoint was passed several waypoints ago or is yet to be passed.

Then press the **E** key.





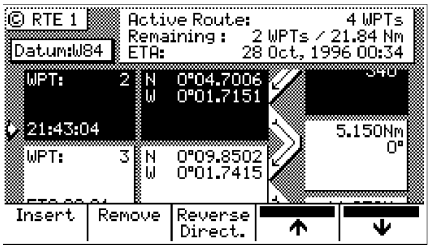
Use the up (↑) softkey to unpass or the down (↓) softkey to pass waypoints in the route until the waypoint marked by the cursor is displayed with white characters on a black background (Daylight display, see **CFG1** *Lighting*).

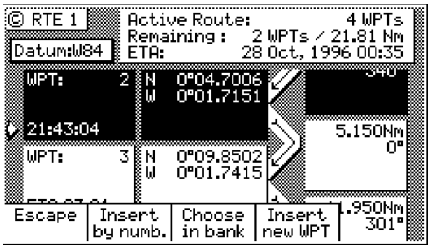
Press the **E** key to end editing.

If for some reason you can't select the waypoint you want (the screen keeps passing waypoints you unpassed), you are probably too close to one of the waypoints. You will need to either change your *Waypoint Pass Criteria*, change your *Waypoint Pass Distance* (see **CFG1** *Navigation*), or remove the waypoint from the route.

Inserting Waypoints or Routes into an Existing Route

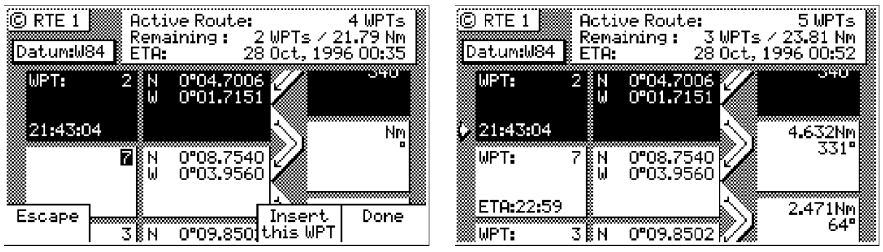
1. Select the **RTE** key until the **RTE1** screen is displayed.
2. Scroll through the route with the cursor key until the cursor arrow is at the bottom of the waypoint you want to insert the new waypoint after.





3. Then press the **E** key.
4. Use one or more of the insert methods described in the *Creating a Multi-Waypoint Active Route* section above.

This example shows Waypoint 7 inserted into the route using the *Insert by Number* method:

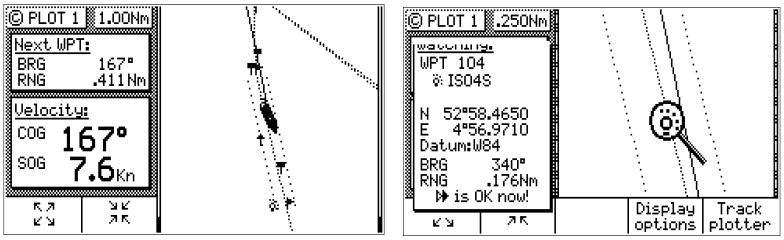


5. Press the **E** key to end editing.

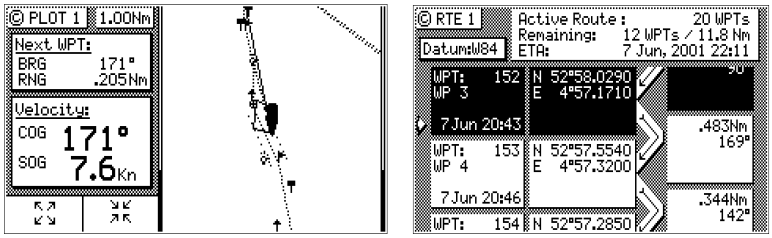
There is one special way to add a waypoint to the active route using the *Plotter* display. This method adds the waypoint between your present position and the next waypoint in your active route.

1. Select either **PLOT1** or **PLOT2** display.
2. Use the zoom-in or zoom-out softkeys to display the waypoint you want to insert. Press the **E** key. All waypoints in the waypoint bank will be displayed if they are within the zoom level of the display.

   Note that the waypoint must have a symbol as the first character of the waypoint name in order for it to be displayed on the **PLOT** screen when the edit mode is not active.



3. Use the cursor key to move the magnifying glass icon over the waypoint or marker that you want to go to.



Verify that the waypoint number and coordinates are correct in the left hand window.

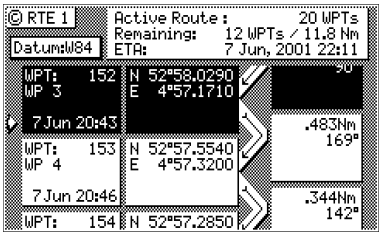
4. Press the **GOTO** function key.
5. Press the **E** key to exit the edit mode.

Note that **RTE1** and **PLOT1** are updated with your new waypoint.

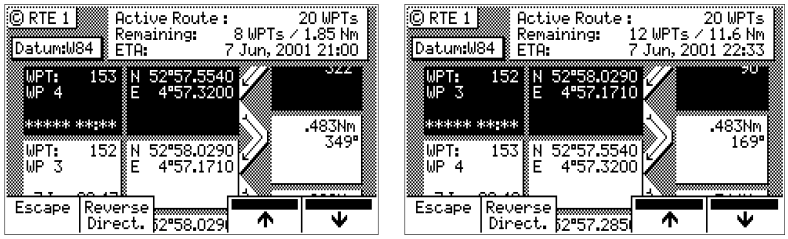
Reversing the Active Route

Once you get to your final destination, you might want to follow the same route home. To quickly accomplish this, simply use the *Reverse Direct* softkey from the main **RTE1** menu.

1. Select the **RTE** key until the **RTE1** screen is displayed.
2. Press the **E** key.
3. Press the *Route Control* softkey.



4. Press the *Reverse Direct* softkey.
5. Press the **E** key. It's that simple!



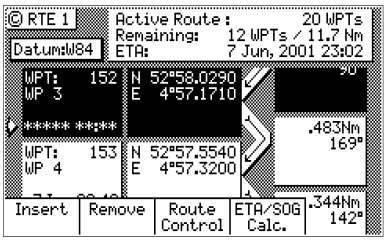
Notice that you still keep the same orientation on the screen, in other words, you always read from the top of the screen to the bottom of the screen. The waypoints are rewritten in reverse order for you.

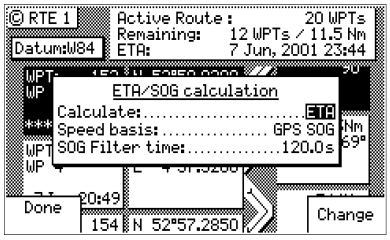
ETA Setup

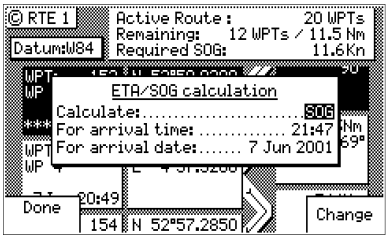
If you choose to use this function, it is probably better to operate the unit in UTC time mode if you are going to cross one or more time zones. Note that the time entered uses the offset to UTC applied in the **CFG1** *Time* display.

The software calculates Estimated Time of Arrival based on how you configure the unit. ETA settings are controlled from the **RTE1** screen. To change the ETA settings:

1. Select the **RTE** key until the **RTE1** screen is displayed.
2. Press the **E** key.
3. Select the *ETA/SOG Calc.* softkey.

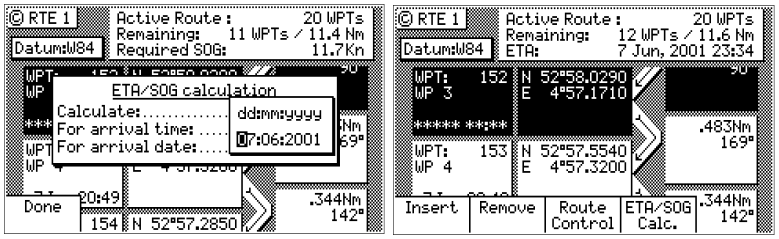






4. Use the *Change* softkey to select which value you want the CDU to calculate, either *ETA* based on speed, or speed (*SOG*) based on desired time and date of arrival.

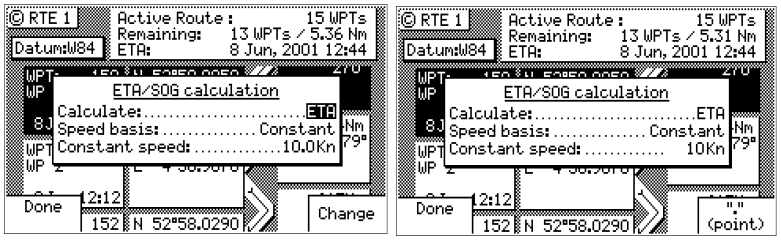
SOG Based on Arrival Date & Time:



5. Enter the arrival time and date. Be sure to enter the date as day, month, year, as indicated on the screen.
6. Press the *Done* softkey.

In this mode, the actual SOG is compared to the required SOG to meet the specified arrival date and time. The result is given in a percentage (%) value next to the displayed SOG in the NAV screens. If the percentage is below 100, you will arrive late. If the percentage is above 100, you will arrive early.

ETA Based on Speed:

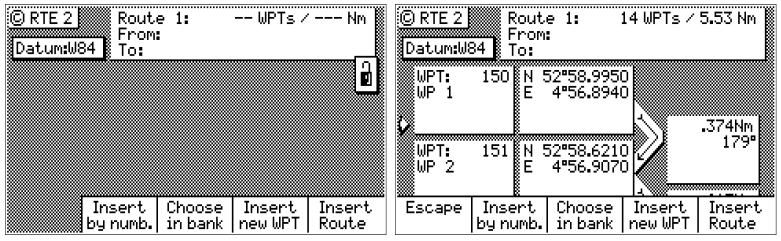


5. Select a *Speed Basis* of either *GPS SOG*, which uses a long filter time (in seconds) that you define, or *Constant*, which uses a speed you intend to maintain (you define the speed).
6. Press the *Done* softkey.

RTE2 - The Route Bank

The Route Bank is a convenient place for you to preprogram segments of a long voyage, or to program routes that you follow over and over again. Creating routes for the Route Bank uses the same methods as the Active Route with a few exceptions: you can't use the **GOTO** key, and you can't use the Plotter screen. You can use other routes as a subset to create a new route. Remember, you can always tie routes together in the Active Route by inserting one after another. You will find a *Route Name* softkey when you first enter the edit mode. The *Route Name* selection allows you to identify each route by name, number and symbol when you are viewing the Route Bank from the main menu. To create a route:

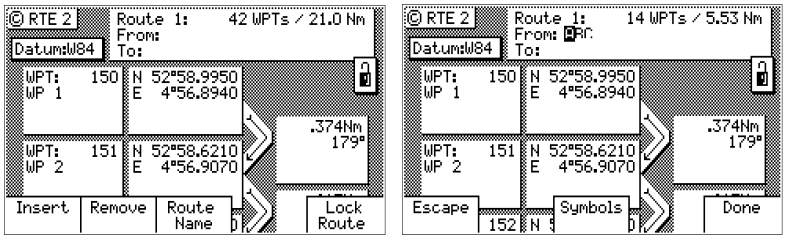
1. Select the **RTE** key until the **RTE2** screen is displayed.
2. Move the cursor to the route number you want to create or edit.
3. Press the **E** key.
4. Use the entry methods described in the *Creating a Multi-Waypoint Active Route* section, following the exceptions noted above.



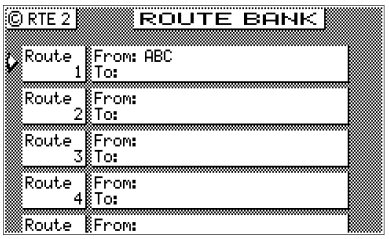
If you have a route in RTE1 that is not stored in RTE2, you can copy it into the Route Bank by selecting *Insert* then *Insert Route*, either in the forward or reverse direction.

5. When you are finished selecting waypoints, press the *Route Name* softkey.

   You can enter any name, number or symbol you want this route to be identified by.



6. Press the *Done* softkey when you are finished editing the name.



Note: It is a good idea at this point to select Lock Route so that way you won't accidentally erase the route sometime in the future.

7. Finally press the **E** key to exit the edit mode.

Waypoint

The Waypoint Bank (**WPT**) is a single list of up to 2,000 waypoints that you store for use in the routes you create. It also stores special coordinates and time, through the use of the Mark or Event function key or external input, or the MOB function key or external input. You can also enter waypoints from other NMEA 0183 devices (see **CFG1** *WPT & RTE In*), such as plotters. You can also output waypoints and routes from the CDU to other NMEA 0183 devices (see **CFG1** *NMEA Out Rnn*, *RTE*, and *WPL*).

You can input very accurate coordinates, down to 18 cm in Lat/Lon, 0.1 m in UTM or 0.1 µs in TDs. You can select from more than 110 Datums to store your waypoints in. The **CFG1** *Position* screen controls which coordinate reference system is used by the CDU.

While entering waypoints in the list is rather straight forward, the software does provide some helpful features that should be mentioned before giving any examples.

There are six methods to view or sort waypoints:

- *Sort By Number* - displays the waypoints in waypoint numerical order, starting with waypoint 0.

Note: You can manually alter Waypoint 0 to a different Point of Departure if you don't want to start your route from your present position.

- *Sort By Name* - displays the waypoints by name in alphabetical order.
- *Sort By Type* - displays the waypoints by symbols, numbers, then names.
- *Sort By Distance* - displays the waypoints which are closest to your present location first.
- *Sort By Age* - displays the waypoints entered most recently, first.
- *Search For WPT* - allows you to type a symbol or name and the screen displays all waypoints having the exact match of the name you type. If you are unsure of the complete name, type a few of the characters you know are in the name, and the software will display all waypoints having the corresponding characters.

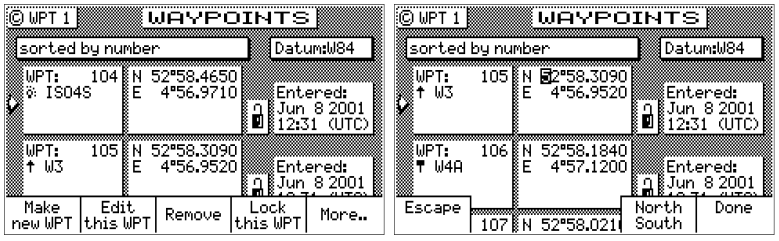
For example, if you are looking for the LA HARBOR ENTRANCE and you enter HAR, the screen will display all waypoints with these three characters in this exact order.

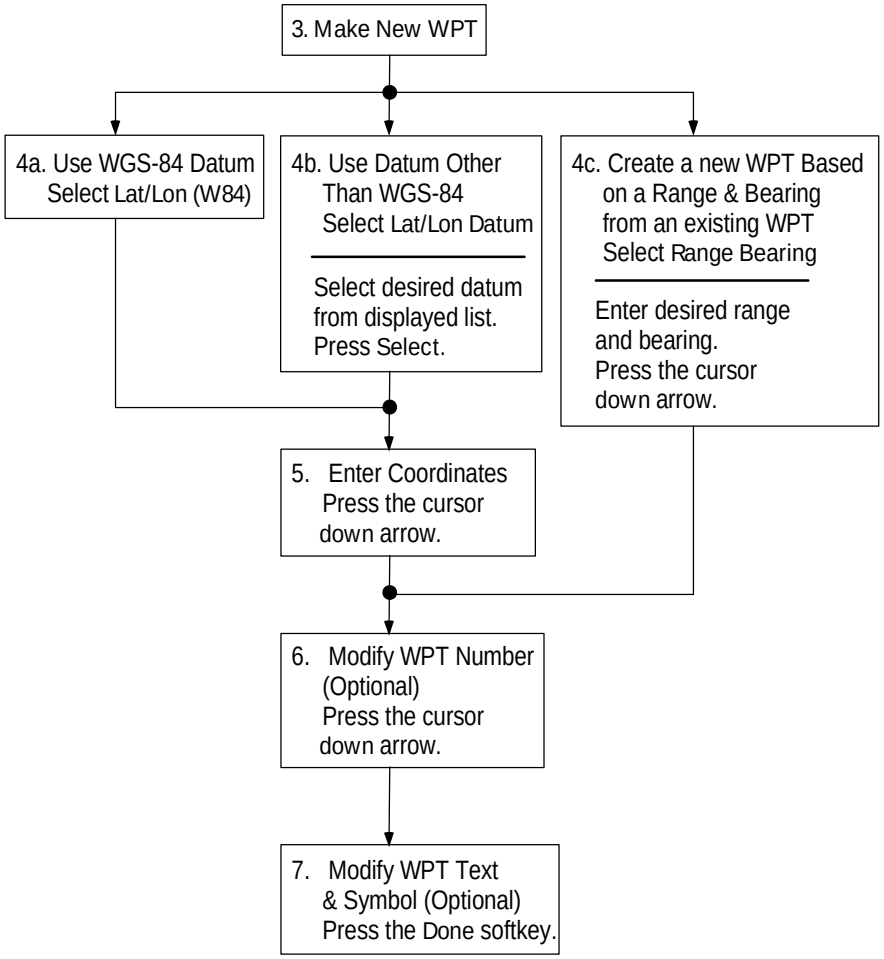
Creating and Editing Waypoints

When editing a waypoint, you are always prompted to select the appropriate datum. You might occasionally see a prompt warning you that the waypoint is used either in a stored route or the active route. *You ultimately have the final decision whether to continue editing the waypoint, or exiting this waypoint by pressing the **E** key again to exit the edit mode.*

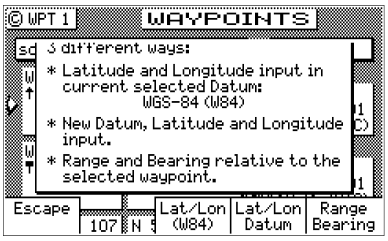
Creating and editing waypoints is easy.

1. Select the **WPT** key until the **WPT1** screen is displayed.
2. Press the **E** key.
3. Press the *Make New WPT* softkey or align the cursor with the waypoint you want to modify and press the *Edit this WPT* softkey.



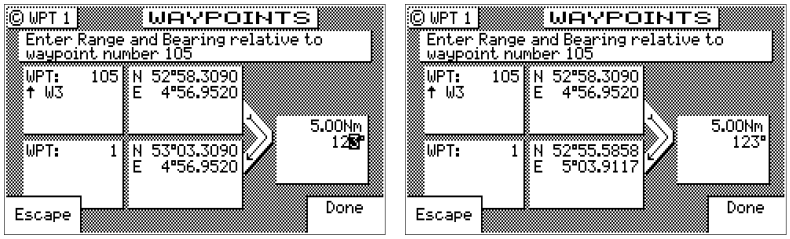


4a. *Make New WPT* - Select *Lat/Lon (W84)*, *Lat/Lon Datum*, or *Range Bearing*.



Lat/Lon (W84) - allows you to enter coordinates in the WGS 84 datum. This choice takes you directly into the coordinate input screen. Go to step 5.

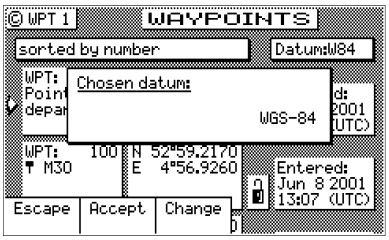
Lat/Lon Datum - allows you to choose a datum (see the list in the screen sample above) from the more than 110 available Datums. Highlight the desired datum and press the *Select* softkey. Refer to *Appendix A - Datum List* for a complete list of datums and their WGS-84 offset. Go to step 5.

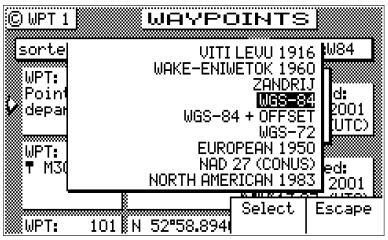


Range Bearing - allows you to define new waypoint coordinates from an existing waypoint in the Waypoint Bank. When you use this feature make sure you align the cursor next to the *from* waypoint number before you press the *Make New WPT* softkey.

Once you have entered the range and bearing, the CDU calculates the coordinates. You can then enter a text description or modify the waypoint number as described in step 6 below. Go to step 6.

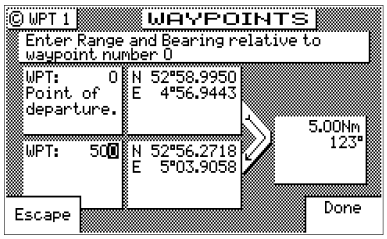
4b. *Edit This WPT* - Select *Accept* to use the WGS 84 datum or press *Change* to choose from the more than 110 available Datums. Highlight the desired datum and press the *Select* softkey. Refer to *Appendix A - Datum List* for a complete list of datums and their WGS 84 offset.

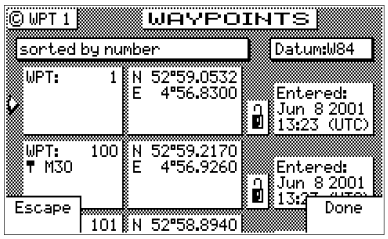




5. Enter the appropriate coordinates using the cursor key and numeric keypad.

6. Move the cursor down and modify the waypoint number if you wish. Otherwise the CDU assigns the next available number, beginning at 1.

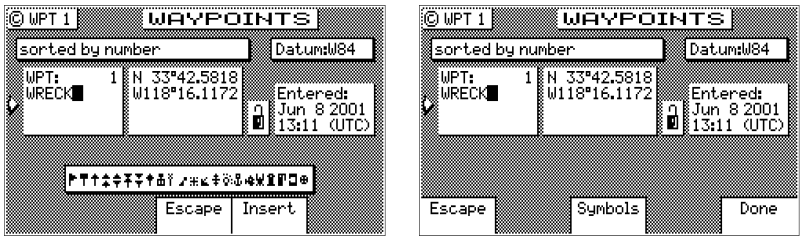




Range & Bearing *Lat/Lon*

This feature allows you to create a range of waypoints within a particular area. For example, you could put all of the waypoints for fishing spots near Catalina Island in the range of 500 to 530, all the waypoints for Cabo San Lucas in the range of 575 to 600, etc.

7. Move the cursor down, and enter the symbol and name information (optional). Use the techniques described in the *Keypad & Display Description* section at the front of this manual.



The following international characters are supported by cycling through the standard letter function key:

ABC = Ä, Å, Æ, À, Ç

DEF = É, È

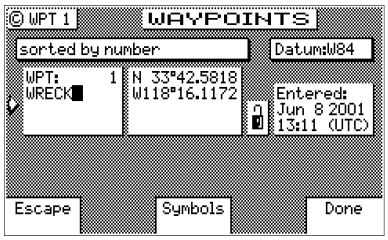
GHI = Í

MNO = Ñ, Ó, Ö

STU = Ú, Ü

Press the **CFG** key when in the edit mode to cycle through these additional characters:

‘ “ $ & ! ( ) ? / + - ° . , :



About one second after you stop scrolling through the alpha characters, the cursor will automatically advance to the next space.

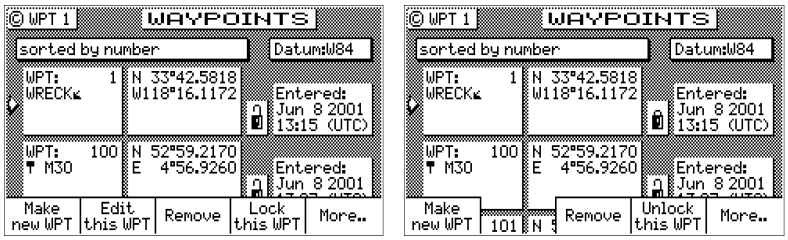
7. Press the *Done* softkey.

8. When you are finished, press the *Lock this WPT* softkey to avoid accidentally erasing the waypoint in the future.

Note: Locked waypoints can not be overwritten by waypoints downloaded from the NMEA port or saved by the Mark or MOB functions.

9. Then press the **E** function key to end editing.

   You can press the **E** key when you finish editing a waypoint. This is treated the same as pressing the *Done* softkey. Pressing *Done* allows you to continue editing and entering other waypoints.



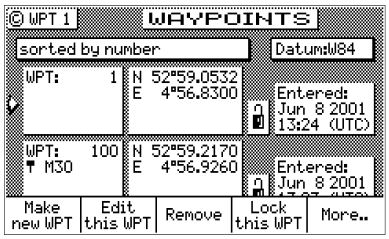
Waypoint Lock/Unlock

Locking a waypoint forces the user to consciously unlock the waypoint before it can be modified and prevents the waypoint from being overwritten when waypoints are being input over the data port. Note that when a waypoint received on the data port has the same waypoint number as a locked waypoint already stored in the CDU, the waypoint data received on the data port is disregarded and lost. Waypoints are locked by one of three methods: 1) selecting *Lock this WPT* when in the waypoint bank edit mode for a particular waypoint; 2) selecting *Lock this WPT* when in the waypoint bank edit mode; or 3) incorporating a waypoint into a route stored in *RTE2* and then locking the route.

Waypoints that are locked from the waypoint bank are indicated by a closed padlock in the display. Waypoints that are party to a locked route will display a message indicating that waypoint can not be modified.

To Lock a Waypoint

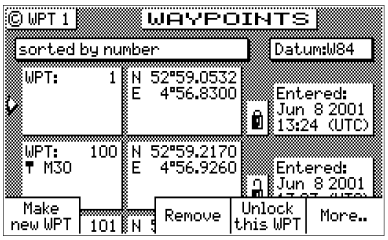
1. Select the **WPT** key until the **WPT1** screen is displayed.
2. Move the cursor to the desired waypoint.
3. Press the **E** key.

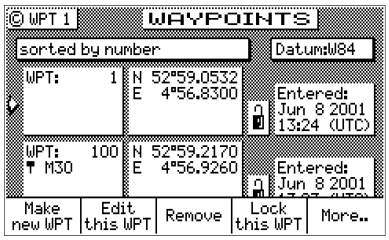


4. Press the *Lock this WPT* softkey.
5. Press the **E** key.

To Unlock a Waypoint

1. Select the **WPT** key until the **WPT1** screen is displayed.
2. Move the cursor to the desired waypoint.
3. Press the **E** key.



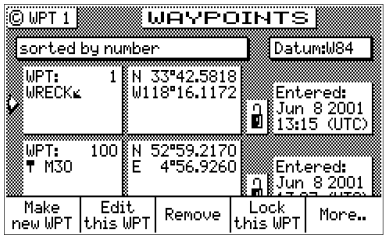


4. Press the *Unlock this WPT* softkey.
5. Press the **E** key.

   If you simply want to modify the waypoint, *Edit this WPT* will be displayed on the bottom left of the screen.

To Lock all Waypoints

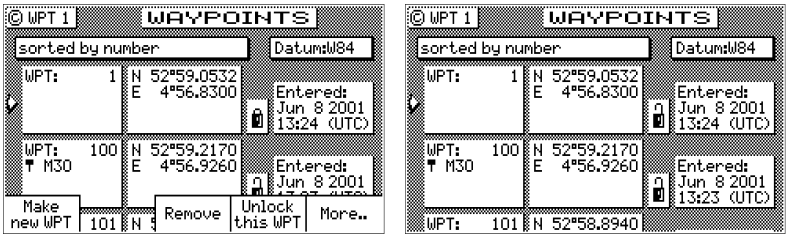
1. Select the **WPT** key until the **WPT1** screen is displayed.
2. Move the cursor to the desired waypoint.
3. Press the **E** key.
4. Press the More softkey.
5. Press the More softkey again.



6. Press the *Lock all WPT* softkey.
7. Press the **E** key.

To Unlock all Waypoints

1. Select the **WPT** key until the **WPT1** screen is displayed.
2. Move the cursor to the desired waypoint.
3. Press the **E** key.
4. Press the More softkey.
5. Press the More softkey again.



6. Press the *Unlock all WPT* softkey.
7. Press the **E** key.

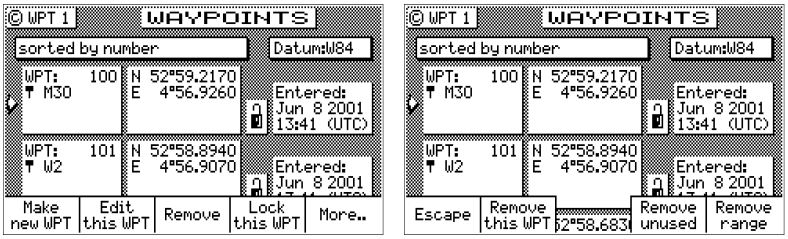
Removing Waypoints

Unlocked waypoints can be overwritten by waypoints received on the NMEA port containing the same waypoint number, by the Mark function, or the MOB function. The Mark and MOB functions start storing waypoints beginning at waypoint 1999 and work their way backwards. When the Waypoint Bank is full, this process starts again at 1999 and begins overwriting each unlocked waypoint in sequence, beginning at 1999. Waypoints that are contained within a stored route can not be removed until they are removed from the stored route in the RTE2 screen. If you try to remove a waypoint stored in a route, a warning will be displayed indicating the first route a waypoint is stored in.

If the waypoint you want remove is locked, refer to the *Waypoint Lock/Unlock* section for a step by step procedure, and then return to this section.

To remove a waypoint:

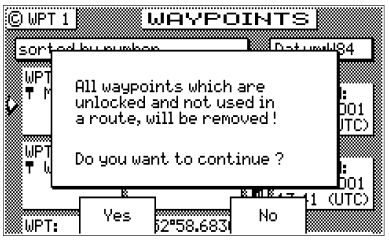
1. Select the **WPT** key until the **WPT1** screen is displayed.
2. Move the cursor to the desired waypoint.
3. Press the **E** key.
4. Press the *Remove* softkey.



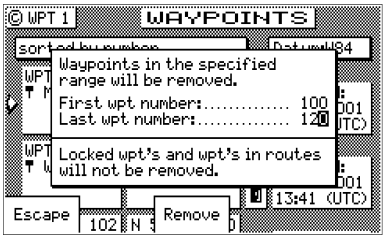
There are three methods to remove a waypoint: *Remove this WPT*, *Remove Unused*, and *Remove Range*:

5a. If you select *Remove this WPT*, the waypoint will immediately be removed from the Waypoint bank.

5b. If you select *Remove Unused*, the CDU will delete all waypoints that are not locked or stored in a route. You will be prompted to confirm the deletion:



5c If you select *Remove Range*, the CDU will delete all unlocked waypoints that are not stored in a route between a range of waypoint numbers that you enter. You will be prompted to confirm the deletion:



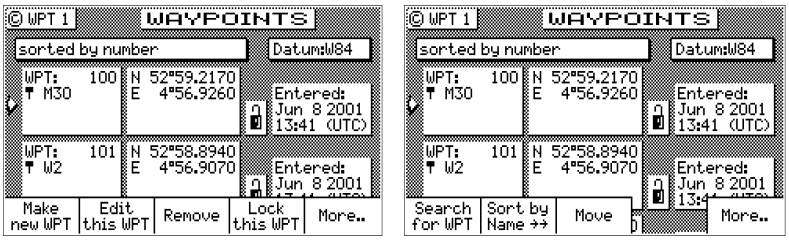
6. Press the **E** key.

Moving waypoints

This feature allows you to create a range of waypoints within a particular area. For example, you could put all of the waypoints for fishing spots near Catalina Island in the range of 500 to 530, all the waypoints for Cabo San Lucas in the range of 575 to 600, etc.

To move a waypoint or range of waypoints:

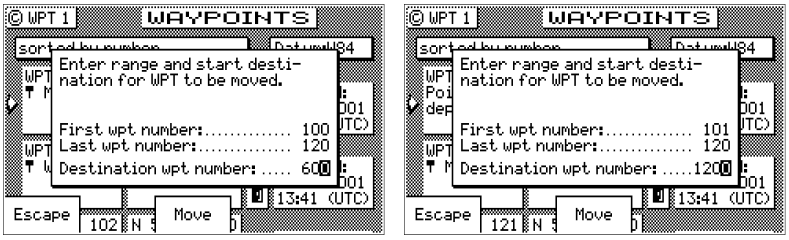
1. Select the **WPT** key until the **WPT1** screen is displayed.
2. Press the **E** key.
3. Press the *More* softkey.
4. Press the *Move* softkey.



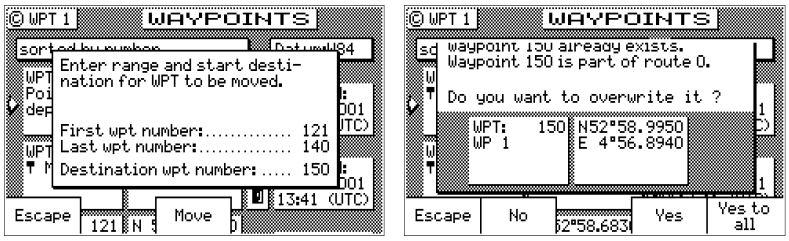
5a. To move a single waypoint, enter the original waypoint number on the *First WPT Number* and *Last WPT Number*.

5b. To move a range of waypoints, enter the first and last waypoint numbers to move on the *First WPT Number* and *Last WPT Number*. Keep in mind that the CDU will sort these waypoints numerically and all waypoints between the entered numbers will be moved to the new location.

6. Enter the waypoint number where you want the first waypoint moved to in *Destination WPT Number*.

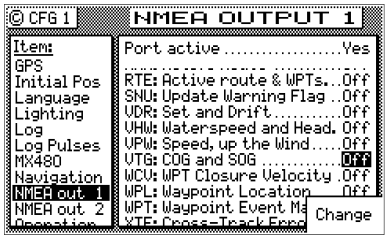


If the destination waypoint number is already being used, you will be prompted to either overwrite the first waypoint (*Yes)* and each subsequent waypoint that is to be overwritten, confirming each waypoint one at a time, overwrite all the waypoints (*Yes To All*), not overwrite any waypoints (*No*); or Escape back to base softkey menu.



Downloading Waypoints & Routes to Other Devices

Refer to the *Installation & Service Manual* for hardware interfacing guidelines.



The CDU can download all of your stored waypoints and routes, and your active route to other NMEA 0183 devices which accept the RTE, Rnn, and WPL data sentences. These sentences are controlled in the **CFG1** *NMEA Out* screens for the identifier given below. The CDU outputs these sentences in the following format:

Rnn *- Routes:*

Waypoint identifiers, listed in order with starting waypoint first, for route number “nn”. The active route in the CDU is always route zero, but in the Rnn sentence the route number can be transmitted as either route 00 or 01.

Rnn is NMEA version 1.5. Use of **GPRTE** is recommended to comply with NMEA version 2.1.

```
field#: 1   2    3    4          1    1   1
                                  4    5   6
    $GPRnn,cccc,cccc,cccc,.....,cccc,cccc*hh<CR><LF>
```

explanation / actual use:

1: nn = active route number, 00 or 01
can be set to 00 or 01 (default 00).

2 - 15: 14 field sequence of route waypoint IDs.

16: Checksum can be set on or off (default on).

***RTE** - Active Route:*

Waypoint identifiers, listed in order with starting waypoint first, for the identified route. Two modes of transmission are provided: "c" indicates that the complete list of waypoints in the route are being transmitted; "w" indicates a working route (active) where the first listed waypoint is always the last waypoint that has been reached (FROM), while the second listed waypoint is always the waypoint that you are currently heading toward (TO). The remaining list of waypoints represents the remainder of the route.

RTE can be sent as version 2.1 and 2.0.

```
field#: 2 3 4   5   6          1    1   1
                               5    6   7
 $GPRTE,x,x,a,cccc,cccc,.....,cccc,cccc*hh<CR><LF>
```

explanation / actual use:

2: Total number of messages being transmitted (a single route may require the transmission of multiple messages). A maximum of 11 waypoints are transmitted in each messages.

3: Message number.

4: Message mode: c = complete route, all waypoints, w = working , 1st listed waypoint is 'FROM', 2nd is 'TO' and remaining are the rest. c/w can be set to c or w (default w).

5: Route identifier, always 00 (Active Route only).

6 - 16: Waypoint identifiers, (less than 11 waypoints may be in the message).

The number of remaining waypoints can be set to 1, 2 or "all" (default all) shortening the drawn track on the plotter.

17: Checksum can be set on or off (default on).

***WPL** - Waypoint Location - NMEA 0183 Standard:*

Latitude and Longitude of specified waypoint. The content of this sentence will normally be the position of the next waypoint in the route.

The **CFG1** *NMEA out* ***WPL*** has a special "Send All" option. Selecting this feature will send all the waypoints in the Waypoint Bank once, independent of the WPL sentence setup as *ON* or *OFF*. This format conforms to the NMEA 0183 standard.

WPL can be sent as version 1.5, 2.0 or 2.1.

```
field#:  2      3 4        5  6   7
```

```
$GPWPL,llll.ll,a,yyyyy.yy,a,cccc*hh <CR><LF>
```

explanation / actual use:

2 & 3: Waypoint Latitude, North or South, N/S number of decimals can be set to 2, 3, 4 or 5 (default 2).

4 & 5: Waypoint longitude, East or West, E/W number of decimals can be set to 2, 3, 4 or 5 (default 2).

6: Waypoint identifier.

7: Checksum can be set on or off (default on).

The WPL record can also contain the description information when *Include Waypoint Names* in the **CFG1** *NMEA, Details* is selected.

***WPL** - Waypoint with Symbols & Description - NMEA 0183 Expanded:*

Latitude and Longitude of specified waypoint. The content of this sentence will normally be the position of the next waypoint in the route.

The **CFG1** *NMEA out* ***WPL*** has a special "Send All" option. Selecting this feature will send all the waypoints in the Waypoint Bank once independent of the WPL sentence setup as *ON* or *OFF*. This format does not strictly conform to the NMEA 0183 standard, and may not work with all equipment. It is provided for your use to store data on a PC using normal ASCII text editors.

WPL can be sent as version 1.5, 2.0 or 2.1.

```
  field#: 2      3 4       5  6                      7
```

```
   $GPWPL,llll.ll,a,yyyyy.yy,a,cccc xxxxxxxxxxzzzzzzzzzz*hh
<CR><LF>
```

explanation / actual use:

2 & 3: Waypoint Latitude, North or South, N/S number of decimals can be set to 2, 3, 4 or 5 (default 2).

4 & 5: Waypoint longitude, East or West, E/W number of decimals can be set to 2, 3, 4 or 5 (default 2).

6. Waypoint identifier; 4 place numeric waypoint number, followed by 1 space, followed by 10 characters for the top line of the description, followed by 10 characters for the bottom line of the description. When this field is output, you may see spaces between the xxx and zzz. These are "fill characters" and are necessary to fulfill the 10 character count to maintain character placement when read back into the CDU.

7: Checksum can be set on or off (default on).

Downloading Waypoints to a Personal Computer

You can use any terminal or communications program to download or upload waypoints and routes to or from the CDU and a PC.

Set the PC to:

4800 baud
8 bits
1 stop bit
no parity
no flow control

When sending data to the CDU, it must be sent in block form, followed by (with an appended) CR (carriage return) and LF (line feed). Normal communications programs, like *Windows 3.1* or *3.11 Terminal* are sufficient to get the job done. Unfortunately, *Hyperterminal* in *Windows 95* doesn't provide as simple a terminal emulation program as *Windows 3.11*, and we have found it is not a reliable interface. We suggest that a third party program be used with *Windows 95*.

Using *Windows Terminal,* do the following (from the *Program Manager*):

1. Connect the CDU's port 2 RS-232 port to the PC's communications port (Refer to the *Installation & Service Manual*).
2. On the CDU press the **CFG** key until **CFG1** screen is displayed.
3. Scroll down the menu to *NMEA Out 2*.
4. Press the **E** key.
5. If the port is already Active (*Yes*), write down which NMEA sentences are set to *Yes*, then set all of the NMEA sentences to *No*. You need to do this to record just the waypoint data.

   If the port is not Active (*No*), change it to *Yes.*
6. Scroll down to the *WPL* record and change it *On.*
7. Select the *Details* softkey.
8. Set *Include Waypoint Names* to either *No* or *Yes*. Refer to *WPL - Waypoint Location - NMEA Compliant* and *WPL - Waypoint With Symbols & Description - NMEA 0183 Non-Compliant* sections in this manual to determine the correct format for your purpose.
9. Set *Decimals in Position* to *4*.
10. Press the *Done* softkey.
11. Set the *WPL* record to *Off (you* will need to turn the data off while setting up the computer).
12. On the computer, double click on the *Accessories* icon.
13. Double click on the *Terminal* icon.
14. Click on the *Settings* menu.
15. Double click on the *Communications* menu item and make the following settings:

    4800 baud
    8 data bits
    1 stop bit
    Parity - none
    Flow Control - none
    Connector - Com1 (or Com2, depending where the external interface is)
    Parity Check - blank
    Carrier Detect - blank
    OK

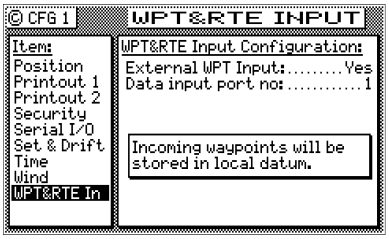
16. Click on the *Transfers* menu.
17. Double click on the *CDU Text File* menu item and make the following settings.
    [give the file a name.txt]
    [select a location (folder) to store the file]
    OK
18. On the CDU, you should still be in edit mode on **CFG1** *NMEA Out 2* with the cursor flashing on *Off* at the *WPL* record. Press the *Send All* softkey.
19. When all the waypoint sentences are sent, click on the *Stop* button on the PC.
20. Press the **E** key on the CDU to exit the edit mode.

Uploading Waypoints from Other Devices

The CDU will accept waypoints from any device which follows the WPL formats identified earlier in the *Waypoint* section. The first two characters following the $ can be any NMEA defined talker ID. You do not have to calculate and include the checksum; however, you must end each data record with a carriage return and line feed. If you do include the checksum at the end of the data record, the CDU will verify the checksum. If the checksum is invalid, the waypoint will be rejected.

Waypoints received on the data port will be stored to the waypoint location specified in the WPL record. If the waypoint location specified in the WPL record is already occupied, the CDU will overwrite the existing waypoint (if it is unlocked). If the existing waypoint is locked, the WPL record received on the input port will be ignored and dropped.

The CDU will only recognize waypoints from one input port at any given time. This port is defined in **CFG1** *WPT & RTE In*.



Uploading Waypoints from a Personal Computer

You can use any terminal or communications program to download or upload waypoints and routes to or from the CDU and a PC.

Set the PC to:

4800 baud
8 bits
1 stop bit
no parity
no flow control

When sending data to the CDU, it must be sent in block form, followed by (with an appended) CR (carriage return) and LF (line feed). Normal communications programs, like *Windows 3.1* or *3.11 Terminal* are sufficient to get the job done. Unfortunately *Windows 95* doesn't provide a basic terminal emulation program; therefore, a third party program is required with *Windows 95*.

Using *Windows Terminal*, do the following (from the *Program Manager*):

1. Connect the CDU's port 2 RS-232 port to the PC's communications port (Refer to the *Installation & Service Manual*).
2. On the CDU press the **CFG** key until **CFG1** screen is displayed.
3. Scroll down the menu to *WPL Input.*
4. Press the **E** key.
5. Set the *Transducer Connected* to *Yes.*
6. Set the *Data Input Port No.* to 2.
7. Press the **E** key.
8. On the computer, double click on the *Accessories* icon.
9. Double click on the *Terminal* icon.
10. Click on the *Settings* menu.
11. Double click on the *Communications* menu item and make the following settings:

4800 baud
8 data bits
1 stop bit
Parity - none
Flow Control - none
Connector - Com1 (or Com2, depending where the external interface is)
Parity Check - blank
Carrier Detect - blank
OK

12. Click on the *Transfers* menu.

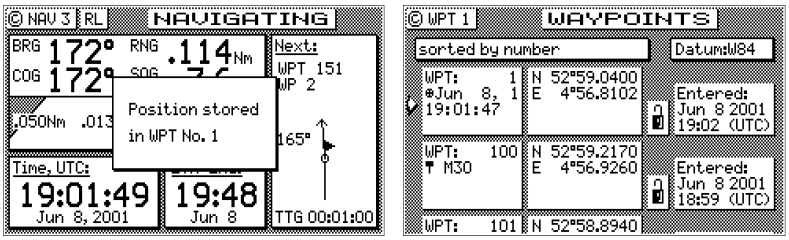
13. Double click on the *Send Text File* menu item and make the following settings:

    [select the correct file name.txt]
    [select the correct location (folder) for the file]
    check the *Append LF* box
    OK

14. When all the waypoint sentences are sent, press the **WPT** key and scroll through the list to ensure all the waypoints transferred properly.

Mark or Event

This function key stores your present position, date and time at the next available waypoint location in the Waypoint Bank. A window pops up on the screen to confirm your key depression, and to tell you where the Mark position is being stored. You can go into the WPT menu and edit the coordinates or description later. This key function is disabled for 2 seconds after each depression.



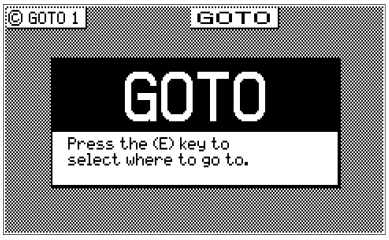
The cross-hair (⊕) symbol to the left of the date in the Waypoint Bank indicates that the Mark or Event key created this waypoint. Note that you can also select the cross-hair (⊕) symbol from the various symbols for other waypoints when editing waypoints.

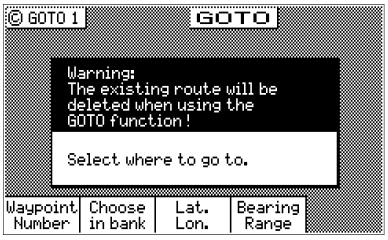
Note: The marker stores the position of the antenna location. Keep this in mind if you are trying to pinpoint items such as buoys, crab pots, etc. For some special applications such as these, you may need to locate the antenna at the point on the boat or ship where you need to make this exact measurement.

GOTO

Using the **GOTO** function key is the fastest way to create a single leg route. This method will cause the existing active route to be erased and overwritten with the new position you define.

1. From any screen press the **GOTO** key.
2. Press the **E** key.





3. Select the waypoint determination method you want:

   Waypoint Number - allows you to choose a waypoint stored in the *Waypoint Bank*, where you enter the waypoint number.

   Choose in Bank - as used in the **Route** function *(refer to Route - Choose In Bank* section of the manual), allows you to view waypoints in the Waypoint Bank as a list.

   Lat. Lon., Grid Point, Loran C TD's, Decca TD's - allows you to define a coordinate and description, which is also stored at the next available waypoint location in the Waypoint Bank.

   Bearing Range - allows you to define a coordinate by specifying the bearing and range from your present position, which is also stored at the next available waypoint location in the Waypoint Bank.

   If you make a mistake, you can use the cursor key to position the cursor over the mistake and overwrite the error.

   Use the **DGPS** key or cursor key to insert a space in the description, if needed.

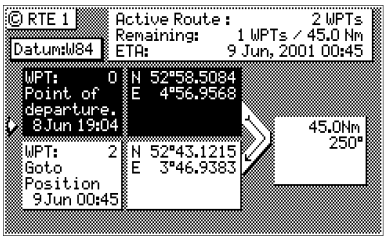
   Use the **CFG** key to select a special character, if needed.

4. To activate the GOTO waypoint, press the **E** key. A warning is

briefly displayed indicating that the active route will be replaced with the GOTO route.

If you decide you don't want to continue with this function, press the *Escape* softkey, then select another function key (e.g. **NAV**) and your original route will have been left intact.

Press the **RTE** function key. You will see two waypoints defined in the center of the screen.



Waypoint 0, the first waypoint, is your *Point of Departure*, or the position you were at when you created the route. The CDU saves and displays the original coordinates, date and time when you created the route in Waypoint 0.

Waypoint 0 is displayed in *Inverse Video*, that is, white characters on a black background (when in the normal Daylight display mode; see **CFG** *Lighting*). This indicates that you have already passed this coordinate. The time stamp at the lower portion of the description window, indicates when the route was created.

To the right of the coordinate window of Waypoint 0 is a bent arrow. The bend in the arrow is adjacent to the range and bearing between the waypoint you just passed and the waypoint you are approaching. Keep in mind that these are the fixed calculated values between these two coordinates and not the real time changing values that you will

see in the navigate screens between your present position and your next waypoint during normal navigation.

Below Waypoint 0 is the waypoint you defined in the **GOTO** function. Notice that this information is in standard video, black characters on a white background, and that an ETA time is displayed in the same position as the waypoint passed time in Waypoint 0. This indicates that the waypoint has not been passed yet. Remember that the ETA time is filtered over time, so allow a few minutes for the filter to settle when you first get underway or make course and speed changes.

Plot

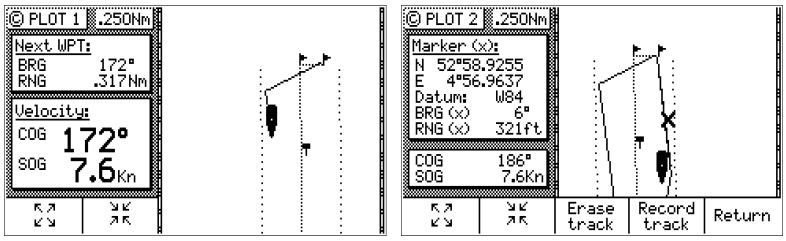
There are two **PLOT** screens. The **RTE1** and **WPT** functions are highly interactive with the **PLOT** screens. The primary difference between the **PLOT1** and **PLOT2** screens is the point of reference. The **PLOT1** screen displays graphic information around the boat at your present position. The boat always remains in the center of the screen. The **PLOT2** screen displays graphic information around a marker. The marker always remains in the center of this screen. If you define some of your navigation markers in the Waypoint Bank with a symbol in the first character position, the navigation symbol will show up in relation to your planned course on the plot screen, just as it does in the **NAV1** *Panorama* screen. In addition to the graphic details provided by the CDU, the *Plot* screens provide basic navigation information, zoom-in/out capability and scaling factors for the display from around 10 to 20 meters, depending on your latitude, out to 128 nautical miles. You will find these screens very helpful in many ways, and we will provide you with a couple of ideas on how to make good use of the **PLOT** function after the screen description which follows.

Note: The Plot screens do not show your route and cross-track error lines when in Great Circle Navigation mode.

The following **CFG** menus directly impact the **PLOT** functions:

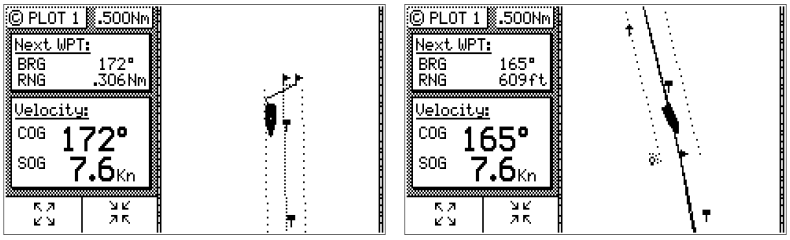
- Navigation - sets a variety of important functions and alarms.
  - ⇨ Rhumb Line or Great Circle navigation
  - ⇨ Range units: nautical miles, nautical miles and meters (when under 1,000 meters), nautical miles and feet (when under 1,000 feet), statute miles, statute miles and meters (when under 1,000 meters), statute miles and feet (when under 1,000 feet), kilometers, or kilometers and meters (when under 1,000 meters)
  - ⇨ Waypoint Pass Criterion and distance
  - ⇨ Waypoint Approach distance
  - ⇨ Autopilot alarm control
  - ⇨ Cross-track error limits
- COG / SOG Filter Settings.

Take a quick look at both screens. They both have a graphical area to the right, and a text data area to the left.



The bottom left softkey is the *Zoom-In* softkey; the second softkey from the left is the *Zoom-Out* softkey. *These two softkeys are active without pressing the* **E** *key*. Each time you depress one of these softkeys, you scale by one-half or by double the graphical area. If you look to the top of the screen, just right of the *page number* (*PLOT 1* or *PLOT 2*), you will see a number in a white square. This is the scale of the graphic window based on the units selected in **CFG1** *Navigation*. Now look along the left and right edge of the graphic window, you will see some vertical black and white dash marks (these are harder to see at small scales like 1 and 2 or at large values such as 64 or 128). Each solid dash mark represents 1 nautical mile. A broken dash mark indicates 1/100th of a nautical mile when you are zoomed in at low scale. You will find your bearing and range to the next waypoint (**PLOT1**) or marker position (**PLOT2**) just below the page number. The PLOT2 screen also provides the marker coordinates and the datum currently in use (set in **CFG1** *Datum*).

The **CFG1** *Navigation* menu allows you to display fractions of the major unit (nautical miles, statute miles, or kilometers) ranges less than 1000 in alternate units of feet or meters.

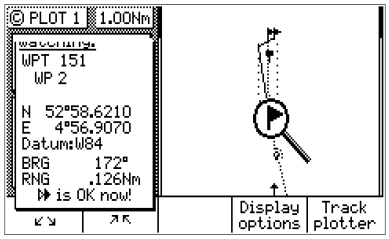


PLOT 1 - Relative to Boat

The information in PLOT1 is always relative to your present position. The boat always remains in the center of the screen and the bearing and range are always from your present position to the next waypoint identified in **RTE1**.

Modifying the Active Route Using the Plot Screen

Press the **E** key to modify the screen to your needs.



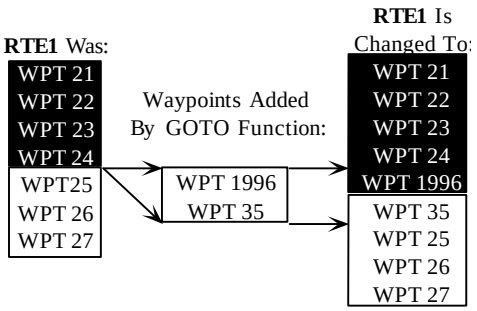
You will notice that a magnifying glass icon appears in the middle of the screen. This icon is used to identify waypoints and symbols which appear on the plot screen. Use the cursor key to move the magnifying glass around. Zooming out allows you to move the magnifying glass over long distances at a faster rate. When the icon is on a symbol, it identifies the symbol in the text area under the description of *Watching:*. This information includes the *Waypoint Bank* storage location (WPT 25), the waypoint description that you gave it, the waypoint coordinates and datum in which it is stored, and your present bearing and range to this location (as opposed to the waypoint you are traveling towards in your active route).

If you want to alter your present course, you can do it very quickly from here.

1. Move the magnifying glass to the new waypoint you want to go to.
2. Press the **GOTO** function key.
3. Press the **E** key. You are done!

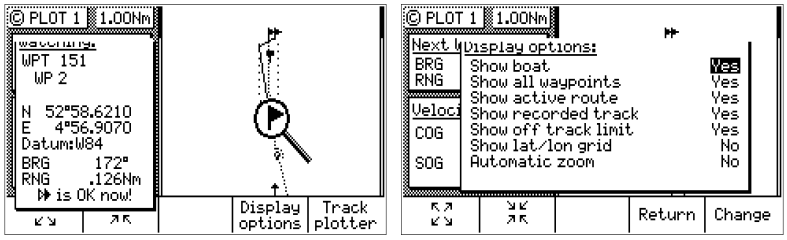
What the above routine actually does is insert two new waypoints into your active route. Let's say that you have an active route with 7 waypoints (21 through 27) in it. Some time after you pass the first 4 waypoints (WPT 24), you decide that you want to alter your course to a waypoint in the Waypoint Bank, but you can't recall the waypoint

number. So you go into the **PLOT1** screen, locate WPT 35 with the magnifying glass and press the GOTO function key. At this point, the active route (RTE1) is modified by placing a new waypoint, your present position (i.e. WPT 1996), after WPT 24. This new waypoint is shown in inverse video, indicating that you have already passed the position. This is good for you because you can indicate in your logs later on when and where you altered your course by the time stamp and coordinates in WPT 1996. Next, you will see WPT 35 in normal video, followed by waypoints 25, 26, and 27.



Customizing the Display

There are a number of display options available, press the **E** key to modify the screen to your needs.

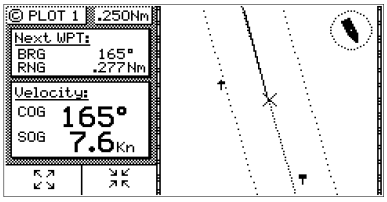


Press the *Display Options* softkey.

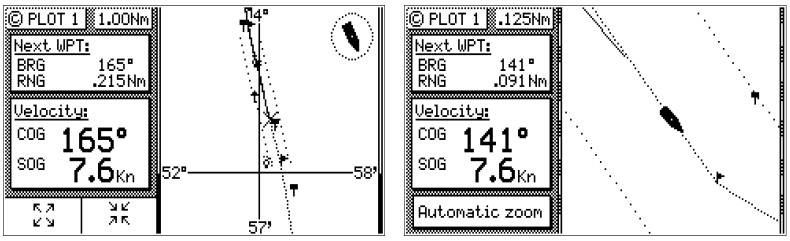
The following choices are available:

- *Show Boat - Yes* is the default condition, which places the boat icon in the middle of the screen. *No* places the boat in a Compass Rose in the upper right corner of the screen (see the diagram below), where your direction is indicated by the boat in the Compass Rose. The boat's position is then indicated by an X in the center of the screen.

- *Show All Waypoints* - *Yes* is the default condition, which displays all waypoints, where the first character of the description is a symbol, in its proper location relative to the boat's position. *No* causes none of the waypoints to be displayed.
- *Show Active Route* - *Yes* is the default condition, which causes the active route (course lines) and its waypoint symbols to be displayed. *No* causes the course lines not to be displayed. Note that these lines can only be displayed in Rhumb Line navigation mode (see **CFG1** *Navigation*).

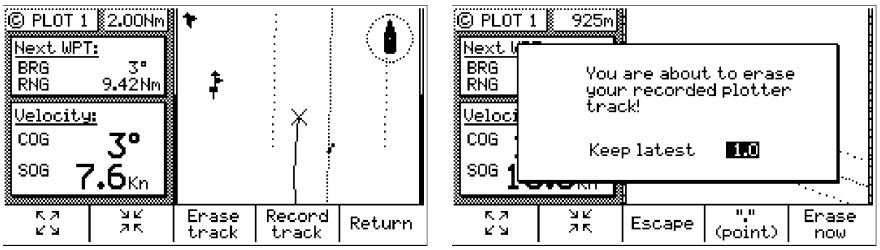


- *Show Recorded Track* - *Yes* is the default condition, which causes the course you have already traveled to be displayed. *No* causes the traveled course not to be displayed.
- *Show Off Track Limit* - *Yes* is the default condition, which causes the active route cross-track error lines to be displayed. These are only displayed for the leg of the course you are presently on. If you reset your cross-track error, these lines are redrawn to reflect the course change (see **NAV2**). *No* causes the cross-track error lines not to be displayed. Note that these lines can only be displayed in Rhumb Line navigation mode (see **CFG1** *Navigation*).
- *Show Lat/Lon Grid* - *No* is the default condition, which causes the coordinate grid not to be displayed. *Yes* causes the Lat/Lon grid to be displayed (regardless of positioning reference system selection in **CFG1** *Position*). Note that the grid is only displayed at the 4 Nm scale or lower.

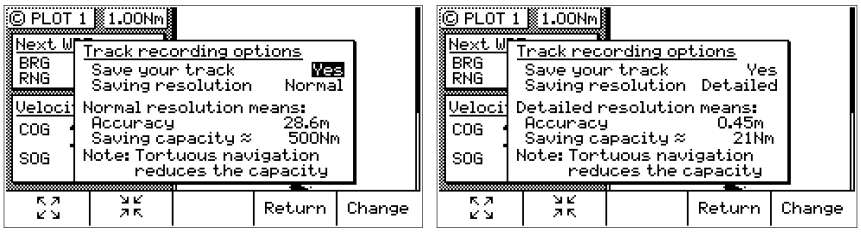


- *Automatic Zoom* - *No* is the default condition, which causes the displayed scale to be controlled by you. *Yes* causes the boat icon to be placed along one edge of the screen and the next waypoint flag to be placed along the opposite edge of the screen. As you approach your waypoint, the screen will automatically zoom in on your course, then expand back out after you pass the waypoint and start the next leg of your course.

If you press the *Return* softkey, then the *Track Plotter* softkey, you will access the recorded track options.



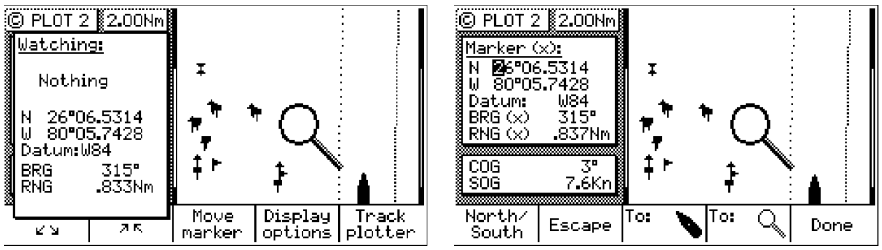
Selecting *Erase Track* allows you to clear your recorded track. You can keep a portion, say the last mile or two, of your recorded track if you like, by specifying the range after you press the *Erase Track* softkey. Press *Erase Now* to confirm your action. Press *Escape* to return the previous screen without erasing or **E** to abort this process.



Selecting *Record Track* allows you to define how your course is saved. Choosing not to save your track may free the processor up to run other functions a little bit faster; however, you are not likely to notice any difference in performance unless the four data ports are near their full throughput capacity. You also have three different levels of track saving capability: *Normal*, *Fine*, and *Detailed*. The software saves each calculated position coordinate to draw the lines for the plot screen. There are a finite number of plot points which can saved in memory, before the CDU begins overwriting the first set of plot points. If you are traveling a long distance at a high rate of speed (say over 10 knots) you probably will want to use the *Normal* selection, which only stores a plot point when your direction changes. If you are doing some tight maneuvering or station keeping tasks, you will probably want to use the *Detailed* selection, which stores a position every 0.5 meters. The *Fine* selection stores a plot point every 7 meters.

PLOT 2 - Relative to Marker

The **PLOT2** functions are the same as the **PLOT1**. Refer to the previous section for customizing the display. One added feature to the **PLOT2** screen is the ability to place the marker at any coordinate that you want and have the CDU automatically calculate a bearing and distance to the marker.



If you want to relocate the marker, press **E** to enter the edit mode, then press the *Move Marker* softkey. You can move the marker by: defining a coordinate (see the flashing cursor over the coordinates in the upper left window), moving the magnifying glass using the cursor keys and pressing the *To* softkey, or by pressing the *To* softkey, which moves the cursor to the boat's present position. If you choose to use the magnifying glass method, make sure you move this icon before you select the *Move Marker* softkey. After you press the *Move Marker* softkey, pressing on the cursor keys only allows you to move within the coordinate fields.

Plot Screen Use Examples

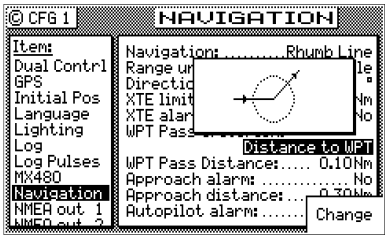
Station Keeping

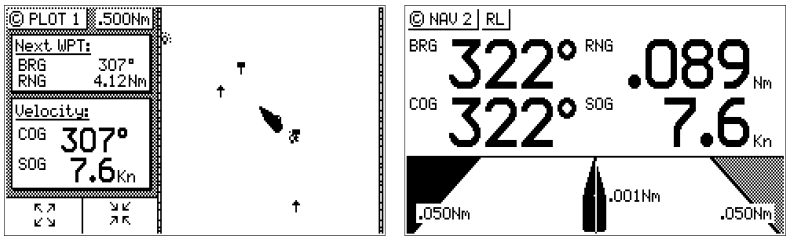
There may be a time when you want to maintain your position at a given location in open water. Some applications for this need may be:

- Staying over a dive wreck.
- Staying over a fishing hole.
- Recovering an oceanographic survey point.

You can easily accomplish this task by two methods: by placing the marker in **PLOT2** on the location you want to maintain and by referring to the bearing and range in **PLOT2** to maintain the position. If you are placing and recovering crab pots along a course line, you can enter your course in the **RTE1** screen, then place the marker at each crab pot in turn.

You can also select *WPT Pass Criterion: Distance to WPT* in the **CFG1** *Navigation* screen and set the *WPT Pass Distance: 0.00;* or set the *WPT Pass Criterion* to *Manual*.





By doing this and putting the coordinate you want to maintain in the **RTE1** screen, you will always get the bearing and distance to the waypoint in the **PLOT1** and **NAV** screens, regardless of your angle of approach. Note for the plot example above, we turned off the cross-track error lines, the active route, and track saving to keep the screen from getting cluttered while drifting.

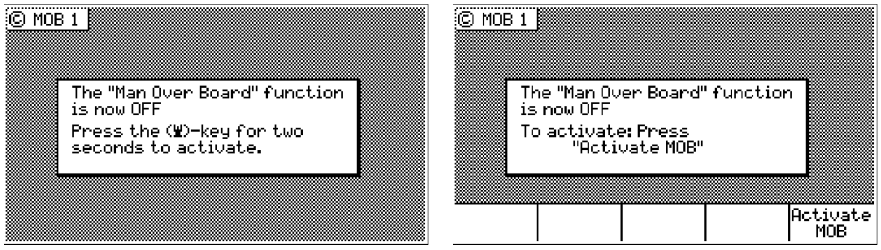
Grid Search

If you are attempting to search a given area, you can use the **PLOT2** screen to define a known coordinate in your search pattern, then use both the **PLOT1** and **PLOT2** screens to view your progress and help maintain your proper separation. You can also use the **RTE1** screen's *Insert New WPT* feature in conjunction with the **CFG1** *Navigation, WPT Pass Criterion: Distance to WPT* (set the *WPT Pass Distance:* to the smallest acceptable value) to create the search pattern you want to follow. In the **RTE1** screen, press *Insert New WPT* to define the coordinates of the first waypoint. Then use the *Insert New WPT* softkey to define subsequent range and bearing coordinates from your original position. This technique allows you to quickly define your search pattern, control the pattern separation, and view your progress along the way. The CDU will prompt you to turn at the predetermined waypoints you defined. This allows you to pay more attention to the task at hand, rather than having to keep a close eye on the GPS receiver.

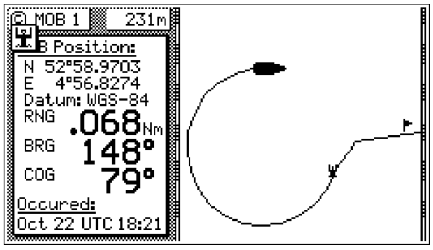
Man Over Board

The Man Over Board function key is located at the bottom right hand corner of the CDU. When depressed for a few seconds, it activates a number of automatic functions described below. You can also active it by pressing **E** and selecting the *Activate MOB* softkey.

Most obviously, it brings up an **MOB1** (Plot) screen. This is an automatic scaling screen. The screen centers on half the distance between your present position and the MOB position. In addition, the MOB position is displayed in the upper left corner, so that you can quickly read the coordinates to others who may be available to render assistance. This plot screen also provides the vital bearing and distance back to the MOB position, as well as your present course over ground.



The MOB position, date and time are stored in the next vacant waypoint memory of the Waypoint Bank for future reference (e.g. log book entries). An MOB symbol is used to denote an MOB waypoint.



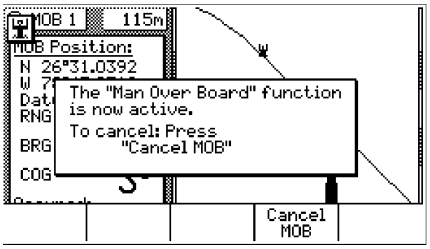
Note: The range and bearing in the PLOT, NAV, and MOB screens all reflect your bearing and range back to the MOB position, not the active route, until the MOB is canceled.

NMEA 0183 sentences (i.e. BWC and BWR) and the printer output are changed to reflect the current crisis situation by also indicating the bearing and range back to the MOB position (until the MOB is canceled). This way, other interfaced equipment can also help guide you back to the MOB position. When the MOB condition is canceled, the NMEA sentences will automatically revert to the active route information. *Don't forget to cancel the MOB so your interfaced equipment will read the correct data!*

The MOB function key and remote MOB input are disabled from subsequent activation until *Cancel MOB* is selected.

Other functions such as *Position* and *Navigate* can still be accessed; however, the screen will revert to the MOB Plot screen after 30 seconds.

To cancel an MOB condition, make sure you are in the MOB Plot screen. Press the **E** key, then select the *Cancel MOB* softkey. Press **E** again to exit the edit mode.



Tide

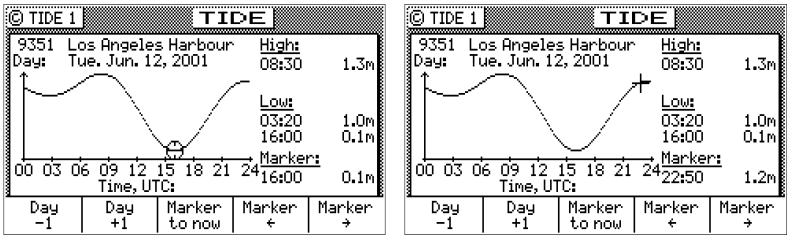
There are two **TIDE** screens. The **TIDE1** screen displays graphic and digital information about the tide conditions at your present position. This is based on tide table constants that you must enter in the **TIDE2** screen, then access through the **TIDE1** screen. You can store up to 100 tide tables in **TIDE2**.

The following **CFG1** menus directly impact the **TIDE** functions:

- Depth - sets the measurement units in meters, feet, or fathoms.

TIDE1 - Current Tide Display

This screen provides the current tide conditions for the tide constants indicated in the upper left hand corner. The number in the upper left corner of the window is the identification number of this table in the *British Admiralty Tide Table* and in the **TIDE2** screen. The name to the right of this number is the port name you entered in the **TIDE2** screen.

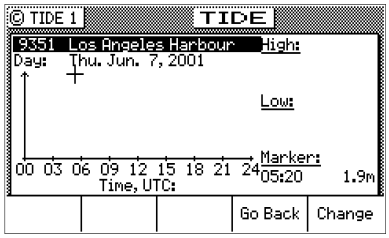


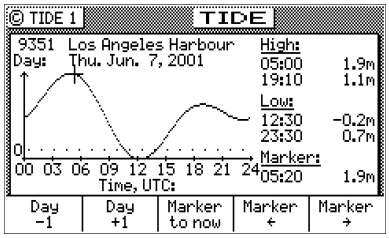
A graphical representation of the tide is given in the middle of the screen. The tide peak references are given to the right of the High/Low time on the right of the screen. High/Low tide times are given to the right of the graph. The marker time (indicated by the clock icon or + sign in the graphic area) and tide condition are given below the High/Low tide information.

The tide marker automatically updates to the current time. When the tide marker is in the automatic mode, the cross-hair indicator is enclosed with a circle (like a clock). You can move the marker forward or backward in time using the softkeys at the bottom of the screen. Return the marker to the present time by simply pressing the *Marker to Now* softkey. When you move the tide marker off of the present time, the marker changes to a + sign. The marker will remain at the manually positioned mark until you either press one of the manual marker con-

trol softkeys, or until you press the *Marker to Now* softkey - which returns the marker to automatic mode (indicated by the clock marker).

The tide measurement units can be displayed in meters, feet, or fathoms. Tide units are controlled along with depth units in the **CFG1** *Depth* screen.





To select another port's tide table, press the **E** function key, and use the *Change* softkey to scroll down the list or the *Go Back* softkey to scroll up the list. You can also use the left and right cursor keys to scroll through the tide tables available in **TIDE2**.

While in the edit mode, you can also move the cursor down to the date and manually change it to any date you are interested in.

Once you have found the table you need, press the **E** key again to load the table.

TIDE2 - Tide Table Port List

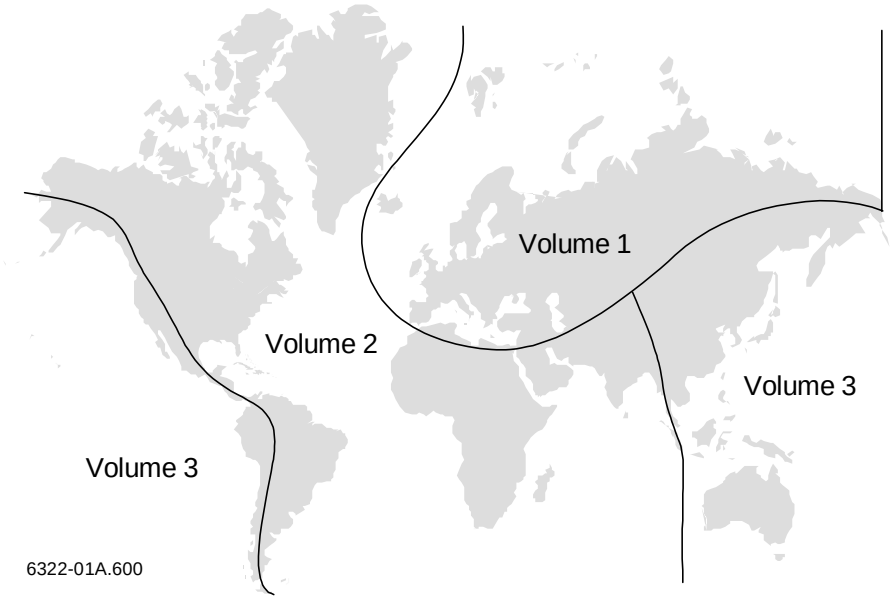
TIDE2 is where you store the constants for the port tide tables you are interested in. You can store up to 100 tide tables. The constants you need can be derived from Part III of:

Admiralty Tide Tables and Tidal Stream Tables
Published by the Hydrographer of the Navy,
United Kingdom

Hydrographic Office
Tauton, Somerset TA1 2DN
United Kingdom

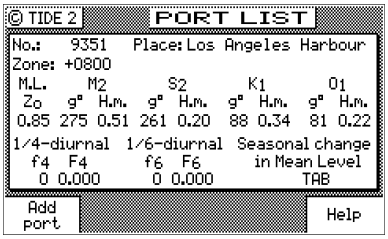
+44-1823-337-900
+44-1823-323-753 Fax
46274 Telex

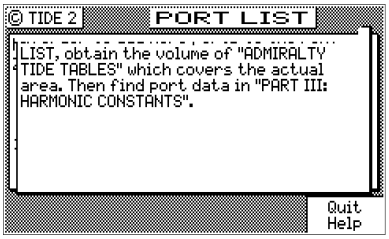
This is a three volume set of tide tables, divided as follows:



The display provides the required tide table document name and section (Admiralty Tide Tables, Part III) under the *Help* softkey when in the edit mode as an added aid to help you identify the proper reference material.

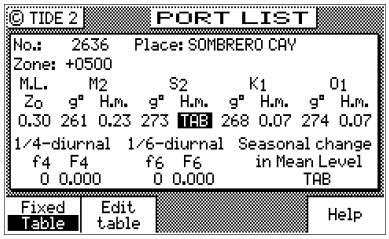
The *Admiralty Tide Tables* port lists are also available, free of charge. Contact your dealer or us at the address, fax, e-mail, or phone number provided at the back of this manual if you have not received a copy of these tide table lists.

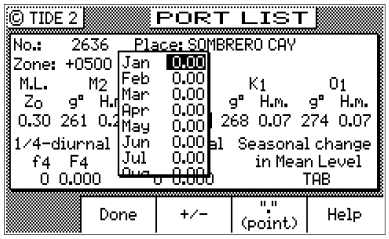




Adding a Port

To add a port to the list, first locate it in Part III of the tide table book, then align the cursor with *Add port to the Port List* and press **E**. The *Zone* in the upper left corner refers to the time zone offset to UTC. Use the name given in the tide table for the name given in the *Place* portion of the screen. To help you locate this port in the printed volume later, use the table number given in the first column of the manual as the tide number in the CDU.





Then simply follow along the table in the manual and enter the appropriate offsets. The software is setup just like the manual. You may encounter a table that requires seasonal offsets. Where these might apply, the CDU provides you the opportunity to input a *Fixed* value or the seasonal *Table* values. Select the first softkey to toggle between these two selections. Use the second softkey, *Edit Table*, to make the necessary corrections. Press the *Done* softkey when you finish the seasonal table, otherwise press the **E** key when the necessary data is entered.

You can scroll through the entered tables with the up and down cursor keys when you are not in the edit mode. You also always have the option to modify or delete a port from the list.

Tide table information is mapped to an area of RAM which is saved during future software upgrades.

Auxiliary

There are seven **Auxiliary** screens described in this section:

AUX1 - Alarm Log

AUX2 - Speed Graph

AUX3 - Not Used

AUX4 - Sun Almanac

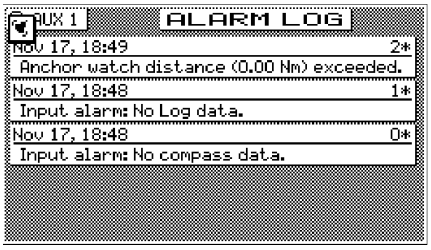
AUX5 - Moon Phases

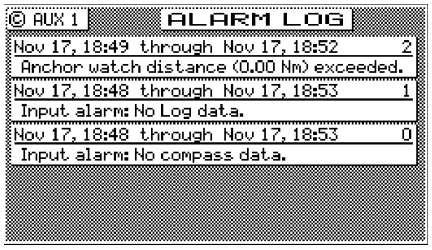
AUX6 - Batteries

AUX7 - Unit Information

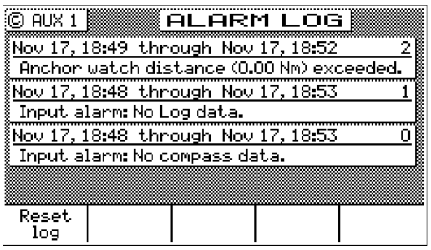
AUX1 - Alarm Log

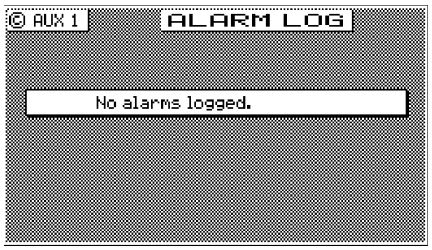
All alarms are registered in this screen, whether or not they have been corrected, until the log is erased or the log is full. When the log is full, the oldest alarms are overwritten. Alarms with an asterisk (*) next to the alarm number have not been corrected and can not be reset until they are corrected.





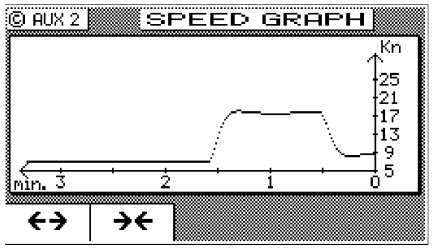
Reset Log clears the alarm log entries, except for any alarm conditions which have not been corrected and any alarms which have occurred since the uncorrected alarm.





AUX2 - Speed Graph

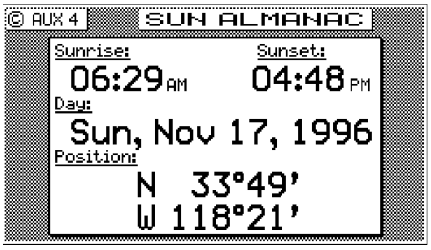
The graph scales automatically to the speed you are at. You can zoom out to the last 56 minutes or in to the last 3.5 minutes. It is a handy tool if you are trying to maintain a certain speed.

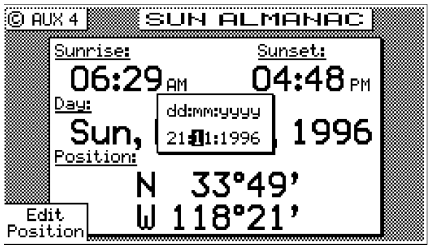


AUX3 - Not Used

AUX4 - Sun Almanac

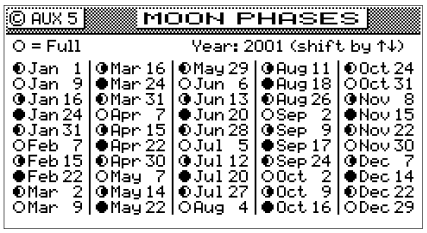
This almanac provides the sunrise and sunset times for a given day and location. You can enter another date or location of interest by pressing the **E** key, and editing the appropriate date and/or place.





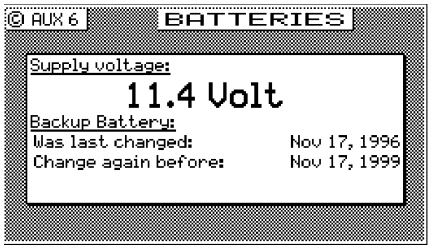
AUX5 - Moon Phases

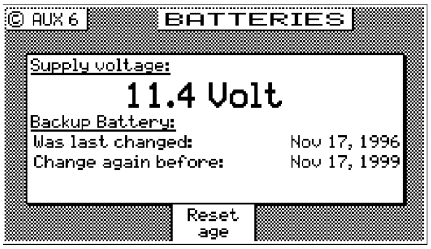
There are no edit functions available here. Moon phases are given in approximately one week increments and include all dates for new, half, and full moon. You change the year displayed by pressing the up or down cursor keys.



AUX6 - Batteries

The supply voltage indicates the *approximate* power being applied to the CDU. This screen is intended to give you a rough indication of the supply voltage. It is not a digital voltmeter and can be off by 0.5 VDC or more. Use it like you would a car battery indicator. The voltage should remain constant when the generators are on, and drop off slowly when running on the boat's batteries. This is also where you reset the Lithium battery age. Press the **E** key and select the *Reset Age* softkey after you replace the Lithium battery. Refer to the *Installation & Service Manual* for instructions on replacing the memory backup battery. This battery has a normal life of about 2 years.

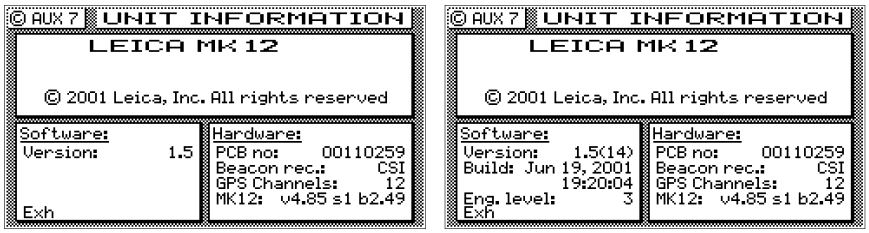




AUX7 -Unit Information

This screen indicates the specific CDU model, software version number, the hardware configuration, and the printed circuit board (PCB) serial number of your CDU. If you are having problems with your CDU, refer to this screen for information to provide to customer service personnel.

A special softkey sequence displays sub-version levels, the actual software build date and time, and allows access to a selftest sequence. This information is useful to the technician and our Field Engineers during troubleshooting. To activate the screen, press the left most softkey three (3) times. Additional information in the *Software* window will be displayed.



MK12 AUX7 Screens

This also activates several engineering screens (the same as turning *Engineering Display* to *Yes* in CFG1 Operation). Refer to *Appendix C - Engineering Mode* for more details.

Position

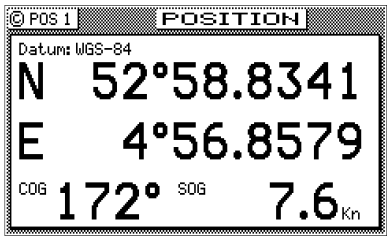
There are three **POS** screens in the CDU. The **POS** functions are highly interactive with a number of **CFG1** menu selections.

The following **CFG1** menus directly impact the **POS** functions:

- COG SOG - sets the filtering time for the displayed values.
- Datum - sets the reference datum for your present position.
- DGPS - sets the internal or external control for RTCM SC-104 corrections which affect your position accuracy.
- GPS - sets an offset for calculating the GPS antenna position if you can't physically locate the antenna exactly where you want it (i.e. over the centerline of the boat); sets the minimum elevation angle to look for satellites; and in 6 channel models, it also controls the satellite selection process.
- Navigation - sets a variety of important functions and alarms (used in other function screens), but only the Range units:
  nautical miles (Nm)
  nautical miles and meters (Nm/mtrs)
  nautical miles and feet (Nm/ft)
  statute miles (Sm)
  statute miles and meters (Sm/mtrs)
  statute miles and feet (Sm/ft)
  kilometers (Km), or
  kilometers and meters (Km/mtrs), affect the **POS** screens.
- Position - sets 2D or 3D mode, antenna height, Lat/Lon, Loran or Decca TDs, or UTM, Grid (optional) and some alarm limits.
- Time - sets appropriate offsets, and 12 or 24 hour clock mode.

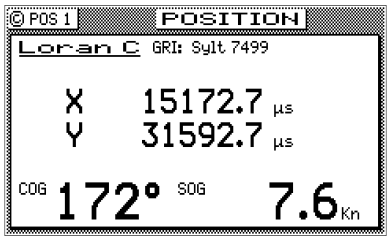
POS1 - Position Display (Large)

This single window display provides the largest presentation of the coordinate information from the CDU. In addition to the coordinates and datum in use, this screen displays the current course and speed over ground. There are no edit functions available in this screen unless it is in *Demonstration* mode. Refer to *Appendix E - Demonstration Mode* for a full description of this feature.



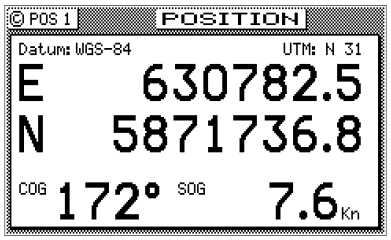
Loran-C

The *POS1* screen expands to accommodate up to four (4) TD's in areas where a fourth TD might be available.



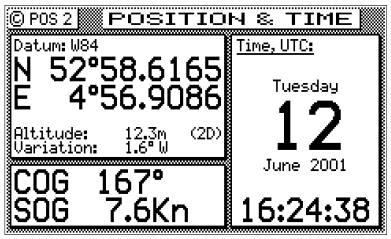
UTM

When using the UTM reference system in the polar regions of the Earth, the CDU displays position using the UPS coordinate system instead of invalid UTM coordinates.



POS2 - Position, Altitude, Magnetic Variation, & Time

This screen is divided into three windows. The upper left window provides your position coordinates, the antenna altitude (above Mean Sea Level - MSL), altitude mode (2D or 3D), the magnetic variation (Variation) for your present position, and the present datum in use for calculating your position.



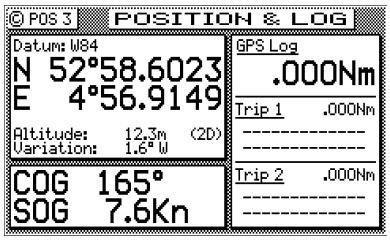
The lower left window displays your course and speed over ground. If the degree symbol has a small ‘c’ under it, this indicates that the magnetic variation and compass deviation table are being calculated and displayed. Refer to the **CFG1** *Compass* section for more details on how to set this up.

The right hand window indicates today’s date and time. This setup is in the **CFG1** *Time* menu. It can be set for UTC time, local 12 hour time, or local 24 hour time. There is an added summer/winter feature to help you remember which direction to set the clock for day light savings in the summer.

There are no editing capabilities in this screen.

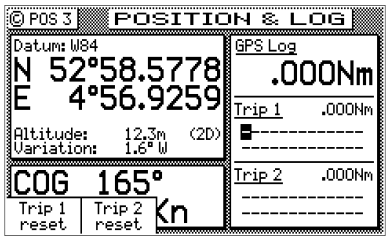
POS3 - Position & Log

This screen is divided into three windows. The upper left window is the same as **POS2** and provides: your position coordinates, the antenna altitude (above Mean Sea Level - MSL), altitude mode (2D or 3D), the magnetic variation (Variation) for your present position, and the present datum in use for calculating your position.



The lower left window is also the same as **POS2** and displays your course and speed over ground. If the degree symbol has a small c under it, this indicates that the magnetic variation and compass deviation table are being calculated and displayed. Refer to the **CFG** *Compass* section for more details on how to set this up.

The right hand window indicates your accumulated mileage since the CDU was first turned on.



You will also find two *Trip Reset* softkeys if you press the **E** key. Two trip logs are provided so that you can log the mileage for:

a) the current leg or day of your trip; and

b) the entire trip.

You will also find a flashing cursor on the second line in the *Trip Log*. This is provided so that you can label what type of mileage you are logging. Edit this field the same way you would any of the description fields for the waypoints.

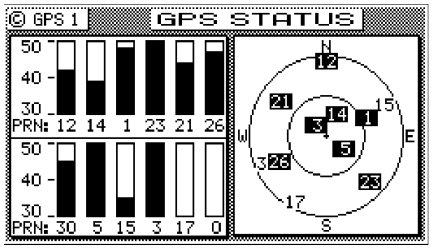
GPS

Three screens are available under the **GPS** function key. The **GPS/ DGPS** functions are highly interactive with these **CFG1** menu selections:

- GPS - sets the lowest elevation at which a satellite will be tracked.
- DGPS - sets the internal beacon receiver to Auto, DGPS only, or Off.

GPS1 - GPS Status Screen

There are two windows in this display. The left window has twelve graphic *Power Bars* representing the twelve GPS receiver channels of the MX421 antenna. The *PRN* (PseudoRandom Number) under each power bar represents the satellite ID number assigned or being tracked on that channel. The power bars indicate the valid receiver power range from 30 to 50. Any portion of the power bar which is filled in, indicates that a satellite is being tracked on that channel. If a power bar is empty, but a PRN number is labeled under the power bar, then the identified satellite is not currently being tracked.

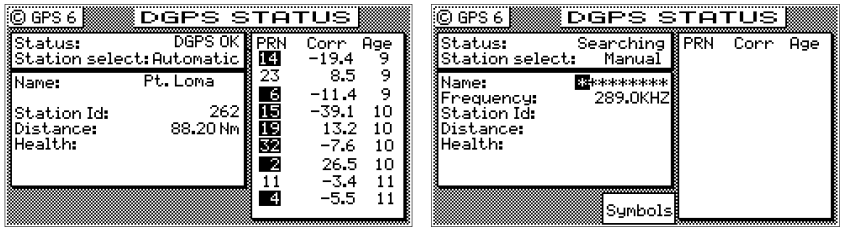


The graphic on the right hand side of the screen indicates where the satellites are relative to your present position. The outer ring represents 0° elevation. The inner ring represents 45° elevation. The + sign represents 90° elevation and your present position. Under normal conditions, the best satellites to track are usually between 15 and 75 degrees in elevation.

GPS 2 through GPS 5 screens are skipped under normal operation.

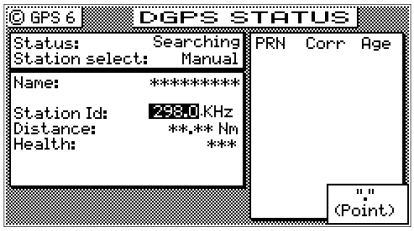
GPS6 - DGPS STATUS

There are three windows in this display, the two left hand windows are divided into control and configuration windows. The right hand window displays all the corrections that are being received.

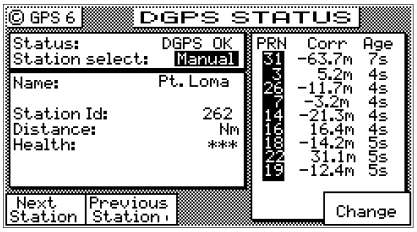


Status will tell you whether the correction data is being decoded is error free or not. Normally, *Status* will indicate *DGPS mode Off, DGPS OK, Tracking* or *Searching*. *DGPS OK* indicates that RTCM SC-104 DGPS corrections are being received without errors within the *Age Limit* set in **CFG1** *DGPS*. These can originate in the MX421B beacon receiver. *Searching* indicates that the beacon receiver is searching for the appropriate frequency and/or modulation of the beacon transmitter. You might see the label *Tracking*, which indicates that a MSK beacon signal is present but DGPS corrections are not being received. This is usually caused by high noise on the beacon receiver or external device.

If you press the **E** key, you can select between *Automatic* beacon search mode, *Manual* beacon tuning mode, or *Off* (models with built-in beacon only). When the receiver is in the *Manual* mode, you can use the cursor key to scroll down into the large window below *Station Selection* and edit the *Reference Station* name. The name you enter will always be associated with the frequency to which you programmed the receiver. If you move to another region that uses a frequency and name you previously entered, the receiver will display the previously entered name. You can enter a new name for any manually tuned frequency at any time.



Use the cursor key to move down the screen again and program the frequency you desire. The receiver will automatically update the *Station ID*. If the beacon station is transmitting its location, the receiver will calculate the distance between the reference station and the receiver. You can usually find current beacon status, location, and operating information from the governing country's Coast Guard or Maritime Safety Administration. You will find a list of known beacon stations in *Appendix B - Beacon List* at the end of this manual. This list may be incomplete at your location, in which case we encourage you to contact the appropriate governing agency.

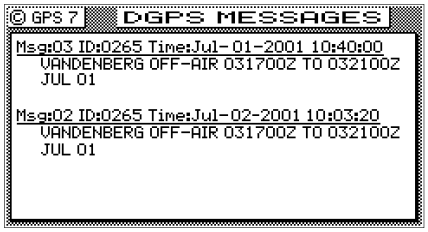


Once you have entered the data for several beacon stations, you can cycle between these stations by pressing the *Next Station* or *Previous Station* softkeys. These softkeys are only displayed if you have entered a name for the reference station.

The window on the right side of the display indicates which satellite ID's are receiving corrections. When the *PRN* number is shown in inverse video, this indicates that the receiver is using the correction in the navigation solution. The *Corr* value is the actual satellite range measurement correction, given in meters. This value is typically between -20 and +20. The *Age* value indicates how long it has been since the satellite range correction was generated, given in seconds.

GPS7 - DGPS Messages

This screen will display the RTCM Type 16 messages received from the beacon station being used. These messages may contain information regarding operational problems and status or any scheduled equipment maintenance of beacon stations operating within the general area.



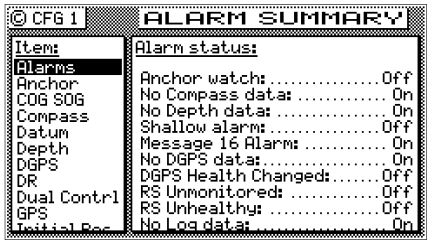
Configuration

There is one **CFG** screen in the receiver during normal operation. Additional configuration screens can be activated for special purposes, as described in the *Engineering Mode* section for example. The **CFG** screen includes setup and control of all of the receiver's primary functions. There are more than 20 separate configuration items in this screen. The display is divided into two windows. The left hand window identifies the primary configuration item. The right hand window displays the current settings. Use the cursor key to select a configuration item of interest, then press the **E** key to edit the actual settings. There are some settings which can not be changed; however, these are displayed so that you have a better understanding of exactly how the receiver is configured. The *Item* list is arranged alphabetically based on the language chosen. This section of the manual is arranged alphabetically for English. You may choose to skip to only the items that interest you at first, then read this complete section at a later time.

Note: This option lists is too long to display on one page of the display. To be sure you have viewed all of the configuration options, scroll through to the bottom of each list with the cursor key.

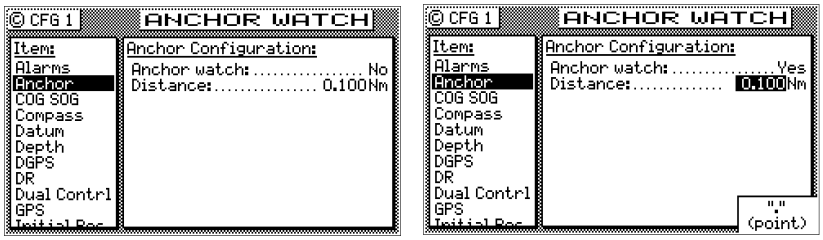
Alarms

This screen allows you to quickly see which alarms are active and inactive. The list of available alarms is interactive with the remaining screens described in this section. Therefore, changing the state of the alarm in a screen such as *Anchor* from *Off* to *On* will also cause the anchor alarm in this screen to go from *Off* to *On*. Likewise, if you turn the anchor alarm from *On* to *Off* in this screen the *Anchor* screen will also match this one.



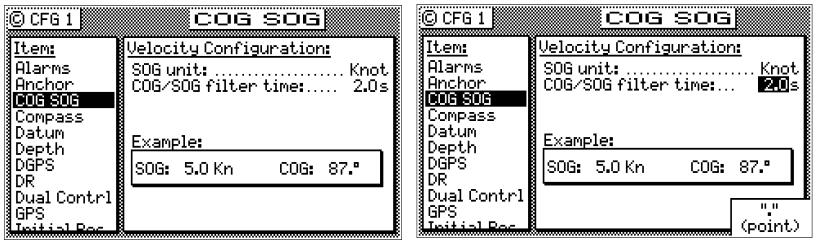
Anchor - Anchor Watch Alarm

This screen allows you to setup an anchor watch alarm and maximum drift radius after you the drop anchor. The receiver will remember the drop coordinates and provide an alarm if the antenna drifts beyond the maximum distance you entered. If you are on a large commercial ship, don't forget that the anchor may be several hundred feet from the receiver antenna. You will need to consider this when setting in the distance.



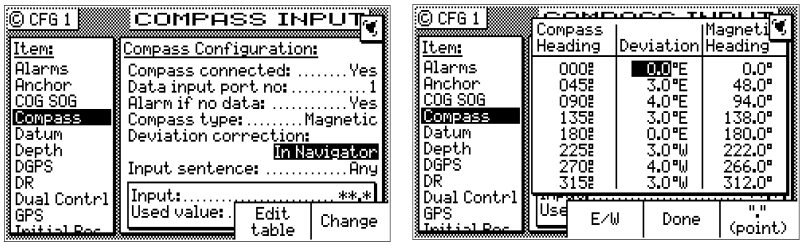
COG SOG - Course & Speed Filter Settings & Setup

This screen controls the Speed Over Ground (SOG) units of measure (meters per second, kilometers per hour, miles per hour, or knots). You can also set a filter time to average your speed and course over ground measurements. This helps to smooth these measurements on the display and NMEA output, a particularly useful tool for slow moving vessels and vehicles. The default filter setting is 10 seconds.



Compass - External Compass Input & Magnetic Variation Table

The receiver will accept a magnetic compass input using the NMEA 0183 data record of xxHDT, xxHDG, xxHDM, xxHCC, xxHCD, xxVHW, or any of the above. “xx” refers to the Talker Identifier as specified in the NMEA 0183 standard. The receiver will accept these data records from any talker ID, and from any version (1.5 to 2.1) of the NMEA 0183 standard.



To implement this feature, change *Transducer Connected* to *Yes*.

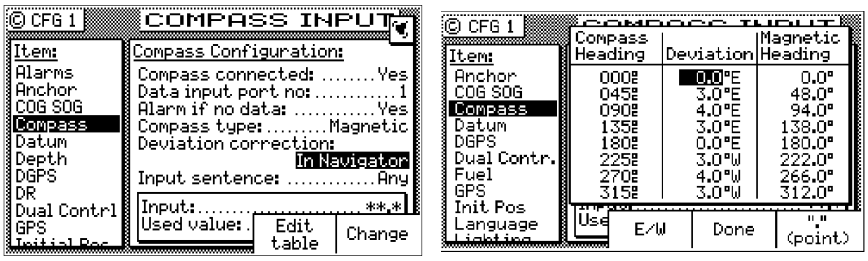
Identify the appropriate input port that the compass connects to the receiver using the *Change* softkey or cursor.

Select whether or not the receiver should give an alarm if data is not received on the input port.

Select the compass type, either *Magnetic* or *Gyro*. Only the NMEA 0183 records identified above are accepted for the gyro input.

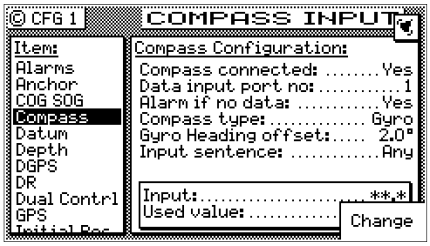
Magnetic:

Select the magnetic deviation method: either *In Compass* - the deviation is corrected before being sent to the receiver; or *In Navigator* - the deviation is corrected by editing a deviation table (*Edit Table* softkey) in the receiver.



Gyro:

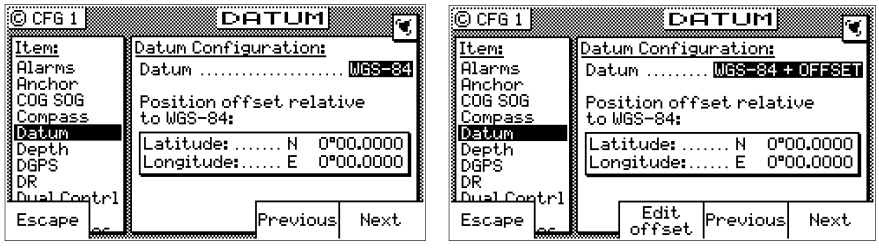
Set the constant *Gyro Heading Offset* (or bias) if any.



Specify the input NMEA 0183 record for the *Input Sentence*. HDT, HDG, HDM, HCC, HCD, VHW, or Any.

Datum - Current Position Calculation

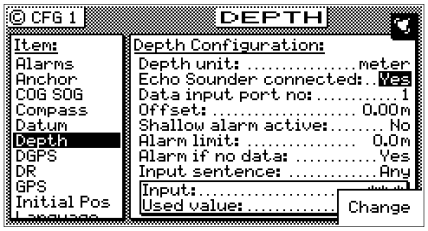
This screen controls which datum the receiver uses to display any position. There are over 100 datums to choose from. Appendix A provides a complete list of available datums. You can enter an offset to WGS-84 if your specific datum is not provided for in the receiver. Use the *Previous* or *Next* softkeys or the cursor key to scroll through the list until you find the datum you need. Press *Escape* to go back to the original datum displayed when you first pressed the **E** key.



Depth - NMEA Input Control

This screen allows you to configure the depth unit (meters, feet, or fathoms) for the *NAV 4* and *TIDE 1* screens .

Depth information is accepted by the receiver from the NMEA 0183 data sentence DBK, DBS, DBT, or DPT on any input NMEA port. Refer to the *Installation Section of this Manual* for hardware interface instructions.



Press the **E** key and move the cursor to the *Echo Sounder Connected* line. Use the *Change* softkey to activate the input data options described below:

Depth Unit - select between meters, feet, or fathoms. This data field sets the depth unit displayed in *NAV 4* and *TIDE 1*, regardless of whether a sensor is connected or not.

Echo Sounder Connected - causes the receiver to look for one of the appropriate NMEA 0183 data sentences when set to *Yes*.

Data Input Port No. - Select the appropriate NMEA 0183 port that the sensor is connected to (Ports 1& 2 for MK12/2 or Ports 1,2, 5-10 for MK12/8). Ports 3 and 4 are reserved for the MX421 antenna controls.

Offset - Input the appropriate offset for the sensor, based on the measurement you are most interested in. If your boat draws about the same amount of water each time you use it, you may want to put in the difference between the sensor and the height and the waterline height. If your boat's draw changes from one trip to another, as would be the case when the receiver is used on a freight ship, you may want to put in the difference between the sensor and the lowest point of the ship's hull.

Shallow Alarm Active - allows you to receive an alarm if the sensor receives depth data lower than the limit you set in *Alarm Limit* (below). The default setting is *Yes*.

Alarm Limit - allows you to specify at what depth you want an alarm to activate. This alarm limit is enabled by the *Shallow Alarm Active* selection of *Yes*.

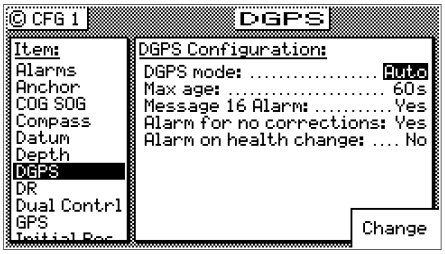
Alarm If No Data - Allows you to receive an audible and visual alarm if NMEA 0183 data is not being received on the data port at regular intervals (typically every few seconds). The available choices are *Yes* and *No* (default).

Input Sentence - Specifies the NMEA 0183 data sentence to read the depth data from. The available choices are *Any (default), DPT, DBS, DBT,* or *DBK* sentence. It is better to specify the appropriate sentence because more than one method of reporting depth may be available on the port.

The window in the lower portion of the screen allows you to see the depth data that is received on the data port (*Input:*) and the data that is actually displayed in *NAV 4* (*Used Value:*).

DGPS - DGPS Configuration

This screen controls the built in beacon receiver in the MX 421B antenna.



Internal Beacon Menu

DGPS Mode:

Auto - sets the receiver to automatic DGPS or GPS modes. This is the default setting. If DGPS corrections are being received and their age is less than the *Max Age* limit, the receiver will operate in DGPS mode (assuming you are receiving corrections for enough satellites to operate in DGPS mode). Otherwise, the receiver operates in GPS positioning mode.

The traffic light will give a green indication when it is in DGPS mode.

When you drop to GPS mode, a DGPS symbol will be displayed (indicating Non Differential GPS mode), and the traffic light will change to Yellow/Green.

Use this mode when maximum navigation coverage is more important than accuracy. Reverting to GPS mode will degrade the overall navigation results, but it is better than no navigation results at all in most circumstances.

DGPS Only - sets the receiver to only provide DGPS position fixes. If corrections are being received and their age is less than the *Max Age* limit, the receiver will operate in DGPS mode (assuming there are enough corrections to operate in DGPS mode). Otherwise, the receiver will not provide any position fix at all.

Use this mode when accuracy is more important than maximum navigation coverage. When operating in this mode, you should also set the *Max Age* to *30* seconds.

Off - sets the receiver to operate in GPS mode only.

Max Age -sets the maximum time limit that the last received DGPS correction will be applied to the satellite range measurement in the receiver. The default setting is *60 seconds*. The receiver will accept values from 10 to 999 seconds. While the receiver will accept a longer period of correction aging than 60 seconds, we highly recommend that 60 seconds be the highest value you use, regardless of your application. Although the beacon system is rated for sub-meter accuracy, there is no guarantee that your receiver will always maintain this level of accuracy in all areas of differential coverage. Chances of maintaining this level of accuracy are far less if you choose to use an age limit longer than 60 seconds.

Message 16 Alarm - sets the alarm to On or Off if a reference station text message is received. The default setting is *Yes*. Received Type 16 messages can be displayed on the *GPS7* screen, regardless of the alarm setting.

Alarm For No Corrections - sets the alarm to on or off if DGPS corrections are not received within the Max Age. The default setting is *Yes*. If the alarm is set to *Yes*, you should notice that the

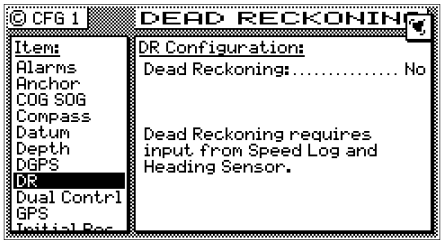
receiver drops out of DGPS mode and into the mode selected in *DGPS Mode* described earlier in this section at the same time the alarm sounds.

Alarm on health change - Sets the alarm to On or Off if the a satellite becomes unhealthy or unusable.

DR - Dead Reckoning

DR, or Dead Reckoning, is an added navigation capability the MK12 CDU can use, should GPS become unavailable, when appropriate compass/heading and speed log sensors are connected and activated. Set the following **CFG** menus along with the DR screen:

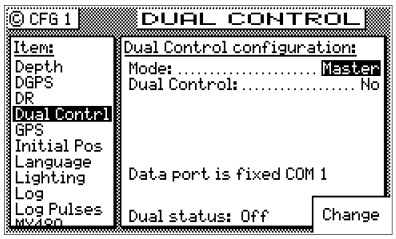
Set & Drift - sets the mode to Yes or No.



DR mode is either set to *Yes* or *No* (default). You also determine whether *Set & Drift* are used in the DR mode in this screen (default is *No*).

Dual Contr. - Dual Station Control

This screen sets the functional control between two MK12 CDU's interfaced together. The default setting is *No*. When this selection is changed to *Yes*, one receiver is set to *Master*, the other receiver is set to *Slave*. These two units will share a common database and one antenna. Refer to *Appendix D* for more detailed information about the dual control setup and operation.



MK12 Dual Control Menu

GPS - Elevation Mask Control

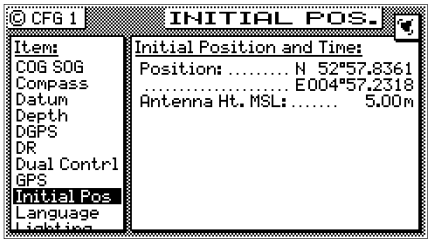
This screen controls the elevation mask angle, or the angle above the horizon, at which the receiver will attempt to track a satellite. Satellites with an elevation below this angle will be tracked but will not be included in the position solution. You can set the elevation limit to any value up to 45°. For most marine applications, the default limit of 5° is appropriate. However, there may be some applications where the receiver is used where a higher elevation limit is desired. For example, if you are trying to get the best possible position from the receiver and the environment you are in has significant foliage which causes low elevation satellites to "pop in and out," you might choose to set the elevation limit to 15° so that only satellites above the tree line are tracked.

Init Pos - Initial Position Entry

This screen is provided to help the receiver get a faster first position fix after a cold start (no almanac). While the receiver is capable of computing its position without any user input, this feature can cause a position fix to occur several minutes earlier in a cold start condition. The only other time this feature is useful is when the receiver has been moved over 300 miles from the last location it was used while being turned off. Again, the receiver will calculate a position fix without any user input in this circumstance. However, moving the receiver to a new location and not inputting a new initial position will cause the receiver to select a satellite constellation consistent with the last known receiver coordinates. In this event the receiver may "get lucky" and find common satellites between the old position and the new location, or it may take up to 20 minutes to go through all of the constellation possibilities. Note that the receiver will stay on the original constella-

tion for 15 minutes before attempting other constellation possibilities. We assume the receiver will be turned on and off in the same general area each time, and we provide the unit every opportunity to try and track satellites at the last known coordinates.

The only other fast way to get the receiver to find a new location quickly is to turn on *Auto DGPS (DGPS mode ON)* in **CFG** *DGPS*. The receiver will automatically retune the GPS receiver to look for satellites for which it is receiving DGPS corrections. If DGPS corrections are received, the receiver will acquire enough satellites to navigate with before the satellite almanac is collected.



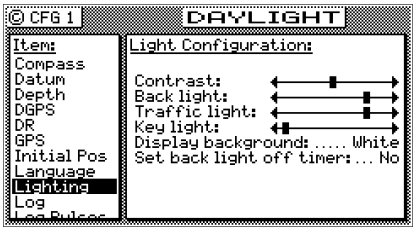
Language - Language Configuration

The receiver supports 9 languages: English, Dutch, French, Finnish, German, Italian, Spanish, Swedish, Danish

Press the **E** key. Use the cursor key to scroll down the list until you find the desired language. Press the **E** key again. The **CFG** menu list will sort the menu selections in alphabetical order based on the language selected.

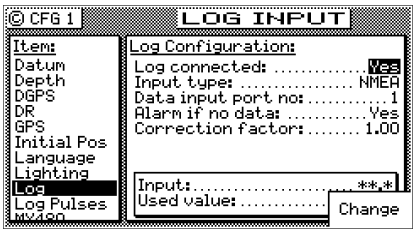
Lighting - Display/Keyboard Light & Contrast Control

There are two basic display setups. The light function key ◑ allows you to instantly switch between two predefined screens (*Daylight* & *Nightlight*).

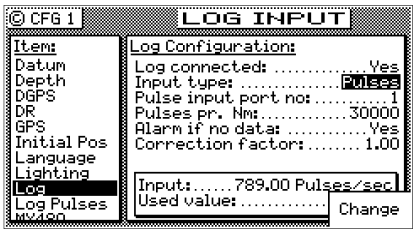


Log - Speed Log Input (Pulse or NMEA 0183)

This screen controls the input port (NMEA-0183 or Pulse) and format of the speed log input to the receiver. In the default condition, the speed log is not connected. NMEA 0183 speed is accepted from the xxVHW data sentence originating in any of the version 1.5, 2.0 or 2.1 format where xx is a valid talker ID as specified in the NMEA 0183 standard. The receiver will also accept speed log pulse input, with pulses of up to 1.5 kHz. Refer to the *Installation Section of this Manual* for the wiring interface instructions.



NMEA 0183 (VHW) Input Screen



Pulse Input Screen

NMEA Input:

Data Input Port No. - Select the appropriate NMEA input port as determined by the hardware interface. Refer to the *Installation Section of this manual* for wiring connection information.

Alarm If No Data - Causes an alarm to activate if data is not received on the port you defined within 10 seconds when *Yes* is

selected (the default condition). To disable the alarm, select *No* with the *Change* softkey.

Correction Factor - Allows you to make minor adjustments to observed or measured errors in your speed through water calculation. The input value will be multiplied by this value before it is used in the receiver. The default value is 1.00.

Digital Pulse Input:

Digital Pulse Input Port No. - Select between *Digital Input Port 1*, or *Digital Input Port* 2. A single pulse input which is calibrated for log pulse rate and the receiver will automatically make the necessary calculations.

Digital Input Port 1 is pin 3 (black/white) of Cable B connector and *Pulse Input Port 2* in pin 2 (black) of Cable B connector. Both ports share pin 1 (shield-GND or power ground) as a common ground. These input ports are different from the NMEA-0183 Input Ports 1 and 2.

Pulses Pr. Nm - This is the calibrated pulses per speed unit value that you must get from the speed log manufacturer.

Alarm If No Data - Causes an alarm to activate if data is not received on the port you defined when *Yes* is selected (the default condition). To disable the alarm, select *No* with the *Change* softkey.

Correction Factor - Allows you to make minor adjustments to observed or measured errors in your speed through water calculation. The input value will be multiplied by this value before it is used in the receiver. The default value is 1.00.

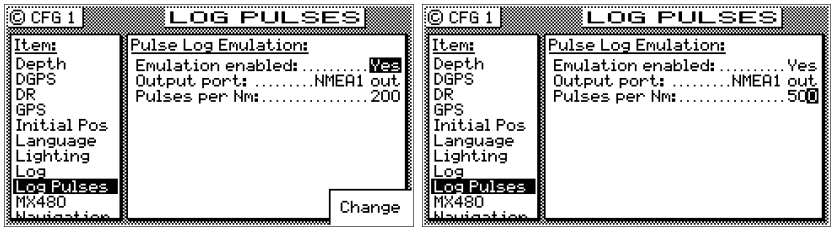
Both input types have a window in the lower portion of the display which indicates the input value in real time. If you input a calibrated pulse rate, you can check for the appropriate speed right here.

You will be able to view the speed log information in the *NAV4* screen when it is implemented in future software.

Log Pulses - GPS SOG Log Pulse Output

This screen controls the output port (Pulse) of the speed over ground log output from the MK12 CDU at a user-defined pulse rate per nautical mile. This output is normally used to feed GPS SOG to an ARPA

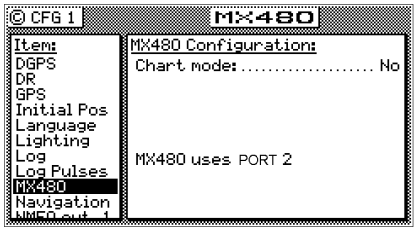
radar. The default state is that the speed log is not active, and set to 200 pulses per nautical mile. Refer to the *Installation Section of this Manual* for the hardware interface from one of the NMEA output ports.



Activate the output by selecting *Yes* to *Emulation Enable*, select the appropriate hardware port, and set the pulse rate based on the device that you are connecting to.

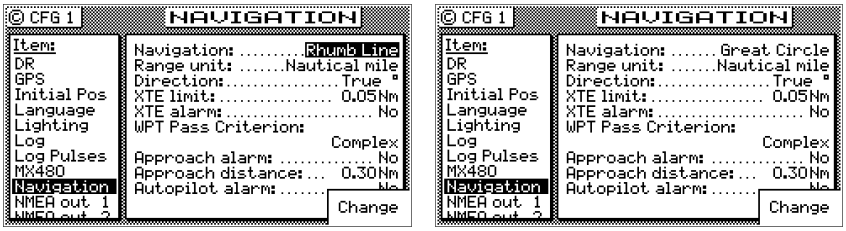
MX480 - MX480 PC Chart Interface Control

The MK12 CDU can be interfaced with the previous Leica MX480 personal computer based electronic charting software. When the MX480 mode is enabled, the chart program assumes the following functions of the receiver: Active Route Creation, Waypoint Library, and Tides. The personal computer must be connected to the RS-232 port of Port 2 on the CDU (refer to the *Installation Section of this Manual).*



Navigation - Navigation Method & Waypoint Pass Criterion Control

This screen sets the navigation mode to Rhumb Line or Great Circle, Cross-track Error limits and alarms, Waypoint Pass Criterion, and Waypoint Approach alarms. These settings have a direct affect on your route calculation and how data is displayed in the **NAV** and **PLOT** screens.



Navigation:

Sets navigation to *Rhumb Line* (default) or *Great Circle* mode.

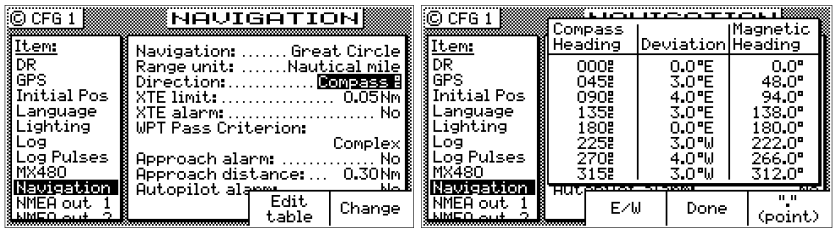
Note: When the navigation mode is set to Great Circle, the PLOT screens will not show your course or cross-track error lines.

Range Unit:

Sets the unit of measure for all range calculations. You can choose between *Nautical Mile* (default), *Nautical Mile & Meters, Nautical Mile & Feet, Statute Mile, Statute Mile & Meters, Statute Mile & Feet, Kilometers,* and *Kilometers & Meters.*

Direction:

Sets all displays which indicate direction to *True* or *Compass*. If you want the receiver to agree with your magnetic compass, select *Compass*. The receiver will automatically add or subtract the appropriate magnetic variation and deviation. Enter the compass deviation table into the receiver in this screen. You can differentiate between *True* and *Compass* settings by observing the degree symbol on any bearing or heading display. *True* is indicated by a degree symbol (°), *Compass* is indicated by a degree symbol with a small *c* under the symbol (c).



XTE Limit:

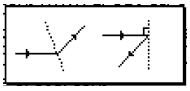
Sets the distance left or right from the course line you consider to be the maximum allowable off-track error (known as cross-track error, "XTE"). The **PLOT** screens will display the scaled cross-track error distance. The **NAV** screens will indicate the cross-track error in numerical format and present the cross-track error graphically scaled left or right of the course line.

XTE Alarm:

Causes an alarm to sound if your position exceeds the maximum XTE Limit defined above when *Yes* is selected (the default condition). To disable the alarm, select *No* with the *Change* softkey.

WPT Pass Criterion:

Sets the waypoint passed determination method. There are five methods available:

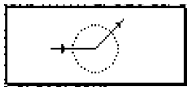
Complex: 

This is the default setting. Passing the waypoint is determined by reaching an imaginary perpendicular line. Or you can pass the waypoint by crossing the bisector line of an acute angle (providing you are within 0.2 NM of the waypoint) or an obtuse angle between your present course line and the next leg of your route.

Manual:

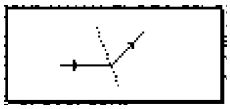
Passing the waypoint can only be accomplished by manually skipping a waypoint. Refer to the *Skipping and Unpassing Waypoints* in the *Route* section of this manual.

This is a great way to perform station keeping maneuvering. Refer to the *Plot Screen Use Examples* in the *Plot* section for further details on this application.

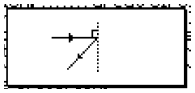
Distance: 

Passing the waypoint is determined by reaching an imaginary circle around the waypoint, the radius of which you can define in WPT Pass Distance. The default value is 0.10 Nm.

If you set this distance to 0.00, you will never pass the waypoint. This is a great way to perform station keeping maneuvering. Refer to the *Plot Screen Use Examples* in the *Plot* section for further details on this application.

Bisector Line: 

Passing the waypoint is determined by reaching the bisector line of an acute or obtuse angle between your present course line and the next leg of your route.

Perpendicular Line: 

Passing the waypoint is determined by reaching an imaginary perpendicular line from your present course line.

Approach Alarm:

Causes an alarm to sound if your position is within the radius defined in *Approach Distance* (below) when *Yes* is selected. To disable the alarm, select *No* (the default condition) with the *Change* softkey.

Approach Distance:

Sets the waypoint approach alarm distance (above) to sound if your position is within the radius defined. The default setting is 0.30 Nm. This is a convenient tool for large boats and ships that need to perform Transfer and Advance maneuvers prior to reaching the waypoint.

Autopilot Alarm:

Causes an alarm when your position is outside the cross-track error limit defined in *XTE Limit* (above) or when you change course

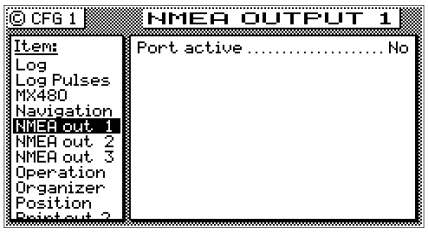
to a new leg in your route (manually or automatically passing a waypoint) when *Yes* is selected. It also causes the NMEA data records of APA, APB, and XTE to change their reported status of *Valid* to *Invalid* when you reach the waypoint of the current leg. This tells the autopilot not to use the data from the receiver. When the alarm is canceled, which requires your depression of the *Cancel Alarm* softkey (displayed during the alarm condition), these data fields will revert to valid data and the autopilot will accept the receiver data again. *This is provided as a safety feature so that the boat does not turn toward a new direction without your knowing of the impending change*. To disable the alarm, select *No* (the default condition) with the *Change* softkey.

NMEA Out 1 & 2 - NMEA 0183 Output Data Control

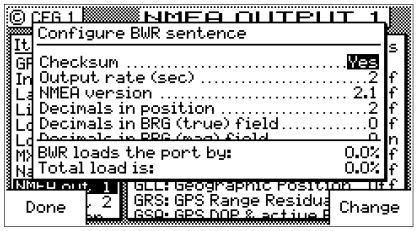
These screens set the specific NMEA 0183 output record parameters as well as the port control. The default setting is *No*. When this selection is changed to *Yes*, you can turn on individual data records. Refer to the installation manual of the device you interfaced with the receiver to determine which output records are required. Refer to the *Installation Section of this Manual* for receiver hardware interface information.

Note: Preplan your interface requirements to ensure all of your interfacing needs are met. When two receivers are interfaced in a dual head configuration, Port 1 is reserved for this interface. Port 2 is the only port where the Print function will operate. All NMEA Ports are RS-422 electrically. Only Port 2 can be configured as either RS-422 or RS-232 and is the only port which should be connected to a computer or other "single ended" interface.

The default condition of each port is *Off*. When you want to output data on a NMEA port, scroll down the *Item* menu to the appropriate *NMEA Out* port number and change *Port Active* to *Yes*. In doing so, the receiver will display all available NMEA 0183 output records.



Scroll down the list using the cursor key until you identify a NMEA 0183 records that you need. Use the *Change* softkey or right arrow key on the cursor to select *On*.



Press the *Details* softkey to view the characteristics for the NMEA record you select. If you notice that the top of some text is cut off by the *Capacity Needed* window, this indicates that there are more selections available than can fit in the window. Use the cursor key to scroll down the list. Each record is controlled separately. Generally speaking, the following controls are available to you for most or all of the records:
All:

Checksum On or Off - NMEA 0183 version 2.1 requires that the checksum is present. Versions 1.5 and 2.0 do not require the checksum. The receiver provides you the option of turning the checksum on or off to provide flexibility in interfacing. It has been our experience that some of the equipment you will interface with may not correctly decode the checksum, or may require the checksum.

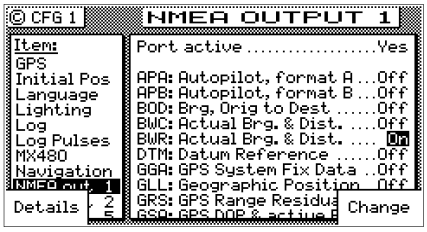
Output Rate - maximum once per second, unless the Multi-Hertz option is installed. Refer to the *Total Load Is* section which follows.

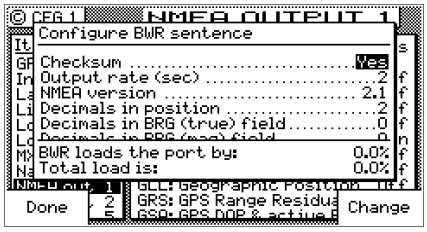
Note: All position information contained in any data

record is output in the local datum selected in CFG Position; except GGA, which provides a selection in the Details screen to output in either WGS-84 or the datum selected in CFG Position.

Most:

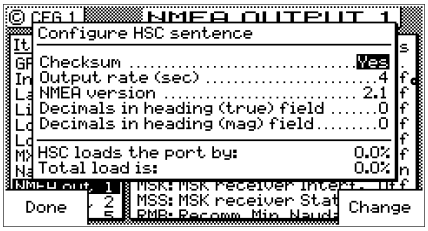
NMEA Version - Some of the NMEA 0183 records are no longer supported by version 2.1. However, you may have an autopilot, plotter, or other older model equipment that does not support the newer version of the NMEA 0183 standard. The receiver provides you the flexibility to interface using older versions of the NMEA standard to support these devices.





Decimals In Lat/Lon - The software allows you to select from 2 to 5 decimal places in records containing position or waypoint information. It has been our experience that other manufacturers sometimes hard code these data records to 2 decimal places (approximately 18 meters for each change in the hundreths place value). The receiver provides you the flexibility to match the expected input on these devices, even though it is capable of outputting to the hundred thousanths place (approximately 18 millimeters for each change in this place value). While the receiver can output to this level of accuracy, don't forget that the receiver is a 80 cm to 1.5 m accurate DGPS receiver at best with DGPS corrections at once per second intervals. In a normal marine environment, your accuracy will be about 2 to 5 meters when receiving DGPS corrections from a beacon transmitter.

Decimals In BRG or *HDG* - The receiver allows you to select from 0 to 1 decimal places in records containing bearing information.



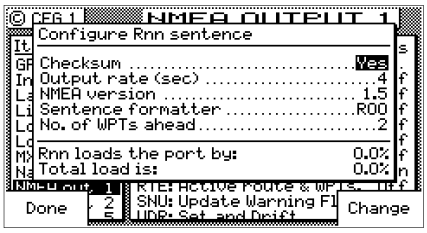
xxx loads the port by - The NMEA 0183 standard limits the port baud rate to 4800 bits per second. It is impossible to turn on every NMEA 0183 data record on one port in the receiver at a once per second output rate, due to the NMEA standard limitation. *xxx loads the port by* tells you how much throughput capacity is required to send the selected data record out the port (where xxx is the NMEA data sentence identifier). If you change the *Output Rate*, *xxx loads the port by:* value will adjust to reflect the change after you move the cursor to the next line. This is a very helpful tool to ensure that you don't loose data due to lack of throughput on the data port.

Total load is - Due to the throughput limitation of the NMEA 0183 standard, you can not turn on all of the output records available from the receiver at a once per second output rate at one time. The *Total load is* counter will help you maximize the port usage on the receiver. It monitors the total throughput capability of all the output records that are currently turned on. If you go over 100% and you require all of the data records that are currently turned on, try reducing the Output Rate for one or more of the less critical data records. Continue this process until the *Total load is* 100.0% or less.

There are several special case screens which provide added support.

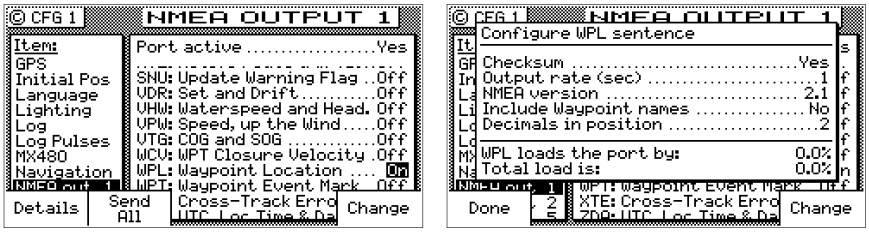
Rnn - Active Route Data Record:

The NMEA-0183 standard allows you to output the active route with an ID sentence that begins either as GPR00 or GPR01. Some of the equipment you might interface may require this sentence to outputs R00 and other equipment may require this data record as R01. The receiver allows you to configure the ID either way (R00 is the default).



WPL - Waypoint Location Data Record:

The receiver outputs all of the waypoints in the active route. If you want to output the complete *Waypoint Bank*, simply press the *Send All* softkey from the *NMEA WPL* screen.



The WPL record, as defined by the NMEA 0183 standard, technically does not allow the output of waypoint descriptions when interfacing to other devices such as Chart Plotters. However, Leica realizes that with 2000 waypoints, you have spent a lot of time preparing your library of waypoints with definitions and symbols. You probably will want to record these to a PC, just in case the memory in the receiver fails in the future. For this reason, we have provided you the option to *Include Waypoint Names* in the WPL record to save your waypoints to a PC or to meet the NMEA 0183 standard for interfacing to other marine equipment. The definition of the differences between these two formats is given in the **WPT** section of this manual and in the NMEA 0183 format section of the *Installation Section of this Manual*.

Other Special Cases Affecting NMEA 0183 Records:

BWC, BWR, APA, APB, RMB, RMC, and Man Over Board (MOB):

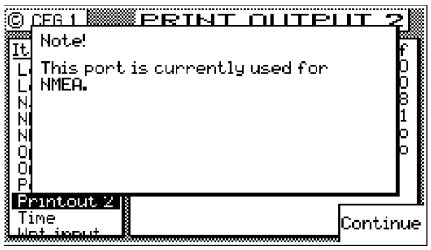
During the period when the Man Over Board function is activated, NMEA 0183 records which contain bearing and range data, such as those identified above (but not limited to these), will reflect the bearing and range back to the MOB position until the MOB function is canceled. Refer to the *MOB* section of this manual.

APA, APB, XTE, and the Navigation Autopilot Alarm:

Refer to the **CFG** *Navigation* section. When the *Autopilot Alarm* is set to *No*, the receiver always indicates an *A*, or valid data to the autopilot or other marine device which might be receiving this data. If the *Autopilot Alarm* is set to *Yes*, then the receiver changes the *A* to a *V*, indicating invalid data when you reach a waypoint or exceed your cross-track error limit set in the **CFG** *Navigation XTE Limit* field. When the alarm is canceled, which requires your depression of the *Cancel Alarm* softkey (displayed during the alarm condition), these data fields will revert to Valid data and the autopilot will accept the receiver data again. *This is provided as a safety feature so that the boat does not turn toward a new direction without your knowing of the impending change.*

Output Port Configuration Conflicts:

Because the Log Pulses, Printer Out, Dual Contr., and NMEA out all use the same hardware, it is only possible to enable one of these formats on any given port. If you have already defined a given port for one format, and you attempt to define a different format for the same port, the receiver will warn you of the port conflict. The first format to be defined on a port maintains the port. The second format will be ignored.



Operation - General Setup and Control Settings

This screen controls a few basic operating settings:

Remember Display: When set to *Yes* (default), the receiver remembers the *Page Number* or screen you viewed the last time you used a particular function. For example, if you normally monitor the *NAV3* display and you decided to look at the *PLOT1* screen, the next time you press the **NAV** function, the receiver will automatically revert to the *NAV3* screen immediately.

If you select *No* for *Remember Display*, the receiver will always display the *first* page of a function when you press the function key.

Edit Timeout: You can set the timeout limit between *None* (default), or 1 to 10 minutes. If you enter the edit mode on any screen and have a timeout period other than *None*, the receiver will automatically exit the edit mode if no keys are touched and the timeout period expires.

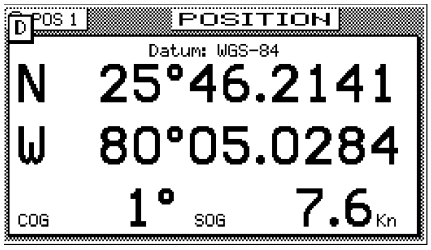
Preceding Zeroes: Places zeroes (0s) before directions less than 100° when *Yes* is selected. For example, 079°. Otherwise directions are shown without the leading zeros when *No* is selected (default). For example, 79°.

Beeper: If you attempt to perform a key function that is not allowed, you normally hear an *Error Tone*. This is performed when the *Beeper* is set to *On* (default). If you don't want to hear the error or any other keyboard beep, set the *Beeper* to *Off*.

Retain External Alarm: Allows the MK12 to hold the external alarm while the alarm condition still exist. When *Retain external alarm* is set to *On*, the external alarm will normalize only when the cause of alarm is corrected.

Engineering Display: This enables an expanded series of display screens in some of the functions. In general, these screens are used by the technician during troubleshooting or by Leica engineers during development testing. Screens which are relevant for troubleshooting are described in *Appendix C* of this manual. The default setting is *No*. If you should enable these screens, the receiver will automatically turn them off the next time power is cycled on the unit.

Demonstration Mode: This enables the receiver to function as though you are under way, even though you are completely stationary. The default setting is *No*. When set to *Yes*, all three Traffic Lights will be illuminated, and a *D* symbol is displayed in the upper left corner of every display. Generally speaking, this feature is used by Leica and your dealer for show room or trade show demonstrations. However, you can use it as a training tool until you become familiar with the receiver. As a safety feature, you can not use it to output NMEA 0183 records on the data ports to test and demonstrate other devices such as autopilots, chart plotters, and radars. Refer to *Appendix E* of this manual for a full description of the *Demonstration Mode*.

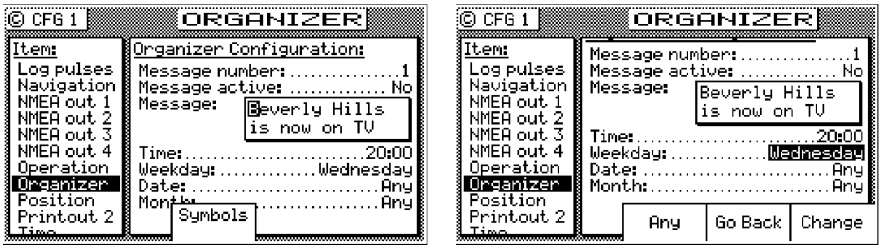


Organizer - Automated Message Reminders

This screen enables you to program the receiver with up to 25 different message reminders (up to 30 characters in length). You can program it to alarm for shift changes, log entry intervals, medication intervals, weather fax updates, etc.

Note: When the Organizer alarm is activated, the voltage on the Alarm Output Port is also activated. If you have other devices connected to this port, you might need to consider what other systems will be affected when the alarm sounds. Leica

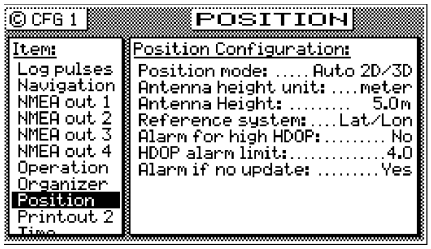
offers an External Alarm controls software option. Check with your dealer or Leica for details on this software package.



The setup is straight forward. Use the *Change* softkey to increment forward through the available choices. Use the *Go Back* softkey to increment backward through the available choices. You can also use the left and right cursor keys to accomplish these same operations. Enter text the same as you do for the waypoints and routes. Use the numeric key pad to enter the appropriate time. Don't forget to set *Message Active* to *Yes* when you are finished editing, to enable the alarm.

Position - Positioning Reference, Mode, & Alarm Control

This configuration screen controls several important parameters which determine your present position.



Position Mode:

Auto 2D/3D: This setting allows the receiver to automatically switch between 2 dimensional (a horizontal position with the antenna height you entered to make up the vertical portion of your position fix), and 3 dimensional position fixing. You need at least 3 satellites to get a 2D position fix and 4 satellites to get a 3D position fix. It may take more than these minimum number of satellites to provide a position fix, based on their geo-

metric relationship to your actual position. The HDOP and VDOP values described in the *GPS* section of this manual will give you a good clue as to the satellite geometry. *Auto 2D/3D* is the default setting.

3D Only: This selection causes the receiver to provide a position fix only when the HDOP and VDOP values or the number of satellites allows a 3 dimensional position to be calculated.

2D: This selection is not accessible to the user. The MK12 uses this mode in the *Auto 2D/3D* mode only when the number of satellites available does not allow for 3D position calculation. The antenna height you entered is used for the vertical portion of your position fix.

Antenna Height Unit:

This selection determines the unit of measure for the antenna height calculation. Available choices are either *Meters* (default) or *Feet*.

Antenna Height:

This is the antenna height above Mean Sea Level (MSL) that you enter for 2D mode positioning, 5.0 meters is the default value. *To achieve maximum position accuracy, it is important to enter an accurate value of the antenna height above MSL*. You can verify your current positioning mode and altitude in the **POS** *POS2* and *POS3* screens.

Reference System:

This setting controls the coordinate system used to display your position. The available choices are *Lat/Lon* (default), *UTM* (Universal Transverse Mercator), or *Loran C*. The receiver will automatically convert any waypoint in the Route Bank or Waypoint Bank when a different coordinate system is entered. Note that when you select a coordinate system other than *Lat/Lon*, data in the NMEA 0183 records will remain in the Lat/Lon format, as defined in the NMEA 0183 standard.

When you select *UTM*, you can set the *Zone* yourself (*Man*), or let the receiver calculate the zone for you (*Auto*, default).

Likewise, when you select Loran C, you can set the *Chain* yourself (*Man*), or let the receiver calculate the chain for you (*Auto*, default).

Alarm For High HDOP:

This allows the receiver to create an alarm for HDOP values which rise above a number that you determine. This indicates that position accuracy is becoming bad, due to poor satellite geometry relative to your position and/or the number of satellites currently under track. You may want to set the alarm to *Yes* if position accuracy is critical to you. Otherwise this alarm is normally set to *No*.

HDOP Alarm Limit:

Sets the HDOP value which will cause the alarm to sound. The default value is 4. The valid range is from 1.0 to 9.9. The higher your HDOP value, the more error you will have in your position fix. Refer to the *GPS1 Current Satellite Status* section of this manual for more information about the HDOP value.

Alarm If No Update:

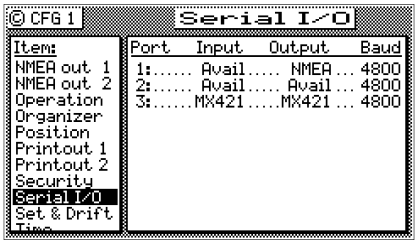
This setting causes an alarm when you stop calculating a position fix for a few seconds when set to *Yes* (default). A setting of *No* disables the alarm when position fix can not be obtained.

Security

The Security screen allows you to lock out the edit function in order to keep crew members or visitors from changing settings that you have made. Once this feature is enabled, a press of the E key will require the correct password to gain access. To disable the security functions, you will be prompted to enter a 5 digit password. You will then be prompted to re-enter the password. The security function is then disabled until you enter a new password through the *CFG1 Security* screen again. Be sure to write your password in a safe place. If you loose your password, you will need to call the factory to reset the security feature.

Serial I/O

This menu provides a means of changing the baud rate to the NMEA I/O ports. Note that the NMEA ports 3 is reserved for the MX421GPS and beacon receiver interface. You have no baud rate control in this port.



Set & Drift

Set & Drift is obtained one of two ways:

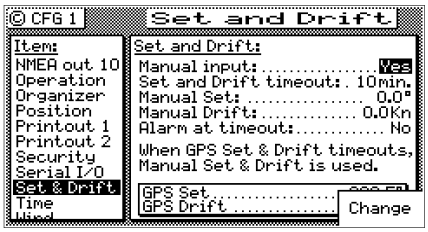
GPS Positioning: Set & Drift is calculated using GPS position, course and speed over ground, with compass and speed log inputs to determine the speed and direction of the water (Set & Drift) when navigating using GPS.

Manual Input: You can enter your own Set & Drift values. Normally this would only be done when you are aware of what the water speed and direction (Set & Drift) generally are (without sensors). When *Manual Input* is set to *Yes*, the receiver applies the users constant during DR navigation. If you have no idea what the water speed and direction are (Set & Drift), is better to set *Manual Input* to *No*, and the receiver will not apply any correction.

Using Set & Drift for DR Positioning:

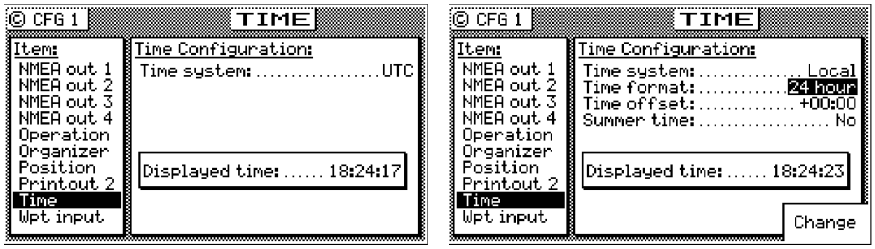
If GPS positioning is lost and the unit reverts to DR mode, the receiver uses the derived Set & Drift as described above until the user defined time-out period expires. When the time-out period expires the receiver uses either a user-entered Manual Set & Drift (*Manual Input* set to *Yes*) or 0 (Manual Input set to set to *No*).

The receiver begins applying manual input Set & Drift after the time-out period you specify (default 10 minutes), based on the conditions stated above.



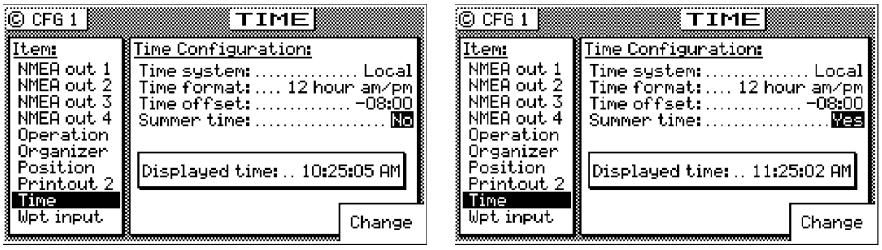
Time - Mode and Format Control

This menu item sets the method in which time is displayed on the receiver.



Time System: Sets the time to *UTC* (default) or *Local*. When *Local* is selected, several parameters associated with local time are displayed.

Time Format: Sets the time to either a *24 Hour* (default) or *12 Hour* clock.



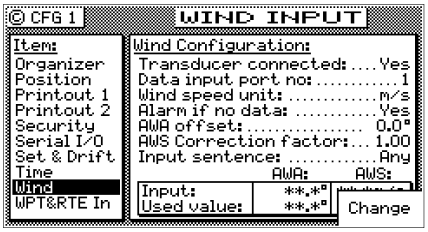
Time Offset: Sets the local offset to UTC time. 0:00 is the default.

Summer Time: Sets the local clock ahead one hour in the summer for daylight savings time when set to *Yes*, or to the Local Offset time when set to *No*.

The adjusted time value is displayed in the lower window so you can verify the current time without having to leave the screen.

Wind

The receiver will display wind information in the *NAV4* screen when connected to a NMEA 0183 sensor which can provide the MWV or VWR sentence.



Data Input Port: 1 (default) or 2 for MK12/2
1 (default) or 2, 5, 6, 7, 8, 9 or 10 for MK12/8
Ports 3 & 4 are reserved for the MX421 GPS and Beacon controls and will not be selected.

Wind Speed Unit: miles per hour, meters per second, knots, kilometers per hour.

Alarm If No Data: Allows you to receive an audible and visual alarm if NMEA 0183 data is not being received on the data port at regular intervals (typically every few seconds). The available choices are *Yes* (default) and *No*.

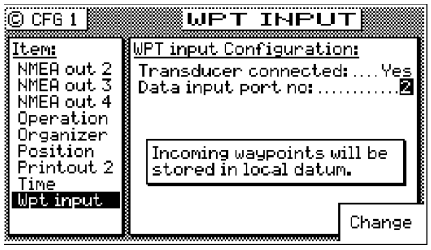
AWA Offset: Allows you to input a constant angle correction value.

AWS Correction Factor: Allows you to input a wind speed correction factor.

Input Sentence: Specifies the NMEA 0183 data sentence to read the depth data from. The available choices are *Any (default)*, *MWV*, or *VWR* sentence. It is better to specify the appropriate sentence, because more than one method of reporting wind may be available on the port.

Wpt & Rte Input - Uploading Waypoints into the Receiver

This screen enables the input data port to receive waypoints and routes from a chart plotter, PC, or other device to the receiver. You can receive this data through any of the 4 NMEA 0183 input data ports. Load the WPL sentences first, then the RTE sentences. Change *Transducer Connected* from *No* (default) to *Yes* and select the appropriate port. Refer to the *Waypoints - Uploading Waypoints from Other Devices* section of this manual for more details on the software interface. Refer to the *Installation Section of this Manual* for hardware interfaces.



Appendix A - Datum List

The receiver supports more than 100 datums. Table A-1 provides the names and abbreviations for these datums.

Table A-1. Datum Names and Abbreviations

WGS-84	W84
WGS-84 + OFFSET	wpo
WGS-72	W72
EUROPEAN 1950	EUR
NAD 27 (CONUS)	NAS
NORTH AMERICAN 1983	NAR
ADINDAN	ADI
AFGOOYE	AFG
AIN EL ABD 1970	AIN
ANNA 1 ASTRO 1965	ANO
ARC 1950	ARF
ARC 1960	ARS
ASCENSION ISL. 1958	ASC
ASTRO BEACON E	ATF
ASTRO B4 SOROL ATL	ast
ASTRO DOS 71/4	SHB
ASTRONOMIC ST. 1952	ASQ
AUSTRALIAN 1966	AUA
AUSTRALIAN 1984	AUG
BANGLADESH	ban
BELLEVUE (IGN)	IBE
BERMUDA 1957	BER
BOGOTA OBSERVATORY	BOO
CAMPO INCHAUSPE	CAI
CANTON ASTRO 1966	CAO
CAPE	CAP
CAPE CANAVERAL	CAC
CARTHAGE	CGE
CHATHAM 1971	CHI
CHUA ASTRO	CHU
CORREGO ALEGRE	COA
DJAKARTA (BATAVIA)	BAT
DOS 1968	GIZ
EASTER ISLAND 1967	EAS
EURO 1950 (Western)	ewe
EURO 1950 (Cyprus)	ecy
EURO 1950 (Egypt)	eeg
EURO 1950 (Iran)	eir
EURO 1950 (Sicily)	esi
EUROPEAN 1979	EUS
FINNISH - KKJ	fin
GANDAJIKA BASE	gan
GEODETIC DATUM 1949	GEO
GUAM 1963	GUA
GUX 1 ASTRO	DOB
HJORSEY 1955	HJO
HONG KONG 1963	HKD
INDIAN (VIETNAM)	ivi
INDIAN (INDIA)	iin
IRELAND 1965	IRL
ISTS 073 ASTRO 1969	IST
JOHNSTON IS. 1961	JOH
KANDAWALA	KAN
KERGUELEN ISLAND	KEG
NAD 27 (CANADA)	ncd
NAD 27 (CANAL ZONE)	ncz
NAD 27 (CARIBBEAN)	ncr
NAD 27 (CENT. AMER)	nca
NAD 27 (CUBA)	ncu
NAD 27 (GREENLAND)	ngl
NAD 27 (MEXICO)	nmx
OBERVATORIO 1966	nob
OLD EGYPTIAN	OEG
OLD HAWAIIAN	OHA
OMAN	FAH
O.S.G.B 1936	OGB
PICO DE LAS NIEVES	PLN
PITCAIRN ASTRO 1967	PIT
PROV. S. CHILEAN 63	HIT
PROV. S. AMER. 1956	PRP
PUERTO RICO	PUR
QATAR NATIONAL	QAT
QORNOQ	QOU
REUNION	REU
ROME 1940	MOD
RT 90 SWEDISH	swe
SANTO (DOS)	SAE
SAO BRAZ	SOA
SAPPER HILL 1943	SAP
SCHWARZECK	SCK
SOUTH AMERICAN 1969	SAN
SOUTH ASIA	SOA
SOUTHEAST BASE	seb
SOUTHWEST BASE	swb
TIMBALAI 1948	TIL
TOKYO	TOY
TRISTAN ASTRO 1968	TDC
VITI LEVU 1916	MVS
WAKE-ENIWETOK 1960	ENW
ZANDRIJ	ZAN

Appendix B - Beacon List

The following list of known DGPS beacon transmission sites is compiled from government agencies and several publications. There may be other beacon sites available which are not on the following list, as the network continues to grow. You can usually find more information regarding available beacon stations from the maritime authority in the country you are in. Leica assumes no responsibility for the accuracy of the information which follows; it is only provided as a matter of convenience.

ALGERIA

RAX CAXINE LT.
xxºxx'N.xxºxx'W
162.5 kHz
xxx baud
ID:
REF 1:
REF 2:

AUSTRALIA

CAPE SCHANCK
38º30' N.144º53'E.
314.0 kHz
100 baud
ID:700
REF1:
REF2:

KARRATHA
20º45' S.116º27'E.
304.0 kHz
100 baud
ID:701
REF1:
REF2:

HORN ISLAND
10º36' S.142º18'E.
320.0 kHz
200 baud
ID:702
REF1:
REF2:

BELGIUM

OOSTENDEN PHARE
51º14'N.02º55'E.
311.5 kHz
100 baud
ID:420
REF1: 640
REF2: 641

BERMUDA

ST. DAVIS HEAD
32º22' N.64º39'W.
311.5 kHz
100 baud
ID:420
REF1: 640
REF2: 641

BRAZIL

PONTA DE SÀO

MARCOS
02º29' N.44º18'W.
300.5 kHz
300 baud
ID:
REF1:

CANADA

GREAT LAKES

POINT PETRIE
43º50' N. 77º09' W.
303.0 kHz
100 baud
ID:
REF1:
REF2:

PORT WELLER
43º15' N. 79º13'W.
302.0 kHz
100 baud
ID:
REF1:
REF2:

SOMBRA
42º43' N. 82º29'W.
306.0 kHz
100 baud
ID:
REF1:
REF2:

TROIS RIVIERES
46º23' N. 72º27'W.
321.0 kHz
100 baud
ID:928
REF1: 314

REF2: 315

LAUZON
46º48’ N. 71º09’W.
314.0 kHz
100 baud
ID:927
REF1: 316
REF2: 317

ST JEAN SUR RICHELIEU
46º19’ N. 73º18’W.
308.0 kHz
100 baud
ID:929
REF1: 312
REF2: 313

WIARTON
44º42’ N.81º08’W.
TBA kHz
100 baud
ID:918
REF1: 310
REF2: 311

EAST COAST
Planned:

HALIFAX
44º40’ N. 63º36’W.
TBA kHz
200 baud
ID:938
REF1: 328
REF2: 329

EAST POINT
46º27’ N. 61º58’W.
314.0 kHz
100 baud
ID:937
REF1: 330
REF2: 331

RIVIERE DU LOUP
47º45’ N. 69º36’W.
TBA kHz
100 baud
ID:926
REF1: 318
REF2: 319

MOISIE
50º12’ N. 66º07’W.
314.0 kHz
100 baud
ID:925
REF1: 320
REF2: 321

PT. ESCUMINIAC
47º40’ N. 64º47’W.
TBA kHz
200 baud
ID:936
REF1: 332
REF2: 333

CRANBERRY ISLAND
45º19’ N. 60º55’W.
286.0 kHz
100 baud
ID:934
REF1: 336
REF2: 337

RIGOLET
54º15’ N. 58º30’W.
TBA kHz
100 baud
ID:947
REF1: 348
REF2: 349

CAP. DES ROSIERS
48º51’ N.64º12’W.
TBA kHz
100 baud
ID:924
REF1: 322
REF2: 323

LA ROMAINE
50º12’ N.60º41’W.
TBA kHz
100 baud
ID:923
REF1: 324
REF2: 325

DEVIL’S HEAD
49º07’ N.58º24’W.
TBA kHz
100 baud
ID:943
REF1: 344
REF2: 345

CAPE BONAVISTA
48º42’ N.53º05’W.
TBA kHz
100 baud
ID:943
REF1: 346
REF2: 347

PARTRIDGE ISLAND
45º14’ N.66º03’W.
311.0 kHz
100 baud
ID:939
REF1: 326
REF2: 327

WESTERN HEAD
43º59’ N.64º39’W.
296.0 kHz, 100 baud
ID:935
REF1: 334
REF2: 335

CAPE RACE
46º39’ N.53º04’W.
288.0 kHz
100 baud
ID:940
REF1: 338
REF2: 339

PORT AUX

BASQUES (NFLD)
47º34’ N.59º09’W.
290.0 kHz
100 baud
ID:941
REF1: 340
REF2: 341

PISTOLET BAY
51º29’ N.55º48’W.
317.0 kHz
100 baud
ID:944
REF1:
REF2:

WEST COAST

TRIPLE ISLAND
54º17’ N.130º52’W.
308.0 kHz
100 baud
ID:
REF1:
REF2:

POINT *ATKINSON*
49º19’ N.123º15’W.
320.0 kHz
100 baud
ID:902
REF1: 302
REF2: 303

RACE ROCKS
48º18’ N.123º32’W.
309.9 kHz
100 baud
ID:
REF1:
REF2:

Planned:

ALERT BAY
50º35’ N.125º55’W.
309.9 kHz
100 baud
ID:909
REF1: 300
REF2: 301

TOFINO
48º18’ N.123º32’W.
309.9 kHz
200 baud
ID:908
REF1: 304
REF2: 305

SANDSPIT
53º14’ N.131º48’W.
TBA kHz
100 baud
ID:906
REF1: 305
REF2: 306

CHINA

BEI TANG
39º06’ N.117º43’E.
310.5 kHz
200 baud
ID: BT
REF1: 608
REF2: 609

QING HUANG DAO
39º55’ N.119 º37’E.
287.5 kHz
200 baud
ID: QH
REF1: 606
REF2: 607

DA SAN SHAN
38º52’ N. 121º50’E.
301.5 kHz
200 baud
ID: DS
REF1: 602
REF2: 603

WANG JIA MAI DAO
36º04’ N.120º26’E
313.5 kHz
200 baud
ID: MD
REF1: 614
REF2: 615

BAO HU
20º00’ N.110º56’E
310.5 kHz
200 baud
ID: BH
REF1: 652
REF2: 653

SHANGHAI
xxºxx' N.xx ºxx'E
XXX.X kHz
100 baud
ID:
REF1:
REF2:
16 Stations Planned

DENMARK

HAMMERODDE
55º18'N. 14º46'E.
289.0 kHz
100 baud
ID:451
REF1: 700
REF2: 701

SKAGEN
57º45'N. 10º36'E.
298.0 kHz
100 baud
ID: 453
REF1:
REF2:

BLAAVANDS HUK
55º33'N. 08º05'E.
296.5 KHz
100 baud
ID:452
REF1:
REF2:

ESTONIA

RISTNA LT.
58º56'N.22º04'E.
307.0 kHz
100 baud
ID:530
840
REF 1:
REF 2:

FINLAND

PORKKALA
59º58'N.24º23'E
285.0 kHz
100 baud
ID:400
REF1:600
REF2:

MÄNTYLUOTO
61º36'n.21º28'E.
298.0 kHz
100 baud
ID:401
REF1: 601
REF2:

OUTOKUMPU
62º41'N.26º01'E.
293.5 kHz
100 baud
ID:403
REF1: 603
REF2:

PUUMALA
61º24'N.28º14'E.
301.5 kHz
100 baud
ID:402
REF1: 602
REF2:

FRANCE

ATLANTIC COAST

Planned:

ECKMUHL
47º48,N. 04º23'W.
312.5 kHz
100 Baud
ID:
REF1:
REF2:

GATTEVILLE
49º42,N. 01º16'W.
297.5 kHz
100 Baud
ID:
REF1:
REF2:

LES BALEINES
46º15,N. 01º34'W.
299.5 kHz
100 Baud
ID:
REF1:
REF2:

CAPE FERRET
44º39,N. 01º15'W.
287.0 kHz
100 Baud
ID:
REF1:
REF2:

MEDITERRANEAN

Planned:

CAP BEAR
42º31,N. 03º08'E.
313.0 kHz, 100 Baud
ID:
REF1:
REF2:

REVELLATA

(Corsica)
42º35,N. 08º46'E.

294.5 kHz
100 Baud
ID:
REF1:
REF2:

GERMANY

WUSTROW
54º20,N. 12º23'E.
314.5 kHz
200 Baud
ID:491
REF1:
REF2:

HELGOLAND,

DÜNE
54º11,N. 07º54'E.
313.0 kHz
200 Baud
ID:492
REF1:
REF2:

ICELAND

REYKJANES
63º49,N. 22º42'E.
292.5 kHz
100 baud
ID:411
REF1:
REF2:

BJARGTANGAR
65º30,N. 24º31'W.
289.0 kHz
100 baud
ID:412
REF1:
REF2:

SKAGATA
66º07,N. 20º06'W..
304.5 kHz
100 baud
ID:413
REF1:
REF2:

RAUFARHÜFN
66º27,N. 15º27'W..
301.5 kHz
100 baud
ID:414
REF1:
REF2:

DJUPIVOGUR
64º39,N. 14º16'W..
295.5 kHz
100 baud
ID:415
REF1:
REF2:

SKARDSFJARA
63º31,N. 17º59'W..
313.0 kHz
100 baud
ID:416
REF1:
REF2:

IRELAND

ENCRYPTED SIG-NALS

MIZEN HEAD
51º27,N. 09º48'E.
300.5 kHz
100 baud
ID:430
REF1: 660
REF2:

TORY ISLAND
55º16,N. 08º15'E.
313.5. kHz
100 baud
ID:435
REF1: 670
REF2:

JAPAN

*TURUGI-ZAK*I
35º08' N.139º40'E.
309.0 kHz
100/200 baud
ID:
REF1:
REF2:

DAIOH-ZANI
34º16' N.136º54'E.
288.0 kHz
100/200 baud
ID:
REF1:
REF2:

Names Unknown:
45º31' N.141º56'E.
295.0 kHz
100/200 baud
ID:
REF1:
REF2:

40º00' N.144º18'E.
309.0 kHz
100/200 baud
ID:
REF1:
REF2:

43º22' N.140º28'E.
316.0 kHz
100/200 baud

ID:
REF1:
REF2:
42º58’ N.144º23’E.
288.0 kHz
100/200 baud
ID:
REF1:
REF2:
41º25’ N.140º05’E.
309.0 kHz
100/200 baud
ID:
REF1:
REF2:
41º26’ N.141º28’E.
302.0 kHz
100/200 baud
ID:
REF1:
REF2:
38º57’ N.139º50’E.
288.0 kHz
100/200 baud
ID:
REF1:
REF2:
37º51’ N.136º55’E.
295.0 kHz
100/200 baud
ID:
REF1:
REF2:
30º16’ N.141º35’E.
316.0 kHz
100/200 baud
ID:
REF1:
REF2:
35º42’ N.140º52’E.
295.0 kHz
100/200 baud
ID:
REF1:
REF2:
34º53’ N.132º02’E.
305.0 kHz
100/200 baud
ID:
REF1:
REF2:
33º52’ N.129º41’E.
295.0 kHz
100/200 baud
ID:
REF1:
REF2:
33º05’ N.139º51’E.
302.0 kHz
100/200 baud
ID:
REF1:
REF2:
33º15’ N.134º11’E.
295.0 kHz
100/200 baud
ID:
REF1:
REF2:
31º59’ N.128º21’E.
302.0 kHz
100/200 baud
ID:
REF1:
REF2:
31º22’ N.131º20’E.
309.0 kHz
100/200 baud
ID:
REF1:
REF2:

LATVIA

Planned:

VENTSPILS

57º22,N. 21º31’E.
308.5. kHz
100 baud
ID:
REF1:
REF2:

NETHERLANDS

AMELAND

53º27,N. 05º37’E.
299.5 kHz
100 Baud
ID:428
REF1: 655
REF2: 656

HOEK VAN HOLLAND

51º59,N. 04º07’E.
287.5 kHz
100 baud
ID:425
REF1: 650
REF2: 651

NORWAY

FAERDER

50º01,N. 10º31’E.
288.0. kHz
100 baud
ID: 500
REF1: 780
REF2:

UTSIRA

59º18,N. 04º52’E.
307.0. kHz,
100 baud
ID: 505

REF1: 785
REF2:

UTVAER
61º02,N. 04º30'E.
300.0. kHz,
100 baud
ID: 507
REF1: 787
REF2:

SVINOEY
62º19,N. 05º16'E.
293.5 kHz
100 baud
ID: 508
REF1: 788
REF2:

HALTEN
64º10,N. 09º24'E.
313.5 kHz
100 baud
ID: 510
REF1: 790
REF2:

SKOMVAER
67º24,N.11º52'E.
300.0 kHz
100 baud
ID: 513
REF1: 793
REF2:

LISTA
58º06,N.06º34'E.
301.0 kHz
100 baud
ID: 503
REF1: 783
REF2:

SKLINNA
65º12,N.10º59'E.
288.5 kHz
100 baud
ID: 511
REF1:
REF2:

TORSVAAG
70º14,N.19º30'E.
291.5 kHz
100 baud
ID: 516
REF1:
REF2:

VARDOE
70º23,N.31º09'E.
307.0 kHz
100 baud
ID: 520
REF1:
REF2:

Planned:

TORUNGEN
58º23,N.08º48'E.
292.5 kHz
100 baud
ID: 501
REF1:
REF2:

HELNES
71º03,N.26º13'E.
288.5 kHz
100 baud
ID: 518
REF1:
REF2:

BELLSUND
77º23,N.13º57'E.
292.5 kHz
100 baud
ID: 523
REF1:
REF2:

POLAND

DZIWNOW
54º01,N.14º44'E.
288.0 kHz
100 baud
ID: 481
REF1:
REF2:

ROZEWIE
54º49,N.18º20'E.
311.0 kHz
100 baud
ID: 482
REF1:
REF2:

RUSSIA

Planned:

BALTIYSK
54º41,N.19º59'E.
298.5 kHz
100 baud
ID:
REF1:
REF2:

SPAIN

Planned:

NORTH COAST

CABO FINISTERRE
42º53,N. 09º16'E.
289.0 kHz
? baud

ID:
REF1:
REF2:

MEDITERRANEAN

CABO GATA
36º43'N. 02º11'W.
298.5 kHz
? baud
ID:
REF1:
REF2:

PUNTA DE CALA

FIGUERA (Mallorca)
39º27'N. 02º31'E.
286.0 kHz
? baud
ID:
REF1:
REF2:

SWEDEN

SKAGS UDDE
63º11'N. 19º01'E.
306.5 kHz
100 baud
ID: 462
REF1:
REF2:

ÖSKÄR
60º32'N. 18º23'E.
291.5 kHz
? baud
ID: 463
REF1:
REF2:

ALMAGRUNDET
59º09'N. 19º08'E.
287.0 kHz
100 baud
ID: 464
REF1:
REF2:

HOBURG
56º55'N. 18º09'E.
302.0 kHz
100 baud
ID: 465
REF1:
REF2:

KULLEN
56º18'N. 12º27'E.
293.5 kHz
100 baud
ID: 466
REF1:
REF2:

Planned:

BJURÖKLUBB
64º29' N.21º35'E.
298.0 kHz
100 baud
ID: 461
REF1:
REF2:

HÅLLÖ
58º20' N. 11º13'E.
297.0 kHz
200 baud
ID: 467
REF1:
REF2:

UNITED KINGDOM

ENCRYPTED

SIGNALS

ST. CATHERINE'S

POINT
50º34' N. 01º18' W.
293.5 kHz
100 baud
ID: 440
REF1: 680
REF2:

LIZARD
49º57' N. 05º12' W.
284.0 kHz
100 baud
ID: 441
REF1: 681
REF2:

POINT LYNAS
53º25' N. 04º17' W.
304.5 kHz
100 baud
ID: 442
REF1: 682
REF2:

RHINNS OF ISLAY
55º40' N. 06º30 'W.
293.5 kHz
100 baud
ID: 443
REF1: 683
REF2:

BUTT OF LEWIS
58º31' N. 06º16' W.
289.5 kHz
100 baud
ID: 444
REF1: 684

SUMBURGH HEAD
59º52' N. 01º16' W.
304.5 kHz
100 baud
ID: 445
REF1: 685
REF2:

GIRDLE NESS
57º08’ N. 02º03’ W.
311.5 kHz
100 baud
ID: 446
REF1: 686
REF2:

FLAMBOROUGH HEAD
54º07’ N. 00º04’ W.
302.5 kHz
100 baud
ID: 447
REF1: 687
REF2:

NORTH FORELAND
51º22’ N. 01º27’ E.
310.5 kHz
100 baud
ID: 448
REF1: 688
REF2:

Planned: 16 Stations

UNITED STATES

ANNETTE ISLAND, AK
55º04’N.131° 37’W
323 KHz
100 baud
ID: 889
REF 1: 278
REF 2: 279
Message: TYPE-9

COLD BAY, AK
55°11’N.162°42’ W
289 KHz
100 baud
ID: 838
REF 1: 296
REF 2: 297
Message: TYPE-9

GUSTAVUS, AK
58°25’N.135°42’ W
288 KHz
100 baud
ID: 892
REF 1: 284
REF 2: 285
Message: TYPE-9

KENAI, AK
60°40’N.151°21’ W
310 KHz
100 baud
ID: 896
REF 1: 292
REF 2: 293
Message: TYPE-9

KODIAK, AK
57°37’N.152°12’ W
313 KHz
100 baud
ID: 897
REF 1: 294
REF 2: 295
Message: TYPE-9

MILLER’S FERRY, AL
32°05’N.087°24’ W
320 KHz
200 baud
ID: 865
REF 1: None
REF 2: None
Message: TYPE-9

MOBILE POINT, AL
30°14’N.088°01’ W
300 KHz
100 baud
ID: 813
REF 1: 026
REF 2: 027
Message: TYPE-9

CAPE MENDOCINO, CA
40°26’N.124°24’ W
292 KHz
100 baud
ID: 885
REF 1: 270
REF 2: 271
Message: TYPE-9

PIGEON POINT,CA
37°11’N.122°23’ W
287 KHz
100 baud
ID: 883
REF 1: 266
REF 2: 267
Message: TYPE-9

POINT ARGUELLO, CA
34°34’N.120°39’ W
321 KHz
100 baud
ID: 882
REF 1: 264
REF 2: 265
Message: TYPE-9

POINT BLUNT, CA
37°51’N.122°25’ W
310 KHz
200 baud
ID: 884
REF 1: 268

REF 2: 269
Message: TYPE-9

POINT LOMA, CA
32°40'N.117°15' W
302 KHz
100 baud
ID: 881
REF 1: 262
REF 2: 263
Message: TYPE-9

CAPE HENLOPEN, DE
38° 47'N.075°05'W
298 KHz
200 baud
ID:.05
REF 1: 010
REF 2: 011
Message: TYPE-9

CAPE CANAVERAL, FL
28°28'N.080°33'W
289 KHz
100 baud
ID: .09
REF 1: 018
REF 2: 019
Message: TYPE-9

EGMONT KEY, FL
27°36'N.082°46' W
312 KHz
200 baud
ID: 812
REF 1: 024
REF 2: 025
Message: TYPE-9

MIAMI, FL (Virginia Key)
25°44'N.080°10' W
322 KHz
100 baud
ID: 861
REF 1: 020
REF 2: 021
Message: TYPE-9

KOKOLE PT, HI
21°59'N.159°45'W
300 KHz
200 baud
ID: 880
REF 1: 260
REF 2: 261
Message: TYPE-9

UPOLU POINT, HI
20°15'N.155°53' W
286 KHz
200 baud
ID: 879
REF 1: 258
REF 2: 259
Message: TYPE-9

ROCK ISLAND, IL
42°00'N.090°14' W
311 KHz
200 baud
ID: 863
REF 1: None
REF 2: None
Message: TYPE-9

ENGLISH TURN, LA
29°53'N.089°56' W
293 KHz
200 baud
ID: 814
REF 1: 028
REF 2: 029
Message: TYPE-9

CHATHAM, MA
41°40'N.069°57' W
325 KHz
200 baud
ID: 802
REF 1: 004
REF 2: 005
Message: TYPE-9

BRUNSWICK, ME
43°53'N.069°57'W
316 KHz
100 baud
ID:.00
REF 1: 000
REF 2: 001
Message: TYPE-9

CHEBOYGAN, MI
45°39'N.084°28' W
292 KHz
200 baud
ID: 836
REF 1: 112
REF 2: 113
Message: TYPE-9

DETROIT, MI
42°18'N.083°06' W
319 KHz
200 baud
ID: 838
REF 1: 116
REF 2: 117
Message: TYPE-9

NEEBISH ISLAND, MI
46°19'N.084°09' W
309 KHz
200 baud
ID: 835
REF 1: 110

REF 2: 111
Message: TYPE-9

SAGINAW BAY, MI
43°38'N.083°50' W
301 KHz
100 baud
ID: 837
REF 1: 114
REF 2: 115
Message: TYPE-9

UPPER KEWEENAW, MI
47°14'N.088°37' W
298 KHz
100 baud
ID: 831
REF 1: 102
REF 2: 103
Message: TYPE-9

WHITEFISH POINT, MI
46°46'N.084°57' W
318 KHz
100 baud
ID:834
REF 1: 108
REF 2: 109
Message: TYPE-9

ST LOUIS, MO
38°37'N.089°45'W
322 KHz
200 baud
ID: 862
REF 1: 154
REF 2: 155
Message: TYPE-9

VICKSBURG, MS
32°20'N.090°55' W
313 KHz
200 baud
ID: 860
REF 1: 150
REF 2: 151
Message: TYPE-9

FT MACON, NC
34° 42' N 76° 41' W
294 KHz
100 baud
ID: 807
REF 1: 014
REF 2: 015
Message: TYPE-9

PORTSMOUTH HARBOR, NH
43°04'N.70°43' W
288 KHz
100 baud
ID: 801
REF 1: 002
REF 2: 003
Message: TYPE-9

SANDY HOOK, NJ
40°28'N.074°00' W
286 KHz
200 baud
Site ID: 804
REF 1: 008
REF 2: 009
Message: TYPE-9

WILDWOOD, NJ
38°57'N.074°51' W
301 KHz
200 baud
ID: 111
REF 1: 038
REF 2: 039
Message: TYPE-9

MONTAUK POINT, NY
41°04'N.071°52' W
293 KHz
100 baud
ID: 803
REF 1: 006
REF 2: 007
Message: TYPE-9

YOUNGSTON, NY
43°14'N.078°58' W
322 KHz
100 baud
ID: 839
REF 1: 118
REF 2: 119
Message: TYPE-9

SALLISAW, OK
35°22'N.094°49' W
299 KHz
200 baud
ID: 866
REF 1: None
REF 2: None
Message: TYPE-9

FT STEVENS, OR
46°12'N.123° 57' W
287 KHz
100 baud
ID: 886
REF 1: 272
REF 2: 273
Message: TYPE-9

ISABELLA, PR
18°28'N.067° 04' W
295 KHz
100 baud
ID: 817
REF 1: 034
REF 2: 035
Message: TYPE-9

CHARLESTON, SC
32°45'N.079°51' W
298 KHz
100 baud

ID: 808
REF 1: 016
REF 2: 017
Message: TYPE-9

MEMPHIS, TN
35°28'N.090°12' W
310 KHz
200 baud

Appendix C- Engineering Mode

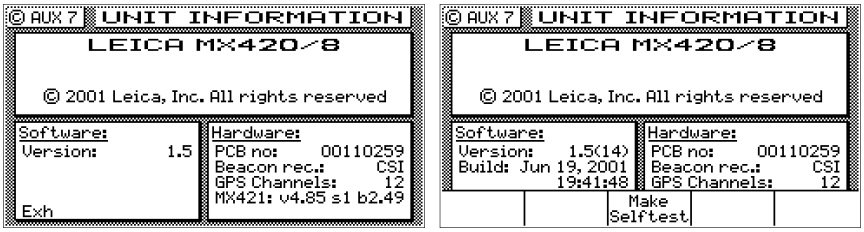
The *Engineering Display*, which is activated in **CFG1** *Operation*, enables an expanded series of display screens in some of the functions. In general, these screens are used by the technician during troubleshooting or by Leica engineers during testing and software debugging. This section describes what information is relevant to you, or the information we need to help you troubleshoot your CDU.

Note: Information which is not described here is unsupported, which means Leica will not expand or provide any more information than what is provided in this manual.

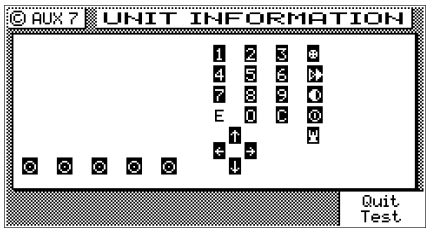
If you should enable these screens, they will be turned off automatically the next time power is cycled on the CDU.

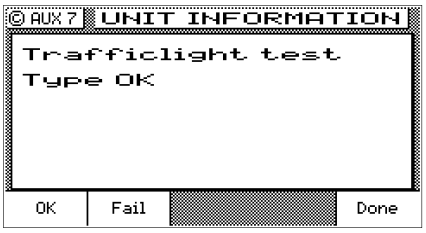
AUX7 - Unit Information & Self Test

When the *Engineering Display* is active, the AUX7 screen adds one line of detail to display the engineering level that is turned on:

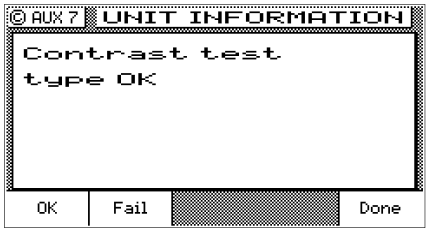


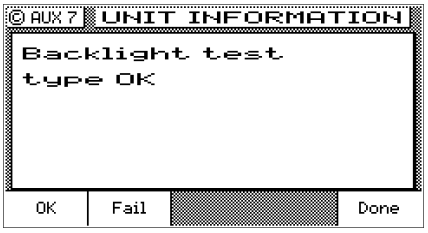
In addition, you can press the **E** function key and run a complete self test by pressing the *Make Selftest* softkey. The first display of the self test is a keypad test. Press each function and softkey once. When you have pressed each once the test will automatically advance to the *Traffic Light* test. Observe that the three traffic lights go from dim to bright. Press *OK* if they illuminate correctly or *Fail* if they don't.



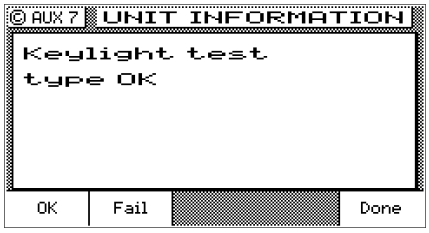


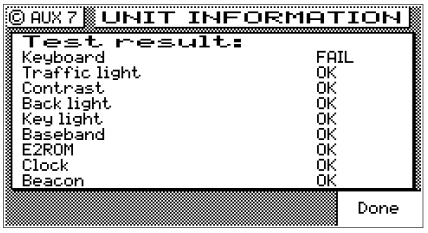
The CDU will go on to conduct a *Contrast* test. Observe that the display goes through its full range of contrast from white to black. Press *OK* if it varies correctly or *Fail* if it doesn't. Next, the CDU will conduct a *Backlight* test. Observe that the display goes through its full range of illumination. Press *OK* if it varies correctly or *Fail* if it doesn't.





Then, the CDU will conduct a *Keylight* test. You may need to dim the lights in the room or shade the keyboard so that you can see the backlights behind the function and softkeys. Observe that the keypad backlights go through their full range of illumination. Press *OK* if it varies correctly or *Fail* if it doesn't.





Upon completion of the above tests, a Test Results screen will be displayed. In addition to the visual tests which you witnessed, the CDU also performs background tests on the program memory (*FLASH ROM*) and the real-time *Clock*. These tests check about 90% of the CDU. The items which it does not check are the input and output ports, the

GPS and Beacon receivers in the antenna.

If one of the background tests fail, you can try clearing the CDU's memory to see if the problem will clear. However, when you clear the memory (also known as a *Cold Start*), you will erase all waypoints and configuration settings. A cold start sets the CDU back to factory default settings.

Otherwise, record the failure(s) and contact your dealer or Leica to arrange for service or repairs. It is possible, but unlikely, that a cold start will correct other failures noted during the selftest. Leica will need the CDU serial number (from the rear panel) and the *Software Version* number to help you further.

Press the **E** key when you are finished viewing the results.

CDU Cold Start - Clearing Memory to Factory Default

When you *Cold Start* the CDU, you will erase all of your waypoints and configuration settings. A cold start sets the CDU back to factory default settings. Perform this procedure if the CDU becomes non-responsive, fails one of the self tests described above, or starts acting very unusually.

To perform the cold start:

1. *Turn the CDU off*. There are three methods you can use:
   A) Press the **On/Off** function key and select the *Yes* softkey, this causes a software shut down of the CDU.
   B) Press and hold the **On/Off** function key for up to 5 seconds, this causes a hardware shut down of the CDU.
   C) Turn power off at the circuit breaker panel feed or power supply which feeds the CDU.
2. Hold the right most softkey down while applying power to the CDU; continue holding the softkey until you hear a normal *key click* for the softkey.
3. Release the softkey.
4. Press the **POS** function key. If the position reads N 00° 00.0000, W 000° 00.0000, then the CDU was properly reset. If it does not read this, try the procedure again.

A common source of memory corruption is an aged Lithium memory

back-up battery. This will result in either a slow deterioration of memory retention or it may abruptly dump all its memory.

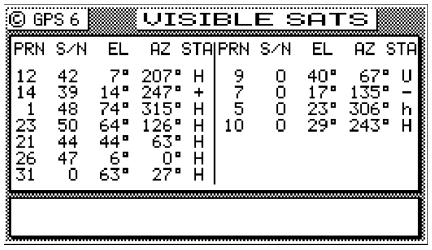
Leica recommends the battery be changed every 2 to 3 years of operation by an authorized technical dealer. Marine electronics dealers or radio shops will typically stock the replacement battery, Lithium type CR2032, 3V.

GPS - GPS CDU Troubleshooting

GPS3 - Visible Satellite Information

This screen provides some basic information about the MX421 smart GPS antenna performance, in that it is basically an extension of *GPS1* screen. It tells you what satellites are available to track at the moment under the PRN number. The signal strength of satellites under track is in the second column labeled S/N. The weakest signal strength that the GPS receiver can track is 25. However, any satellite with a signal strength under 32 is considered *troubled*, and the GPS receiver will not use that satellite in the navigation solution. Troubled satellites tend to cause position jumps and greatly reduce the accuracy of the GPS position fix.

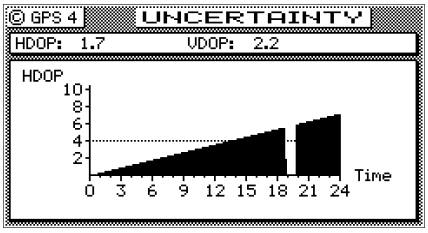
The *EL*, *AZ*, and *STA* values represent the satellite's *Elevation* and *Azimuth*, and Almanac *Status* respectively.



Low signal to noise (S/N) quality numbers may be an indication of local interference from on-board electronic equipment such as Radar, INMARSAT, VHF, SSB and other high power transmitters. Review the installation of the entire system to ensure you have followed proper procedures for cabling, power, and, most importantly, grounding and antenna placement. The majority of these problems will be resolved by better grounding and antenna location selection. Regarding grounding, the water intake for the engine, or any other electrical ground relying on the engine or generator for Earth ground, is not good for the GPS and *especially* the beacon receiver.

GPS4 - GPS Position Uncertainty

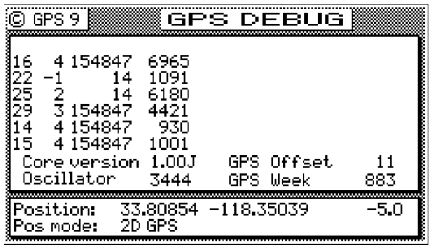
This screen presents a bar graph representing the HDOP for the past 23 hours. If you are trying to do precision work or navigation in the same general area (within 100 miles) as the day before, you can look at this screen to see when the best HDOP periods are. The GPS constellation shifts back 4 minutes per day. That means you can expect the GPS coverage to be virtually the same today as it was yesterday.



The small 1 hour gap in the bar graph represents the 24th hour. The gap is provided to ease the readability of the bar graph for the present time. The dashed line extending horizontally from the 4 represents the current *HDOP Limit Alarm*, which is set in **CFG** *Position*. The current HDOP and VDOP values are given in the upper window.

GPS5 - GPS Debug Screen

This screen is useful during satellite acquisition. It can present some important clues as to why the MX421 GPS smart antenna is not working properly.



The first 6 rows of data represent GPS channel status. There are 4 columns of data for each channel:

Columns 1 & 5: represents the PRN number assigned to a specific receiver channel; a PRN number of 0 indicates there are no satellites available to track on that channel.

Columns 2 & 6: represents the current receiver channel status:

-1 or 1: the receiver channel is unlocked and searching for a satellite.

2: the receiver channel found a carrier signal and is attempting to *Frame*, or synchronize, on the ID pattern and message frame boundaries of the satellite. It is not unusual for this value to go from a 2 back to a 1 because it is possible that the wrong carrier for the identified satellite was found.

3: the receiver channel found the correct carrier for the satellite identified and is collecting the satellite ephemeris. A new ephemeris is collected once a satellite is first acquired and once an hour thereafter.

4: the receiver channel is decoding the navigation data from the satellite.

Columns 3 & 7:

Receiver status = -1 or 1: represents the amount of time the receiver channel has been using a particular oscillator offset, when a 2 digit value is displayed. After about 10 to 30 seconds, depending on the receiver mode, the timer resets to 0, and another oscillator offset is used to find a carrier. This procedure is followed until a GPS carrier is found.

If the receiver was tracking satellites and has since dropped one or all of them, the value displayed is the channel time which is maintained by the navigator processor. As more time passes between tracking the satellites, more error is introduced into this time. It is not unusual to see several seconds of separation between channel times in this mode. This will be corrected when a satellite is picked up and the receiver reverts to mode 3 or 4.

Receiver status = 2: The oscillator value begins adjusting to the center frequency of the carrier, but the counter contin-

ues to run.

Receiver status = 3 & 4*:* The displayed value changes to the *channel time* of the receiver . All receiver channels with a mode of 3 or 4 should have the same channel time. The channel time is a clock that is recovered from the satellite and used to make navigation range measurements.

Columns 4 & 8: represents the current oscillator offset for the given receiver channel. A wide range of values are possible and normal. These values will also change as you and the satellites move to maintain a lock on the center frequency of the satellite carrier.

Core Version: represents the GPS CDU baseband firmware version. This is not the same as the information given in *AUX7*, the navigation firmware version.

Oscillator: represents the current oscillator offset value. This value is present for Leica engineering use only. It has a wide range of variation possibilities. Refer to the *GPS8 - Oscillator Offset Temperature Curve Fit* section in this manual.

GPS Offset: is the reported difference in seconds between GPS time and UTC time, as reported by the satellite. A positive time indicates GPS time is ahead of UTC time.

GPS Week: is the reported GPS week from the satellite. You may have heard about a possible GPS week rollover problem within the GPS industry occuring on August 21, 1999 or on January 1, 2000. The receiver software is designed to correctly adjust to the GPS week rollover and millennium rollover.

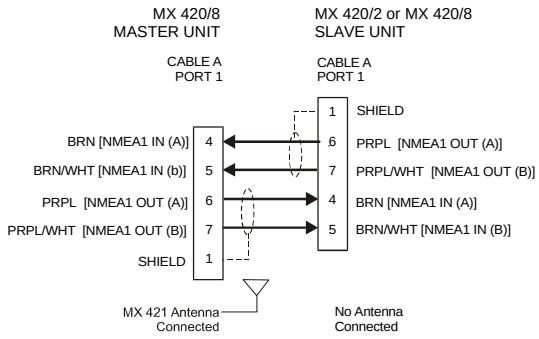
Position: is the current calculated position in decimal degrees. A positive latitude is North. A positive longitude is East. The value on the far right is the ellipsoid height. The ellipsoid height normally varies quite a bit from altitude, which is usually expressed in reference to Mean Sea Level.

Pos Mode: is the current mode of your position solution.

Appendix D - Dual Control Head Mode

The Dual Control mode, which is enabled in the **CFG** *Dual Contr.* screen, allows you to connect two apMK12 CDUs in a *Master/Slave* configuration where a common data base is shared between the two CDU control heads. This configuration also allows you to use one antenna connected to the Master unit for both CDUs. The remaining data and the alarm output ports are still available on each unit for individual use on each CDU.

The hardware interface is accomplished by connecting NMEA Output 1 to NMEA Input 1 between the two units. Refer to the *Installation Section of this Manual* for the appropriate pinouts.



The interface between the two units takes place over a high speed data link. The master unit must be connected to the antenna. The master unit receives the position fix data from the MX421/B antenna and is then transferred to the slave unit at a one second rate (the same as the position calculation). Due to the high speed data link, there is virtually no visible position delay between the two units.

When the two units are first configured as master and slave, the master unit mirrors to the slave, and the *Common Data Base* (see Table D-1) is downloaded from the master to the slave. This function also takes place each time the units are powered up. If you happen to have the CFG1 Dual Control screen active, the status bar will indicate *Mirroring* during the database update period.

Table D-1. Master/Slave Common Database

Data Base	Comments
Present Position	Update once per second
Time	Update once per second. Displayed in the same mode on both units.
Date	
Routes	Only one unit can make changes at any given time.
Waypoints	Only one unit can make changes at any given time.
Reset XTE	Only one unit can make changes at any given time.
DGPS Setup	Only one unit can make changes at any given time.
Dual Control Alarms	
Man Over Board	Only one unit can make changes at any given time.

The items detailed in Table D-2 are independently controlled at the individual CDU heads.

Table D-2. Independently Controlled Functions

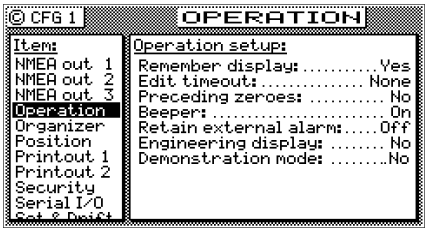
Data Base	Comments
Plotter Setup	Navigate Displays
GPS Engineering Display	Position Displays
Dual Control Setup	Auxiliary Displays
Lighting Setup	Tide Displays
DGPS Displays (slave reflects the conditions in master)	GPS Displays (slave reflects the conditions in master)
NMEA Out	Printer Out 2
Waypoint Sorting	

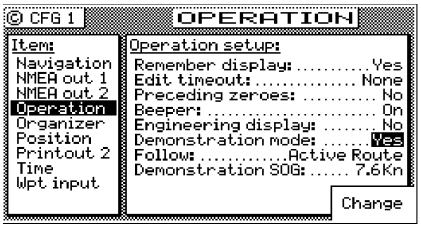
Turning Master and Slave Units Off

Before turning the power off to either the master or slave unit, make sure you go to the **CFG1** screen and disable the dual control function. If the master unit is turned off while in dual control mode, the slave unit will not be connected to the antenna nor display a position. The unit that remains on will alarm until the data link is re-established, the unit is turned off, or Dual Control is turned off.

Appendix E - Demonstration Mode

This enables the CDU to function as though you are under way, even though you are completely stationary. The default setting is *No*. When set to *Yes*, all three Traffic Lights will be illuminated, and a *D* symbol is displayed in the upper left corner of every display. Generally speaking, this feature is used by Leica and your dealer for show room or trade show demonstrations. However, you can use it as a training tool until you become familiar with the CDU. You can also use it to output NMEA 0183 records on the data ports to test and demonstrate other devices such as autopilots, chart plotters, and radars.





In the **CFG** *Operation* screen, activate the *Demonstration Mode* by selecting *Yes*.

Follow:

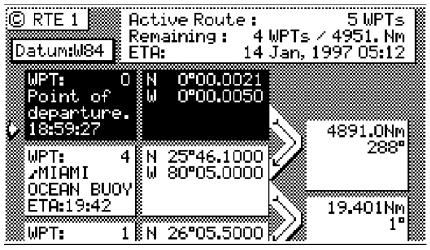
Active Route: causes the CDU to use the route loaded in RTE1 screen.

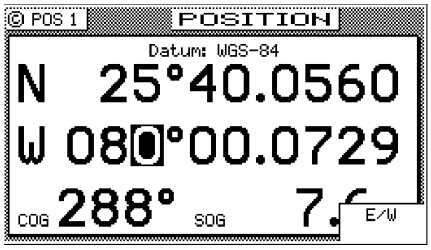
Rhumb Line: causes the CDU to follow the bearing you input in this screen under *Demonstration COG*.

Demonstration SOG: causes the CDU to simulate a speed of up to 99 knots. Slower speeds of 5 to 25 knots provide the best demonstration results.

Demonstration COG: causes the CDU to simulate a course over ground of up to 359.9 degrees when Follow is set to *Rhumb Line*.

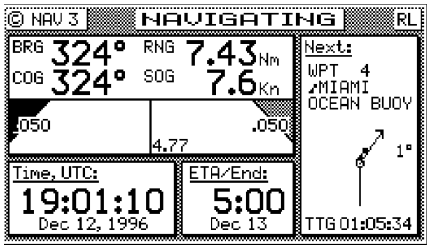
To setup your course, load the desired waypoints into *RTE1*. Notice that the CDU loads your point of departure as N 00, W 000.

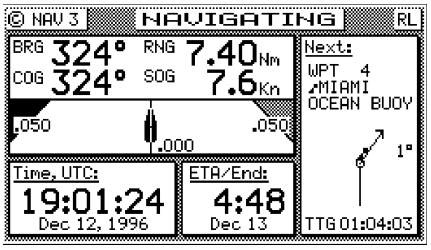


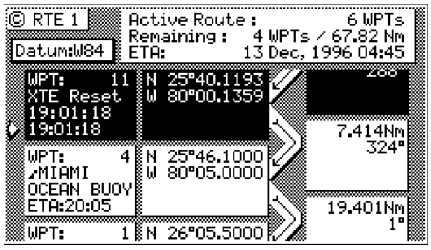


Before you adjust your position, set your *WPT Pass Criterion* to *Distance* in the *CFG1 Navigation* screen. To adjust your position, pick a point near your first waypoint. A distance of 1 or 2 miles from the first waypoint is good to start with. Go to the **POS1** screen and press **E**.

Next, press the **NAV** function key, then the **E** key. Press the *Reset XTE* softkey. Press the **E** key. This resets your cross-track error and updates the active route in **RTE1** with the adjusted position.







Now just use the CDU as you normally would. You can output NMEA 0183 data records to other devices. *Be careful, however, other instruments will interpret the data as completely valid.* So, don't run the *Demonstration Mode* while you are underway and connected to devices that are being used in real time, like your autopilot.

Appendix F - Installation Section

Supplied Equipment

Equipment supplied with the apMK12 is shown in table below:

Item	Component	Qty.	Part Number	Wt (lbs.)	Figure #
1.0	apMK12 GPS Navigation System Consisting of:	1	726328		
1.1	apMK12, 2-Port Control and Display Unit	1	726225	2.6	
1.2	Mounting Bracket	1	713451		
1.3	Mounting Kit	1	715671		
1.4	Power /NMEA Cable (Cable A)	1	725614		
1.5	apMK12 Operation & Installation Manual	1	726226		
1.6	apMK12 Operator's Quick Guide	1	726227		
1.8	Tide Table Manual	1	721714		
2.0*	MX421-10 Smart GPS antenna System* with 15 meter cable	1	726233		
***GPS only model. *For apMK12 DGPS Navigation System (P/N 726329) model substitute antenna unit with MX421-10B smart DGPS Antenna unit P/N 726232).**					

GENERAL

The apMK12 Control and Display Unit (CDU) is splashproof and can be installed both above and below deck. To ensure that the back of the display unit remains splashproof, protection covers must be used around the connectors. The installation should meet the requirements of the helmsman, the crew or other users. When flush mounted, locate a smooth and flat surface to insure that the gasket makes full contact with the mounting surface. Ensure that the navigator is mounted in a place where water flows off easily. Avoid places where water may accumulate for any period of time.

External Power

The apMK12 operates on 12 ~ 32 VDC supply. It can tolerate voltages no lower than 10 volts and no higher than 35 volts. It draws about 1 ampere at 12 VDC (with the MX421/B antenna connected). Power wire colors are:

- Red --------- +12~32 VDC
- Black ------ Negative Return (-)

Figures 1 and 2 shows the apMK12 rear panel connector and power and data I/O cable (cable A). Even though the navigator has a reverse polarity protection device we recommend that the installer observe proper polarity before hooking up the power leads. Leica also recommends using a 2 Amp. fuse in-line with the red wire as close to the battery as possible. This not only protects the navigator but also the cabling.

CDU Grounding

Connect the navigator unit to ground to avoid static charge build up. This can be done in either one of two ways:

1. Connect the Cable A shield to the boat's *Sea Water Groun*d.
2. Connect the grounding stud of the navigator to the boat's *Sea Water Groun*d.

Note** : **'Sea water ground' is any electrically conductive material that is directly in contact with sea water.

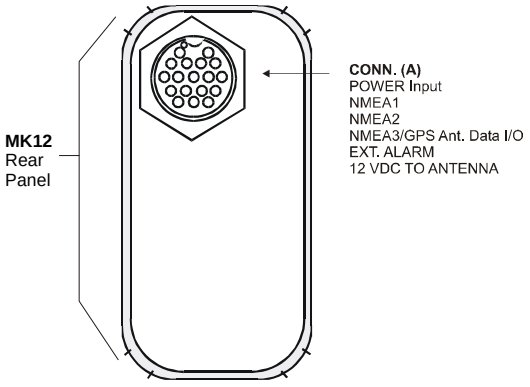


Figure 1 - ap*MK12 Rear Panel Connector*

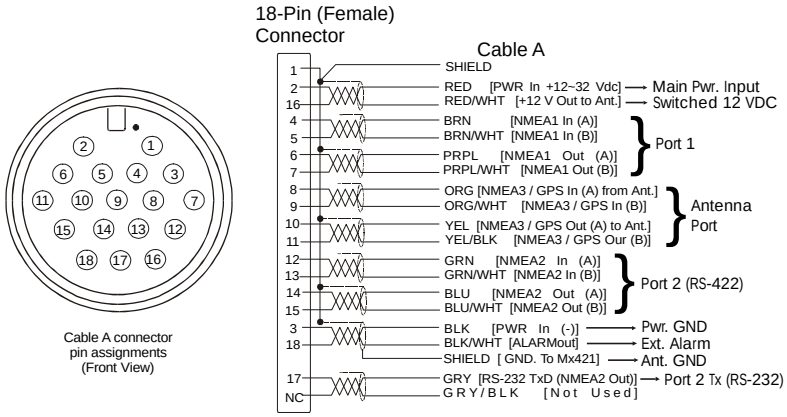


Figure 2 - Cable A Connector and Wiring Diagram

ANTENNA INSTALLATION

Antenna Location

The GPS smart antenna (MX421) should be mounted with a relative clear view of the horizon. Do not mount the antenna on top of a very tall sailboat mast, as the rolling motion of the vessel may degrade the COG and SOG calculations, particularly when in DGPS mode.

The MX421 antenna must be placed outside the beam path of transmitting radar (typically +15 °horizontally from the array's center point).

It must be mounted lower than the INMARSAT satcom (A, B, C, or M; typically +10° from the array's center point in any of the possible transmitting directions and at least 5 meters from any side lobe or back lobe direction). The GPS antenna should be mounted below and at least 5 meters away from these types of antennas.

Do not place it within 3 meters of a SSB or VHF radios or their antennas.

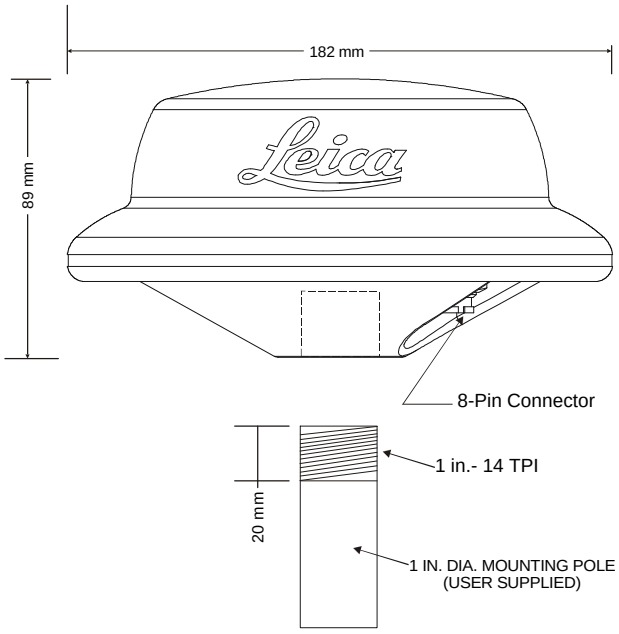


Figure 3 - MX421 Antenna Dimensions and Mount Specifications

Antenna Options

Two antenna options are available for the apMK12, namely:

- MX421-10 (GPS only antenna)
- MX421B-10 (GPS with built-in automatic beacon receiver)

These antenna models look identical and they are wired the same way. The antenna model is indicated on the serial number tag on the underside of the antenna. The drive voltage to the antenna is 12 VDC ±10%, and normally provided by the apMK12. Refer to Figures 4 and 5 for the MX421 antenna wiring diagrams.

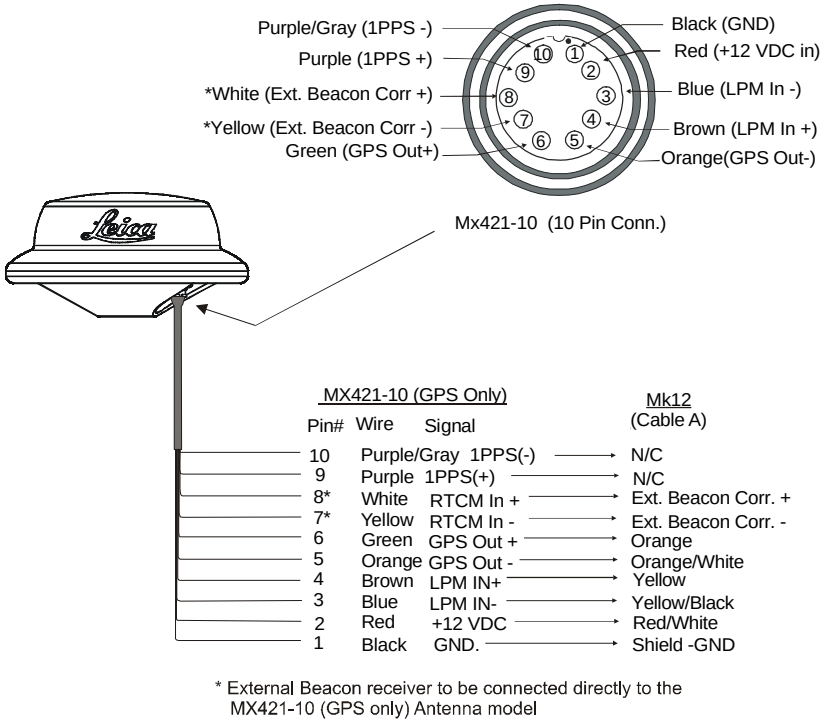


Figure 4 - MX421-10 (GPS only) Antenna Wiring Diagram

External Beacon Receiver Connection

Differential corrections from an external beacon receiver can be connected to the MX421-10 GPS model only. Connections are done directly to the antenna cable (Pins 7-yellow and 8-white) of the MX421-10 unit. The MX421-10 will accept the RTCM SC-104 signal at 4800 baud.

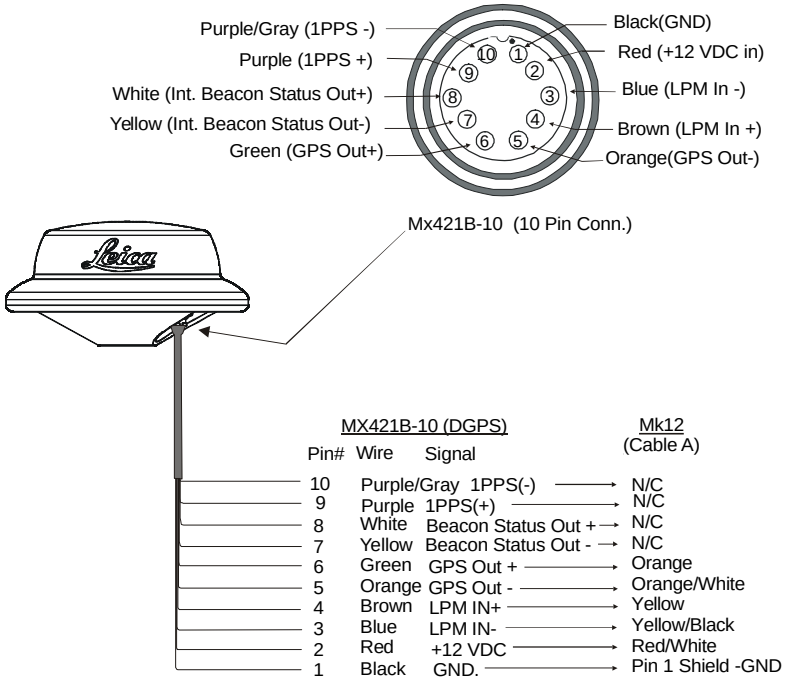


Figure 5 - MX421B-10 DGPS Antenna Wiring Diagram

NAVIGATOR INSTALLATION

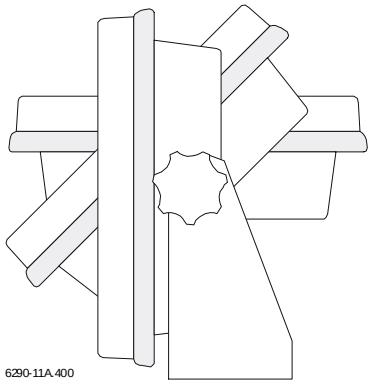
The *Navigator* is the primary unit with the integrated display and keypad. The navigator can be mounted using one of three techniques:

- Gimbal mount
- Flush mount
- Frame mount

Each of these techniques are described below. All the hardware necessary to complete the Flush and Gimbal mount is provided with the apMK12. You will need rear panel access to complete these types of mounts. The Frame mount is an option for applications where front panel removal is not desired or rear panel access is not available. The hardware necessary for the Frame mount is sold separately (P/ N 715707). It is important to consider the space behind the unit to prevent sharp cable bends before commencing with the installation. A minimum of 100 mm. free space is needed behind the unit for cable dressing.

Gimbal Mounting

A pivot Mounting Bracket including finger screws and rubber friction washers are delivered with the apMK12. Place the self adhesive rubber washers around the two threaded holes at each side of the navigator. Use the two machine screws with the large palm grips to secure the apMK12 to the mounting bracket. Adjust the viewing angle to meet your needs.



Flush Mounting

Drilling and cutting instructions for flush mounting are given in Figure 4. The maximum bulkhead thickness which can be used in this configuration is 9 mm (7/ 16 in). Cut a notch deep enough to accommodate the flush mount bracket, Allen head bolt, and Allen screw driver for thicker bulkheads

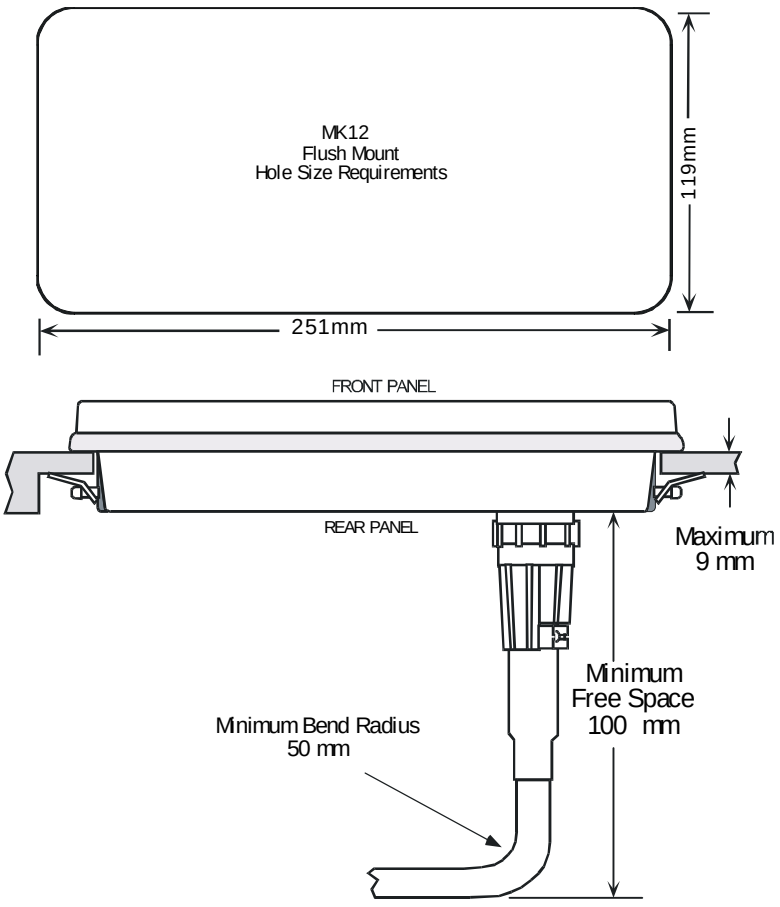


Figure 4 - Standard Flush Mount and Cable Clearance

Flush Mount Frame

If access to tighten the screws from the backside is impossible, an optional Flush Mounting Frame is available (P/ N 715707). First, mount the frame to the navigator. Next, attach all of the hardware interfaces to the appropriate port (i. e. antenna, power, etc.). Finally, mount the entire assembly to the panel from the display side. The frame is oversized (300 mm x 175 mm; 11.81 in x 6.89 in). The frame mount hole cut dimensions are given in Figure 5.

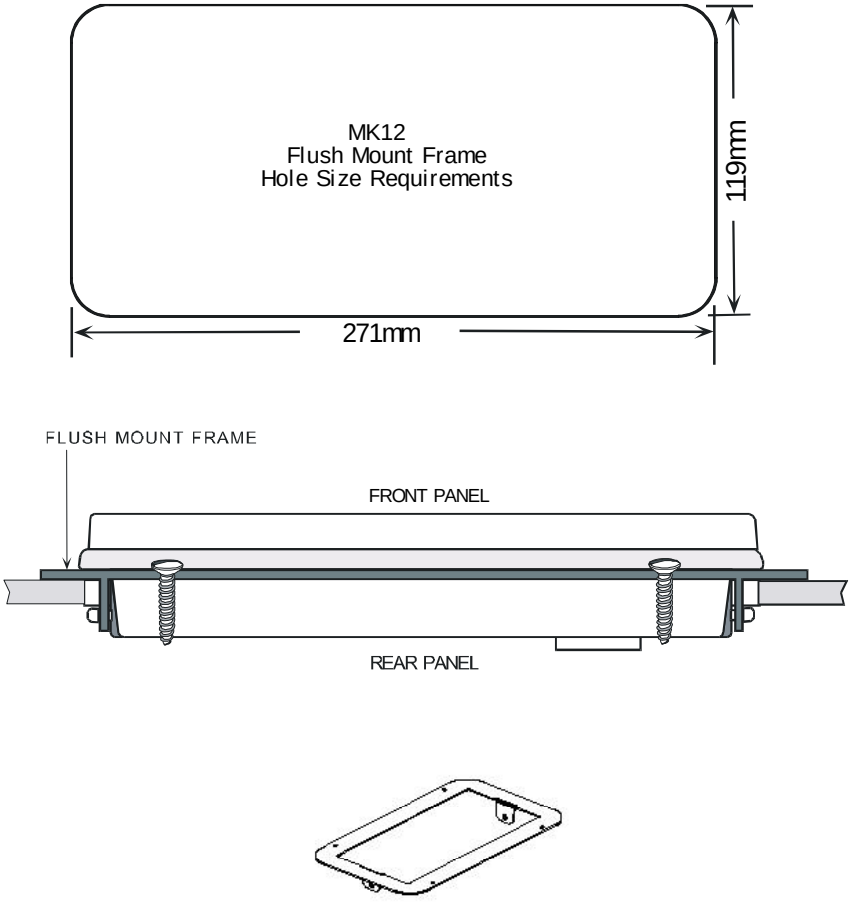


Figure 5 - Optional Flush Mount Frame Installation

Turning Power On and Off

The navigator is turned on by briefly pressing the ⏻ key. Please do not keep the key pressed for more than one second, as this will turn the navigator off again when the key is released. This key is also used to turn the power off by either of two methods:

a) Software Control:
A normal short key press displays the softkey option boxes *Yes* or *No* to turn the power off. Respond by pressing the *Yes* softkey under the box turns the navigator off. Selecting *No* cancels the operation, and returns the unit to normal operation.

b) Hardware Control:
Pressing the power key for more than 3 seconds turns the power off under hardware control (the softkey option will also be displayed under normal operating conditions). The apMK12 can not be turned on again for 10 seconds when this method is used. Attempting to turn the unit on during this 10 second period, will only activate the navigator for as long as the key is not released. This option is not normally used, and is provided as an emergency alternative to the software power control.

If the external power to the unit fails for any reason, the navigator will remember if it was on or off for about 20 minutes. That is if the navigator was on when the power failed and the power comes back within 20 minutes, the navigator will turn itself on again. Otherwise, it will stay turned off until the ⏻ key is pressed.

EQUIPMENT INTERFACING

Introduction

The apMK12 has two user data I/O ports which are NMEA 0183 protocol capable. Anyone of these ports can be used to communicate with other external equipment which utilize the NMEA 0183 standard. Ports 1 & 2 are configured for RS-422 standard. However, NMEA port 2 can be either as RS-422 or as RS-232. Only one of these two electrical interface standards may be implemented at any given time on port 2. The RS-232 port standard is used to connect to a personal computer or any other RS-232 or *single ended interfac*e. The RS-422 electrical interface will almost always work with the older NMEA 0183 version 1.5 electrical interface; both of which are *balanced line interface*s. If for some reason you can't get this interface to work, try the Port 2 (RS-232) interface on these older equipment.

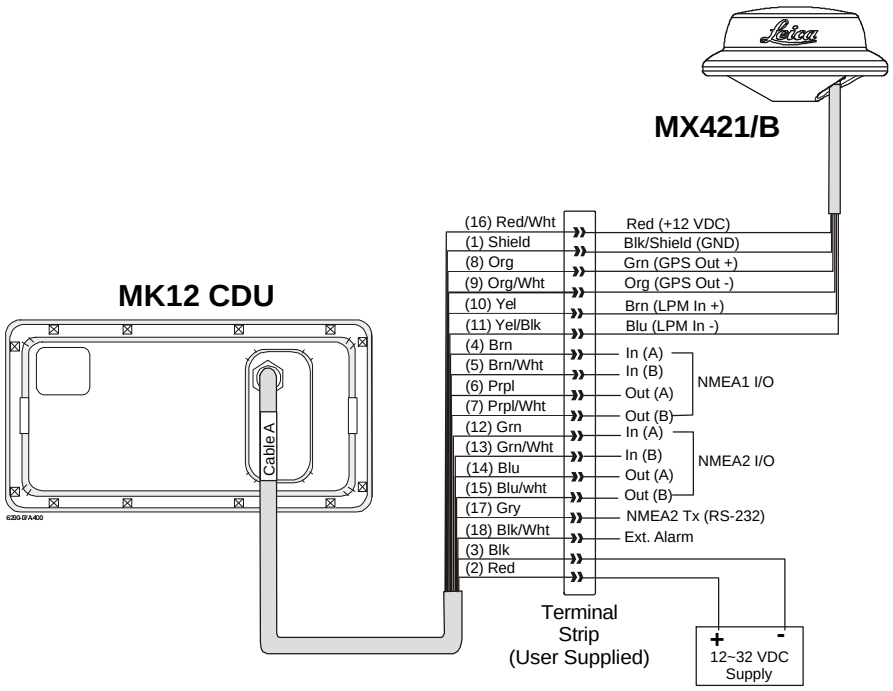


Figure 6 - ap*MK12 GPS Navigator System Diagram*

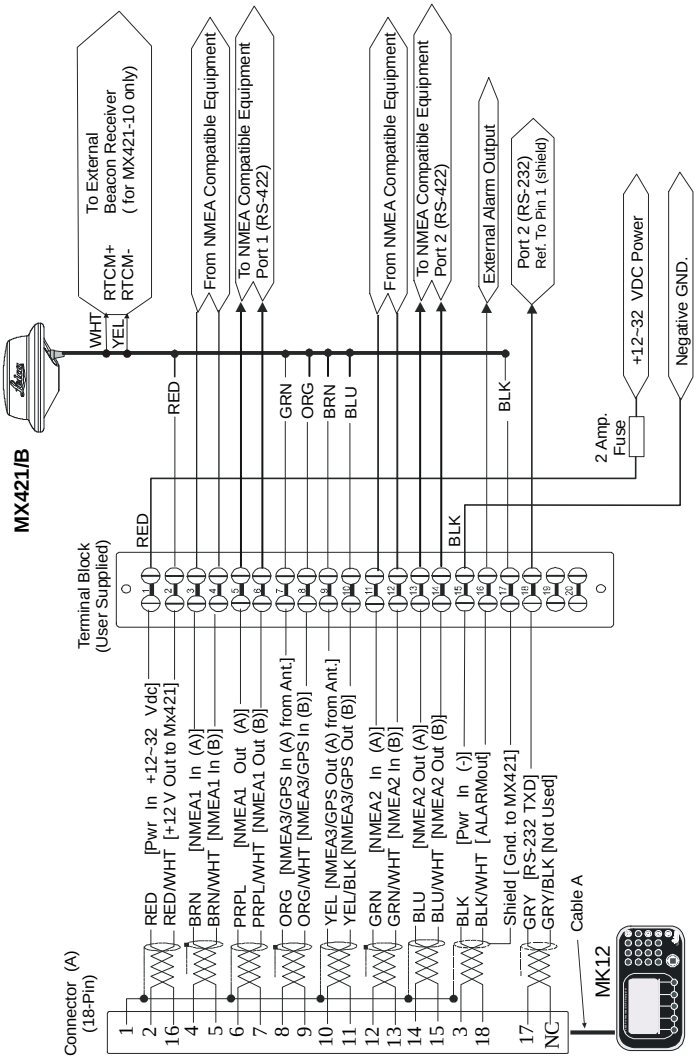


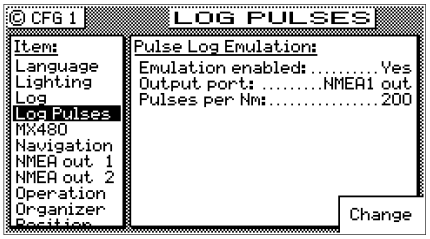
Figure 7 - ap*MK12/MX421 Wiring Diagram*

Speed Over Ground Pulse Output

The apMK12 outputs the GPS calculated speed over ground in a pulse format. Refer to the Specifications section of this manual for signal characteristics.

The pulse output is derived from any available NMEA Out ports (shared with the NMEA 0183 function) on the apMK12. Therefore, the ports are available for either pulse output or NMEA 0183 output. Don't forget that only NMEA2 Out (Port2) can be either RS-232 or RS-422 port. Pulse output NMEA1 is connected to pins 6 (signal) and 7 (return; not ground). Pulse output port 2 is connected to pins 14 (signal) and 15 (return; not ground). These are RS-422 level signals, and may not be compatible with every installation.

To setup the apMK12 software, select the *CFG1 Log Pulses* screen. This screen controls the output port (Pulse) of the speed over ground log output from the apMK12 at a user determined pulse rate of 100 to 500 pulses per nautical mile (200 is the pre-selected value). The default condition of the Speed-Over-Ground output is not active.

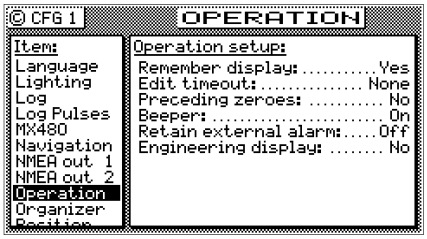


Alarm Output

The apMK12 external alarm is switched to ground potential when an alarm condition exits. The normal signal characteristics are that the line signal is held open (floating) during no alarm condition, and the signal is sent to Ground when an alarm condition occurs. When an alarm condition is corrected or acknowledged, the signal returns to open condition.

In some installation, it may be required to retain the external alarm while the alarm condition still exist. This can be accomplished by setting the "Retain external alarm" under the *CFG/Operations* to *On*. This setting will hold the external alarm line to ground potential even when

the alarm is acknowledged in the unit.
The external alarm is derived from the “ALARMout” port on pin 18 (Black/White - ALARMout). The software is set up in each of the appropriate *CFG1* menu screens.



Using an external relay connected to an external 12 VDC power supply will allow you to have a choice of a normally open or close isolated contacts. See Figure 7 for relay diagram.

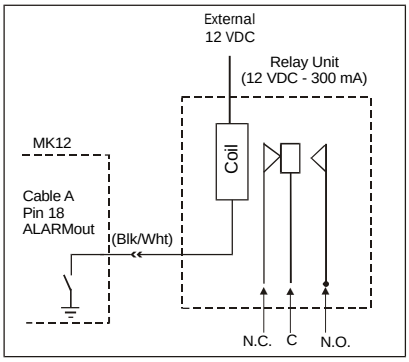


Figure 7 - External Alarm Relay Diagram

Port 2: RS- 422 / RS- 232 Serial Interface

The CDU has a standard RS- 232 interface (similar to a PC COM). The RS- 232 use the same internal UART logic as the NMEA port 2. The TxD RS- 232 output and the NMEA2 out RS- 422 output carries the same serial data, but with the electrical levels of each standard. The input is shared, and can only be set up to either receive RS- 232 input or NMEA RS- 422 input.

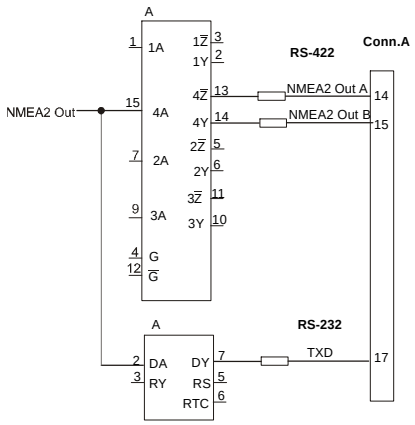


Figure 8 - Port 2: RS- 422 / RS- 232 Port Schematic

NMEA Interface

The apMK12 meets the NMEA 0183 version v1.5, v2.01 or v2.1 electrical standard for marine interface communications with other on-board electronic equipment, such as:

Radars, Plotters, Autopilots, Fish Finders, etc.

There are differences in the electrical interface specification between NMEA 0183 version 1.5 (introduced in 1987) and NMEA 0183 version 2.0 and later (introduced in 1994). Some older model equipment utilize RS-232, others use RS-422, and others meet the older version 1.5 specification. In an effort to simplify your interface capabilities, you should take the time to determine which electrical interface specification all of the interfaced equipment meets.

Cable provided for the NMEA signals are shielded pairs. If extension cable is needed, be sure to use shielded pair cables in order to avoid spurious signal radiation. More than one NMEA listener can be connected in parallel to the same NMEA talker. The maximum number of listeners connected to a single talker is dependent on the combined listener input impedance's, and the capacity available for data throughput.

ap*MK12 NMEA 0183 Sentences*

The NMEA Standard provides for asynchronous transmission, with a single *Talker* and multiple *Listeners* per line. Typical use includes information transfer from electronic positioning and navigational devices to autopilots, plotters, terminals, printers, etc.

Table 1 show all the NMEA 0183 sentences that can be selected in the APMK12 CDU.

NMEA Output Sentences

All sentences have the identifier “GP” for Global Positioning Systems. All position data are in the user selected (displayed) datum except for GGA where the datum can be manually set to WGS84, independent of the selected (displayed) datum.

RMB is transmitted only if an active route is present. Please refer to the *Route* section of the *Operator’s Manual* for details on setting up an active route.

APA , **APB** , and **XTE** , are transmitted only if an active route is present and the *Autopilot Alarm* in each of these NMEA sentence setup screens is *Enabled* and this feature is not in an alarm condition.

ID	DESCRIPTION	ID	DESCRIPTION
*** APA**	Autopilot Sentence A	**RMB**	Recommended Minimum Navigation Information
APB	Autopilot Sentence B	**RMC**	Recommended Minimum Specific GPS/ Transit Data
BOD	Bearing Origin to Destination	***Rnn**	Routes
BWC	Bearing & Distance to Waypoint - Great Circle	**RTE**	Routes
BWR	Bearing & Distance to Waypoint - Rhumb Line	***SNU**	Loran- C SNR Status
DTM	Datum Reference	**VDR**	Set & Drift
GGA	GPS Fix Data	**VHW**	Water Speed and Heading
GLL	Geographic Position - Latitude/ Longitude	**VPW**	Speed Measured Parallel to Wind
GRS	GPS Range Residuals	**VTG**	Course & Speed Over Ground
GSA	GPS DOP & Active Satellites	**WCV**	Waypoint Closure Velocity
GST	GPS Pseudorange Noise Statistics	**WPL**	Waypoint Location
GSV	GPS Satellites In View	**XTE**	Cross- Track Error, Measured
HSC	Heading Steering Command	**ZDA**	Time & Date
MSK	MSK Receiver Interface	**ZTG**	UTC & Time to Destination Waypoint
MSS	MSK Receiver Signal Status		
* **APA** , **Rnn** and **SNU** are older sentence formats (version 1.5) not recommended for new designs.			

Table 1- NMEA 0183 Output Sentences

Input NMEA 0183 Sentences

The apMK12 recognizes version 1.5, 2.0, and 2.1 NMEA input records. The apMK12 can utilize the following input sentence formats:

Depth: DBK, DBS, DBT, and/ or DPT

Heading: HCC, HDM, HDT, RMA (only when GPS is not available), RMC (only when GPS is not available), VHW, and VTG (only when GPS is not available)
Position: GLL, RMA, RMC (only when GPS is not available)

Speed: RMA , RMC , VHW, VTG (only when GPS is not available)

Transducer: MMB, XDR

Waypoints: The received WPL data will overwrite the memory content of the waypoint location which is contained in the received WPL sentence.

The APMK12 does not process the TALKER identifier (first two characters following the $ of NMEA 0183 sentences) for any NMEA sentences received. Any pair of characters within the NMEA specification are recognized.

The APMK12 does process floating numerical formats in the received sentences.

Although the current version of the NMEA 0183 standard requires that a checksum be present, the checksum is not required by the apMK12. However, if the checksum is included in the NMEA sentence, the apMK12 will reject any sentence where the checksum and data do not correlate.

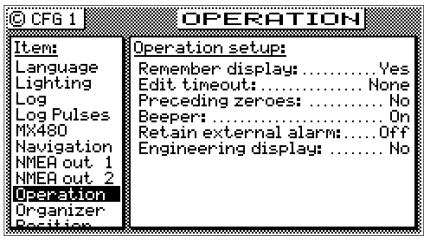
Viewing Input Data

You can view data being sent to the APMK12 by other equipment or loop a APMK12 output port back to an unused input port to verify if it is outputting data to other equipment. This is a great tool to use when you are first interfacing equipment.

To activate the *Input Data* screen:

Press **CFG** .

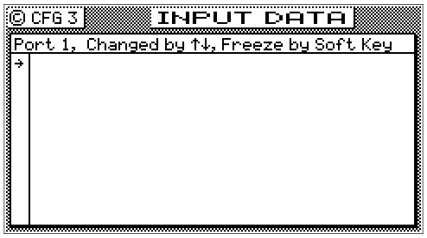
Scroll through the menu and select *Operatio*n.



Press **E** and change *Engineering Display* from *No* to *Yes*.

Press **E** again to exit the edit mode.

Press the left cursor key until the **CFG3** *Input Data* screen is displayed.



Press the up or down cursor key until the proper input port number is displayed.

The data that you will see on the screen is unprocessed. Therefore, if there are errors in the data, you can compare the data against the NMEA 0183 standard.

Dual Control (Remote) Interface

The Dual Control mode, which is enabled in the **CFG** *Dual Contr.* screen, allows you to connect two apMK12s in a *Master/Slave* configuration where a common database is shared between two apMK12 control heads. This configuration also allows you to use one antenna connected to the Master unit, for both apMK12s. The remaining data ports, the MOB /Event input port, and the alarm output ports are still available on each unit for individual use on each apMK12. .

The hardware interface is accomplished by connecting NMEA1 Output to NMEA1 Input between the two units.

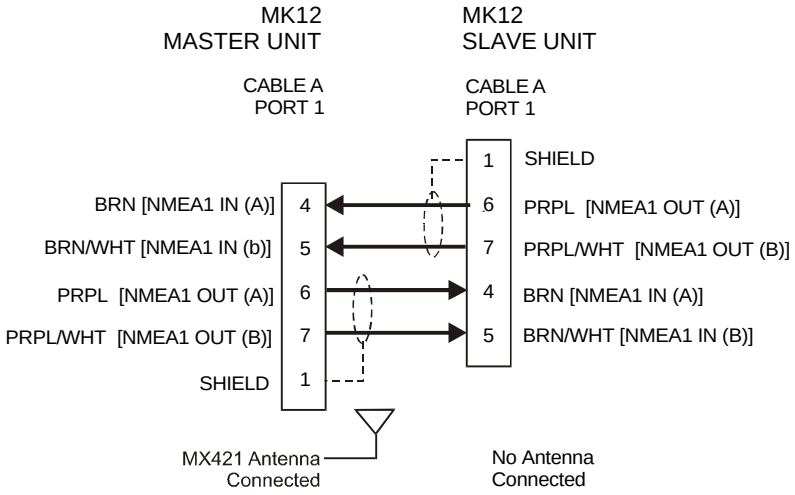


Figure 9 - MX420 Dual Control Data Interface

The interface between the two units takes place over a high speed data link. The master unit must be connected to the antenna. The master unit receives the satellite signals and beacon signals and performs the position calculation function. The resulting position fix data is then transferred to the slave unit at a one second rate (the same as the position calculation). Due to the high speed data link there is virtually no visible position delay between the two units.

When the two units are first configured as master and slave, the master

listens for a configuration polling message from the slave. Once the master recognizes the slave's polling message, the *Common Data Base* (see Table below) is downloaded from the master to the slave. This function also takes place each time the units are powered up.

Data Base	Comments
Present Position	Update once per second
Time	Update once per second. Displayed in the same mode on both units.
Date	
Routes	Only one unit can make changes at any given time.
Waypoints	Leave the screen and reenter it or press the **E** key to refresh the screen if viewing the screen at the same time in both units. Only one unit can make changes at any given time.
Reset XTE	Only one unit can make changes at any given time.
DGPS Setup	Only one unit can make changes at any given time.
Dual Control Alarms	
Man Over Board	Only one unit can make changes at any given time.

Table 5. Master / Slave Common Data Base

The items detailed in Table 6 are independently controlled at the individual MX420 control heads.

Plotter Setup	Navigate Displays
GPS Engineering Display	Position Displays
Dual Control Setup	Auxiliary Displays
Lighting Setup	Tide Displays
DGPS Displays (slave reflects the conditions in master)	GPS Displays (slave reflects the conditions in master)
NMEA Out	Printer Out 2
Waypoint Sorting	

Table 6. Independently Controlled Functions

Troubleshooting Guide

The apMK12 is virtually maintenance free. There are, however, a few important points to note.

Please check your installation carefully before returning the apMK12 to the dealer or factory for service. A few troubleshooting tips follow.

The apMK12 performs a variety of self tests during normal operation. If a function fails the self test, the navigator displays an *Internal Error* message every one minute.

Table 7. Troubleshooting Tips

Problem	**Diagnosis**
No response: (Black LCD display and no traffic light)	No external power supply Check supply voltage Check for reverse polarity Check wire installation Check if external fuse is blown
No keyboard response or partial keyboard response	Corrupted memory faulty keyboard faulty processor Return the unit for repair
Battery low alarm	External battery low Check power supply voltage and installation
No position update; won't track satellites (Red traffic light blinking for more than 10 minutes)	Jamming by other on- board or adjacent transmitters Faulty antenna or antenna cable Relocate GPS antenna Replace antenna Return the unit for repair
No position update; tracking satellites (Red traffic light solid all the time)	DGPS mode set to *DGPS Only* and no corrections are being received GPS satellite signals weak (satellites dropping in and out) Check maximum cable length restrictions and cable condition (for weak satellite signal condition) Return the unit for repair
All data lost at power up	Backup battery is dead Replace the internal backup battery
No DGPS update; not tracking beacon station	DGPS mode set to *Off,* so no corrections are being received. *Station Select* is set to *Manual.* Faulty antenna
No data output to peripheral equipment	NMEA output data not configured Wrong NMEA version Wrong output rate, or format Wrong electrical standard Too many data sentences turned on (throughput overflow) More than one NMEA *talker* on the circuit Faulty port The MX420 requires the user to enable NMEA Return the unit for repair

Memory Backup Battery

The internal real time clock and memory which stores the waypoints, alarm limits, etc., is backed up by a lithium cell battery. The expected life time is 2 years at 21° C, but this is based on the temperature the navigator is stored at when not in use. The higher the temperature, the shorter the life and vice versa.

Backup Battery Replacement

Marine electronics dealers or a radio shops will typically stock the replacement battery, Type **CR2032**, 3V Lithium battery.

The battery is located on the apMK12 processor board. Leica recommends this service to be done by a qualified service technician.

Appendix G - Technical Specifications

MX421-10 Smart GPS Antenna

GPS:

Type:	L1, 1575 MHz, C/ A Code, 12 channel continues tracking
Update rate:	Once per second
Accuracy:	1 m 2DRMS Position with DGPS 3 m 2DRMS without correction
Dynamics:	Velocity: 460 m/ s Acceleration: 2.5g
Time to first fix:	Less than 1 minute with almanac 15 minutes from coldstart.
Reacquisition:	15 seconds typical
DGPS Input:	RTCM SC- 104 format, from internal beacon receiver.

Beacon (MX421B-10):

Type:	2 channels, Automatic or Manual tuning
Frequency:	283.5 - 325 KHz, in 500 Hz steps
Dynamic Range:	100dB
Adjacent Channel Rejection:	40dB (500 Hz)
Bit rate:	25, 50,100, or 200 (auto- sync)
RTCM Messages Supported:	Type 1, 2, 3, 5, 7, 9,16

ap*MK12 Control and Display Unit (CDU)*

Display:

Part name:	LMG7410PLFC (Hitachi)
Dots:	240 by 128
Duty:	1/ 128
LCD:	Film type black and white (negative type). Bottom polarizer is transmissive type.
Matches polarized sunglasses.	
Viewing dir.:	6 O'clock
Back light:	Cold cathode fluorescent lamp
Protection:	Acryl 7N PMMA window

Keyboard:

Type:	Tactile silicone rubber
Contact:	Carbon
Back light:	Yellow LEDs

Front enclosure:

Plastic:	ABS/ PC- blend Cycoloy C1200

Back enclosure:

Metal:	Cast aluminum1575 MHz

Connector:

Connector A:

Panel plug:	18-Pin Male (Conxall)

Cables:

Cable A:

Type:	9-Pair Shielded - Wire 24x 0.2mm
Connector:	18-Pin (Female - Conxall)

Antenna:

Type:	10 wire (24 AWG) shielded
Connectors:	
Antenna end:	10-Pin Female Conxall
Navigator end:	None

Antennas:

MX421-10 GPS Smart Antenna Unit

Freq.:	GPS L1 , 1575 MHz

MX421B-10 DGPS Smart Antenna Unit

Freq.:	GPS L1 , 1575 MHz
Beacon:	283.5 - 325 KHz

Physical

ap*MK12 CDU:*

Height:	145 mm (5.71in)
Width:	271 mm (10.67in)
Depth overall:	53 mm (2.52in)
Depth flush mounted:	24.5 mm (0.98in) to wall

Depth for cables:	100 mm (3 in.)
Weight:	1238 g (2.75 lbs.)
Weight gimbal mount:	214 g (0.47lbs)
Cable	
Cable A:	2 m (6 ft)

MX421-10 Antenna:

Height:	89 mm (3.27 in)
Diameter:	182 mm (7.28in)
Cable Length:	
Supplied:	15 m. (Standard length)
Options:	20 or 40 meters

Environmental

ap*MK12 CDU:*

Operating Temperature:	-15 to +55 °C. IEC 60, clause 4.5.2 and 4.5.4 (draft 3rd edition).
Storage Temperature:	-30 to +70 °C. IEC 945, clause 4.5.2 and 4.5.4 (draft 3rd edition).
Humidity:	IEC 945, clause 4.5.3 (draft 3rd edition).
Vibration:	IEC 945, clause 4.5.7 (draft 3rd edition).
Solar Radiation:	MIL- STD- 810E, Method 505.3, Procedure II.
Corrosion:	945, clause 4.5.10 (draft 3rd edition).
Water Resistance:	MIL- STD- 108E, Procedure 4.10.
	EMC: EN 50081- 1/ 1992, EN 50082- 1/ 1992 and 55022/ 1994 class B, IEC 801- 2/ 1991, IEC 801- 3/ Draft Second Edition, IEC 801- 4/ 1998, IEC 945/ 1994, IEC 80/ 106/ CDV/ 1995 (Draft IEC945), FTZ 171 R 32/ Aug. 1985, FTZ 171 R 45/ Jan. 1989, FTZ 171 R 46/ Dec 1988.

Compass Safe Distance:	Recommended 1.5 m.

MX421 Antenna:

Operating Temperature:	-25 to +70 °C.
Humidity:	MIL- STD- 810E, Method 507.3, Procedure I. 100% R. H. for 30 days at 24 °C.

Power:

ap*MK12 CDU:*

Type:	DC/ DC switch mode with galvanic separation.
Consumption:	Less than 11W (display back light on). Typical 8W at 24 volt external supply voltage. Typical 8.7 W at 12 volt external supply voltage
Supply voltage:	12 or 24 volt battery: 9.6 volt dc to 32 VDC
Reverse protection:	-100 volt: internal diode
Over voltage protection:	+40 volt: fuse and transient voltage suppression
Fuse:	Internal over current / over tempera ture fuse. Automatic resetting.
Insulation:	Supply voltage to data pins or shield: Maximum 50 VDC
Antenna supply:	12 VDC, maximum 500mA.

Antenna:

MK 421:	12 VDC, 200 mA
MK 421B:	12 VDC, 280 mA

ap*MK12 CDU Inputs and Outputs:*

NMEA talker (all outputs): Meets NMEA 0183 version 2.1.

Levels:	Maximum ±6 volt, minimum ±2 volt, A out relative to B out.
Current:	Minimum 15mA.
Protection:	-1 volt to +6 volt, output relative to shield, ±50 volt, output relative to external power lines.

NMEA listeners (all inputs): Meets NMEA 0183 version 2.1.

Insulation:	Opto coupler. Maximum ±50 volt, input relative to shield or power supply lines.
Impedance:	Minimum 500 Ohms, A-In relative to B-In
Threshold:	Maximum 2 volt and 2 mA
Protection:	±15 volt, A- in relative to B- in, ±50 volt, input relative to shield or power

Alarm output

Signal levels:	When not in Alarm state, or after acknowledged alarm: Normally Open When in Alarm On state: Closed to Ref. GND.
Cable A Pin:	Pin 18 (N.O. contact to GND)

Antenna voltage output (Cable A)

DC voltage:	12 VDC, ±1.0 VDC loaded; (11.5 VDC nominal unloaded)
DC current:	Maximum 500 mA at 12.0 volt dc.

Glossary

ALARM

Message by which the navigator signals the occurrence of an event. The alarm is indicated by an audible tone and/or a message (or icon) on the display.

ALMANAC

Library of coarse satellite orbital characteristics used to calculate satellite rise times, set times, angles of elevation, etc. Almanac data is valid for 181 days.

ALTITUDE

The height of the antenna over mean sea level.

AMBIENT

Surrounding or encompassing environment.

ANTENNA HEIGHT

The height (over the waterline) in which the antenna is installed. This value is used in 2D mode only.

ATMOSPHERIC PRESSURE

See BAROMETRIC PRESSURE.

APPARENT WIND ANGLE (AWA)

The angle of the wind as measured on the moving vessel relative to the heading of the vessel. An AWA of 0° indicates a wind from straight ahead, whereas 180° indicates a wind from straight astern. An AWA of 90°St indicates a wind perpendicular to the vessel from its starboard side.

APPARENT WIND SPEED (AWS)

The speed of the wind as measured on the moving vessel.

AZIMUTH

In satellite navigation, the angular distance measured on the horizon circle in a clockwise direction from the north point in the horizon to the satellite point in the horizon.

BAUD

Transmission rate unit of measurement for binary coded data (bit per second).

BEARING

The direction of one terrestrial point from another, expressed as angular distance from North, clockwise through 360°.

BIT

Short form of Binary Digit. The smallest element of data in a binary-coded value.

CENTRAL MERIDIAN

The meridian (see MERIDIAN) that passes through the center of the referenced grid (Zero longitude).

CHARACTER STRING

Contiguous characters (other than spaces) in a message.

CHECKSUM

The value sent with a binary-coded message to be checked at the receiving end to verify the integrity of the message.

CLICK (KEYBOARD)

The audible tone generated when a key is activated.

CLOCK

A precisely-spaced, stable train of pulses generated within an electronic system to synchronize the timing of digital operations within the system.

CLOCK OFFSET

The differences between the times at the CDU/processor tracking a satellite, the satellite itself, and GPS system time.

C/A CODE

See COARSE/ACQUISITION CODE

COARSE/ACQUISITION (C/A) CODE

The NAVSTAR satellite signal that may be accessed by civilian members of the user community.

COEFFICIENT OF EARTH FLATTENING

The value F that quantitatively describes by how much the earth's ellipsoid semimajor axis (A) is shorter than the semiminor axis (B). F = (A-B)/A.

COG

See COURSE OVER GROUND

COMPASS BIAS

Angle of misalignment between the steering compass and the keel line of the vessel or long axis of the vehicle.

COMPASS DEVIATION

See DEVIATION.

COMPASS HEADING

Compass reading before correction for deviation and variation.

COMPASS MAGNETIC VARIATION

See MAGNETIC VARIATION.

COURSE

The horizontal direction in which a vessel is steered or intended to be steered, expressed as angular distance from north clockwise through 360°. (Strictly the term applies to direction through the water, not the direction intended to be made good over the ground). The course is often designated as **true**, **magnetic**, or **compass** as the reference direction is true, magnetic, or compass, respectively.

COURSE LINE

A line, as drawn on a chart, extending in the direction of a course (Rhumb Line).

COURSE OVER GROUND

Course made good relative to the sea bed.

CROSS TRACK ERROR (XTE)

The perpendicular distance from the vessel to the actual course line (track) as defined in the active route.

CURSOR

A flashing rectangle superimposed on a character position in the display window, indicating that a character may be entered in that position, or that the existing character may be changed via the keyboard.

DATUM

The framework on which the coordinates used to define position on the Earth's surface are based. In the navigator, a datum is defined by the following parameters:

A and I/F. Size and shape of a reference ellipsoid.

DX, DY, DZ. Position of the reference ellipsoid origin in relation to the satellite datum ellipsoid origin.

DEAD RECKONING

The process of determining changes of position based on measured speed and course over measured time periods.

DECCA LINES OF POSITION (LOPs)

The phantom Decca Lines of Position used in the navigator are based on mathematical models. Local deviations in propagation speed are not included. The calculated positions may therefore differ from positions obtained from dedicated Decca receivers by several hundred meters.

DEFAULT

A condition that the navigator assumes automatically if no other condition is initiated by the operator.

DEVIATION (COMPASS)

Magnetic compass reading error due to local magnetic field influences.

DGPS

See DIFFERENTIAL GPS.

DIFFERENTIAL GPS (DGPS)

A method of refining GPS position solution accuracy by modifying the locally computed position solution with correction signals from an external reference GPS CDU (monitor).

DILUTION OF PRECISION (DOP)

A figure of merit for the quality of GPS-derived position and clock bias estimates, based on the geometry of the selected satellite constellation. The smaller the DOP, the less the magnification of the range measurement error into position and clock bias errors. Generally, the more spread out the satellites, the lower the DOP. The most common DOPs are as follows:

HDOP - Horizontal dilution of precision.

GDOP - Geometric dilution of precision.

PDOP - Position dilution of precision.

VDOP - Vertical dilution of precision.

EARTH FLATTENING COEFFICIENT

See COEFFICIENT OF EARTH FLATTENING.

EDIT

To modify existing display data via the keyboard.

EDIT MODE

The state in the navigator where it is possible to enter or change data. EDIT MODE is accessed by pressing the **E**-key. Press the **E**-key once more to ENTER the data into the memory and leave EDIT MODE.

ELEVATION ANGLE

The angle made by the line-of-sight range to the satellite and the horizontal plane of the navigator antenna. Thus, the elevation angle is 90 degrees when the satellite is overhead and 0 degrees when it first appears on the horizon. Satellites whose maximum elevation angle is less than 5 degrees are not good candidates for providing an accurate position (latitude and longitude) update.

ELLIPSOID

A spheroid whose north-south axis is shorter than the east-west axis (oblate spheroid).

ENTER

To store data in the memory of the navigator.

EPHEMERIDES (Singular: EPHEMERIS)

Tabulations of accurate data describing celestial position and health of the satellites over a 24-hour period. The data is up-loaded to the satellites every 12 hours.

ETA

Estimated Time of Arrival. Calculated on basis of the distance to the destination and the current (or estimated) speed.

FILTER TIME

If the GPS signals are distorted by Selective Availability (S/A) the COG and SOG readings will be unstable, especially at low speeds. In order to smooth out the readings you can adjust the COG/SOG filter time (CFG 1, COG SOG)

FLUX GATE COMPASS

A magnetic compass sensor without needle or card, whose two- or three-phase sinusoidal output is a heading reference. Interfaced to the navigator via the NMEA interface.

FORCE HEALTHY

A feature of the navigator that permits the user to override the data flag in the almanac that tells the navigator that the quality of the data from a satellite is inadequate for navigation. This feature should be used only with the greatest care.

FORCE UNHEALTHY

A feature of the navigator that permits the operator to inhibit a satellite position update even though the quality of the data from that satellite apparently is acceptable.

FUNCTION

A specific operational capability of the navigator.

FUNCTION KEY

A key on the front panel of the navigator that selects a specific function.

GEODETIC

Associated with the science of Geodesy, which includes the means of determining absolute position with uniform accuracy at all points

on the Earth's surface.

GEOGRAPHIC COORDINATES

Angular displacements along parallels of latitude and meridians of longitude on an ellipsoidal surface. Ellipsoidal coordinates.

GEOID

The Earth's surface with all topographical undulations removed (equipotential surface) so that all points on the surface approximate mean sea level.

GEOIDAL HEIGHT

Deviations of the geoid above and below the ellipsoid due to non-uniformity of the Earth's mass. Geodal height is positive when the deviation is outward from the central volume of the ellipsoid, and negative when it is inward.

GDOP (Geometric Dillusion of Precision)

An indicator of the accuracy in position (latitude, longitude, altitude, and time). See DILUTION OF PRECISION.

GLOBAL POSITIONING SYSTEM (GPS)

The NAVSTAR Global Positioning System, which consists of orbiting satellites, a network of ground control stations, and user positioning and navigation equipment. The system has 24 satellites plus 3 active spare satellites in six orbital planes about 20,200 kilometers above the earth.

GMT

Greenwich Mean Time. See also UNIVERSAL TIME COORDINATED.

GPS LOG

A feature of the navigator that measures the sailed distance based on the GPS signals rather than a water distance sensor.

GPS SYSTEM TIME

Time corrected to Universal Time Coordinated (UTC) and used as the time standard by the user segment of the GPS system.

GREAT CIRCLE NAVIGATION

Navigation based on a Great Circle calculation. The advantage of Great Circle navigation is that it brings you the shortest way through the active route. The disadvantage is that a Great Circle track may differ from the straight rhumb line that is easily drawn on a Mercator projected chart. Great Circle navigation is recommended for ocean voyages only. The advantage increases by higher latitude (north or south).

HDOP (Horizontal Dillution of Precision)

An indicator of the two dimensional accuracy in position (latitude and longitude). See DILUTION OF PRECISION.

HEADING

The direction in which the vessel is pointed, expressed as angular distance from north clockwise through 360 degrees. HEADING should not be confused with COURSE. The HEADING is constantly changing as the vessel yaws back and forth across the course due to the effects of sea, wind, and steering error.

HEADING-TO-STEER

The angle of track required to steer the vessel or vehicle from its present position to its planned destination point. This angle differs from heading, which is its present angle of track with respect to true north.

HEALTH

See SATELLITE HEALTH.

INCLINED PLANE

A geometric surface that is tilted with respect to another arbitrary reference plane (for example, the Earth's equatorial plane).

INITIALIZE

To enter constants into the navigator to enable it to start positioning and/or navigating accurately.

INTERFACE

Electronic circuits that permit the passage of data between different types of devices; For example, the speed and heading interface circuit permits data from a speed log and compass to pass to the

navigator processor.

IONOSPHERE

A layer of ionized air about 80 kilometers (50 miles) above the earth's surface.

IONOSPHERIC INTERFERENCE

Distortion imparted to a broadcast radio signal as it passes through the ionosphere.

KALMAN FILTER

A software routine that produces the navigation solution (see NAVIGATION SOLUTION).

KEY LOCK

Disabling the **E**-key so that data entries cannot be inadvertently made.

LEG

One of the segments in a route.

LEEWAY

The leeward drift of the vessel from the true course due to wind.

LOCAL TIME ZONE

The time zone (see TIME ZONE) in which the navigator is located.

LOCAL TIME ZONE OFFSET

The number of hours by which the local time zone differs from Universal Time Coordinated.

LORAN-C TIME DIFFERENCES (TDs)

The phantom Loran-C Time Differences used in the navigator are based on mathematical models. Local deviations in propagation speed and Additional Secondary Factors (ASF) are not included in the algorythm. The calculated positions may therefore differ from positions obtained when using a dedicated Loran-C receiver by several hundred meters.

MAGNETIC DEVIATION

The error introduced into the steering compass reading by nearby ferrous metal mass distorting the earth magnetic flux field surrounding the compass.

MAGNETIC HEADING

Direction, as sensed by the steering compass, in relation to magnetic north.

MAGNETIC NORTH

Direction in the plane of the observer's horizon toward the earth's north magnetic pole.

MAGNETIC VARIATION

The angle by which magnetic north varies from true north at any given point on the earth's surface. This value is automatically added to the magnetic heading input to provide true heading for calculation and display purposes.

MENU

A list of functions in the display. Selection of a function from the list is accomplished with either the toggle key or the soft keys.

MERCATOR CHART

A map developed by Mercator projection wherein the curved surface of the Earth's ellipsoid is projected onto a cylinder and the cylinder is "unwrapped" to form a flat representation of the ellipsoid.

MERIDIAN

The circumference line of a meridian plane. The meridians define longitude. A special case meridian is the Greenwich meridian, whose longitude is 0 degrees and to which all other meridians are referenced.

MOTION DYNAMICS

Characteristics of changes in attitude and location of a moving object according to its application and/or environment. For example, vessels at sea in rough waters may have low forward velocity but high-rate, short-term changes in attitude due to yaw, pitch and roll.

NAVIGATION SOLUTION

The mathematical derivation of navigation components (for example, speed, heading, set, drift) from a series of satellite position updates plotted over time.

NMEA

National Marine Electronics Association. The NMEA electronics interface specifications have been developed under the auspices of the Association. The NMEA 0183 is an internationally recognized specification for interfacing marine electronics. NMEA 0183 version 2.1 is identical to IEC 1162-1.

PARALLEL

The perimeter of a parallel plane in the earth's ellipsoid. The parallels define latitude. A special case parallel is the equator, whose latitude is 0 degrees and to which all other parallels are referenced.

PARITY BIT

A bit added to, or subtracted from, a binary coded message for parity checking purposes.

PARITY CHECK

A simple statistical operation performed by the software that monitors binary coded data being transmitted to verify that the received message is the same as the transmitted message.

PARITY CONVENTION

In checking message parity (refer to PARITY CHECK), the software may be designed to check either odd parity or even parity. The choice is called parity convention: either odd or even parity convention. Under odd parity convention rule, the binary-coded message has the parity bit set to make up an odd number of message bits. Under even parity convention rules, the binary-coded message has the parity bit set to make up an even number of message bits.

P-CODE

A limited-access signal broadcast by the NAVSTAR satellites currently available only to military users.

PDOP (Position Dillusion of Precision)

An indicator of the accuracy in position (latitude, longitude, and altitude). See DILUTION OF PRECISION.

PLANE PROJECTION

The technique of converting the curved surface of the Earth to a flat surface to represent a map.

POSITION UPDATE

The redefining of position by analysis of satellite orbital data as referenced to time.

PRN

See PSEUDO-RANDOM NUMBER.

PROCESSOR

The processor circuit card in the console that controls system operations and computes the positioning/ avigation solutions.

PROMPT

A message on the display instructing the operator to make a keyboard entry.

PSEUDO-RANDOM NUMBER (PRN)

The identification number of a GPS satellite.

PSEUDO-RANGE

Range that includes errors due to clock offset.

PULSE SPEED SENSOR

Speed log whose speed output signal is defined by a pulse rate output.

RANGE RESIDUAL

The difference between the expected satellite range and the measured satellite range for the last measurement taken from each satellite in the constellation.

REFERENCE COMPASS

The compass against which the steering compass (see STEERING COMPASS) may be calibrated.

REFERENCE ELLIPSOID

A mathematical description of the Earth's ellipsoidal shape (see ELLIPSOID), which is the reference frame for positioning compu-

tation.

REFERENCE GPS MONITOR

A GPS CDU whose precise (surveyed) position is known. It compares its own GPS position solution to the surveyed position and generates correction values as a function of the position coordinate differentials. The correction values are transmitted to user GPS CDUs for use as corrections to their own GPS position solutions.

RESET

To return stored values to either the default value or zero in memory.

RHUMB LINE

The course of a vessel that keeps a constant compass direction, drawn as a line on a chart or globe and cutting across all meridians at the same angle. A rhumb line is a straight line on a Mercator chart.

RHUMB LINE NAVIGATION

Navigation based on Rhumb Lines. See also GREAT CIRCLE NAVIGATION.

RMS

See ROOT MEAN SQUARED.

ROOT MEAN SQUARED (RMS)

A statistical measure of probability, stating that an expected event will happen 68% of the time. In terms of position update accuracy, 68 position updates out of 100 will be accurate to within specified system accuracy.

ROUTE

A route is a sequential list of waypoints describing a planned voyage. The active route is the route used for the actual navigation of the vessel.

S/A

See SELECTIVE AVAILABILITY

SATELLITE HEALTH

Go or no-go message for each satellite included in the almanac data. The message states whether or not the measurements from those particular satellites can be relied upon for accurate results.

SATELLITE SIGNAL

Transmitted electromagnetic energy from a GPS satellite whose time of arrival is measured by the navigator to calculate the position of the navigator antenna.

SELECTIVE AVAILABILITY (S/A)

A system whereby the accuracy of GPS is reduced. S/A is controlled by the U.S. Department of Defense.

SEMIMINOR AXIS

The distance from the center of the earth's ellipse to the ellipse surface as measured along the polar axis. It is identified symbolically with the letter B, and it varies according to the reference datum used for position coordinates.

SENSOR

A device that detects a change in a physical stimulus and turns it into a signal that can be measured.

SET AND DRIFT

The direction and the speed of the water over ground (current).

SIGNAL-TO-NOISE RATIO (S/N)

Quantitative relationship between the useful and non-useful part of the received satellite signal. A high S/N indicates a good receiving condition.

S/N

See SIGNAL-TO-NOISE RATIO

SOFTWARE

Values programmed and preloaded into memory. The values represent a permanent set of instructions for running the automatic

functions (computations) of the navigator.

SOG

See SPEED OVER GROUND

SPACE SEGMENT

The orbiting satellite part of the Global Positioning System.

SPEED OVER GROUND

Speed in relation to the sea bed.

SPHEROID

See ELLIPSOID.

STEERING COMPASS

The compass used for navigation. It may be a direct-reading compass from which the heading may be entered into the navigator via the keyboard; or, it may be an electronic heading sensor that enters heading data to the navigator via an optional interface.

TIME OFFSET

The number of hours and minutes by which the TIME ZONE differs from UTC (see below).

TIMEOUT

In the navigator, the automatic return to normal operation from edit mode if left unattended. The timeout delay is set in **CFG 1**, *Operation.*

TIME ZONE

One of 24 longitudinal segments around the world, each generally 15 degrees and 1 hour wide. Please check locally for the exact time zone offset relative to UTC (see below).

TRACK

In routes: The course lines between the waypoints.

In the plotter: The line showing the past movements of the vessel.

TRANSDUCER

A device that transfers power from one system to another in the same or in different form. See also SENSOR.

TRIP LOG

In the navigator, an easily resetable sum log that accumulates the distance sailed over ground based on the GPS signals. See also GPS LOG.

TRUE HEADING

Direction in relation to true north. True heading is compass heading corrected for MAGNETIC DEVIATION and VARIATION. The true heading used by the navigator for navigation calculations is a composite of magnetic heading input from the NMEA compass, magnetic variation as calculated by the navigator, and the values entered into the compass deviation table.

TRUE NORTH

Direction along the meridian of the observer to the north pole.

TRUE WIND ANGLE (TWA)

Similar to APPARENT WIND ANGLE, but compensated for the motion of the vessel. TWA and AWA are equal if the vessel is not moving.

TRUE WIND DIRECTION (TWD)

The direction of the wind over ground, expressed as an angular distance from north clockwise through 360°.

TRUE WIND SPEED (TWS)

The wind speed relative to either ground or water rather than to the moving vessel.

UNCERTAINTY

In the navigator, an indication of the expected accuracy expressed as the radius of a circle around the calculated (displayed) position. The uncertainty is expressed in meters or feet. The calculation of uncertainty is based on the HDOP value.

UNIVERSAL TIME COORDINATED (UTC)

Greenwich mean time corrected for polar motion of theEarth and seasonal variation in the Earth's rotation.

UPDATE

See POSITION UPDATE.

UTC

See UNIVERSAL TIME COORDINATED.

UTM

See UNIVERSAL TRANSVERSE MERCATOR.

UNIVERSAL TRANSVERSE MERCATOR

Alternative grid system used in harbor areas and for land applications instead of latitude and longitude.

VDOP (Vertical Dillusion of Precision)

An indicator of the accuracy in altitude. See DILUTION OF POSITION.

VELOCITY MADE GOOD (VMG)

The speed by which the vessel is moving in the upwind direction. When tacking, the optimization should be based on VMG (assuming that TWD is expected to be fairly constant). See also WAYPOINT CLOSURE VELOCITY.

VISIBLE SATELLITE

A satellite whose orbit has placed it above the earth's horizon (elevation angle >0°) from the location of the navigator and is, therefore, available for acquisition. The navigator will not use satellites with an elevation angle < 5°.

VMG

See VELOCITY MADE GOOD.

WAYPOINT

A point, usually along the track of the vessel or vehicle, whose position coordinates may be stored in the navigator. The point position is the basis for the heading, range, heading-to-steer, estimated time of arrival, and steering display calculations.

WAYPOINT CLOSURE VELOCITY (WCV)

The speed the vessel is moving in the direction of the next waypoint. WCV should be used for optimization in cases where TWD is expected to vary drastically before the waypoint is reached. See also VELOCITY MADE GOOD.

WAYPOINT PASS CRITERIA

The criterion by which the navigator determines the passing of a waypoint. The criterion is selected in **CFG 1**, *Navigation*.

WCV

See WAYPOINT CLOSURE VELOCITY.

WORLD GEODETIC SYSTEM (WGS)

World-wide datums (WGS 72 and WGS 84) used for satellite navigation systems. The main difference between WGS 72 and WGS 84 is a small eastward shift. The resulting difference in position will normally be 0.01 minute of longitude, which will not be noticeable on charts of scale 1:50 000 or smaller. You may thus use the WGS 84 Plus Offset datum with charts marked with a WGS 72 offset. All charts will eventually be converted to WGS 84 datum.

X-TRACK ERROR (XTE)

See CROSS TRACK ERROR.

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