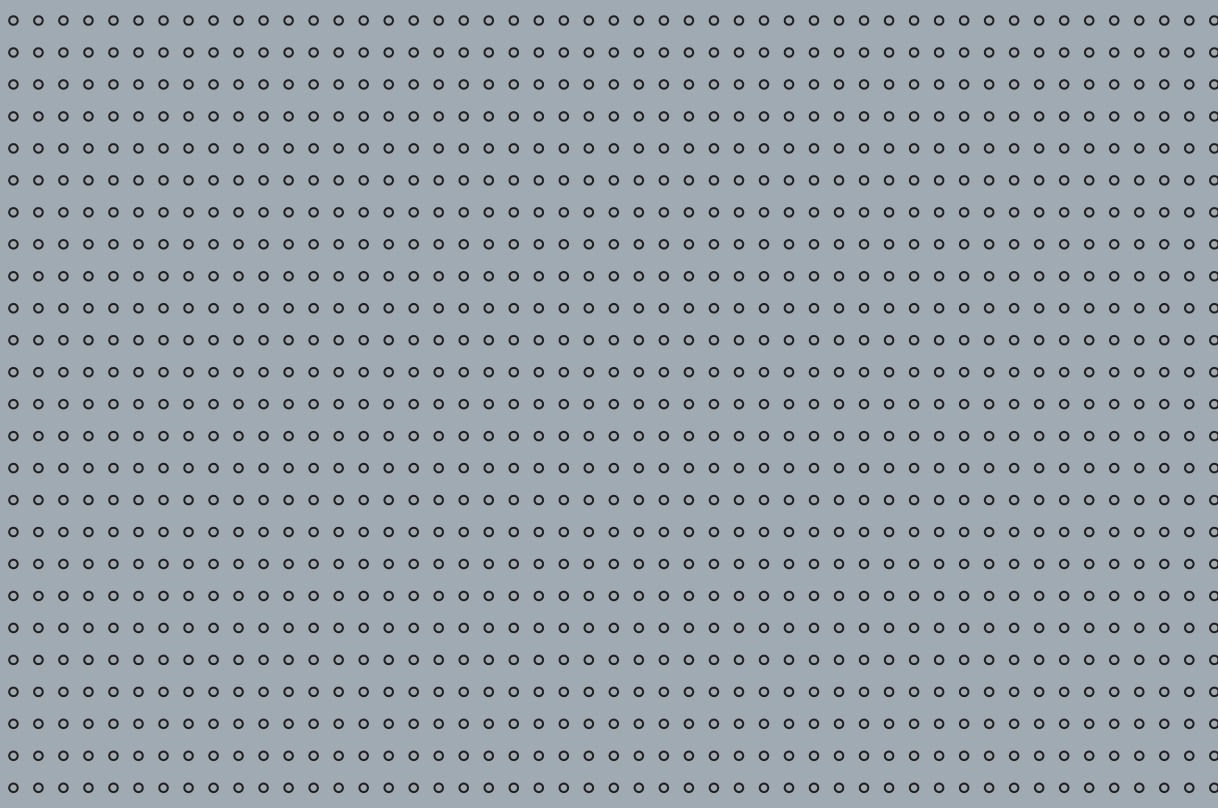
SIMRAD

Master the Elements

# Manual

## Simrad MX510 and MX512 Navigation Systems

English



# Operator & Installation manual

## Simrad MX510 and MX512
## Navigation Systems

English

Document no: 510 100 2002
Revision: B
Date: May 2010

The original language for this document is English. In the event of any discrepancy between translated versions and the English version of this document, the English document will be the official version.

To the best of our knowledge, the content in this publication was correct at the time of printing.

As we are continuously improving our products we retain the right to make changes to the product and the documentation at any time. Updated manuals are available from our website www.simrad-yachting.com, and are free to download.

## IMPORTANT NOTICE!!

**THE MX51x IS AN AID TO NAVIGATION ONLY.** ***UNDER NO CIRCUMSTANCES SHOULD IT BE USED IN LIEU OF AUTHORIZED GOVERNMENT CHARTS. ITS ACCURACY CAN BE AFFECTED BY MANY FACTORS SUCH AS EQUIPMENT DEFECTS, ENVIRONMENTAL CONDITIONS, OR IMPROPER OPERATION. THE USER IS RESPONSIBLE FOR SAFE NAVIGATION OF THE VESSEL. THIS INCLUDES CONSULTING AUTHORIZED GOVERNMENT CHARTS AND EXERCISING COMMON PRUDENCE AND NAVIGATIONAL JUDGEMENT AT ALL TIMES.***

## How To Contact Us?

Contact your local SIMRAD Marine dealer for:

- Installation, Service, & Technical Support
- Sales of Accessories
- Hardware and Software Upgrades

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

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

**USA Office:**

**NAVICO TORRANCE**

A Division of NAVICO, Inc.

23868 Hawthorne Blvd., Suite 201
Torrance, California 90505-5908
USA

+1-310-791-8213 Telephone
+1-310-791-6108 Fax

**Europe:**

**NAVICO UK Ltd.**

Contact your dealer.

www.simrad-yachting.com/
Store-locator

**Internet:**

www.simrad-yachting.com/en/Products/Professional/MX-Line/

## 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.

MX51_ CDU Serial No.:_____

Antenna Model: _____

Antenna S/N: _____

## About this manual

Models Covered are:

MX51x GPS/DGPS

MX51x/BR

MX51x/BRIM

MX51x/MUC

This manual covers the operation and installation of both the MX510 and MX512 CDU models. The keypad operation of these models are identical.

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, 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 into two main parts. The first section deals with the operation while the second section talks about the installation and electrical interface. We start by describing first the MX51x models covered in this book, then the special front panel features including the traffic light indicator and USB connector. The sections that follow detail each primary function as it is presented on the front panel (i.e. NAV, RTE, WPT, PLOT, ...CFG). The appendices describe important details about special functions and installation of the MX51x.

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***

MX51x Quick Reference Guide (P/N 510 100 2003)

## Symbols used in this manual

Important text that requires special attention from the reader is emphasized as follows:

☞ *Used to draw the reader's attention to a comment or some important information.*

⚠ ***When necessary, used to warn personnel they should proceed carefully to prevent risk of injury and/or damage to equipment.***

Blank page

# Contents

**1 About GPS Navigation ..... 11**

Special notes ..... 11

**2 Functional Description ..... 13**

CDU Configurations ..... 13

Basic CDU configuration ..... 13

MX51x DGPS ..... 13

MX51x/BR ..... 13

MX51x/BRIM (Backup Receiver Integrity Monitor) ..... 14

MX51x/MUC (Multi Unit Control) ..... 14

**3 DGPS Beacon System ..... 15**

**4 Keypad & Display Description ..... 17**

Differential GPS Traffic Light Operation: ..... 17

GPS Traffic Light Operation: ..... 18

The Display: ..... 19

+ Virtual Softkeys: ..... 19

The Function Keys: ..... 20

Programmable Keys (F1 to F4) ..... 20

Mark / MOB Key ..... 20

GOTO ..... 21


POWER ON/OFF ..... 21

CLR (CLEAR) ..... 21


CURSOR ..... 21

ENTER ..... 21


DAY/NIGHT View ..... 21

FUNCTION Keys ..... 22

Automatic Identification System (AIS) ..... 22

Navigate ..... 22

Dead Reckoning ..... 23

NAV1 - The Panorama Screen ..... 23

NAV2 - Basic Steering Information ..... 25

NAV3 - Expanded Navigation Information .....25
NAV4 - Sensor Input Navigation .....26
NAV5 - Compass Display Screen.....28
NAV6 - Compass Display Screen.....28


Route.....28
RTE1 - The Active Route.....29
Creating a Route Using the GOTO Key:.....29
Erasing an Existing Route.....31
Creating a Multi-Waypoint Active Route .....32
Insert By Number.....32
Choose in Bank .....33
Insert New Waypoint .....34
Insert Route .....34
Maneuvering Within the Route.....35
ETA Setup .....37
SOG Based on Arrival Date & Time: .....37
RTE2 - The Route Bank .....38


Waypoint.....39
Creating and Editing Waypoints.....39
Waypoint Lock/Unlock.....42
Removing Waypoints.....43
Moving waypoints.....44
Saving or Restoring Memory Data Using a USB Device .....46
Downloading Waypoints & Routes to Other Devices.....47
Downloading Waypoints to a Personal Computer.....49
Uploading Waypoints from Other Devices .....50
Uploading Waypoints from a Personal Computer.....51


Mark / MOB .....52


GOTO.....52


Plot.....54
PLOT 1 - Relative to Boat.....55
Customizing the Display .....55
Plot Screen Use Examples .....57
Grid Search .....57


Man Over Board .....58
Remote MOB.....59


Auxiliary.....59

AUX1 - Alarm Log ..... 59
AUX2 - Speed Graph ..... 59
AUX3 - Not Used ..... 60
AUX4 - Sun Almanac ..... 60
AUX5 - Moon Phases ..... 60
AUX6 - Batteries ..... 60
AUX7 -Unit Information ..... 60
AUX 10 - Tide ..... 61
Current Tide Display ..... 61
AUX 11 - Tide Table Port List ..... 62
Adding a Port ..... 63


Position ..... 64
POS1 - Position Display (Large Lat/Long Digits) ..... 64
User GRID ..... 65
POS2 - Position, Altitude, Magnetic Variation, & Time ..... 65
POS3 - Position & Log ..... 65


GPS ..... 66
GPS1 - GPS Status Screen ..... 66
GPS2 - GPS Health Screen ..... 66
GPS3 - Visible Satellites ..... 67
GPS4 - GPS Position Uncertainty ..... 67
GPS5 - RAIM Status Screen ..... 67
GPS6 - DGPS STATUS ..... 69
GPS7 - DGPS Messages ..... 70


Configuration ..... 71
Alarms ..... 71
Anchor - Anchor Watch Alarm ..... 71
COG SOG - Course & Speed Filter Settings & Setup ..... 71
Compass - External Compass Input & Magnetic Variation Table .. 72
Datum - Current Position Calculation ..... 73
Depth - NMEA Input Control ..... 73
DGPS - DGPS Configuration ..... 74
DGPS Mode: ..... 74
DR - Dead Reckoning ..... 75
Dual Control - Dual Station Control ..... 75
GPS - Elevation Mask Control ..... 76
Initial Pos - Initial Position Entry ..... 77
LAN - Local Area Network ..... 77
LAN Output (NMEA 0183 OVER IP) ..... 78
Language - Language Configuration ..... 78

Lighting - Display/Keyboard Light, Contrast Control & Set Display Default Setting ..... 78
Log - Speed Log Input (Pulse or NMEA 0183) ..... 79
Log Pulses - GPS SOG Log Pulse Output ..... 79
LORAN-C Integration ..... 80
Raytheon: ..... 80
Locus: ..... 81
Memory ..... 83
Navigation - Navigation Method & Waypoint Pass Criterion Control 83
NMEA Out 1 - NMEA 0183 Output Data Control ..... 85
Other Special Cases Affecting NMEA 0183 Records: ..... 87
Operation - General Setup and Control Settings ..... 88
Organizer - Automated Message Reminders ..... 88
Position - Positioning Reference, Mode, & Alarm Control ..... 89
Printout (n) - Printer Output Control ..... 90
ROT (Rate of Turn) ..... 91
Security ..... 92
Serial I/O ..... 92
Time - Mode and Format Control ..... 92
USB - USB Mass Storage Configuration ..... 93
VGA ..... 94
Wind ..... 94
Wpt & Rte Input - Uploading Waypoints into the MX51x ..... 95

**5 Installation ..... 97**
List of Components ..... 97
Installation notes ..... 99
General ..... 99
Electronic Connections ..... 99
Wire Preparation Procedure ..... 100
External Power ..... 100
Antenna Installation ..... 101
MX51x Navigator Installation ..... 102
Equipment Interfacing ..... 103
Mechanical installation drawings ..... 115
MX510 Electrical installation drawings ..... 123
MX512 Electrical installation drawings ..... 131

**6 Technical specifications ..... 141**

**Appendix A - Datum List ..... 145**

**Appendix B - Engineering Mode ..... 147**
AUX7 - Unit Information & Self Test ..... 147

CDU Cold Start - Clearing Memory to Factory Default ..... 148
GPS - GPS CDU Troubleshooting..... 149
GPS3 - Visible Satellite Information ..... 149
GPS4 - GPS Position Uncertainty ..... 149
Antenna Reset Tools ..... 150

**Appendix C - Multiple Unit Control (Via LAN) ..... 151**
Dual Control Configuration: ..... 151
Turning Master or Slave Units Off ..... 152
Backup Receiver Integrity Monitoring (BRIM) ..... 152
Multiple Unit Control Configuration..... 152

**Appendix D - Demonstration Mode..... 155**

**Appendix E - AIS connection for MX512 only ..... 157**
Introduction ..... 157
Ship-to-Ship Data Exchange ..... 157
Coastal Surveillance ..... 158
Vessel Traffic Systems ..... 158
AIS Communications Scheme..... 159
AIS Message..... 160
MX512/AIS the Total Shipboard GPS/DGPS/AIS Solution .. 162
AIS System Setup ..... 162
AIS Config Setup..... 162
AIS Static ..... 163
Configuring the AIS Voyage ..... 166
AIS Function Key..... 168
AIS 1 – OWN SHIP DATA ..... 168
AIS 2 - Remote Ship List ..... 170
AIS 3 - RECEIVED (RX) SAFETY MESSAGES..... 171
AIS 4 - TRANSMIT (TX) SAFETY MESSAGE ..... 171
AIS 5 - TX Safety List ..... 172
AIS 6 - REGIONAL AREAS ..... 173
AIS 7- LONG RANGE (LR) DISPLAY ..... 174
AIS 9 – AIS STATUS ..... 176
AIS11 – Security Log ..... 176
AIS12 - Remote Ship EPFS ..... 176
AIS13 - Remote Ship Data..... 177
PLOT 3 – AIS Plot Screen ..... 177
Automatic Identification System Installation Section ..... 178
Compass Diagram ..... 179

**Appendix F - Glossary ..... 185**

***Blank page***

# 1 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 5 meters 2D RMS or better

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 1 meter or better for 95% of the time, subject to the availability, accuracy, and control of the DGPS correction transmission from the Beacon Station.

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

### *Compass Safe Distance*

1 meter.

***Blank page***

# 2 Functional Description

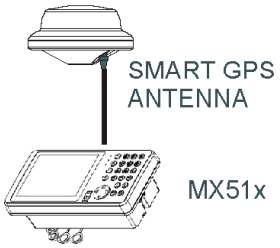
The MX510 and MX512 Navigation CDU models are generally described in this manual as MX51x Control and Display Unit (CDU). Their general operating features are identical and will be described in common details in this manual. Specific model number will be called in areas where they differ from one another.

## CDU Configurations

The MX510 and MX512 Navigation System is available in several configurations. Please refer to the Auxiliary Unit Information section of the manual to view sample screens to identify your particular model. Described below are the various configurations and their differences.

### Basic CDU configuration

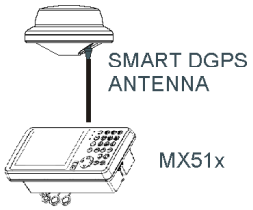
The MX510 has two (2) bidirectional user NMEA ports while the MX512 has nine (9) bidirectional user NMEA ports. Both models have one (1) high-speed Local Area Network (LAN) port and two USB ports. The basic GPS navigation model includes the CDU and a smart GPS antenna




*Basic MX510/512 GPS Configuration*

### MX51x DGPS

The MX51x DGPS model is supplied with a smart DGPS antenna with built-in Beacon receiver (MX521A B-10 DGPS). The smart DGPS antenna unit can achieve better than 1 meter accuracy in areas with good beacon differential coverage.

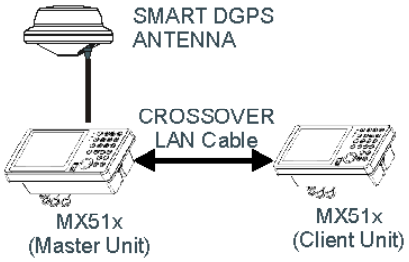



*Basic MX51x DGPS Configuration*

### MX51x/BR

The MX51x/BR configuration is a dual-control system where two MX51x (one operating as a master and the other as a slave) is supplied. Only one MX521A smart DGPS antenna is required. The antenna unit is connected only to the master unit. The two MX51x CDUs communicate via the high-speed LAN port.

☞ *LAN port must be setup before enabling this feature. The units can be connected together using an ethernet crossover cable (when connected directly) or through a hub/ switch/router. See section 4 of this manual for setup details.*



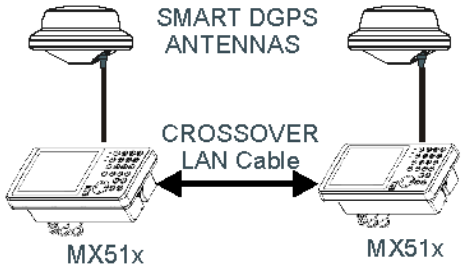

*MX51x BR Beacon and Remote Configuration*

## MX51x/BRIM (Backup Receiver Integrity Monitor)

The MX51x/BRIM is an enhanced Dual-Control configuration wherein two MX51x CDUs and two MX521A smart DGPS antennas are supplied. The two MX51x units are connected in dual-control configuration but they operate as independent navigator units with dedicated antennas. The Integrity Monitoring (IM) feature is a software option that works in the MX51x CDU hardware.

This configuration allows data to be shared between two remotely separated stations (i.e. navigator's station and helmsman's station), with independent access to various information fields. The purpose of this configuration is to enable each CDU to calculate its own position, then check the operational status of the other GPS receiver. The GPS receiver with the best overall operational status provides the system position. This is a fully redundant system, with self-recovery capabilities. The Integrity Monitor function can be set to Automatic switch over or forced to the any of the units for position and navigation functions.

☞ *LAN port must be setup before enabling the IM feature. The units can be connected over an ethernet crossover cable or through a hub/switch/router. See section 4 of this manual for setup details.*




*MX51x/BRIM System Configuration*

## MX51x/MUC (Multi Unit Control)

The MX51x/MUC is a configuration wherein three or more MX51x units are networked together using a hub or a router switch. In a MUC network one unit is assigned as a master unit and the rest are either slaves or repeaters. Slave units are able to display navigation data and control the master unit remotely while the repeaters can only display navigation data. A maximum of five MX51x units can be a member of the MUC network, one master unit, one or two slaves and the rest as repeaters. Please refer to the installation notes section of this manual for the MUC diagram.

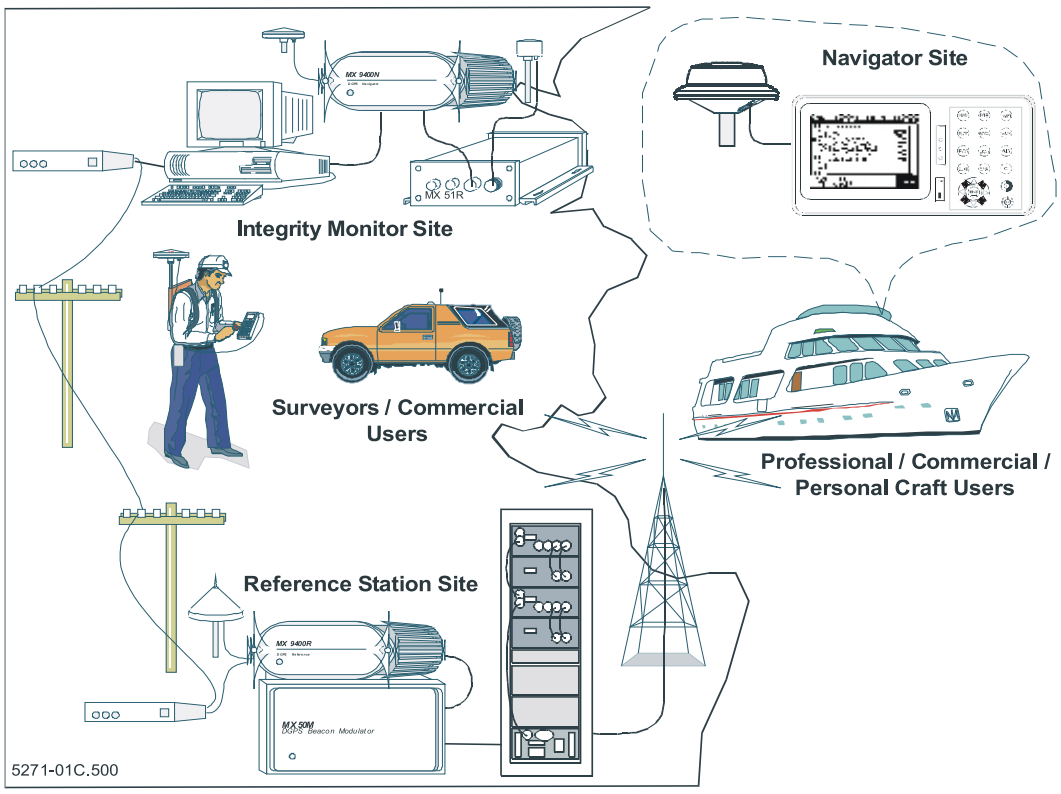
☞ *1) In general, this manual will refer to all versions of this product line simply as the MX51x CDU, CDU or navigator. Where distinction between models is necessary, the particular model type will be indicated.*

*2) Four MX Smart antenna models are compatible with the MX51x CDU. They are the MX421-10 (GPS or DGPS), MX525A (DGPS only), MX521A (GPS or DGPS ) and MX575A DGPS Compass.*

# 3 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.

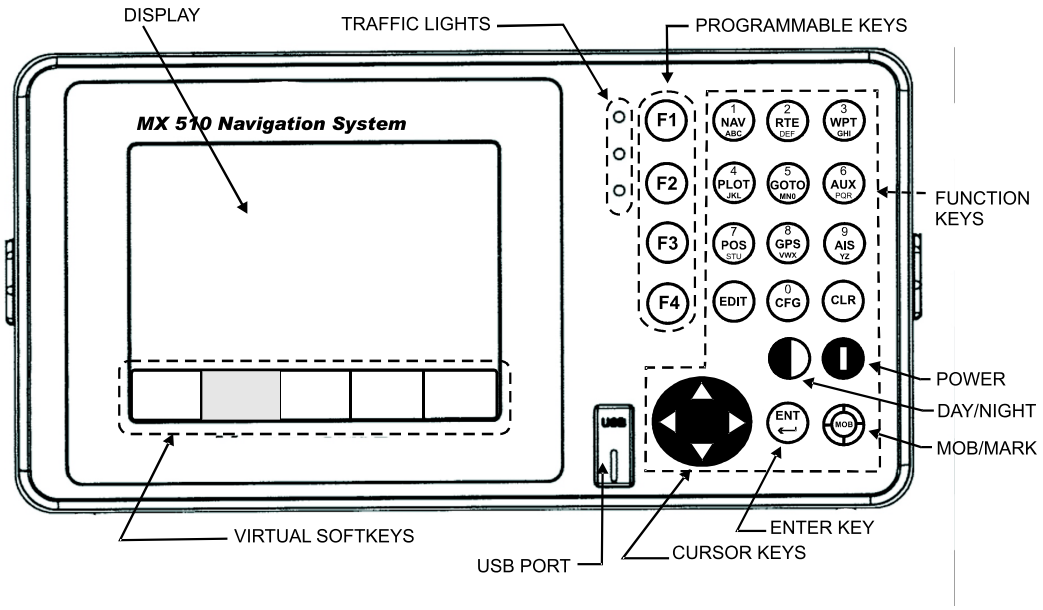



Because of the limited range of the beacon transmitters, typically 150 to 400 km, the corrections generated by the reference station are always valid for users who can receive the correction signals and maintain a 5 meter or better accuracy figure.

***Blank page***

# 4 Keypad & Display Description

The MX510 and MX512 keypad operation and traffic light indications are identical. The **Traffic Lights** on the right side of the display will tell you how your navigator is operating.




☞ *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 20 minutes under these circumstances. If it still does not change to Red Solid, refer to the troubleshooting section in the page 110 of this 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 fix 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 600 seconds. During this period, your positioning information maybe less than optimal, and position accuracy may be off by as much as 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 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 in the page 110 of this 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 MX51x uses a 6.4" monochrome quarter VGA LCD display. It provides optimum viewing in virtually all angles and 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 ◐ DAY/NIGHT dual function key allows you to quickly change between day or night time screen viewing.

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 located in the upper left hand corner (i.e. 

). These page numbers are there to help you 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 the UP and DOWN arrows to zoom in or out, all of the screens require that you press the **EDIT** (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).

## EDIT + Virtual Softkeys:

The Edit key activates or deactivates the virtual 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 EDIT 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 EDIT key to end editing. Some edit screens provide an Escape softkey. If you decide for some reason that you don't want to use the changes you have made, highlighting the Escape softkey and pressing the ENT key will restore the original information. However, once you press the EDIT key, all changes are accepted and the original data is lost.

The virtual softkeys at the bottom of the display are so named because their purpose changes from one menu (or screen) to the next. All of the screens require that you press the **EDIT** (Edit Mode) function key before the virtual softkeys can be accessed. Then use the LEFT and RIGHT cursor arrows to highlight the desired virtual softkey and press the **ENT** key (refer to pg. 21) to choose it. Don't forget to press the **EDIT** function key when you have finished to exit.

## The Function Keys:

The MX51x has 17 function keys. These keys are used to directly access various navigation, positioning, GPS, configuration and other screens. One function key is used to mark your present position, and to activate the Man-Over-Board feature when depressed for a few seconds.

The ten function keys with alphanumeric designations are described in the following chapters. The MARK/MOB keys and the GOTO keys are described below.

The function keys are also used in the edit mode to enter alphanumeric information for route and waypoint names.


## Programmable Keys (F1 to F4)

These keys are like the memory buttons in car radios. They can be programmed to quickly bring-up a particular screen that you use all the time. To memorize a particular screen, all you need to do is first select the desired display using the regular function keys, then press and hold the F1 (or another F# key) for about 3 seconds until a series of short beeps is sounded. The function key is now programmed. The next time you wish to bring up that particular screen, just press the F# key momentarily. You may reprogram any F# key at will.


## Mark / MOB Key

This dual function key when pressed momentarily marks your present position and stores it 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. The CDU is also capable of performing this function from a remote contact closure input via the AUX Cable (MOB/Event) wire. Refer to section 5 - Installation section of this manual for interface instructions.

When depressed for 3 seconds, this function key activates a number of automatic MOB 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 range and bearing 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 urgent 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 **EDIT** function key, then press the ENT key to select the *Cancel MOB* softkey.

The MX51x CDU is also capable of performing the MOB function from a remote switch. If the switch is pressed for less than 2 seconds, the action is registered as a Mark Position. If the switch is pressed for 3 seconds, the MOB function is activated. Refer to the *Installation* section of this manual for interface instructions.


## GOTO

This function key allows you to quickly create a route from your present position to waypoint or a route. 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.

## POWER ON/OFF

This DUAL function key turns the unit on and off. When depressed momentarily 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 pressing the power key for about 5 seconds. When the GPS is turned off using this technique, you can not reapply power for 10 seconds.

☞ *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 "CLR" button when power is applied for about six seconds, then the memory will be cleared.*


## CLR (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.

Holding this button down for 6 seconds will clear the entire memory of the MX51x CDU.

## CURSOR

This function key is the most used of all the function keys. When pressing the **EDIT** key to activate the virtual softkeys, the **LEFT** and **RIGHT** arrow cursor keys are used to scroll left and right from one softkey to the next. 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.


## ENTER

This key is often used just like the **EDIT** and the CURSOR keys. When pressing the **EDIT** key to activate the softkeys, the **ENT** key is used to select the particular virtual softkey of user's choice.

## DAY/NIGHT View

Press this key to toggle between night or day view.

When depressed for a few seconds, this dual function key allows you to quickly switch between two predetermined display lighting conditions, day or night time settings.

You may also control the day/night view using the CFG => Lighting menu.

## FUNCTION Keys

You might have noticed that above and below each primary function key 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 function key repeatedly until the appropriate letter or number appears. If you accidentally go past the desired letter, repeat pressing the function key and the letter will come up again. You can toggle between upper and lower case characters by pressing the function 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 'EDIT' 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) allows 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). 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.

` " $ & ! ( ) ? / + - ° . , :


## Automatic Identification System (AIS)

This is a special function key used for diplaying AIS related data. TThe AIS feature is a licensed option in the MX512 model. Contact your dealer or NAVICO to purchase the AIS license.

*When this key is pressed, the message "AIS Not Available on this Version" will be displayed.*


## Navigate

There are six **NAV** screens. **NAV1** through **NAV3** are primary navigation screens. **NAV4, NAV5,** and **NAV6** 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. WGS84 is the preferred Datum for most navigation calculation including AIS.

- 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 to either Lat/Lon 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 may have figured out by now that you will need to pay close attention to the configuration screens. The good news is that you probably have to setup the CDU one time and you can save the configuration data in a USB memory stick (or flash RAM) for future use. The memory stick will allow you to easily restore or clone another MX51x to your special configuration.

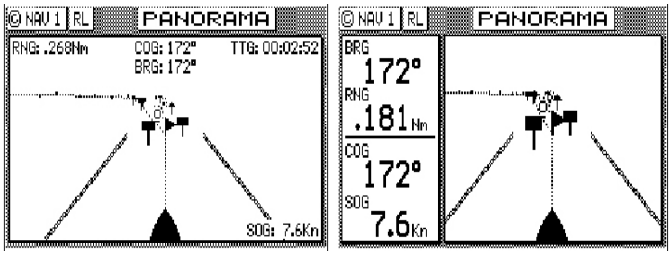
### Dead Reckoning

The MX51x 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 right corner 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 in this screen, you will need to create a route in **RTE1** screen first.

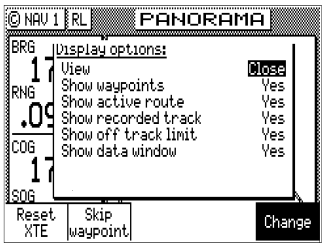
The somewhat triangular shape at the bottom center of the screen represents the bow of the boat. Icons on the screen are always related to this object. The two dash lines extending from the bottom of the screen towards the center of the screen represent your cross-track error limits. The dotted line 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 **EDIT** 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 highlighting the *Reset XTE* softkey from the display, and pressing the *ENT* key.

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 the *EDIT* key, highlight the *Skip Waypoint* softkey, and press the *ENT* key. 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 **EDIT** in the **RTE1** screen.

**3** Highlight the *Route Control* softkey and press **ENT**.

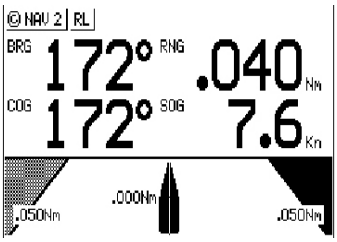
**4** Highlight the up arrow softkey (fourth from the left) and press **ENT** once.

**5** Press the **EDIT** key again.

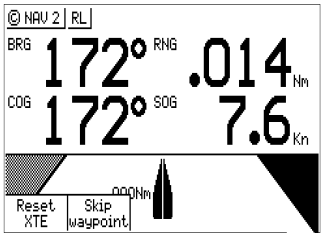
Refer to the *Route* section of this manual for more details about skipping and unskipping waypoints.

## NAV2 - Basic Steering Information

The NAV2 screen provides the bearing (BRG) and range (RNG) to the waypoint you are approaching in large bold 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 **EDIT** key and selecting *Reset XTE* softkey then ENT. This will save your autopilot from having to work hard to get you back on course. Press the **EDIT** key again to get back into normal display mode.

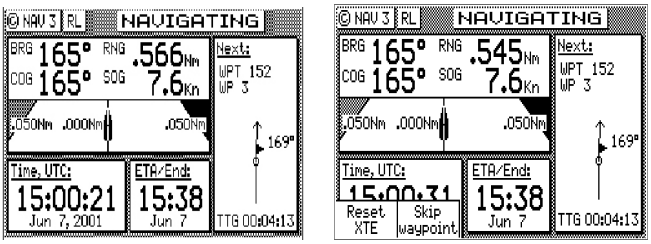
In addition, if you decide you want to skip this waypoint, and go on to the next one, Press the **EDIT** key, and select the *Skip Waypoint* softkey then ENT. Press the **EDIT** key to exit. If you skip one waypoint manually, and the CDU starts skipping more waypoints by itself, you probably need to 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.

## NAV3 - Expanded Navigation Information

The NAV3 screen has four windows. The upper left window is a smaller version of NAV2 screen. 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 as 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 *NAV4* 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. *Section 5* of this manual will guide you through the interfacing capabilities of the CDU.

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

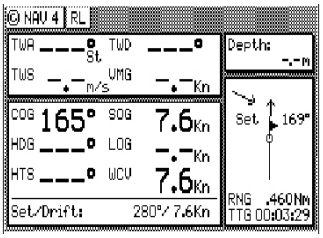
*Compass* - Sets the input port number, compass type (Gyro, MX575 or Magnetic), compass deviation table, and the input NMEA 0183 record from which to derive the compass information. The NMEA 0183 record should be specified by the user, because several NMEA 0183 records may contain compass information. 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), alarms, and a correction factor (if needed).

*Set & Drift* - automatically calculated based on GPS derived values.

*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.



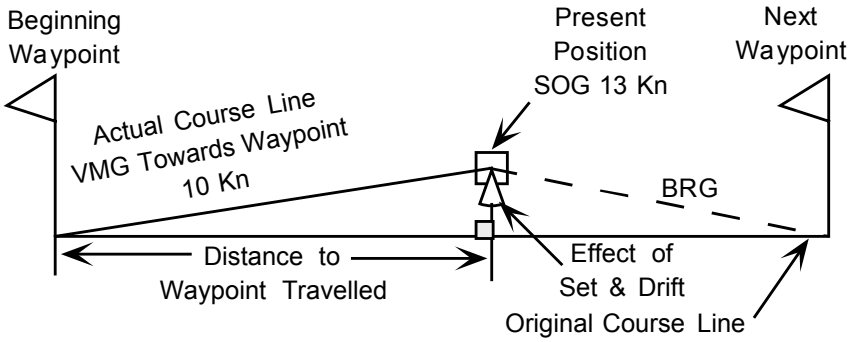

This screen is divided into four windows. The window on the top left provides details relating to the *True Wind Angle* (TWA), *True Wind Speed* (TWS) and *True Wind Direction* (TWD), which are taken from the NMEA 0183 record of MWV or VWR. If the wind information is given in relative terms, the CDU 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.

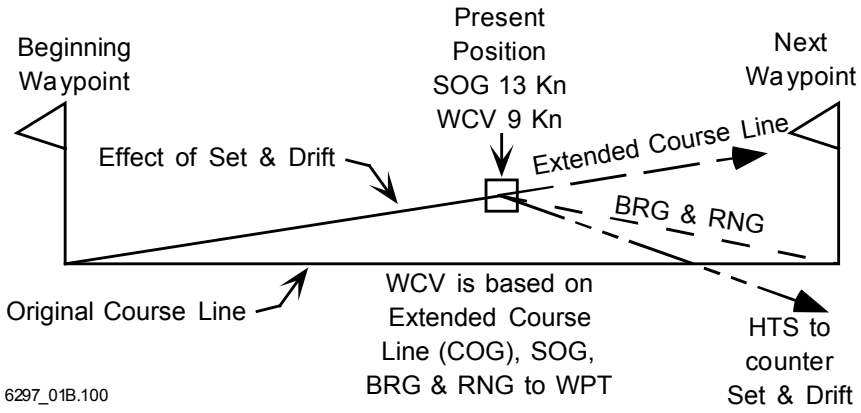
The window below the wind data provides information relating to your course and speed. You will find the *Course Over Ground* (COG calculated by the MX421 smart GPS antenna), *Heading* (HDG, your NMEA 0183 compass input)*, and Heading To Steer* (HTS) data on the left side of the window. HTS data is calculated 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.

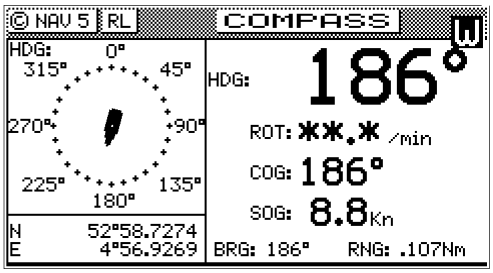
*Reset XTE and Skip Waypoint*, described at the end of **NAV2**, is also available in **NAV4**.

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 this 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.

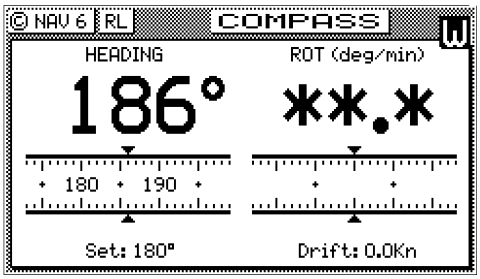
### NAV5 - Compass Display Screen

The *NAV5* screen displays the Heading and Rate of Turn values of the MX575 Satellite Compass (or Gyro) in digital and compass row formats. In addition, it also displays the position, COG, SOG, BRG, and RNG. This screen can be accessed by pressing the NAV key repeatedly until you reach the desired NAV screen.




### NAV6 - Compass Display Screen

The *NAV6* screen displays the Heading and Rate of Turn of the MX575 in large digital and tape measure style readouts. In addition, it also displays the Set and Drift. This screen can be accessed by pressing the NAV key repeatedly until you reach the desired NAV screen.




☞ *The NAV1 - NAV5 screens are not active until the antenna is detected.*

## 2 RTE DEF 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 99 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 remain 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 Lat/Lon or UTM 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.

*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*

☞

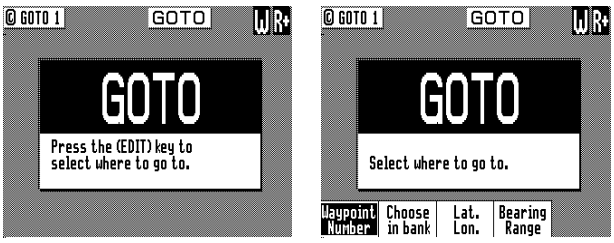
The *RTE1* screen is where you are likely to do most of your trip preparation. There are several methods you can use to create routes. You are sure to find one or more methods which meet your needs in the following sections.

### 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.

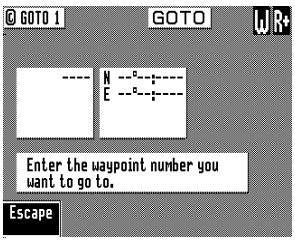
**2** Press the **EDIT** key.



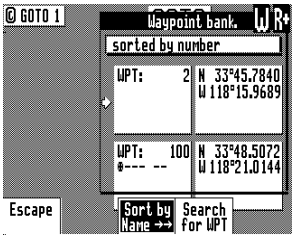

**3** Using the left or right arrow keys, highlight the softkey desired and press the **ENT** key:

*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 waypoint list. Enter the number of the waypoint, verify that the coordinates are correct, and press the **EDIT** key to copy the waypoint to the active

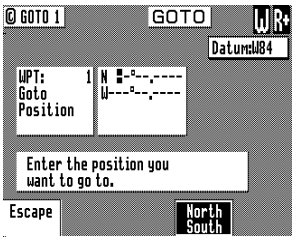
route.



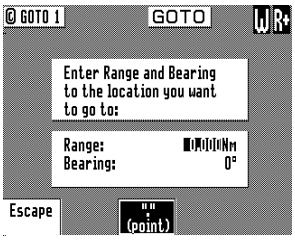

*Choose In Bank* - allows you to scroll through the Waypoint Bank. Align the cursor with the desired waypoint and press the **EDIT** key. The waypoint is automatically inserted into the active route and the unit will revert to the NAV screen, displaying bearing and distance to this waypoint.




*Lat. Lon.* - 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 **EDIT** 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 **EDIT** 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.

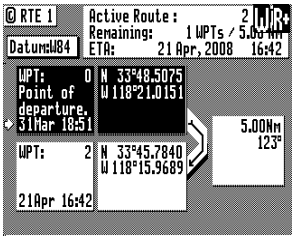
Use the **0** key to select a special character, if needed.

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

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

**4** 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 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 navigation 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

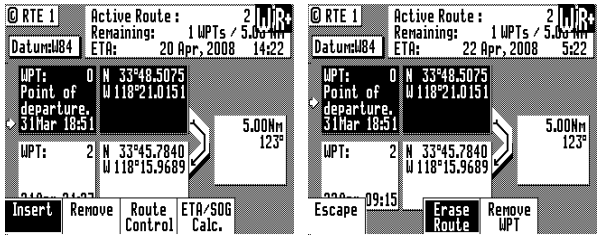
To erase the active route:

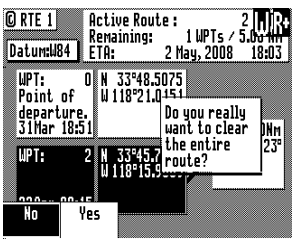
**1** Select the **RTE** key until the **RTE1** screen is displayed.

**2** Press the **EDIT** key.

**3** Highlight the *Remove* softkey and press the **ENT** key.

**4** Highlight the *Erase Route* softkey and press the **ENT** key.




**5** Highlight the *Yes* softkey and press the **ENT** key to confirm.

The active route is now erased and ready for new input. If you want to work in other areas of the CDU first, you will need to press the **EDIT** 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.

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 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*

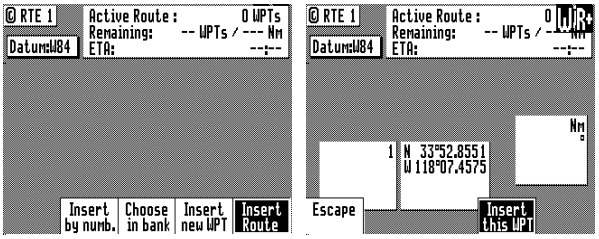
The following example assumes **RTE1** is empty. Follow the directions in the *Erasing an Existing Route* section to start with an empty route if you have waypoints in the **RTE1** screen.

**1** Select the **RTE** key until the **RTE1** screen is displayed.

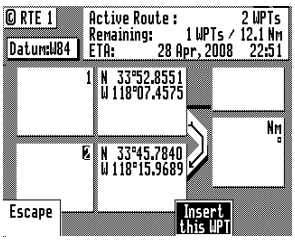
**2** Press the **EDIT** key to enter the edit mode.

**3** Highlight the *Insert* softkey from the display and press the **ENT** key. Skip to the next step if RTE1 is empty.

**4** Highlight *Insert by Number* softkey from the display and press the **ENT** key.




**5** Use the EDIT 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, highlight the *Insert this WPT* softkey and press **ENT**.

**7** You can then choose to select another waypoint using the same method, highlight *Escape* and press **ENT** to go back one level and use another method to enter waypoints, or highlight *Done* and press **ENT** to go back to the main menu.

**8** Don't forget to press the **EDIT** key to end your editing.

### Choose in Bank

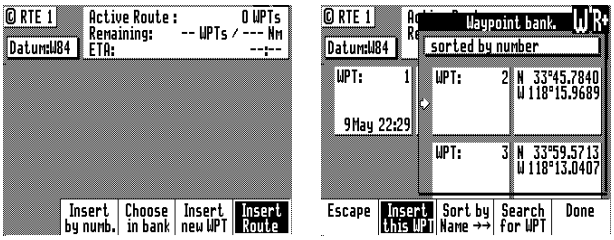
The following example assumes **RTE1** is empty. Follow the directions in the *Erasing an Existing Route* section to start with an empty route if you have waypoints in the **RTE1** screen.

**1** Select the **RTE** key until the **RTE1** screen is displayed.

**2** Press the **EDIT** key to enter the edit mode.

**3** Highlight the *Insert* softkey from the display and press **ENT**. Skip to the next step if RTE1 is empty.

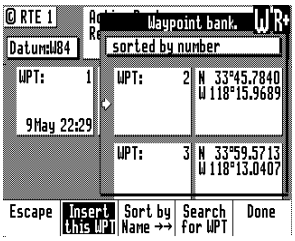
**4** Highlight *Choose in Bank* from the display and press **ENT**.




**5** Select a waypoint by:

**a** Highlighting the Sort By softkey and press ENT 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** Highlighting the Search for WPT softkey and press ENT. 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, higlight the *Insert this WPT* softkey then press **ENT**.

**7** When you are finished, Highlight the *Done* softkey then press **ENT** 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* to go back to the main menu.

**9** Don't forget to press the **EDIT** key to end your editing.

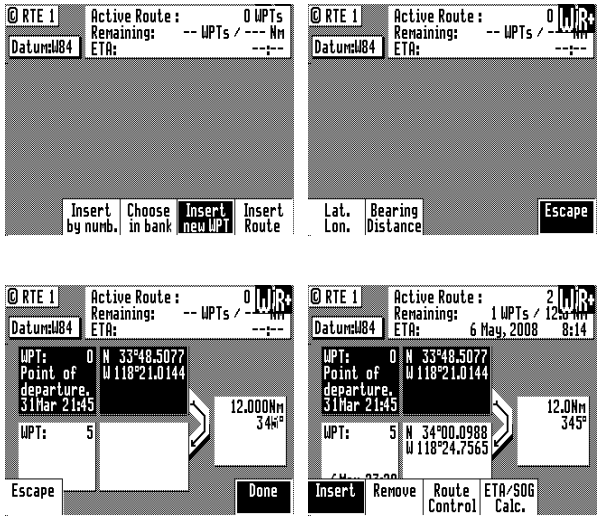
### Insert New Waypoint

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 **EDIT** key to enter the edit mode.

**3** Highlight *Insert new Waypoint* softkey from the display and press ENT.




**4** Choose either *Bearing, Distance* or *Lat/Lon* (Grid Point, or TD if you are using other coordinate systems). Use the EDIT 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.

**5** When the information is correct, highlight the *Done* softkey and press **ENT**.

**6** 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.

**7** Don't forget to press the **EDIT** key to end your editing.

### Insert Route

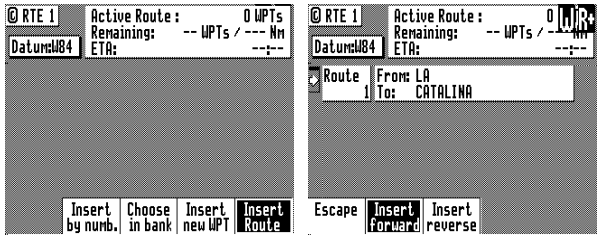
The following example assumes **RTE1** is empty. Follow the directions in the *Erasing an Existing Route* section to start with an empty route if you have waypoints in the **RTE1** screen.

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 **EDIT** key to enter the edit mode.

**3** Highlight *Insert Route* softkey from the display and press **ENT**.



**4** Use the cursor key to scroll through the available defined routes, which are created in the *RTE 2* screen, in numerical order.

**5** When you have found the route you want, highlight the *Insert Fwd* or the *Insert Reverse* softkey and press **ENT**. *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.

**6** You can then choose to select another route using the same method or select another method to enter waypoints.

**7** Don't forget to press the **EDIT** key to end your editing.

## Maneuvering Within the Route

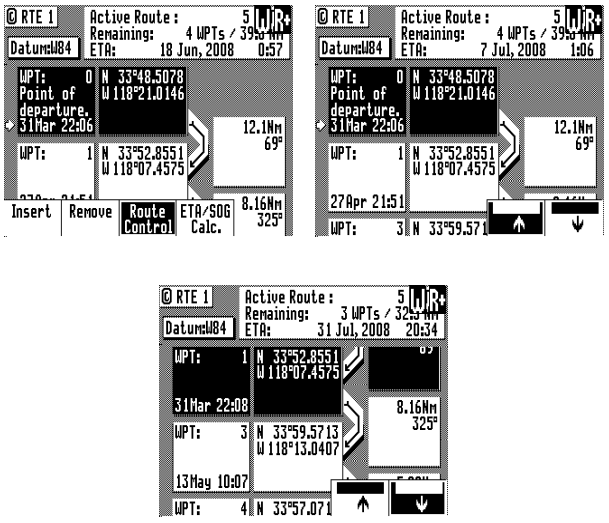
### *Scrolling*

You can use the cursor key to scroll up and down the active route points. 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 or 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 MX51x will allow you 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 **EDIT** 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*).

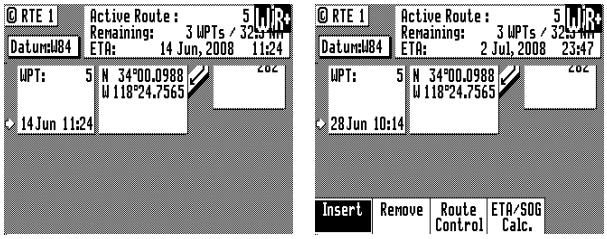
Press the **EDIT** key to end editing.

If for some reason you can't select the desired waypoint (the screen keeps passing waypoints you unpassed), you are probably too close to the waypoint. 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** Press the **RTE** key until the **RTE1** screen is displayed.

**2** Scroll through the route points with the cursor key until the cursor arrow is at the waypoint you want to insert the new waypoint after.



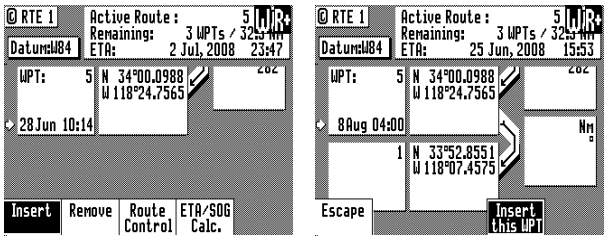

**3** Then press the **EDIT** key.

**4** The *Insert* softkey is already highlighted, press ENT.

**5** Highlight *Insert by Numb.* softkey, press ENT.

**6** Enter the Wpt. # (in this example use number 1).

**7** Highlight the *Escape* softkey then press ENT.




**8** Press the **EDIT** key to end editing.

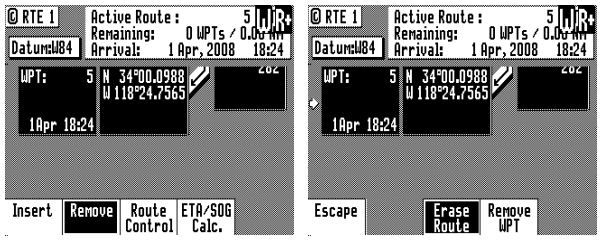
### *Reversing the Active Route*

When you arrive at 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** Press the **RTE** key until the **RTE1** screen is displayed.

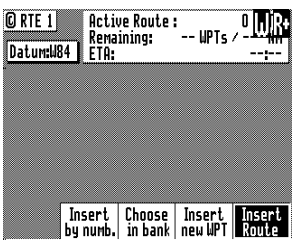
**2** Press the **EDIT** key.

**3** If the previous route is still on the display, highlight the *Remove* softkey and press **ENT**. Otherwise, jump to step 5.

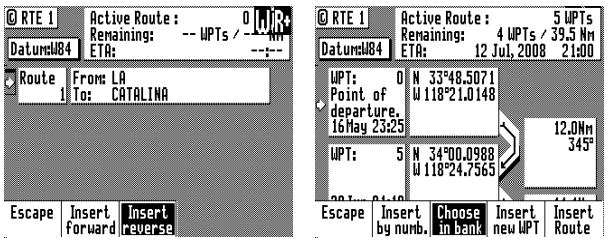



**4** Highlight the *Erase Route* softkey and press **ENT**. This will clear the route.

**5** Highlight the *Insert Route* softkey and press **ENT**.



**6** Highlight *Insert Reverse* softkey, press **ENT**.




**7** Press the **EDIT** key to exit.

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

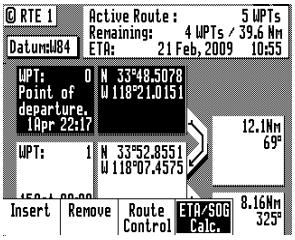
If you choose to use this function, it is probably better to operate the unit in UTC time mode if you are going to cross one or more time zones. Note that the time entered uses the offset to UTC applied in the **CFG1** *Time* display.

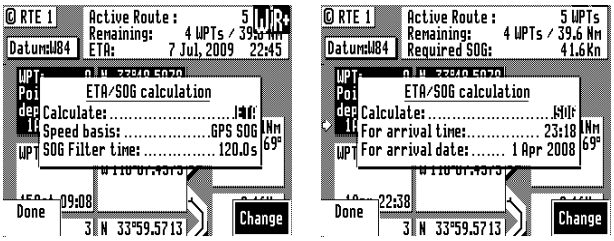
The software calculates Estimated Time of Arrival based on how you configure the unit. ETA settings are controlled from the **RTE1** screen. To change the ETA settings:

**1** Press the **RTE** key until the **RTE1** screen is displayed.

**2** Press the **EDIT** key.

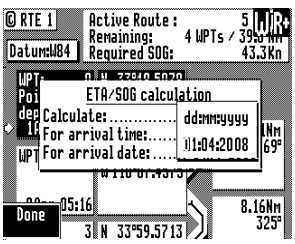
**3** Highlight the *ETA/SOG Calc.* softkey and press **ENT**.




**4** Highlight the *Change* softkey and press **ENT** 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:

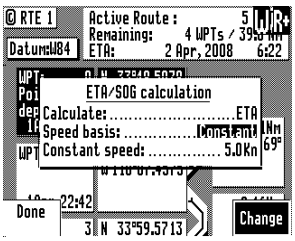



**1** Enter the arrival time and date. Be sure to enter the date as day, month, year, as indicated on the screen.

**2** Highlight the *Done* softkey and press **ENT**.

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:***




**1** 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).

**2** Highlight the *Done* softkey and press **ENT**.

## RTE2 - The Route Bank

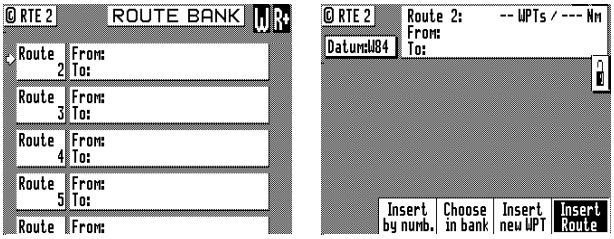
The Route Bank is a convenient place to pre-program segments of a long voyage, or to program routes that you follow repeatedly. Creating routes for the Route Bank uses the same methods as the Active Route with a few exceptions: you can't use the **GOTO** key, and you can't use the Plotter screen. You 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* allows you to clearly 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 **EDIT** key.

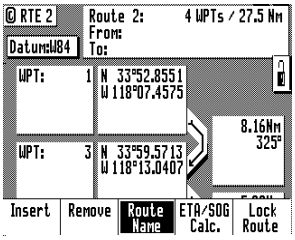
**4** Use the entry methods described in the *Creating a Multi-Waypoint Active Route* section.



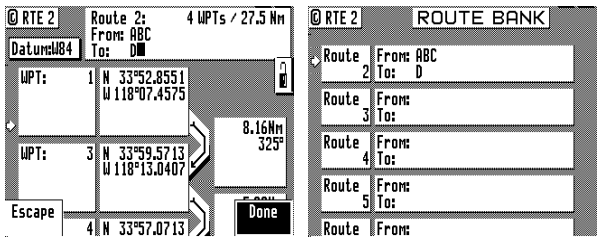

If you have a route in RTE1 that is not stored in RTE2, you can copy it into the Route Bank by selecting *Insert* then *Insert Route*, either in the forward or reverse direction.

**5** Highlight the *Escape* softkey and press **ENT**.

**6** When you are finished adding waypoints, highlight the *Route Name* softkey and press **ENT**.




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




**7** Highlight the *Done* softkey and press **ENT** when you are finished editing the name.

☞ *It is a good idea at this point to select Lock Route so that way you don't accidentally erase the route.*

**8** Finally press the **EDIT** key to exit the edit mode.

☞ *The RTE1 screen is not active until the antenna is detected.*

## Waypoint

The Waypoint Bank (WPT) is a list of waypoints that you created using various methods. The most common method is by manually entering Lat/Long coordinates. Another convenient method is by using the Mark function key to saved your present position. Waypoints can also be downloaded from external waypoint data devices, such as plotters or ECDIS.

While entering waypoints in the list is rather straight forward, the MX51x provides helpful waypoint management tools that should be mentioned before giving examples.

Below are six methods of managing the waypoint bank:

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

☞ *Waypoint "0" is a computer waypoint. The MX51x automatically loads the present position in this waypoint when a new destination is selected to go to.*

- *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 EDIT key again to exit the edit mode.*

Creating and editing waypoints is easy.

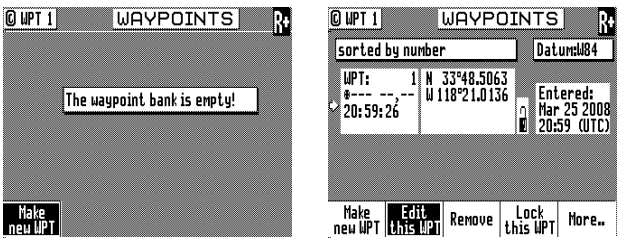
**1** Press the **WPT** key to display the **WPT1** screen.

**2** Press the **EDIT** key to bring up the softkey.

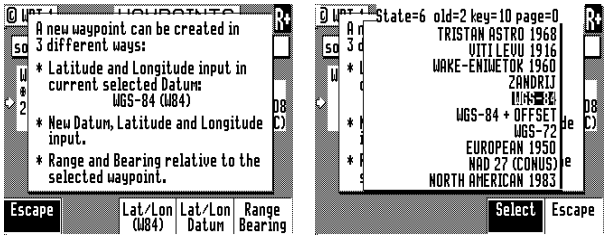
**3** When the waypoint bank is empty, the softkey *"Make New WPT"* is highlighted,

press **ENT** to select it.

**4** Scroll left to *"Make new WPT"* and press **ENT** to start entering L/L coordinates for waypoint #1 or if you want to modify an existing waypoint, highlight the *"Edit this WPT"* softkey then press **ENT**.

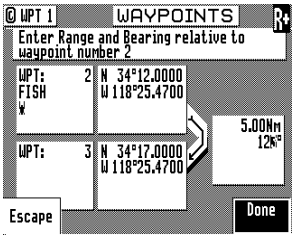



**a** *Make New WPT* - Select *Lat/Lon (W84)*, *Lat/Lon Datum*, or *Range Bearing*.




*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.

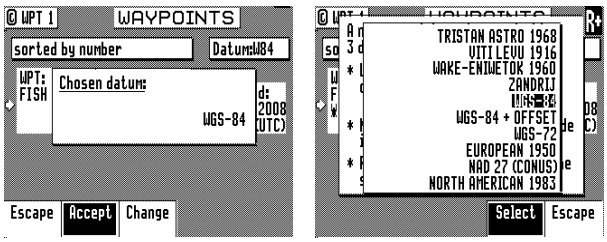
*Lat/Lon Datum* - allows you to choose a datum (see the list in the screen sample above) from the more than 110 available Datums. Highlight the desired datum and highlight the *Select* softkey then press **ENT**. Refer to *Appendix A - Datum List* for a complete list of datums and their WGS-84 offset.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

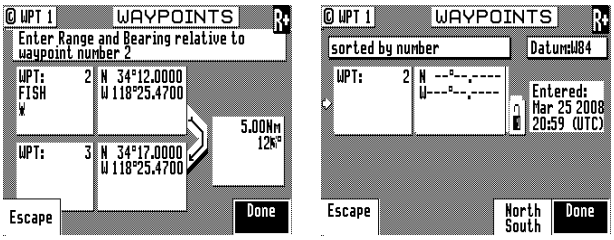
Once you have entered the range and bearing, the CDU calculates the coordinates. You can then enter a text description or modify the waypoint number as described in step 6 below. Go to step 6.

**b** *Edit This WPT* - Select *Accept* to use the WGS 84 datum or highlight *Change* and press **ENT** to choose from the more than 110 available Datums. Highlight the desired datum and highlight the *Select* softkey then press **ENT**. 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.

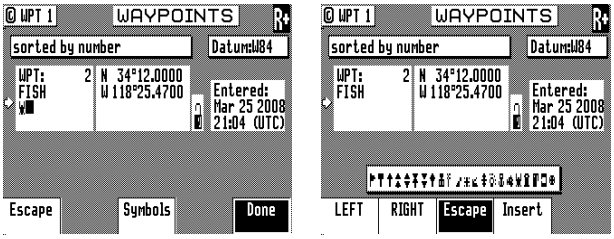
**6** Move the cursor down and modify the waypoint number if you wish. Otherwise the CDU assigns the next available number, beginning at 1.




*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 *EDIT 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

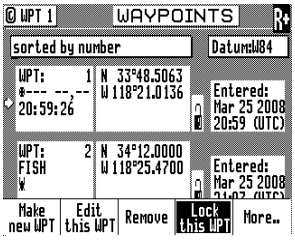
GHI = Í

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.

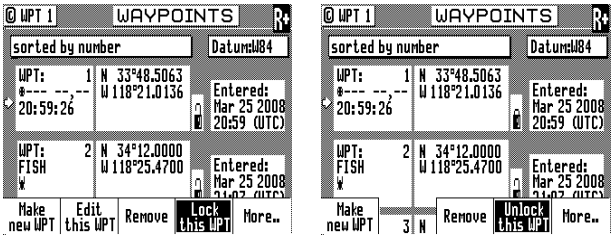
**8** Highlight the *Done* softkey and press **ENT**.

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

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

**10** Then press the **EDIT** function key to end editing.

You can press the **EDIT** key when you finish editing a waypoint. This is treated the same as highlighting the *Done* softkey and press **ENT**. Highlighting *Done* then press **ENT** 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.

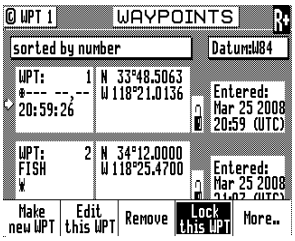
Waypoints that are locked from the waypoint bank are indicated by a closed padlock in the display. Waypoints that are party to a locked route will display a message indicating that waypoint can not be modified.

### *To Lock a Waypoint*

**1** Press the **WPT** key to display the **WPT1** screen.

**2** Scroll to the desired waypoint.

**3** Press the **EDIT** key.




**4** Highlight the *Lock this WPT* softkey then press **ENT**.

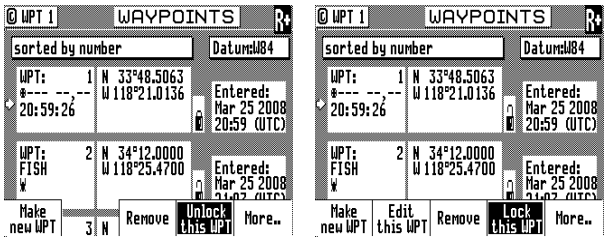
**5** Press the **EDIT** key.

### *To Unlock a Waypoint*

**1** Press the **WPT** key.

**2** Scroll to the desired waypoint.

**3** Press the **EDIT** key.




**4** Highlight the *Unlock this WPT* softkey then press **ENT**.

**5** Press the **EDIT** 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*

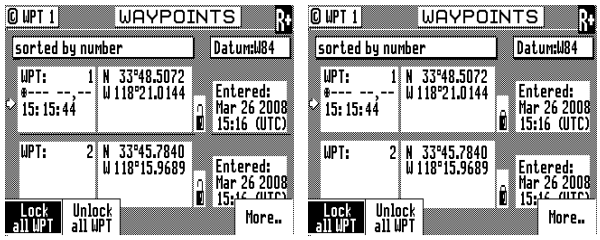
**1** Press the **WPT** key.

**2** Scroll to the desired waypoint.

**3** Press the **EDIT** key.

**4** Highlight the *More* softkey and press **ENT**.

**5** Highlight the *More* softkey again and press **ENT**.




**6** Highlight the *Lock all WPT* softkey and press **ENT**.

**7** Press the **EDIT** key.

### *To Unlock all Waypoints*

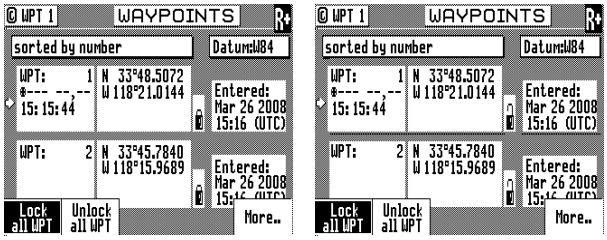
**1** Press the **WPT** key.

**2** Scroll to the desired waypoint.

**3** Press the **EDIT** key.

**4** Highlight the *More* softkey and press **ENT**.

**5** Highlight the *More* softkey again and press **ENT**.




**6** Highlight the *Unlock all WPT* softkey and press **ENT**.

**7** Press the **EDIT** key.

## *Removing Waypoints*

Unlocked waypoints can be overwritten manually or by waypoints received on the NMEA port. 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.

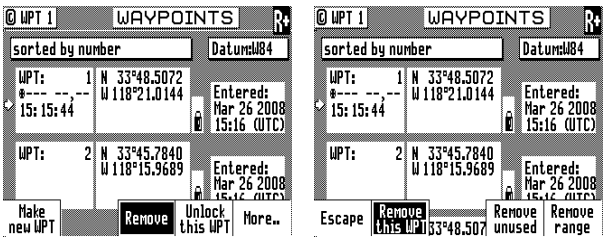
To remove a waypoint:

**1** Press the **WPT** key.

**2** Scroll to the desired waypoint.

**3** Press the **EDIT** key.

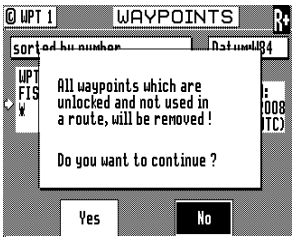
**4** Highlight the *Remove* softkey then press **ENT**.



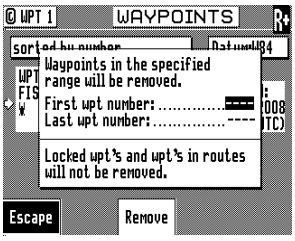

**5** There are three methods to remove a waypoint: *Remove this WPT*, *Remove Unused*, and *Remove Range*:

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

**b** 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:




**c** 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 **EDIT** 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.

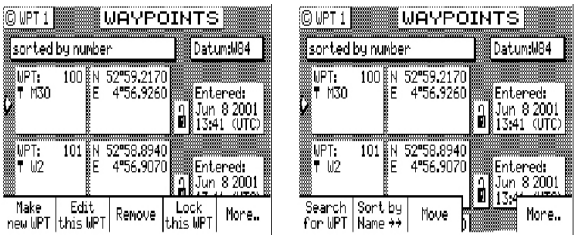
To move a waypoint or range of waypoints:

**1** Press the **WPT** key.

**2** Press the **EDIT** key.

**3** Highlight the *More* softkey then press **ENT**.

**4** Highlight the *Move* softkey then press **ENT**.

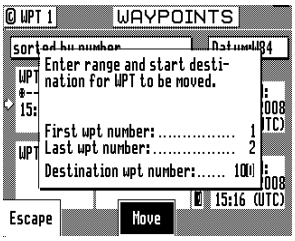



**5**

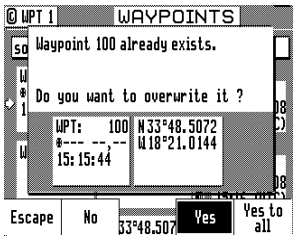
**a** To move a single waypoint, enter the original waypoint number on the *First WPT Number* and *Last WPT Number*.

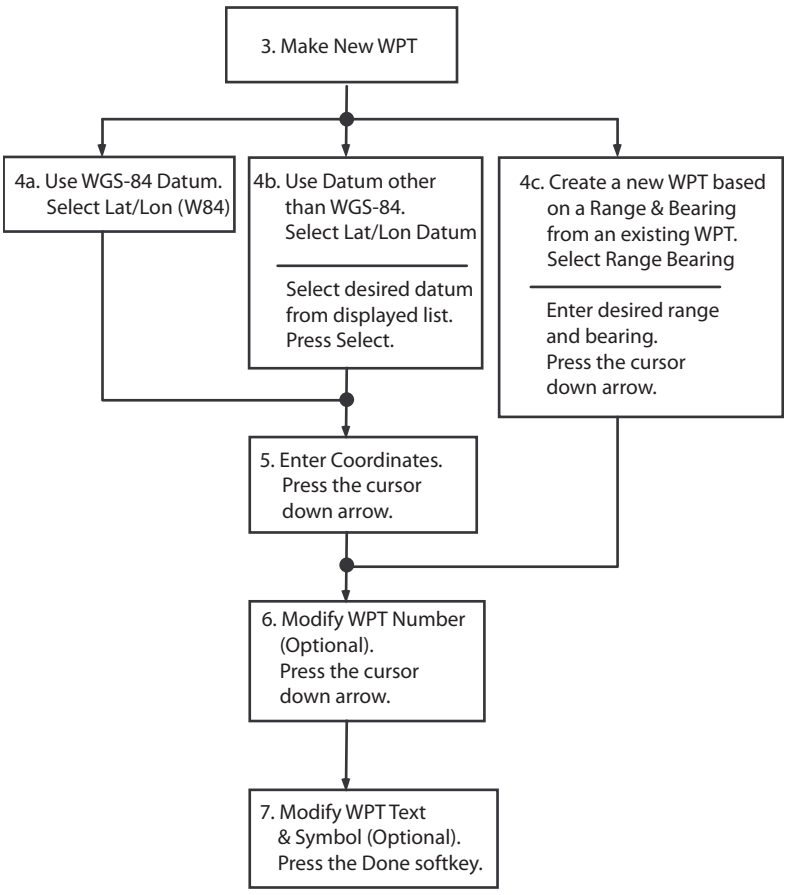
**b** To move a range of waypoints, enter the first and last waypoint numbers to move on the *First WPT Number* and *Last WPT Number*. Keep in mind that the CDU will sort these waypoints numerically and all waypoints between the entered numbers will be moved to the new location.

**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.  Don't forget to press the EDIT key to exit.



### Saving or Restoring Memory Data Using a USB Device

The MX51x is equipped with two sealed USB connectors, one in front and one in the back of the unit. They can be used to conveniently save or restore navigation data such as waypoints, routes, plot tracks and configuration settings using a USB memory stick.

☞ *It is important that the USB stick be formatted first to Windows FAT 32 before using it with the MX51x. The USB formatting procedure is available in the Installation section of this manual.*

To store memory data in the USB device, do the following:

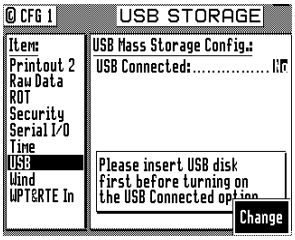
**1** Insert the USB device in the MX51x.

**2** Press the **CFG** key.

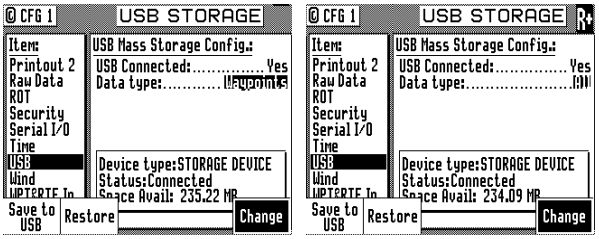
**3** Scroll down to USB menu.

**4** Press the **EDIT** key.

**5** The *Change* softkey is highlighted at this point, press **ENT** key.

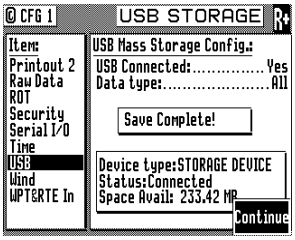



**6** Wait for the MX51x to recognize the USB device before proceeding. It will indicate the device type, status and memory space available when it is done checking the USB device.




**7** Highlight "Data type" then press **ENT** to change to Waypoints, Routes, Plot, Config or All. Using "All" will save everything.

**8** Highlight *Save to USB* softkey then press **ENT**. It will take a few seconds to save the data. The MX51x will tell you when the process has been completed.




**9** Press the ENT to continue.

**10** Before removing the USB, set the USB connected to NO. This is important to prevent causing damage to the USB device or the data in it.

To restore memory data from the USB device to the MX51x, do the following:

**1** Insert the USB device in the MX51x.

**2** Press the **CFG** key.

**3** Scroll down to USB menu.

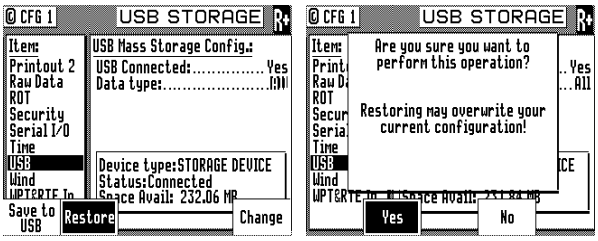
**4** Press the **EDIT** key.

**5** The *Change* softkey is highlighted at this point, press **ENT** key.

**6** Wait for the MX51x to recognize the USB device before proceeding.

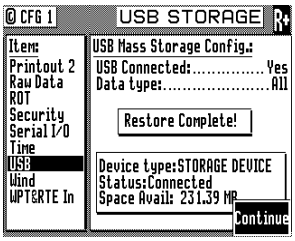
**7** Highlight "Data type" then press **ENT** to change to either Waypoints, Route, Plot, Config or All. Using "All" will restore everything.

**8** Highlight *Restore* softkey then press **ENT**.




**9** It will pop-out a dialog window asking if this is what you want to do. Answer YES (0r NO) by pressing the ENT key (or scroll to NO if you are not sure and press the ENT key).

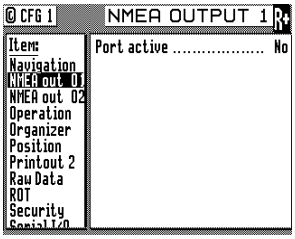
**10** Depending on the amount of data, it may take 5 to 10 seconds or longer to complete this action. The display will advise you when it is done restoring.




**11** Before removing the USB, set the USB connected to NO. This is important to prevent causing damage to the USB device or to the data in it.

## *Downloading Waypoints & Routes to Other Devices*

The MX51x can download all stored waypoints, routes and configuration settings to other NMEA 0183 compatible devices which accept the WPL, RTE, and Rnn data sentences. These sentences are controlled in the **CFG1** *screen NMEA Out* (1 or 2) 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 is 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 unreliable. We suggest that a third party terminal program be used with *Windows 95 (or higher)*.

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

**1** Connect the CDU's port (1or 2) to the PC's communications port (Refer to the *Appendix G* of this manual).

**2** On the CDU press the **CFG** key.

**3** Scroll down the menu to *NMEA Out 1 (or which ever port number is required).*

**4** Press the **EDIT** 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** Highlight the *Details* softkey and press **ENT**.

**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** Highlight the *Done* softkey and press **ENT**.

**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 1* 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.

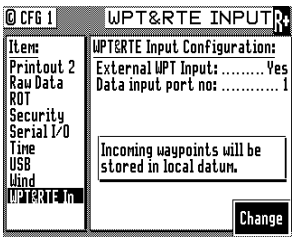
**20** Press the **EDIT** key on the CDU to exit the edit mode.

### 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 and new Windows O/S* doesn't provide a basic terminal emulation program; therefore, a third party program is required with *Windows 95* and above.

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

**1** Using an RS-232 to RS-422 convertor, connect the CDU's port 1 or 2 to the PC's communications port.

**2** On the CDU press the **CFG** key until **CFG1** screen is displayed.

**3** Scroll down the menu to *WPL Input.*

**4** Press the **EDIT** key.

**5** Set the *Transducer Connected* to *Yes.*

**6** Set the *Data Input Port No.* to 2.

**7** Press the **EDIT** 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.

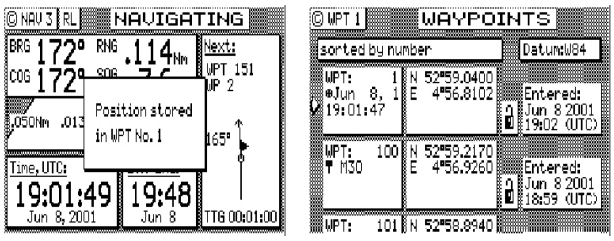
**13** Double click on the *Send Text File* menu item and make the following settings:

[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 / MOB

This is a dual function key that either stores your present position, date and time at the next available waypoint location in the Waypoint Bank or when pressed continuously for 3 seconds, calculates a MOB range and bearing to a saved spot (See MOB section on page 58). 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.

The CDU is also capable of performing this function from a remote contact closure input via the AUX Cable "MOB/Event" wire. Refer to the *Installation* section of this manual for interface instructions. Contact closure on the two input pins for less than 2 seconds causes a Mark position to be generated. Contact closure on the two input pins for longer than 2 seconds causes a Man Over Board condition to be generated.

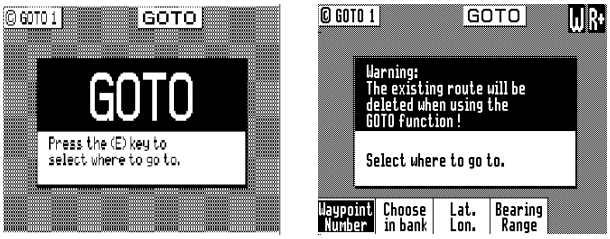
☞ *The marker stores the position of the antenna location. Keep this in mind if you are trying to pinpoint items such as buoys, crab pots, etc. For some special applications such as these, you may need to locate the antenna at the point on the boat or ship where you need to make this exact measurement.*

## *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 **EDIT** 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., UTM*- allows you to define a coordinate and description, which is also stored at the next available waypoint location in the Waypoint Bank.

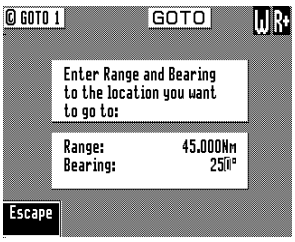
*Bearing Range* - allows you to define a coordinate by specifying the bearing and range from your present position, which is also stored at the next available waypoint location in the Waypoint Bank.

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.

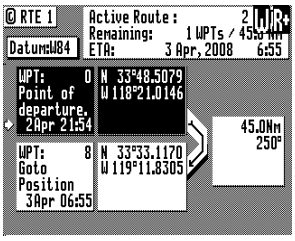
Use the **CFG** key to select a special character, if needed.

**4** To activate the GOTO waypoint, press the **EDIT** 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, highlight the *Escape* softkey and press **ENT**, 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

The **PLOT1** screen displays graphic information around the boat at your present position. The boat always remains in the center of the screen.

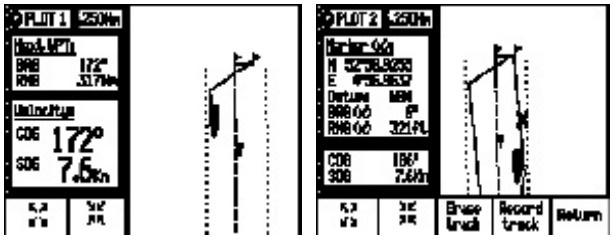
If you define some of your navigation markers in the Waypoint Bank with a symbol in the first character position, the navigation symbol will show up in relation to your planned course on the plot screen, just as it does in the **NAV1** *Panorama* screen. In addition to the graphic details provided by 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 feature 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.

☞ *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:

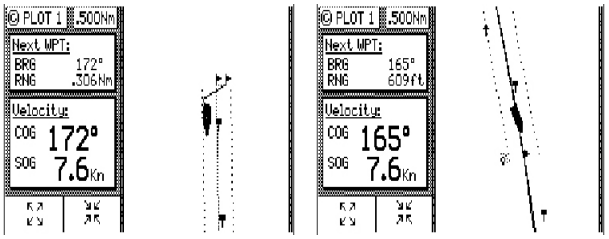
- Navigation - sets a variety of important functions and alarms.
  - Rhumb Line or Great Circle navigation
  - Range units: nautical miles, nautical miles and meters (when under 1,000 meters), nautical miles and feet (when under 1,000 feet), statute miles, statute miles and meters (when under 1,000 meters), 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.




In the PLOT screen the **UP arrow** key is the *Zoom-out* key; the **DOWN arrow** key is the *Zoom-In* key. Each time you depress one of these arrow keys, 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*, 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.

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.

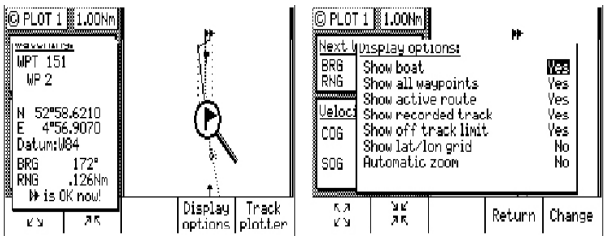



## PLOT 1 - Relative to Boat

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**.

## Customizing the Display

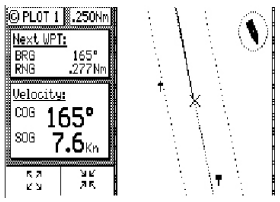
There are a number of display options available, press the **EDIT** key to modify the screen to your needs.




Highlight the *Display Options* softkey and press the **ENT** key.

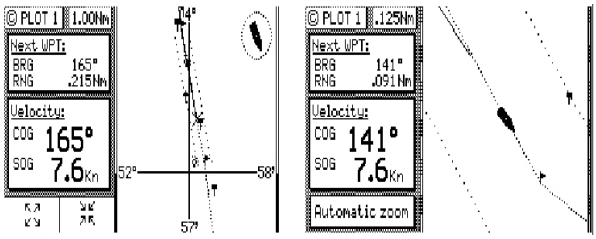
The following choices are available:

- *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*).



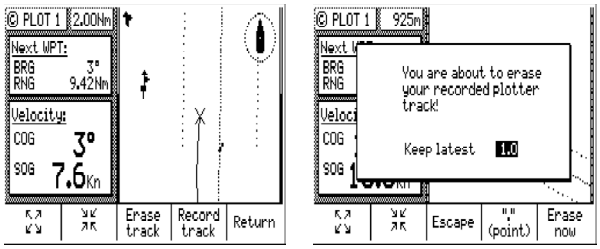

- *Show Recorded Track - Yes* is the default condition, which causes the course you have already traveled to be displayed. *No* causes the traveled course not to be displayed.
- *Show Off Track Limit - Yes* is the default condition, which causes the active route cross-track error lines to be displayed. 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.

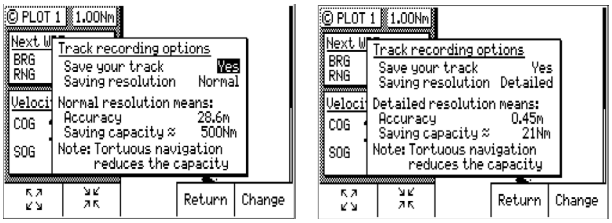



- *Automatic Zoom* - *No* is the default condition, which causes the displayed scale to be controlled by you. *Yes* causes the boat icon to be placed along one edge of the screen and the next waypoint flag to be placed along the opposite edge of the screen. As you approach your waypoint, the screen will 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 highlight the *Return* softkey and press **ENT**, then highlight the *Track Plotter* softkey and press **ENT**, you will access the recorded track options.




Selecting *Erase Track* then pressing the **ENT** key 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 highlight the *Erase Track* softkey and press **ENT**. Highlight *Erase Now* and press **ENT** to confirm your action. Highlight *Escape* and press **ENT** to return the previous screen without erasing or **EDIT** to abort this process.




Selecting *Record Track* then pressing **ENT** 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 all 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 Screen Use Examples

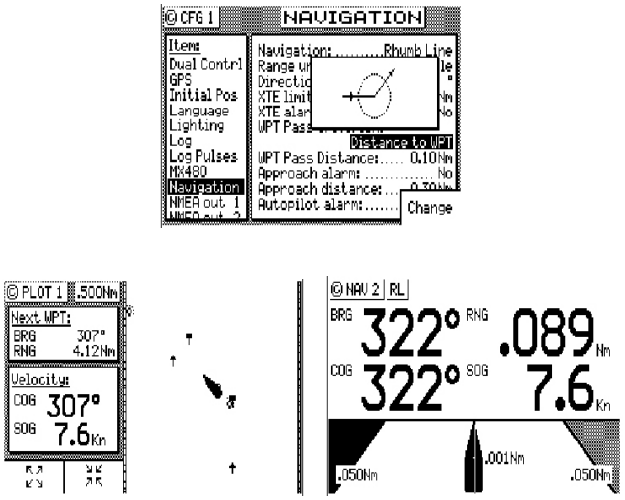
### *Station Keeping*

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.

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

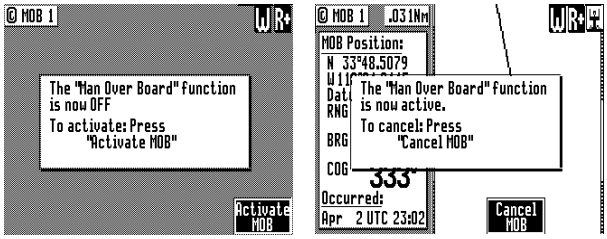
If you are attempting to search a given area, you can use the **PLOT1** screen to view your progress and help maintain your proper separation. You can also use the **RTE1** screen's *Insert New WPT* feature in conjunction with the **CFG1** *Navigation, WPT Pass Criterion: Distance to WPT* (set the *WPT Pass Distance:* to the smallest acceptable value) to create the search pattern you want to follow. In the **RTE1** screen, highlight *Insert New WPT* and press **ENT** 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.

☞ *The PLOT screen is not active until the antenna is detected.*

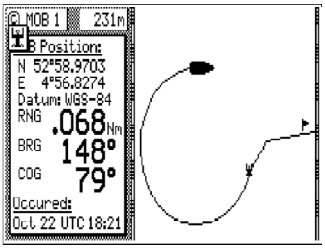
## Man Over Board

The Man Over Board function key shares the same key with the *"Mark or Event"* function key. When depressed for 3 seconds, it activates a number of automatic functions described below.

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.



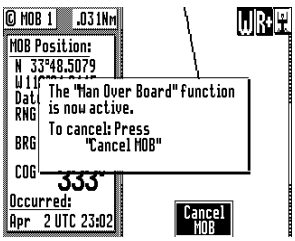

☞ *The range and bearing in the PLOT, NAV, and MOB screens reflect your bearing and range back to the MOB position, not the active route.*

NMEA 0183 sentences (i.e. BWC and BWR) and the printer output are changed to reflect the current situation by also indicating the bearing and range back to the MOB position. 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 **EDIT** key, then highlight the *Cancel MOB* softkey and press **ENT**. Press **EDIT** again to exit the edit mode.



### Remote MOB

The MX51x is capable of performing the MOB function from a remote contact closure input via the AUX (8-pin) cable. If the contact closure is made for 3 seconds, the input is registered as a MOB Position. Refer to the *Installation* section of this manual for wiring interface instructions.

## Auxiliary

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

*AUX1 - Alarm Log*

*AUX2 - Speed Graph*

*AUX4 - Sun Almanac*

*AUX5 - Moon Phases*

*AUX6 - Batteries*

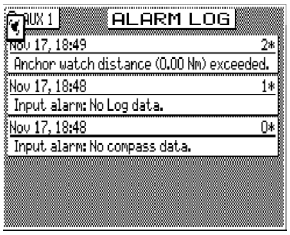
*AUX7 - Unit Information*

*AUX10 - Current Tide Display*

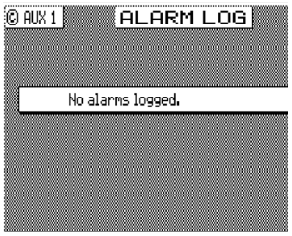
*AUX11 - Tide Table Port List*

### 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.

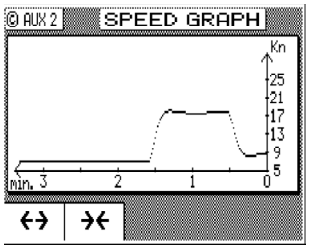



*Reset Log* clears the alarm log entries, except for any alarm conditions which have not been corrected and any alarms which have occurred since the uncorrected alarm.




### AUX2 - Speed Graph

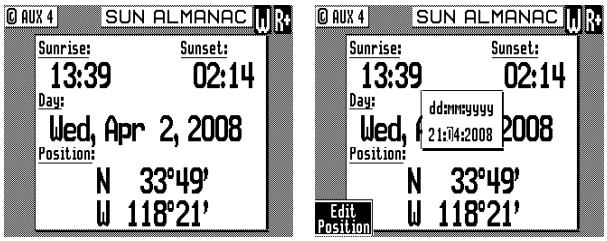
The graph scales automatically to the speed you are at. You can zoom out to the last 56 minutes or in to the last 3.5 minutes. It is a handy tool if you are trying to maintain a certain speed.



### AUX3 - Not Used

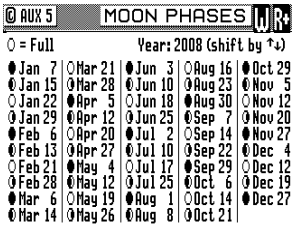
### AUX4 - Sun Almanac

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 **EDIT** key, and editing the appropriate date and/or place.



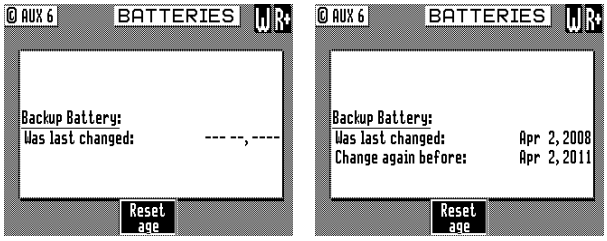

### AUX5 - Moon Phases

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

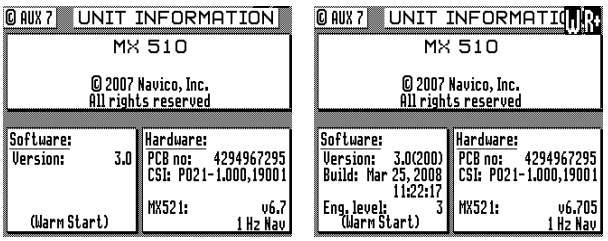
This display is where you reset the Lithium battery age. Press the **EDIT** key and highlight the *Reset Age* softkey then press **ENT** after you replace the Lithium battery. Refer to the *Installation* section of this manual for instructions on replacing the memory backup battery. This battery has a normal life of about 2 years.



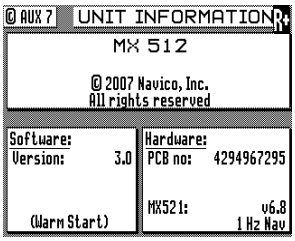

### AUX7 -Unit Information

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 **EDIT** key, then press the *'1'* or *'NAV'* key three (3) times. Additional information in the *Software* window will be displayed.




*MX510 AUX7 Screens*




*MX512 AUX7 Screen*

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

### AUX 10 - Tide

There are two **TIDE** screens, which are located under the **AUX** option. The **AUX 10** 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 **AUX 11** screen, then access through the **AUX 10** screen. You can store up to 100 tide tables in **AUX 11**.

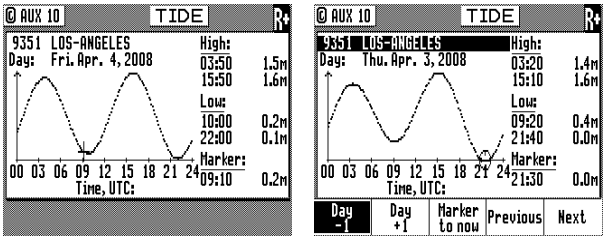
The following **CFG1** menus directly impact the **TIDE** functions:

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

☞ *The Tide function is not active until the antenna is detected.*

### Current Tide Display

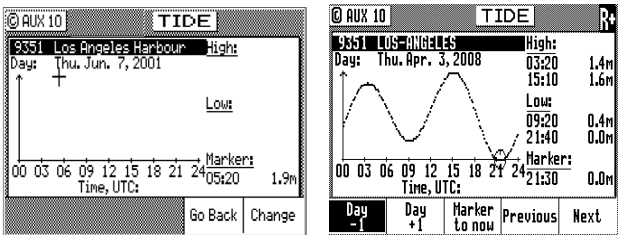
This screen provides the current tide conditions for the tide constants indicated in the upper left hand corner. The number in the upper left corner of the window is the identification number of this table in the *British Admiralty Tide Table* and in the **AUX 11** screen. The name to the right of this number is the port name you entered in the **AUX 11** 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 . You can move the marker forward or backward in time using the up or down arrow keys. Return the marker to the present time by simply highlighting the *Marker to Now* softkey then pressing the **ENT** key. 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 select one of the manual marker control softkeys, or until you highlight the *Marker to Now* softkey and press **ENT** - which returns the marker to automatic mode.

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 **EDIT** function key, and use the *Change* softkey to scroll down the list or the *Go Back* softkey to scroll up the list.

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 **EDIT** key again to load the table.

### AUX 11 - Tide Table Port List

**AUX 11** is where you store the constants for the port tide tables you are interested in. You can store up to 100 tide tables. You can purchase the Admiralty Tide Table Part III book from:

Admiralty Tide Tables and Tidal Stream Tables

Published by the Hydrographer of the Navy,

United Kingdom

Hydrographic Office

Tauton, Somerset TA1 2DN

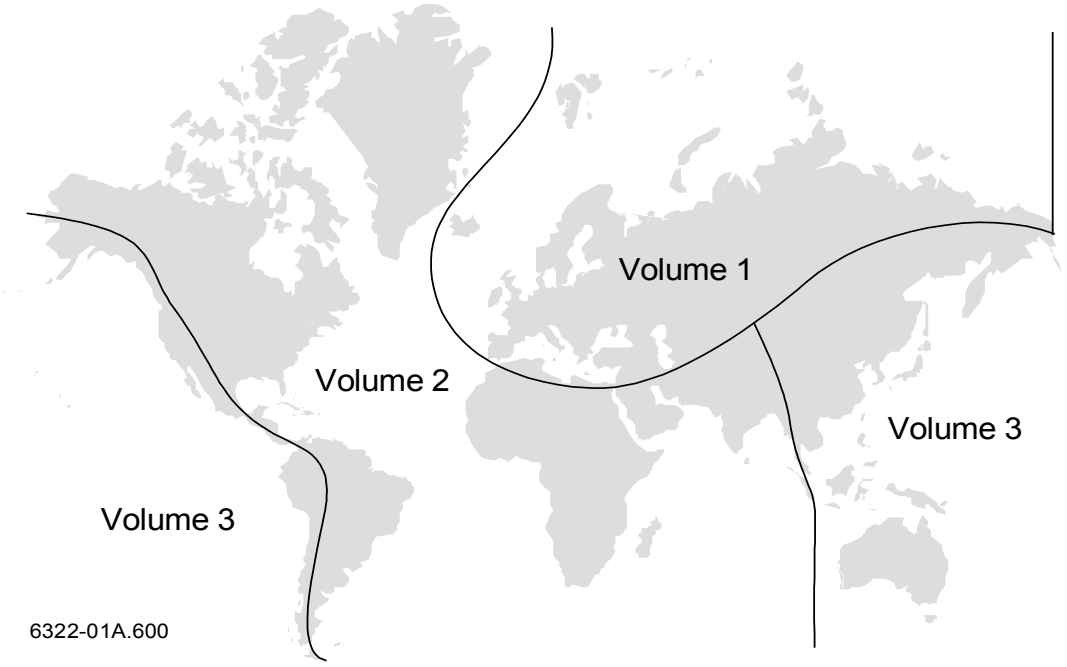
United Kingdom

+44-1823-337-900

+44-1823-323-753 Fax

46274 Telex

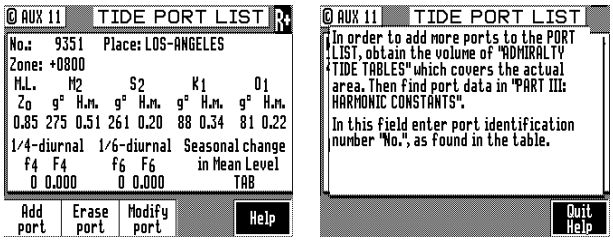
This is a three volume set of tide tables, divided as follows:



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.

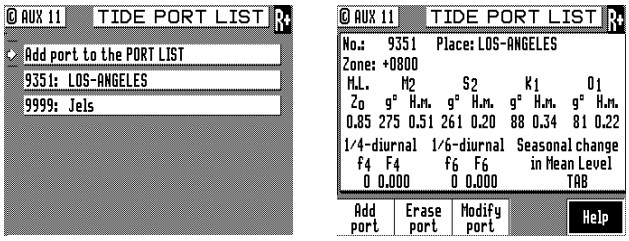
Information about the *Admiralty Tide Tables* port lists and other publications and where they can be purchased is available from the official Admiralty Chart and Publications website at www.ukho.gov.uk.

You may also contact us by fax, e-mail, or phone number provided at the back of this manual if you need information on how to get a copy of the tide table list.




## 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 **EDIT**. 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. Highlight the first softkey and press **ENT** to toggle between these two selections. Highlight the second softkey, *Edit Table*, and press **ENT** to make the necessary corrections. Highlight the *Done* softkey and press **ENT** when you finish the seasonal table, otherwise press the **EDIT** 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 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.

## 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)

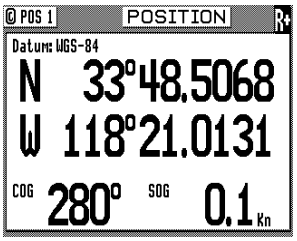
  kilometers (Km), or

  kilometers and meters (Km/mtrs), affect the **POS** screens.
- Position - sets Lat/Lon or UTM, Grid (optional) and some alarm limits.
- Time - sets appropriate offsets, and 12 or 24 hour clock mode.

### POS1 - Position Display (Large Lat/Long Digits)

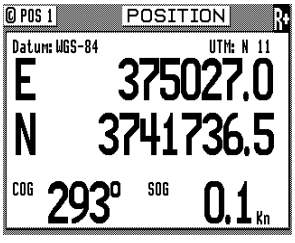
This display provides the largest presentation of the Lat/Long coordinates from the CDU. In addition to the coordinates and datum in use, it also displays the current course (COG) and speed (SOG) over ground. There are no edit functions available in this screen unless it is in *Demonstration* mode. Refer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

#### *Latitude & Longitude*




#### *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.

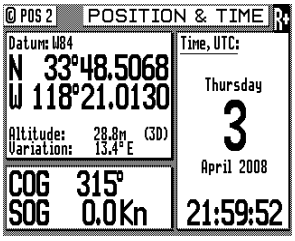


### User GRID

User defined grids is an optional feature of the MX51x. When enabled you can set the receiver to provide Easting and Northing position data based on a local grid. The grid function is set up in the **CFG1** Position screen. A special license is required to activate this special feature.

### 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.



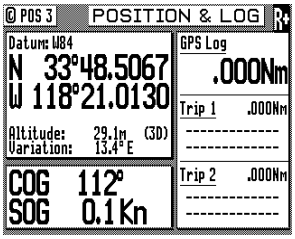

The lower left window displays your course and speed over ground. If the degree symbol has a small 'c' under it, this indicates that the magnetic variation and compass deviation table are being calculated and displayed. Refer to the **CFG1** *Compass* section for more details on how to set this up.

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.

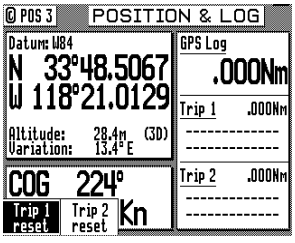
### POS3 - Position & Log

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 **EDIT** 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.

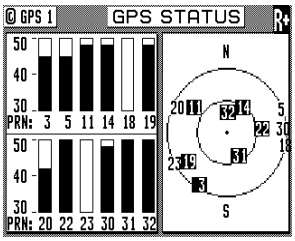
## GPS

Several GPS and DGPS 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 MX smart 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. 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.

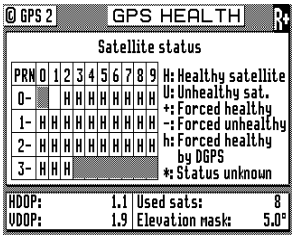



The right window indicates where the satellites are located in the sky relative to your present position. The outer ring represents 0° elevation. The inner ring represents 45° elevation. The center represents 90° elevation and your present position. Under normal conditions, the best satellites to track are usually between 15 and 75 degrees in elevation.

### GPS2 - GPS Health Screen

There are two windows in this display, the top window is a table indicating the satellite health status. The *PRN* (PseudoRandom Number) ID table is divided into columns and rows. the rows represent the 10s digit of the ID number and the columns represent the 1' digit of the ID number. The satellite system consists of up to 32 satellites. The ID numbers are called PsuedoRandom Number to denote an ID number for each satellite regardless of the Satellite Vehicle Number (SVN).

To find a particular satellite ID, for example PRN24, go down the left hand column and locate the 10's digit 2. Then go across the row until you intersect with the 1' digit in this case 4.

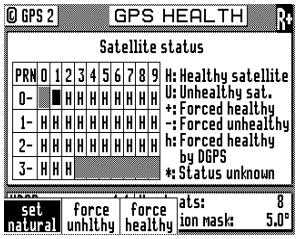



The legend on the right of the table explains what each of the satellite indicators represent.

You can deselect a particular PRN# by doing the procedure below:

**1** Press the EDIT key.

**2** Scroll to the PRN number desired.

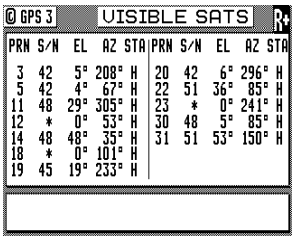



**3** Highlight "force unhealthy" softkey, press ENT to change the value to "-".

**4** Press the EDIT key to exit.

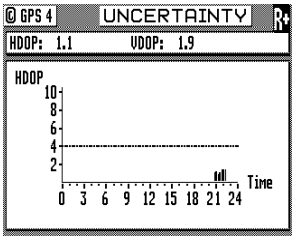
### GPS3 - Visible Satellites

This screen provides some basic information about the GPS receiver performance just like GPS1 and GPS2 screens. It shows the PRN satellite ID, the signal to noise ratio is indicated under the S/N column, while the EL is the elevation angle and the AZ is the azimuth direction. Typically, S/N numbers between 40-50 are good SNR numbers. Anything below 32 is considered very low and will not be tracked.



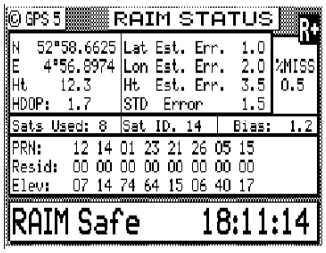

### GPS4 - GPS Position Uncertainty

This screen presents a bar graph representing the Horizontal Dilution of Position (HDOP) for the past 24 hours. This feature keeps track of how good (or bad) the GPS system was and based on this you can figure out how it will be like the next day if you are navigating within the same general area as the day before. This is a good tool for Hydro surveying work. The HDOP limit designated by the dash line is typically set to 4. If the limit is exceeded, an HDOP alarm will be sounded.




### GPS5 - RAIM Status Screen

RAIM (Receiver Autonomous Integrity Monitoring) is a fault-detection feature required by the IMO for commercial vessels. It is another layer of safety that alerts the operator that a condition may exists in the GPS positioning solution that reduces the desired accuracy of the ship's position. This feature requires at least five or more GPS satellites to operate properly, four satellites or less are considered to be a caution or unsafe RAIM condition. If the statistical RAIM error exceeds a selected limit (100 meters default) a "**RAIM Unsafe (R-)**" or "**RAIM Caution (R?)**" alarm will be indicated in the MX CDU. This means that the RAIM estimated position error is equal or greater than the preset limit. The operator is advised to take extra precautionary measures when using the navigation solution until the RAIM indicator switches to "**RAIM safe R+**" condition. When less than 5 satellites are receivable a "**RAIM Caution**" will be indicated.




The **GPS5** screen shows the position Lat/Long, height of antenna, HDOP, number of satellites used, the satellite ID number that may cause the statistical error and its bias value. It also shows a table containing the PRN numbers of satellites in use, their residual errors and elevations. Below it is the RAIM Status indicator and time. The RAIM icon is shown on the top-right corner of the display.

Position errors may be caused by unhealthy satellites, incorrect pseudoranges, poor DGPS corrections and excessive atmospheric interference. When the RAIM caution or RAIM unsafe alarm is on, the GPS/DGPS accuracy may be degraded but still usable when navigating in open waters.

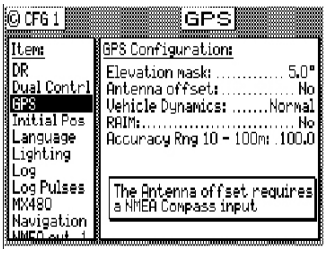
When the RAIM option is enabled an icon is posted on the top right corner of all screens.

R+ - means **RAIM safe** condition

R- - means **RAIM Unsafe** condition, position errors exceeded the range limit specified under the CFG/GPS/Accuracy Rng.

R? - **RAIM Caution**. Not enough satellites are available for proper RAIM calculation.

The **GPS5** RAIM screen works interactively with the GPS/RAIM menu under the CFG key.




Use the procedure below to activate the RAIM feature;

**1** Press the **CFG** key.

**2** Scroll down to the *GPS* menu.

**3** Press the **EDIT** key to bring up the cursor.

**4** Scroll down to "RAIM: .....No"

**5** Highlight the **Change** softkey and press **ENT** to switch it to "Yes".

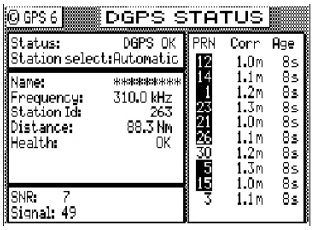
**6** Scroll down to "Accuracy Rng 10-100m: 100" to change the range. Otherwise you may skip this step. 100 meters is the default value.

☞ *The **GPS5** RAIM Status screen is available in MX51x models with program version 3.0 and using the MX521 or MX525 antenna sensors.*

⚠ ***The MX51x and RAIM feature is an <u>aid</u> to navigation ONLY.*** *Under no circumstances should it be used in lieu of authorized government charts. Its accuracy can be affected by many factors such as equipment defects, environmental conditions, or improper operation. The user is responsible for safe navigation of the vessel. This includes consulting authorized government charts and exercising common prudence and navigational judgement at all times.*

## GPS6 - DGPS STATUS

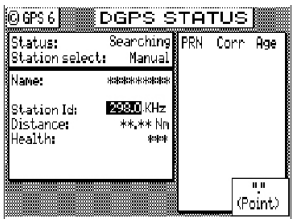
There are several windows in this display, the left hand windows are divided into control and configuration windows. The right hand window displays all the corrections that are being received. Shown below is the GPS6 screen.



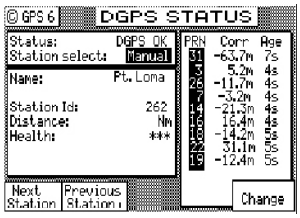

*MX51x GPS6 Screen*

*Status* will tell you whether the correction data is being decoded is error free or not. Normally, *Status* will indicate either *DGPS mode Off, DGPS OK*, *Tracking* or *Searching* (Automatic search mode) or *No Lock* (Manual tuning mode). *DGPS OK* indicates that RTCM SC-104 DGPS corrections are being received without errors within the *Age Limit* set in **CFG1** *DGPS*. These information originates from the MX smart antenna beacon receiver. *Searching* indicates that the beacon receiver is searching for the appropriate frequency and/or modulation of the beacon transmitter in automatic search mode. *No lock* indicates that the beacon receiver is not receiving DGPS corrections from the selected station in manual tuning mode. 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 **EDIT** key, you can select between *Automatic* beacon search mode, *Manual* beacon tuning mode, or *Off*. When the receiver is in the *Manual* tuning 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*. Once the beacon station transmits its location, the MX51x will calculate the distance between the reference station and the receiver, otherwise this will be blank. You can usually find current beacon status, location, and operating information from the governing country's Coast Guard or Maritime Safety Administration.




When you are in manual tuning mode, pressing the **EDIT** key will bring up the cursor on the *Frequency*. You can only complete the manual tuning operation by pressing the **EDIT** key when the *Frequency* is highlighted.

Program the frequency you desire and press the **EDIT** key. The CDU will automatically update the *Station ID*. Once the beacon station transmits its location, the CDU will calculate the distance between the reference station and the receiver.

You can usually find the current beacon status, location and operating information from the governing country's Coast Guard or Maritime Safety Administration or in the Internet.

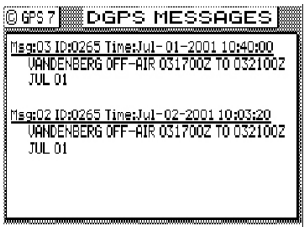
Once you have entered the data for several beacon stations, you can cycle between these stations by pressing the *Next Station* or *Previous Station* softkeys. These softkeys are only displayed if you have entered a name for the reference station.

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 secionds.

### GPS7 - DGPS Messages

This screen will display the 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.

☞ *The GPS screen is not active until the antenna is detected.*



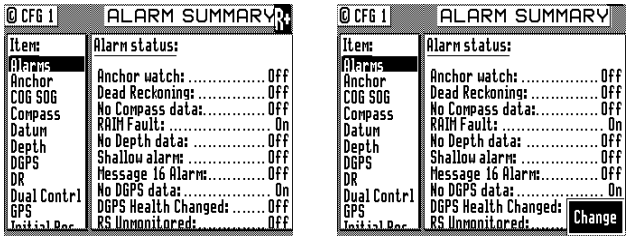
## Configuration

The **CFG** screen includes setup and control of all of the MX51x'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 items. The right hand window displays the current settings. Use the cursor key to select a configuration item of interest, then press the **EDIT** 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.

☞ *The configuration list is too long to show in one page of the display. To view all of the configuration menu, scroll through to the bottom of each list with the cursor key.*

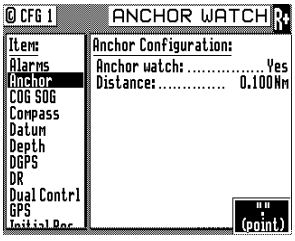
## Alarms

This screen allows you to quickly see which alarms are active or not. 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.



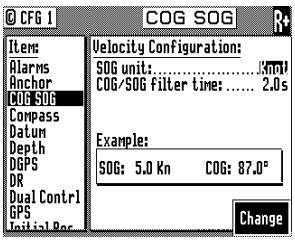

## Anchor - Anchor Watch Alarm

This screen allows you to setup an anchor watch alarm and maximum drift radius after you drop the anchor. The MX51x 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 MX51x antenna. You will need to consider this when setting in the distance.



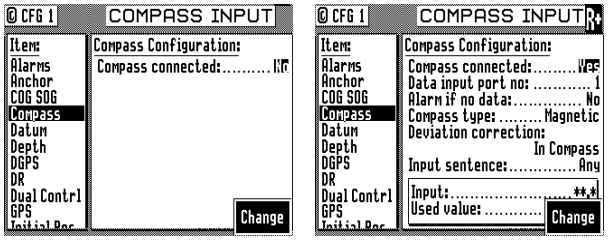

## COG SOG - Course & Speed Filter Settings & Setup

This screen controls the Speed Over Ground (SOG) unit 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. The default filter setting is 2.0 seconds.




## Compass - External Compass Input & Magnetic Variation Table

The MX51x will accept compass input using the NMEA 0183 data record of xxHDT, xxHDG, xxHDM, xxHCC, xxHCD, xxVHW, or any of the above. The "xx" refers to the Talker Identifier as specified in the NMEA 0183 standard. It will accept these data records vitually from any talker ID, and from any version (1.5 or higher) of the NMEA 0183 standard.




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

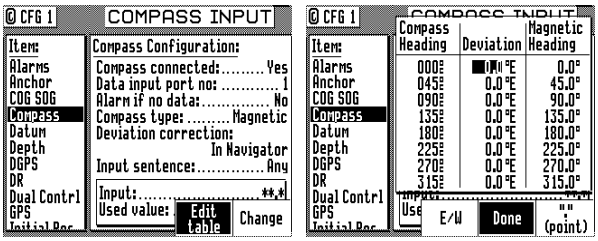
Identify the appropriate input port that the compass connects to the CDU by using the *Change* softkey.

Select whether or not the MX51x should give an alarm if data is not received on the input port.

Select the compass type, either *Magnetic*, *Gyro, or MX575*. Only the NMEA 0183 records identified above are accepted for the gyro input.

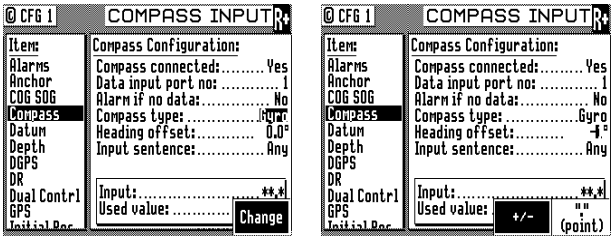
*Magnetic:*

Select the magnetic deviation method: either *In Compass* - the deviation is corrected before being sent to the MX51x; or *In Navigator* - the deviation is corrected by editing a deviation table (*Edit Table* softkey) in the MX51x.




*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.

*MX575:*

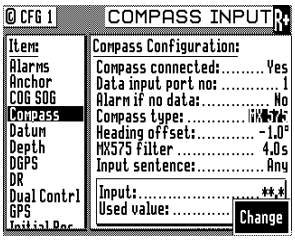
There are two ways the MX575A DGPS compass can be connected to the MX51x, namely:

- PORT3 as source of Positioning, Heading and ROT.
- PORT1 (or 2) as source of Heading and ROT only

If the MX575 is used as a positioning and heading device on NMEA Port3, set *Data input port no* to *3.* This will automatically configure the MX575 to work at 19,200 Baud rate and the HDG output will be set to 10 Hz on power up.

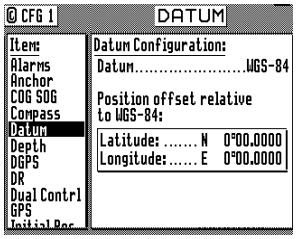
If the MX575 is used as a heading & ROT device only, set *Data input port no* to the port number used (1 or 2) other than port 3. *(See MX575 Satellite Compass Installation & Operation Manual for details)*.

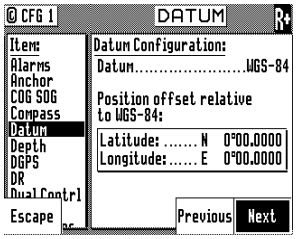
Set the constant *MX575 Heading Offset* (or bias) if any.




## Datum - Current Position Calculation

This screen controls which datum the MX51x uses to display the position Lat/Lon. 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 MX51x. Use the *Previous* or *Next* softkeys or the cursor key to scroll through the list until you find the datum you need. Highlight *Escape* then press **ENT** to go back to the original datum displayed when you first pressed the **EDIT** key.

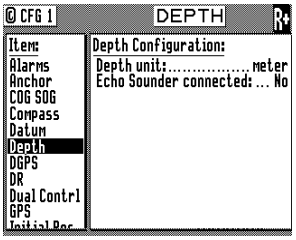


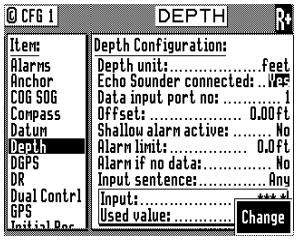




## Depth - NMEA Input Control

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 MX51x 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 **EDIT** key and move the cursor to the *Echo Sounder Connected* line. Press the ENT key to *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 MX51x 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 (Port 1 or 2). Ports 3 and 4 are reserved for the Smart 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 waterline height. If your boat's draught changes from one trip to another, as would be the case when the MX51x 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 *No*.

*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*.

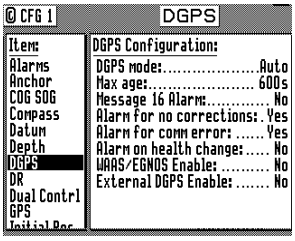
*Alarm If No Data* - Allows you to receive an audible and visual alarm if NMEA 0183 data is not being received on the data port at regular intervals (typically every few seconds). The available choices are *Yes* (default) and *No*.

*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 CFG menu allows you to control the built in beacon receiver in the smart antenna unit.




*DGPS Menu*

*DGPS Mode:*

*Auto - sets the smart antenna to automatically switch between 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 MX51x 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 be green when it is in DGPS mode.

When it drops to GPS mode, a DGPS symbol will be displayed (indicating Non Differential GPS mode), and the yellow and green traffic light will be on.

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 smart antenna to only provide DGPS position fixes*. If corrections are being received and their age is less than the *Max Age* limit, the MX51x will operate in DGPS mode (assuming there are enough corrections to operate in DGPS mode). Otherwise, the antenna will not provide any position fix at all.

Use this mode when accuracy is more important than maximum navigation coverage. It is recommended to set the *Max Age* to *30* seconds in this mode.

*Off* - sets the smart antenna to operate in *GPS* mode only.

*Max Age -sets the maximum age limit that the last received RTCM correction will be applied to the satellite range measurement in the receiver.* The default setting is *600 seconds*. The MX51x will accept values from 10 to 999 seconds. Due to the removal of the S/A dithering from the satellite signal, you may now use values of 600 seconds in the maximum age and still be very accurate.

*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) beacon 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 will notice that the MX51x 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 a satellite becomes unhealthy or unusable.

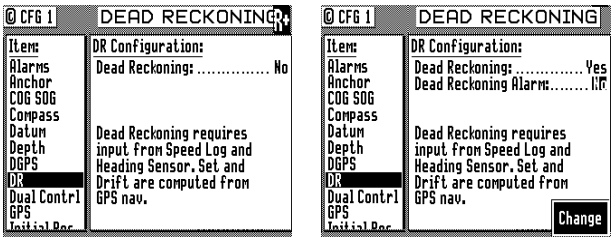
*WAAS/EGNOS enabled* - sets the source of differential correction to come from satellite based augmentation system such as US-WAAS or European-EGNOS system. Although this systems are available, they are still non-IMO compliant. Use of these differential correction sources should be done with great caution.

*External DGPS Enabled* - gives the user the capability to accept RTCM SC-104 corrections from an external beacon unit (receing the Coast Guard or a Private Beacon Reference Station). The MX51x allows you to control the baud rate of SC-104 Data input port. The following baud rates can be used: 2400, 4800, 9600 or 19200 Bauds.

☞ *WAAS/EGNOS and External RTCM are available only for the MX521A, MX525A smart antennas or MX575A GPS Compass. The MX421-10 GPS smart antenna can use external RTCM correction only.*

## DR - Dead Reckoning

The DR (Dead Reckoning), is an added navigation feature of the MX51x in the event that there is no GPS positioning available. This feature requires external speed log and heading sensor inputs to work properly. When the DR setting is set to 'Yes' and appropriate compass/ heading and speed log sensors are connected and activated, the MX51x will automatically switch to DR calculation when the GPS positioning becomes unavailable. A DR icon on the top right corner of the display indicates that the position displayed is derived from DR calculation.




To set the DR to 'Yes' , scroll down to DR menu then press the **EDIT** key. Press the **ENT** key to activate the '**Change**' softkey. Press the **EDIT** key again to exit the edit mode.

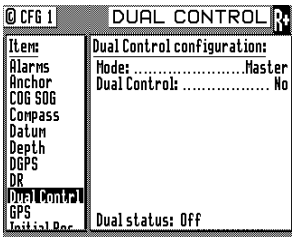
## Dual Control - Dual Station Control

This screen sets the functional control between two or more MX51x CDU's in a LAN network. The default setting is *No*. When this selection is changed to *Yes*, one MX51x is set to *Master*, the other MX51x is set to *Slave*. Up to five MX51x units can be networked together using the LAN port. The MX51x connected to the antenna is normally the Master unit and the other member/s can be either slaves or repeaters. The *Slave* unit/s will share a common waypoint and route database with the master. It can also make changes in some of the configuration settings. A slave unit can be made into a *Repeater*. Repeaters only act as a display unit. They cannot be used to change configuration settings. Once an MX51x is set as a repeater it will require a special password (which is set by the *Master* unit in *CFG1/Security*) to change it back to a slave.

Whether a unit is a slave or repeater, it will still share a common waypoint and route database as the master. Refer to *Appendix C* for more detailed information about the dual-control and multiple unit control setup and operation.

☞ *CFG1/LAN menu must be setup before enabling the Dual-Control feature. A dual control system consists of one Master and one Slave. A Multiple Unit Control (MUC) system consists of one Master, at least one Slave (maximum of two), and up to three (if any) Repeaters. A multiple unit control system must contain a minimum of three MX51x and a maximum of five MX51x units altogether.*

⚠ *In a Multiple Unit Control configuration, this option must be enabled (by changing **Dual Control** to **Yes**) for all Slave and Repeater units before enabling it in the Master unit.*

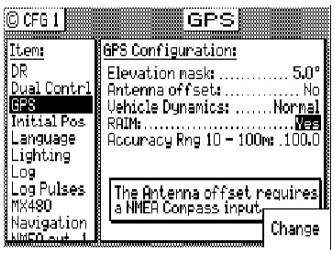



*MX51x Dual Control Menu*

## GPS - Elevation Mask Control

This screen controls the *elevation mask* angle, or the angle above the horizon, at which the MX51x 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 90°. For most marine applications, the default limit of 5° is appropriate.

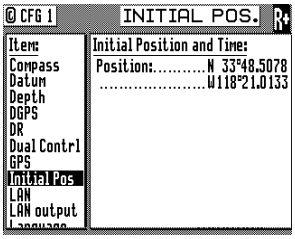
The *Antenna Offset* allows you to virtually offset your antenna location. That is, if you are forced to place the antenna in a location other than where you want your position fix calculated (due to superstructure or other high power antennas), you can place the antenna in a practical location. Then enter the appropriate *Antenna Offset*, and the MX51x will calculate your position in the place where you would have preferred to place the antenna.




The *RAIM* menu is available only in MX51x models where the RAIM feature is enabled. For more detailed information about RAIM, please refer to Page 67 of this manual. Standard MX51x CDU will only show the Elevation mask and Antenna offset menu items.

## Initial Pos - Initial Position Entry

This screen is provided to help the GPS receiver in the smart antenna to get a faster first position fix. While the smart antenna is capable of computing its position without any user input, this feature can cause a position fix to occur several minutes earlier. Another time this feature is useful is when the MX51x has been moved over 300 miles from the last location it was used while in the off condition. Again, the MX51x will calculate a position fix without any user input in this circumstance. However, moving the MX51x 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 MX51x 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 MX51x will stay on the original constellation for 15 minutes before attempting other constellation possibilities. We assume the MX51x 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.

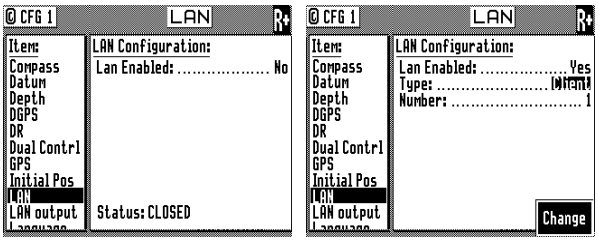



## LAN - Local Area Network

This feature allows the MX51x to communicate with another MX51x via LAN interface (RJ45). This data link is used by the MX51x for dual control, integrity monitoring, and multiple control applications. Below are IP addresses used by the Host and Client units within its local network.

| Type | IP Address |
|---|---|
| Host | 192.168.100.250 |
| Clients | (See below) |
| Number 1 | 192.168.100.251 |
| Number 2 | 192.168.100.252 |
| Number 3 | 192.168.100.253 |
| Number 4 | 192.168.100.254 |

*MX 510 IP Address Table*




To activate *LAN*, press the **EDIT** key and press the ENT key to activate the *Change* softkey to change *LAN Enabled* to *Yes*. Use the *Change* softkey to modify the options described below:

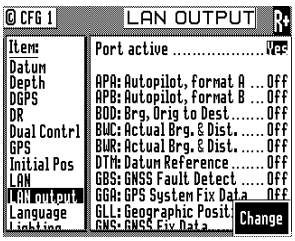
*Type* - select between *Host* or *Client*. In a dual or multiple unit control system, the Master will be the Host and the Slave(s) will be the Client(s).

*Number* - this option is only available when Type is Client. The available values are 1, 2, 3, or 4 (which determines the IP address of the CDU). Each Client has to be assigned with a unique number (1, 2, 3, or 4). Any two or more Clients with the same number will create an IP address conflict, and therefore, will activate an IP Conflict Alarm. Please refer to the previous IP address table for the designated IP numbers.

When the connection is successful, the *Status* will display *ESTABLISHED*.

## LAN Output (NMEA 0183 OVER IP)

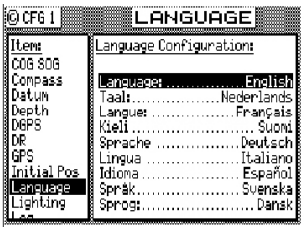
This screen is very similar to the NMEA Out screens. It sets the specific NMEA 0183 output record parameters. The default setting is No. When this selection is changed to Yes, you can turn on individual data records, and transmit them using the Local Area Network (LAN) connection.




This feature can be used to integrate the MX 510 to an Integrated Bridge System by connecting the CDU to a PC-based IBS system using LAN (RJ45).

## Language - Language Configuration

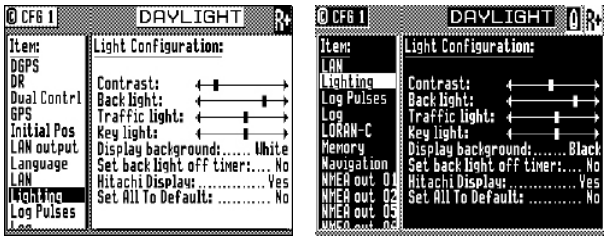
The MX51x supports 9 languages: English, Dutch, French, Finnish, German, Italian, Spanish, Swedish and Danish.




Press the **EDIT** key. Use the cursor key to scroll down the list until you find the desired language. Press the **EDIT** 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 & Set Display Default Setting

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




*Contrast*- Controls the viewing angle of the display

*Backlight*- Controls the display backlight intensity

*Traffic light* - Controls the brilliance of the three traffic LEDs

*Display background - selects black or white display background*

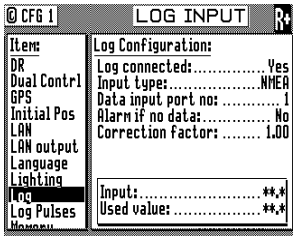
*Set back light off timer* - turns the backlight to minimum brillinace when no keypad activity is detected within 30 seconds (time is configurable)

*Hitachi Display* - controls the LCD parameters to match the LCD made by Hitachi

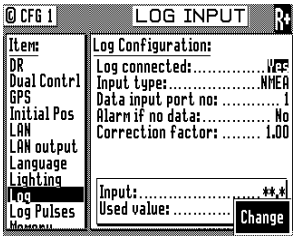
*Set All to Default* - When set to Yes, all display settings will be set to factory settings.

## 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 MX51x. 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, 2.1, or 2.3 format where xx is a valid talker ID as specified in the NMEA 0183 standard. The CDU 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 *Appendix F* of this manual for wiring connections.

*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 MX51x. The default value is 1.00.

Digital Pulse Input:

*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 MX51x. The default value is 1.00.

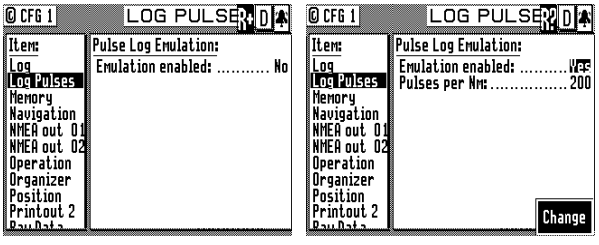
Both input types have a window in the lower portion of the display which indicates the input value in real time. If you input a calibrated pulse rate, you can check for the appropriate speed right here.

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 MX51x 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 not active, and set to 200 pulses per nautical mile. The Log Pulses output connection is done using the 8-pin AUX connector.

Refer to the *Installation section* of this manual for the hardware interfacing.

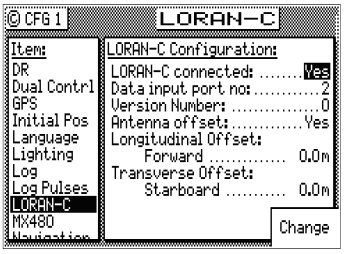



Activate the output by selecting *Yes* to *Emulation Enable* and set the pulse rate based on the device that you are connecting to.

## LORAN-C Integration

This feature will be available only when the optional *Loran-C* license is purchased and activated. The MX 51x has two selections for Loran-C integration (Raytheon and Locus).

***Raytheon:***




To implement this feature, change *LORAN-C connected* to *Yes*.

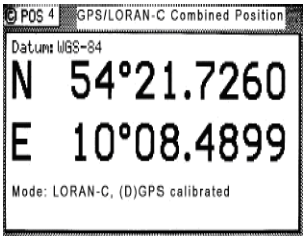
Identify the appropriate input port (*1 or 2*) that the LORAN-C device connects to by using the *Change* softkey.

Select the appropriate *Version Number* with the range from 0 to 9.

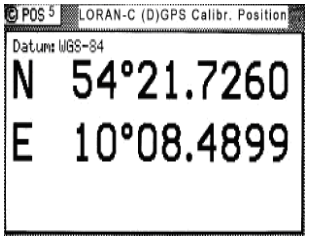
The *Antenna offset* option of the LORAN-C feature is tied to the *Antenna offset* from the GPS feature. Note that any changes you make to the Antenna offset in LORAN-C will also modify the Antenna offset in the CFG1/GPS screen. The *Antenna offset* allows you to virtually offset your antenna. That is, if you are forced to place the antenna in a location other than where you want your position fix calculated (due to superstructure or other high power antennas), you can place the antenna in a practical location. Enter the appropriate *Antenna offset*, and the receiver will calculate your position in the place where you would have preferred to place the antenna.

After the LORAN-C (Raytheon) feature is enabled, you will have 3 new screens ***(POS 4, POS 5, POS 6)***, which display the following information:

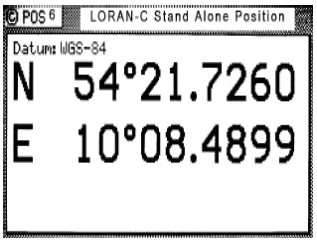
- *POS 4 - GPS/LORAN-C Combined Position*
- *POS 5 - LORAN-C Calibrated Position*
- *POS 6 - LORAN-C Stand Alone Position*_____



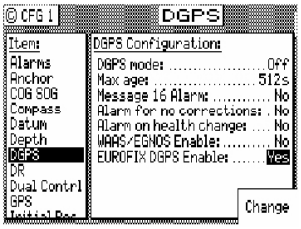

The *POS 4* screen displays the *GPS/LORAN-C combined position* and navigation modes received from the *$PMVX1* message (which is based on (D)GPS if GPS is available, and based on (D)GPS calibrated LORAN-C position if GPS is not available) from the LORAN-C receiver. The *$PMVX1* message is formatted just like the NMEA GGA message, except that its GPS quality indicator ranges from 0-5. The GPS quality indicator is displayed as a navigation mode on the POS 4 screen.



The *POS 5* screen displays the *(D)GPS calibrated LORAN-C position* received from the GLL message from the LORAN-C receiver.

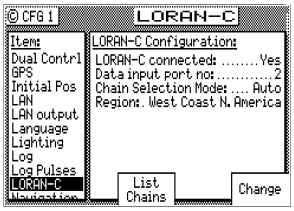



The *POS 6* screen displays the *stand-alone (uncorrected) LORAN-C position* received from the RMA message from the LORAN-C receiver.




When *Loran-C (Raytheon)* option is enabled, the MX51x gives the option to accept *EUROFIX DGPS* corrections instead of the External DGPS corrections under the CFG1/ DGPS Configuration screen.

**Locus:**



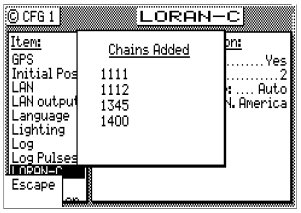

To implement this feature, change *LORAN-C connected* to *Yes*.

Identify the appropriate input port (*1 or 2*) where the LORAN-C device connects to by using the *Change* softkey.

Select the chain selection mode, either *Auto* or *Manual*.

*Auto:*

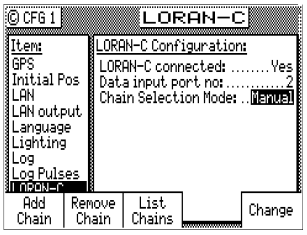
When the chain selection mode is *Auto*, you can view the list of current chains by using the left or right arrow key to highlight the *List Chains* softkey and press the *ENT* key to select. You can also choose the desired region by using the left or right arrow key to highlight the *Change* softkey and press the *ENT* key to select.

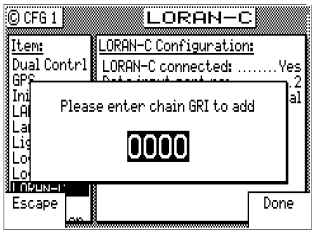


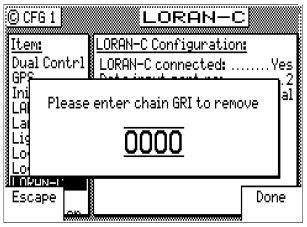

*Manual:*

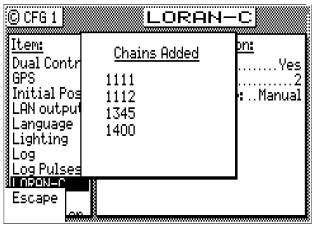
Select this option to manually add or remove the list of chains. To add a chain, use the left or right arrow key to highlight the *Add Chain* softkey, and press the *ENT* key to select. Enter the 4 digits chain GRI then select the *Done* softkey to add the chain. To remove a chain, use the left or right arrow key to highlight the *Remove Chain* softkey, and press *ENT* to select. Enter the 4 digit chain GRI and select the *Done* oftkey to remove the chain.

You can view the list of current chains by using the left or right arrow key to highlight the *List Chains* softkey, then press *ENT* to select.

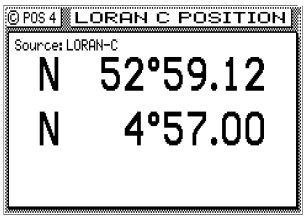


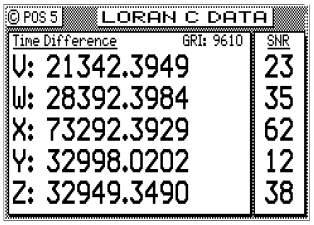



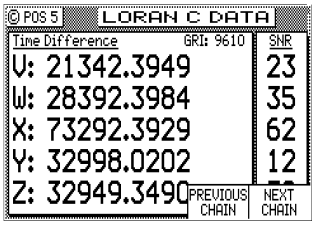




After the LORAN-C (Locus) feature is enabled, you will have 2 new screens ***(POS 4, POS 5)***, which display your LORAN-C information.




The POS 4 screen displays the geographical coordinates of the Loran-C position in the form – degrees, minutes, and hundredths of a minute.




The POS 5 screen displays the Station GRI, Time Difference (TD), Warning status (CYCLE, BLINK), and Signal-to-Noise (SNR) data for different slave stations of a particular Loran-C chain being used.

This screen also allows you to scroll through data of different chains if multiple chains are being used.

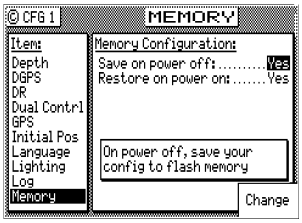
**1** Press **EDIT** key to bring up the *PREVIOUS CHAIN* and *NEXT CHAIN* softkeys.

**2** Use the left or right arrow key to highlight the PREVIOUS CHAIN or NEXT CHAIN softkey then press the ENT key to select and view data from different chains (if more than one chains are being used).

**3** Press the EDIT key once more to exit the softkey menu.

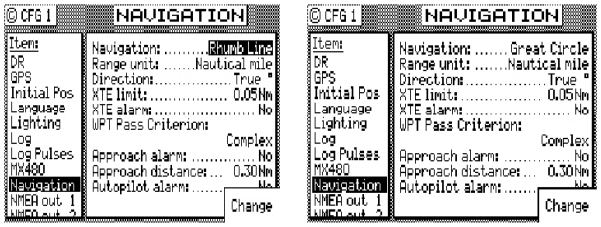
### *Memory*

This screen allows the user to have the option to save and restore waypoints, routes, and system configuration using the MX51x internal flash memory.




## 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 effect 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.

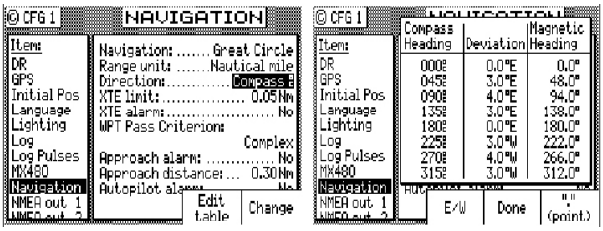
☞ *When the navigation mode is set to Great Circle, the PLOT screens will not show your course or cross-track error lines.*

*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 MX51x to agree with your magnetic compass, select *Compass*. The MX51x will automatically add or subtract the appropriate magnetic variation and deviation. Enter the compass deviation table into the MX51x 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*:

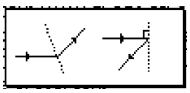
Sets the distance left or right from the course line you consider to be the maximum allowable off-track error (known as cross-track error, "XTE"). The **PLOT** screens will display the scaled cross-track error distance. The **NAV** screens will indicate the cross-track error in numerical format and present 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. To disable the alarm, select *No* (default) with the *Change* softkey.

*WPT Pass Criterion*:

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

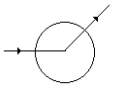
Complex: 

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:*

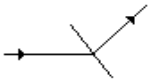
Passing the waypoint can only be accomplished by manually skipping a waypoint. Refer to the *Skipping and Unpassing Waypoints* in the *Route* section of this manual.

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.

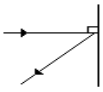
*Distance:* 

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 MX51x. When the alarm is canceled, which requires your highlighting of the *Cancel Alarm* softkey then press **ENT** (displayed during the alarm condition), these data fields will revert to valid data and the

autopilot will accept the MX51x 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 - NMEA 0183 Output Data Control

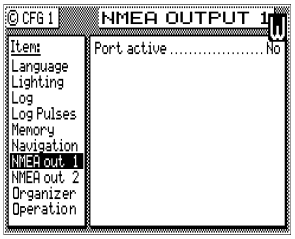
These screens set the specific NMEA 0183 output record parameters as well as the port control. The default setting is *No*. When this selection is changed to *Yes*, you can turn on individual data records. Refer to the installation manual of the device you interfaced with the MX51x to determine which output records are required. Refer to the *Installation* section of this manual for MX51x hardware interface information.

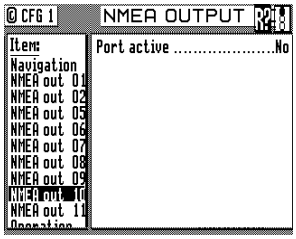
*MX510 Model* - has two user NMEA ports available, two antenna ports (NMEA3 & 4) dedicated to the MX smart antenna, and one Local Area Network (LAN) port.

*MX512 Model* - has 11 user NMEA ports, two antenna ports (NMEA 3&4), one LAN port and one VGA port.

☞ *Pre plan your interface requirements to ensure all of your interfacing needs are met. All NMEA Ports are RS-422 electrically. We recommend using these ports to interface to a computer or other "single ended" interface.*

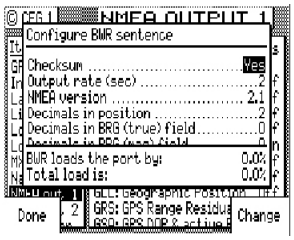
The default condition of each port is *Off*. When you want to output data on a NMEA port, scroll down the *Item* menu to the appropriate *NMEA Out* port number and change *Port Active* to *Yes*. In doing so, the MX51x will display all available NMEA 0183 output sentences.




*MX510 NMEA Out Menu* *MX512 NMEA Out Menu*

Scroll down the list using the cursor key to the desired NMEA 0183 sentence. Highlight the *Change* softkey then press **ENT** to select *On*.




Highlight the *Details* softkey then press **ENT** 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:

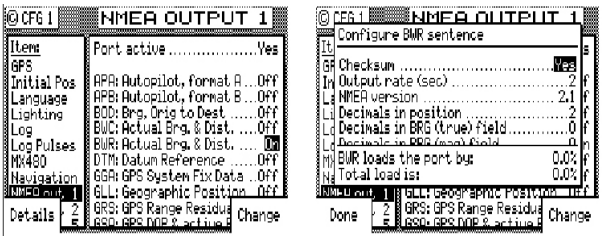
*Checksum On or Off* - NMEA 0183 version 2.1 and above requires that the checksum is present. Versions 1.5 and 2.0 do not require the checksum. The MX51x provides you the option of turning the checksum on or off to provide flexibility in interfacing.

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

☞ *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.*

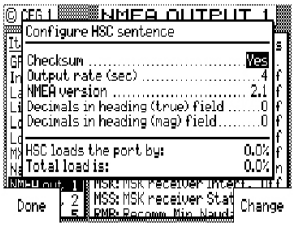
Most:

*NMEA Version* - Some of the NMEA 0183 records are no longer supported by version 2.3. 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 MX51x 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.. The MX51x provides you the flexibility to match the expected input on these devices.

*Decimals In BRG* or *HDG* - The MX51x allows you to select from 0 to 1 decimal places in records containing bearing information.



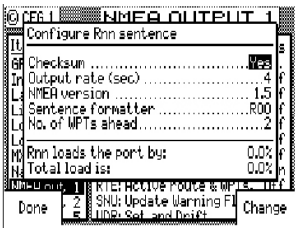

*xxx loads the port by* - The NMEA 0183 standard limits the port baud rate to 4800 bits per second. It is impossible to turn on every NMEA 0183 data record on one port in the receiver at a once per second output rate, due to the NMEA standard limitation. *xxx loads the port by* tells you how much throughput 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 lose 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.

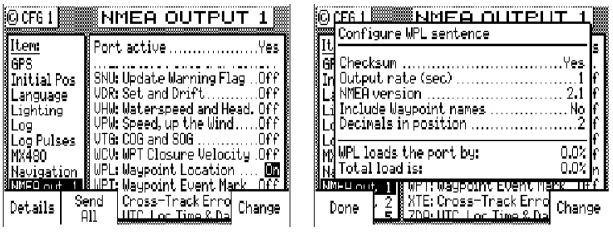
*Rnn - Active Route Data Record:*

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 MX51x allows you to configure the ID either way (R00 is the default).



*WPL - Waypoint Location Data Record:*

The MX51x outputs all of the waypoints in the active route. If you want to output the complete *Waypoint Bank*, simply highlight the *Send All* softkey then press **ENT** 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, MX Marine 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 or USB memory stick, just in case the memory in the MX51x 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 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 in the *Installation section* of this manual.

## Other Special Cases Affecting NMEA 0183 Records:

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

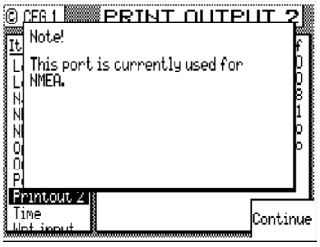
During the period when the Man Over Board function is activated, NMEA 0183 records which contain bearing and range data, such as those identified above (but not limited to these), will reflect the bearing and range back to the MOB position until the MOB function is canceled. Refer to the *MOB* section 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 MX51x always indicates a mode *'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 MX51x changes the mode 'A' to *'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 highlighting of the *Cancel Alarm* softkey then pressing **ENT** (displayed during the alarm condition), these data fields will revert to Valid data and the autopilot will accept the MX51x data again. *This is provided as a safety feature so that the boat does not turn toward a new direction without you knowing of the impending change.*

*Output Port Configuration Conflicts:*

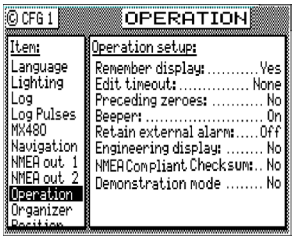
The NMEA output ports can only be assigned once. If you have already defined a given port for one format, and you attempt to define a different format for the same port, the MX51x will warn you of the port conflict. The first format to be defined on a port maintains the port. The second format will be ignored.



## Operation - General Setup and Control Settings

This screen controls a few basic operating settings:

*Remember Display:* When set to *Yes* (default), the MX51x 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 MX51x will automatically revert to the *NAV3* screen immediately.




If you select *No* for *Remember Display*, the MX51x 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 MX51x 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 CDU 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.

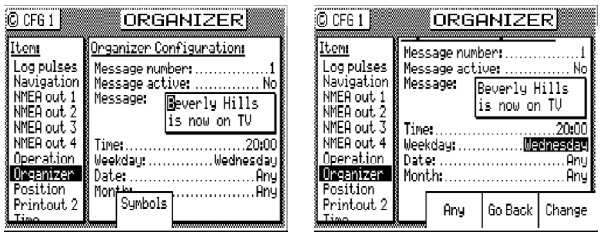
*Engineering Display:* This enables an expanded series of display screens in some of the functions. In general, these screens are used by the technician during troubleshooting or by MX Marine engineers during development testing. Screens which are relevant for troubleshooting are described in *Appendix B* of this manual. The default setting is *No*. If you should enable these screens, the MX51x will automatically turn them off the next time power is cycled on the unit.

*Demonstration Mode:* This enables the MX51x 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 right corner of every display. Generally speaking, this feature is used by MX Marine 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 MX51x. 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 D* of this manual for a full description of the *Demonstration Mode*.

## Organizer - Automated Message Reminders

This screen enables you to program the MX51x 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.

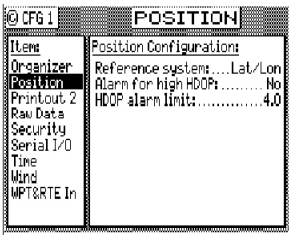
☞ *When the Organizer alarm is activated, the voltage on the Alarm Output Port is also activated. If you have other devices connected to this port, you might need to consider what other systems will be affected when the alarm sounds. MX Marine offers an External Alarm control option license that will allow you to control the internal and external alarm settings individually. Check with your dealer or MX Marine for details on External Alarm license option.*




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.




*Reference System:*

This setting controls the coordinate system used to display your position. The available choices are *Lat/Lon* (default) or *UTM* (Universal Transverse Mercator). The MX51x 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 MX51x calculate the zone for you (*Auto*, default).

*Alarm For High HDOP:*

This allows the MX51x 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*.

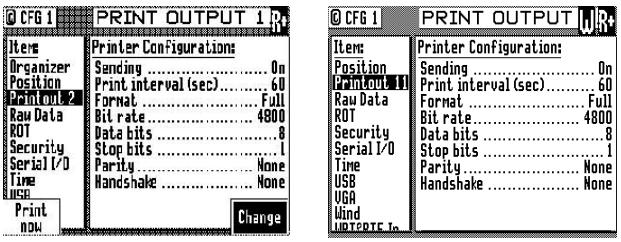
*HDOP Alarm Limit:*

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.

## Printout (n) - Printer Output Control

This menu item controls the printer output sometimes required for commercial shipping. The interface is accomplished on NMEA Out 2 port for the MX510 or NMEA Out 11 port on MX512 models. The printer output is simple ASCII text designed to operate on any serial line printer, including narrow column printers.

The MX51x has two print formats, namely: *Full* or *Brief*.




*MX510 Printout2 Menu* *MX512 Printout11 Menu*

A sample of the *Full* printer output format is given below:

MX510 Navigator

==========

20:42:41 UTC 12 Apr 2002

POS Mode : DGPS 3D Datum:W84

Position : N 33 48.5056

W 118 21.0073

Altitude : 5.6 m

COG: 346 T SOG: 0.1 Kn

ROUTE: From WPT 0 To WPT 1

NAV Mode : RL XTE: .108L Nm

BRG: 345 T Dist: 2.51 Nm

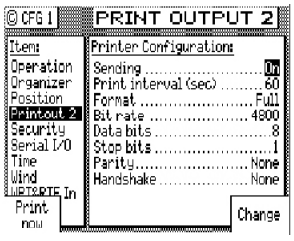
SATS Used: 6 HDOP 1.4 VDOP 1.6

DGPS Age : 9s Station ID: 262

SW Vrs. 1.5 MX421 V4.84

---

Route and DGPS information is printed if these functions are active.




Here is a sample of the *Brief* format without an active route:

MX510 Navigator

==========

21:24:00 UTC 12 Apr 2002

POS Mode : DGPS 3D Datum:W84

POS: N 33 48.5124 W 118 21.0213

COG: 152T SOG: 0.1 Kn

---

Here is a sample of the *Brief* format with an active route or MOB condition:

MX510 Navigator

==========

21:24:00 UTC 11 Aug 1997

POS Mode : DGPS 3D Datum:W84

POS: N 33 48.5124 W 118 21.0213

COG: 152T SOG: 0.1 Kn

BRG: 239T Dist: 27.4 Nm XTE:0.14L Nm

RTE: RL From WPT 1234 To WPT 1357

---

*Sending:* Causes the printer output to be turned *On* or *Off* (default).

*Print Interval (Sec):* Allows you to control how often the print out will be sent to the printer port. The default value is 60 seconds, and the valid range is from 1 to 9999 seconds.

*Format:* Allows you to choose either the *Full* or *Brief* formats described above.

*Bit Rate:* This allows you to control the port interface baud rate to match the printer or computer you are interfacing with. The available baud rates are: 600, 1200, 2400, 4800 (default), 9600 or 19,200.

*Data Bits:* This allows you to match the printer's requirement of *7* or *8* (default) bit serial data.

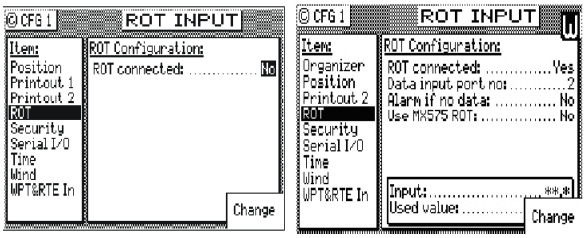
*Stop Bits:* This allows you to match the printer's requirement of *1* (default) or *2* stop bits.

*Parity Check:* This allows you to match the printer's requirement of *None* (default), *Even* or *Odd* parity.

*Handshake:* This allows you to match the printer's requirement of *No* (default), *XON/XOFF* or *HW* (Hardware; CTS, RTS ).

## ROT (Rate of Turn)

The ROT configuration menu is available in the MX51x model. The "ROT connected" mode can be toggled to YES or NO, by pressing the **EDIT** key and then highlighting the '**Change**' softkey and press **ENT**.




*Data input port no:* 2 (valid port selections are 1,2, or 3*)

*Alarm if no data: .. No* ('Yes' value sets the alarm to sound if no ROT input data is detected in 5 seconds)

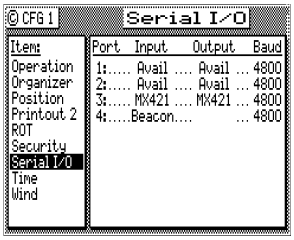
**Use MX575 ROT: No* ('Yes' value would allow the MX51x to use ROT data from Port 3 when the MX575 is used as a positiong and heading device. 'No' value would allow the MX51x to use ROT data from any available port other than Port 3 when the MX575 is used as a heading device only *(See MX575 Satellite Compass Installation and Operation Manual for details)*.

## Security

The Security screen allows you to lock out the **EDIT** key in order to keep crew members or visitors from changing settings that you have made.  Once this feature is enabled, a press of the **EDIT** 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 reenter the password. The security function is then disabled until you enter a new password through the *CFG1 Security* screen again. Be sure to keep your password in a safe place. If you lose your password, you will need to call the factory to reset the security feature.


## Serial I/O

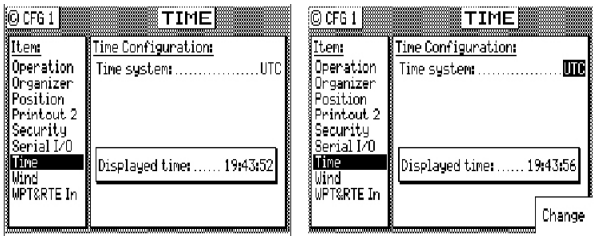
This menu provides a means to verify the status and baud rate settings of all the NMEA ports. Note that the NMEA ports 3 & 4 are reserved for the Smart antenna GPS and Beacon receiver interface. You have  no control in these two ports. You can not change the baud settings in its original values.




*MX51x Serial I/O Menu*

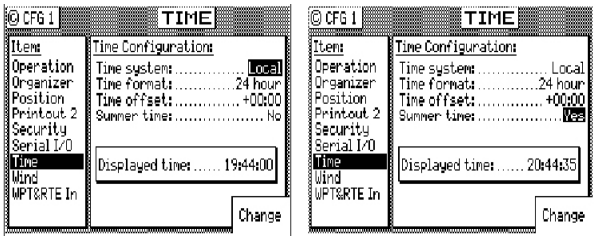
## Time - Mode and Format Control

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




*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.



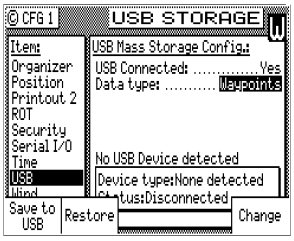
*Time Offset:* Sets the local offset to UTC time. 0:00 is the default.

*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.

## USB - USB Mass Storage Configuration

This option controls the saving and restoring of your waypoints, routes, and system configuration via an external USB device. In the event where you do a software upgrade for your MX51x CDU for example, all your waypoints, routes, and system configuration will be lost. This option allows you to save them to a USB device (i.e. USB flash drive) beforehand, and restore them from your USB device after the software upgrade is completed. This way, you do not have to manually re-enter all your waypoints, routes, and system configuration settings.




To implement this feature, plug your USB device into the USB port of the MX51x CDU first, and change *USB Connected* to Yes. Allow a few moments for the CDU to read and detect your USB device. Ensure that status displays *Connected* before continuing.

Select the data type, either *Waypoints*, *Routes*, *Config,* or *All* by using the *Change* softkey.

*Waypoints:*

This sets the CDU to save (*Save to USB* softkey) or restore (*Restore* softkey) your waypoints using your USB device.

*Routes:*

Select routes will set the CDU to save (*Save to USB* softkey) or restore (*Restore* softkey) your routes using your USB device.

*Config:*

Allows the CDU to save (*Save to USB* softkey) or restore (*Restore* softkey) your system configuration settings using your USB device.

*All:*

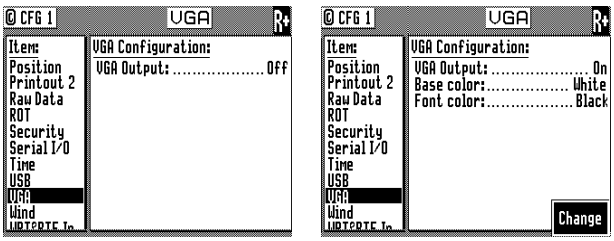
Allows the CDU to save (*Save to USB* softkey) or restore (*Restore* softkey) your waypoints, routes, and system configurations all at once.

☞ *If you are finished using this feature and wanted to remove your USB device from the CDU, ensure that USB Connected is changed to No and press the EDIT key once more to exit EDIT mode before removing the device.*

⚠ ***Please format your USB device using FAT32 file system before use. Refer to the Installation section for fomatting procedure and hardware compatibility list.***

## VGA

This menu is available in the MX512 model only.  It controls the VGA output display base (background) and font colors.




To control the VGA output, do the following:

**1** Press  the EDIT key to bring up the cursor.

**2** Press the ENT key to turn the VGA feature to ON.

**3** Press the down arrow key to scroll down to Base Color.

**4** Press the ENT key repeatedly until the color desired is shown.

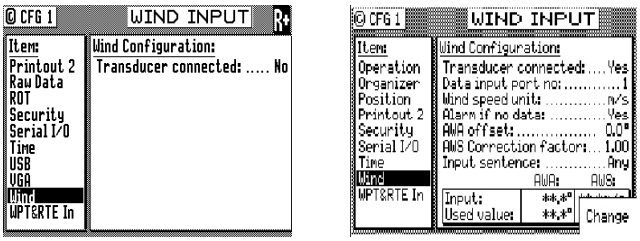
**5** Scroll down to Font Color.

**6** Press the ENT key repeatedly until the deired color for font is shown.

**7** Press the EDIT key to exit.

## Wind

The MX51x 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.

*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) or *No*.

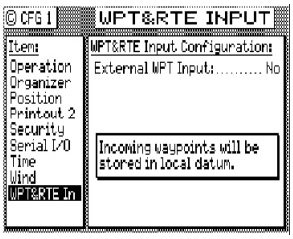
*AWA Offset:* Allows you to input a constant angle correction value.

*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 MX51x

This screen enables the input data port to receive waypoints and routes from a chart plotter, PC (VMS), or other device to the MX51x. You can receive this data through any of the user 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 interface.




☞ *Turn the WPT & RTE In option to No after the waypoint and route banks have been downloaded to prevent an inadvertent change of the MX51x memory bank.*

***Blank page***

# 5 Installation

## List of Components

| Item | Description | Qty | Part Number | Remarks |
|---|---|---|---|---|
| 1.0 | MX510 Navigation System | | | |
| Includes the following: | | | | |
| 1.0.1 | MX510, 2 Port CDU | 1 | 510-000-0000 | Standard |
| 1.0.2 | Mounting U-Bracket | 1 | 510-100-2002 | Standard |
| 1.0.3 | Mounting Knobs | 1 | 500-100-2006 | Standard |
| 1.0.4 | 12-Pin Power/Data Cable | 1 | 500-100-2001 | Standard |
| 1.0.5 | Operator & Installation Manual | 1 | 510-100-2003 | Standard |
| 1.0.6 | Quick Reference Guide | 1 | 510-100-2005 | Standard |
| 1.1 | MX Smart Antenna Unit | 1 | See Table 1.1 (Choose one) | Option |
| 1.2 | Antenna Cable | 1 | See Table 1.2 (Choose one) | Option |
| 1.3 | Junction Box | 1 | 500-100-1002 | Option |
| 1.4 | Ethernet Linker (DC LAN Hub) | 1 | NS004721 | Option |
| 1.5 | Flush Mounting Frame | 1 | 9525-200-74070 | Option |

*Table 1.0 Standard Parts for MX 510 Mode*

| Item | Description | Qty | Part Number | Remarks |
|---|---|---|---|---|
| 1.0 | MX512 Navigation System | | | |
| Includes the following: | | | | |
| 1.0.1 | MX512, 9 Port Control and Display unit (CDU) | 1 | 512-000-0000 | Standard |
| 1.0.2 | Mounting U-Bracket | 1 | 510-100-2002 | Standard |
| 1.0.3 | Mounting Knobs (set) | 1 | 510-100-2006 | Standard |
| 1.0.4 | MX512-JB Junction Box with cables:<br>Power/Data cable<br>Ant. Cable<br>Aux Cable<br>44-Pin Cable | 1<br>1<br>1<br>1<br>1 | 512-100-1001<br>500-100-2001<br>3508-102-70150<br>500-100-2001<br>512-100-2001 | Standard |
| 1.0.5 | Operator & Installation Manual | 1 | 510-100-2003 | Standard |
| 1.0.6 | MX510/MX512 Quick Guide | 1 | 510-100-2005 | Standard |
| 1.1 | GPS or DGPS Smart Antenna | 1 | See Table 1.1 (Choose one) | Option |
| 1.2 | Antenna Cable | 1 | See Table 1.2 (Choose one) | Option |
| 1.3 | Tide Table Manuals | 1 | 721714 | Option |
| 1.4 | Ethernet Linker (DC LAN Hub) | 1 | NX004721 | Option |
| 1.5 | Flush Mounting Frame | 1 | 9525-200-74070 | Option |

*Table 2.0 Standard Parts for MX 512 Model*

| Item | Component | Part Number |
|---|---|---|
| 1.0 | MX521A GPS Smart Antenna | 727050 |
| 1.1 | MX521A DGPS Smart Antenna | 727051 |
| 1.2 | MX525A DGPS Sensor | 727061 |
| 1.3 | MX421B-10 DGPS Smart Antenna | 9525-200-80110 |
| 1.4 | MX575A DGPS Satellite Compass | 9525-200-80900 |

*Table 1.1 Smart Antenna Selection Chart*

| Item | Description | Part Number |
|---|---|---|
| 1.0 | Antenna Cable (with one 10-pin Connector) | |
| 1.0.1 | 3 meters | 3508-102-70150 |
| 1.0.2 | 20 meters | 3508-102-70170 |
| 1.0.3 | 40 meters | 3508-102-70180 |
| 1.0.4 | 60 meters | 3508-102-70640 |
| 1.0.5 | 80 meters | 3508-102-70185 |
| 2.0 | Antenna Cable (with two 10-pin Connectors) | |
| 2.0.1 | 3 meters | 500-100-1008 |
| 2.0.2 | 20 meters | 500-100-1006 |
| 2.0.3 | 40 meters | 500-100-1007 |
| 2.0.4 | 60 meters | 500-100-1009 |

*Table 1.2 Antenna Cable Assembly Selection Chart*

# Installation notes

## General

The MX51x Control and Display Unit (CDU) is splashproof and can be installed both above and below deck. To flush mount, use the optional flush mount bracket. Ensure that the navigator is mounted in a dry place or where water flows off easily. Avoid places where water may accumulate for any period of time.

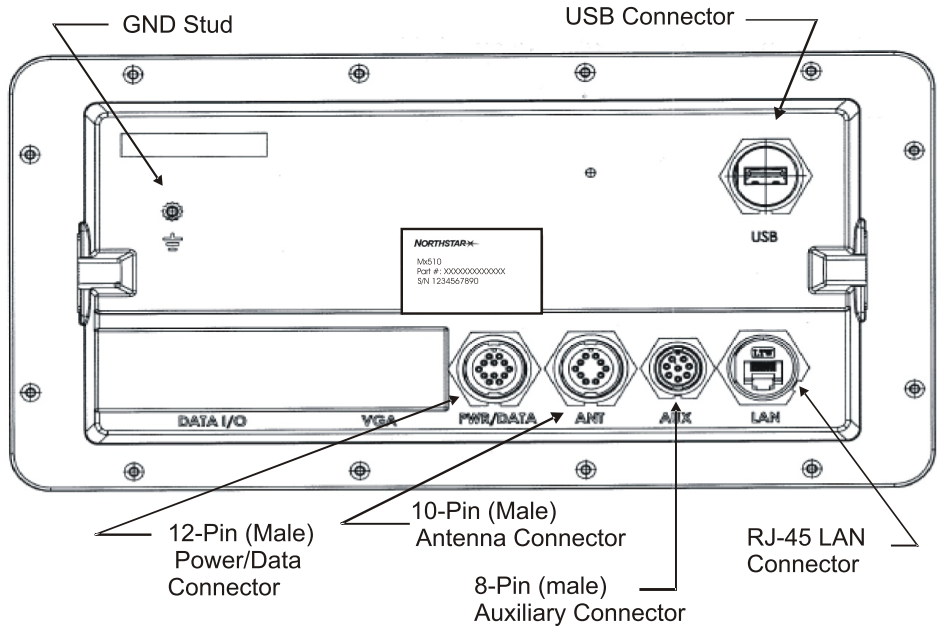
## Electronic Connections

Refer to figures in Section 5 for the mechanical drawings of the display console and for the electrical interface cables.

The **MX510** has five connectors at the back, namely;

- Power/Data Connector (12-Pin)
- Antenna Connector (10-Pin)
- Auxiliary Connector (8-Pin)
- RJ-45 LAN Connector
- Rear USB 2.0 Connector

The **MX512** has all the five connectors of the MX510 plus a 44-Pin Data I/O and 15-Pin VGA connectors. The NMEA port #5 through #11 is accessible through the Data I/O connector.




The PWR/DATA cable is standard accessory cable included in the kit. The AUX, LAN and antenna cables are optional items that can be ordered separately. Specify the proper antenna cable length when ordering.

## Wire Preparation Procedure

***PWR/DATA Cable (6-Pairs Twisted):***

We recommend that the main cable insulation (black plastic) be stripped about 5 inches back to expose the color-coded leads. Below are the color and signal designation of the wires:

Pin 1 --- Red ---------- +10-32 VDC

Pin 2 --- Black -------- Negative GND.

Pin 3 --- Blue ------- NMEA TX1-

Pin 4 --- Brown -------  NMEA TX1+

Pin 5 --- Orange --------- NMEA RX1-

Pin 6 --- Green ------  NMEA RX1+

Pin 7 --- Yellow --------  NMEA TX2 -

Pin 8 --- White -------  NMEA TX2+

Pin 9 --- Purple ----  NMEA RX2-

Pin 10 -- Grey ------ NMEA RX2+

Pin 11 -- Lite Green -- GND Fast Channel IN

Pin 12 ---------- GND

Strip the individual wire insulation about 1/2 inch to make it more convenient to connect the wires to terminal strip posts. Use electrical tape or shrink tubing to protect exposed shield wires. Use a 20-position terminal strip to terminate the PWR/DATA and AUXiliary cables. This item is not supplied with the product.

***AUX Cable (4-Pairs twisted):***

Below are the color and signal designation of the wires:

Pin 1 --- Yellow ------- Ext. MOB Input

Pin 2 --- Green  -------- GND.

Pin 3 --- Blue ---------- Dry Contact 1

Pin 4 --- Purple --------  Dry contact 2

Pin 5 --- Grey ---------- Speed Log IN +

Pin 6 --- White ---------  Speed Log IN -

Pin 7 --- Orange -------  Speed Log Out +

Pin 8 --- Brown ---------  Speed Log Out -

☞ *An optional Junction Box (P/N 500 100 1002) is available for easy plug & play installation. This junction box has all the three cables (Pwr/Data, Aux and Antenna) pre-installed.*

## External Power

The MX51x will to operate 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 antenna connected). Power wire colors are red (+) and black (-). Even though the navigator has a reverse polarity protection device, we recommend that the installer observe proper polarity before hooking up the power leads. Use a 2 amp. fuse in line with the red wire.

***Navigator Grounding***

The internal electronic circuits of the navigator are isolated from the external power supply. Connect the ground stud to ship's seawater ground to avoid static charge build up.

☞ *Seawater ground is any electrically conductive material that is directly in contact with sea water.*

## Antenna Installation

### *Antenna Location*

The MX series smart antennas (MX421, MX521, MX575 & MGL3) are designed for exposed installation. They should be mounted with a relative clear view of the horizon as shown in page 120 of this manual. Do not, mount the antenna on top of a very tall mast, as this may degrade the COG and SOG calculations, particularly when in DGPS mode. Ensure the antenna is placed outside the beam path of transmitting radar (typically +15° horizontally from the array's center point) and 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.

### *Antenna Options*

Four antenna models can be used with the MX51x, namely:

- MX421 D/GPS smart antenna
- MX521A D/GPS smart antenna
- MX525A D/GPS Sensor
- MX575A Satellite Compass

Wiring hookup to the MX421, MX521A, and MX525A antenna models are the same. The 12 VDC drive voltage to the antenna is normally provided by the MX51x CDU.

### *Antenna Connector*

The 10-pin connector at the bottom of the antenna housing provides the necessary interfacing between the smart antenna and the MX51x CDU. Refer to the MX antenna wiring diagram shown in the *Installation* section of this manual.

| MX Smart Antenna Configurations | | | | | |
|---|---|---|---|---|---|
| **Pin #** | **Wire Color** | **10-Pin Conn (MX521/MX525)** | | **10-Pin Conn (MX421-10)** | |
| | | **MX521 DGPS** | **MX525 DGPS** | **MX421-10 GPS** | **MX421-10B DGPS** |
| 1 | BLK/SHIELD | Negative Ground | | | |
| 2 | RED | +10.5 ~ 32 VDC | | | |
| 3 | BLU | Proprietary Message (LPM) In (-) | | | |
| 4 | BRN | Proprietary Message (LPM) In (+) | | | |
| 5 | ORG | GPS Out (-) | | | |
| 6 | GRN | GPS Out (+) | | | |
| 7 | YEL | Beacon Status Out (-) | Beacon Status Out (-) | RTCM In (-) | Beacon Status Out (-) |
| 8 | WHT | Beacon Status Out (+) | Beacon Status Out (+) | RTCM In (+) | Beacon Status Out (+) |
| 9 | PRPL | RTCM In (+) | RTCM In (+) | 1 PPS (+) | |
| 10 | PRPL/GRY | RTCM In (-) | RTCM In (-) | 1 PPS (-) | |

☞ *For MX575 connection, please refer to page 127 and page 140 of this manual or to the MX575 Installation & Operation Manual.*

### *Antenna Cable Options*

The MX smart antenna does not come standard with an antenna cable assembly. The dealer/installer has to determine the length required and order the appropriate cable length. The following cable sizes are available:

- 3 m, Antenna Cable (with 2 connectors) -- P/N 500-100-1008
- 20 m, Antenna Cable (with 2 connectors) -- P/N 500-100-1006
- 40 m, Antenna Cable (with 2 connectors) -- P/N 500-100-1007
- 60 m, Antenna Cable (with 1 connector) -- P/N 3508-102-70640
- 60 m, Antenna Cable (with 2 connectors) -- P/N 500-100-1009
- 80 m, Antenna Cable (with 1 connector) -- P/N 3508-102-70185

### *External Differential Connection*

Differential corrections from an external beacon receiver can be connected to either the MX421-10 (GPS only) or the MX521A/MX525A D/GPS models. RTCM connections are done directly to the antenna cable;

MX421 (GPS only) antenna -- Pins 7 (yellow) and 8 (white)

MX521A/MX525A antenna ---- Pins 9 (purple) and 10 (grey)

The MX series antennas are compatible with the standard RTCM SC-104 signal at 4800 baud.

## MX51x Navigator Installation

The *Navigator* or CDU is the primary unit with the integrated display and keypad. The navigator can be mounted using one of two techniques:

- Gimbal mount (supplied)
- Frame mount (optional)

Each of these techniques are described below. All the hardware necessary to complete Gimbal mount is provided.

The Frame mount is an option for applications where front panel removal is desired or rear panel access is not available. The Frame mount bracket is sold separately. It is important to consider the space behind the unit to prevent sharp cable bends before commencing with the installation. A minimum of 200 mm free space is needed behind the unit for cable routing.

### *Gimbal Mounting*

A pivot Mounting Bracket including finger screws are supplied with the MX51x. Use the two machine screws with the large palm grips to secure the MX51x to the mounting bracket. To adjust the viewing angle, loosen the side crews and then adjust the tilt angle of the display.

### *Flush Mount Frame*

An optional Flush Mounting Frame is available. First, survey and mark-out the location where the unit is to be mounted. Make sure there is a minimum clearance of 200 mm behind the panel. Cut the mounting hole as shown on Figure 5.6. Mount the MX51x to the mounting frame. Attach all the cable interfaces to the appropriate connectors. Finally, mount the entire assembly to the panel from the display side.

### *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. Below are two methods for switching power to the MX510:

**a** Software Control:

Pressing the ⏻ key momentarily will display the softkey option boxes *(Yes* and *No)*. Respond Yes by pressing the *ENT* key to turn the navigator off. Selecting *No* cancels the operation, and returns the unit to normal operation.

**b** b) Hardware Control:

Pressing the ⏻ key for more than 3 seconds, turns the power off under hardware control. The MX51x 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 MX510 has two user NMEA ports while the MX512 has nine. Any of these data ports can be used to communicate with other external equipment using the standard NMEA 0183 protocol. All NMEA interface ports are configured for RS-422 standard. This configuration complies with all NMEA 0183 hardware versions. 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, use an RS232 -to-RS422 interface converter.

Other features available from the MX51x are:

- External Man-Over-Board (MOB) switch input (also used for quick save of waypoint)
- Pulse speed log input
- Pulsed speed log output
- External alarm
- Compass row displays (when connected to an MX575 GPS Compass)

Refer to Section 5 of this manual for wiring information.

### *External Man Over Board & Event*

An external push button (normally open) switch can be connected between the pin 1 (MOB/Event) input and REF GND of the AUX cable to activate the MOB/Mark function.

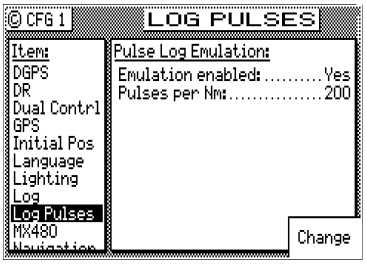
The Man-Over-Board (MOB) function is activated when the external switch is pressed and held for 3 seconds. Once activated, the MOB condition can only be canceled from the MX51x front panel display. Refer to the Operation section of the manual for this operation and more details on the Man Over Board function. When this switch is pressed for 1 second, this causes your present position and time to be stored as a waypoint in the waypoint bank. A message indicating which waypoint number is used will be displayed on the MX51x screen for up to 5 seconds.

### *Speed Over Ground Pulse Output*

The MX51x can output the GPS calculated speed over ground in a pulse format.

The pulse output is derived from pins 7 (orange) & 2 (green) of the AUX cable. The speed log out (+) is the orange wire, while the speed log (-) is on the green wire. It is a 0-12 Volt signal pulse.

To setup the MX51x speed pulse output, press the CFG key then scroll down to *Log Pulses* menu. Press the E key, then press the ENT key to change the Emulation enabled to Yes (default value is No). This menu also controls the number of pulses per nautical mile (200 is the pre-selected value). Press the E key when you are done with editing.

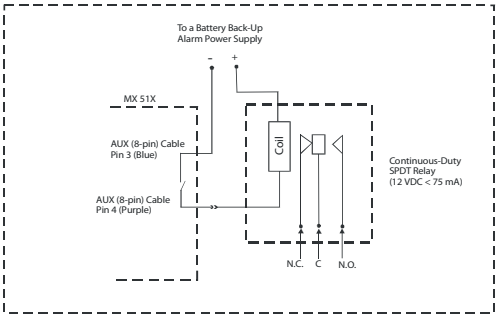


### *External Alarm Output*

The MX51x Ext. alarm output connection is on pins 3 and 4 of the AUX (8-pin) cable. They are held open (floating) during normal operations. In an alarm condition, the external alarm pin is switched to ground potential. When an alarm condition is cleared or acknowledged, the Ext. alarm signal will return to open condition automatically (refer to table below for relay conditions). However, it is possible to retain the external alarm condition by setting the "Retain external alarm:" to ON under the CFG1/Operation menu. At this setting, the external alarm signal can only be cleared by correcting the problem.

| **Ext. Alarm Relay Conditions** | |
|---|---|
| MX51x Turned OFF | Energized |
| MX51x Turned ON (No Alarm) | Not Energized |
| MX51x Turned ON (With Alarm) | Energized |
| 12 VDC Input Power Failure | Energized |

The external alarm is derived from the "EXT alarm" port on AUX cable, pin 3 (Blu) and pin 4 (Prpl). The software is setup in each of the appropriate *CFG1* (Alarms) menu. The relay coil supply voltage must be connected to an independent battery backed-up alarm supply. Make sure the relay coil voltage is compatible with the voltage rating of the alarm power supply (i.e. NTE Electronics Relay - P/N R14-11D10-12 for use in a 12 VDC supply). The negative ground of the alarm power supply must be connected to Pin 3 (Blu) of the AUX (8-pin) cable (refer to the relay diagram below).




### *NMEA Interface*

The MX51x meets the NMEA 0183 version 2.3 electrical standard for marine interface communications with other marine 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.

### *NMEA Interface to other Equipment*

The MX51x complies with the NMEA 0183 V2.3 protocol. As version V2.1 is not necessarily compatible with the older version V1.5, the differences in hardware are mentioned here to avoid possible conflicts:

*Listener:*

The listener input works with a threshold of 2 volts compared to the former 4 volt. It is still an insulated input and, in general, there should not be any interface problems receiving data from the older standard.

*Talker:*

The talker output is a RS-422 output:

NMEA talker output B is active compared to GND or shield of the navigator. *In the old version, output B was normally tied to GND or shield.*

The maximum drive voltage between the talker A and B outputs is ±6 volt.

☞ *Compared to the former 0 to 15 volt output, the negative voltage between the talker A and B output may be a problem on older listeners which do not meet the new standard*.

The minimum output voltage may be as low as ±2 volt. This is ***not compatible*** with the former 4 volt input threshold and may be the cause of interface problems. If this is the case, try using an RS-232 to RS-422 convertor to interface with the MX510. This may more likely solve the problem. Otherwise third party conversion boxes may be necessary.

Cables provided for the NMEA signals are shielded pairs. If extension cables are needed, be sure to use similar 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.

### *MX51x 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.

The NMEA 0183 Standard uses an 8 bit ASCII block oriented protocol, that is not compatible with the NMEA 0180 simple format or the NMEA 0182 complex format due to differences in data format, baud rate and parity bits.

### *Data Format*

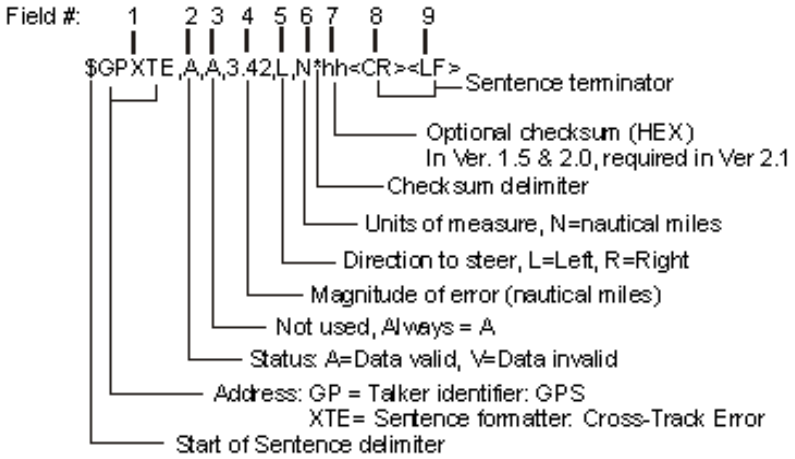
Data are transmitted in different sentences, each containing one or more data fields. A field consists of a string of characters immediately preceded by a "," (comma) character, except for the first (address) field which is preceded by "$", indicating the beginning of a new record. Hex 0D 0A <CR>< LF> - end of sentence - must follow the last field in each sentence.

The data fields are identified only by their position within the sentence as determined by the field delimiters (comma). Numerical data fields within a sentence may vary in length from one sentence to another, depending on the precision available.

Data field position is therefore determined only by counting "," (commas) rather than counting the total number of characters from the beginning of the sentence.

The last data field is not followed by a comma delimiter. When a checksum is used, the last data field is followed by an asterisk "*", indicating that the checksum follows. The checksum is the absolute value calculated by exclusive -OR'ing the 8 data bits (no start bits or stop bits) of each character in the sentence between, but excluding "$" and "*". The hexadecimal value of the most significant and least significant 4 bits of the result are converted to two ASCII characters (0- 9, A- F) for transmission. The most significant character is transmitted first.

Example:



### *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 - Greate 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 and 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 5.1 NMEA 0183 Output Sentences*

### *Input NMEA 0183 Sentences*

The MX51x recognizes version 1.5, 2.0, 2.1, 2.3, and 3.0 NMEA input records. The MX51x can utilize the following input sentence formats:

***Depth**:* DBK, DBS, DBT, and/ or DPT

***Gyro**:* HCC, HDM, HDT, RMA, RMC, VHW, and VTG

***Position***: GLL, RMA, RMC

***Speed**:* RMA , RMC , VHW, VTG or pulses-per-second

***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 MX51x 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 MX51x 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. However, if the checksum is included in the NMEA sentence, the MX51x will reject any sentence where the checksum and data do not correlate.

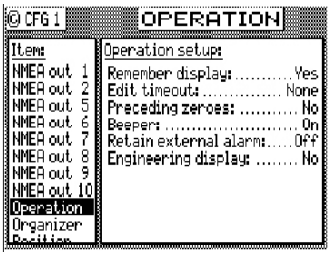
### *Viewing Input Data*

You can view data being sent to the MX51x by other equipment or loop the 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** .

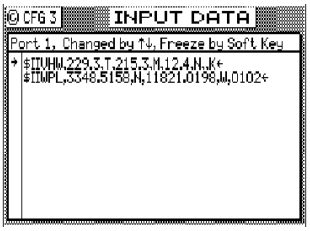
Scroll through the menu and select *Operation*.




Press **EDIT** and change *Engineering Display* from *No* to *Yes*.

Press **EDIT** again to exit the edit mode.

Press the left cursor key until the **CFG3** *Input Data* screen is displayed.



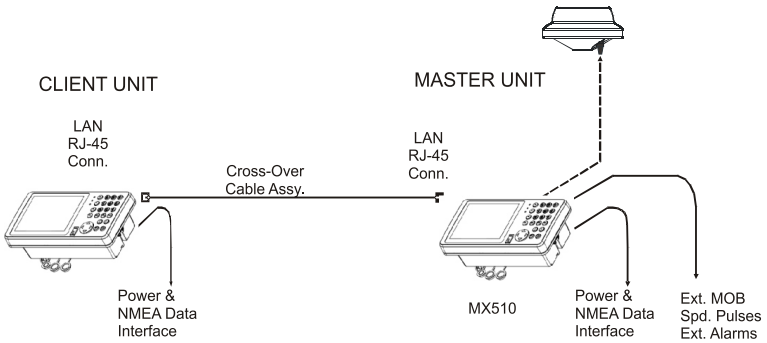

Press the up or down cursor key until the proper input port number is selected.

Press the EDIT key to start or stop the data scroll on the display.

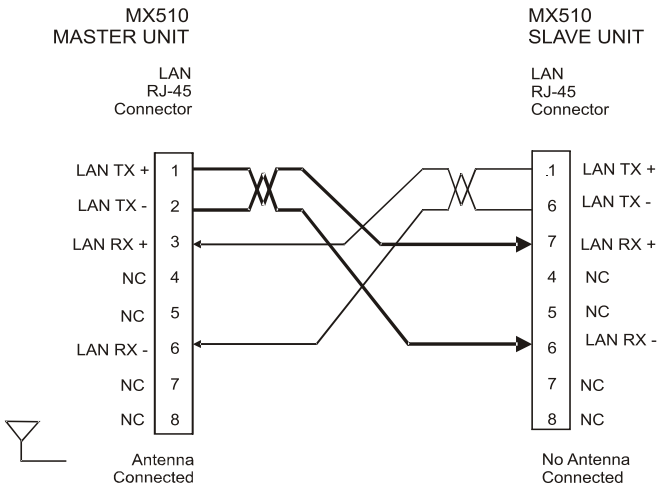
The data that you will see on the screen is unprocessed. Therefore, if there are errors in the data, you can compare the data against the NMEA 0183 standard. You can also use this screen to verify that data is being received from external RTCM sources or other equipment communicating with the MX51x.

### *Dual Control (Remote) Interface*

The Dual Control feature allows you to connect two (or more) MX510s (or MX512s) in a *Master / Slave* configuration where a common database is shared between two (or more) MX51x control heads.  This configuration also allows you to use one antenna connected to the Master unit, for all MX51xs. The  remaining data ports, the MOB/Event input port, and the alarm output ports are still available on each unit for individual use.




The hardware interface is accomplished by connecting the RJ-45 connectors of the MX51x units using a crossover (null) LAN cable (for two units) or CAT5 Ethernet cables with an Ethernet switch (for more than two units). You can purchase a pre-made LAN crossover cable or CAT5 Ethernet cable assembly from MX Marine dealers or you can make it up yourself using the diagram below.




*MX51x LAN Crossover (Null) Cable Diagram*

The interface between the two (or more) units takes place over a high speed (100 Mbps) data link. The master unit must be connected to the smart GPS antenna unit (MX421, MX521A, MX525A, or MX575A). The master unit receives the position data then transfer it to the slave unit(s) 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 (or more) units.

When two (or more) units are first configured as master and slave(s), the master listens for a configuration polling message from the slave(s). Once the master recognizes the slave's polling message, the *Common Data Base* (see Table below) is downloaded from the master to the slave(s). 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*

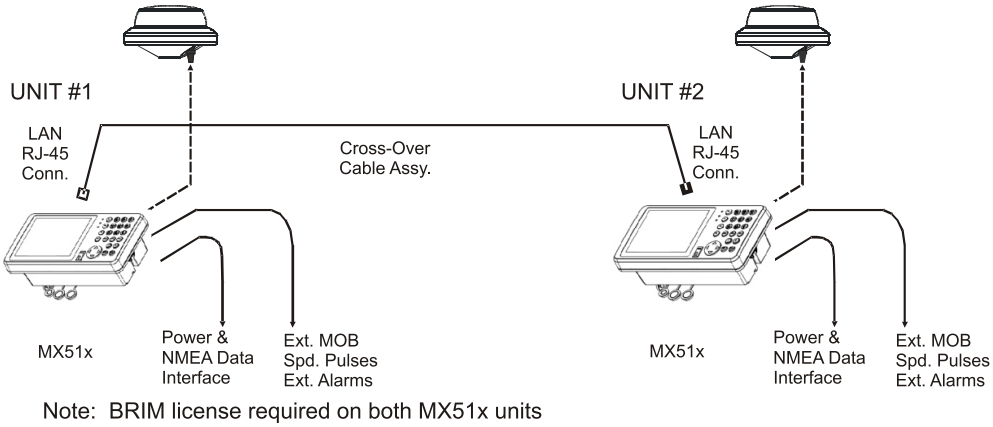
The items detailed in Table 6 are independently controlled at the individual MX51x control heads.

| | |
|---|---|
| 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 the master | GPS Displays (slave reflects the conditions in the master |
| NMEA Out | Print Out 2 |
| Waypoint Sorting | |

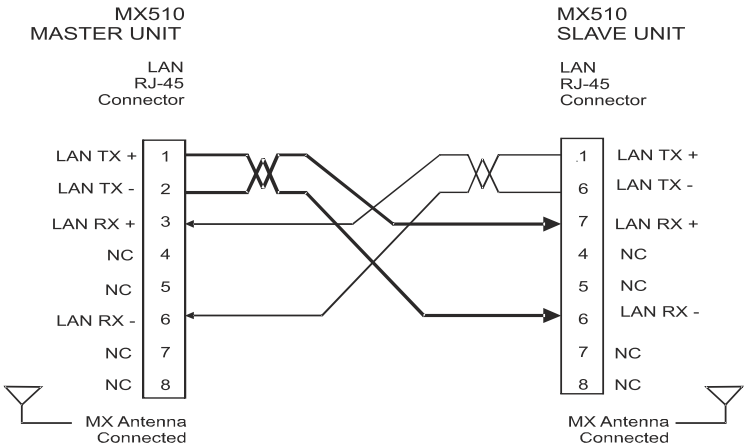
*Table 6. Independently Controlled Functions*

### *MX51x/BRIM (Backup Receiver with Integrity Monitoring) Feature*

The Integrity Monitoring (IM) feature allows the dual-control MX51x units to constantly compare each GPS position solutions and, if configured to do so, give an alarm and/or automatically switch to the unit with the "better" GPS solution.




Both MX51x units are functional D/GPS receivers and both continuously calculate GPS solutions. The IM algorithm continuously compares the two position solutions. If the GPS Source is set to Automatic, it begins by using the Master calculated position. However, it continuously compares the "used" solution to the "other" solution. If the "other" solution is better, it will switch to use that position solution. Essentially, the Master mode will transfer automatically to the unit whose position solution is being used for navigation.




*Cross-Over LAN Cable Diagram*

**Once the Dual-Control IM license is enabled, CFG1/Dual Control screen looks like this:**

| DUAL CONTROL | | |
|---|---|---|
| Mode: | Master | (options: Master, Slave) |
| Dual Control: | Yes | (options: Yes, No) |
| GPS Source: | Automatic | (options: Automatic, Master, Slave) |
| Integrity Alarm: | Yes | (options: Yes, No) |
| GPS Source: | Master | (options: Master, Slave) |
| Dual Status: | OK | (options: OK, No Comm, Mirroring) |

**To enable the functionality of the Dual Control Integrity Monitoring, you must set the following to:**

| | |
|---|---|
| Dual Control: | Yes |
| GPS Source: | Automatic |

### *Troubleshooting Guide*

The MX51x is virtually maintenance free. There are, however, a few important points to note.

Please check your installation carefully before returning the MX510 to the dealer or factory for service.  A few troubleshooting tips follow.

The MX51x performs a variety of self tests during normal operation. If a function fails the self test, the navigator will display an *Internal Error* message every one minute.

| Problem | Diagnosis |
|---|---|
| No response: (Black LCD display and no traffic light) | - No external power supply<br>- Check supply voltage<br>- Check for reverse polarity<br>- Check wire installation<br>- Check if external fuse is blown |
| No keyboard response or partial keyboard response | - Corrupted memory<br>- Faulty keyboard<br>- Faulty processor<br>- Return the unit for repair |
| Battery low alarm | - External battery low<br>- 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<br>- Faulty antenna or antenna cable<br>- Relocate GPS antenna<br>- Connect the MX421 power directly to the external 12 VDC supply<br>- Replace antenna<br>- 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<br>- GPS satellite signals weak (Satellites dropping in and out)<br>- Check maximum cable length restrictions and cable conditions (for weak satellite signal condition)<br>- Return the unit for repair |
| All data lost at power up | - Backup battery is dead<br>- Replace the internal backup battery |
| No DGPS update; not tracking beacon station | - DGPS mode set to *Off*, so no corrections are being received<br>- *Station Select* is set to *Manual*<br>- Faulty antenna |
| No data output to peripheral equipment | - NMEA output data not configured<br>- Wrong NMEA version<br>- Wrong output rate or format<br>- Wrong electrical standard<br>- Too many data sentences turned on (throughput overflow)<br>- More than one MNEA *talker* on the circuit<br>- Faulty port<br>- The MX420 requires the user to enable NMEA<br>- 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 battery. The expected life time is about 3 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 of the battery.

#### Backup Battery Replacement

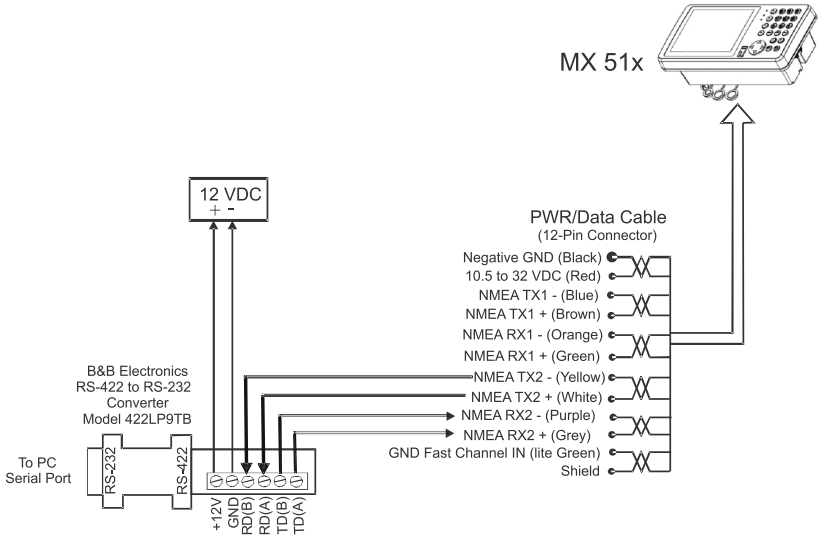
Marine electronics dealers or radio supply stores will typically stock the replacement battery, Type TL-5902, 3.6 V (1/2 AA) Lithium battery.

The battery is mounted in a socket located on the Main PCB processor board. MX Marine recommends this service to be done by a qualified service technician.

### *MX51x PC Interface*

The MX51x data ports are all RS-422 type data interface. If you need to connect the MX510 to a PC we recommend using an RS-422 to RS-232 converter as shown below.

The MX512's port 11 is an RS-232 port. You can connect this port directly to a PC serial port.




***PC Interface Cable Diagram***

### *Software Update Procedure*

*Updating the MX51x program can be done Using the USB port:*

Tools, cables and software needed:

- 12-pin power cable
- DC power supply 12-24 VDC
- One (1) USB device (i.e. USB flash drive)
- (Refer to *page 241* for hardware compatibility list)
- PC or laptop with Windows XP (or higher) and a USB port
- *.bin file – the program itself

**Procedure:**

**1** Insert your USB device into a PC or laptop.

**2** Format the USB device using *FAT32* file system. Refer to page 240 for instructions of how to format.

**3** Download the MX510.bin file (the program itself) from the BNT-ME website and save it onto your USB device. *(Note: Do not rename the file. The filename should remain as "MX510" in uppercase.)*

**4** Safely remove your USB device from the PC or laptop.

**5** Power off the MX510 CDU.

**6** Insert your USB device into the USB port of the MX510.

**7** Press and hold down the ***NAV*** button on the MX510 unit and power ON the unit.

Release the 'NAV' key after the unit is powered on.)

**8** MX510 CDU will now bring up the *MX510 Software Bootloader*.

**9** Please allow a few moments for the *MX510 Software Bootloader* to detect and mount your USB device.

**10** After the USB device is successfully mounted, the software bootloader will copy the program to RAM.

**11** Upon completion of Copying program to RAM, the software bootloader will burn the program to flash.

**12** Upon completion of Burning program to flash, the MX510 will jump to the program itself (POS2 screen), and software upgrade procedure is completed.

**13** If there's any problem, please go back to step 1 and try again.

**Hint:**

It is highly recommended that the MX510 navigator be cold started after downloading the program. Please note that all settings including waypoints and routes will be lost.

This is important to flush out the residual memory, which may cause problems with the operation of the unit.

**Memory Clear Procedure:**

**1** After downloading the software, turn the power off to the MX510 by turning off the 12 VDC circuit breaker (this may also be accomplished by removing the 12-Pin Cable from the back of the unit).

**2** Press and hold down the *CLR* key.

**3** Apply 12-volt power to the unit and wait for about 5 seconds. The MX510 will come on and display the Northstar logo.

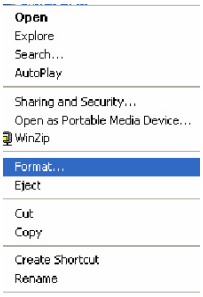
**4** Release the *CLR* key.

**5** The memory is now cleared.

***USB Device Formatting Procedure:***

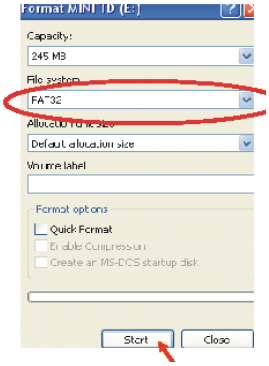
**1** Insert the USB Memory Stick into the USB port of your PC or laptop.

**2** Go to *My Computer*, right click on your USB device drive (i.e. '*E:*'), and select "*Format...*"




**3** Ensure that the *File System* is set to *FAT32*. DO NOT check on *Quick Format*.

**4** Click on the *Start* button to begin format.




**5** Click *OK* after format is completed.

**6** *Safely remove* your USB device from the PC or laptop.

### *USB Flash Drive Hardware Compatibility List*

The following is a list of recommended USB flash drive brands that have been tested :

- Sandisk (256MB)
- Lexar (256MB)
- PNY (256MB)
- Memorex (256MB)

***USB flash drives that are not listed may not work properly with the MX51x.***

***Blank page***

## Mechanical installation drawings

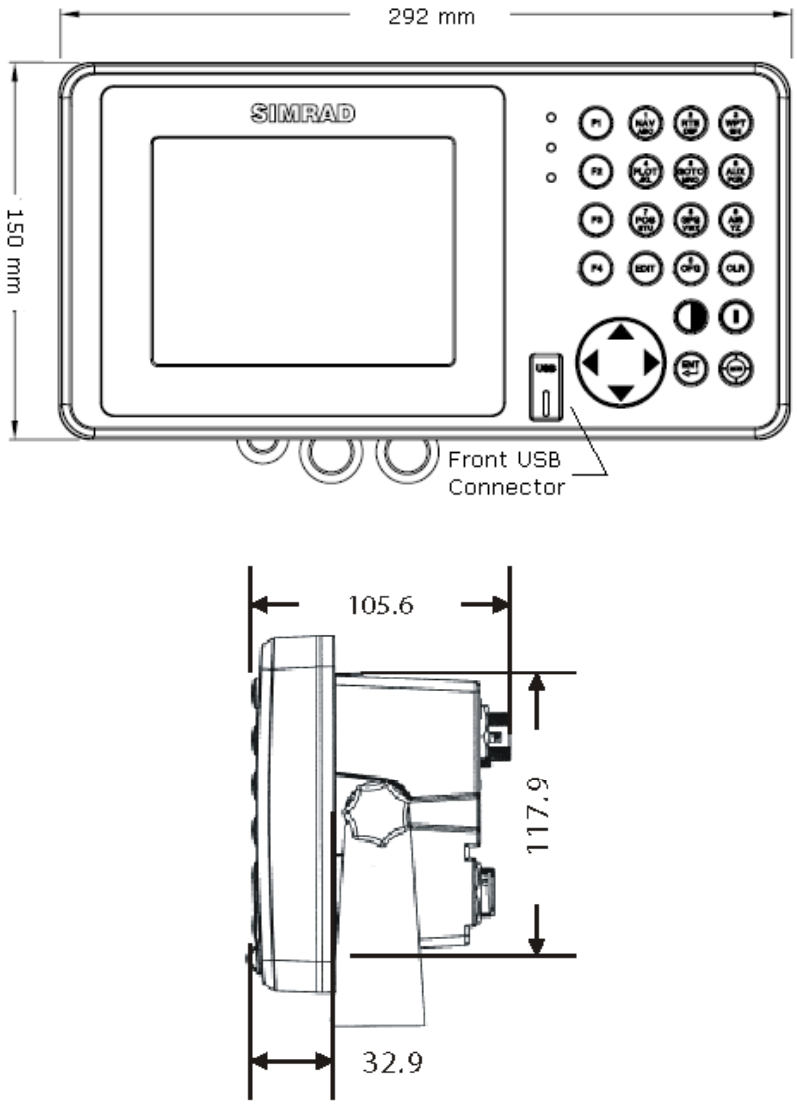



*Figure 5.1- MX51x Display Console Dimensions (mesurements are in mm)*

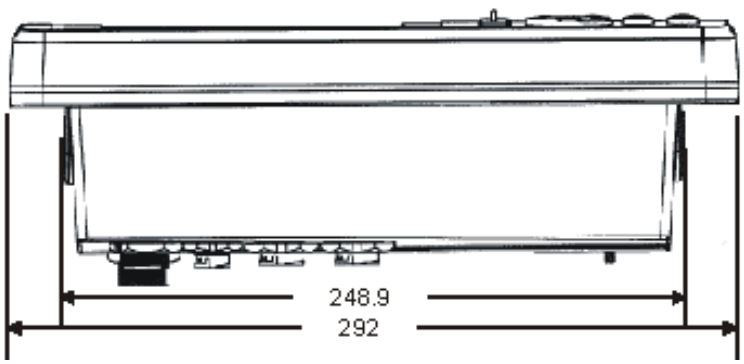



*Figure 5.2 - MX510/MX512 Display Console (Top View )*

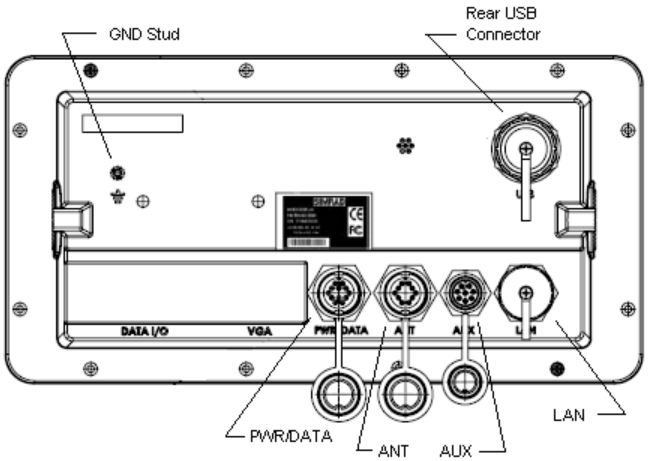



*Figure 5.3 - MX 510 Rear Connector Configuration*

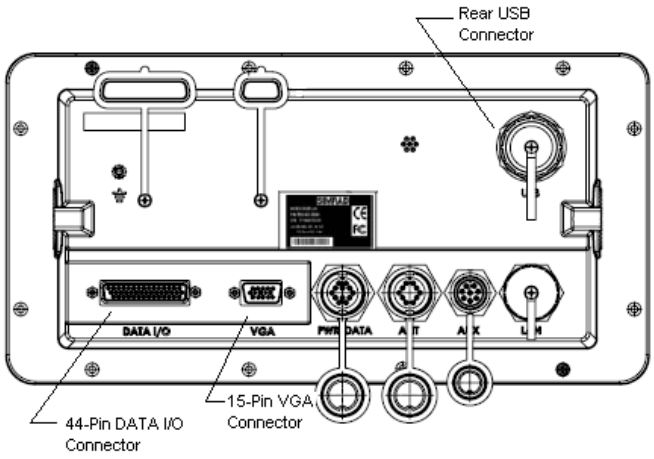



*Figure 5.4 - MX512 Rear Connector Configuration*

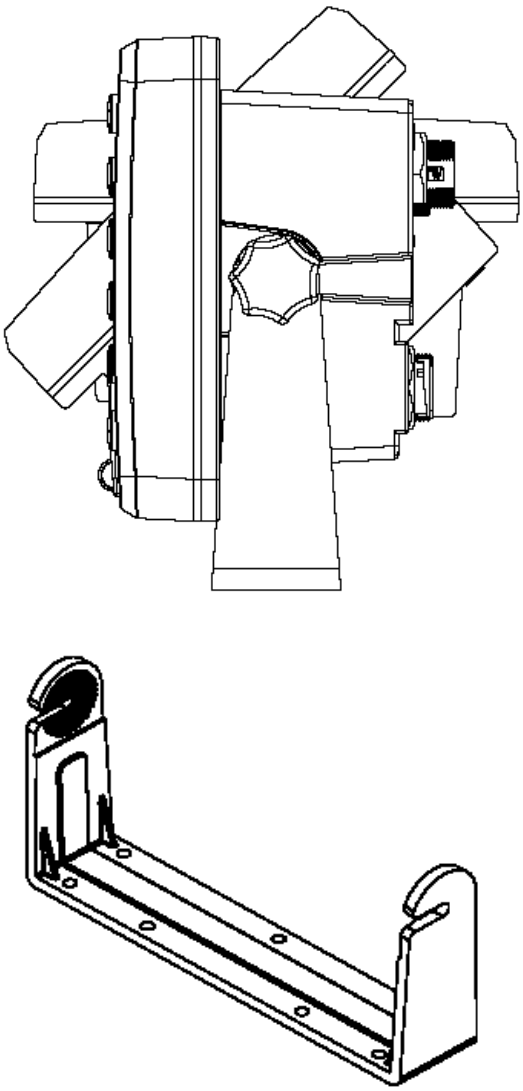


*Figure 5.5 - Gimbal Mounting Bracket*

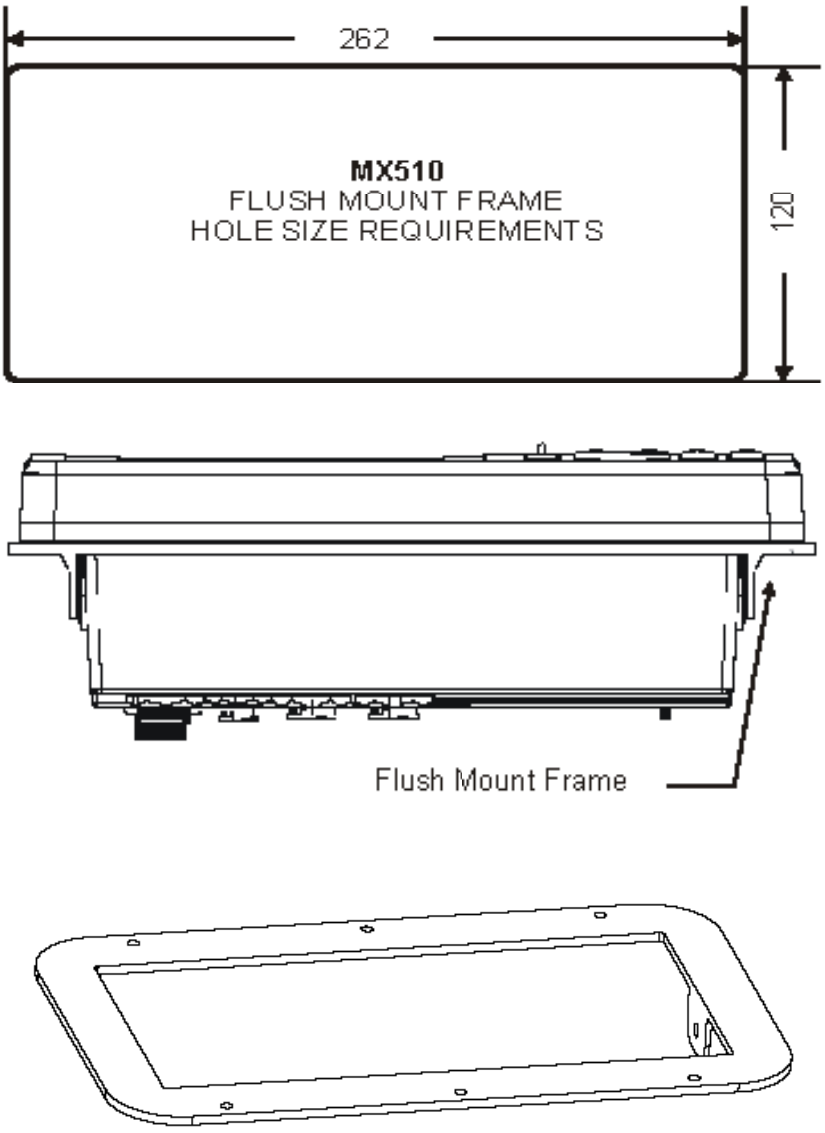



*Figure 5.6 - Optional Flush Mounting Frame*

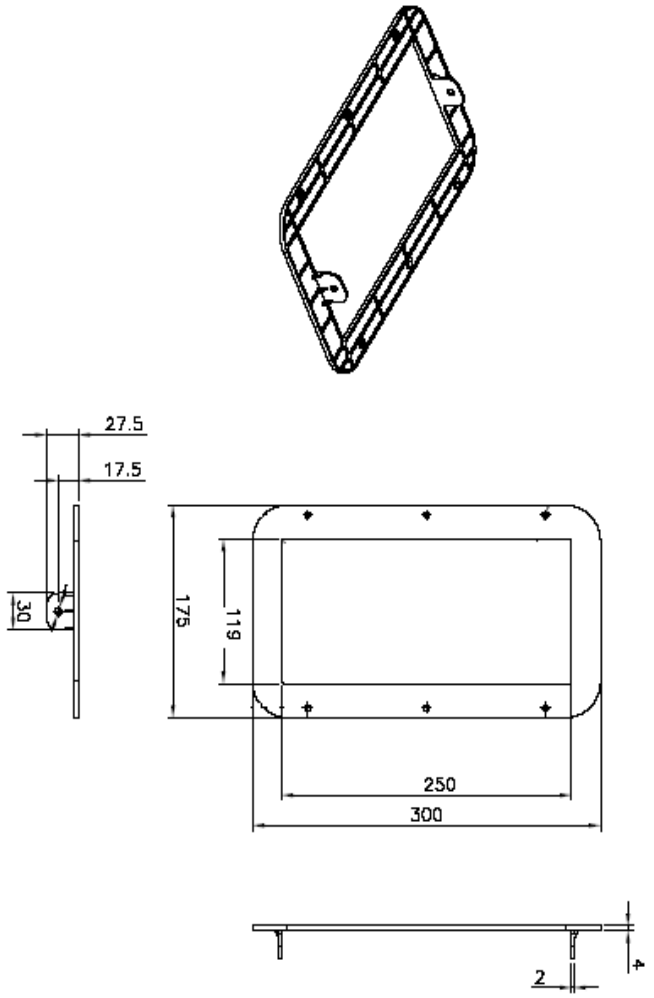



*Figure 5.7 - Optional Flush Mount Frame Dimensions*

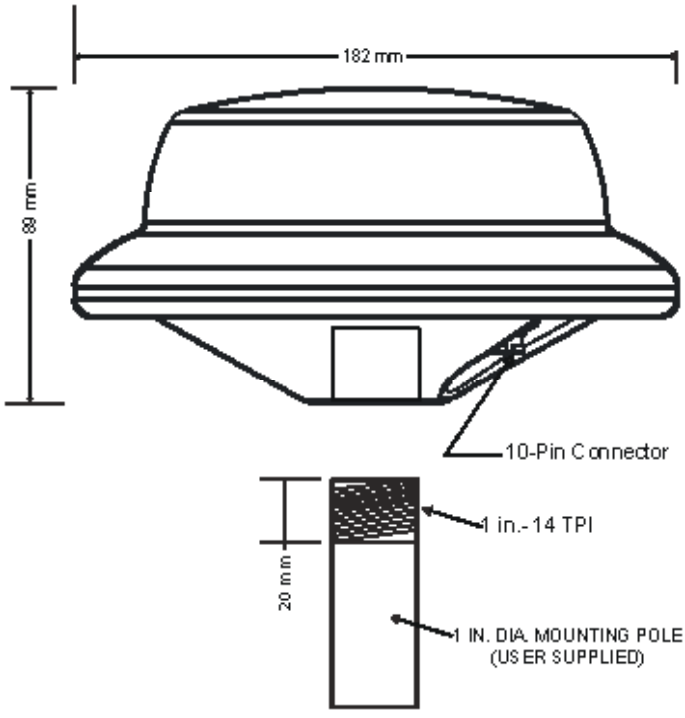



*Figure 5.8 - Standard Smart Antenna Dimensions and Mounting Specifications*

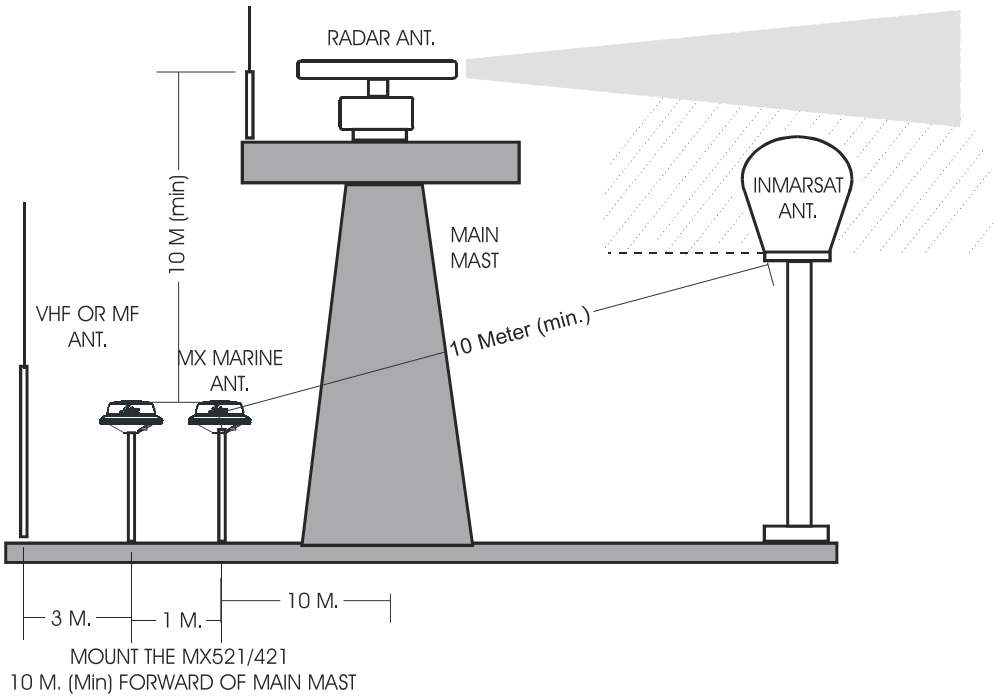



***Figure 5.9 - Antenna Location Diagram***

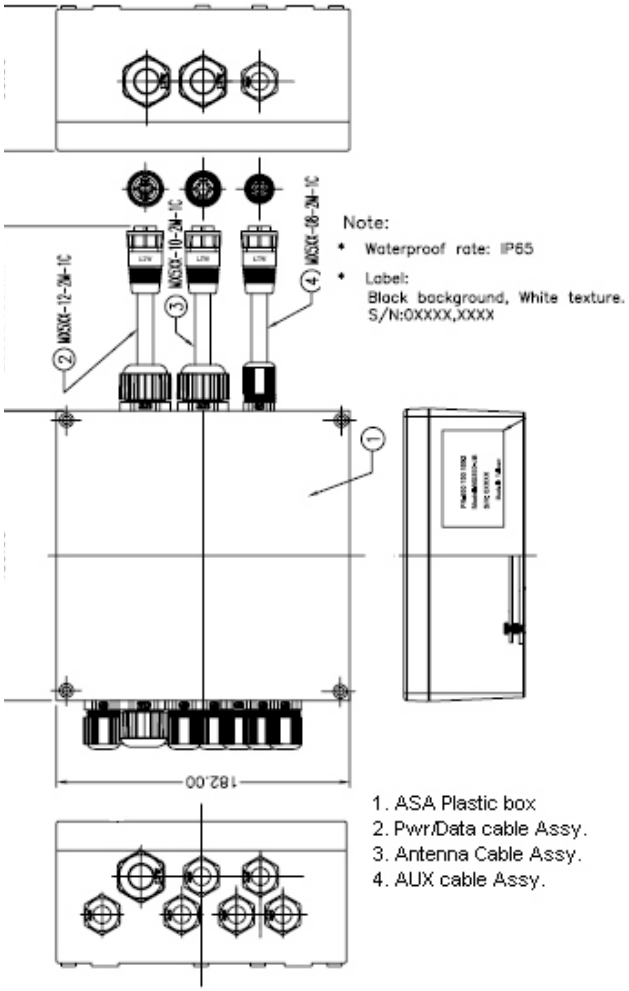



*Figure 5.10 - MX500/MX510-JB Junction Box (Optional equipment)*

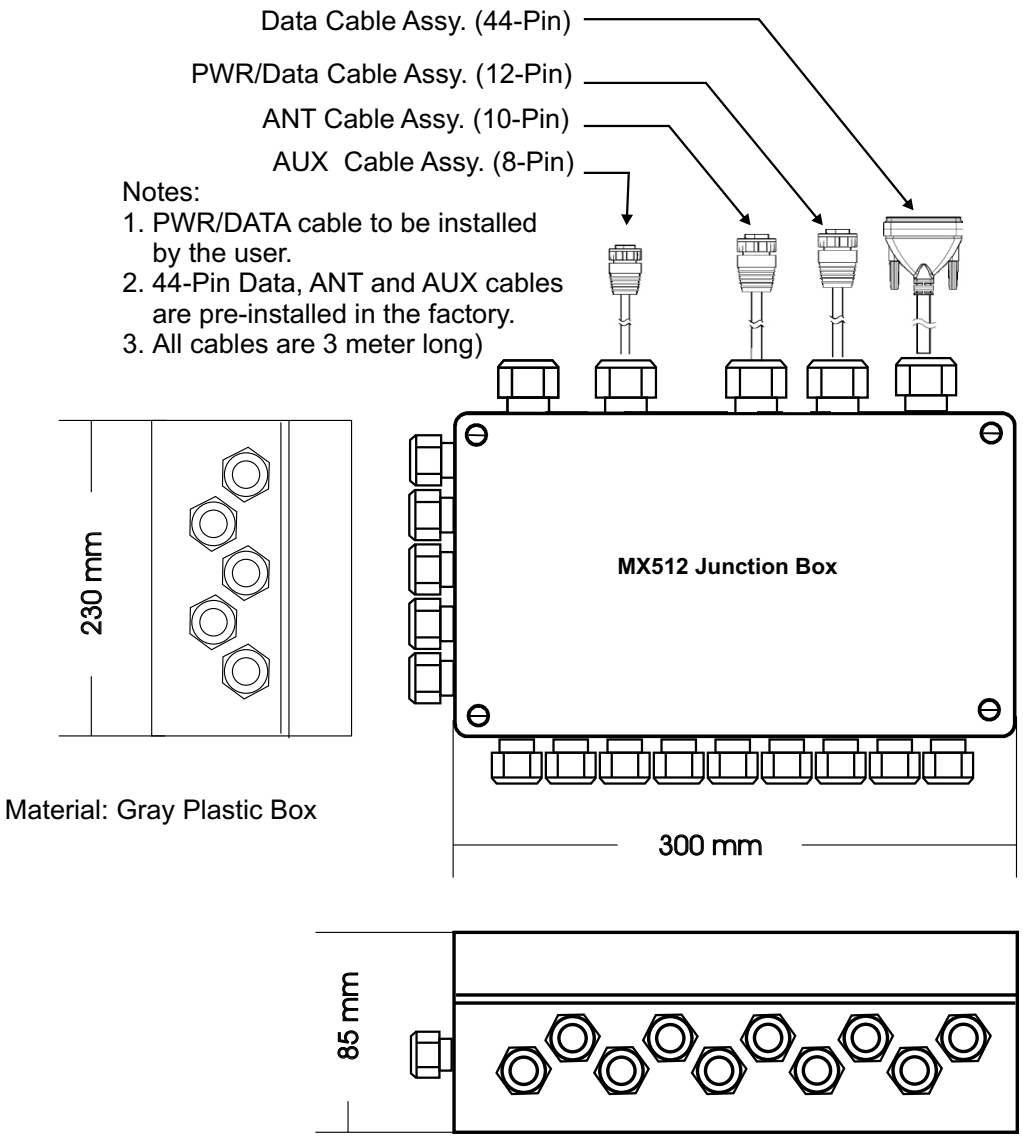



*Figure 5.11 - MX512 Junction Box Dimensions*

## MX510 Electrical installation drawings

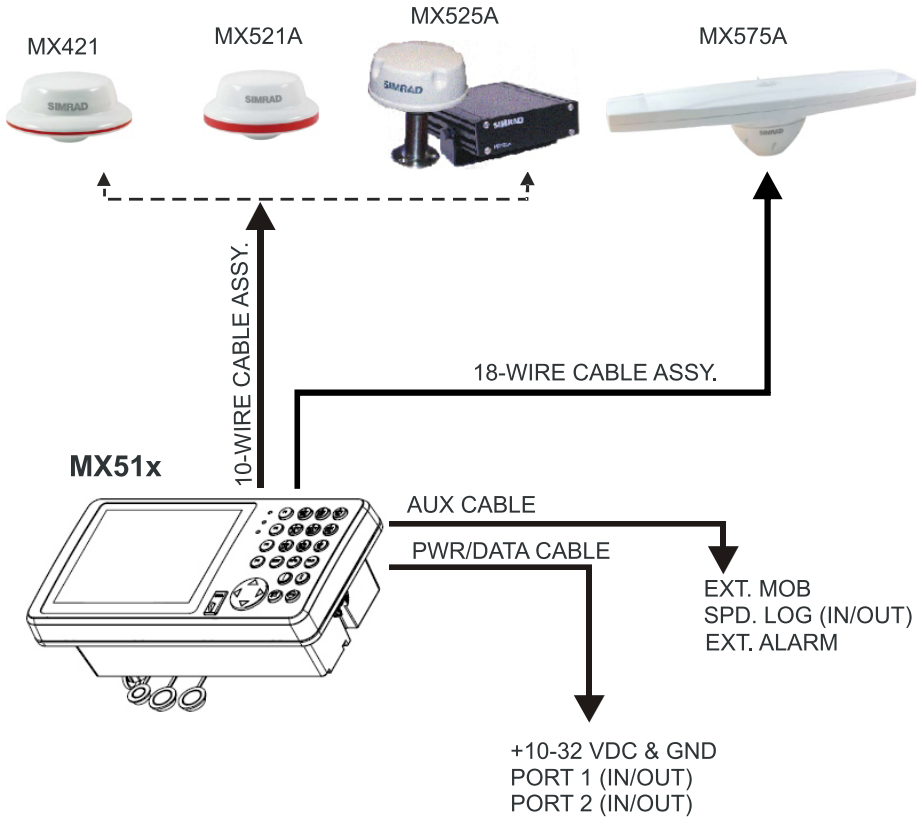



*Figure 5.12 MX 510 Basic System Configuration*

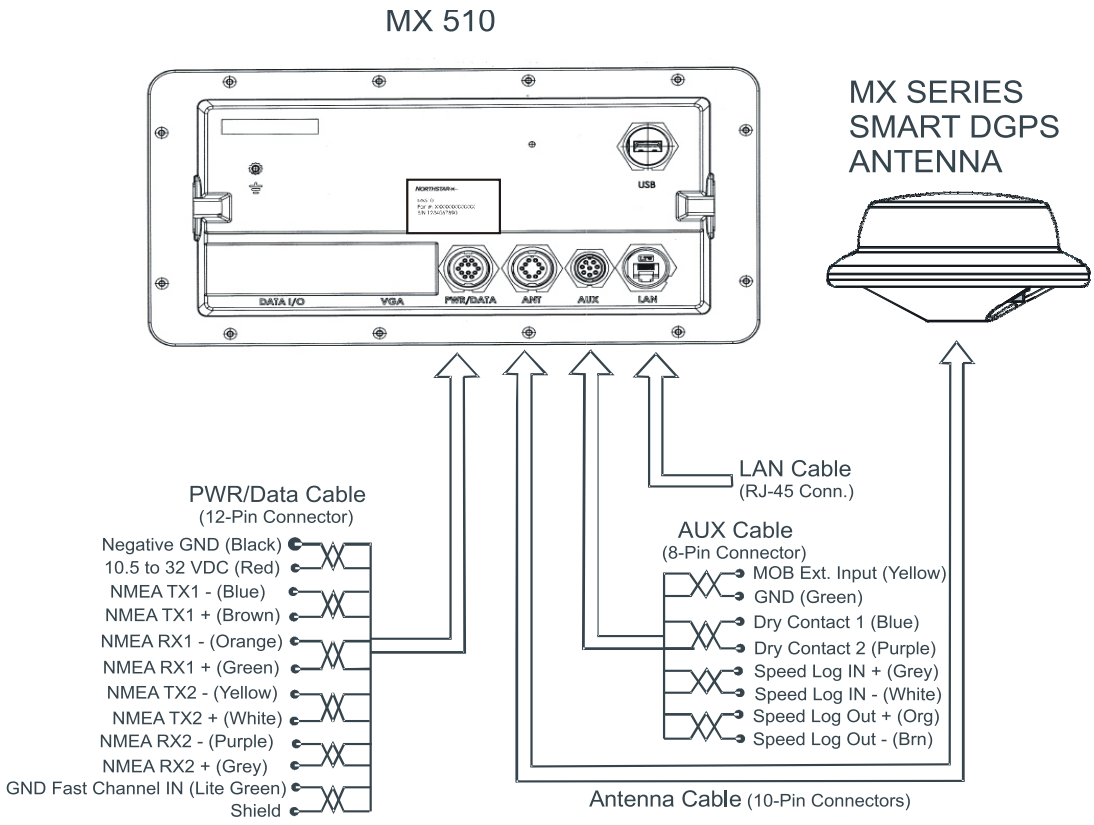



*Figure 5.13 MX510 Rear-Panel Connector Configuration*

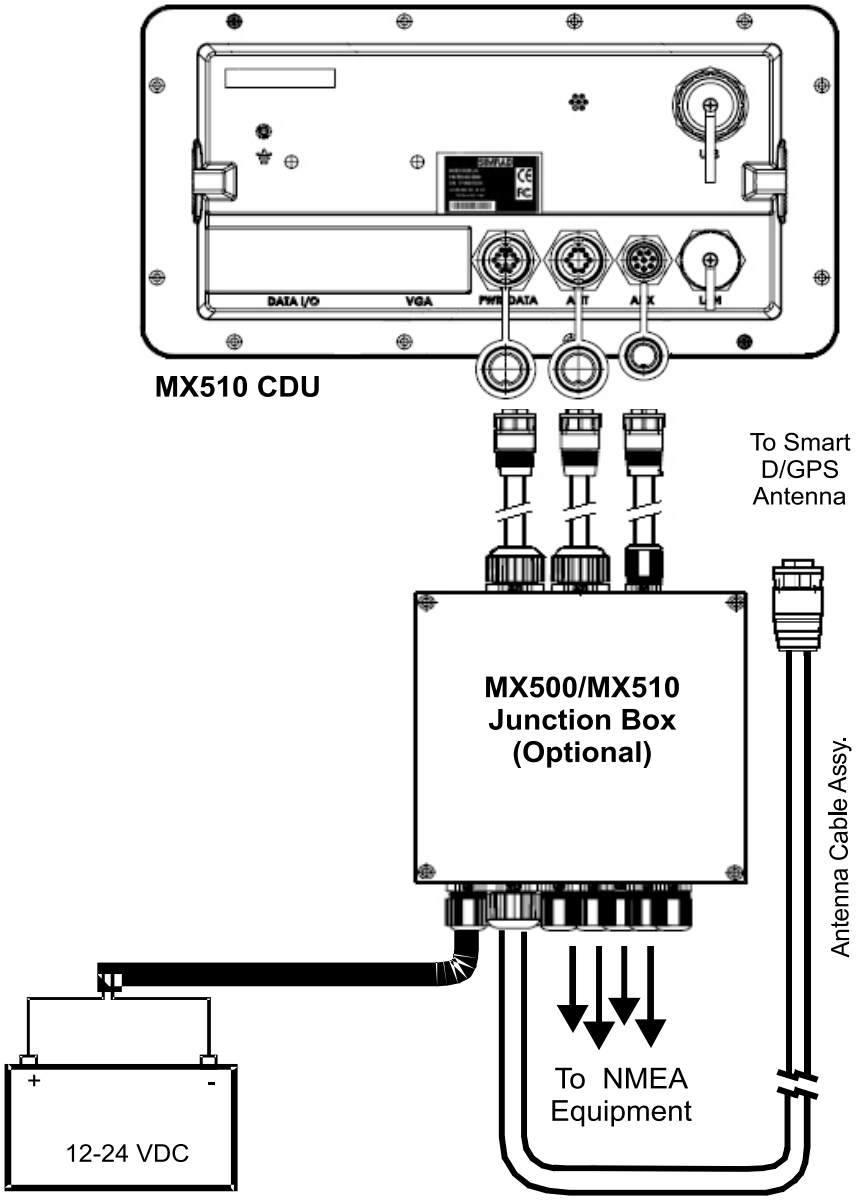



*Figure 5.14 MX510 with Optional Junction Box*

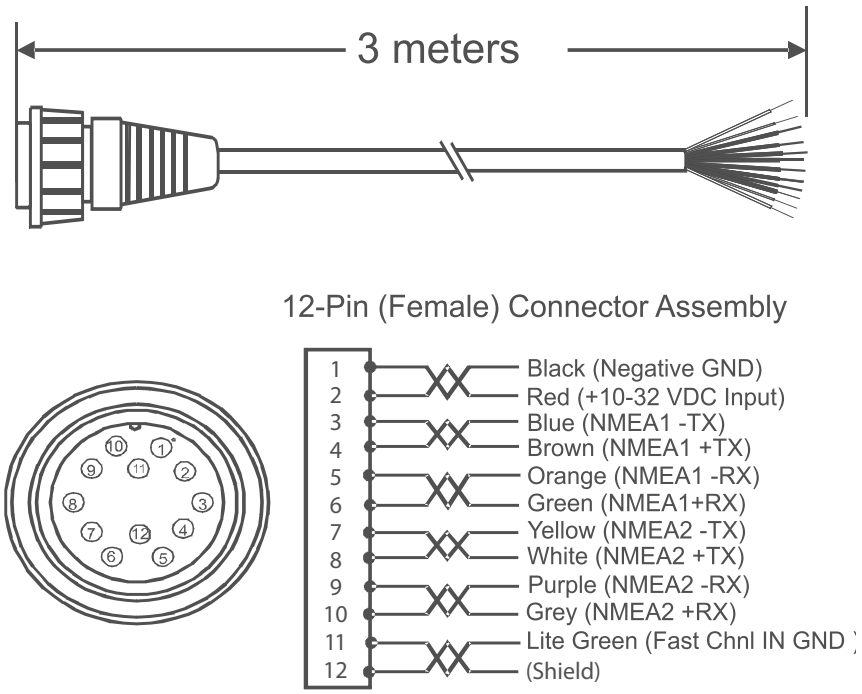



*Figure 5.15 Power/Data Cable Diagram*

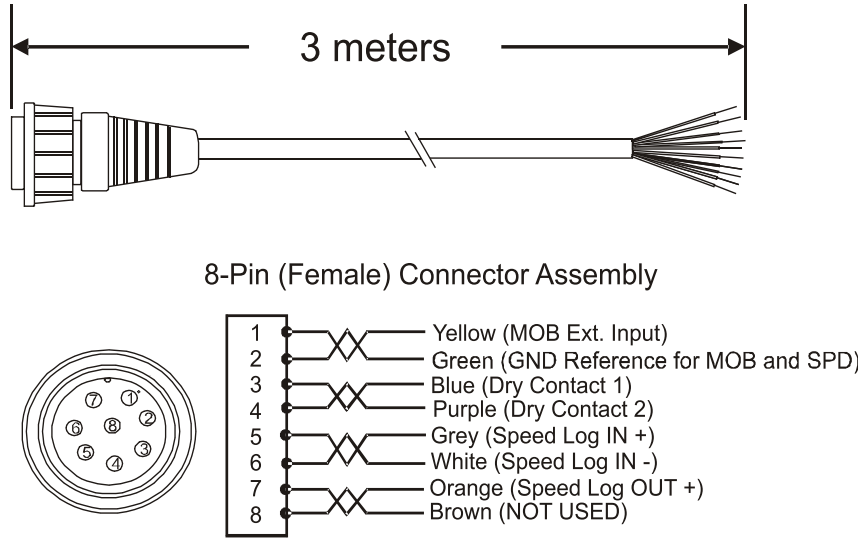



*Figure 5.16 Auxiliary Cable Diagram*

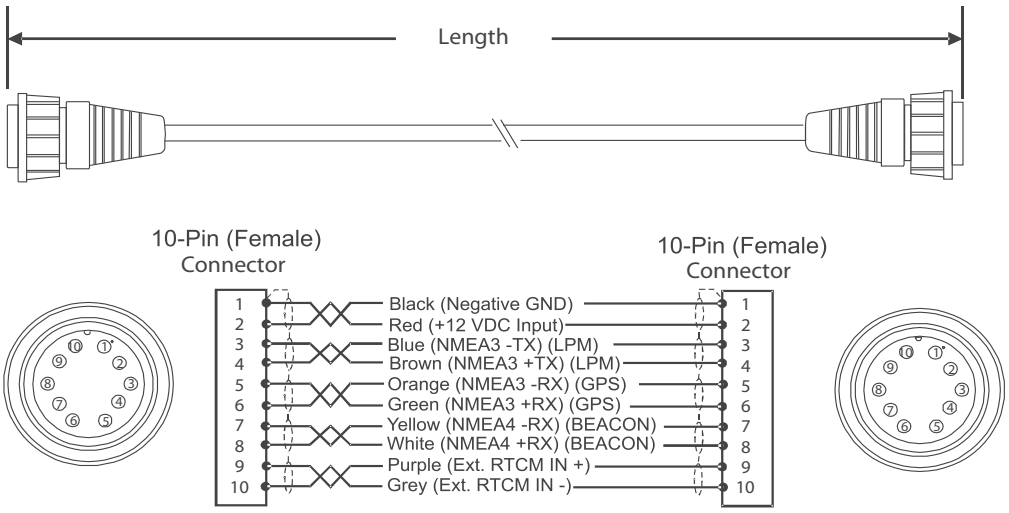



*Figure 5.17 Double-Ended Antenna Cable Diagram*

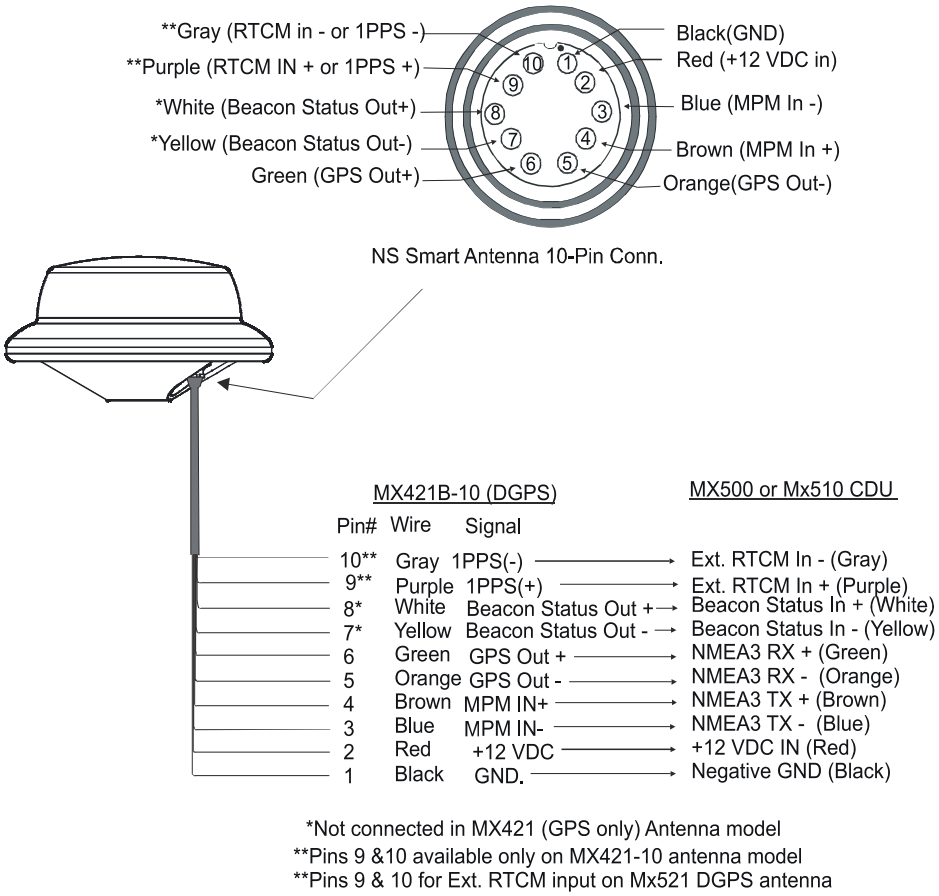



*Figure 5.18 Smart D/GPS Antenna Wiring Diagram*

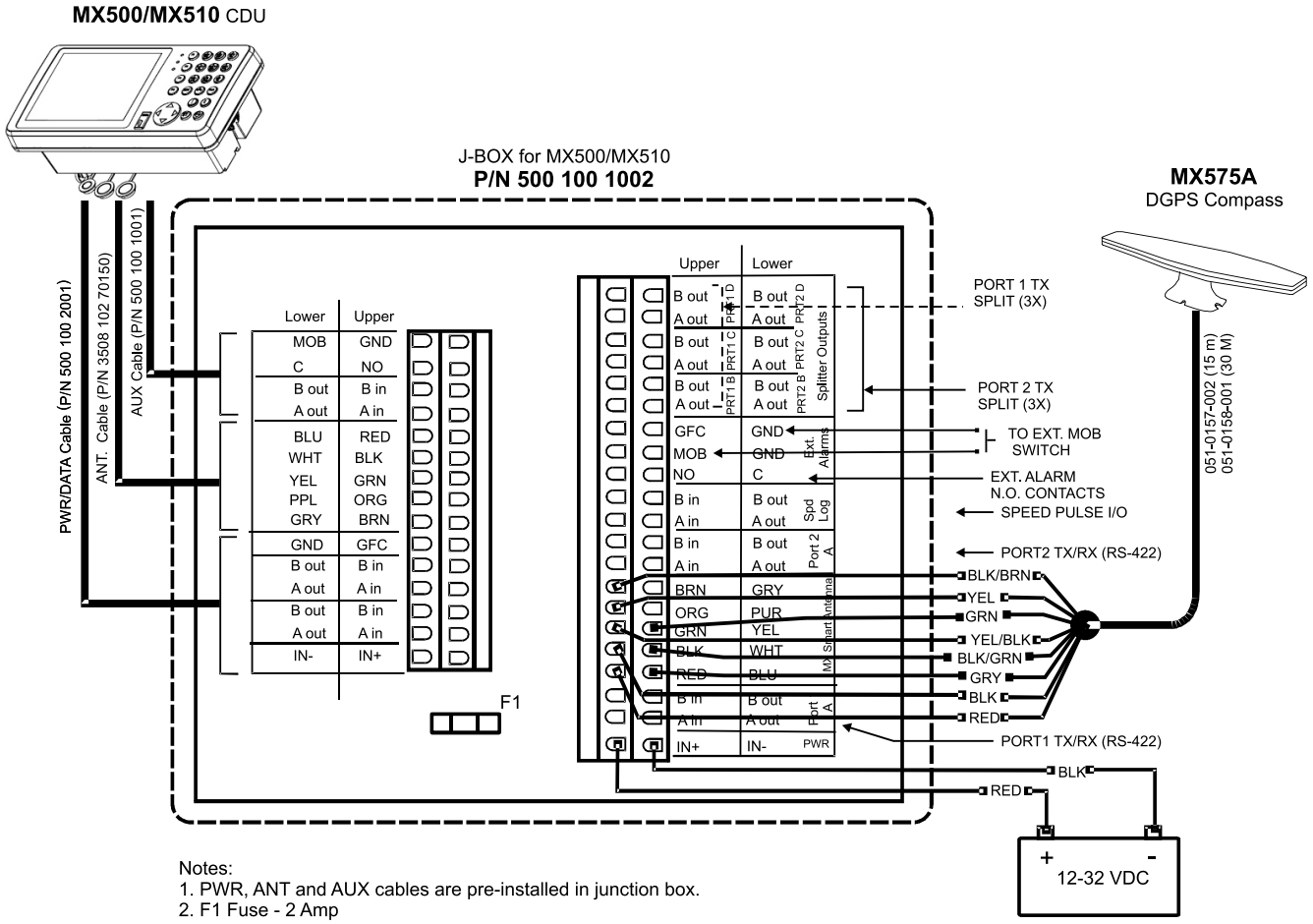



*Figure 5.19 MX510 to MX575A GPS Compass Wiring Diagram*

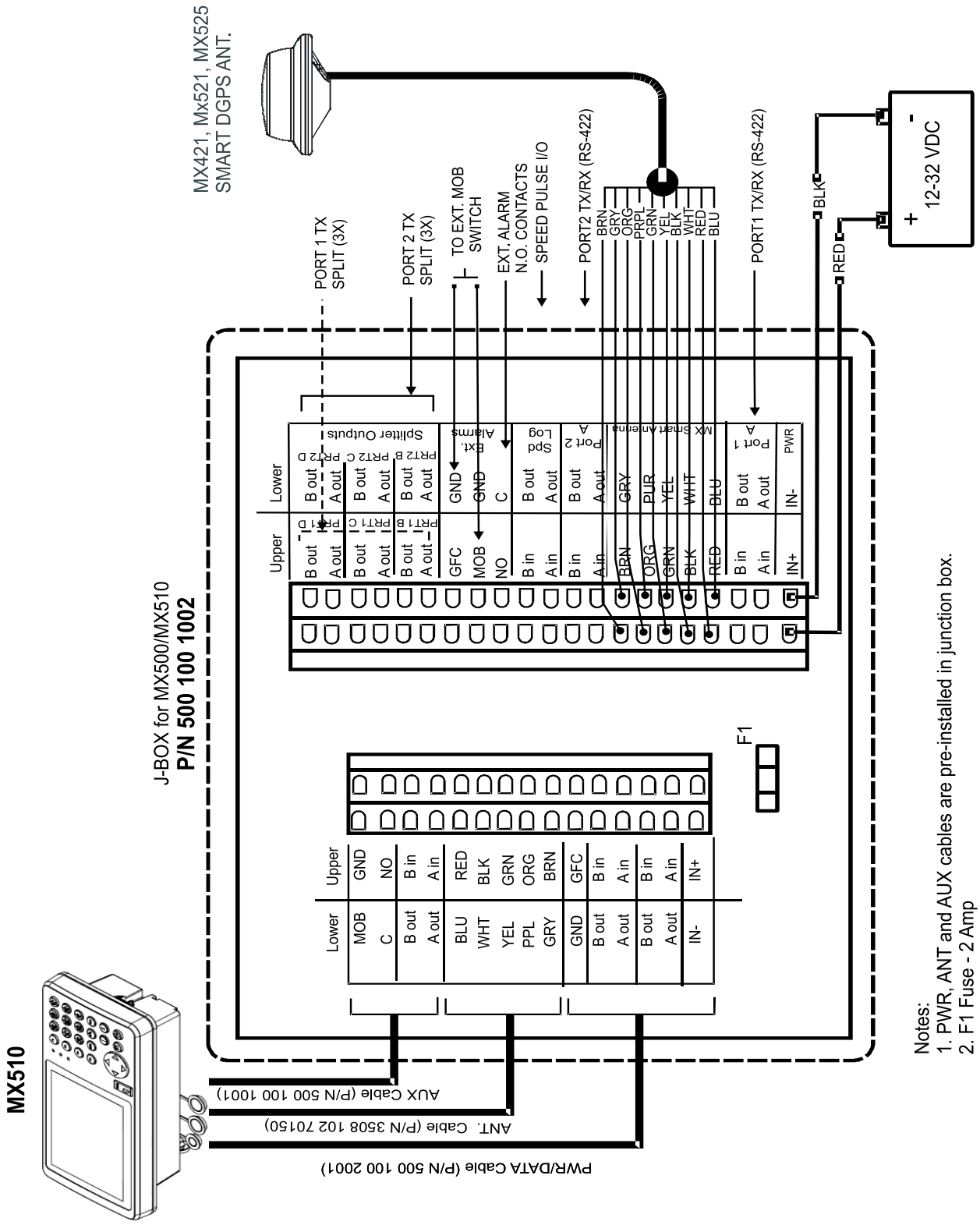



*Figure 5.20 MX500/MX510-JB Junction Box Wiring Diagram*

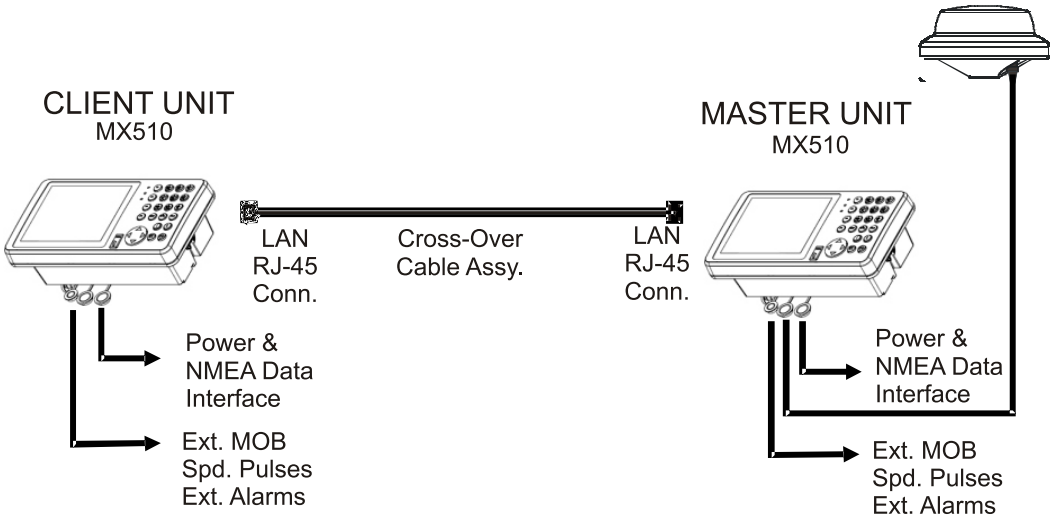
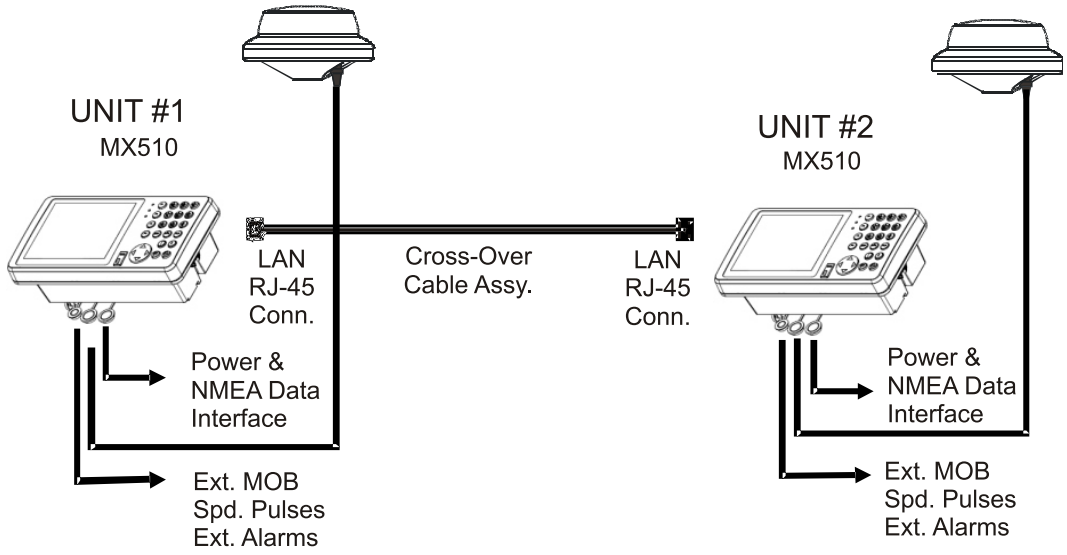



*Figure 5.21 MX510 Dual-Control Configuration*




Note: BRIM license required on both MX51x units

*Figure 5.22 MX510 Backup Receiver Integrity Monitoring Configuration*

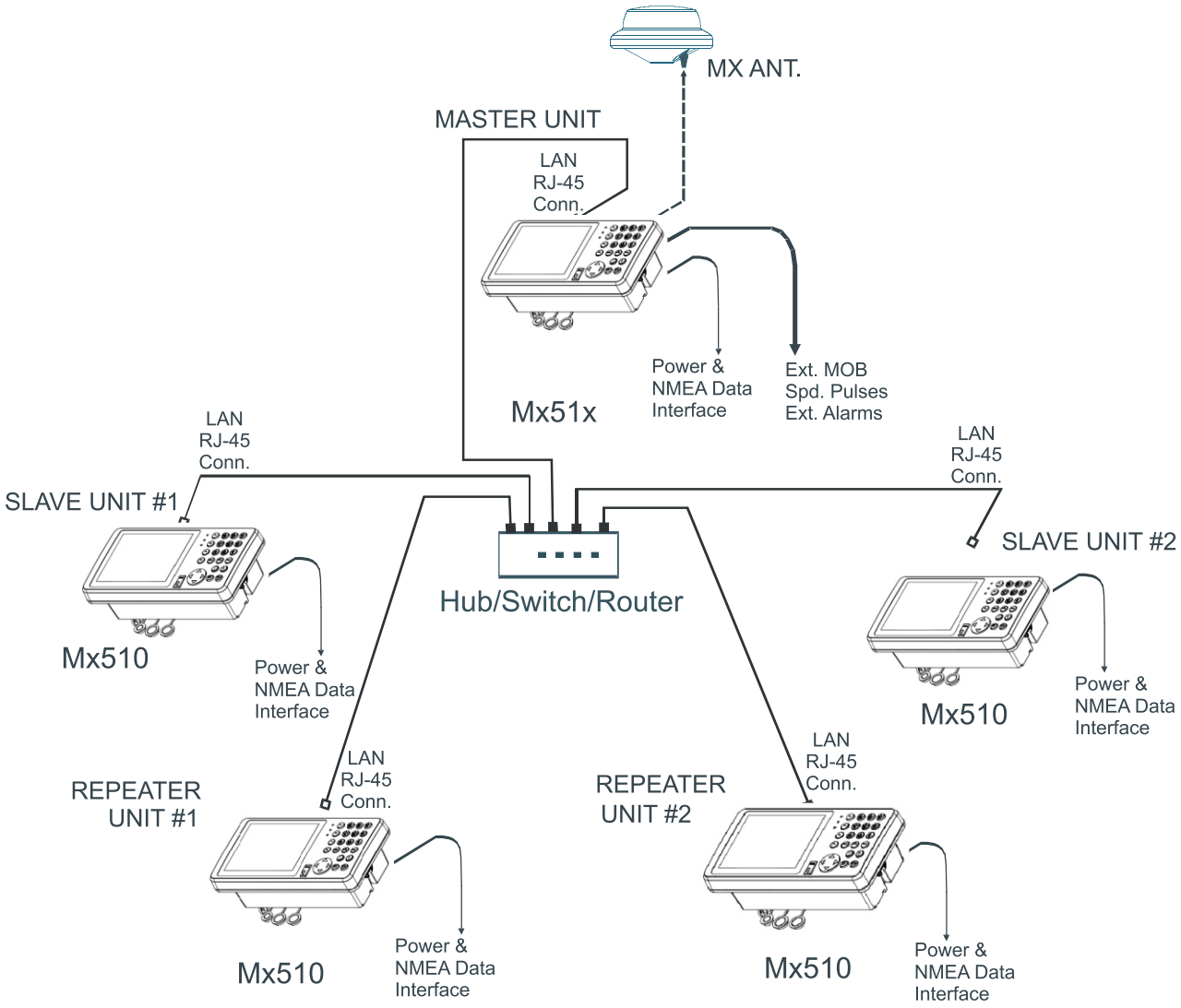



*Figure 5.23 Multiple Control Configuration*

*Notes:*

## MX512 Electrical installation drawings

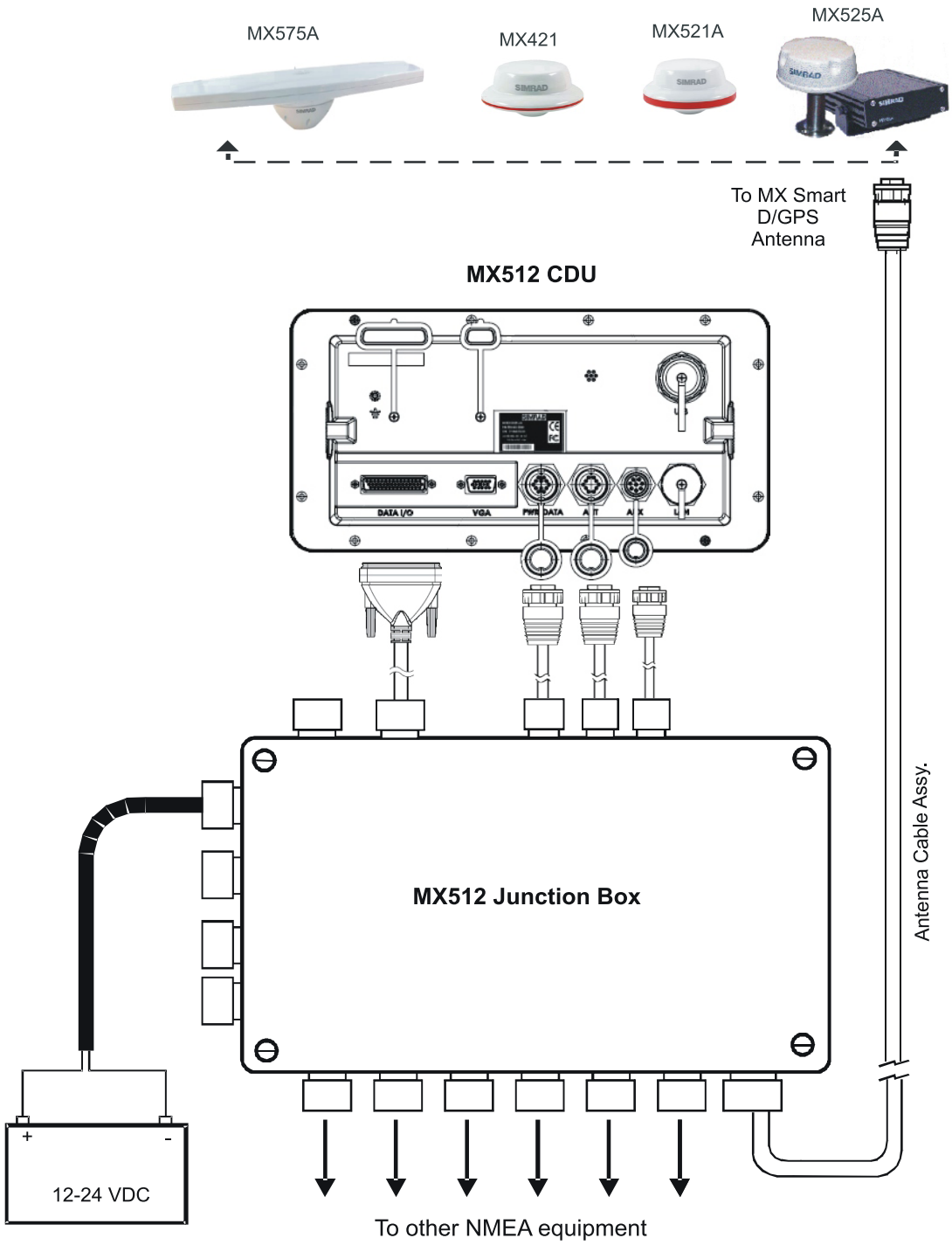



*Figure 5.24 - MX512 Basic System Configuration*

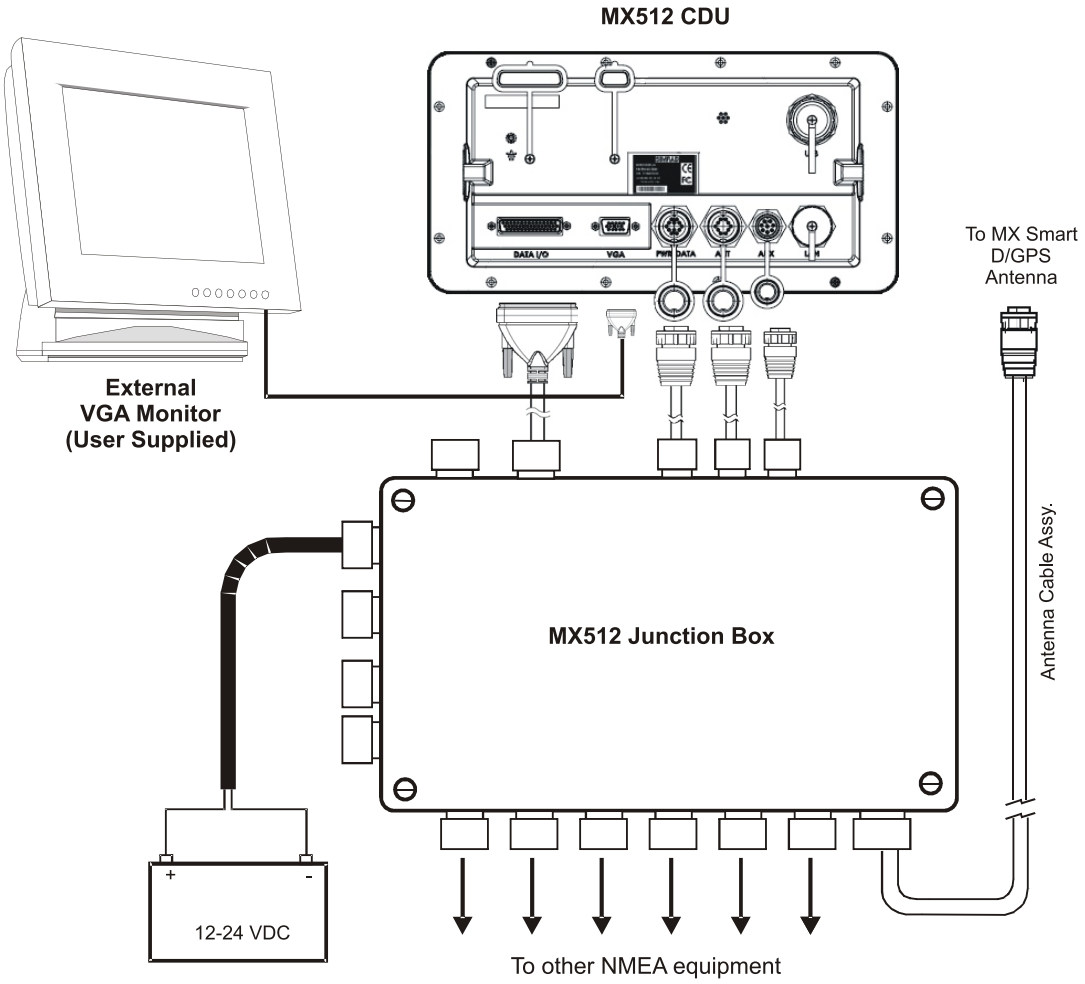



*Figure 5.25 - MX512 Junction Box Assembly*

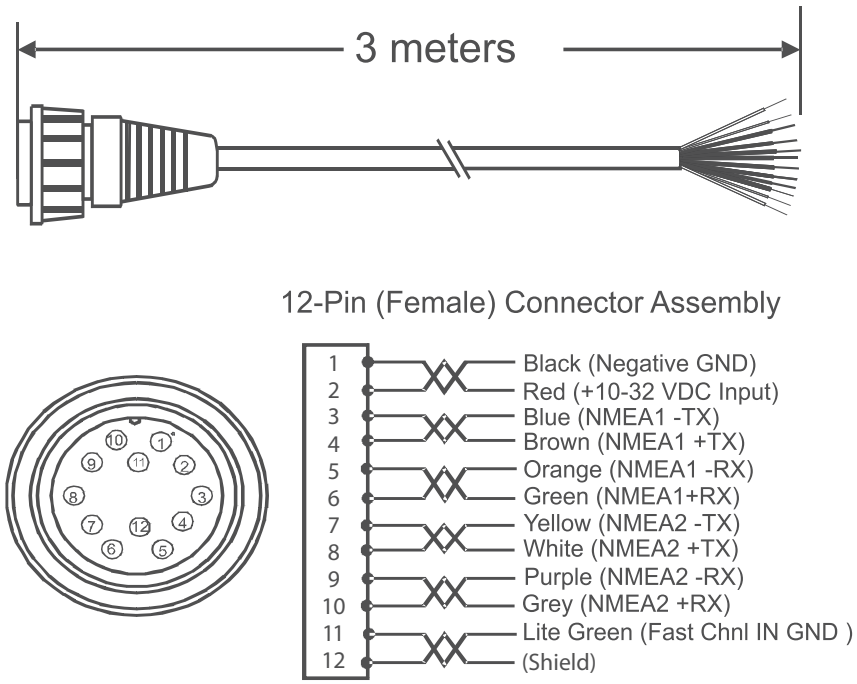



*Figure 5.26 - 12-Pin Power/Data Cable Assembly Diagram*

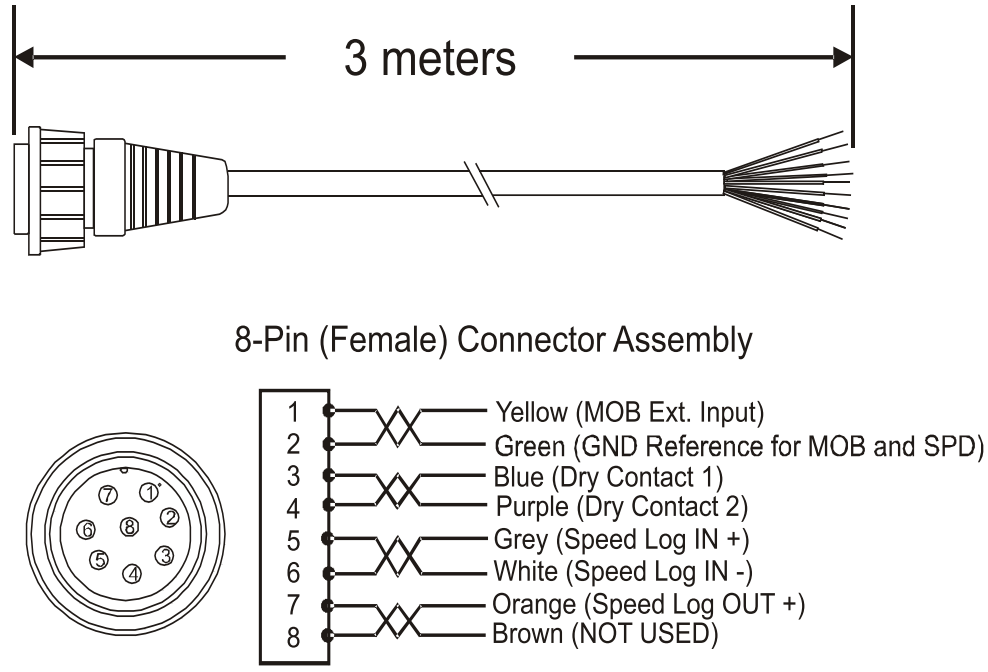



*Figure 5.27 - Auxiliary Cable Assembly Diagram*

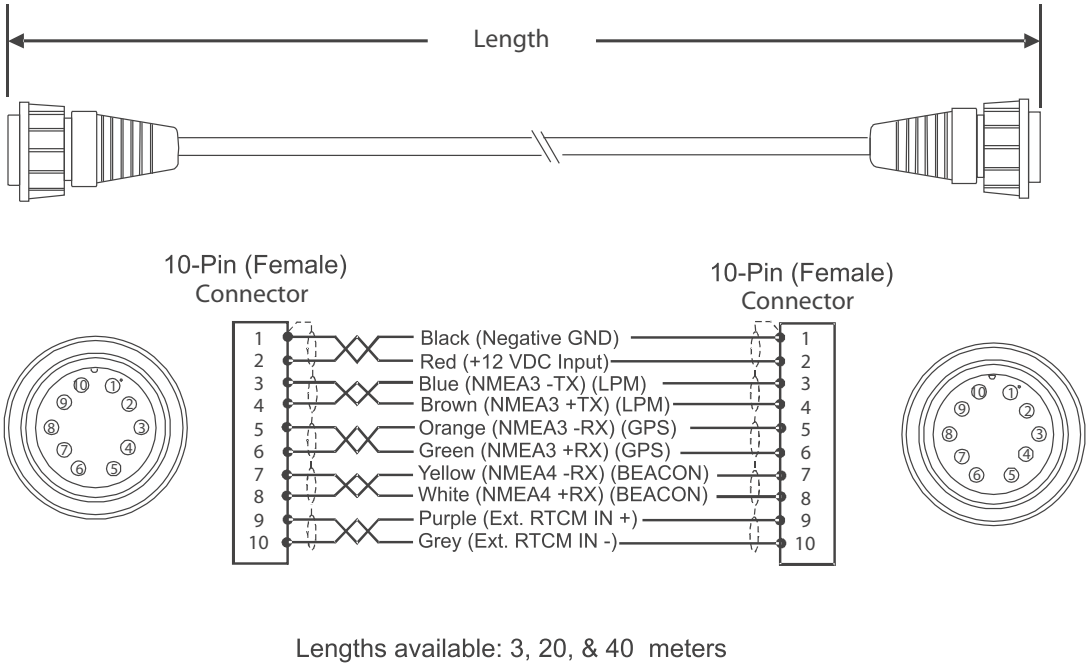



*Figure 5.28 - Double-Ended Antenna Cable Assembly Diagram*

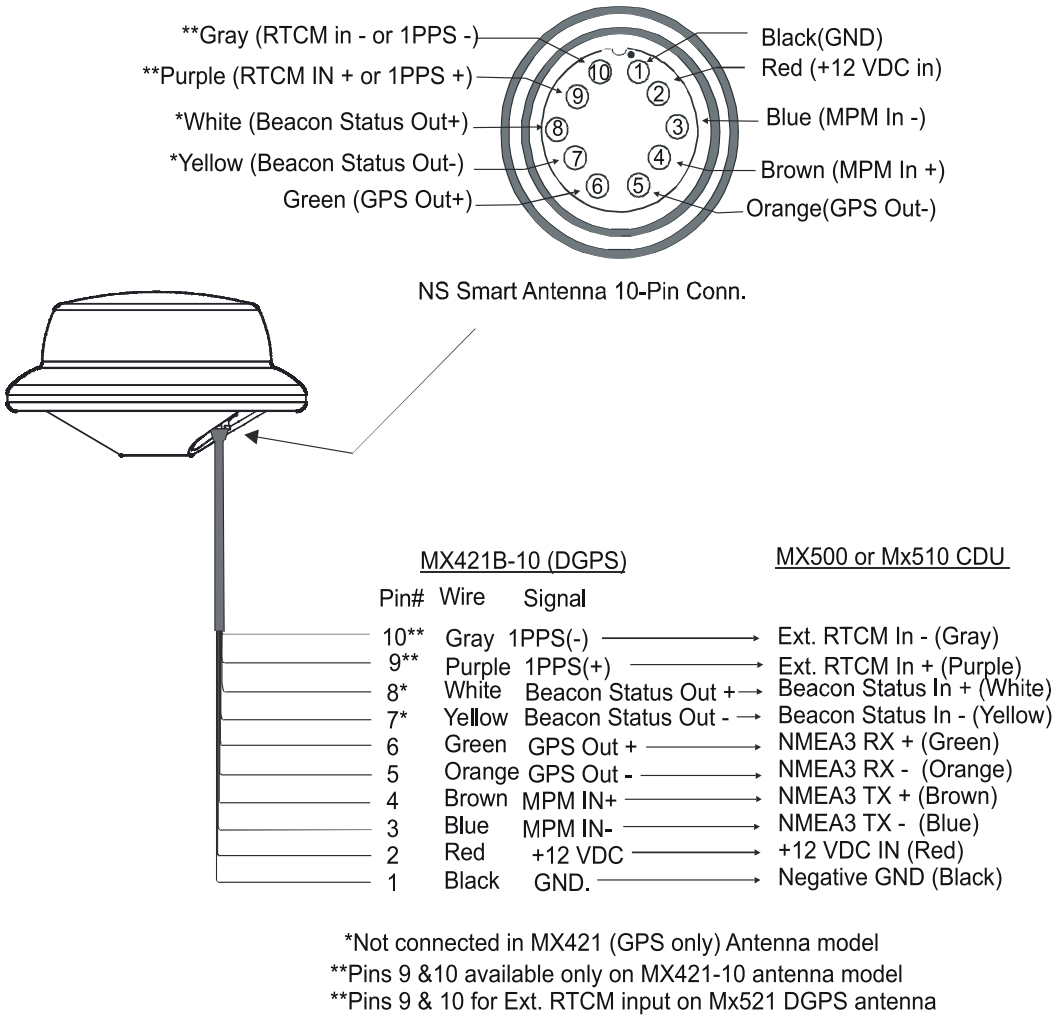



*Figure 5.29 - MX421B-10 or MX521 DGPS Antenna Wiring Diagram*

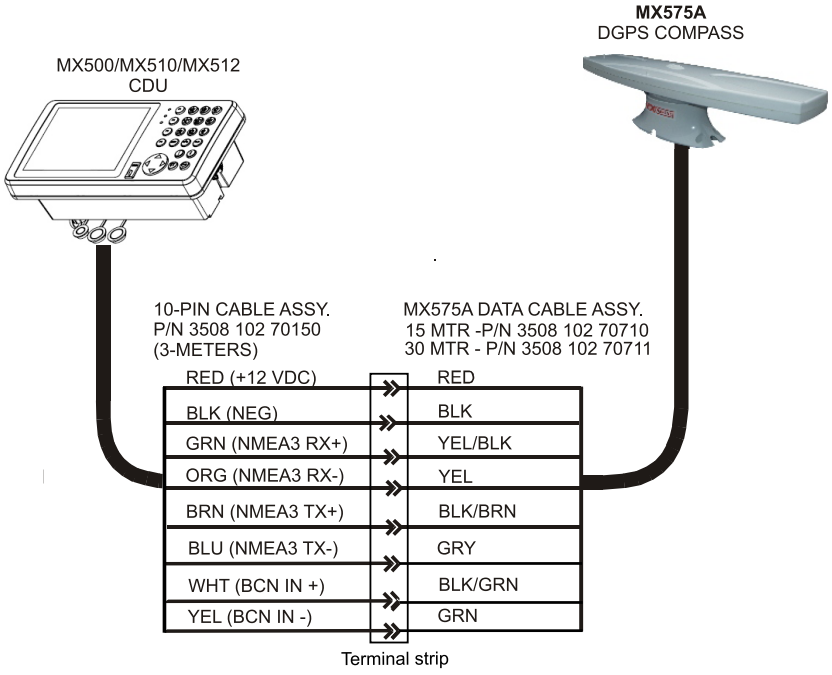



*Figure 5.30 - MX51x to MX575 Antenna Wiring Interface*

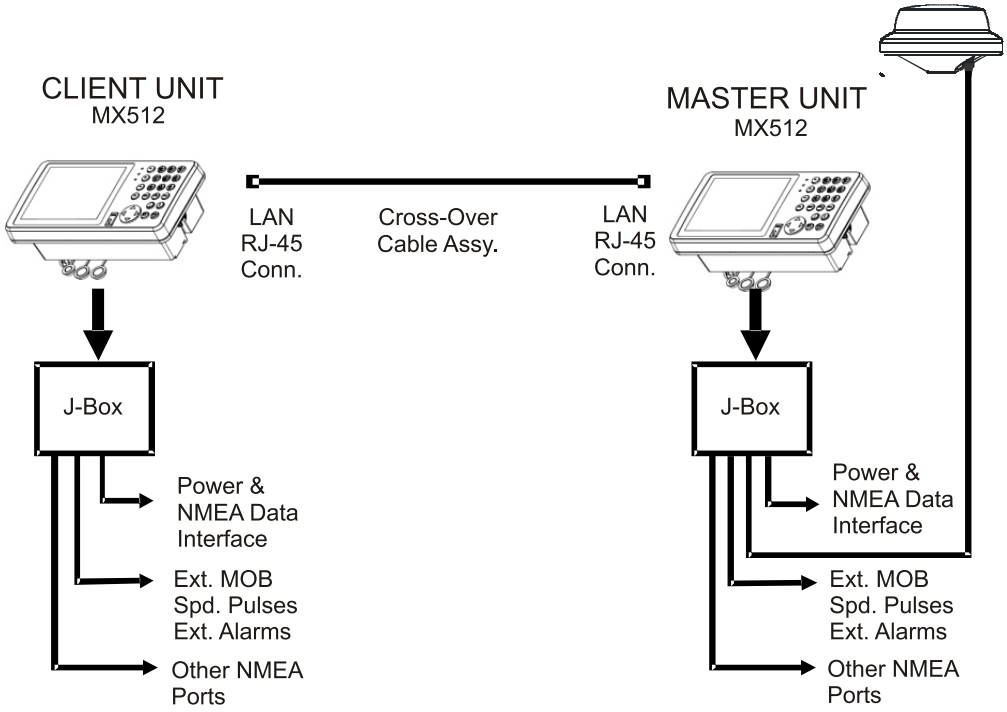



*Figure 5.31 - MX512 Dual Control Configuration*

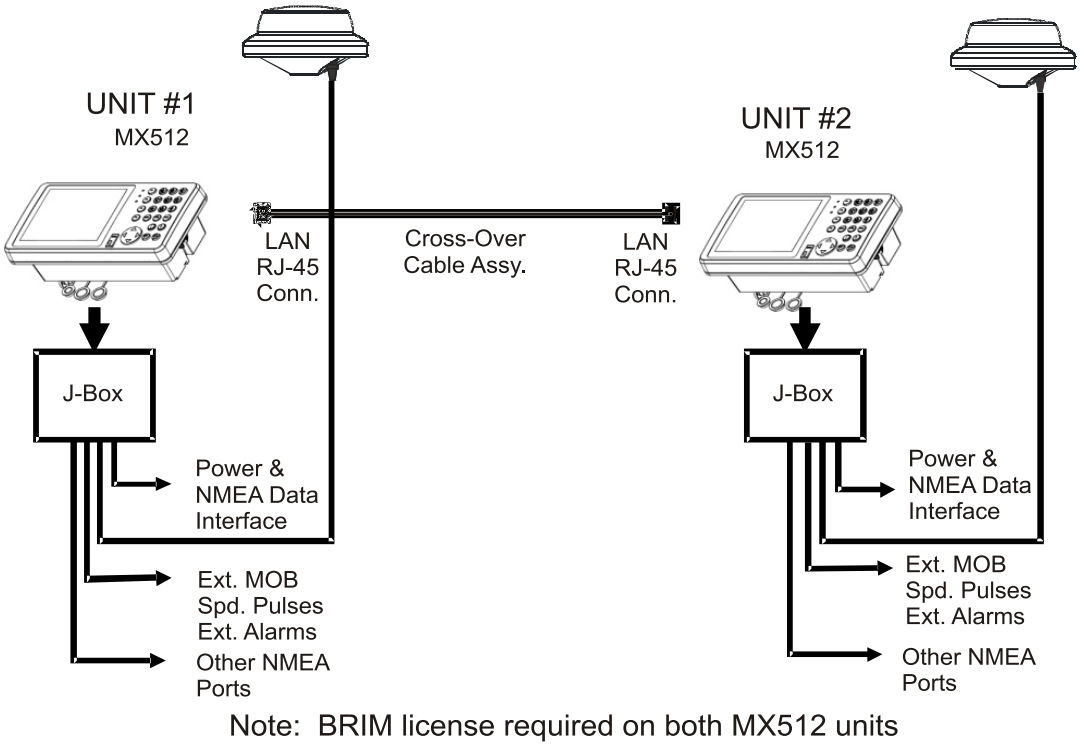



*Figure 5.32 - MX512 Backup Receiver Integrity*

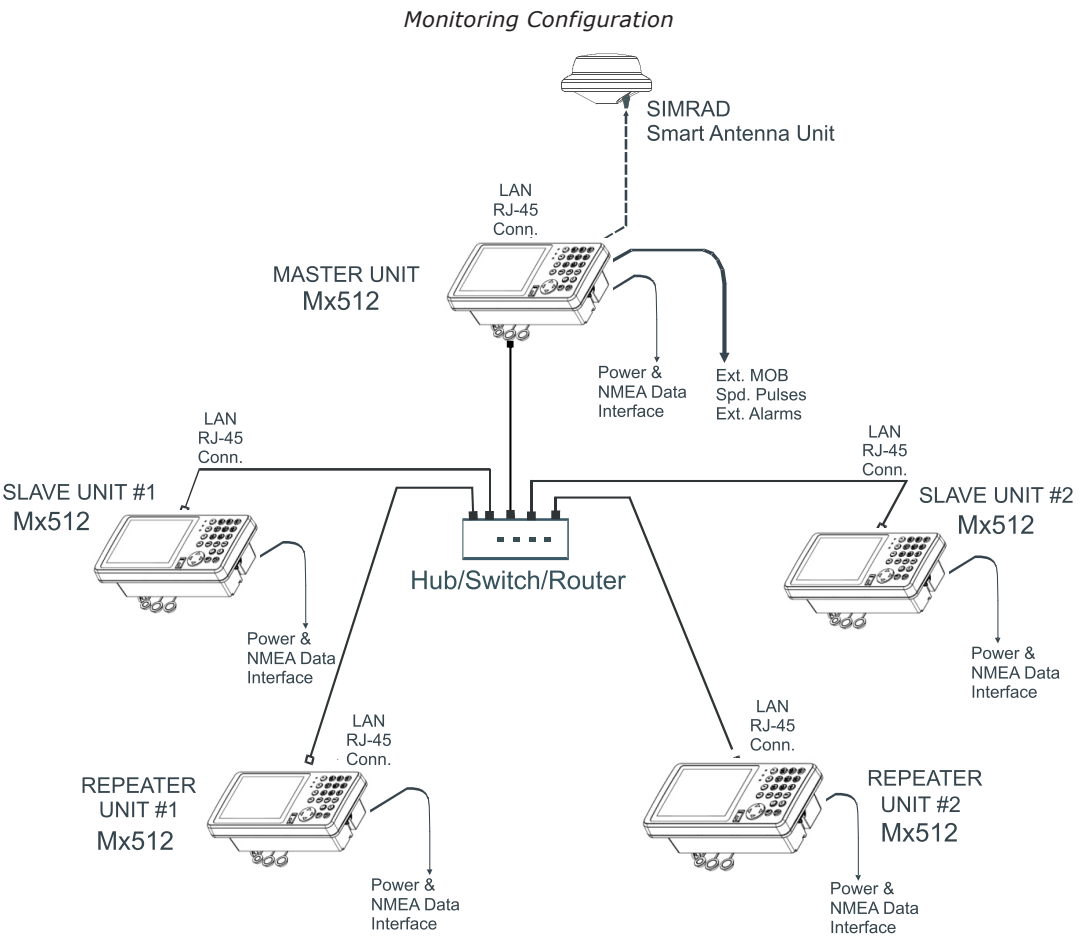
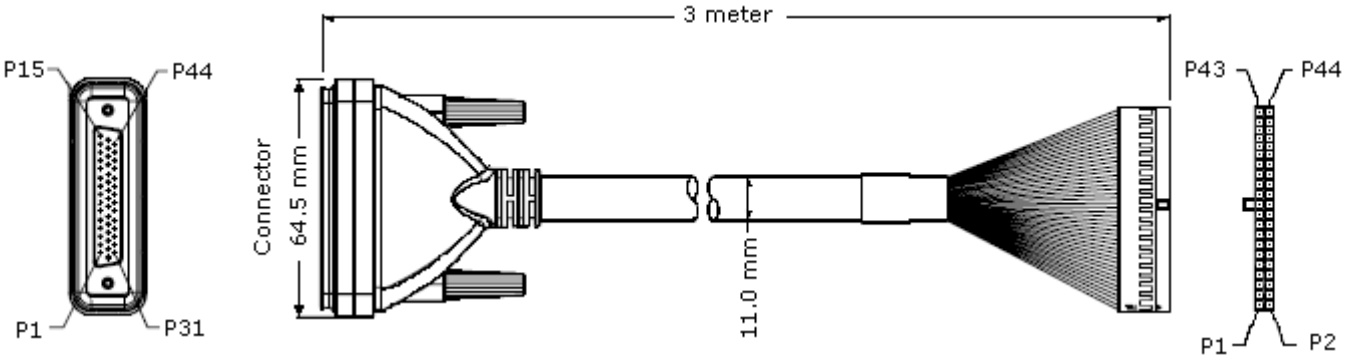



*Figure 5.33 - Multiple Unit Control Configuration*



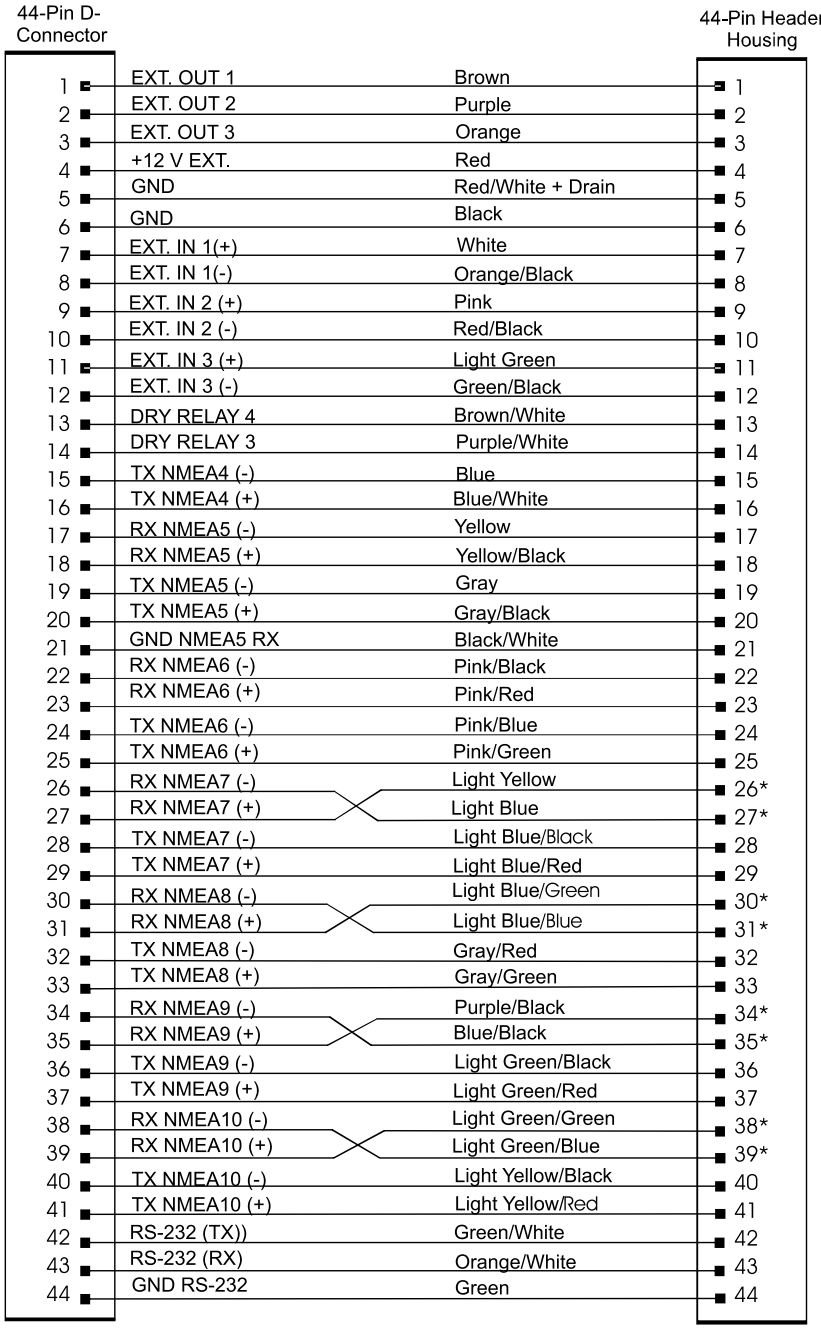




*Figure 5.34 - 44-Pin Cable Assembly Diagram (for the MX512 model only)*

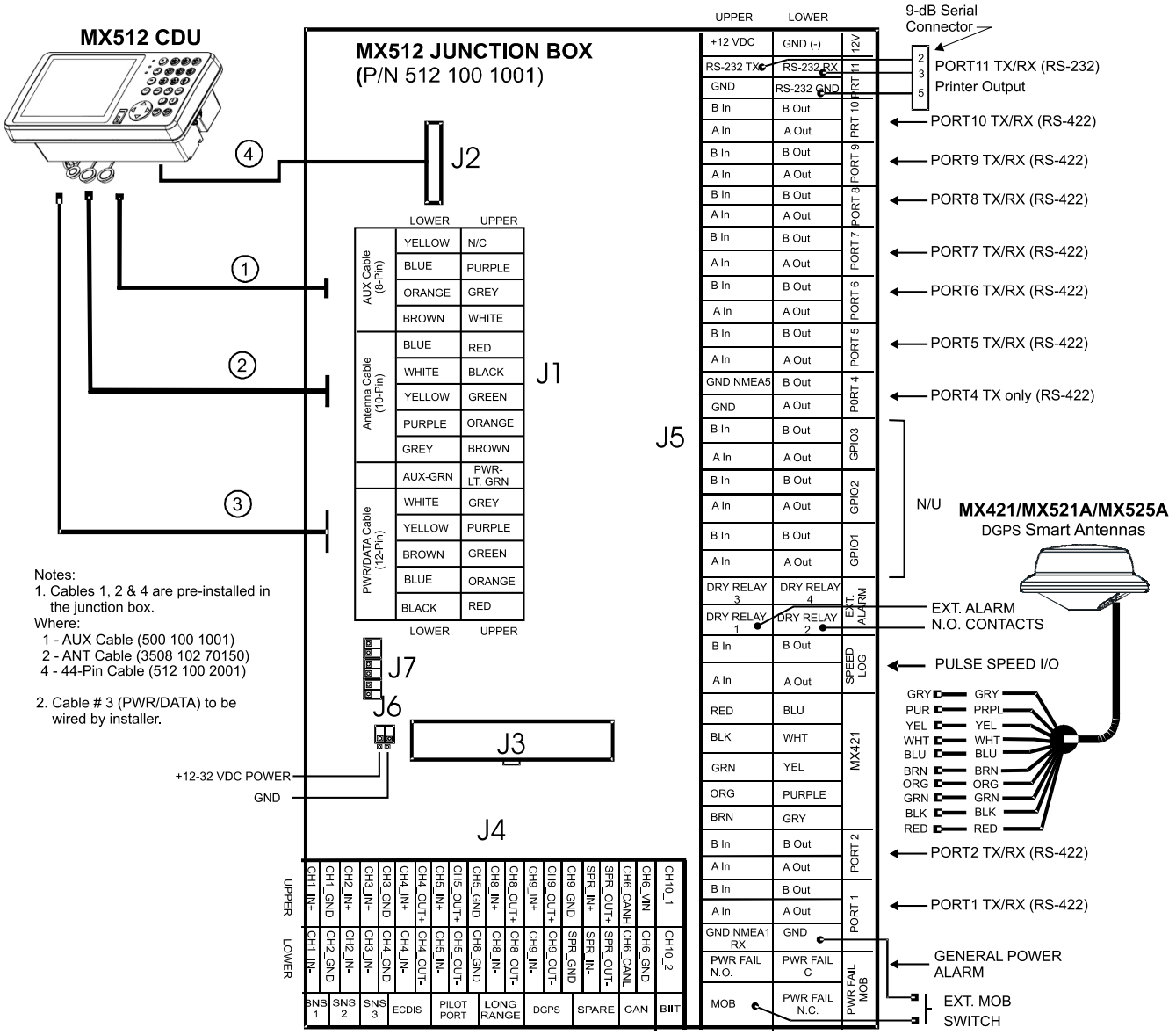



*Figure 5.35 - MX512 and Smart Antenna Junction Box Connection Diagram*

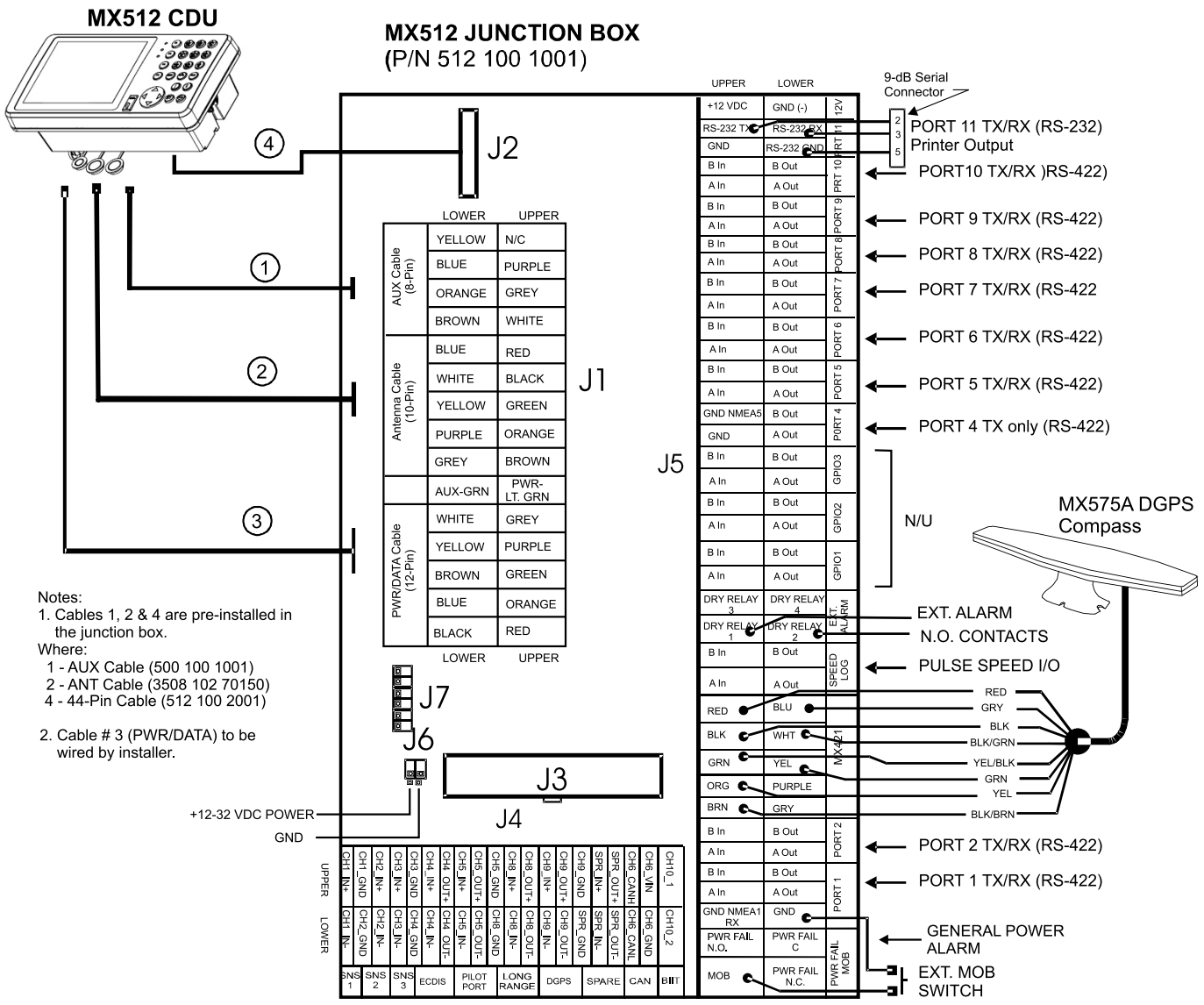



*Figure 5.36 - MX512 and MX575A Junction Box Connection Diagram*

# 6 Technical specifications

## MX51x Control and Display Unit (CDU)

***Display:***

| | |
|---|---|
| Pixels: | 6.4 inch, 1/4 VGA 320 x 240 |
| LCD: | Black and White STN. Matches polarized sun glasses. |
| Viewing dir.: | 6 O'clock. |
| Back light: | CCFL |

***Keyboard:***

| | |
|---|---|
| Type: | Tactile silicone rubber |
| Contact: | Carbon |
| Back light: | Yellow LEDs |

***Front enclosure:***

| | |
|---|---|
| Plastic: | Black ABS/Plastic |

***Back enclosure:***

| | |
|---|---|
| Plastic: | Black ABS/Plastic with EMI conductive spray |

***Connectors:***

| | |
|---|---|
| Power/Data: | 12-Pin Male (LTW) |
| Antenna: | 10-Pin Female (LTW) |
| AUX : | 8-Pin Female (LTW) |
| LAN : | RJ-45 |
| Rear USB: | USB 2.0 |
| Front USB: | USB 2.0 |
| *For MX512 model (Only)* | |
| VGA : | 15 Pin D-Conn. |
| Multi-Port NMEA : | 44-Pin D-Conn. |

***Cables:***

| | |
|---|---|
| Power/Data: | 12-wire (Female Connector), 3 meters |
| Auxiliary: | 8-wire (Female connector), 3 meters |
| Antenna: | 10-Wire (F-F 10-Pin LTW connectors) cable |
| Antenna Cable Lengths: | 3, 20, 40, 60 or 80 meters (order as needed) |
| LAN Crossover Cable: | 2 meters RJ-45 cable Asssembly |
| *For MX512 model (Only)* | |
| VGA Cable: | 2 meter with 15-Pin D-connectors |
| 44-Pin Multi-NMEA Cable: | 2 meter with 44-Pin D-connector and 44-Pin Header connector |

## MX Series Smart D/GPS Antenna

***Receiver GPS:***

| | |
|---|---|
| Type: | L1, 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. |

***Differential Correction***

***Beacon:***

| | |
|---|---|
| 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 |
| SBAS: | WAAS, EGNOS, MTSAT |

## Physical

***MX51x CDU:***

| | |
|---|---|
| Height: | 150 mm |
| Width: | 292 mm |
| Depth overall: | 105.6 mm |
| Depth flush mounted: | 32.9 mm (to wall) |
| Depth for cables: | 150 mm. |
| Weight: | 2.0 lbs. |

***MX521 Antenna:***

| | |
|---|---|
| Height: | 89 mm. |
| Diameter: | 182 mm. |
| Cable: | Choose from 3, 20, 40, 60 or 80 m |
| Weight: | 1.9 lbs. |

## Environmental

***MX51x CDU Console:***

| | |
|---|---|
| Operating Temperature: | -15 to +55 °C. IEC/EN 60945 Ed. 4 |
| Storage Temperature: | -30 to +70 °C. IEC/EN 60945 Ed. 4 |
| Humidity: | IEC/EN 60945 Ed. 4 |
| Vibration: | IEC/EN 60945 Ed. 4 |
| Corrosion: | IEC/EN 60945 Ed. 4 |
| EMI: | IEC/EN 60945 Ed. 4 |
| Water Resistance: | IPC 65 |
| IMO: | MSC 112 (73), IEC 61108-1, IEC 61162-1, IEC 60945 Ed. 4 |
| FCC: | Part 15, Subpart B, Class B |
| Compass Safe Distance: | > 1 m. (Recommended) |

## Power

***MX51x CDU :***

| | |
|---|---|
| Power Supply Type: | DC/ DC switch mode with galvanic separation |
| Consumption: | <11W (display back light on). Typical 8W at 24 volt external supply voltage. Typical 8.7W at 12 volt external supply voltage |
| Supply voltage: | 10.5 to 32 VDC |
| Reverse protection: | -100 volt: internal diode |
| Over voltage protection: | +40 volt: fuse and transient voltage suppression |
| Fuse: resetting | Internal over current / over temperature fuse. Automatic |
| Insulation: | Supply voltage to data pins or shield: Maximum 50 VDC |
| Antenna supply: | 12 VDC, @ 500mA |

***MX Antennas:***

| | |
|---|---|
| MX 421B: | 12 VDC, 280 mA |
| MX 521A: | 12 VDC, 200 mA |
| MX 525A: | 12 VDC, 200 mA |

## MX51x CDU Inputs and Outputs

MX510: 2 NMEA Ports (RS-422)

MX512: 9 NMEA Ports (8x RS-422, 1x RS-232)

The input and output circuits of the serial interfaces meet the requirements of:

- **NMEA 0183** version 1.5, 2.0, 2.1, 2.2 & 2.3
- **IEC 61162-1** including the requirements of **ITU-T V.11**.

***NMEA talker (all outputs):***

| | |
|---|---|
| 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):***

| | |
|---|---|
| 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 |

***LAN***

| | |
|---|---|
| Protocol: | NMEA over TCP/IP, MX proprietary messages |
| Connector: | RJ-45 |

***MOB/ Event input***

| | |
|---|---|
| Insulation: | Maximum ±50 volt, input relative to power supply lines |
| Impedance: | 3.5 Kohm input relative to Reference GND |
| Pull-up: | 15 Kohm to internal 12 volt |
| Threshold: | Positive going maximum 2.3 volt, input relative to Reference GND |
| | Negative going minimum 0.6 volt, input relative to Reference GND |
| | Hysteresis minimum 0.6 volt |
| Protection: | ±25 volt, input relative to shield |
| | ±50 volt, input relative to external power lines |
| Frequency: | Triggered with 50 mS bounce control |
| Pulse width: | Minimum 100 mS |

***Alarm output***

| | |
|---|---|
| Dry Contact: | Normally Open, when not in Alarm state, or after acknowledgement. |
| | Closed to Ref. GND, when in Alarm On state. |

***Antenna voltage output***

| | |
|---|---|
| DC voltage: | 12 VDC, ±1.0 VDC loaded; (11.5 VDC nominal unloaded) |
| DC current: | 500 mA @ 12.0 volt DC |

***Speed Log Pulse Input/output***

| | |
|---|---|
| DC voltage: | 0-12 VDC, pulses |
| Number of pulses: | 100-500 selectable |

# Appendix A - Datum List

The MX51x supports more than 100 datums. Table A-1 provides the names and abbreviations for these datums.

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

Notes

# Appendix B - 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 SIMRAD 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 MX51x.

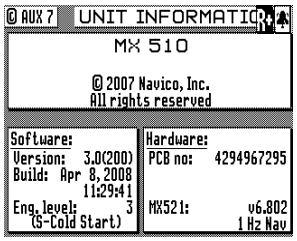
☞ *Information which is not described here is unsupported, which means SIMRAD will not expand or provide any more information than what is provided in this manual.*

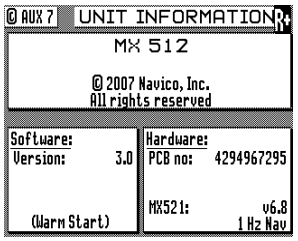
If you should enable these screens, they will be turned off automatically the next time power is cycled on the MX510.

## AUX7 - Unit Information & Self Test

This screen indicates the software version, the hardware configuration, the printed circuit board (PCB) serial number of the main board, the antenna model and software version detected (if available) and AIS transponder (if available).

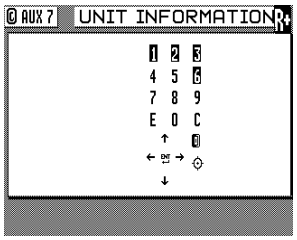
A special key sequence displays sub-version levels, the actual build date and allows access to a selftest sequence. When the *Engineering Display* is active, the AUX7 screen adds one line of detail to display the engineering level that is turned on:

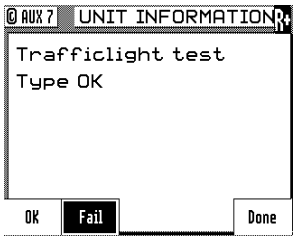


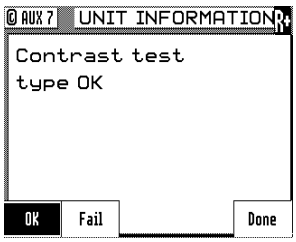

*MX510 AUX7 Screen* *MX512 AUX7 Screen*

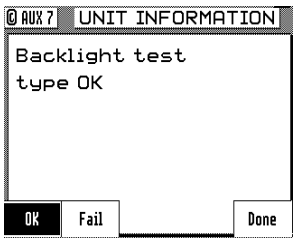
To access the Eng'g screens, press the **EDIT** key and #1 key three times. This will bring up the Eng'g level to mode 3. Pressing the EDIT key will bring up softkeys that you use to run a complete self test by highlighting the *Make Selftest* softkey then pressing **ENT**. The first display of the self 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. Highlight the *OK* softkey then press **ENT** if they illuminate correctly or *Fail* if they don't.



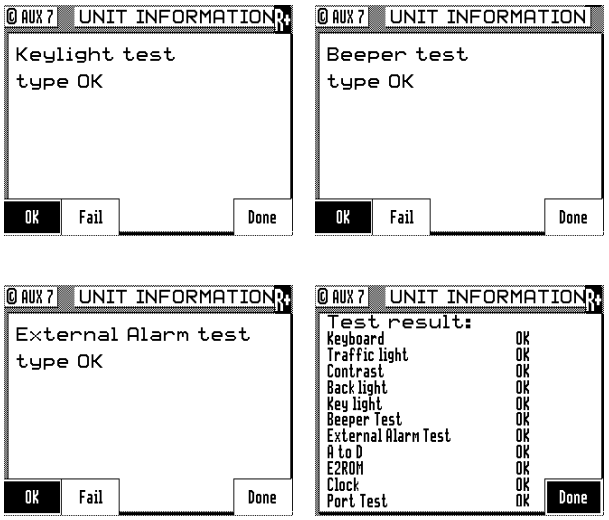




The CDU will go on to conduct a *Contrast* test. Observe that the display goes through its full range of contrast from white to black. Highlight *OK* then press **ENT** if it varies correctly or *Fail* if it doesn't. Next, the CDU will conduct a *Backlight* test. Observe that the display goes through its full range of illumination. Highlight *OK* then press **ENT** 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. Highlight *OK* then press **ENT** if it varies correctly or *Fail* if it doesn't. Next, the CDU will conduct a *Beeper* test. Listen that the internal beeper activates for about a second. Highlight *OK* then press **ENT** if it varies correctly or *Fail* if it doesn't. Finally, the CDU will conduct an *External Alarm* test. Listen that the external alarm activates continuously. Highlight *OK* then press **ENT** 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*), the real-time *Clock,* and the *Serial (NMEA) Ports*. These tests check about 90% of the CDU. The items which it does not check are 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. It is highly recommended to save the database into a USB memory stick prior to doing the cold start procedure.

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

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

## CDU Cold Start - Clearing Memory to Factory Default

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. When you *Cold Start* the CDU, it will erase all of waypoints, routes and configuration settings.

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 highlight the *Yes* softkey then press **ENT**. 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. This is the preferred method.

**2** Hold the **CLR** button down while applying power to the CDU; continue holding the button until you hear a normal *key click* for the softkey.

**3** Release the button.

**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, try the procedure again.

A common source of memory corruption is when the Lithium memory back-up battery gets depleted. This will result in either a slow deterioration of memory retention or it may abruptly dump all its memory.

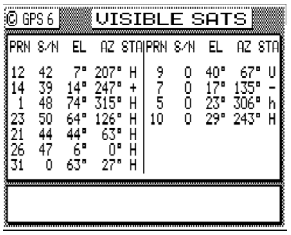
It is recommends the battery be changed every 2 to 3 years of operation by an authorized technical dealer. Marine electronics dealers or radio shops will typically stock the replacement Lithium battery, type TL-5902, 3.6V (1/2 AA).

## GPS - GPS CDU Troubleshooting

### GPS3 - Visible Satellite Information

This screen provides some basic information about the MX Marine-SIMRAD 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.

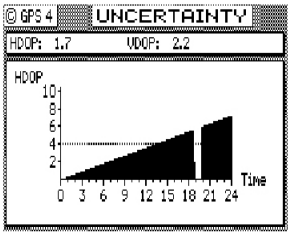
The *EL*, *AZ*, and *STA* values represent the satellite's *Elevation* and *Azimuth*, and Almanac *Status* respectively.




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.

## Antenna Reset Tools

Special tools are available in the MX51x CDU that can be used to reset the GPS and Beacon engines in the smart antenna. Use them only in extreme cases when the GPS or beacon receiver fails or takes too long to lock-on. The "*MX Ant Reset*" softkey will clear the satellite almanac memory of the GPS engine and reset all settings of the antenna to factory default conditions. The "CSI Reset" softkey resets the differential beacon board.

### *Antenna Reset Procedure:*

This procedure will work only under Engineering level mode.

**1** Press the **AUX** key several times to bring up the AUX7 screen

**2** Press the **EDIT** key

**3** Press the '#1' or 'NAV' button 3 times (to bring-up Eng'g level 3)

**4** Press the EDIT key 2 times

**5** Highlight the **"MX Ant Reset"** softkey then press **ENT** to reset the GPS engine (or the **"CSI Reset"** softkey to reset the beacon engine)

**6** Press the **EDIT** key to exit

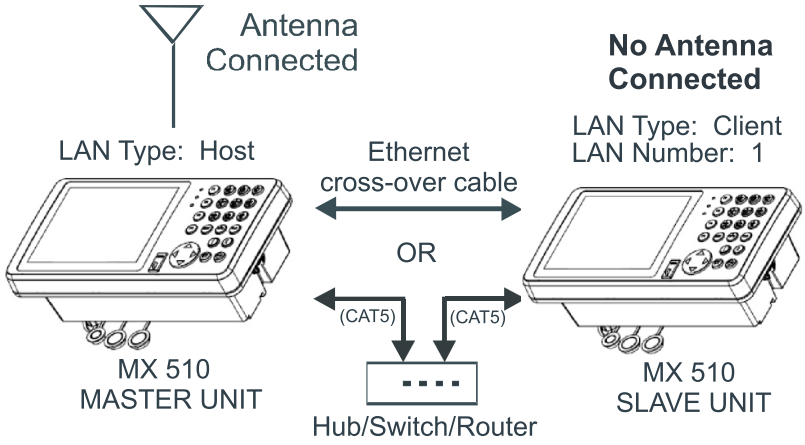
**7** Press the **GPS** key to display the GPS or DGPS Status screen

# Appendix C - Multiple Unit Control (Via LAN)

## Dual Control Configuration:

The Dual Control mode allows you to connect one MX51x as a *Master* and another MX51x as a *Slave* unit. This allows a common data base to be 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 ports, the MOB/Event input port, and the alarm output ports are still available on each unit for individual use on each CDU.

The hardware interface is accomplished by connecting the two units together via the Local Area Network (LAN) port. You can use an Ethernet cross-over (null) cable or a LAN hub (or Ethernet switch). Refer to page 77 of this manual to setup LAN.




The interface between the two units takes place over a high speed (100 Mbps) data link. The master unit must be connected to the antenna. The master unit receives the NMEA signals from the smart antenna and pass it along to the slave unit. 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.

| 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 |

***Table D-1. Master/Slave Common Database***

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

| 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 | |

***Table D-2. Independently Controlled Functions***

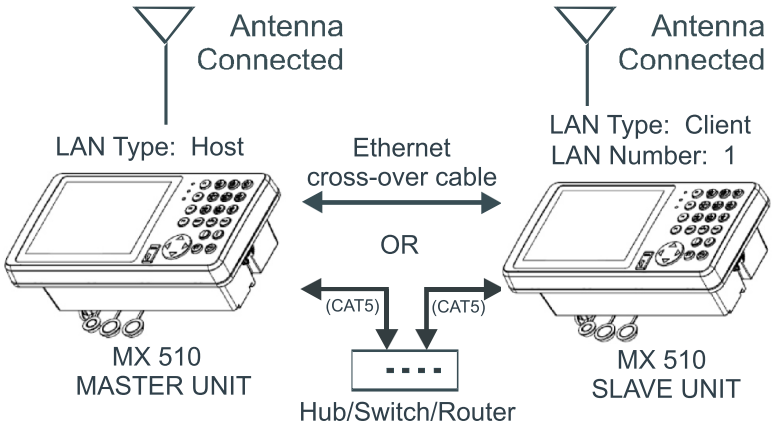
## Turning Master or Slave Units Off

Before turning the power off to either the master or slave unit(s), it is recommended that the dual control function be disabled first. If not, 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.

## Backup Receiver Integrity Monitoring (BRIM)

BRIM is a fault-detection and recovery algorythm in the MX51x software that compares position solutions between two independent systems. Whoever has the best accuracy becomes the unit in control. The basic requirements are; they are both MX51x models with its own GPS/DGPS smart antenna and both have the IM option enabled.

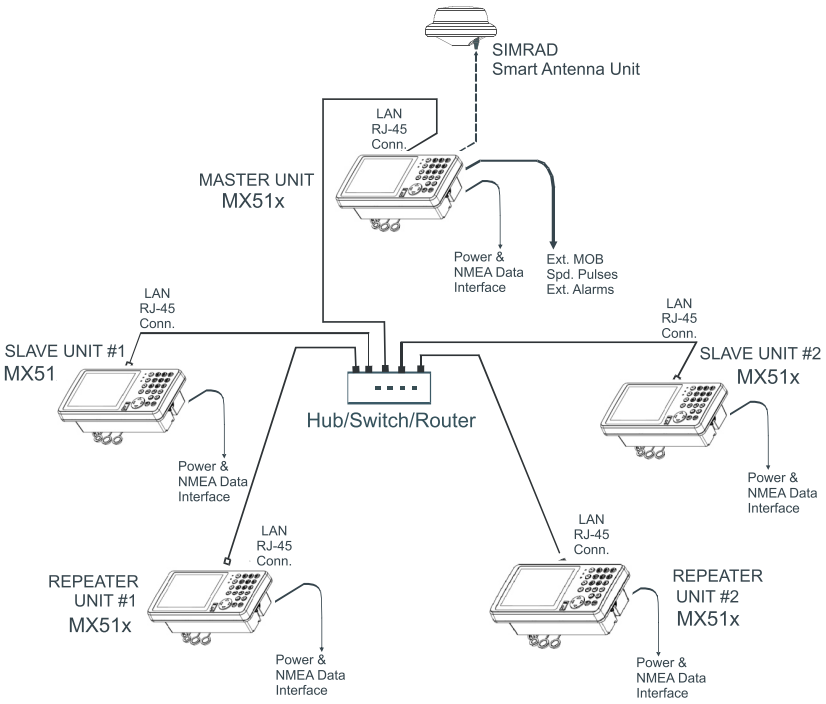
This IM feature can be found under the CFG/Dual Control menu in units that has the IM license. This menu item is normally hidden and will show only when another MX51x unit has been detected.




### Multiple Unit Control Configuration

The Multiple Unit Control mode allows you to connect one MX51x as a *Master*, up to two MX51x as *Slave* units, and up to three MX51x as *Repeater* units. The *Repeater* unit, however, only acts as a display unit. It has no capability to modify any setting unless a password (set by the *Master* unit in *CFG1/Security*) is entered. The Multiple Unit Control system must have a minimum of three MX51x and a maximum of five MX51x units altogether (see Table D-3). The system must have one *Master* and at least one *Slave*. This allows a common data base to be shared among the CDU control heads. This configuration also allows you to use one antenna connected to the Master unit for all CDUs. 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 CDU. This feature can be enabled in the **CFG** *Dual Control* menu.

The hardware interface is accomplished by connecting the units together via an Ethernet switch (or hub). Refer to page 77 of this manual to setup LAN.




The interface among the units takes place over a high speed (100 Mbps) data link. The master unit must be connected to the antenna. The master unit receives the NMEA signals from an MX antenna and pass it along to the slave and repeater units at a one second rate. Due to the high speed data link, there is virtually no visible position delay among the units.

When the units are first configured as master, slave, and repeater, the master unit mirrors to the slaves and repeaters, and the *Common Data Base* (see Table D-1) is downloaded from the master to the slaves and repeaters. 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.

The Table D-3 below shows all the possibilities in the Multiple Unit Control system.

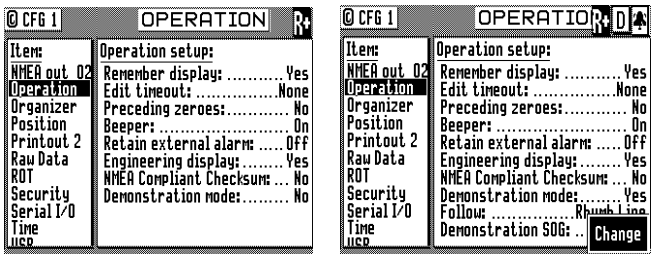
| | Master | Slave | Repeater |
|---|---|---|---|
| **Number of MX510 Units** | 1 | 1 | 1 |
| | 1 | 2 | 0 |
| | 1 | 1 | 2 |
| | 1 | 2 | 1 |
| | 1 | 1 | 3 |
| | 1 | 2 | 2 |

*Table D-3. Multiple Unit Control Configuration*

***Blank page***

# Appendix D - 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 SIMRAD and dealers 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 other devices such as autopilots, chart plotters, and radars.




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

*Follow:*

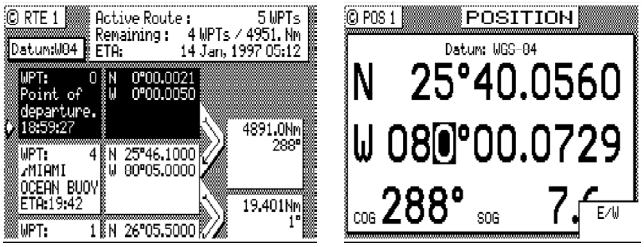
*Active Route:* causes the CDU to use the route loaded in RTE1 screen.

*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.

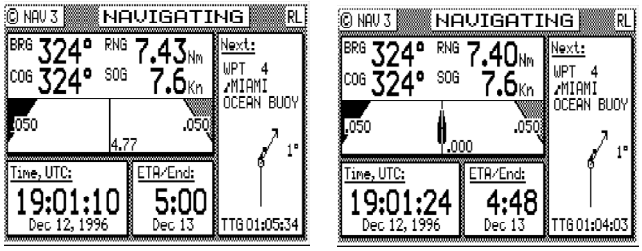
*Demonstration COG:* causes the CDU to simulate a course over ground of up to 359.9 degrees when Follow is set to *Rhumb Line*.

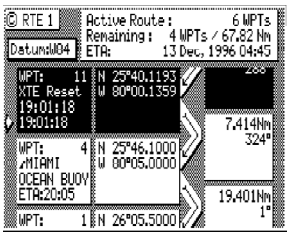
To setup your course, load the desired waypoints into *RTE1*. Notice that the CDU loads your point of departure as N 00, W 000.




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 1or 2 miles from the first waypoint is good to start with. Go to the **POS1** screen and press **EDIT**.

Next, press the **NAV** function key, then the **E** key. Press the *Reset XTE* softkey. Press the **EDIT** 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 may interpret the data as completely valid.* So, don't run the *Demonstration Mode while you are underway.*

# Appendix E - AIS connection for MX512 only

## Introduction

AIS is a shipborne broadcast transponder system in which ships continually transmit their ID, position, course, speed and other data to all other nearby ships and shoreside authorities on a common VHF radio channel.

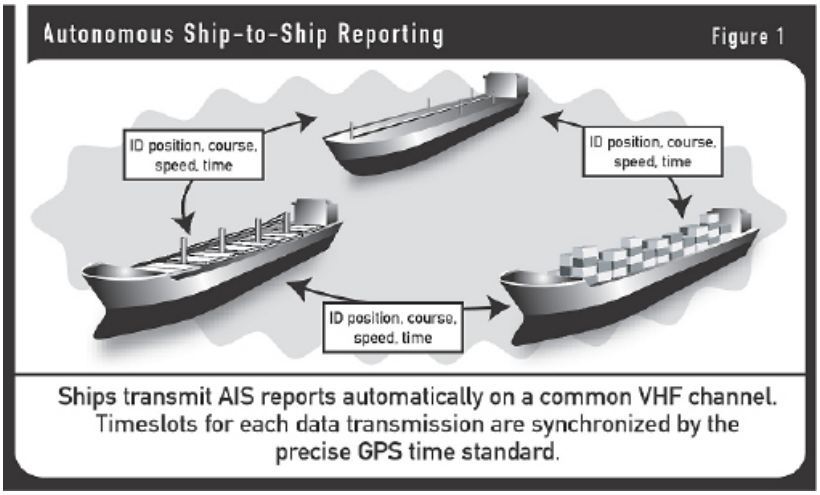
The concept is derived from the pioneering work of a Swedish inventor named Håkan Lans, who developed in the mid 1980s an ingenious technique for spontaneous, masterless communication, which permits a large number of transmitters to send data bursts over a single narrowband radio channel by synchronizing their data transmissions to a very precise timing standard.

AIS is designed to operate in one of the following modes:

- In a ship-to-ship mode for collision avoidance
- In a ship-to-shore mode as a means for coastal states to monitor and obtain information about a ship and its cargo
- As a traffic management tool when integrated with a Vessel Traffic System (VTS)

## Ship-to-Ship Data Exchange

The primary operating mode for AIS will be autonomous ship-to-ship reporting. In this mode, each ship transmits its data to all other AIS-equipped ships within VHF range. The unique communications scheme permits these data transmissions to take place independently without the need for a master control station.




Position and other data are fed automatically from the ship's sensors into the AIS system, where the data is formatted and transmitted in a short data burst on a dedicated VHF channel. When received on the other ships, the data is decoded and displayed for the officer of the watch, who can view AIS reports from all other "Class A" and "Class B" AIS-equipped ships within range in graphic and text format.

The AIS data may optionally be fed to the ship's integrated navigation systems and radar plotting systems to provide AIS "tags" for radar targets. The AIS data can also be logged to the ship's Voyage Data Recorder (VDR) for playback and future analysis.

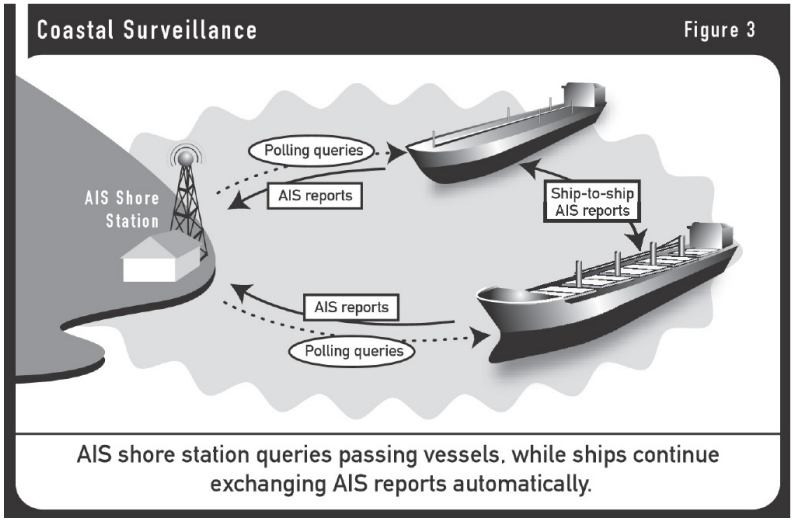
Updated AIS messages are transmitted every few seconds, to keep the information up to date. Note that the ship-to-ship data exchange takes place automatically without any action required by the watch officer on either ship.

In pilotage waters, a pilot can plug a laptop computer, loaded with his own navigation program, directly into the ship's AIS system. In this way, the pilot can monitor the position and movement of all other vessels in the area independent of the ship's installed navigation systems.

## Coastal Surveillance

In coastal waters, shoreside authorities may establish automated AIS stations to monitor the movement of vessels through the area. These stations may simply monitor AIS transmissions from passing ships, or may actively poll vessels via the AIS channels, requesting data such as identification, destination, ETA, type of cargo and other information.

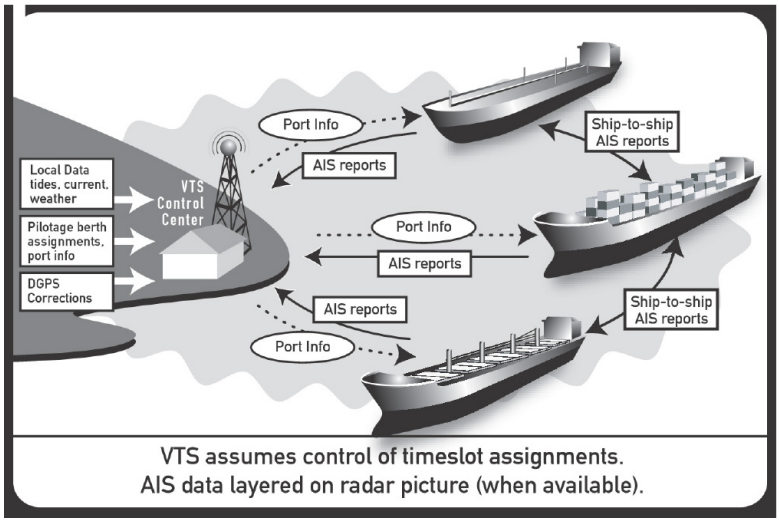
Coast stations can also use the AIS channels for shore-to-ship transmissions, to send information on tides, notices to mariners and local weather forecasts. Multiple AIS coast stations and repeaters may be tied together into Wide Area Networks (WAN) for extended coverage.




Coastal nations may use AIS to monitor the movement of hazardous cargoes and control commercial fishing operations in their territorial waters. AIS data can be logged automatically for playback in investigating an accident, oil spill or other event. AIS is also a useful tool in search and rescue (SAR) operations, allowing SAR coordinators to monitor the movements of all surface ships, aircraft and helicopters involved in the rescue effort.

## Vessel Traffic Systems

When integrated with shore-based vessel traffic systems (VTS), AIS provides a powerful tool for monitoring and controlling the movement of vessels through restricted harbors and waterways. The AIS can augment traditional radar-based VTS installations, providing an AIS "overlay" on the radar picture, or can provide a cost-effective alternative in areas where it is not feasible to establish radar-based systems. When integrated with radar, the AIS can ensure continuous coverage, even when the radar picture is degraded by heavy precipitation or other interference.




The AIS channels can be used to transmit port data, pilotage, berth assignments,

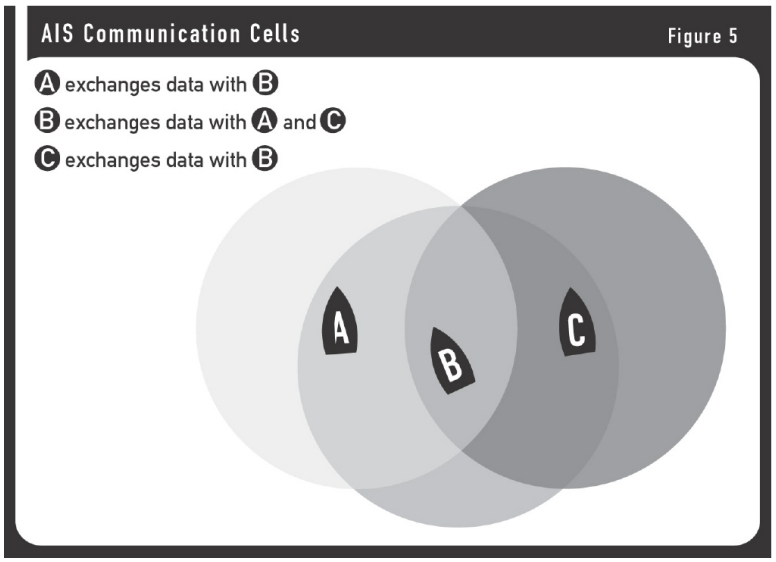
shipping agency information, tides and currents, notices to mariners and other information from shore to ship, as well as ship-to-ship and ship-to-shore AIS reports.

It is also possible for the VTS to broadcast the complete harbor picture to all ships in the area, so the masters and pilots all share the same "big picture."

The VTS center can assume control over the assignment of time slots for AIS messages to ensure optimum data exchange within the coverage area. Special dedicated channels may be designated for local-area AIS operations. The shipboard AIS equipment will have the ability to shift to different channels automatically when directed by the shoreside VTS controller.

### AIS Communications Scheme

AIS messages must be updated and retransmitted every few seconds at a minimum, since the usefulness of the data decays rapidly as a function of time. To accommodate this high update requirement, AIS utilizes a unique self-organizing time-division multiple access (SOTDMA) data communications scheme, which uses the precise timing data in the GPS signals to synchronize multiple data transmissions from many users on a single narrowband channel.




Each ship broadcasts its AIS messages and receives messages from all ships within VHF radio range. The area in which AIS messages can be received is called the ship's "cell". Each ship is in this way in the center of its own communication cell.

The practical size of the cell can be varied according to the traffic density on the AIS channel. If the number of AIS messages begins to overload the network, the ship's AIS system can automatically shrink its cell by ignoring weaker stations further away in favor of those nearby.

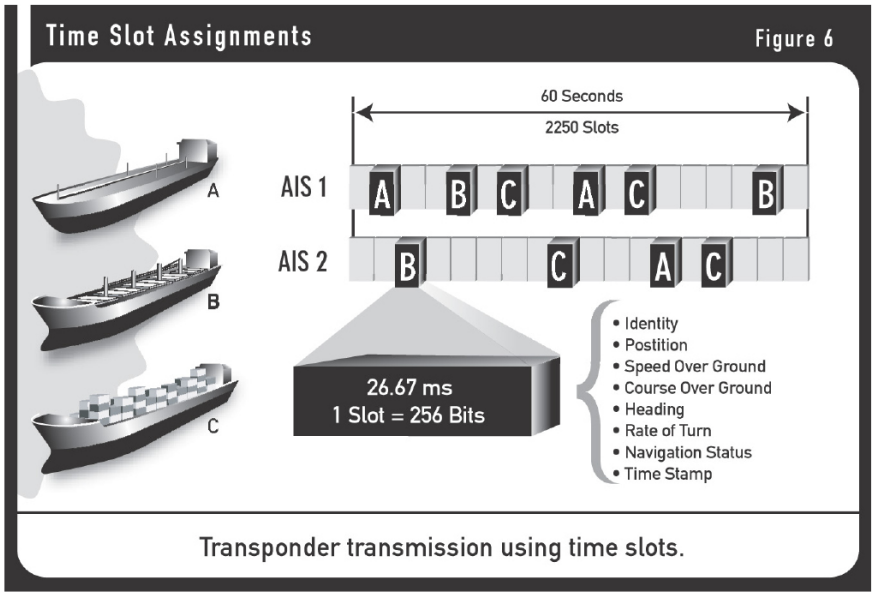
Under the SOTDMA protocol, each minute of time is divided into 2,250 timeslots. An AIS report fits into one or several of these 2,250 timeslots, which are selected automatically based on data link traffic and projections of future actions by other stations currently on the network. When a ship first enters the cell of another ship, it takes an unoccupied timeslot. The AIS stations continually synchronize their slot selections with each other.

Timeslots and time-out periods are selected on a randomized basis. When a station changes its slot assignment, it announces to all other stations on the channel its new location and time-out for that location. Each station continually updates its internal "slot map" to reflect changes in occupied slots and time-outs. Special provisions are made for automatic conflict resolution in the event two stations end up in the same timeslot, to ensure that stations always choose unoccupied slots.

In situations of high traffic density it may be necessary to reduce the number of ships in a communication cell, as described above. This enables time slots used by weak stations far away, to be used also by a station nearby. The AIS system applies very specific rules on how this reoccupation of timeslots is done.

The key to the SOTDMA scheme is the availability of a highly accurate standard time reference, to which all of the stations can synchronize their time slot assignments, in order to avoid overlap. This time reference is supplied by the precise timing signal in the

GPS satellite message. Thus, GPS plays a critical role in AIS, providing the universal time reference as well as positioning data for each ship.




AIS data transmissions utilize a robust 9.6 kbps FM /GMSK (Gaussian Minimum Shift Keying) modulation technique, which is specified in ITU Recommendation M.1371.1. The International Telecommunications Union (ITU) has designated two dedicated frequencies for AIS. They are 161.975 MHz (marine band channel 87B) and 162.025 MHz (channel 88B). In some parts of the world, such as the United States, where these frequencies may not be available for AIS, other channels may be designated.

The MX535A transponder has two independent VHF receivers, which are normally tuned to the two AIS frequencies, as well as one transmitter, which alternates its transmissions back and forth between the two. It can also be retuned to other frequencies, for instance when operating under the control of a shore-based VTS. This can be done either manually or remotely by the AIS shore station.

## AIS Message

AIS is designed to work autonomously and continuously in a ship-to-ship mode, but the specifications provide for switchover to an "assigned mode" for operation in an area subject to a competent authority responsible for traffic monitoring, with the data transmission intervals and timeslots set remotely by the shoreside authority. Alternatively, the AIS can work in a "polling mode" in which the data transfer occurs in response to interrogation from another ship or shore station.

**Information provided by the AIS falls into several categories:**

*Static data*

- IMO number (where available)
- Call sign and name
- Ship's name
- Type of ship
- Location of position-fixing antenna on the ship
- (aft of bow and port or starboard of centerline)

*Dynamic data*

- Ship's position with accuracy indication and integrity status
- Time in UTC
- Course over ground
- Speed over ground
- Heading
- Navigational status (e.g., "at anchor," "not under command,"

- manually entered)
- Rate of turn (where available)

*Voyage related data*

- Ship’s draft
- Hazardous cargo (type)
- Destination and ETA (at master’s discretion)

*Safety-related messages*

- As needed

Dynamic information is derived from interfaces with the ship’s GPS and other sensors. Static information is programmed into the unit at commissioning. Voyage-related data is entered manually by the master through a password-protected routine. Safety messages can be inserted at any time by the ship or shore station.

The static and voyage-related data are transmitted every six minutes, when amended or on request (for instance, when interrogated by a Vessel Traffic System operator). Safety messages are sent as needed. The update rates for dynamic information will depend on the ship’s status and speed, according to the following schedule:

| **Dynamic information schedule** | |
|---|---|
| At anchor | 3 minutes |
| 0-14 knots | 10 seconds |
| 0-14 knots and changing course | 3.3 seconds |
| 14-23 knots | 6 seconds |
| 14-23 knots and changing course | 2 seconds |
| 23+ knots | 2 seconds |
| 23+ knots and changing course | 2 seconds |

he AIS specifications also allow for insertion of brief binary messages from ships or shore stations. Such messages might include notices to mariners, navigational warnings, tides and currents, weather forecasts, SAR communications and ship-specific instructions from a VTS operator. The AIS standard also includes formats for transmission of differential GPS error correction data. This can provide valuable redundancy to existing beacon DGPS systems in critical navigation areas.

### MX512/AIS the Total Shipboard GPS/DGPS/AIS Solution

There are two AIS licenses available for the MX512 CDU model, namely:

- MX512/ Basic MKD, and
- MX512/AIS Navigation

The Basic MKD license provides control and display interface to the MX535A AIS transponder and other navigation sensors, while the MX512/AIS does all this and also provides complete DGPS navigation functionality.

The basic MX512/MKD system incorporates:

- MX512 Control and Display Unit (CDU) with MKD license
- MX535 Class "A" AIS transponder

The MX512/AIS with navigation system incorporates:

- MX512 Control and Display Unit (CDU) with AIS license
- MX521A DGPS smart antenna
- MX535 Class "A" AIS transponder

The MX512 Navigation System is built to meet all existing applicable international marine standards, and it is designed to be compliant also to future standards through software upgrades.

The MX512 CDU collects and decodes AIS reports from other stations and provides a readout of information from all AIS-equipped ships and shore stations. Data can be viewed in text or graphic form. It gathers inputs from ship's sensors and organizes the data for transmission via AIS.

The CDU is also used for entering AIS static and voyage-related information for AIS broadcasts, as well as system setup functions. High-speed serial data ports are provided for outputs to the ECDIS, ARPA or other shipboard systems. An extra port has been provided for a ship's pilot to plug into the AIS system.

## AIS System Setup

Prior to using the MX512/AIS CDU, it is necessary to configure the AIS menus under the CFG key, namely:

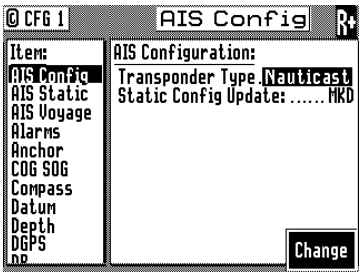
- **AIS Config**
- **AIS Static**
- **AIS Voyage**

### AIS Config Setup

The MX512/AIS was designed to work with three types of AIS transponder systems. The "Transponder Type" menu provides selection to:

- Nauticast (MX535A) (default selection)
- SAAB R3 (MX432)
- ATLAS (MX531)

The "Static Config Update" menu is used to determine where the "AIS Static" configuration information can be updated from. Two possible selections are the MKD (MX512/AIS) or ECDIS (a PC-based charting system). This setting is important to determine where the configuration setup will be done and to ensure that all subsystems contain the same AIS configuration information.



Follow the procedure below to select the "Transponder Type" and "Static Config Update" settings:

**1** Press the **CFG** key.

**2** Scroll to the **AIS Config** menu.

**3** Press the **EDIT** key (the default value will be on Nauticast).

**4** If not, press the ENT key to activate the '**Change**' softkey to toggle to Nauticast.

**5** If you need to pass control to ECDIS, press the Down arrow key to highlight the "Static Config Update" line.

**6** Press the ENT key to activate the '**Change**' softkey to ECDIS (MKD is the default selection).

**7** Press the **EDIT** to exit.

## AIS Static

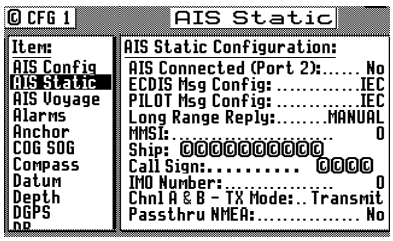
The AIS Static menu contains both the ship's static data and AIS transponder configuration.

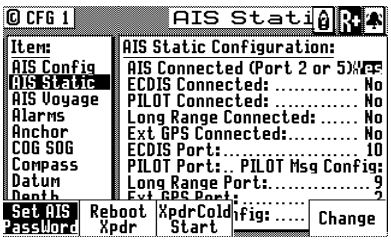
Critical AIS static setup items (such as MMSI, IMO, Ship name & Call Sign) are password protected. Setup items that require administrator password are indicated in the Display Field Descriptions below. If an invalid or missing password is used, an 'AIS Alarm' is displayed and the entry will be rejected. Acknowledge the 'Cancel alarm' softkey by pressing the ENT key to continue.

Follow the procedure below to enter the required AIS static information :

**1** Press **CFG** key.

**2** Scroll to the **AIS Static** under the 'Item' column.




**3** Press the **EDIT** key to bring up the cursor on AIS Static setup.

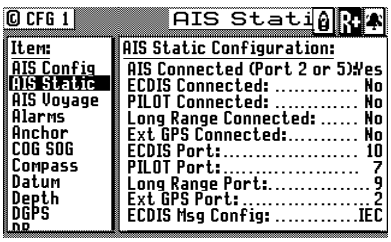
**4** The cursor will be on "AIS Connected (Port 5): - No". Move the highlight to CHANGE softkey and press the ENT key to change the value to "Yes".

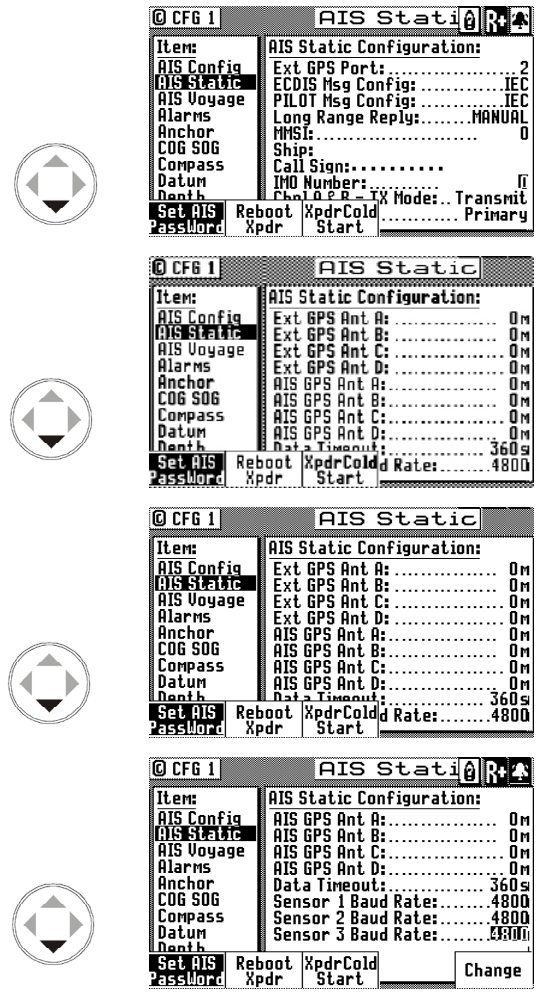
**5** Using the left arrow key, highlight the "Set AIS Password" softkey then press the ENT key.

**6** Using the alphanumeric keys, enter the password "admin", highlight the DONE softkey and press the ENT key to accept the password.

**7** Scroll down to other required AIS setup items and enter the values or press the ENT key to activate the Change softkey to toggle the value.

**8** Press the **EDIT** key when you are done editing the AIS Static menu. More AIS Static configuration parameters are available by scrolling down using the down arrow cursor key as shown in the following pages.






***Note:*** *A total of 35 lines are available under the AIS Static menu. If only 10 lines are available when you scroll down, the MX512 may not be communicating with the transponder. Verify that the "AIS Connected" value is set to YES and the correct transponder type is selected.*

***Display Field Descriptions:***

**AIS, ECDIS, PILOT, Long Range, Ext. GPS Connected:**

Highlight the Change softkey then press the ENT key to select Yes or No. Yes means that the selected unit is connected to the MX512.

**ECDIS, PILOT, Long Range, Ext. GPS Port:**

Use the Change softkey to select the serial port number to which the device is connected. "AIS Port" is pre-selected to NMEA5, Long-Range Communication port is NMEA 9, ECDIS is on NMEA 10 and the Pilot port is on NMEA 7.

**ECDIS and PILOT Msg Config:**

Use the Change softkey to select between IEC or PAIS protocol for the communication standard used with the associated device. IEC protocol is preferred for most AIS interface.

**Long Range Reply:**

Use the Change softkey to select between AUTO, Manual or Off. In Manual mode, the user is prompted to reply to the Long-Range system when interrogated. In Auto mode, the MX512/AIS automatically sends a reply when interrogated. In Ext. Appl (External Application) mode, the MX512/AIS passes the request onto the high-speed ports (ECDIS & Pilot), and waits for their response to prepare answer back to long range system.

**MMSI:**

A unique 9-digit Maritime Mobile Service Identity number used for identification of ship and message (administrator password required).

***Note:*** *When editing critical transponder setup items use the administrator password "admin".*

**Ship:**

Enter the vessel name up to 20 characters (administrator password required). The symbol ©©©©© indicates name is not available.

Call Sign:

Enter the 7 character vessel's call sign (administrator password required). The symbol ©©©© indicates call sign is not available.

**IMO Number:**

Enter the 9-digit IMO identification number when available (administrator password required).

**Chnl A and B TX Mode:**

Use the Change softkey to select between Transmit or Silent (administrator password required).

**MX Ant.and External GPS:**

Use the Change softkey to select between Primary and Secondary. The MX Ant is defaulted as the primary source of GPS data while the Ext. GPS is set as the secondary.

**MX Ant A, B, C, D:**

These are four dimensions from the bow, stern, port beam, and starboard beam to the horizontal reference point on the ship for the MX421 GPS antenna used by the MX512/ AIS unit. The sum of A + B is the length of the ship in meters, and the sum of C + D is the width of the ship in meters. Default values are zeroes.

**Ext GPS Ant A, B, C, D:**

Specify the position offset of the external GPS antenna (similar to the Int. GPS Ant A,B,C,D).

**AIS GPS Ant A, B, C, D:**

Specify the position offset of the GPS antenna used in the MX423 AIS transponder (administrator password required).

**Data Timeout:**

Normally set to 360 seconds. Controls the time the AIS target is displayed before it is dropped out of the PLOT3 screen if no new message is received.

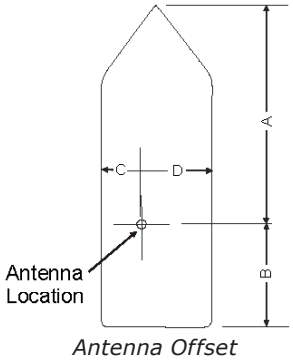
Sensor 1, 2 or 3 Baud Rate:

Controls the output baud rate speed of the MX535A Sensor ports. Default is 4800 baud.

*Softkey Descriptions:*

Set AIS PassWord Used to enter the administrator password to change critical AIS transponder setups that require the administrator password.

Change Used to toggle through various selections available in the field.




*Antenna Offset*

***How to change transponder settings under the AIS Static configuration using the administrator password?***

**1** Press the CFG key

**2** Highlight the AIS Static menu.

**3** Press the EDIT key to bring up the cursor.

**4** Highlight the Change softkey and press the ENT key to change the AIS Connected Port 5 to YES.

**5** Move the cursor down to MMSI, Ship or Call Sign field.

**6** Highlight the Set AIS PassWord softkey and press ENT.

**7** Enter the administrator password (i.e. admin)

To enter the example password "admin" do the following:

**a** Press the #1 key to bring up the lowercase letter "a".

**b** The cursor will advance to the next character.

**c** Press #2 key 1 time to bring-up the letter "d".

**d** Press the #5 key one time for letter "m".

**e** Press the #3 key 3 times for letter "i".

**f** Press the #5 key 2 times for letter "n".

**g** Press the Done softkey.

**8** Move the cursor to the MMSI number and enter the desired value.

**9** Move the highlight to "Ship:" and spell out the name of the vessel (up to 20 alphanumeric characters).

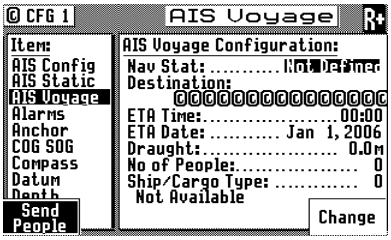
**10** Move the highlight to "Call Sign:" and enter up to 7 characters.

**11** To change other setup items use the cursor key to scroll down or up and enter the number or name required or press ENT key to activate the Change softkey.

**12** At the end of editing, press the EDIT key to exit.

## Configuring the AIS Voyage

Information about the ship's destination, ETA time and date, number of passengers/crew and type of vessel are entered in the MX512 for each voyage or whenever needed.




AIS Voyage Parameter Descriptions:

Nav Stat - This setup item controls the AIS status icon shown on the upper-right corner of the display. Below are all available nav-stat icons and descriptions. Highlight the Change softkey and press the ENT key to change the navigation status.

**Destination** - Enter the 20 character destination name. A string of ©©©©© indicates the destination has not been set.

**ETA Time** - Enter the estimated time of arrival at the desired destination.

**ETA Date** - Enter the estimated date of arrival at the desired destination.

**Draught** - Enter draught height in meters.

**No. of People** - Enter the number of people on board (1-8191).

**Ship/Cargo Type** - Use the Change softkey to toggle ship cargo choices. Refer to table

A.2 for possible ship type values (0-255).

***Softkey Descriptions:***

- used to toggle through various values available in the field.

- this softkey sends the information about the number of people on-board to the transponder for broadcasting.

***Nav Stat Icons and Descriptions:***

 - Vessel underway

 - Not Defined

 - Vessel not commanded, limited maneuverability, limited by draught, aground or reserved for future use.

 - Ship is anchored or moored

 MX512 is not communicating with transponder

**Note:** *The displayed icons located on the top-right corner of the screen is set to blink off and on every 3 seconds to allow the operator to see what is behind it and is not considered an alarm condition.*

**Table A.2 ID Numbers Used in AIS**

| ID Number | Special Craft |
|---|---|
| 50 | Pilot Vessel |
| 51 | Search and Rescue Vessel |
| 52 | Tugs |
| 53 | Port Tenders |
| 54 | Vessels with Anti-Pollution Facilities or Equipment |
| 55 | Law Enforcement Vessels |
| 56 | Spare – For assignment to local vessel |
| 57 | Spare – For assignment to local vessel |
| 58 | Medical Transports (As defined in the 1949 Geneva Conventions and Additional protocols) |
| 59 | Ships according to Resolution No. 18 (Mob-8.3) |

**Other Ships**

| First Digit (*) | Second Digit (*) | First Digit (*) | Second Digit (*) |
|---|---|---|---|
| 1 - Reserved for future use | 0 – All ships on the type | - | 0 - Fishing |
| 2 - WIG | 1 – Carrying DG, HS, or MP IMO hazard of pollutant category A. | - | 1 - Towing |
| 3 - See right column | 2 – Carrying DG, HS, MP IMO hazard or pollutant category. | 3/vessel | 2 – Towing and length of the tow exceeds 200m or breadth exceeds 25m |
| 4 - HSC | 3 – Carrying DG, HS, MP IMO hazard or pollutant | - | 3 – Engaged in dredging or underwater operations |

| | | | |
|---|---|---|---|
| 5 - See above | 4 – Carrying Carrying DG, HS, MP IMO hazard or pollutant category C. | - | 4 – Engaged in diving operations |
| | 5 – reserved for future use | - | 5 – Engaged in Military Operations |
| 6 - Passenger Ships | 6 – reserved for future use | - | 6 - Sailing |
| 7 - Cargo Ships | 7 – reserved for future use | - | 7 – Pleasure craft |
| 8 - Tankers | 8 - reserved for future use | - | 8 – reserved for future use |
| 9 - Other Types of ships | 9 - No additional information | - | 9 - reserved for future use |

DG - Dangerous Goods

HS – Harmful Substances

MP – Marine Pollutants

(*) Note: The identifier should be constructed by selecting the appropriate first and second digit

## AIS Function Key

Several AIS display pages are available under the AIS key. Pressing the AIS key repeatedly will scroll through the following AIS screens (paging can also be done by using the left or right arrow keys after pressing the AIS key), namely:

AIS1 - OWN SHIP DATA

AIS2 - REMOTE SHIP LIST

AIS3 - RX SAFETY MSGS

AIS4 - TX SAFETY MSG

AIS5 - TX SAFETY LIST

AIS6 - REGIONAL AREAS

AIS7 - LONG RANGE LIST

AIS9 - AIS Status

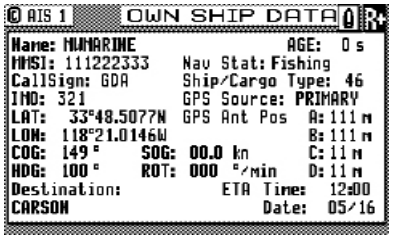
AIS11 - SECURITY LOG

AIS12 - REMOTE SHIP EPFS

AIS13 - REMOTE SHIP DATA

## AIS 1 – OWN SHIP DATA

This display shows the ship's information transmitted by the AIS transponder. Information such as ships's name, MMSI #, call sign, IMO #, ship type/cargo, navigation status are all configured under the AIS Static setup, while the destination and ETA are taken from the AIS Voyage setup. It also gives you an idea which GPS is being used under the GPS Source field and its antenna offset data.



***Display Field Descriptions:***

**Name:** Vessel's name

**MMSI:** Maritime Mobile Service Identity number used for identification of ship and message

**Ship/Cargo Type:** Ship & Cargo Type (see table A-1 for values)

**Age:** Age of the information on the display, in seconds

**Nav Stat:** Navigation status as entered in AIS Voyage setup

**Call Sign:** Assigned radio call sign of the vessel

**IMO:** International Marine Organization number (when available)

**GPS Source:** Source of the GPS information in use. The choices are Primary (MX421, MX521 or MX525 smart GPS sensors), Secondary (external GPS attached to the MX512 CDU), and Backup (Transponder GPS).

**Lat/Lon:** Position fix of the GPS in use

**GPS Ant Pos:** In-use GPS Antenna location (A, B, C & D values see below) with reference to aft of bow and port or starboard of centerline.

**HDG:** Gyro reading, in degrees

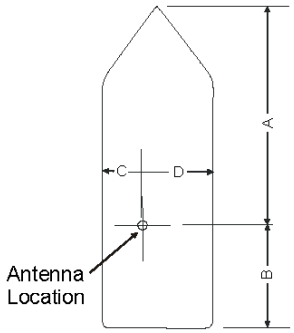
**COG:** Course Over Ground (degrees)

**ETA:** Estimated time of arrival (date & time)

**ROT:** Ship's Rate-Of-Turn, in degrees per minute

**SOG:** Speed Over Ground (knots)

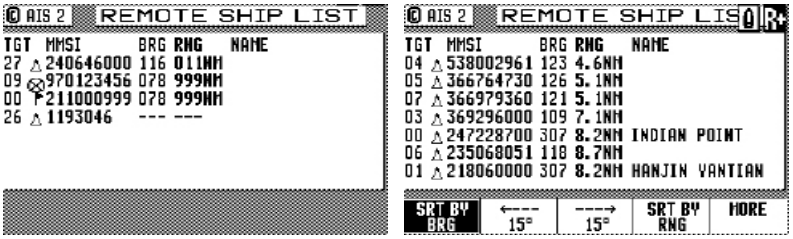
**Destination:** Operator entered destination under the AIS Voyage setup screen

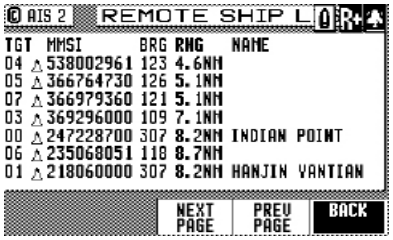



*GPS Antenna Offset Diagram*

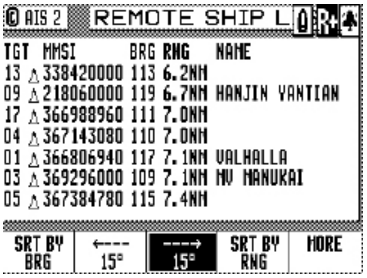
## AIS 2 - Remote Ship List

This display shows a list of ships equipped with AIS transponders that are being tracked within VHF range. The list can be sorted by range from your location or by bearing. Because of space limitation, only 7 vessels are displayed per page. More data can be displayed by pressing the EDIT key, highlighting the MORE softkey then pressing the ENT key to bring up the NEXT PAGE softkey. Using the Up or Down arrow keys will also scroll through the list of targets.




Pressing the ENT key when the SRT BY BRG softkey is highlighted will show the display below (note the BRG range indicated on the top-right corner of the display). You can scroll left or right by highlighting the ←--- 15° or ---→ 15° softkey and then pressing the ENT key to list other ships around you in 15 degree increments.




***Display Field Description:***

**TGT:** Target number of MMSI database for quick vessel access. TGT corresponds with vessels shown on the PLOT3 display. The icon indicates the vessel type.

*AIS2 icons and their meaning:*

 Class "A" or Class "B" AIS vessel

 Aircraft involved in SAR operation

 Search and Rescue (SAR)

 Aid to Navigation

**MMSI:** Defines the unique vessel ID

**RNG:** Range (meters) from your ship to the remote vessel

**BRG:** Bearing (degrees) from your ship to the remote vessel

**NAME:** Name of remote vessel

*Softkey Descriptions:*

SRT BY BRG - User can choose to have a list of MMSIs displayed in 15 degrees increments.

←--- 15° - Shift bearing search by 15 degrees left

<--- 15° - Shift bearing search by 15 degrees right

SRT BY RNG - User can choose to display the MMSIs by distance relative to the vessel

MORE - Additional softkeys are available

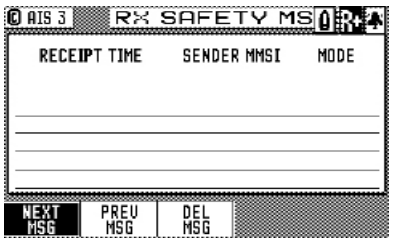
NEXT PAGE - Shows the next 7 MMSIs

PREV PAGE - Shows the previous 7 MMSIs

BACK - Return to the original softkey setup

## AIS 3 - RECEIVED (RX) SAFETY MESSAGES

This display stores all AIS safety messages broadcast by other AIS stations or messages addressed to your ship. The MX512/AIS will retain the last 100 messages received. You have the option to manually delete the message by pressing the DEL MSG softkey. When the number of messages exceeds 100, the oldest message will be overwritten.




*Display Field Descriptions:*

**RECEIPT TIME** - Date and time the message was received

**SENDER MMSI** - MMSI of the originator of the message

**MODE**

**ADDRESSED** - sent only to one particular vessel

**BROADCAST** - sent to all vessels

**Text Message received.**

*Softkey Descriptions:*

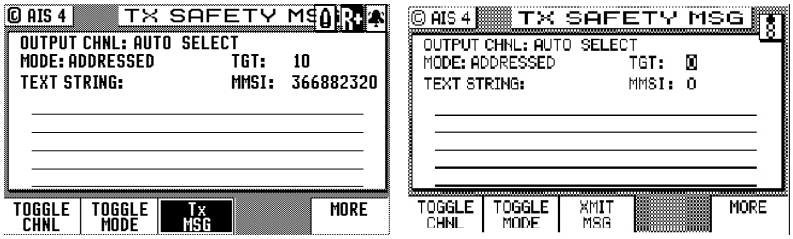
NEXT MSG - highlight this softkey and press the ENT key to display the next message received (maximum of 100 messages are stored in memory)

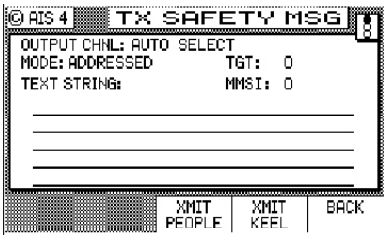
PREV MSG - highlight this softkey and press the ENT key to display the previous message received

DEL MSG - delete the displayed message

## AIS 4 - TRANSMIT (TX) SAFETY MESSAGE

This display allows you to write and send short text messages dealing with safety at sea and broadcast it to all AIS equipped vessels or address it to a specific station.






*Display Field Descriptions:*

**OUTPUT CHNL** - This field specifies which channel is to be used for sending the safety message. User can scroll through four different settings. The data displayed in this field can be altered by pressing the Edit key then highlight the TOGGLE CHNL softkey and press the ENT key repeatedly to toggle through 4 choices, namely: Auto Select, Channel A, Channel B or Both A&B. Default value is Auto Select.

**MODE-** This field shows whether the message is to be sent to a specific MMSI (addressed) or to all (broadcast). Highlight the TOGGLE MODE softkey and press the ENT key to select either ADDRESSED or Broadcast

**TGT** - This field gives the short target number which is directed to the appropriate MMSI.

MMSI - This field indicates the MMSI number related to the target (TGT) number selected to send the text message.

**TEXT String** - Enter the text message to be sent using the alphanumeric keypad.

*Softkey Descriptions:*

The softkeys can be displayed by pressing the **EDIT** key first.

TOGGLE CHNL- Each time this soft key is activated, the transponder channel selection is changed. The following values are available:

AUTO SELECT - transponder determines on which channel to broadcast the information

CHANNEL A - broadcast on channel A only

CHANNEL B - broadcast on channel B only

BOTH A & B - broadcast on both channels

TOGGLE MODE - This softkey toggles the output mode between ADDRESSED or BROADCAST. When addressed is selected, the MMSI number will be displayed automatically when the TGT number is specified.

XMIT MSG- Highlight this softkey and press the ENT key sends the text message to the transponder for broadcasting.

MORE - Show more softkeys

XMIT PEOPLE - This key sends the number of people (specified in the AIS Voyage setup) to the transponder.

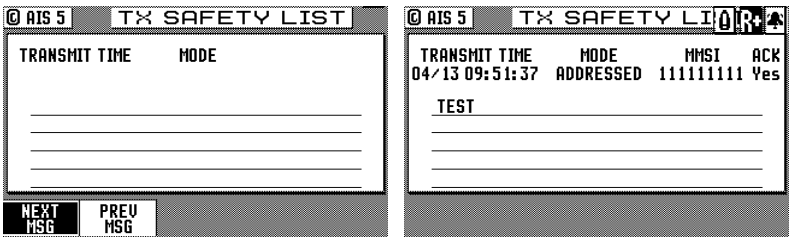
XMIT KEEL- This softkey commands the transponder to send the Height Over Keel as set in the AIS Static configuration screen.

BACK- Shows the previous softkeys

**Note:** *Don't forget to press the EDIT key to exit the editing mode.*

## AIS 5 - TX Safety List

This display allows you to scroll through the safety messages you transmitted under the AIS 4 (TX SAFETY MSG) screen.




***Display Field Description:***

**Transmit Time** - Time the message was transmitted

**Mode** - Whether it was addressed or broadcast

**MMSI** - The unique ID of the target

**ACK** - Auto acknowledgement field. Values are either Yes or No.

**Message Field-** Text message sent.

***Softkey Description:***

NEXT MSG - View next message

PREV MSG - View previous message

## AIS 6 - REGIONAL AREAS

Two VHF and one DSC receiver channels have been designated for AIS use worldwide. These frequencies are:

- IS 1 (Channel 87B, 161.975 MHz, (2087)
- AIS 2 (Channel 88B, 162.025 MHz, (2088)
- DSC (Channel 70, 156.525 MHz)

Under normal masterless operation, the AIS transponder operates autonomously with other ships or AIS base stations using the AIS1 & 2 frequencies. When entering areas controlled by a competent authority (i.e. Coast Guard) under Vessel Tracking System (VTS) rules, the AIS transponder can be polled and controlled by the VTS station. In this situation, data communication between ship-to-ship and ship-to-shore stations are done through the DSC frequency (channel 70). All VTS related activities are happening without any user intervention.

The controlling VTS base station schedules all ship's data transmission and provides the regional parameters shown in AIS 6 display, such as:

- Operating frequency, bandwidth and mode of Channel A & B receivers
- Northeast and Southwest corner coordinates of the region
- Zone size
- Date and time tag

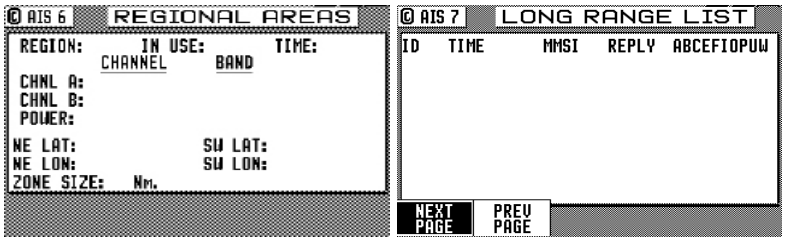
These parameters are stored in the memory bank of the AIS transponder and can be displayed in the CDU. Up to eight regions can be stored by the transponder. The AIS constantly checks the stored region boundaries and compares it to its own position. If the distance to the region boundaries is greater than 500 miles from its own position or the time tag was older than five weeks, those stored regions will be erased from memory.

The operator (administrator) has the option to do a full or partial editing of the regional parameters when needed. The conditions below have to be observed when editing:

- Use the correct channel numbers (see table A-1, page 143 or in the AIS card)

- Latitude difference should be no less that 20 NM or larger than 200 NM
- Longitude difference should be no less than 20 NM or larger than 200 NM
- The zone size should be no less than 1 square mile or larger than 8 square miles
- Distance to the zone is less than 500 NM from you current position

Manual entries violating any of the above conditions will be rejected by the AIS transponder without notifying the operator. If the region memory is full, the oldest regional memory will be replaced by a newly accepted one.




***Display Field Descriptions:***

**REGION** - Region ID (1- 8)

**IN USE** - YES if the ship is currently operating in the displayed region or NO if not

**Time** - Time in the region, HH:MM format

**CHANNEL** - Channel number assigned to channels A & B

**BAND -** Normal or Narrow bandwidth

**TX/RX** - Transmit and receive channel status

Values: (N) the channel is not in use

(Y) the channel is in use

**POWER** - Power level (High or Low)

**NE LAT, NE LON, SW LAT, SW LON** - Northeast and Southwest corner coordinates of the region area

**ZONE SIZE** - in nautical miles

**Updated at:** Date and time tag of the regional parameters

*Softkey Descriptions:*

NEXT REGION - softkey used to display information for the next region.

PREV REGION - softkey used to display information for the previous region.

REFRESH - request new regional parameters from the transponder.

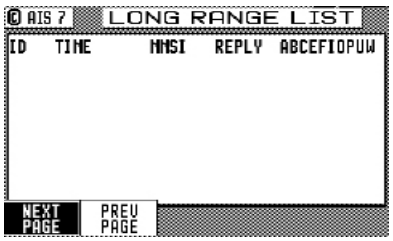
**Note:** *The MX512 will inform the operator if the zone size or delta Lat/Lon are too small. Also, the vessel's position must be within 500 Nm of the region or the AIS will not accept the input.*

## AIS 7- LONG RANGE (LR) DISPLAY

This display shows a list of queries by other AIS stations going through the INMARSAT-C or other long-range communication systems. The MX512/AIS can be set to respond to long-range interrogations either automatically, manually (default) or by external application.

When the setting is in AUTO, the MX512 will provide the requested information automatically. When in MANUAL, the operator needs to highlight the SEND REPLY softkey and press the ENT key to reply. This softkeys can be brought up by pressing the EDIT key. Every time a long range query is received, the MX512 will pop-up a message window accompanied by an audio alarm. When in "Ext Appl" mode the external application will need to respond to the MX512/AIS with permission to reply.

To look at the long-range list, press the AIS key several times until it shows the AIS 7 Long Range screen (as shown).




Display Field Descriptions:

**ID** - Query index number (0-99)

**TIME** - Time when the long-range message was received (HH:MM)

**MMSI`** - ID of requesting station

**REPLY** - YES-means the query has been answered

**NO** - means no reply has been sent yet

**ABCEFIOPUW** - an 'X' under each letter heading denotes the information requested in the interrogation message

Reply message description:

**A** - Ship's: name, call sign and IMO number

**B** - Date and time of message composition

**C** - Position

**E** - Course over ground

**F** - Speed over ground

**G** - Destination and Estimate Time of Arrival (ETA)

**H** - Draught

**I** - Ship/Cargo type

**J** - Ship's: length, breath, type

**K** - Persons on board

***Softkey Descriptions:***

Pressing the **EDIT** key will bring up the following softkeys:

NEXT PAGE this softkey is used to advance the display to show the next page of information.

PREV PAGE this softkey is used to show the previous page of information.

SEND REPLY this softkey becomes available only when Long Range inquiry is received, otherwise it will not be there.

To reply to long-range interrogation in manual mode, do the following:

**1** Press the 9 AIS YZ key several times until the AIS 7 screen appears.

**2** Press the EDIT key to show the softkeys.

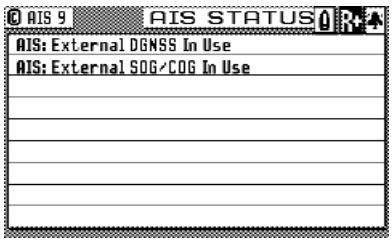
**3** Highlight SEND REPLY softkey and press ENT key. A pop-up window requesting for an ID number will appear.

**4** Enter the listed ID number to reply to.

**5** Press EDIT key to exit.

## AIS 9 – AIS STATUS

This display shows the operational status of the AIS transponder.



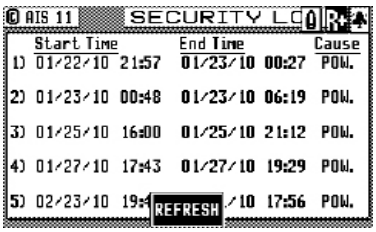

The table below is a list of possible AIS related messages generated by the transponder:

| Display Messages Text Messages |
|---|
| AIS: UTC Clock Lost |
| AIS: Primary External DGNSS In Use |
| AIS: Primary External GNSS In Use |
| AIS: Backup DGNSS In Use (Beacon) |
| AIS: Backup DGNSS In Use (Msg 17) |
| AIS: Backup GNSS In Use |
| AIS: Backup SOG/COG in Use |
| AIS: HDG Data In Use |
| AIS: ROT Data In Use |
| AIS: Channel Management Parameters Changed |
| AIS: Secondary External DGPSNN In Use |
| AIS: Secondary External GPSNN In Use |
| AIS: Secondary External SOG/COG In Use |
| AIS: UTC Clock OK |
| AIS: Boot Sequence In Process |

*Table A.3 - AIS 9 Display Messages*

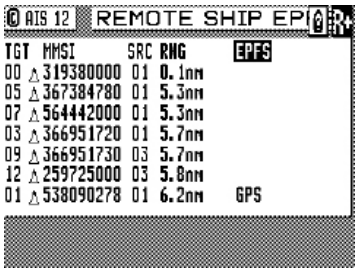
## AIS11 – Security Log

This AIS screen shows the list of Dates and Times the AIS transponder have been out of operation. Use the DOWN (or UP) arrow key to scroll through the list. Pressing the EDIT key will bring up the "REFRESH" softkey.



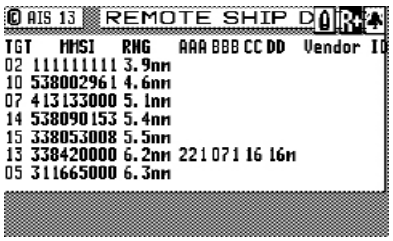

## AIS12 - Remote Ship EPFS

This AIS screen indicates the MMSI, SRC (transmitted message type 1, 3 or 18), RNG (Range), EPFS (Electronic Positon Fixing System) or source of position used by the taget ships (i.e. GPS, GLONASS, etc.). Use the DOWN (or UP) arrow key to scroll through the list.



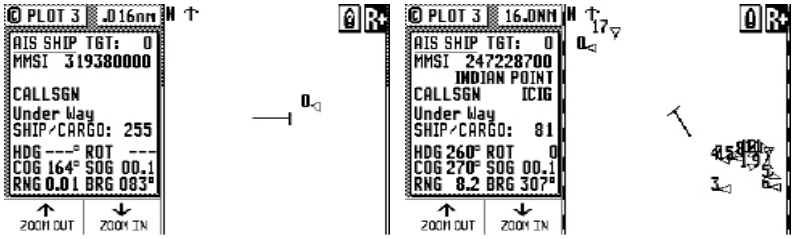
## AIS13 - Remote Ship Data

This AIS screen indicates the MMSI, RNG, Ship Dimensions (meters) and name of transponder manufacturer. Use the DOWN (or UP) arrow key to scroll through the list.




## PLOT 3 – AIS Plot Screen

The PLOT3 screen is accessed by pressing the PLOT key two times or until the PLOT3 screen is shown. This display shows a graphical representation of the area surrounding the your vessel. All boats equipped with AIS that are within the display resolution will be shown. Each boat icon has an index number next to it corresponding to the target number shown in the AIS2, AIS12 and AIS13 displays. The boat icons are oriented according to their heading. The icon in the center of the screen is your ship. To zoom-in press the DOWN arrow key. To zoom-out press the UP arrow key.




*Softkey Description:*

< + > - This softkey enables the user to quickly view information for the next target. In addition to the ship identification data, the range and bearing from your ship to the target is also calculated.

< - > - This softkey enables the user to quickly view information for the previous target.

GOTO - This softkey enables the user to quickly access information for a specific target by entering its index number. It gives access to information from all vessels in the database. The displayed vessels are the same ones listed in the AIS2 Remote Ship List display. The MKD will display both Class A or B AIS targets.

ZOOM IN - Down Arrow - Zoom In.

ZOOM OUT - Up Arrow - Zoom Out.

*Plot 3 Icons:*

AIS equipped vessel with index number

Own Ship icon

Base Station

Search and Rescue (SAR)

Aids to Navigation

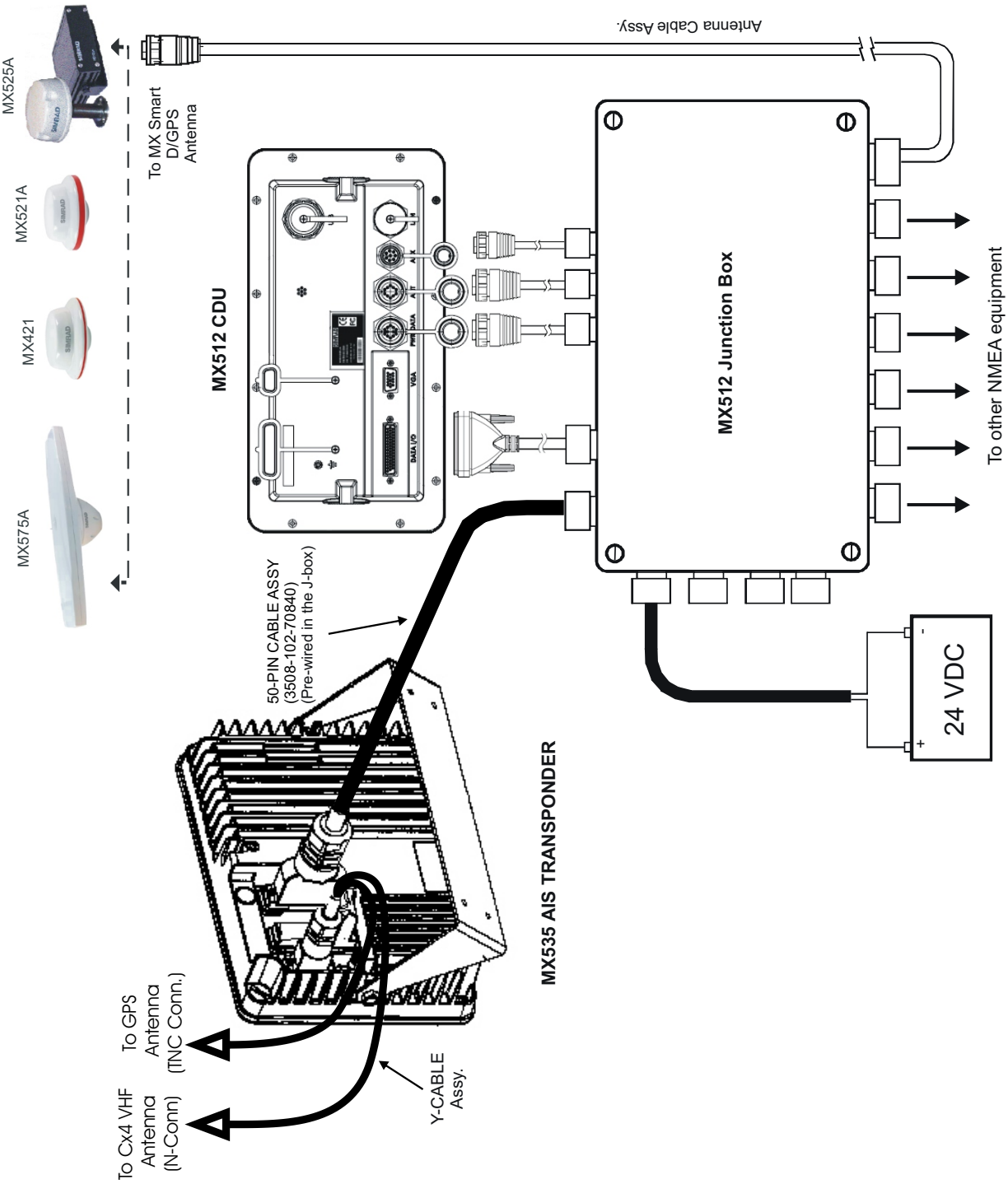



*Figure E-1: AIS System Diagram*

## Compass Diagram

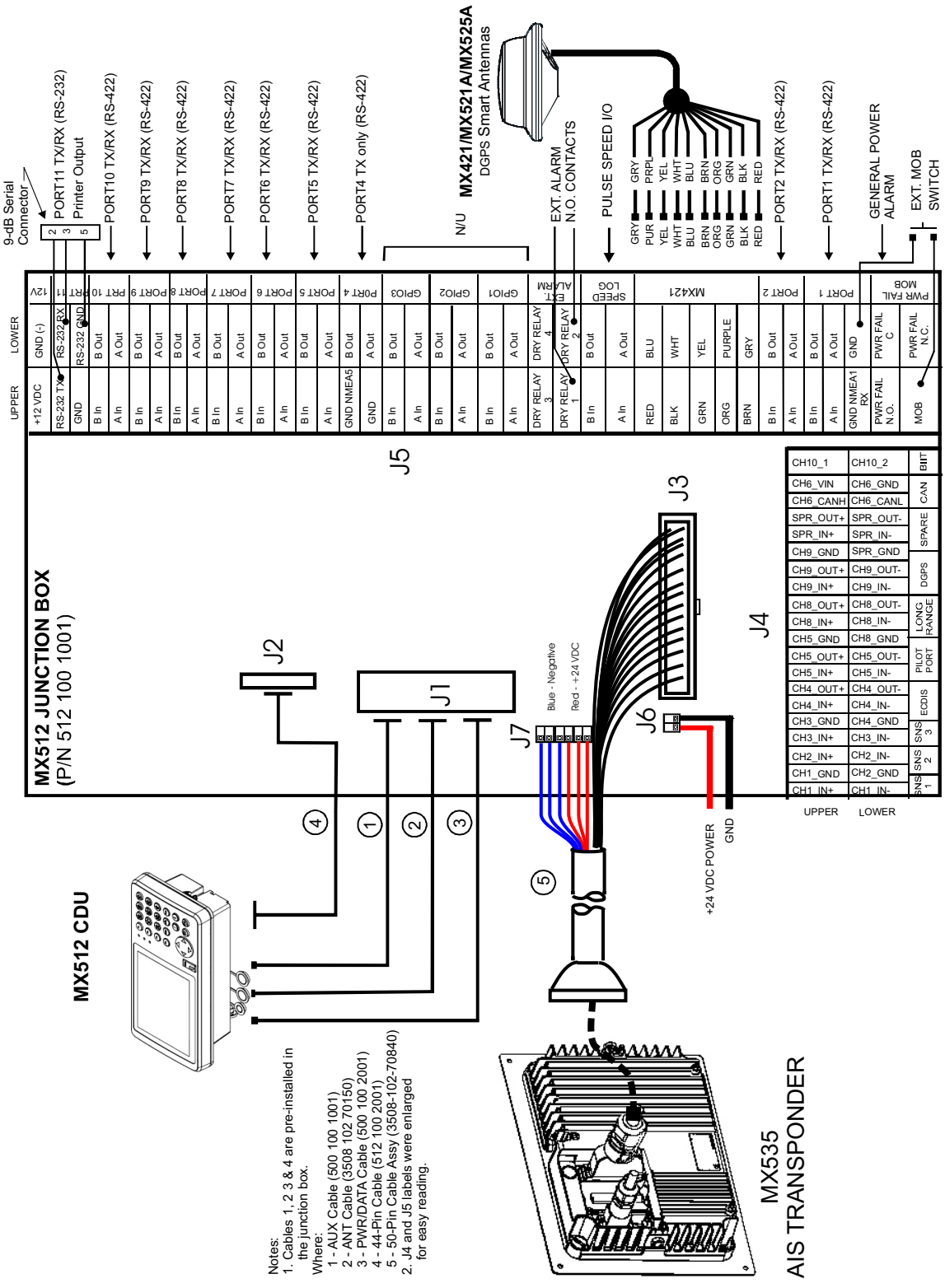



*Figure E-2: MX535A Wiring Diagram with MX512 DGPS Navigation Smart Antenna*

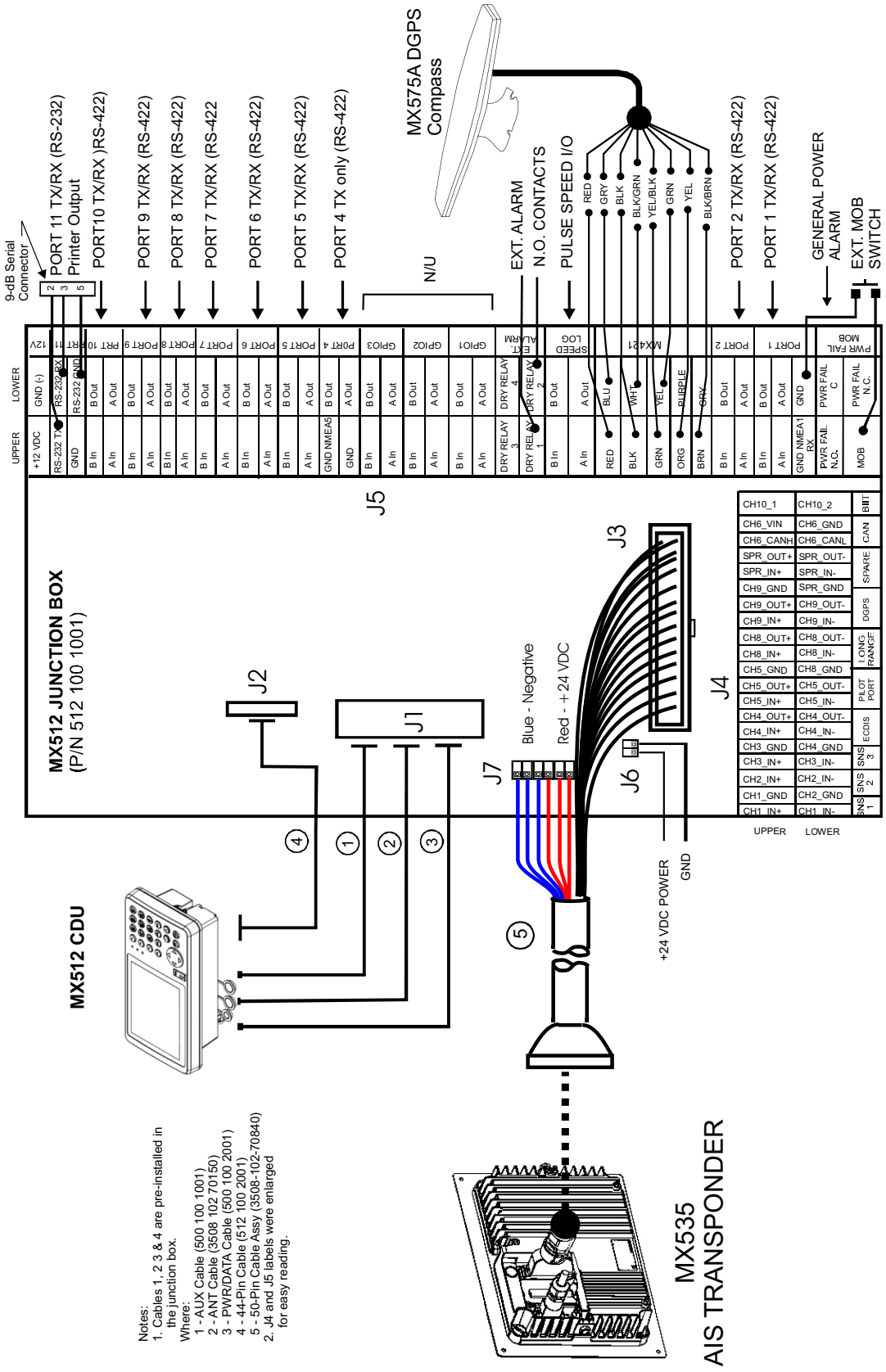



*Figure E-3: MX535A with MX512 CDU and MX575A DGPS*

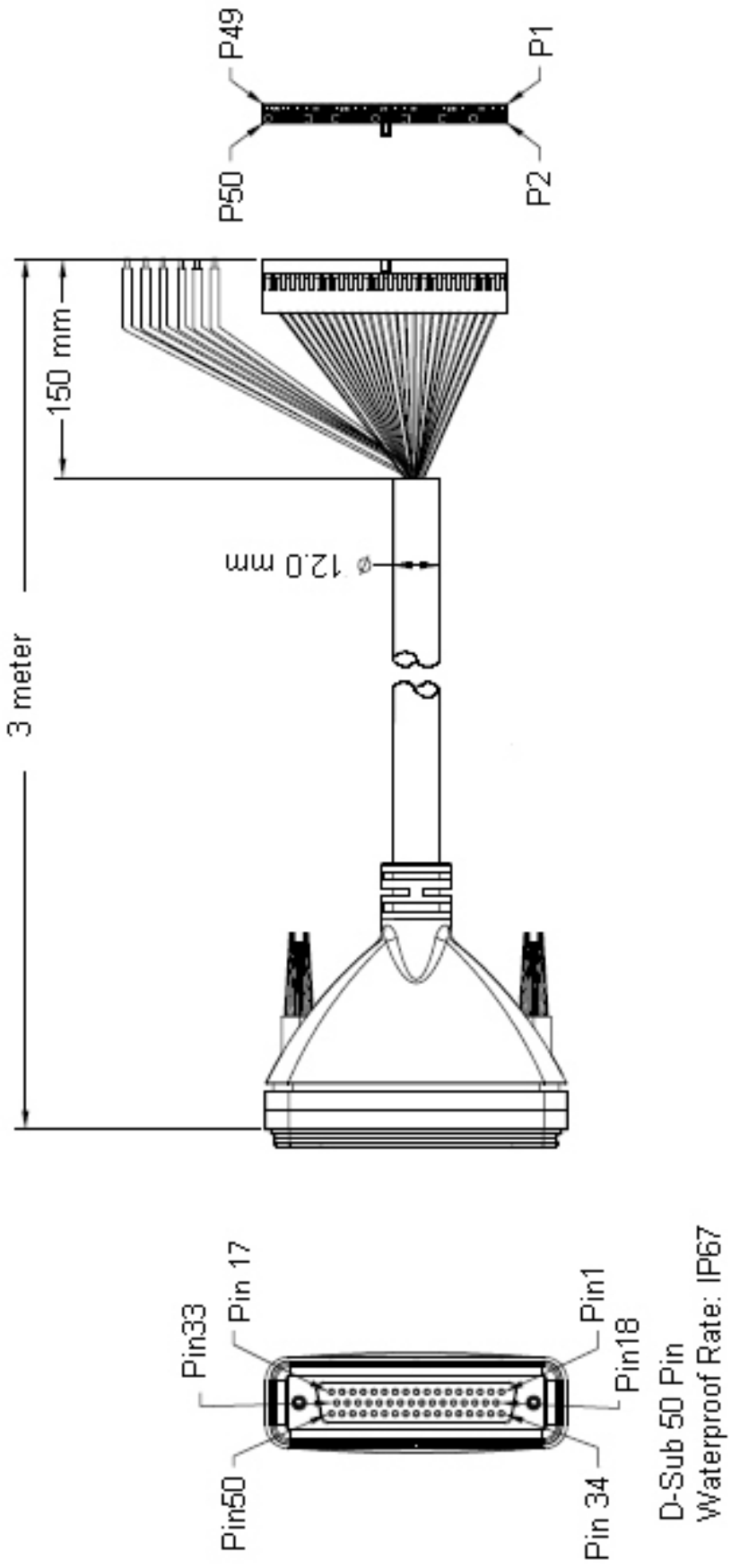



*Figure E-4: 50-Pin AIS Cable Assembly*

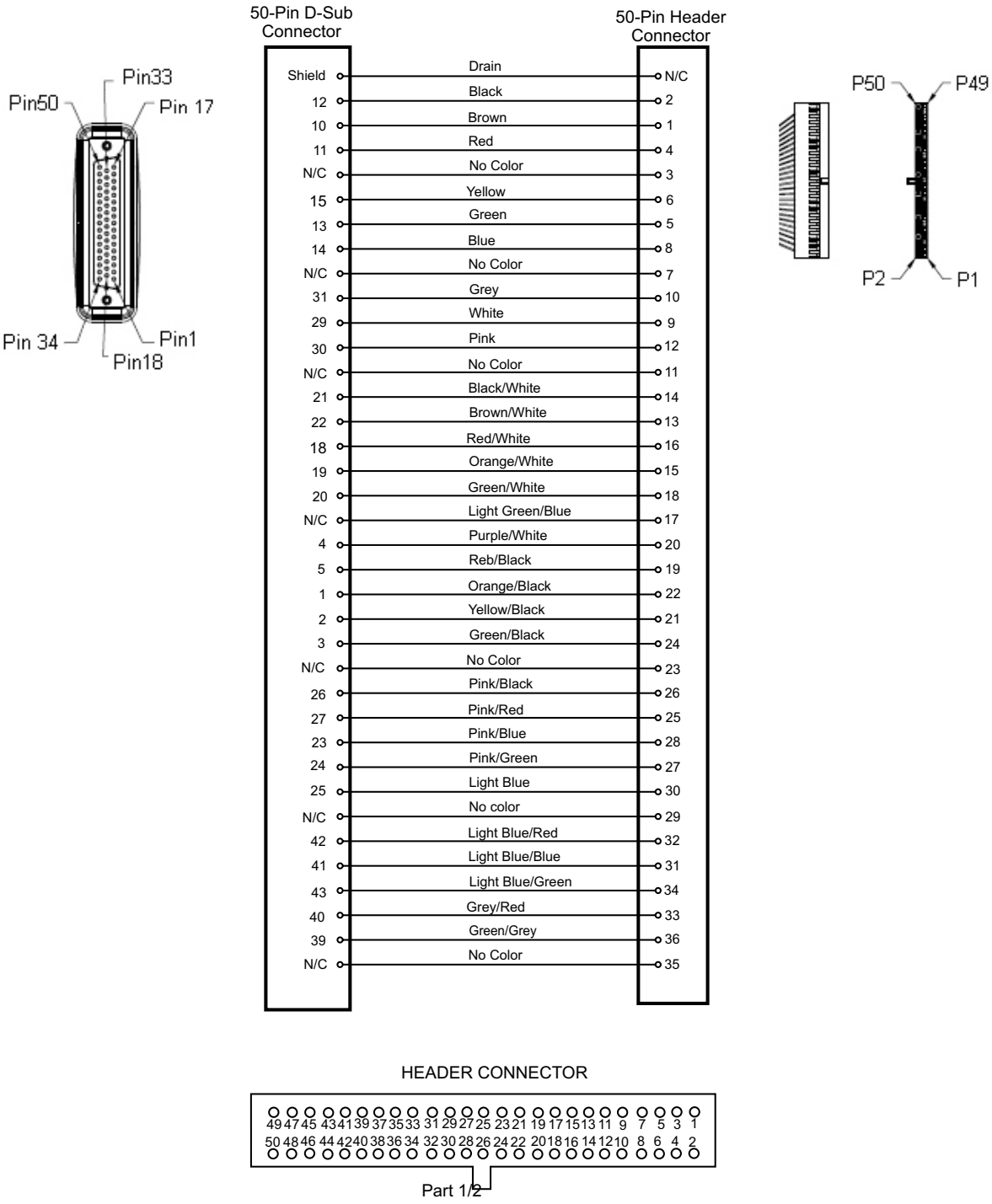



*Figure E-5: 50-Pin Cable Assembly (part A)*

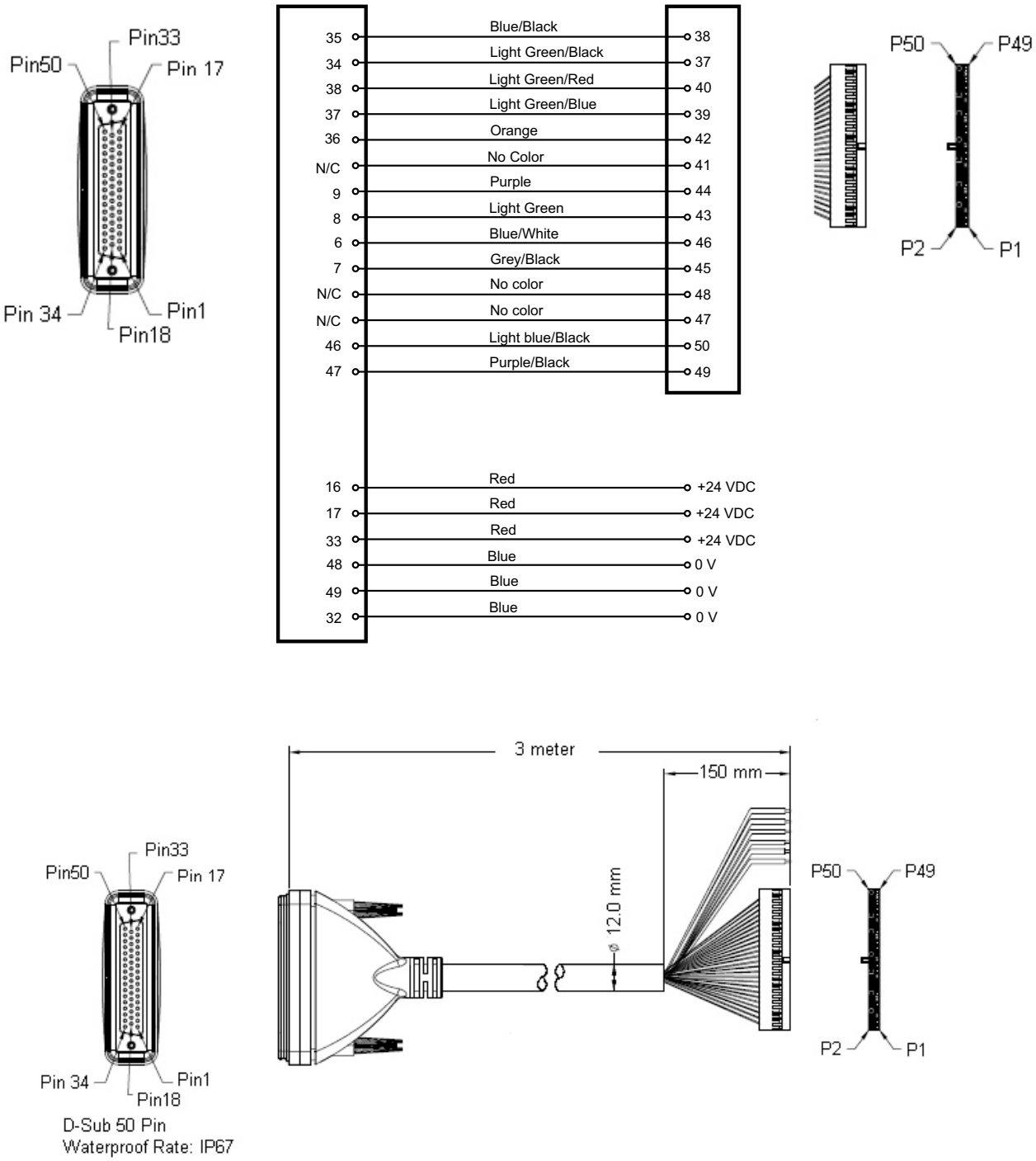



*Figure E-5: 50-Pin Cable Assembly (part B)*

***Blank page***

# Appendix F - Glossary

AIS - Automatic Identification System.

A shipboard broadcast transponder system in which ships continually transmit their ID, position, course, speed and other data to other nearby ships and shoreline authorities on a common VHF radio channel.

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 relative to the WGS-84 elipsoid and geoidal height.

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° 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.

Assigned Mode

A transponder operates in an assigned mode if it is instructed by an external system to follow certain dictated rules, such as, which slots to use for transmission.

Autonomous Mode

A transponder operates autonomously if it is independent of external control.

AUX

Auxiliary Port – A communication port on the AIS transponder, which can be used for NMEA or RTCM, input.

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.

bps

Bits Per Second.

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.

ECDIS (Electronic Chart Display and Information System)

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.

ELIPSOID

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 uploaded 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.

FATDMA

Fixed Access Time Division Multiple Access – Data link access protocol used by base station transponders to allocate transmission slots on the data link. These slots are fixed and will thus not change until the base station transponder is re-configured.

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.

FM

Frequency Modulation – The method by which a signal offsets the frequency in order to modulate it on a data link.

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. Geoidal height is positive when the deviation is outward from the central volume of the ellipsoid, and negative when it is inward.

GDOP (Geometric Dilution of Precision)

An indicator of the accuracy in position (latitude, longitude, altitude, and time). See DILUTION OF PRECISION.

GFSK

Gaussian-Filtered-Shift-Keying – A standardized method of modulating digital data prior to transmission on a data link.

GMSK

Gaussian-Minimum-Shift-Keying – GFSK using BT-products and modulation index which optimizes the modulated signal.

GNSS

Global Navigation Satellite System – A common label for satellite navigation systems (such as GPS and GLONASS).

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.

GLONASS

A satellite navigation system developed and operated by Russia.

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 Dilution 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.

IEC

International Electro-technical Commission.

IMO

International Maritime Organization

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.

ITDMA

Incremental Time Division Multiple Access – Access protocol for pre-announced transmissions of temporary or non-repeatable character. It is also used during data link network entry.

ITU

International Telecommunication Union.

KALMAN FILTER

A software routine that produces the navigation solution (see NAVIGATION SOLUTION).

KEY LOCK

Disabling the **EDIT**-key so that data entries cannot be inadvertently made.

LED

Light Emitting Diode.

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 algorithm. 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.

MMSI

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 Dilution 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.

Polled Mode

A transponder is in a polled mode during a request-response session only. Distinguish this from a station, which is polled into certain slots. This station is first polled and then enters assigned mode.

POSITION UPDATE

The redefining of position by analysis of satellite orbital data as referenced to time.

PRN

See PSEUDORANDOM NUMBER.

PROCESSOR

The processor circuit card in the console that controls system operations and computes the positioning/ navigation solutions.

PROMPT

A message on the display instructing the operator to make a keyboard entry.

PSEUDORANDOM NUMBER (PRN)

The identification number of a GPS satellite.

PSEUDO-RANGE

Range that includes errors due to clock offset.

PSP

Presentation System Port – A communication port on the AIS transponder used as an interface to external systems, i.e. the MX420.

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.

RATDMA

Random Access Time Division Multiple Access – Access protocol for transmissions which have not been pre-announced. This is used for the first transmission during data link network entry or for messages of non-repeatable character.

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 computation.

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.

RTCM

Radio Technical Commission for Maritime Services.

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

SOTDMA

Self Organized Time Division Multiple Access – An access protocol, which allows autonomous operation on a data link while automatically resolving transmission conflicts.

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.

TDMA

Time Division Multiple Access – An access scheme for multiple access to the same data link.

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 the Earth 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.

VDL

VHF Data Link.

VDOP (Vertical Dilution 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.

VHF

Very High Frequency – A set of frequencies in the MHz region.

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.

VTS

Vessel Traffic Service

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)

Worldwide 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.

1PPS

One Pulse Per Second – A timing signal generally provided by GNSS receivers.


MX510 and MX512 Manual EN, Doc.no.510-100-2002 Rev.B

SIMRAD

Master the Elements