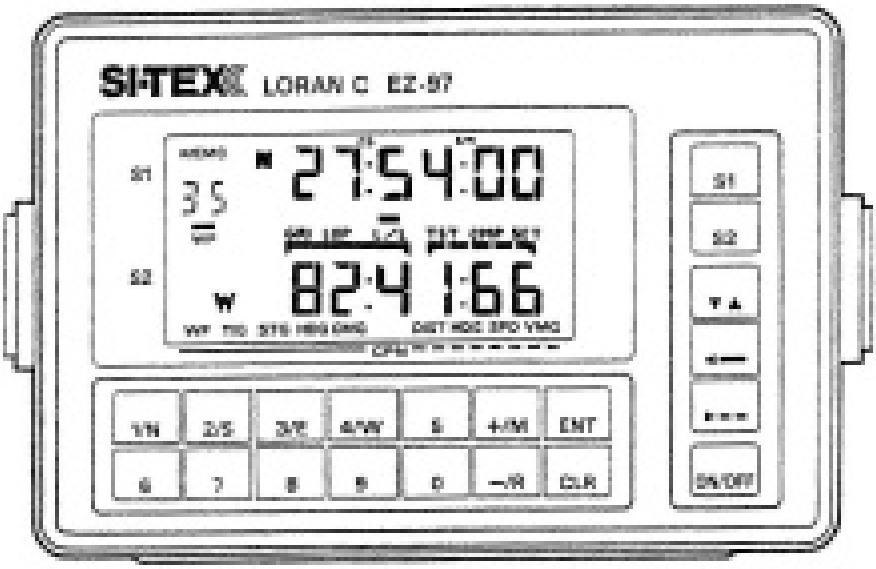
SI-TEX



INSTALLATION·OPERATION MANUAL

INTRODUCTION

Congratulations on your choice of the SI-TEX EZ-97 Dual Automatic Loran C Receiver. You will find it to be an easy-to-use and highly accurate aid to navigation that should provide many years of trouble free service. In order to facilitate installation and use of your new EZ-97, we recommend that you carefully and thoroughly read through these instructions. The fundamental knowledge presented in this handbook is essential for proper operation.

CAUTION

Your new SI-TEX EZ-97 Loran C Receiver is intended for use as an accurate aid to navigation. Navigational information derived from your EZ-97 is expected to be accurate, however, the information should always be double-checked to confirm the accuracy and reliability of the data.

Your EZ-97 must be used in conjunction with certified nautical charts which contain LORAN C information. Nautical catalogues are available from local chart dealers who can also help you determine which charts are required for navigating in your area of interest. Alternatively, charts may be obtained by mail from the following sources:

National Ocean Survey
Distribution Division (C-44)
Riverdale, MD 20804

telephone number (301) 436-6990.

Chart catalogues are also available from N.O.S. at no charge. The catalogues show which charts are currently available, and also indicate whether they contain Loran C data for U.S. Coastal waters.

The Canadian Hydrographic Services issues Loran C charts and chart catalogues for the Canadian East Coast, West Coast, and Great Lakes Areas. These may be obtained from:

Canadian Hydrographic Services
Department of Fisheries and Environment
Ottowa, Ontario K1A 0E6, Canada

For those areas outside of U.S. Coastal waters, (i.e., Mexican waters, Central and South American waters, and other areas) chart catalogues and charts may be obtained from:

Defense Mapping Agency
Topographic Center, ATTN: DDCP
6500 Brookes Lane
Washington, D.C. 20315

SECTION ONE

LORAN C--A BRIEF DESCRIPTION

Although Loran C is a proven, highly accurate aid to navigation, it should always be used in conjunction with other aids available to the navigator. The compass provides reliable directional information, and should always be used for navigation. Physical sightings of buoys, lights, range markers, and landmarks, as well as information from depth sounders, radio direction finders, radar, and celestial observations, as available, verify your position and confirm navigational system accuracy.

Loran C and computerized navigational systems can save time, increase safety, and reduce costs by providing accurate navigational data. However, various factors may influence the accuracy of the total system. Each component of the total system may contribute an element of error due to individual accuracy limitations. The way you use your navigational equipment, charts, and plotting tools is also of major importance in minimizing inaccuracies. The prudent navigator will know as much as possible about his equipment, and never rely on any one navigational aid.

DEFINING THE SYSTEM

LORAN is an acronym for LOng RAnge Navigation. It is an electronic system of navigation which uses shore-based transmitters, and shipboard receivers. Loran provides mariners the means to accurately and electronically determine their position at sea.

Although the Loran C system is quite complex, use of the system does not require any special technical expertise. It is not required that you fully understand the system to use it as a navigational aid. However, more extensive knowledge will allow more effective use of the system. The following information will provide a good basis for more complete understanding of the Loran C system. It will also provide you with a working knowledge of the terminology involved.

The Loran C system is a pulsed low frequency (100 KHz) hyperbolic radio-navigational system which utilizes a chain, or group, of shore-based transmitting stations. Each chain is comprised of a MASTER (M) transmitting station, and at least two SECONDARY transmitting stations. The stations of a Loran C chain transmit groupings of pulses at specified Group Repetition Intervals (GRI). The individualized GRI is used to electronically identify the Loran C chain for a designated area of coverage.

GRI DESIGNATIONS

The Group Repetition Interval (GRI) is specified in microseconds and has been designed so that it contains a sufficient time interval for transmission of pulse groupings from each station. Additionally, it allows enough time between each pulse grouping that signals from two or more stations do not overlap (in time) anywhere in the coverage area.

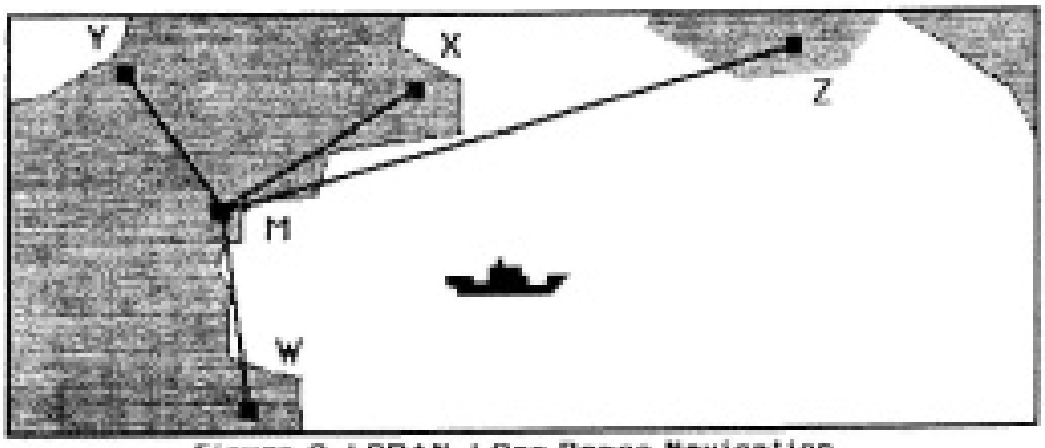


Figure 2. LORAN-LOng Range Navigation

The GRI rate structure used for Loran C operation is between 40,000 microseconds and 99,990 microseconds.

Each Loran C chain is designated by the first four digits of the GRI rate. For example, 7980 designates the GRI rate for the Southeastern United States Loran C chain. The GRI's for all other areas of coverage are presented elsewhere in this manual.

Each station transmits one pulse grouping per GRI. The MASTER (M) pulse group consists of eight pulses spaced 1,000 microseconds apart, and a ninth pulse spaced 2,000 microseconds after the eighth. Each secondary station transmits a pulse grouping consisting of eight pulses spaced 1,000 microseconds apart.

The ninth pulse of the MASTER station is used to provide MASTER station identification. Transmission difficulties within the secondary stations are indicated by an on-off toggling of the first two pulses. This toggling activates an alarm circuit within the Loran C receiver unit.

THE LORAN C CHAIN

Each Loran C chain provides navigational data for a predetermined coverage area. Within the chain, one transmitter is designated the MASTER (M) station, and it provides the basis for identification and synchronization of the Loran C chain. The other transmitters are designated as Secondary stations. For convenience, they are usually designated as stations W, X, Y, and Z, and are referenced to the (M) station.

All pulsed signals transmitted by Secondary stations are synchronously timed with the signals broadcast from the MASTER station. The synchronous pulses from the Secondary stations are transmitted at precise time intervals which are adjusted so that they will each arrive at the receiver at a different time.

The Loran C unit receives these signals, processes them to measure the difference in time of arrival, and determines the Time Difference (TD). The TD is measured in microseconds (millionths of a second). Loran C derives its accuracy from the exacting measurement of the TD's in microseconds, and from the inherent stability of low frequency signal propagation.

HOW IT WORKS

The Loran C hyperbolic navigation system operates on the principle that because radio signals travel at a constant speed over water, the measurement of the difference in time of arrival of signals from two stations, when observed at a specific point within the coverage area, is also a measure of the difference in distance from the two stations to the observation point. This concept establishes the Time/Distance relationship.

Navigation using the Loran C system requires the use of the MASTER (M) station and any two secondary stations, W, X, Y, or Z, within the same

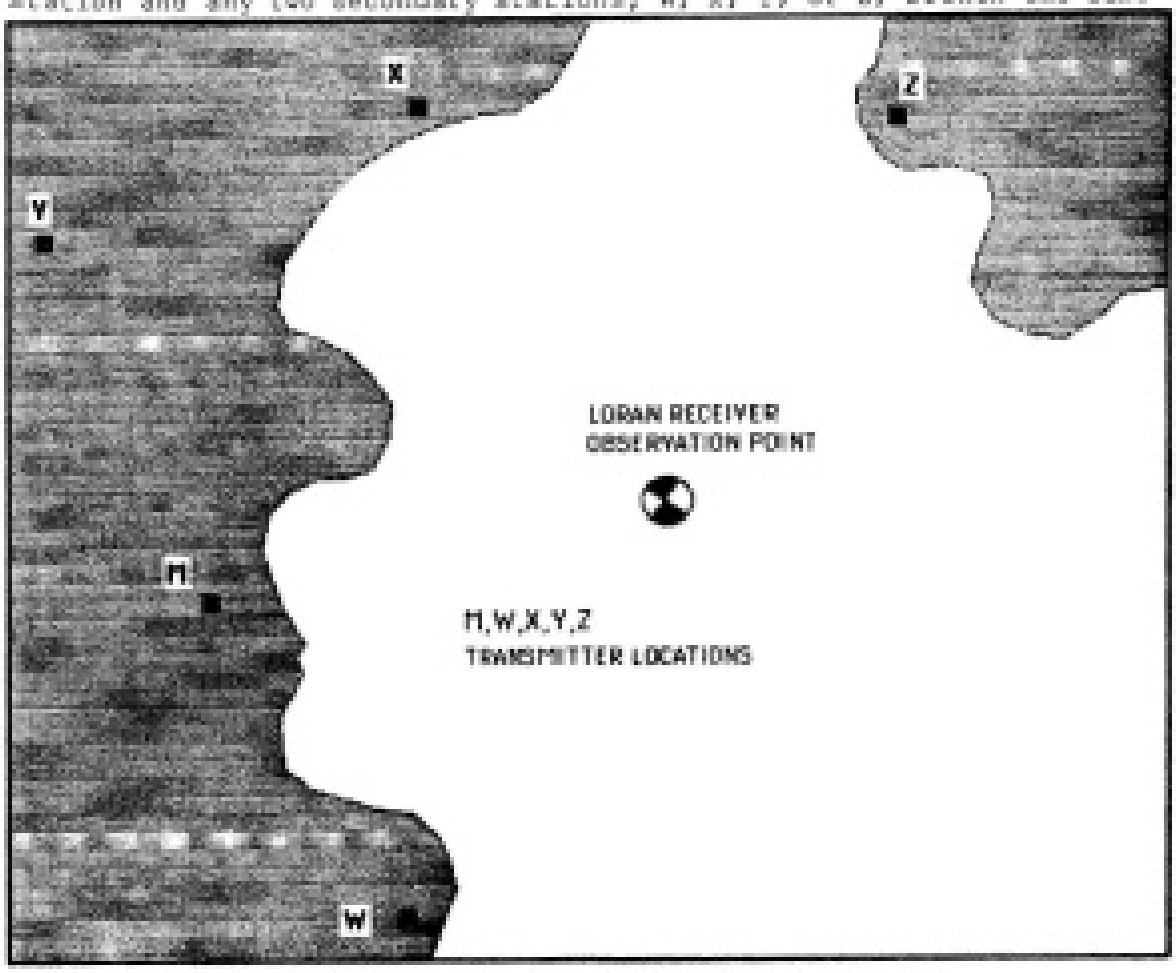


Figure 3 Typical Loran C Chain Configuration

Loran C chain, to measure the Time Difference/Distance Difference from the two stations to the observation point.

Usually, the Loran C receiver must be programmed to recognize and identify the MASTER station GRI of the Loran C chain. Once programmed, the receiver can measure the TD's, and present them on a digital display. Figure 3 illustrates a typical Loran C chain configuration. The MASTER (M), and Secondaries W, X, Y, and Z, are separated by several hundred miles.

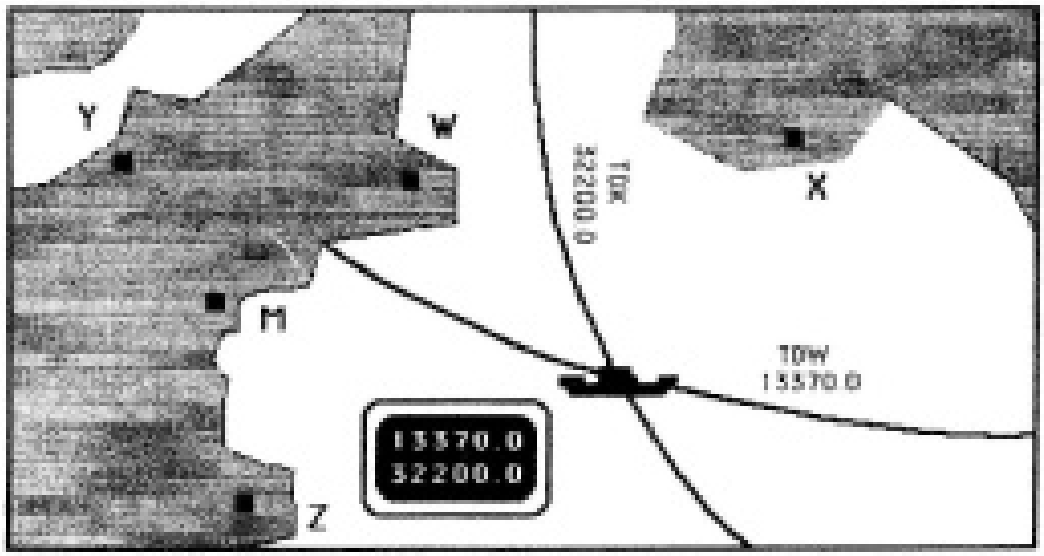


Figure 4 Sample Plots

In Figure 4, the MASTER (M) and two Secondaries, W, and X, are used as an example. The MASTER (M) station transmits synchronized Loran C pulses at precise time intervals. The receiver, located aboard ship, synchronizes on these pulses. At precise time intervals--after the MASTER station transmission--both Secondary stations, W and X, transmit synchronized pulses in timed sequence. The shipboard receiver measures the slight TD's required for each of the pulses to reach the observation point from each transmitter location. The receiver then presents each of the TD's on its display readout.

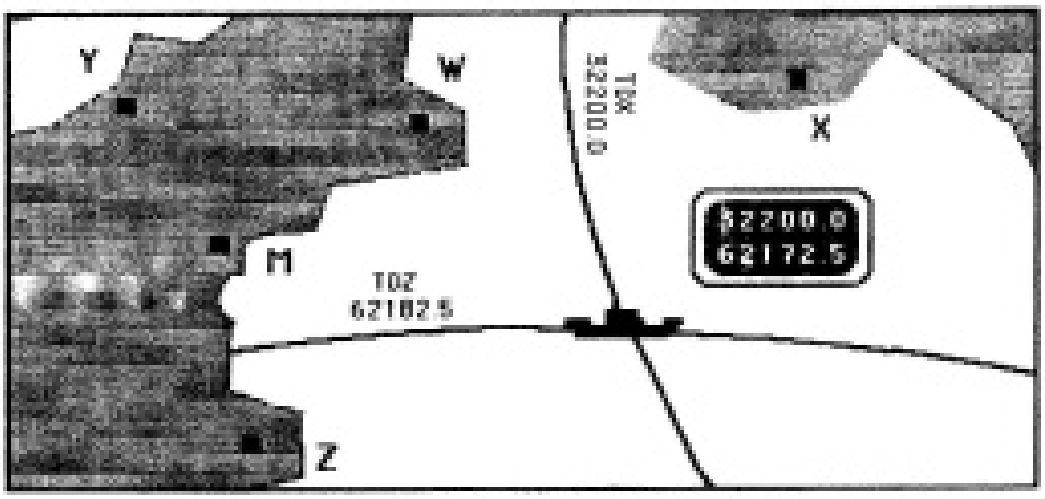
In this example, the TD measured from station W to the shipboard receiver is designated TDW, and the TD measured from station X is designated TDX. A graphical plot (a line drawn through the locus of all points) of all observation points having the same measured TD (or: distance difference) between M and W, is a hyperbola. This line is called a Line Of Position or LOP. In this instance, the LOP-W (Line Of Position relative to M and W stations) indicates that the observation station is somewhere along the plotted line.

NOTE: TD'S AND LOP'S ARE USED INTERCHANGEABLY THROUGHOUT THIS BOOK. IN TERMS OF NAVIGATION, THEY ARE ESSENTIALLY THE SAME THING.

Similarly, LOP-X is a graphical plot of the measured TD between M and X. It can be seen that the observation point, or shipboard receiver, is also located somewhere along LOP-X. The intersection or crossing point of these two LOP's is the observation point or position where the shipboard receiver is located.

Since the Time Differences (TD's) are measured in microseconds, the graphical lines forming the LOP's are designated in microseconds. Thus, an LOP is designated by a number, in microseconds, having the same constant measured time difference. The LOP's are plotted on Loran C nautical charts for the designated area of each Loran C chain. The LOP numbers displayed by the receiver are compared with the same numbers on the nautical chart and the intersection of the LOP's on the chart represent the position or location of the receiver.

The operator of a Loran C receiver can navigate to and from positions located on Loran C charts using the Lines of Position indicated by the receiver to determine the course to a waypoint or destination. Arrival at the waypoint or destination is indicated when the LOP's displayed on the receiver correspond to the LOP's printed on the chart.



Position plotted with different Secondary pair
Figure 5. Sample plots

The example we presented here used secondary stations W and X to demonstrate the use of the Loran C system. Any two secondaries may be used in combination to provide the required navigational data, and any other secondary can be used to verify the data when used in conjunction with either or both of the secondaries.

NAVIGATING WITH LORAN C

Successful use of the Loran C system begins with the receiver and the user/operator. The user/operator must be familiar with the various factors which may influence system accuracy when establishing position. Overall accuracy is the result of individual accuracies such as the selection of the best secondary stations, plotting a Loran C fix indicated by the receiver, and interpolation between LOP's using the charts.

The first step is to decide which chain to use (SEE APPENDICES FOR LISTING OF REGIONAL LORAN CHAIN GRI'S). In some areas that choice may be dictated by avalability of only one chain. In other areas, two chains may provide overlapping coverage. The user/operator must decide which chain will provide optimal coverage in his area.

The second step is to select the secondary stations. The two secondary

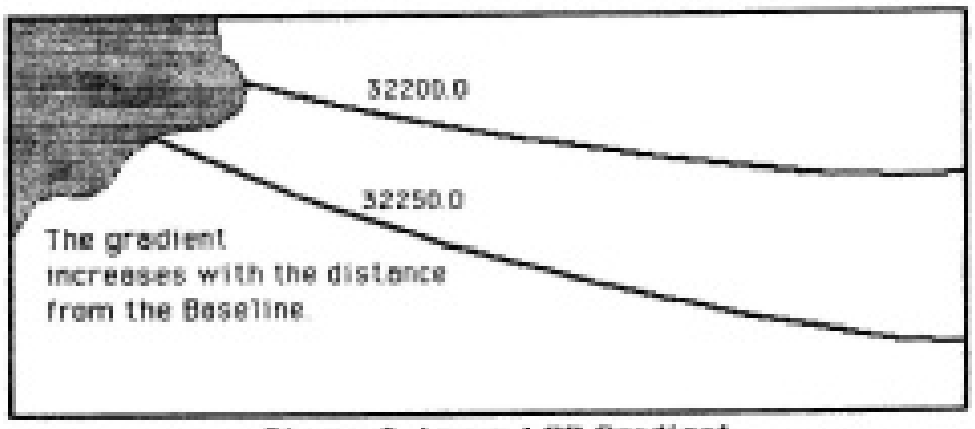


Figure 6. Loran LOP Gradient

stations should be chosen which provide the greatest navigational accuracy. Loran C chains were designed to provide two LOP fixes for all of the coverage area. The operator may choose to use two secondary stations in one area of coverage--two others in another area of coverage. The operator may wish to verify accuracy by checking and cross-checking fixes provided by each of the secondary stations in an area. The most important factors when choosing secondary stations are: the crossing angle of the LOP's; the gradient between the secondary LOP's. The operator should choose the best combination of crossing angles and gradient to obtain the desired accuracy. Choose the secondary LOP's which provide the greatest crossing angle. Ideally, a 90 degree crossing would be most desirable , however, it rarely occurs. Since anything less than 90 degrees is something of a compromise, choose those LOP's which most nearly provide a 90 degree angle. Whenever possible, do not use LOP's which provide crossing angles of less than 30 degrees.

Choosing LOP's less than 30 degrees does not provide a measurement problem--this Loran will measure all the Time Differences with equal accuracy. The problems occur when LOP's are used for plotting a fix and when interpolating between LOP's. It is difficult to establish a position on the chart when two LOP's cross at small angles and present nearly parallel lines.

LOP GRADIENT

Choose secondary LOP's so that the gradient--or time difference separation between the LOP's represents the smallest distance per microsecond (see Figure 6). In some areas, a gradient of 10 microseconds between LOP's on the chart may represent one mile of distance. In other areas, a gradient of 10 microseconds between LOP's may represent five miles of distance, or more, depending upon the location and the distance from the Master Secondary pair.

Consult your local SI-TEX dealer for advice on the most frequently used chain and secondaries in your area.

BASELINE EXTENSIONS

CAUTION: DO NOT USE THE MASTER-SECONDARY PAIR IN THE VICINITY OF THE BASELINE EXTENSION.

When operating in the area of the baseline extension, microsecond gradients change rapidly because of the hyperbolic nature of the LOP's. There is the strong possibility of introducing large errors in the position because of an inability to determine on which side of the baseline you may be located. Baseline extension areas are marked on Loran C charts. When encountering these conditions, choose an alternative secondary station and avoid using the secondary station in the baseline extension area.

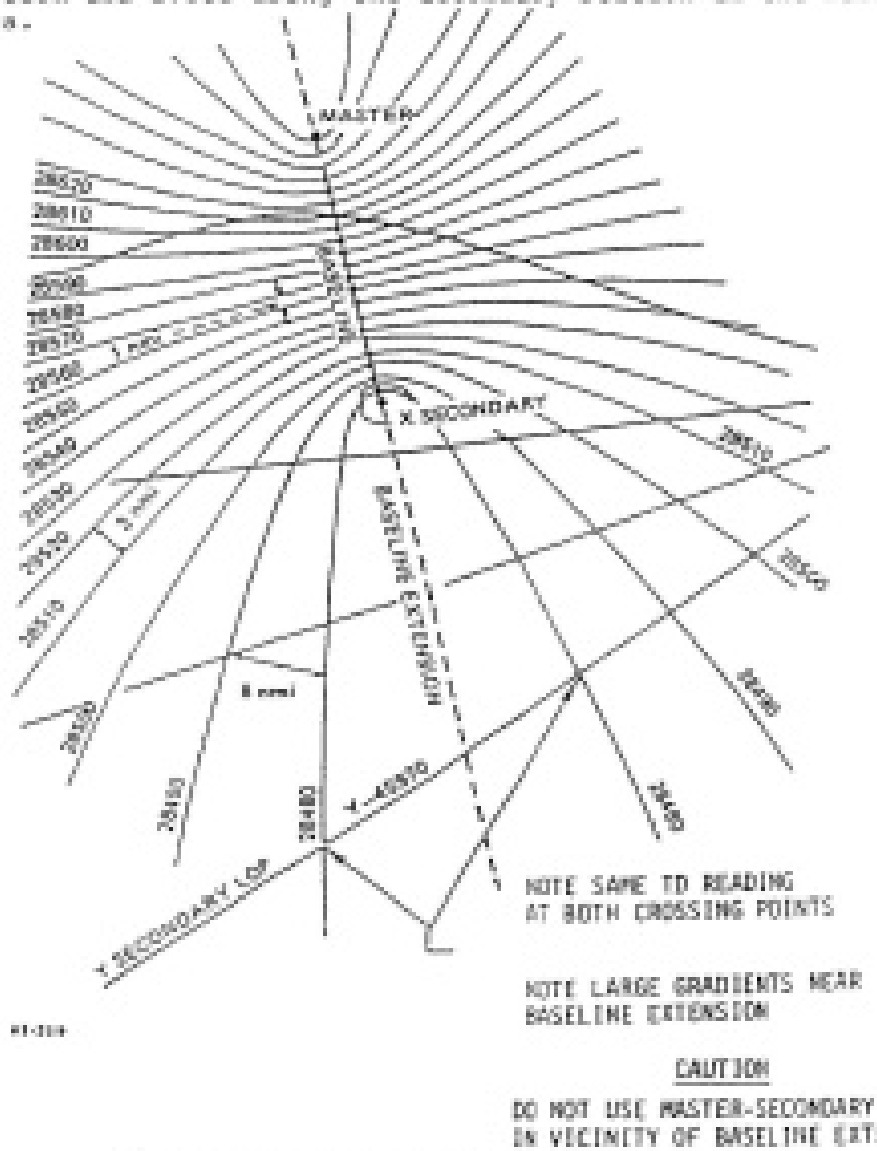


Figure 7 Baseline Extensions

ASF, LANDPATH DELAY, OR GRIDWARP

Radio signals travel at different rates of speed over land and water. Because of this, small differences in the TD readings on the receiver may be noted when compared to the LOP's printed on the charts. This delay is called the Land Effect, or Landpath Delay, and is generally known as an Additional Secondary Factor or ASF. Some Loran C charts contain adjustments for the ASF, however, an average adjustment was used and a difference may be noted in some locations.

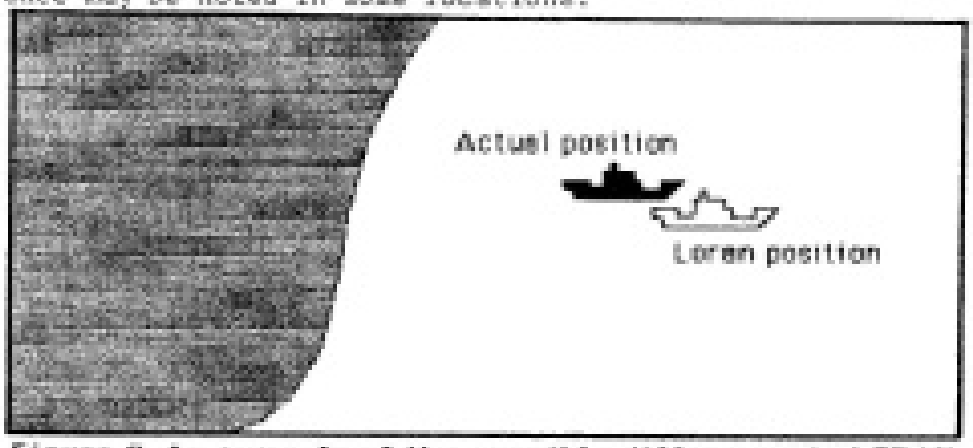


Figure 8. An example of the possible difference in LORAN position and actual position that can result from the effects of ASF, Land effect, or Gridwarp.

CONVERTING TIME DIFFERENCE MICROSECONDS TO NAUTICAL MILES

Some nautical charts contain mileage reference scales. In most cases, nautical charts use the Mercator projection which generally means that the LATITUDE side of the chart is drawn on a scale of approximately one (1) nautical mile (6,000 feet) per one (1) minute of latitude. Check your charts to determine which reference it may have. Either may be used to determine the relationship between nautical miles and microseconds for a specific area. NOTE: The same conversion does not apply to all areas of the Loran C chain because of the change in gradient, or spacing, between the loran lines of position which continues to increase as the distance from the loran stations increases. For greatest accuracy, the conversion should be made every 5 to 10 miles, or 5 to 10 minutes of latitude. DO NOT USE THE LONGITUDE SCALE.

The procedure is as follows:

1. Determine the number of microseconds between LOP's. Using a ruler, or a pair of dividers, measure the spacing or gradient between these two LOP's.
2. Transfer this same measurement to the latitude scale or mileage reference scale. Determine the number of miles for this measurement--1 minute of latitude = 1 NM = 6,000 feet.
3. EXAMPLE OF THE CONVERSION
   If the measurement of the LOP gradient produced 10 microseconds equal to 2.0 nautical miles on the latitude scale, then--
   10 microseconds = 2.0 NM = 12,000 feet. Divide all numbers by

100 to get 0.1 microsecond = 0.02 NM = 120 feet.

Note that if the nautical mile measurement was 4.0 NM, then the distance in feet would be doubled--240 feet. Conversely, if the measurement was 1.0 NM, then the distance would be halved--60 feet per 0.1 microsecond.

The ability to precisely determine a geographic position using the Time Differences or Latitude/Longitude as measured by a Loran C receiver is known as Absolute Accuracy. The Absolute Accuracy of Loran C varies from 0.1 to 0.25 nautical miles--using Loran C nautical charts. Absolute Accuracy should be used to know your position when operating in a new area or when making an ocean crossing.

The ability to return to a specific position where you have been before, and have recorded the TD's or Lat/Lon coordinates, is known as Repeatable Accuracy. By using Loran C numbers for a particular location, you may obtain your greatest accuracy using Loran C. Repeatable Accuracy also depends upon your location in the coverage area, installation, and signal quality. Under optimal conditions, repeatable accuracies in the 40 to 60 foot range may be obtained in some areas.

It is the Repeatable Accuracy factor inherent in Loran C that makes it particularly useful to those wanting to return to a specific location. If, for example, you know the location of shoals, sand bars, bottom obstructions, or other hazards to navigation, you can easily avoid them. Additionally, if you have discovered a particularly good fishing spot, you can easily return to it.

THE USER IS ADVISED TO OBTAIN A COPY OF "LORAN C CORRECTION TABLES" TO DETERMINE THE ABSOLUTE ACCURACY OF LORAN FOR ANY SPECIFIC AREA OF COVERAGE.

LORAN C ASF CORRECTION TABLES

Pub. No	Chain/Rate (GRI)
LCPUB2211100c	Canadian East Coast/5930
LCPUB2211200c	Northeast U.S./9960
LCPUB2211300c	Great Lakes/8970
LCPUB2211400c	Southeast U.S./7980
LCPUB2212100c	U.S. West Coast/9940
LCPUB2212200c	Canadian West Coast/5990
LCPUB2212300c	Gulf of Alaska/7960
LCPUB2212400c	North Pacific/9990

Each publication covers an entire chain and may be obtained from:

Defense Mapping Agency
Office of Distribution Services
Attn: DDCP
Washington, D.C. 20315

Or, from your local chart dealer.

COORDINATE CONVERSION

Converting coordinates from TD's to Lat/Lon can provide many advantages to the user/operator. While TD's provide accurate geographic position information using Loran C charts, Lat/Lon provides accurate position

information using any marine charts which contain Lat/Lon coordinates. Interpolation using the charts is made easier because Lat/Lon coordinates are more equally spaced, and have a consistent gradient. The gradient refers to the number of microseconds change between TD Lines of Position or the number of degrees/minutes change between Lat/Lon coordinates.

The most direct course to a destination is provided by using Lat/Lon for navigation. Lat/Lon is not influenced by the hyperbolic, or curving nature of the LOP's produced by TD's. For short transits, however, the curving LOP's produce little noticeable effect on the course traveled except when in those areas very near a transmission station.

The Lat/Lon conversion system employed by this Loran uses a mathematical equation which represents the curvature of the earth's surface as a constant, and the propagation of Loran C signals as occurring over an all-seawater path. It does not account for propagation anomalies, or ASF's, caused by signals travelling over long land paths, general land path characteristics, large building structures, bridges, or other factors. Propagation anomalies, as a general rule, increase the signal propagation time because signals travel more slowly over land masses.

Because most Loran C stations are located inland, signals will generally travel over land for at least a portion of their transmission. This results in computation differences from signals travelling over an all-seawater path. These propagation anomalies are called Secondary Phase Factors (SF) and Additional Secondary Phase Factors (ASF). SF's are the predictable effects which change TD's of Loran signals travelling over an all-seawater path. SF's are factored into the Lat/Lon conversion computation. The accuracy of the calculations, however, will diminish in direct relationship to the closeness of the Loran C receiver to the transmitting station.

The ASF is the unpredictable effect induced in TD's of signals travelling around hills, buildings, and other structures, rather than over an all-seawater path. ASF's are not considered in the calculations because they can vary from place to place.

Because ASF's vary, the accuracy of plotted positions will be adversely effected unless a COMPENSATION factor is applied to the calculation. The COMPENSATION factor is a quantity which consists of an indication of Direction and an indication of Magnitude. The Direction factor indicates addition to, or subtraction from, the Lat/Lon calculation. The Magnitude factor represents a numerical value of the compensation which must be added to, or subtracted from, the Lat/Lon calculation.

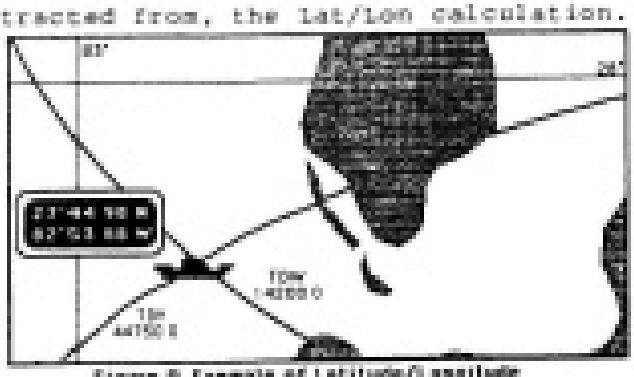


Figure 9: Example of Latitude/Longitude position computed from LOPs.

SECTION TWO

INSTALLATION OF THE LORAN

The Loran has been designed for uncomplicated installation. No special technical skills or unusual tools are required. However, in order to maximize the effectiveness of the Loran, the following recommendations should be noted and followed.

Tabletop installation, with the mounting bracket at the bottom of the receiver, is considered standard. However, the Loran may be bulkhead mounted with the bracket to the rear, or mounted overhead with the bracket to the top of the unit.

Whether the location chosen is tabletop, bulkhead, or overhead, the receiver unit should be installed in a location which will provide for convenient operation of the unit, and for easy observation of the displayed information. The chosen location should provide protection from extreme weather conditions, away from direct sun, sea spray, and rain. (See Specifications) Water damage is excluded from warranty provisions.

Both the power cable and antenna coupler cable should be routed away from other electrical cables and equipment which may radiate ambient electrical noise interference.

Before finalizing installation of the receiver and antenna coupler, operate the Loran for several hours. Observe any interference or interaction which may occur when the vessel is running and when other equipment is operated. Alter the receiver location, or cable routing, to minimize interference.

Figure 11 shows mounting dimensions, and illustrates standard tabletop mounting. The mounting bracket may be removed from the receiver unit, and used as a template for locating mounting holes. To remove the mounting bracket from the receiver, loosen the mounting knobs on each side of the unit. Move the receiver forward to disengage it from the bracket.

MOUNTING THE RECEIVER UNIT

1. Use the mounting bracket as a template to locate and mark mounting holes.
2. Mount the bracket to the mounting surface using all four screws. Tighten mounting screws securely.
3. Allow enough clearance around receiver to connect power, antenna and ground cables.
4. Observe all precautions described above for selecting mounting location.

ANTENNA/ANTENNA COUPLER LOCATION AND MOUNTING

The best location for the antenna and antenna coupler is at the highest spot on the vessel, away from any other rigging. The antenna must not be mounted under, or within a mass of metal rigging. Metal rigging can cause blind spots within the reception area any time it comes between the

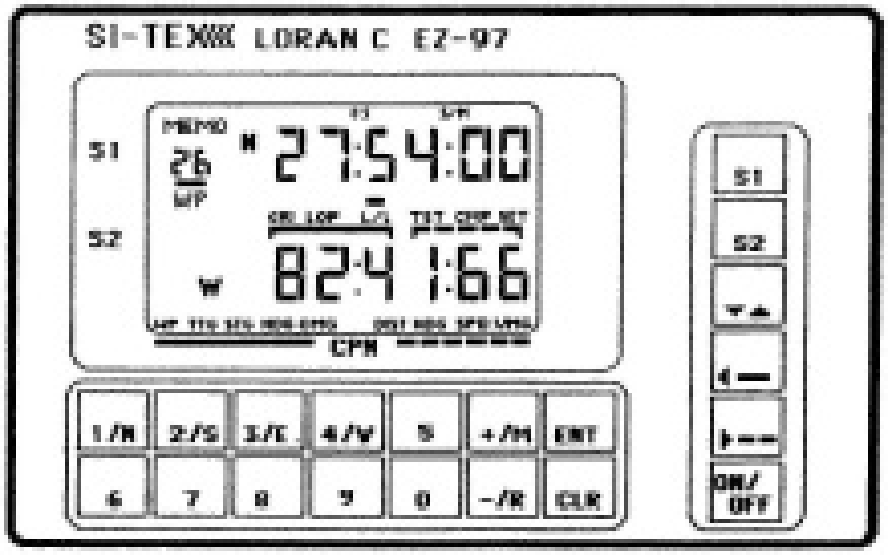


Figure 10 LAT/LON Display

antenna and the transmitting station. CHOOSE A LOCATION CLEAR OF ALL METAL RIGGING.

1. Mount the antenna coupler at least 6 feet from the receiver.
2. Recommended mounting locations:
   Sailboats--Mizzen mast; spreader; top of stern rail. Insulated backstays may also be used as antennas.
   Center Console Boats--top of console; gunwale.
   Other Power Boats--flying bridge; cabin top or side.
3. The antenna should be mounted in a vertical position and should be accessible for servicing.
4. The antenna should be mounted as far away as possible from any other antennas. At least 6 feet horizontal and/or 3 feet vertical distance is recommended.
5. Check signal quality at various locations to ensure choosing the best possible location. See the OPERATION section of this manual for TEST MODE (TST) information.
6. 49 feet of coaxial cable, with attached connector, is provided with the antenna coupler. Up to 150 feet of cable may be used, if required. The cable length should not be less than 18 feet minimum. Use RG58A/U cable, if additional length is required.

Figure 8 shows good antenna placement. Figure 9 illustrates antenna coupler mounting.

7. The antenna coupler is designed to be mounted on an extension pole or swivel mount (not supplied). The lower section of the coupler housing has a threaded mounting (1"x14 thread) to mate with standard fiberglass extension poles.
8. If a laydown base mount is used, caulking or sealer must be applied around the base of the coupler and cable entrance to prevent water leakage.

As an alternative, the antenna coupler may be strapped to a vertical stanchion using stainless steel hose clamps (not supplied).

THE ANTENNA IS NOT SUPPLIED WITH THE LORAN AND MUST BE PROVIDED BY THE USER.

The antenna coupler is designed to use a standard 7 to 8 foot fiberglass whip antenna. The top of the coupler has a 3/8" x 24 thread insert to provide direct mounting of the whip antenna.

POWER REQUIREMENTS AND RF GROUNDING

Operating voltage range is from 11 to 15 VDC only. No changes are required for operation within this range. A power source capable of supplying a continuous current of 0.5 amps at 11 to 15 VDC is required. Operating voltage may exceed 15 VDC for brief periods without harm to the Loran receiver. CAUTION: USE ONLY NEGATIVE GROUND WHEN CONNECTING LORAN.

MAKING THE POWER CONNECTION

Verify power source voltage and polarity before connection to the Loran. An assembled power connector and cable are provided to facilitate the power connection. CAUTION: REVERSE POLARITY CAN CAUSE SERIOUS DAMAGE TO THE LORAN. REVERSE POLARITY DAMAGE IS EXCLUDED FROM THE WARRANTY PROVISIONS. Do not use an external switch or circuit breaker to energize the Loran.

Observe the color coding of the power connector cable. The RED lead should be connected to the positive (+) side of the power source. The BLACK lead should be connected to the negative [-] side of the power source. Connector Pin 1 is the red (+) lead. Pin 2 is the black (-) lead.

Reconfirm voltage and polarity before connecting the power connector to the 81-97. Observe the keyway on the power connector. DO NOT FORCE THE CONNECTION.

RADIO FREQUENCY (RF) GROUNDING

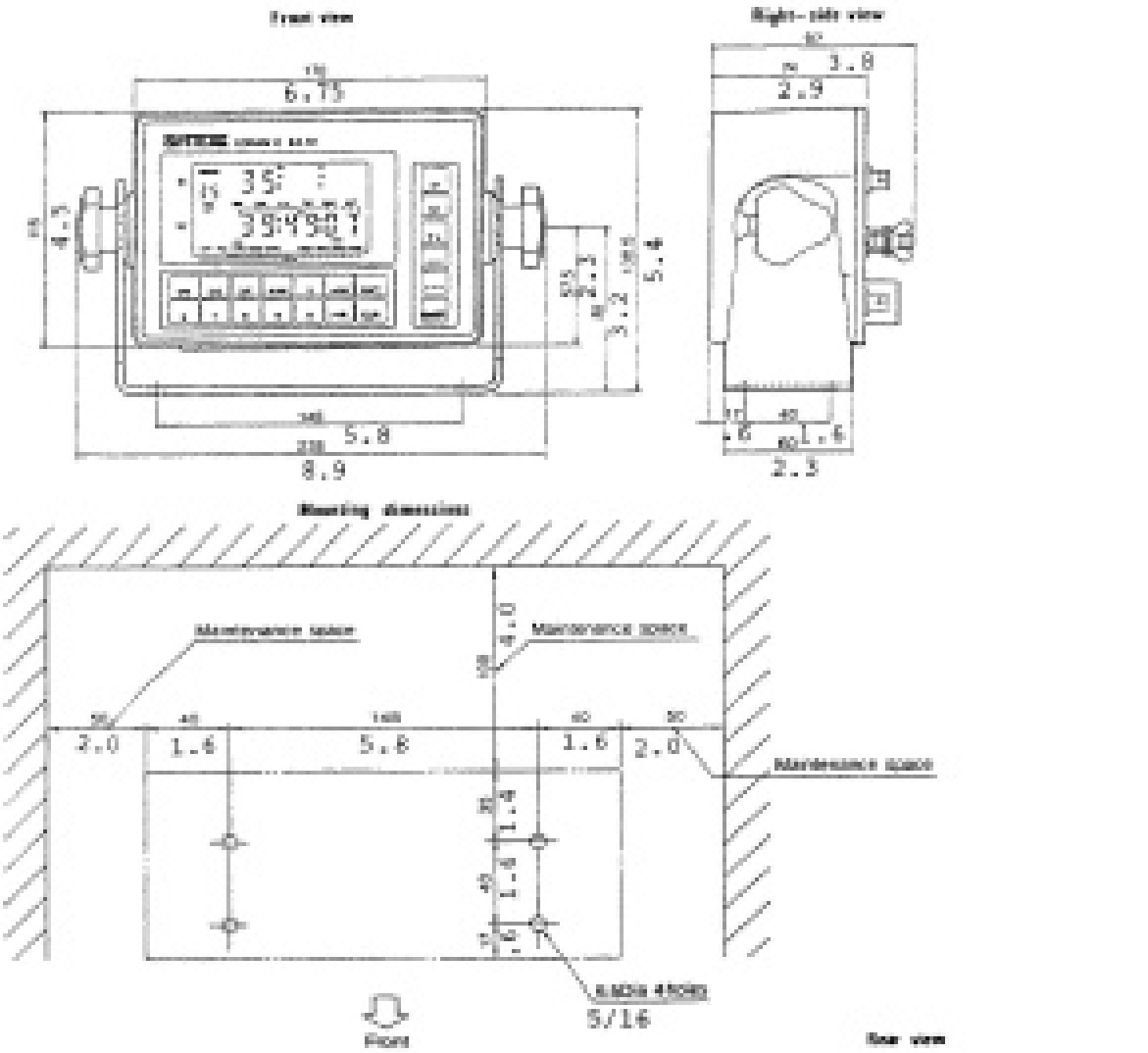
The Loran requires a good RF ground connection to operate correctly. Failure to install a proper ground will result in poor or erratic operation of the Loran.THE NEGATIVE TERMINAL ON THE BATTERY IS NOT A GOOD R.F. GROUND.

A wing-nut is provided on the rear of the Loran for connection of the RF ground. Use #10 AWG standard wire for connecting the Loran to the vessel's ground system. The ground wire should be securely connected to the engine block, or to a common seawater grounding plate.
Some boats may require special grounding systems. Before finalizing installation, verify effective grounding of the Loran.

FUSE AND FUSEHOLDER

A fuse and fuseholder is located on the back of the unit. It is provided to protect the equipment from overload conditions. A BLOWN FUSE USUALLY INDICATES A TROUBLE CONDITION IN THE EQUIPMENT. If the fuse blows repeatedly, have the equipment checked and repaired by a qualified service technician.

> CAUTION: DO NOT INSTALL A HIGHER RATED FUSE. THE WARRANTY WILL BECOME INVALID AND EXCESSIVE DAMAGE TO THE EQUIPMENT MAY RESULT.



Top figure is mm.
Bottom figure is inches.

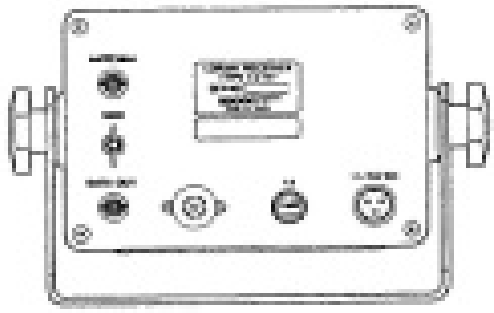


Figure 11 Mounting Dimensions

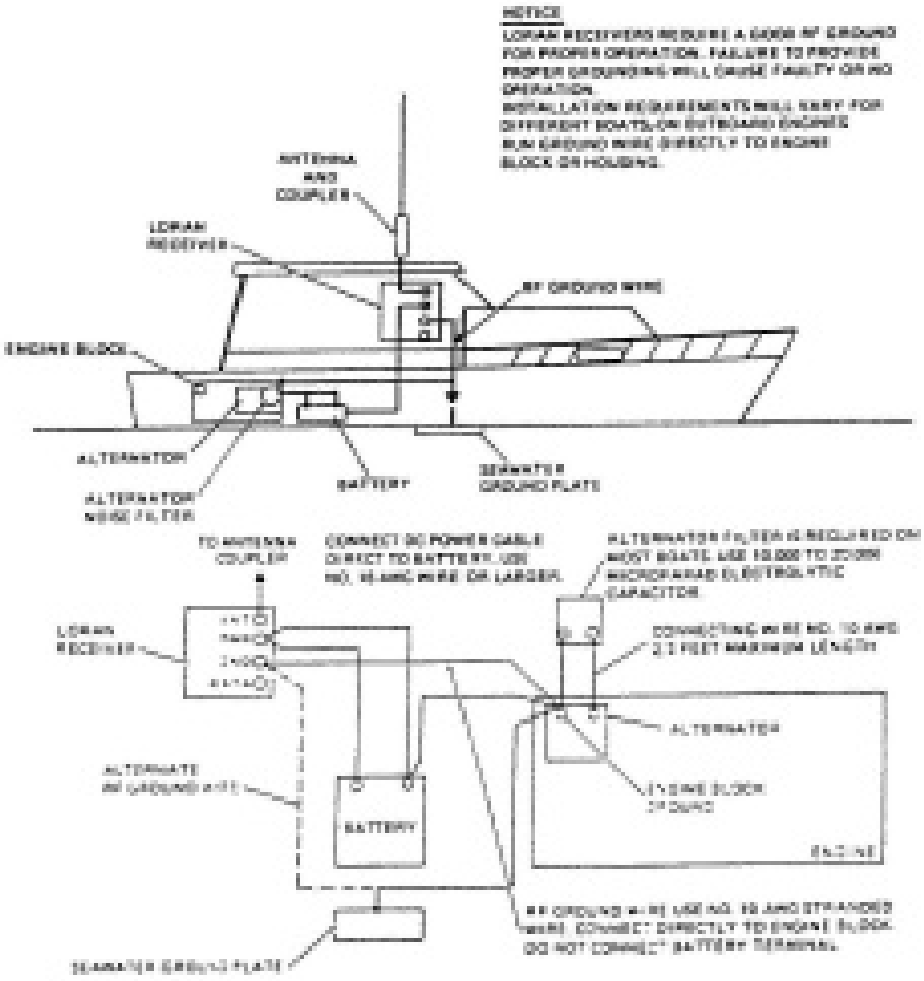


Figure 12 Typical Installation Wiring Diagram

FUSE AND FUSEHOLDER (CONTINUED)

To replace the fuse:

1. Disconnect, antenna and power cables and ground wire.
2. Replace blown fuse with 1.0 AMP in F7R1 (+) line.
3. Re-connect power and antenna cables, and ground wire.
4. Energize unit and check for proper operation.

INTERNAL BATTERY POWER

The Loran main unit contains a small internal lithium battery which enables the receiver to maintain memory of any stored programmed information. The batteries are not rechargeable. Battery life expectancy is in the range of two to three years. When this battery becomes discharged, stored data will be lost. After the battery is replaced,the loran will require re-initialization in accordance with specified operating procedures. See SECTION 3 for initialization procedures.

The internal batteries are soldered in place within the unit. If replacement is required, it should be done only by a qualified technician. Improper connection could cause damage to the unit.

REDUCING ALTERNATOR/GENERATOR INTERFERENCE

After the unit is properly installed, a signal analysis should be performed. This procedure is accomplished using the test (TST) mode described in SECTION SEVEN of this manual.

The most common source of electrical interference to loran operation is the onboard alternator/generator. As a practical rule, all alternator/generator systems will require some sort of electronic noise suppression filters.

A 20,000 microfarad capacitor will provide excellent noise filtering in most situations. The capacitor must be installed directly to the alternator/generator terminals to be effective.

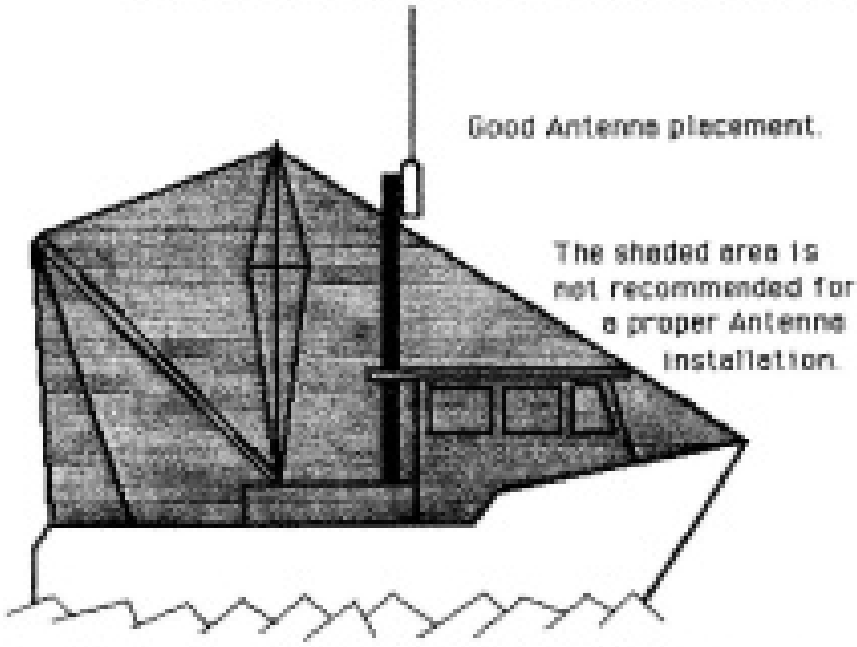
Specifications for a typical recommended capacitor are:
20,000 MFD, -20% + 50%, 50 WVDC, Temp. 85 C.

In many cases, the effects of interference can be reduced or eliminated by relocating the antenna coupler. In any event, the following list of recommendations should be followed prior to finalizing location of the antenna coupler and main unit.

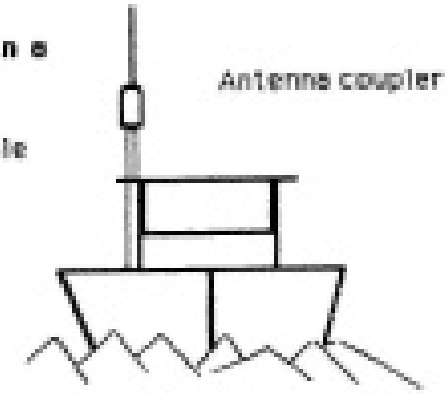
1. Install a 20,000 microfarad, computer grade, vented electrolytic capacitor from the alternator/generator output terminal to any of three grounds--the engine block; alternator/generator housing; ship's ground. Testing may be required to determine best ground.
2. Connect the Loran power cable directly to the battery terminals. Do not connect the power cable to distribution terminals which carry power for other equipment.
3. Perform the interference analysis in the test (TST) mode as described.

REDUCING ALTERNATOR/GENTERATOR INTERFERENCE [CONTINUED]

4. Relocate the vessel's voltage regulator to within 12 inches of the alternator/generator. Install shielded wires from the regulator to the alternator/generator, grounding the shield to the engine block or ship's ground.
5. Reduce the length of main battery cables, both + and -.
6. In the event that alternator/generator noise can not be suppressed satisfactorily, it may be necessary to replace or rebuild the alternator/generator to eliminate the source of interference.



Typical Antenna placement of an installation on a Commercial type vessel.



Typical extension pole mounting on an Open Console type boat.

Figure 13 Typical Antenna Placement on Commercial Vessel
Figure 14 Typical Antenna Placement on Open Console Boat

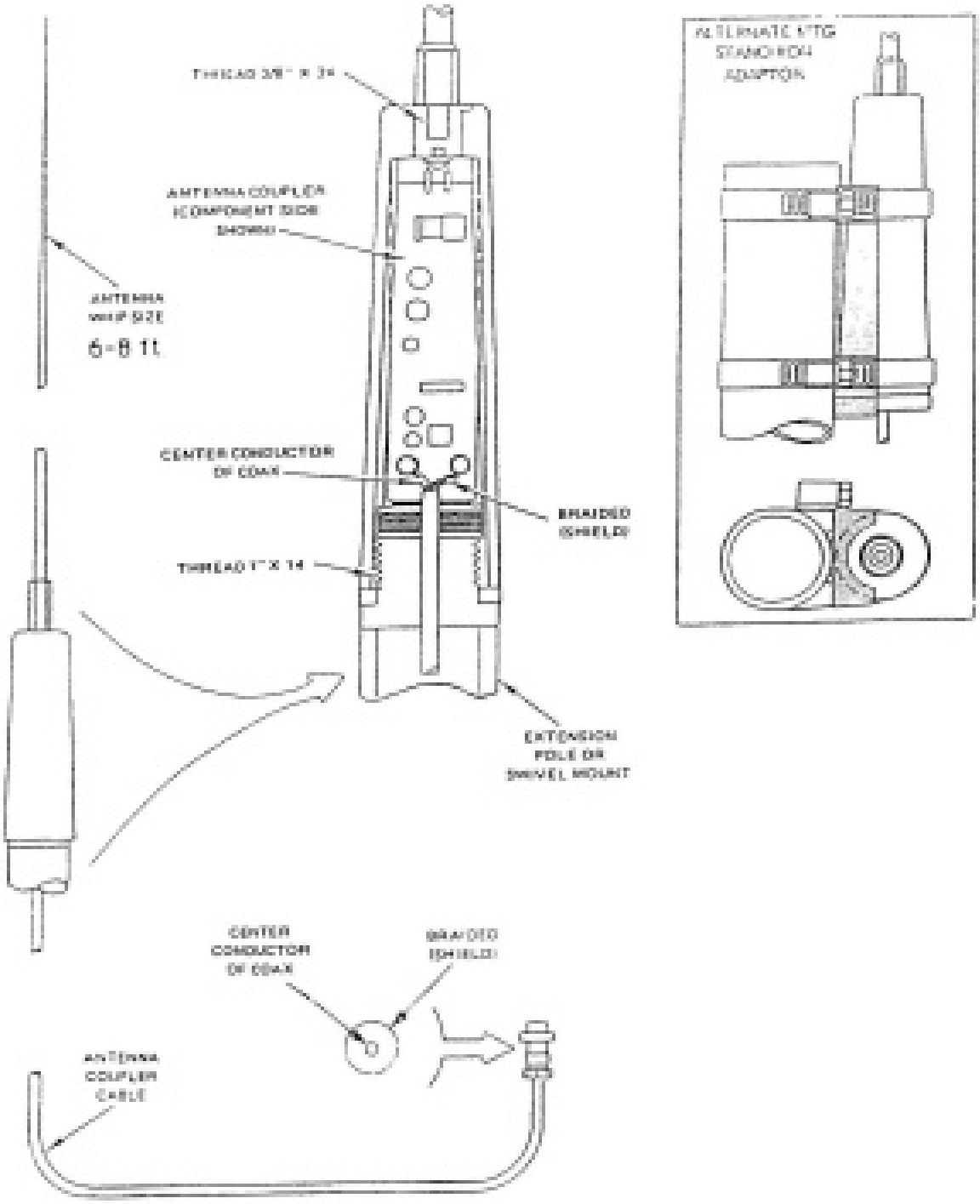


Figure 15 Antenna Coupler

SECTION THREE

KEYBOARD DESCRIPTION AND FUNCTION

The EZ-97 is an easy-to-use electronic aid to navigation, but familiarity with the keys, and their functions, is essential.

The keyboard of the EZ-97 consists of a 16-key numeric touchpad, and a 4-key function and mode select touchpad.

The ON/OFF key energizes the EZ-97. Additionally, when energized it begins acquisition of Loran signals. It also controls the level of brightness of the keyboard and display backlighting. Each press of the ON/OFF key presents one of two levels of brightness. The ON/OFF key will also turn power to the EZ-97 off. Information in memory is protected by the internal batteries, and is not lost when the EZ-97 is turned off.

The UP/DOWN key moves the Mode Indicator Bar from the Operating Modes (LOP and Lat/Lon only), in the upper half of the display, down to the Course Computer functions in the lower half of the display, and back again, as required.

The LEFT movement key moves the Mode Indicator Bar to the left while in the Operating Modes in the upper half of the display window. In doing so, it selects the following modes of operation: GRI; LOP; L/L; TST; CMP; and SET. It also moves the Mode Indicator Bar to the left while in the Course Computer function. In the Course Computer function, it selects the following modes of operation: NP; TTG; STG; HDG; CMG; and Left Side Display Blanking.

The RIGHT movement key moves the Mode Indicator Bar to the right while in the Operating Modes in the upper half of the display window. In doing so, it selects the following modes of operation: GRI; LOP; L/L; TST; CMP; and SET. It also moves the Mode Indicator Bar to the right while in the Course Computer function. In the Course Computer function, it selects the following functions: DIST; HDG; SPD; VMG; and Right Side Display Blanking.

Figure 16 Function Keys

Figure 17 Keyboard

THE S1 KEY (CONTINUED)

The S1 Key controls five operational modes, and their respective displays.

1. GRI Mode: a. Selects the Secondary to be displayed in the S1 (top) display area.
   b. Causes the Secondaries to rotate through the S1 (top) display area.
2. LOP Mode: a. Selects the Secondary to be displayed in the S1 (top) display area.
   b. Causes the Secondaries to rotate through the S1 (top) display area.
3. L/L Mode: a. Selects the primary complementary Lat/Lon solution.
4. TST Mode: a. Selects the Secondary or Master test information to be displayed in the S1 (top) display area.
   b. Causes the Secondary and Master test information to rotate through the S1 (top) display area.

The S2 Key also controls five operational modes and their respective displays.

1. GRI Mode: a. Selects the secondary to be displayed in the S2 (bottom) display area.
   b. Causes Secondaries to rotate through the S2 (bottom) display area.
2. LOP Mode: a. Selects the Secondary to be displayed in the S2 (bottom) display area.
   b. Causes the Secondaries to rotate through the S2 (bottom) display area.
3. L/L Mode: a. Selects alternate complementary Lat/Lon solution.
4. TST Mode: a. Selects the Secondary or Master test information to be displayed in the S2 (bottom) display area.
   b. Causes the Secondary or Master test information to rotate through the S2 (bottom) display area.

The +/M Key affects six operational modes and their respective displays.

1. GRI Mode: a. Jumps the tracking point of the Master station by +10 microsecond increment on both Secondaries.
2. LOP Mode: a. Stores present position (as LOP's) in instant memory each time the key is pressed.
   b. Increments instant memory each time key is pressed.
   c. Instant memory numbers include 51 through 60. After memory number 60 has been used, instant memory starts again at 51 replacing stored LOP's with new LOP's.
3. L/L Mode: a. Stores present Lat/Lon position in instant memory.
   b. Increments memory each time key is pressed.
   c. Instant memory numbers include 51 through 60 After memory number 60 has been used, instant memory starts again at 51 replacing stored Lat/Lon coordinates with new Lat/Lon coordinates.
4. CMP Mode: a. Stores converted Lat/Lon position in waypoint memory. IT MUST BE FOLLOWED BY A TWO-DIGIT MEMORY NUMBER ENTRY to specify memory location.
   b. Used to indicate positive compensation value when entering compensation directly into the LOP's and CMP Mode functions 91 and 92.

+M KEY (CONTINUED)

c. Pushed after entering the two-digit compensation value. It is then followed by an ENT key press.
d. Used to indicate a positive correction when entering HDG/STG compensation for CMP Mode function 98.
e. Adds the amount of correction entered to the current HDG information.

5. TST Mode: a. Displays internal oscillator offset when +/M is pressed once.
b. When +/M is pressed a second time, Loran signal test information is displayed.

6. WP Mode: a. Stores Waypoint information in waypoint memory. MUST BE FOLLOWED BY A TWO-DIGIT NUMBER to specify memory location.

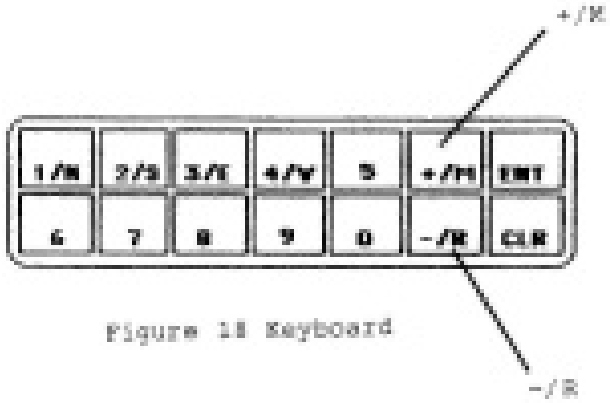


Figure 18 Keyboard

The -/R Key controls seven modes, and their respective displays.

1. GRI Mode: a. Adjusts the tracking point of the Master Loran signal by minus 10 microsecond. Shows as a -10 increment on both Secondaries.

2. LOP Mode: a. Recalls positions stored in instant memory.
b. Decrements instant memory each time key is pressed, from 60 through 51.

3. L/L Mode: a. Recalls positions stored in instant memory.
b. Decrements instant memory each time key is pressed, from 60 through 51.

4. CMP Mode: a. Recalls LOP waypoints in memory. If Lat/Lon is desired, LOP's must be manually converted.
b. Waypoints recalled must be designated by their two-digit memory location number.
c. Used to indicate a negative correction when entering

-/R KEY (CONTINUED)

HDG/STG compensation in CMP function.

d. Subtracts the amount of correction entered to the current HDG information.

e. Used to indicate a negative compensation value when entering compensation directly into LOP's in CMP mode functions 91 and 92.

f. Pushed after entering the two-digit compensation value. This must be followed by an ENT key press.

5. Set Mode: a. Selects the SET mode function to be displayed. Must be followed by function code 98 or 93-97.

6. WP Mode: a. Recalls waypoint position information in memory. Must be followed by the two-digit memory location number.

7. TST Mode: a. Displays internal oscillator offset if pressed once.

b. displays secondary test information when pressed a second time.

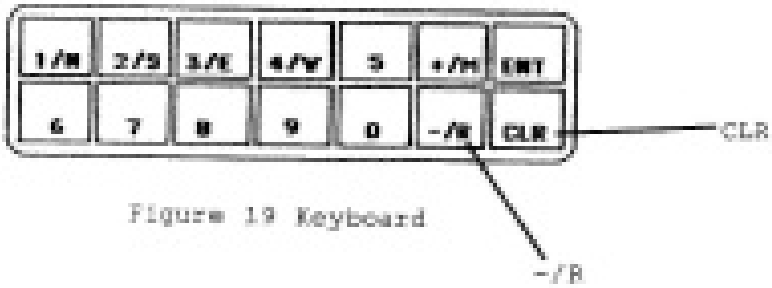


Figure 19 Keyboard

The CL Key controls eight operational modes and their respective displays.

1. GRI Mode: a. Silences audible alarms (Cross-track error, Arrival, and Anchor Watch).

b. Restarts acquisition of loran signals and tracking process.

c. Clears errors made during entry of GRI information.

2. LOP Mode: a. Silences audible alarms (Cross-track error, Arrival, and Anchor Watch).

b. Returns EZ-97 to normal tracking after storing present position in instant memory.

c. Returns EZ-97 to normal tracking after recalling position or waypoint information stored in instant memory.

3. L/L Mode: a. Silences audible alarms (Cross-track error, Arrival, and Anchor Watch).

THE CL KEY (CONTINUED)

b. Returns EZ-97 to normal tracking after storing present position in instant memory.
c. Returns EZ-97 to normal tracking after recalling position or waypoint information stored in instant memory.

4. CMP Mode:
a. Clears Display area after a conversion operation.
b. Clears keyboard entry errors made during LOP entry for conversion.
c. Cancels and clears Lat/Lon compensation manually applied to Lat/Lon readout.
d. Cancels and clears HDG and STG compensation.
e. Clears keyboard entry errors made during compensation entry.
f. Clears keyboard entry errors made during L/L compensation entry.

5. SET Mode:
a. Clears keyboard entry errors.
b. Sets XTE, Arrival, Anchor Watch alarm limits to zero which inhibits alarm function.

6. WP Mode:
a. Cancels recalled Waypoint and returns display back to current waypoint information.
b. Clears keyboard entry errors.

7. CMG Mode:
a. Resets elapsed timer to zero.
b. Resets Course Made Good to 360 degrees.
c. Resets CMG and VMG starting point.

8. VMG Mode:
a. Resets elapsed timer to zero.
b. Resets Velocity Made Good to zero knots.
c. Resets VMG and CMG starting point.

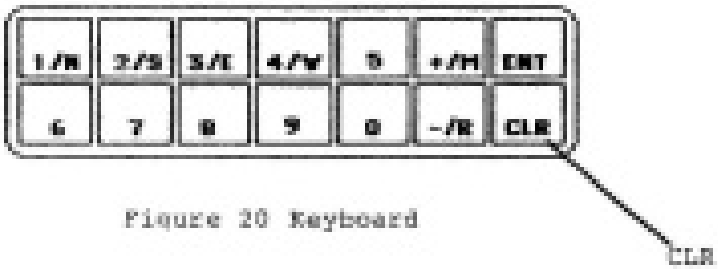


Figure 20 Keyboard

The ENT Key controls seven operational modes and their respective displays.

1. GRI Mode:
a. Used to complete entry of GRI.
b. When pressed without numerical entries, GRI is cleared and EZ-97 restarts. All modes and

functions are reset to their default values.

2. CMP Mode: a. Enters LOP's to be manually converted to Lat/Lon coordinates. Starts Manual Conversion process.
   b. Used in entering Lat/Lon compensation from known coordinates of the current position.
   c. When ENT is pressed, the values are entered and the compensation engaged.
3. SET Mode: a. Enters limits and data into each of the eight SET Mode functions.
   b. When ENT is pressed, the data is entered and activated.
   c. Used in entering waypoints for imaginary course, distance, and bearing computations.
4. WP Mode: a. Enters manually entered waypoint information and recalled waypoint from any waypoint in memory or in instant memory, for Course Computer navigation.
5. LOP Mode: a. Resets course Computer points of origin when pressed after entering the digit "1."
   b. Cancels current waypoint and enters the next waypoint when pressed after entering the digit "9" while operating in the automatic waypoint sequencing mode.
6. L/L Mode: a. Used in the same fashion as for LOP Mode.
7. Course Computer Mode: a. Used in the Course Computer function TTG, STG, RBG, CMG, DIST, SPD, and VMG in the same fashion as LOP mode.

The 1/N Key has three principle functions.
1. It enters a number value of "1" in: waypoint data; Set mode; GRI; compensation; and memory number entry.
2. It designates latitude information being entered as being in the northern hemisphere.
3. Followed by an ENT key press, it resets point of origin in LOP, L/L, and Course Computer operating modes.

The 2/S Key has two principle functions.
1. It enters a number value of "2" in: waypoint data; Set mode; GRI; compensation; and memory number entry.
2. It designates Latitude information being entered as being in the southern hemisphere.

The 3/E Key has two principle functions.
1. It enters a number value of "3" in: waypoint data; Set mode; GRI; compensation; and memory number entry.
2. It designates Longitude information being entered as being in the eastern hemisphere.

The 4/W Key has two principle functions.
1. It enters a number value of "4" in: waypoint data; Set mode; GRI; compensation; and memory number entry.
2. It designates Longitude information being entered as being in the western hemisphere.

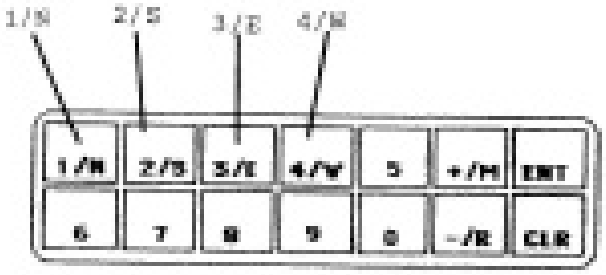


Figure 21 Keyboard

Keys 5 through 8 are used for number entry in: Course Computer; Set mode; GRI; compensation; and memory number entry.

Key 9 enters a number value of "9" in: Course Computer; Set mode, GRI; compensation; and memory number entry. When in L/L, LOP, or Course Computer modes, pressing Key 9 will advance the waypoint sequence to the next waypoint when the ENT Key is pressed immediately following.

SECTION FOUR

DISPLAY AREA DESCRIPTION

The Display Area of the EZ-97 is an easily read, backlighted, Liquid Crystal Display. Familiarity with the Display Area will help ensure optimal use of the EZ-97 Loran C receiver.

MEMO
The Mode Indicator Bar under MEMO indicates that displayed information is being stored or recalled from memory.

WP
There are two WP indicators in the display. One is located below MEMO in the S1 Display Area. The second is located in the lower left corner of the S2 Display Area.

An Indicator Bar over the WP in the MEMO area indicates that the number appearing under MEMO is the address code for an entered waypoint.

An Indicator Bar over the WP in the S2 Display Area places the EZ-97 in the Waypoint Mode.

The Waypoint mode is used for entry, storage, recall, and transfer of waypoint memory information.

MEMO/WP NUMBER
An Indicator Bar under MEMO indicates that the two-digit number displayed is being recalled from, or stored in memory.

When the Indicator Bar is visible over WP, the waypoint whose number is displayed is being used as the current waypoint.

When the EZ-97 is in the SET mode, the two-digit SET function number is displayed here.

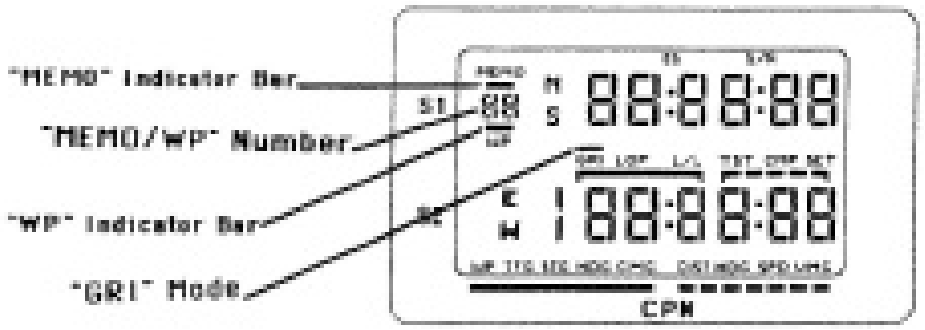


Figure 22 Display Area

DISPLAY AREA DESCRIPTION (CONTINUED)

In LOP and L/L modes, the instant memory two-digit address code being stored is shown when the +/M Key is pressed.

In LOP and L/L modes, the instant memory two-digit address code being recalled is shown when the -/R Key is pressed.

When the EZ-97 is in the Course Computer mode, the waypoint number is displayed here.

GRI
A Mode Indicator Bar over GRI allows entry of GRI, or Chain Code.

It is also the initial selection for the entry of Secondary Stations in the S1 and S2 Display Area.

When a Mode Indicator Bar is visible over GRI, Loran signal acquisition can be restarted by pressing the CL Key.

The tracking point of the Master Station signal and the Secondary Station signal can be "bumped" in 10-microsecond intervals by pressing the +/M Key or the -/R Key. This is to aid in getting in fringe (skywave) areas.

LOP
A Mode Indicator Bar over LOP displays current position in TD's or LOP's.

By pressing the +/M Key, the current position will be stored in instant memory.

By pressing the -/R Key, the instant memory positions are recalled.

Pressing the CL Key restores the EZ-97 to normal tracking.

Course Computer functions are accessed from this mode by using the ▲▼ Key to move the Mode Indicator Bar down to the Course Computer function area in the lower Display Area.

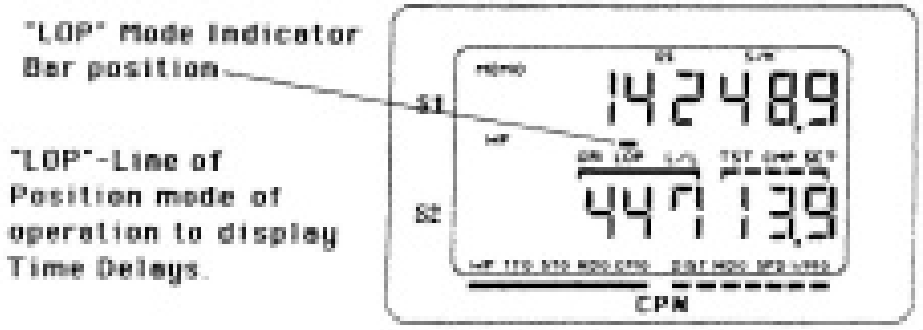


Figure 23 Display Area (LOP)

DISPLAY AREA DESCRIPTION [CONTINUED]

The point of origin of the Course Computer may be reset by pressing the 1/M Key, followed by pressing the ENT Key.

Pressing 9, followed by pressing ENT will display the next waypoint in auto-waypoint sequencing.

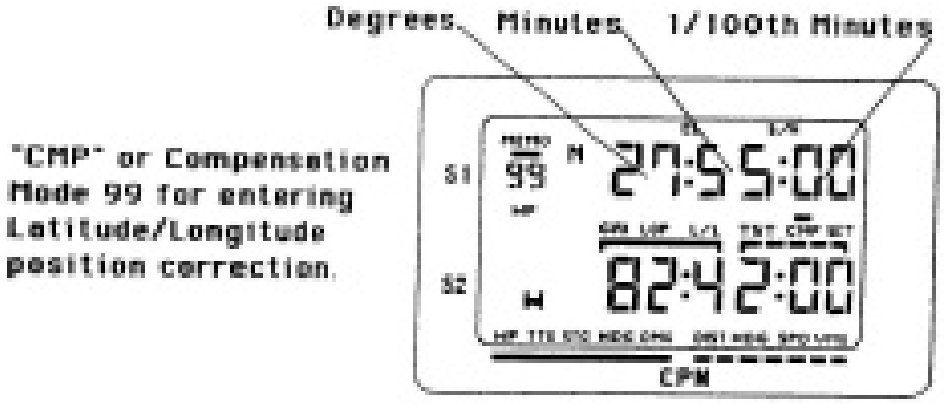


Figure 24 Display Area (L/L)

L/L
Displays current position in Lat/Lon coordinates--degrees, minutes and hundredths of minutes.

Current position is stored as instant memory by pressing the +/M Key in this mode.

Instant memory positions are recalled by pressing the -/R Key in this mode.

Pressing the CL Key returns the EZ-97 to normal tracking.

Course Computer functions may be accessed in this mode by using the ▲▼Key to move the Mode Indicator Bar to the Course Computer functions in the lower half of the Display Area.

Point of origin in the Course Computer may be reset in this mode by first pressing the 1/M Key, followed by pressing the ENT Key.

Pressing 9, followed by pressing the ENT Key will change the waypoint in auto-waypoint sequencing to the next waypoint number.

CMP
There are four modes of operation in the CMP mode.

DISPLAY AREA DESCRIPTION (CONTINUED)

A. LOP's can be converted to Lat/Lon coordinates. They may be LOP's of current GRI, or LOP's of other GRI's. Pressing the S2 key in this mode displays the complementary Lat/Lon solution. Pressing the S1 Key returns the EZ-97 display to the primary solution.

B. In this mode, manual compensation of Lat/Lon position may be accomplished. Press the -/R Key followed by pressing 9 and 9.

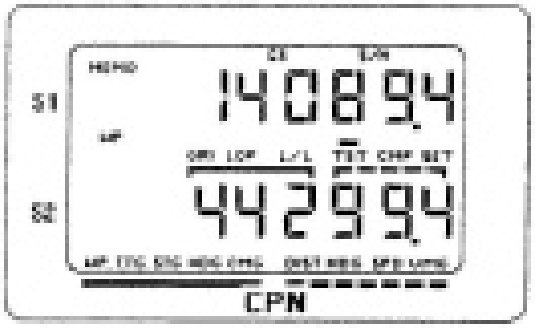
C. Heading (HDG) and Bearing (BTG) readouts can be altered in this mode. First, press the -/R Key followed by pressing 9 and then 8. NOTE: Heading and Bearing is in degrees true when uncorrected (default). Any compensation entered will cause warning indicators to be present in the Display Area (see Section Six).

D. ASF compensation can be added to either or both current LOP's in the CMP mode using the R, 9, and 1 Keys and the R, 9, and 2 Keys.

TST
When the Mode Indicator Bar is over TST, signal quality information from the S1 Secondary is displayed in the S1 Display Area. Signal quality information about the S2 Secondary is displayed in the S2 Display Area.

The signal quality of the Master and all other Secondaries can be displayed by rotating the display using the S1 and S2 Keys.

For both S1 and S2, the first and second digits from the left identify the station being monitored.



"TST"-Test Mode display with a signal quality value of 089 for the S1 secondary and 299 for the S2 secondary.

Figure 35 Display Area (TST)

The third, fourth and fifth digits give actual signal quality indications. NOTE: THE LOWEST DEPENDABLE READING IS 025 IF THE EZ-97 HAS SETTLED AND CS ALARM HAS EXTINGUISHED.

DISPLAY AREA DESCRIPTION (CONTINUED)

The sixth digit from the left is the mode of settling. There are four modes of settling and the sixth digit will change automatically during the settling period. The EZ-97 will not settle until the 4th mode is reached, however a 4 in the sixth space does not indicate that EZ-97 has settled. Only the CS indicators determine if a particular station has settled.

Pressing the +/M Key or the -/R Key in the CMP mode will display the oscillator frequency offset in both S1 and S2 Display Areas. Maximum allowable offset value is 30. Press the +/M Key or the -/R Key a second time to return EZ-97 to signal test information display.

"TST"-Test Mode showing the maximum allowable oscillator offset value of 20.

Figure 26 Display Area (Oscillator Test)

SET
There are five SET mode functions which are accessed by pressing the -/R Key and the two digit function number while in the SET mode. The function number will be displayed in the MEMO area.

When accessed, the SET mode values are displayed in the S1 and S2 Display Area.

SET 90--LAT/LON DATA OUTPUT FORMAT
Four different serial data output format, corresponding to the connected equipment, is offered by EZ-97. This output is via a BNC connector on the back panel of the unit. (See Section Twelve for format definitions)

SET 93--SPEED AVERAGING FACTOR
Normal (default) setting is a value of 3. Averaging range is from 1 through 3. The slower the vessel, the higher the averaging factor. It takes approximately four minutes to get a valid speed readout after the vessel speed has stabilized. Heading information uses the same averaging factor. Heading is derived from the same position information.

SET 94--DISTANCE AND BEARING CALCULATIONS BETWEEN ANY 2 WP'S IN MEMORY
Press the -/R Key, followed by the two digit memory address code of the

starting waypoint. Follow by entering the two digit memory address code for the second waypoint, then press the ENT Key. Distance, in nautical miles, is displayed in the S2 Display Area--bearing, in degrees true, is displayed in the S1 Display Area.

SET 95--ANCHOR WATCH ALARM LIMIT
Sets the radius of the Anchor Watch perimeter. [See Section Six to change/enter perimeter values]

SET 96--ARRIVAL ALARM LIMIT
Sets the limit for triggering the Arrival Alarm and automatic sequencing to the next waypoint. (See Section Six to change/enter limits]

SET 97--CROSS TRACK ERROR ALARM LIMIT
Sets the off-course limits for triggering the Off Course Alarm. (See Section Six to change/enter limits]

CS
In the GRI, TST, and LOP modes, the colons immediately below the CS in the Display Area are tracking condition alarm indicators for the displayed LOP's. Colons indicate that Secondary station signal is not in cycle-lock and the position readout is not usable.

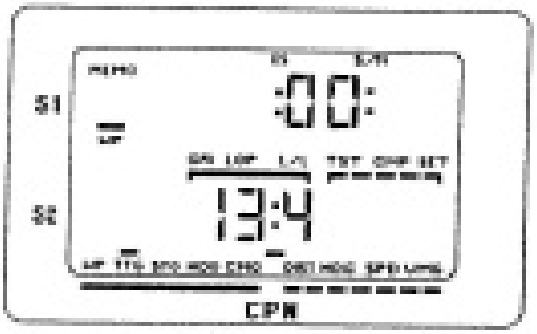
The CS Alarms can be extinguished by moving the Mode Indicator Bar over TST, and then returning it to the tracking mode. If the signal quality is not adequate, the CS Alarm will again appear.

DISPLAY AREA DESCRIPTION (CONTINUED)

S/N

In the GRI, TST, and LOP modes, the colons immediately below the S/N in the Display Area are tracking condition alarm indicators for the LOP's currently displayed. Colons indicate that the Signal to Noise ratio is not within acceptable limits and that the current position readouts may not be reliable.

NOTE: IN GRI AND LOP MODES, BLINKING MODE INDICATOR BARS INDICATE A CS AND/OR S/N ALARM CONDITION EXISTS FOR THE MASTER STATION. IN ALL OTHER MODES, BLINKING MODE INDICATOR BARS MEAN AN ALARM CONDITION EXISTS FOR THE MASTER STATION AND/OR ANY OF THE SECONDARY STATIONS.



Compunav Display showing Cross Track Error in the top, Time To Go (TTG) in the left side bottom with the right side bottom information blanked out.

Figure 27 Display Area (TTG, Cross Track Error)

TTG

Gives Time-To-Go, at established speed and heading, to the next destination or waypoint. TTG greater than one hour is displayed in hours and ten minute increments. TTG less than one hour is displayed in one minute increments. TTG is displayed on the left side of the lower Display Area only. It takes approximately four minutes after stabilizing before the TTG readouts are accurate. If the vessel is not underway, the TTG readouts will be 99 99, indicating maximum time to go.

Cross tracking error is displayed in the S1 Display Area during the TTG mode unless VMG is selected in the right side Course Computer functions.

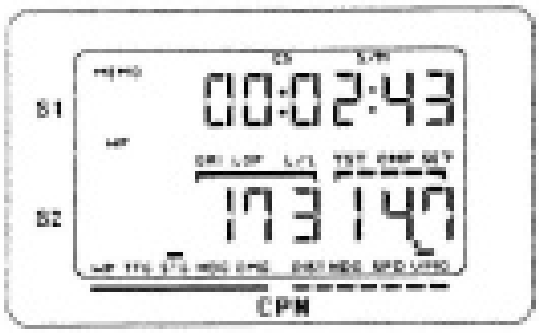
"STG"-Steering or Bearing to the waypoint shown in the left side bottom display. The top (S1) display information is Cross Track Error.

Note right side bottom (S2) display is blanked.

Figure 28 Display Area (STG, Cross Track Error)

STG
Displays the bearing, or course-to-steer, to the next entered waypoint. Bearings are displayed in degrees true unless a compensation value has been introduced in the CMP 99 mode.

The initial bearing is the computed line which will result in a cross track error reading of (00) in the S1 Display Area. Bearing is always computed from present position. During this mode, cross track error is displayed in the S1 Display Area unless VMG has been selected on the right side Course Computer functions.



S2 Display showing "STG" and "VMG" information. During display of Velocity Made Good (VMG) the S1 display area shows Elapsed Time in days, hours, and minutes.

Figure 29 Display Area (STG, VMG, Elapsed Time)

HDG
Displays the average heading over the bottom in degrees true unless a compensation value has been entered in the CMP mode. HDG may be selected from either the right or left side of the S2 Display Area. The HDG accuracy may be adversely affected by poor crossing angles, wide gradients, and vessel speed. When the vessel is not underway, HDG information will be random. Once underway, up to four minutes may be required to stabilize the HDG information.

HDG is computed from the same change in position information used to compute speed, and the speed averaging factors affect the heading information in the same way as they affect the speed made good information.

It is not necessary to enter a waypoint to obtain heading information. During this mode, cross track error information is displayed in the S1 Display Area unless CMG or VMG is selected.

CMG
Course Made Good is the average heading from an initial starting point. The display is in degrees true, and appears on the left side of the S2 Display Area. Elapsed time is displayed in the S1 Display Area. By pressing the CL Key,in this mode, the elapsed timer and initial starting point are reset.

Course Made Good (CMG) display shown with right side S2 display area blanked out.

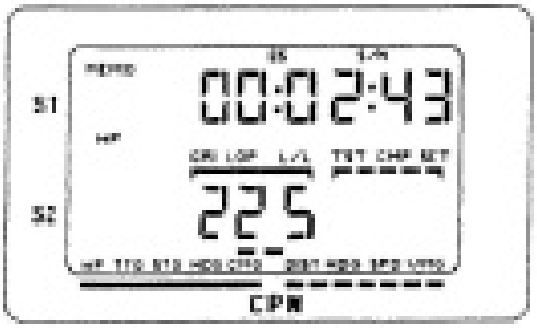
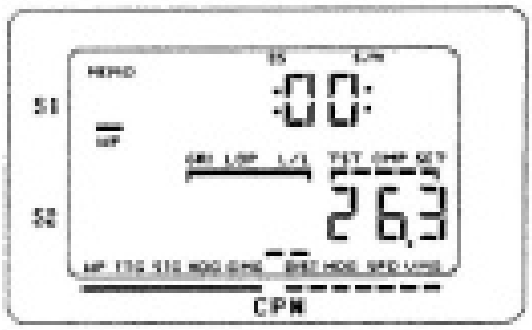


Figure 30 Display Area (CMG)

DIST
DIST displays the distance between two points in memory, or distance to go to a waypoint or destination. DIST is displayed in the right half of the S2 Display Area. When distance to a waypoint becomes less than 100 nautical miles, the display changes to 1/10th nautical mile resolution.

Cross track error is displayed in the S1 Display Area during this mode unless CMG is selected in the left side Course Computer function area.



"DIST"-Distance to the waypoint with Cross Track Error shown in the S1 display area and the left side S2 display area blanked out.

Note: Distances less than 100 NM are shown with 0.1Nautical mile resolution.

Figure 31 Display Area (DIST to WP, Cross Track Error)

SPD
Displays average speed over the bottom in the right half of the S2 Display Area. The speed readout becomes usable after vessel's speed has stabilized for approximately four minutes. The accuracy of SPD is greatly affected by LOP crossing angles, gradients, and course changes which all tend to degrade speed readouts.

The faster a vessel crosses the LOP's, the more stable is the speed readout.

SET mode 93 allows averaging factors from one to three to be entered into EZ-97. Increasing the speed averaging factor gives a longer speed averaging. Decreasing the value of the speed averaging factor shortens speed averaging. To stabilize the speed readout, increase the averaging factor.

Cross track error is displayed in the S1 Display Area during this mode unless CMG is selected in the left side Course Computer functions.

Display of "SPD"- Speed over the bottom with Cross Track Error in the S1 display and left side S2 display blanked out.

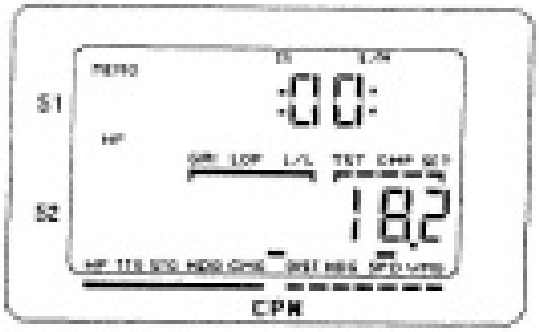


Figure 32 Display Area (SPD, Cross Track Error)

VMG
Velocity Made Good is an average speed from an initial starting point. The display is in knots and appears on the right side of the Display Area.

Elapsed time is displayed in the S1 Display Area whenever VMG is selected, and cross track error is not displayed.

Pressing the CL Key, in this mode, will reset the timer and the starting point for both VMG and CMG.

Display in "VMG" (Velocity Made Good) mode of operation. Elapsed Time is Shown in the S1 display area with the left side S2 display area Blanked out.

Note: The Elapsed Time is display whenever "VMG" or "CMG" functions are selected.

Figure 33 Display Area (VMG, Elapsed Time)

Cross Track Error shown in the S1 display area and the left side S2 display area blanked out.

Note: Distances less than 100 NM are shown with 0.1Nautical mile resolution.

Figure 34 Display Area (Cross Track Error)

CROSS TRACK ERROR

Cross track error is the Course Computer off-course indicator. It computes a line from the starting point to the first waypoint, and indicates which way a vessel is off track in 1/100ths or 1/10ths of a nautical mile. It is best used with the STG function.

Cross track error is not displayed when CMG or VMG are selected.

SECTION FIVE

FIRST TIME OPERATION

Once the EZ-97 has been properly connected, it is ready to use. First time start-up procedure is simply a matter of following the ten steps listed below.

Step 1. Press the ON/OFF Key.

Step 2. Press the ◀— Key or the ▶— Key to move the Indicator Bar over the GRI Mode in the Display Window.

Step 3. Press the ENT Key. Do this regardless of your current location. A series of 9's will appear in the Display Window.

Step 4. Enter the 4 digits of the GRI (Chain Code) for current location. Each digit will appear in the Display Window as it is pressed. In the event an error is made, press the CL Key to clear Display.

Step 5. When Step 4 is completed, press the ENT Key. The GRI will appear in both S1 and S2 Display Windows.

Step 6. Now, WAIT! LOP's will appear in the Display Window, and each Secondary available in the local chain will rotate through both Display Windows.

Step 7. Press the S1 Key to select the S1 Secondary used in local area. Pressing the S1 Key will also cause Secondaries to rotate through the S1 Display Window.

Step 8 Press the S2 Key to select the S2 Secondary used in current locale. Pressing the S2 Key will also cause Secondaries to rotate through the S2 Display Window.

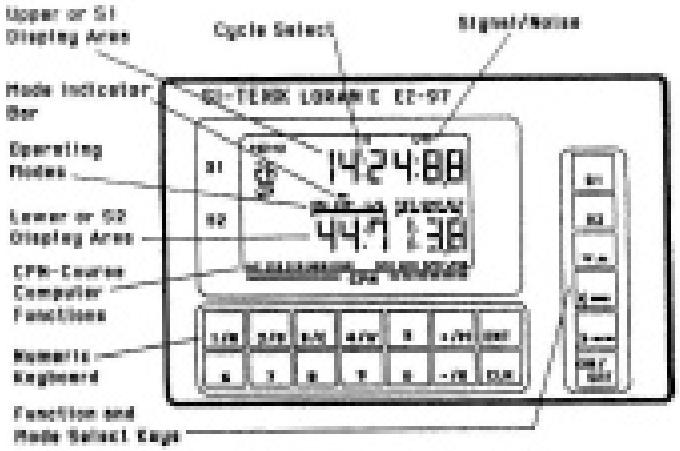
Step 9. Allow the EZ-97 to "settle" until the CS and S/N ALARMS have ceased, and the Mode Indicator Bar over GRI has stopped blinking.

Step 10. Use the ▶— Key to move the Indicator Bar over LOP of L/L for Line Of Position of Latitude/Longitude displays.

Step 11. To turn the EZ-97 "OFF," move the Mode Indicator Bar back to LOP or L/L in the upper Display Area. Press and hold the ON/OFF Key until the Display Area is clear.

NOTE: IT IS NOT NECESSARY TO REPEAT THE INITIALIZATION PROCEDURE EACH TIME THE LORAN IS USED. IT IS REQUIRED FOR FIRST TIME OPERATION AND AFTER PERIODS OF NON-OPERATION WHEN INTERNAL BATTERY FAILURE CAUSES LOSS OF MEMORY INFORMATION.

EZ-97 LORAN C BRIEF OPERATING INSTRUCTIONS



OPERATING MODES

GRI-Group Repetition Interval	TTG-Time To Go
LOP-Lines of Position	STG-Steering(or Bearing)
L/L-Latitude/Longitude	HDG-Heading
TST-Test Mode	CMG-Course Made Good
CMP-Compensation Mode	DIST-Distance To Waypoint
SET-Set mode	SPD-Speed
WP-Waypoint	VMG-Velocity Made Good
CPN-Course Computer mode	

Figure 1. Front Panel Displays and Keyboard

LORAN C Chains (GRI)

4990-CENTRAL PACIFIC	7980-SOUTHEAST U.S.	9970-NORTHWEST PACIFIC
5990-CANADIAN WEST COAST	7990-MEDITERRANEAN SEA	9990-NEW CANADIAN
7930-NORTH ATLANTIC	8970-GREAT LAKES	9990-NORTH PACIFIC
7960-GULF OF ALASKA	9940-U.S. WEST COAST	9960-ICELANDIC
7970-NORWEGIAN SEA	9960-NORTHEAST U.S.	

FIRST TIME OPERATION

OPERATION	MODE	KEY PRESS SEQUENCE	TYPICAL DISPLAY
GRI ENTRY	GRI	[CLR] [▲▼] OR [▲▼] [7] [9] [8] [0] [ENT]	007980 007980
TURNING TEST SET	LOP L/L	[▲▼] RETURN BAR TO LOP OR L/L MODE [CLR] HOLD 5 SECONDS	
SELECT LOPS	GRI	TOP DISPLAY [S1] SELECT LOWER DISPLAY [S2] SELECT	142488 447138
LOP DISPLAY	LOP	[▲▼] POSITION BAR OVER LOP	142488 447138
LAT/LON DISPLAY	L/L	[▲▼] POSITION BAR OVER L/L IF DISPLAY IS ALL 7's REPEAT LOP SELECT	N275400 W824166
SPEED & HEADING DISPLAY	HDG & SPD	[▲▼] POSITION BAR OVER HDG [▲▼] POSITION BAR OVER SPD	HDG 00 SPD 273126
CMG & VMG DISPLAY	CMG & VMG	[S1] POSITION BAR OVER CMG [▲▼] POSITION BAR OVER VMG UPPER-CMG, VMG, VMG, LOWER-CMG & VMG → PRESS CLR TO RESET PLACES TO ZERO	000136 273148
BASIC NAVIGATION PROGRAMMING			
DIRECT ENTRY LOP WAYPOINT	WP	SELECT LOP MODE [▲▼] OR [▲▼] SELECT WP [▲▼] [▲▼] [1] [4] [2] [5] [0] [0] [0] [0] [0] [0] [ENT]	142500 447250
DIRECT ENTRY LAT/LON WAYPOINT	WP	SELECT L/L MODE [▲▼] OR [▲▼] SELECT WP [▲▼] [▲▼] [N] [2] [7] [5] [4] [0] [0] [W] [8] [2] [4] [1] [6] [6] [ENT]	N275400 W824166
DISPLAY BEARING & DISTANCE	STG & DIST	AFTER WP ENTRY [▲▼] POSITION BAR OVER STG [▲▼] POSITION BAR OVER DIST	CROSS-TRACK ERROR 00 359030 (STG) (DIST)
DISPLAY TIME-TO-GO (TTG)	TTG	AFTER WP ENTRY [▲▼] POSITION BAR OVER TTG	00 145030 (TTG) (DIST)
DISPLAY SIGNAL QUALITY MONITOR	TST	FROM TTG & DIST DISPLAY [▲▼] POSITION BAR OVER TST [▲▼] HIGH NUMBERS INDICATE POOR SIGNAL. DIGITS 3,4,5	140894 442894 BLINK SIGNAL QUALITY
RESET OF POINT OF ORIGIN FOR THE COURSE	LOP L/L OR CPN	TO RESET POINT OF ORIGIN AND CROSS-TRACK ERROR PRESS [CLR] [ENT]	AS INITIAL DISPLAY

FIGURE 55 Brief Operating Instructions

ADVANCED OPERATION

OPERATION	MODE	KEY PRESS SEQUENCE	TYPICAL DISPLAY
LOP WAYPOINT STORAGE IN MEMORY	WP	[Y/A] [NAV] POSITION BAR OVER WP [CW] [CCW] [CW] [CCW] [CCW] [9] [9] [CCW] [CCW] [7] [CW] [CCW] [9] AFTER NUMBER ENTRY PRESS [CW] [9] [CW] [ST] MEMORY NUMBER	LOP CHANNEL 142488 447138
L/L WAYPOINT STORAGE IN MEMORY	WP	[Y/A] [←] POSITION BAR OVER WP [CW] [CCW] [7] [9] [CCW] [9] [9] [CCW] [9] [CCW] [CCW] [CW] [9] [9] AFTER NUMBER ENTRY PRESS [CW] MEMORY NUMBER [9] [CW] [ST]	L/L CHANNEL 275400 824166
WAYPOINT RECALL	WP	FROM L/L [Y/A] OR LOP [NAV] POSITION BAR OVER WP [CW] [0] [CW] [ST]	WAYPOINT THAT DE LOPs OR L/L
ENTER RECALLED WAYPOINT	WP	FROM L/L [Y/A] OR LOP [←] POSITION BAR OVER WP [CW] [9] [CW] [ENT] TO DISPLAY NAV INFO PRESS [←]	L/L CHANNEL 275400 824166
TRANSFER MEMORY WAYPOINTS	WP	FROM L/L [Y/A] OR LOP [←] POSITION BAR OVER WP [CW] [9] [CW] [CCW] [CCW] [9] [ST]	LOP CHANNEL 142488 447138
INSTANT MEMORY STORAGE	LOP OR L/L	WHILE ON LOP OR L/L PRESS [CW] TO RETURN TO NORMAL TRACK [ST]	LOP CHANNEL 142488 447138
INSTANT MEMORY RECALL	LOP L/L OR WP	WHILE ON LOP OR L/L PRESS [CW] TO RETURN TO NORMAL TRACK [ST]	LOP CHANNEL 142488 447138
AUTOMATIC WAYPOINT SEQUENCE	WP	FROM L/L [Y/A] OR LOP [←] POSITION BAR OVER WP [CW] [MEMO NUMBER] [ENT] [CW] [MEMO NUMBER] [ENT] [CW] [MEMO NUMBER] [ENT] REPEAT FOR UP TO TEN MEMO NUMBERS [←] MOVE BAR TO A DIFF FUNCTION TO ACTIVATE	LOP CHANNEL 142746 447584
TO SKIP A WAYPOINT IN AUTO SEQUENCE	LOP, L/L or NAV MODE	[9] [ENT] STOPS AUTOMATIC WAYPOINT SEQUENCING TO THE NEXT ENTERED WAYPOINT	L/L CHANNEL 275400 824166
MANUAL LOP TO L/L CONVER-SION	CMP	FROM LOP OR L/L [ST] POSITION BAR OVER CMP - ENTER LOPs [CW] [CCW] [9] [9] [9] [CCW] [CCW] [9] [9] [9] [9] [ENT]	ENTERED LOPs 140000 440000 L/L RESULT 255480 822655

ADVANCED OPERATION (CONT.)

OPERATION	MODE	KEY PRESS SEQUENCE	TYPICAL DISPLAY
TEMPORARY COURSE DISPLAY	SET	FROM LOP OR L/L [←] POSITION BAR OVER SET [CW] [9] [CCW] [CW] [FIRST MEMO NUMBER] [SECOND MEMO NUMBER] [ENT]	CLEARANCE 1743 00 1199 CONTINUED
LAT/LON MANUAL CORRECTION	CMP	FROM LOP OR L/L [←] POSITION BAR OVER CMP [CW] [9] ENTER PRESENT CORRECT L/L [CW] [CCW] [7] [9] [CCW] [CW] [9] [CCW] [9] [CCW] [CCW] [CW] [CCW] [9] [ENT]	00 18 000025
LOP CORRECTION	CMP	FROM LOP OR L/L [←] POSITION BAR OVER CMP [CW] [9] [CW] FOR S1 [ENTER 2 DIGITS] [ENT] [CW] [9] [CCW] FOR S1 [ENTER 2 DIGITS] [ENT]	142473 - 15 - 15 447153
COMPUTE-INTERP L/L	L/L	[ST] OR [ST] POSITION BAR OVER L/L [ST] TO RETURN TO THE PRIMARY SOLUTION [ST]	133953 1305308
HEADING & BEARING CORRECTION	CMP	FROM LOP OR L/L [←] POSITION BAR OVER CMP [CW] [9] [ENTER 3 DIGITS FROM 10 DEGREES] [CCW] OR [CW] [ENT]	-00025 0 2743
INITIAL LIMITS SET MODE	SET	SELECT SET MODE [ST] SPEED AVERAGING [CW] [9] [CW] ANCHOR WATCH [CW] [9] [9] ARRIVAL ALARM [CW] [9] [9] CROSSTRACK ALARM [CW] [9] [7]	SPEED AVERAGING 000003 000003
CHANGING SET MODE LIMITS	SET	FROM LOP OR L/L [ST] POSITION BAR OVER SET FOR SPEED AVERAGING [CW] [9] [CCW] [ENTER 1 DIGITS] [ENT] ANCHOR WATCH [CW] [9] [9] [ENTER 2 DIGITS] [ENT] ARRIVAL ALARM [CW] [9] [5] [ENTER 2 DIGITS] [ENT] CROSS TRACK ERROR ALARM [CW] [9] [7] [ENTER 2 DIGITS] [ENT]	000003 000003 000050 000050 000005 000005 000050 000050
ENGAGE ANCHOR WATCH	WP	FROM LOP OR L/L [Y/A] [NAV] POSITION BAR OVER WP THEN PRESS [0] [ENT] TO CLEAR POSITION BAR OVER WP PRESS [ENT]	L/L CHANNEL 275400 824166

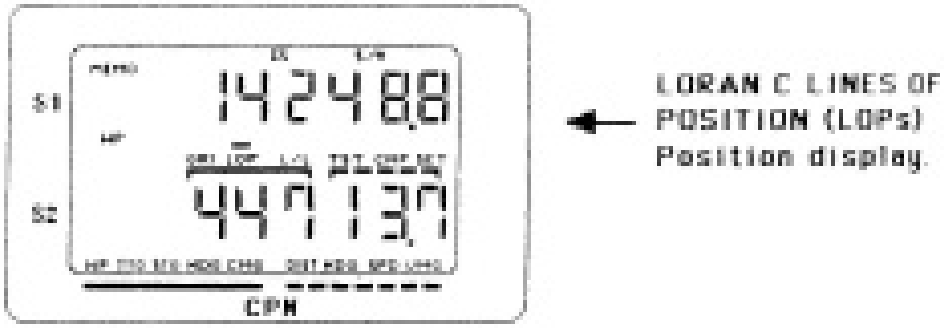


Figure 36 Display Area (LOP's)

POSITION DISPLAYS

Positions may be displayed in either Loran Lines Of Position (LOP's), or in Latitude/Longitude (L/L). To choose LOP's or L/L, use the ◀— Key or the ▶— Key to move the Mode Indicator Bar over the desired form of display.

LOP's will be displayed with 1/10th microsecond resolution.

Latitude/Longitude (L/L) will be displayed in degrees, minutes, 1/10ths and 1/100ths of minutes.

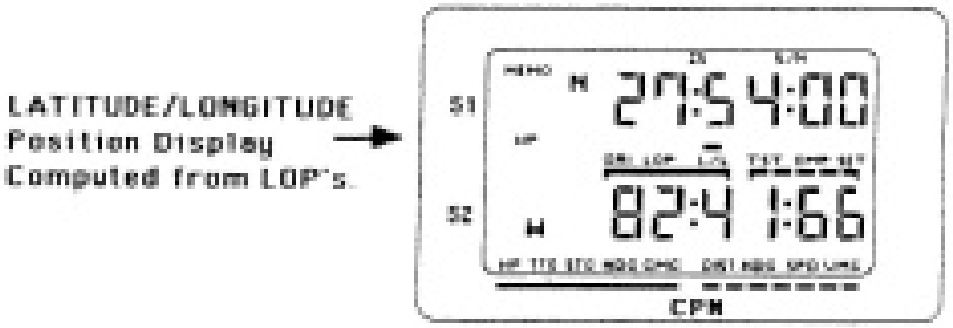


Figure 37 Display Area (Lat/Lon)

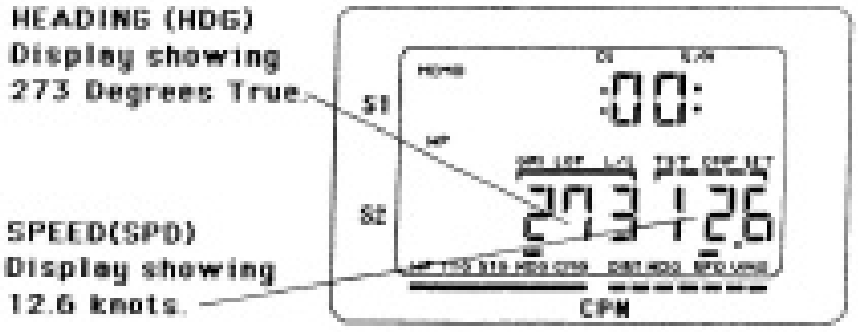


Figure 38 Display Area (SPD, HDG)

SPEED AND HEADING DISPLAYS

To display Speed (SPD) or Heading (HDG), use the ◄— Key, or the ►— Key, to move the Mode Indicator Bar over either LOP or L/L. Press the ▲▼ Key to activate the built-in Course Computer functions which will be displayed in the lower Display Area.

Using the ◄— Key, or the ►— Key, move the two Mode Indicator Bars over the Course Computer functions until one is over HDG, and the other is over SPD. Speed and Heading will appear in the lower Display Area relative to the order in which they were selected.NOTE: IT IS NOT NECESSARY TO ENTER OR USE A WAYPOINT IN ORDER TO DISPLAY SPEED AND HEADING INFORMATION.

DISPLAYING VELOCITY MADE GOOD (VMG) AND COURSE MADE GOOD (CMG)

While using the Course Computer, both VMG and CMG may be displayed. To display VMG, use the Key to move the Mode Indicator Bar over VMG in the lower Display Area. The three digits displayed in the lower right Display Area show Velocity Made Good, in knots. Elapsed time is displayed in hours and minutes in the upper Display Area. Both elapsed time, and the start-point for VMG are reset by pressing the CL Key.

CMG is displayed by the three digits in the lower left Display Area by pressing the◄— Key to move the Mode Indicator Bar over CMG. Course Made Good is displayed in degrees true.

The elapsed timer is common to both VMG and CMG displays, which all begin with Power On. Start-points and elapsed timer may be reset by pressing the CL Key when either CMG or VMG are displayed. NOTE: CMG AND VMG ARE COMPUTED AT EACH ONE MINUTE INTERVAL AFTER POWER-ON OR AFTER PRESSING THE CLR KEY IN EITHER CMG OR VMG MODE.

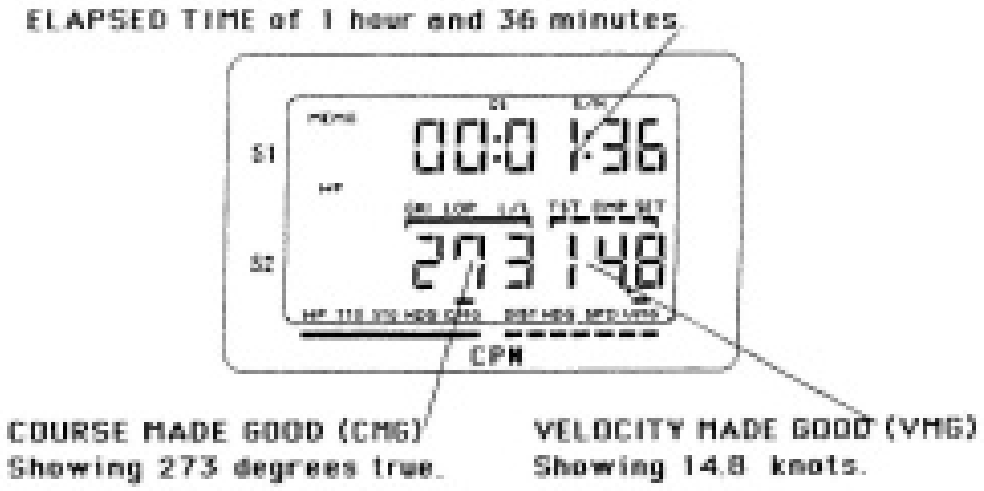


Figure 39 Display Area (CMG, VMG, Elapsed Time)

ADJUSTING DISPLAY BRIGHTNESS

Display brightness and Keyboard backlighting have two levels of brightness. To dim the brightness of Display and Keyboard backlighting, press the ON/OFF Key once, briefly. A second brief press will restore brightness to original levels. NOTE: PRESSING AND HOLDING THE ON/OFF KEY WILL RESULT IN A POWER-DOWN OF THE EZ-97.

SECTION SIX

ALARMS AND THEIR FUNCTIONS

E2-97 is equipped with a built-in audible alarm which may be user-enabled in three situations.

1. ARRIVAL ALARM--When approaching an entered waypoint, an intermittent beep tone will sound at a user-determined distance from that waypoint. The alarm may be silenced by briefly pressing the CL Key.

   The initial value of this alarm is automatically set at 0.5 NM. For the procedure to change this value, see SECTION NINE: Changing Set Mode Limits.

2. ANCHOR WATCH ALARM--An intermittent beep tone will sound when an anchored vessel drifts outside a user-determined perimeter. Anchor Watch may be engaged by going to the Waypoint Entry Mode and pressing a 0, followed by pressing the ENT Key. When the vessel drifts outside the Anchor Watch Area, the beep tone alarm will sound.

   The initial value of this alarm is automatically set at 5.0 NM. For the procedure to change this value, see SECTION NINE: Changing Set Mode Limits.

   To disable the anchor watch alarm, set the perimeter to 0.0 and press the ENT Key while in SET Mode #95.

3. OFF COURSE ALARM--A steady tone will sound when the vessel is off course by a user-determined limit. This function may be enabled to alert a vessel's pilot to a specific off course condition.

   The initial value of this alarm is automatically set at 5.0 NM. For the procedure to change this value, see SECTION NINE: Changing Set Mode Limits.

   Once the alarm has sounded, it may be silenced by pressing the CL Key. To disable the off course alarm, enter 0.0 as the alarm limits.

NOTE: THE OFF COURSE ALARM IS ACTIVE FOR THE WAYPOINT IN THE COMPUTER. IT WILL SOUND WHEN OFF COURSE TO ANY ENTERED WAYPOINT AND SHOULD BE DISABLED WHEN NOT DESIRED.

VISIBLE ALARMS SEEN IN THE DISPLAY AREA

Seven types of visible alarms may be seen in the Display Area. They are: steady colons (:); blinking colons (:); blinking decimal points (.); Blinking LOP center digits; blinking bar; steady bar.

The following conditions are represented by visible alarms:

1. CS ALARM IN THE LOP MODE--When steady colons (:) are visible beneath the CS position in the Display Area, currently displayed position may not be correct. When the CS ALARM is present for either the Master or

Secondary, the tracking point of the Loran C signal is suspect. The presence of colons (:) is normal when in the L/L Mode.

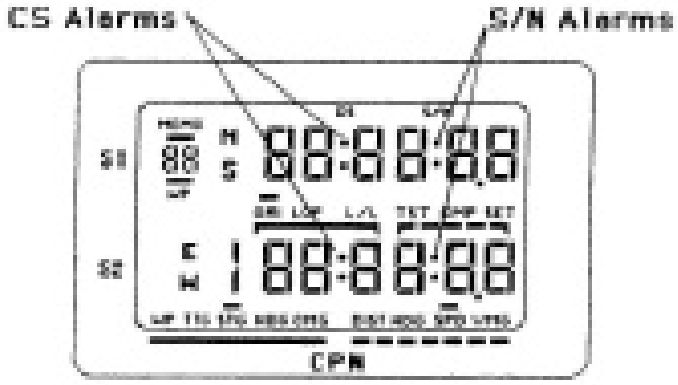


Figure 40 Display Area (CS and S/N Alarms)

CS ALARMS may be manually cancelled by using the ◄— Key, or the —►Key to move the Mode Indicator Bar over the TST Mode and then back to a Tracking Mode. THIS DOES NOT CORRECT THE SOURCE OF THE PROBLEM. If the CS Alarm comes on again, the Loran station transmitter, or interference is suspected.

2. S/N ALARMS--An alarm condition is indicated by solid colons under the S/N Display Area. An S/N alarm is a signal to noise condition which has adversely affected Loran C reception. It is usually caused by reception of a signal which is not strong enough to track properly. The reasons for this condition may be: fringe area operation; poor grounding; alternator noise; improper antenna placement; near-band RF sources.

   S/N alarms cannot be cancelled manually except by correcting the problem or changing to a stronger set of Loran stations.

   When signal quality indications in the TST Mode are below 825, a S/N alarm will generally be the result.

3. BLINKING COLONS (:)--These serve to remind the operator that there is some form of compensation currently in use in the RZ-97. Blinking colons in L/L Mode usually indicate position, HDG, or STG compensation is currently in use. Blink occurs about every 12 to 20 seconds.

4. BLINKING DECIMAL POINTS(.)--These serve to remind the operator that there is some form of compensation currently in use in the LOP Mode. As with the blinking colons, these compensations may be in position, HDG, or STG.

5. LOP CENTER DIGITS BLINKING--When LOP center digits are blinking, it indicates a warning has been broadcast from the Loran C transmitting

Station. The usual cause for a warning transmission is a problem with one or more transmitters within the system, however, weak signal conditions may sometimes initate a warning transmission and fool the EZ-97. In many cases the blink is not transmitted and the user must rely on the other alarms.

Two digits (#3 and #4) may blink in the LOP or GRI Mode, and the Mode Indicator Bar may blink in the L/L Mode. These must be cancelled by using either the ◄—Key or the ►—Key to move the Mode Indicator Bar over TST and back again to LOP or L/L Modes.

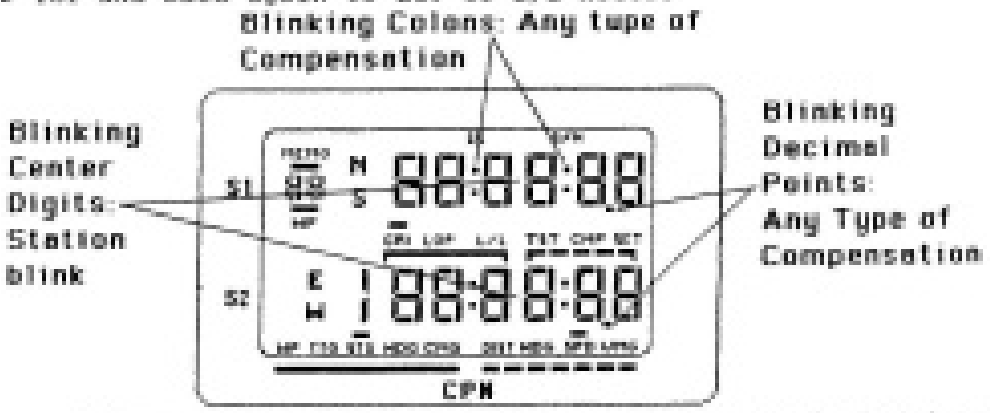


Figure 41 Display Area (Blinking Colons, Decimal Points and Center Digits)

6. BLINKING BAR OVER WP--This advises the operator that a planned route has been entered and that the Automatic Waypoint Sequencing function is in operation. The Automatic Waypoint Sequencing function may be cancelled by entering a new waypoint.

7. BLINKING BAR UNDER "MEMO"--This indicates that the display is currently showing information recalled from Memory. The two digits displayed beneath the Memo Bar refer to the waypoint memory number of the information in the Display Area.

8. BLINKING MODE INDICATOR BAR--This indicates a WARNING to the operator that in the GRI or LOP Mode, the Master Station signal has not cycle-locked, has a poor signal to noise level, and/or has a station blink signal.

   In any other mode, a blinking Mode Indicator Bar warns of loss of cycle-lock, signal condition, and/or station blink problems for any of the Secondary Stations.

9. STEADY BAR UNDER "MEMO"--This is the normal display condition after entering a single waypoint, and when operating in all normal tracking modes and Course Computer modes. It also returns to a steady condition after clearing a memory recall or waypoint storing operation.

VISIBLE ALARMS (CONTINUED)

NOTE: WHEN A STEADY BAR UNDER "MEMO" IS VISIBLE, THE DISPLAYED POSITION MAY NOT REPRESENT THE CURRENT POSITION OF THE VESSEL. THE INFORMATION DISPLAYED DEPENDS UPON THE OPERATION SELECTED.

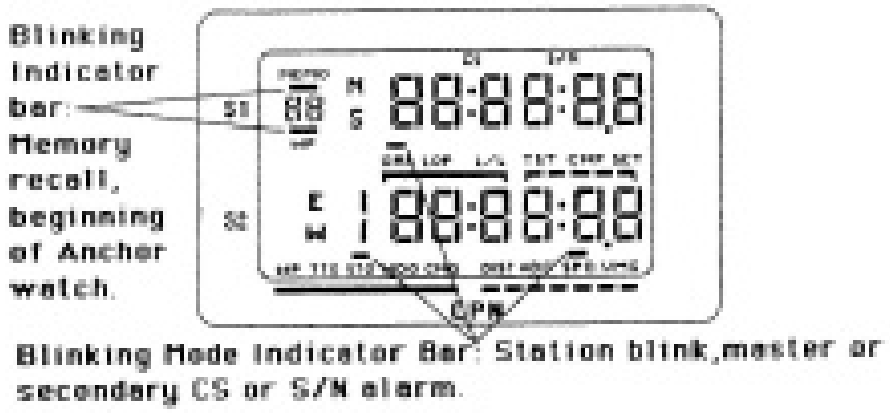


Figure 42 Display Area (Blinking Mode Indicator Bar)

SECTION SEVEN

PROGRAMMING THE EZ-97 FOR BASIC NAVIGATION

ENTERING AND USING WAYPOINTS

NOTE: Automatic Waypoint Sequencing is covered in SECTION EIGHT under "Advanced Operation."

WAYPOINTS are defined as either LOP's or Lat/Lon designations for assumed destinations. The built-in Course Computer in the EZ-97 will compute the most direct course and distance to a destination which is entered as a waypoint. The Course Computer does not consider islands, reefs, or other hazards to navigation, when plotting a course. Always check updated charts and current Notice to Mariners when plotting a course in an unfamiliar area.

Position Displayed in LOP's.

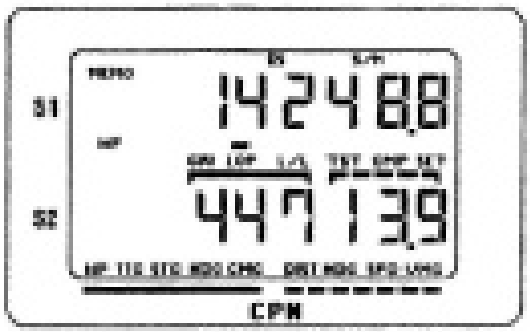


Figure 43 Display Area (LOP's)

ENTERING LOP'S AS WAYPOINTS

Waypoints may be entered as LOP's by using either the ◀— Key, or the ▶— Key to move the Mode Indicator Bar over LOP. NOTE: SETTING THE MODE INDICATOR BAR OVER LOP PRIMES THE COMPUTER TO ACCEPT ONLY LOP WAYPOINTS. If the Mode Indicator Bar is not visible in the upper Display Area, press the ▼▲ Key to select Operation Mode. Once LOP's are displayed, press the ▼▲ Key once more to activate the EZ-97 Course Computer. Next, press and hold the ◀— Key until the left side Mode Indicator Bar is over WP.

Using the keyboard, enter the twelve digits of the two LOP's. IF AN ERROR IS MADE AT THIS POINT, PRESS THE CL KEY TO ERASE THE LINE. ALL DIGITS WILL HAVE TO BE REENTERED.

When the digits correctly represent the two LOP's, press the ENT Key. The information is now entered as a waypoint, and a Bar Indicator will be

visible over the WP in the upper left side of the Display Area.

The ◄— Key, and ►— Key may now be used to select the desired navigation information: TTG; STG; HDG; SPD; VMG; DIST; CMG.

ENTERING LAT/LON COORDINATES AS A WAYPOINT

Waypoints may be entered as Lat/Lon coordinates by using the ◄— Key, or the ►— Key to move the Mode Indicator Bar over L/L. NOTE: SETTING THE MODE INDICATOR BAR OVER L/L PRIMES THE COMPUTER TO ACCEPT ONLY L/L WAYPOINTS. If the Mode Indicator Bar is not visible in the upper Display Area, press the ▼▲ Key to select Operation Mode. Once Lat/Lon coordinates are displayed, press the ▼▲ Key once more to activate the EZ-97 Course Computer. Next, press and hold the ◄— Key until the left side Mode Indicator Bar is over WP.

Using the keyboard, enter the Latitude portion for the waypoint by pressing N or S followed by the six digits of the Latitude. Then, enter E or W followed by the six or seven digits of the Longitude. IF AN ERROR IS MADE AT THIS POINT, PRESS THE CL KEY TO CLEAR THE LINE. ALL THE CLEARED DIGITS WILL HAVE TO BE REENTERED.

NOTE: NORTH LATITUDE IS ALWAYS USED BECAUSE LORAN IS NOT AVAILABLE IN THE SOUTHERN HEMISPHERE. WEST LONGITUDE IS USED WHEN WEST OF GREENWICH, ENGLAND, TO 180 DEGREES, WEST. EAST LONGITIDE IS USED WHEN EAST OF GREENWICH, ENGLAND, TO 180 DEGREES, EAST.

Once the Lat/Lon coordinates are correctly displayed, press the ENT Key. The Lat/Lon coordinates are now entered as a waypoint, and a Bar Indicator will be visible over the WP in the upper left side of the Display Area.

The ◄— Key and the ►— Key may now be used to select the desired navigation information: TTG; STG; HDG; SPD; DIST; CMG; VMG.

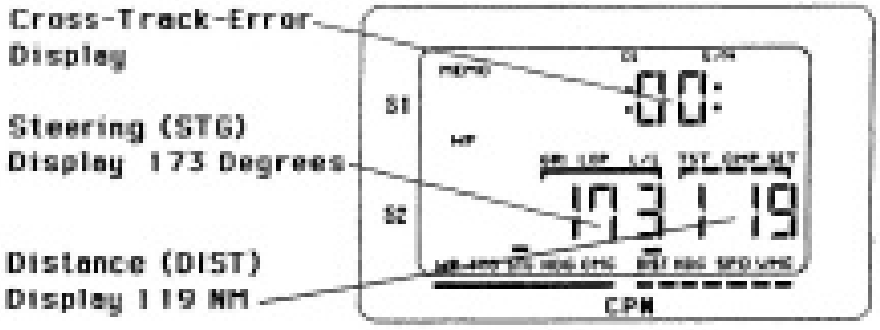


Figure 44 Display Area (Cross Track Error, STG, DIST)

DISTANCE TO A WAYPOINT

Use the ►— Key to move the Mode Indicator Bar over DIST in the lower right half of the Display Area. The distance to the waypoint in nautical miles will be displayed in the lower portion of the Display Area. Cross Track Error will be displayed in the upper Display Area unless the left side Mode Indicator Bar is over CMG.

STEERING OR BEARING TO A WAYPOINT

Use the ◄— Key to move the Mode Indicator Bar over STG. The Bearing to Steer to the waypoint will be displayed in degrees true.

TIME-TO-GO (TTG) TO A WAYPOINT

Use the ◄— Key to move the Mode Indicator Bar over TTG. Time-To-Go, based on averaged speed of the vessel, will be displayed in hours and ten minute increments in the lower portion of the Display Area.

CROSS TRACK ERROR

Cross Track Error is automatically displayed in the upper portion of the Display Area during Course Computer functions except during the display of CMG, VMG, or waypoint entry mode. Cross Track resolution can be changed from .01 NM to 0.1 NM, and back again, by pressing the 01 Key. The 0.1 NM Cross Track resolution is indicated by decimal points appearing in the Cross Track Error Display Area.

NOTE: AFTER CHANGING OR REENTERING GRI, CROSS TRACK RESOLUTION IS AUTOMATICALLY RESET TO .01 NM. THE 0.1 NM CROSS TRACK RESOLUTION IS USED IN AREAS OF WIDE GRADIENT OR POOR CROSSING ANGLES TO MAKE CROSS TRACK ERROR READOUT MORE STABLE.

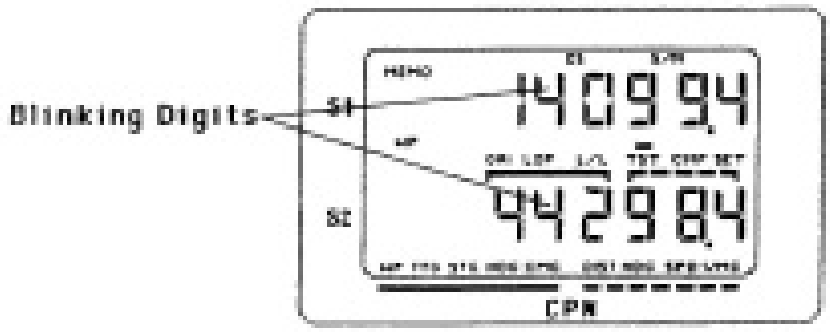


Figure 45 Display Area (TST Mode Sample Display)

SIGNAL MONITORING IN THE TEST (TST) MODE

The EZ-97 will display the TEST (TST) values for the Master and all Secondaries in a Loran chain.

SIGNAL MONITORING IN THE TEST MODE (CONTINUED)

To view this information, use the ▼▲ Key to move the Mode Indicator Bar up to the operating mode. Next, press the ◄— Key or the ►— Key to move the Indicator Bar over TST. The TEST values for the two Secondaries being used will be displayed in their respective positions in the Display Area.

The TEST values for the other Secondary and Master stations is displayed by pressing the S1 and/or S2 Keys. This causes the TEST information to rotate through the Display Area. The rotation can be stopped by pressing either the S1 and/or S2 Keys a second time.

Oscillator Offset values are displayed by pressing +/M or -/R Keys. Pressing +/M or -/R a second time returns the display to the test values for the Secondary stations.

NOTE: MAXIMUM ALLOWABLE OSCILLATOR OFFSET IS 20 (TWENTY).

Display showing CROSS-TRACK-ERROR Alarm Limit, "Set" mode 97

Press

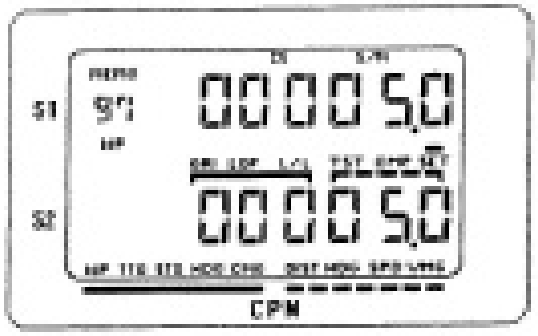


Figure 46 Display Area (SET Mode Display)

DISPLAYING INITIAL (DEFAULT) VALUES OF THE SET MODE

The initial (default) values of the SET Mode can be displayed by using the ◄— Key, or the ►— Key to move the Mode Indicator Bar over the SET mode.

To then display preset values in each function, press the -/R Key and then the two-digit address code as listed below. The two-digit address code will be displayed in the upper left portion of the Display Area, under MEMO.

Address codes, and initial values are as follows:

98 L/L Data Output Format
93 Speed Averaging Constant.....Default Value: 2
94 Imaginary Course Distance and Bearing....No Default Value
95 Anchor Watch Alarm Limit.....Default Value: 5.0 NM

DISPLAYING INITIAL (DEFAULT) VALUES OF THE SET MODE (CONTINUED)

96 Arrival Alarm Limit.....Default Value: 8.5NM
97 Cross Track Error Alarm Limit.....Default Value: 5.0 NM

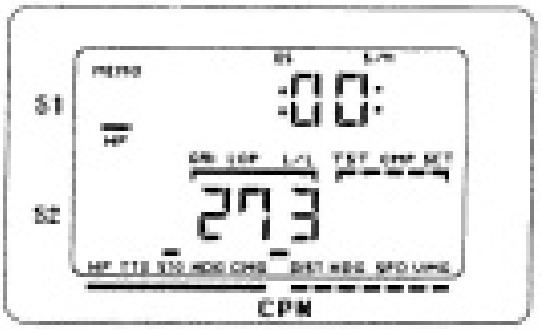
NOTE: TO CHANGE INITIAL (DEFAULT) VALUES, SEE SECTION EIGHT

ADJUSTING DISPLAY AND KEYBOARD BRIGHTNESS

Two levels of Display Area brightness, and Keyboard backlighting are selectable by the operator/user.

When standard initializing procedures are followed, the display and keyboard are at their brightest. To dim display and keyboard, press the ON/OFF Key once, briefly.

To restore the display and keyboard to full brightness, press the ON/OFF Key once again, briefly.



Display with right side Course Computer function blanked.

Note: Mode Indicator bar is in the unlabled position.

Figure 47 Display Area (Right Side Blanked)

BLANKING THE NAVIGATION DISPLAY

The Display Area of the EZ-97 may be blanked-out in two sections: lower left side; lower right side.

The left and/or right side of the lower Display Area can be blanked in the Course Computer mode. To blank the left side, use the Key to move the Mode Indicator Bar to the unlabeled area between CMG and DIST. The left side will no longer be visible.

To blank the right side, use the ← Key to move the right Mode Indicator Bar to the unlabeled area between CMG and DIST. The right side will no longer be visible.

If both Mode Indicator Bars are placed in the blank area between CMG and

BLANKING THE NAVIGATION DISPLAY (CONTINUED)

DIST, the entire lower Display Area will be blank.

To restore the left side information, use the ◄— Key to move the Mode Indicator Bar over the desired Course Computer function. The left side of the Display Area will then display the desired information.

To restore the right side information, use the ►— Key to move the Mode Indicator Bar over the desired Course Computer function. The right side of the Display Area will then display the desired information.

SECTION EIGHT

USING THE EZ-97 ON A DAY-TO-DAY BASIS

After the EZ-97 has been initialized the first time, subsequent operation requires only that the ON/OFF Key be pressed, and the unit be allowed to settle. The CS and S/N Alarms must extinguish, the Mode Indicator Bar must stop blinking, and LOP's or L/L Coordinates will be displayed. The EZ-97 is now ready for use.

> NOTE: THIS ASSUMES THAT THE EZ-97 WAS POWERED DOWN IN EITHER L/L OR LOP MODES. IF IT WAS POWERED DOWN IN SOME OTHER MODE, USE THE KEY OR THE KEY TO MOVE THE MODE INDICATOR BAR OVER GRI, THEN PRESS THE CL KEY. FOLLOWING THIS PROCEDURE WILL RESTART THE ACQUISITION PROCESS. SECONDARY STATIONS WILL NOT HAVE TO BE RE-SELECTED. WHEN THE CS AND S/N ALARMS EXTINGUISH, AND THE MODE INDICATOR BAR HAS STOPPED BLINKING, USE THE KEY OR THE KEY TO MOVE THE MODE INDICATOR BAR TO OTHER DISPLAY MODES.

Navigation information may be selected as described in SECTION SEVEN. Additional Keyboard Selection Information is described in SECTION THREE.

Position Displayed in LOP's.

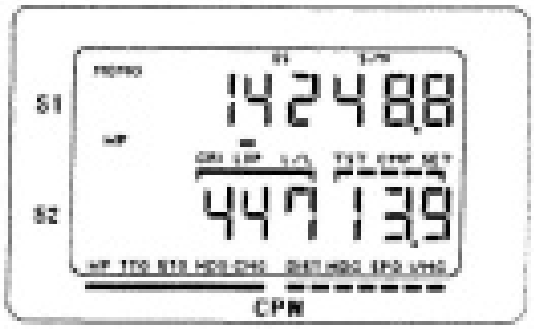


Figure 48 Display Area (LOP's)

CHANGING THE CHAIN CODE (GRI)

In the course of daily operation, it may be necessary to change the Chain Code (GRI) when proceeding from one area to another. To accomplish this, use the ◄— Key or the —► Key to move the Mode Indicator Bar to its position over GRI. Press the ENT Key and all 9's will appear in the Display Area.

Next, enter the four digits of the GRI Code using the numerical keyboard. The digits selected will appear in the upper half of the Display Area. If an error is made at this point, press the CL Key, and re-enter the correct four digit code.

CHANGING THE CHAIN CODE (GRI) (CONTINUED)

Press the ENT Key. The four-digit GRI code will momentarily appear in both upper and lower Display Area. This will be followed by a cycling through of available Secondaries in both upper and lower Display Area.

As the Secondaries cycle through the Display Area, press the S1 Key to select the desired Secondary for the S1 Display Area. Likewise, press the S2 Key to select the Secondary for the S2 Display Area.

When the EZ-97 has settled, other modes of operation may be selected.

The display of 9's indicates the Loran is ready for entry of the local Chain Code (GRI).

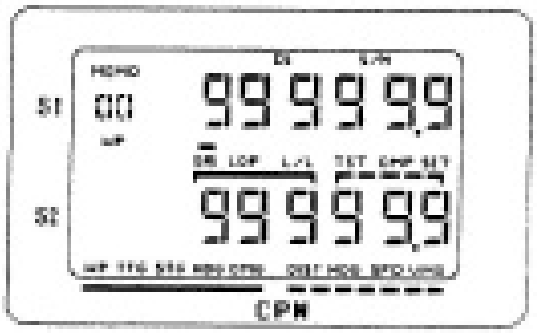


Figure 49 Display Area (9's Displayed)

SECTION NINE

USING AND AUTOMATICALLY CYCLING WAYPOINTS

NOTE: SEE SECTION SIX, "ENTERING AND USING WAYPOINTS" FOR BASIC WAYPOINT ENTRY INFORMATION. WAYPOINTS MUST BE STORED IN MEMORY BEFORE THEY CAN BE RECALLED. WAYPOINTS CAN BE ERASED ONLY BY STORING A NEW WAYPOINT IN THE SAME MEMORY NUMBER.

RECALLING WAYPOINTS ALREADY IN MEMORY

To recall a waypoint which has been stored in Memory, press the ◄— Key to move the Mode Indicator Bar over WP. Press the -/R Key, and enter the two-digit memory number.

The waypoint stored at that memory address will be displayed in the Display Area. The two-digit memory location will be displayed under MEMO in the upper right hand corner of the Display Area.

LOP's or L/L coordinates recalled from a specific memory location will remain in the Display Area unless the CL Key is pressed.

To recall other waypoints in memory, repeat the above procedure using different two-digit memory locations.

NOTE: DURING A RECALL OPERATION THE MODE INDICATOR BAR UNDER MEMO WILL BE BLINKING. AFTER THE ENT KEY IS PRESSED, THE MODE INDICATOR BAR ABOVE WP WILL BE VISIBLE.

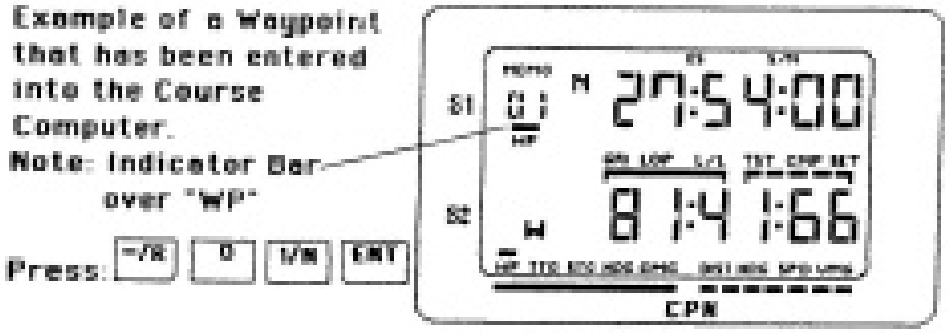


Figure 50 Waypoint entered into Course Computer

USING THE RECALLED WAYPOINT

Recalled waypoints may be entered into the Course Computer whenever they are displayed in the Display Area. Simply press the ENT Key. The blinking Mode Indicator Bar under MEMO will stop, and a Mode Indicator Bar will appear over WP. Navigation information relative to the displayed waypoint may then be requested by using the ◄— Key or the —► Key to move the Mode Indicator Bar over the desired function.

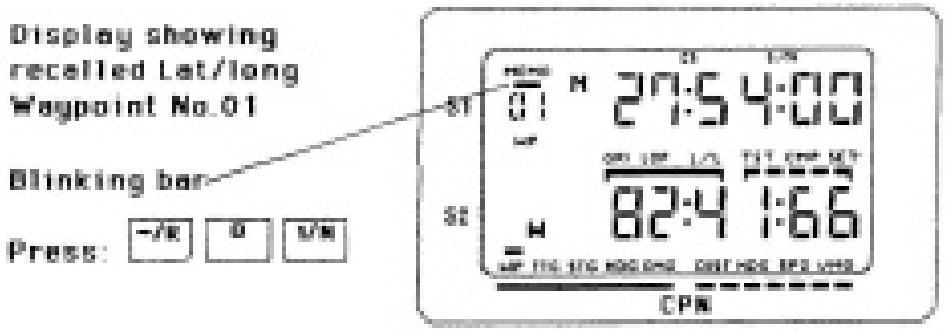


Figure 51 Recalled Waypoint

MOVING WAYPOINTS ALREADY IN MEMORY

Though very helpful in day-to-day operation, the cycling nature (from 51 to 60) of Instant Memory can mean that useful information may be overwritten and lost. To avoid this, Instant Memory information should be transferred to Waypoint Memory (01 to 50) whenever it is convenient.

To accomplish the transfer, activate the Course Computer by pressing the ▼▲ Key, and move the Mode Indicator Bar over WP by using the ◄— Key.

Then, press the -/R Key, and enter the two-digit address code for the desired instant memory information.

Follow by pressing the +/M Key and the two-digit code (01 to 50) of the new WP location. This new WP two-digit address code will now appear under MEMO in the Display Area. Additionally, the Mode Indicator Bar under MEMO will now be "06."

Waypoints may be moved from one memory location to a new memory location any time the the Display Area is in the WP mode.

To return to normal operation, use the ◄— Key to move the Mode Indicator Bar to any other function.

Memory Indicator Bar does not blink during this operation.

Press: +/M

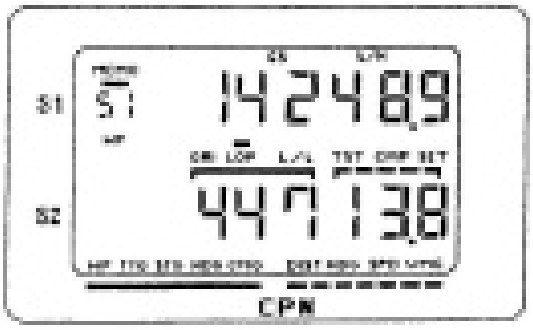


Figure 52 Instant Memory Storing of LOP's

INSTANT STORING OF PRESENT POSITION

LOP's or Lat/Lon coordinates for current position may be instantly stored for later use whenever the EZ-97 is in LOP or L/L mode.

Press the +/M Key one time to store current LOP or Lat/Lon coordinate in instant memory. Assigned two-digit memory code address for the instant memory stored position will be sequential from 51 through 68. After instant memory code 68 has been assigned, EZ-97 will begin reassigning numbers sequentially, beginning at 51. When the new waypoint is stored, the old one is automatically erased.

The Mode Indicator Bar under MEMO will be blinking when EZ-97 is operating in the recall mode.

RECALLING POSITIONS FROM INSTANT MEMORY

When in either the LOP or L/L mode, instant memories may be recalled by pressing the -/R Key. Each time the -/R Key is pressed, the next lower instant memory information is displayed (from 88 to 51) with the corresponding two-digit instant memory code displayed under MEMO.

No matter whether EZ-97 is in LOP or L/L mode, when the -/R Key is pressed, the instant memory information will be displayed in the form in which it was entered. LOP's will be displayed as LOP's. Lat/Lon coordinates will be displayed as Lat/Lon coordinates.

Instant memories may also be recalled in the WP mode. When the EZ-97 is in either LOP or L/L modes, activate the Course Computer functions in the lower Display Area by pressing the ▼▲ Key.

Next, use the ◄═══Key to move the Mode Indicator Bar over the WP location. Then, press the -/R Key and the two-digit address code for the instant memory desired. Information in that memory designation will then be displayed in the Display Area. The two-digit memory address code will redisplayed under MEMO.

NOTE: DURING MEMORY RECALL OPERATIONS, THE MODE INDICATOR BAR UNDER MEMO WILL BE BLINKING.

Memory Indicator Bar blinks on and off during this operation.

Press: -/R

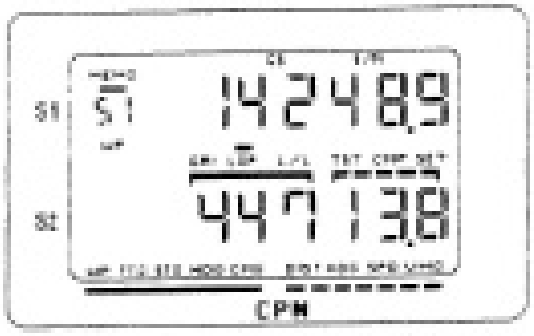


Figure 51 Recalled Position from Instant Memory

AUTOMATIC WAYPOINT SEQUENCING

The Automatic Waypoint Sequencing function of the EZ-97 allows the operator to input, in whatever order desired, as many as ten (10) of the waypoints stored in memory. The EZ-97 will then automatically change the waypoint being used to the next waypoint when the vessel enters the Arrival Alarm area for the current waypoint.

NOTE: TO CHANGE THE RADIUS OF THE ARRIVAL ALARM, SEE SECTION FIVE.

AUTOMATIC WAYPOINT SEQUENCING (CONTINUED)

To use the Automatic Waypoint Sequencing function of the EZ-97, the following steps must be completed:

1. Press the ◄— Key to move the Mode Indicator Bar over WP;
2. Press the -/R Key, and the two digit address code for the first waypoint;
3. Press the ENT Key to enter that waypoint number as the first waypoint which will be sequenced;
5. Repeat Steps 3 and 4 for each additional waypoint to a maximum of 10 (ten) waypoints. The two-digit address code for each entered will be displayed under MEMO until the ENT Key is pressed. Once the ENT Key is pressed, the two-digit address code of the first waypoint input will always be displayed.

NOTE: WAYPOINTS MUST BE ENTERED IN THE ORDER IN WHICH THEY WILL BE USED. AS EACH WAYPOINT IS RECALLED, THE TWO-DIGIT ADDRESS CODE WILL BE DISPLAYED UNDER MEMO.

MANUALLY CONVERTING LOP'S TO LAT/LON COORDINATES

The EZ-97 will allow the operator to convert TD's to Lat/Lon coordinates easily and quickly. To accomplish this conversion, use the ◄— Key or the —► Key to move the Mode Indicator Bar over CMP. The current GRI will then be displayed.

METHOD ONE:
Use the numerical keyboard to enter the LOP's to be converted into latitude/longitude.

When all twelve digits have been entered, press the ENT Key. The Lat/Lon coordinates will be displayed when the computation is completed.

METHOD TWO:
LOP's in memory may also be easily and quickly converted into Lat/Lon coordinates while in the CMP mode by pressing the -/R Key, followed by the two-digit address code for the LOP to be converted. Then, press the ENT Key. The Lat/Lon coordinates will be displayed when the computation is completed.

METHOD THREE:
LOP's of another chain may also be quickly converted into Lat/Lon coordinates while in the CMP mode. First, enter the GRI of the LOP's to be converted. Do this by using the numerical keyboard to key in the four digits of the chain code. Then press the ENT Key. Follow this by entering the LOP's to be converted, press the ENT Key. The Lat/Lon coordinates will be displayed when the computation is completed.

If the converted Lat/Lon coordinates are to be stored after conversion, press the +/M Key and enter the two-digit memory address code. The new two-digit memory address code will appear under MEMO in the Display Area.

Be sure to press the CL Key before entering any new LOP's for conversion.

DISPLAYING AN IMAGINARY COURSE

The EZ-97 will compute and display the distance and bearing between any two waypoints in memory. In order to make this computation, it is firstnecessary to move the Mode Indicator Bar to the SET mode. Follow this by pressing the -/R Key and the digits 9 and 4.

The information displayed at this point is the distance and bearing between the point of origin (start) and the current waypoint in use. To begin to compute the imaginary course, press the -/R key, and the two-digit memory address code for the supposed origin (start). That number will now appear under MEMO.

Next, enter the two-digit memory address code for the waypoint at the imaginary destination. Then, press the ENT Key. The upper Display Area will show the bearing in degrees true. The lower Display Area will show the distance in nautical miles between the two waypoints.

Be certain to press the CL Key before entering any new imaginary course information.

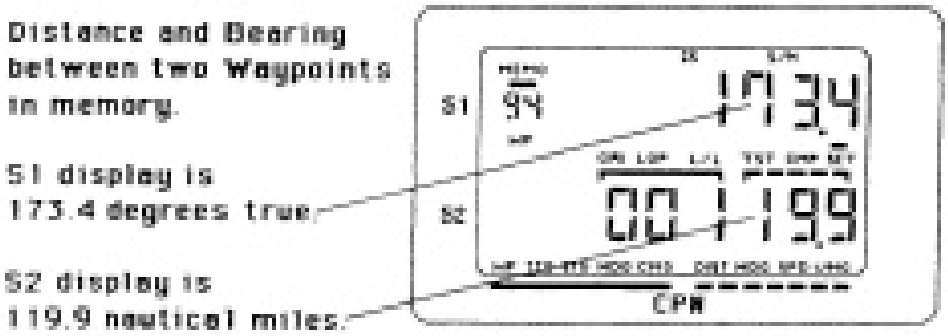


Figure 54 Distance and Bearing Between Two WP's

MANUAL COMPENSATION OF LOP AND LAT/LON COORDINATES

Either of two methods may be employed to enter manual compensation corrections to the positions displayed by the EZ-97.

The first method requires that the current, correct Lat/Lon location be known.

Using the ◄— Key or the —► Key, place the Mode Indicator Bar over CMP. The current GRI code will then be displayed in the Display Area. Press the -/R Key and enter the number 99.

The Display Area will then show the amount of compensation currently being

applied. This value should be all zeros.

At this point, the current, correct Latitude and Longitude must be entered by first entering N or S, followed by the six digits of Latitude. Next, enter W or E, followed by the six or seven digits of Longitude. Then press the ENT Key.

In a few seconds, the amount of compensation/correction will appear in the Display Area. By then pressing the S2 Key, the corrected Lat/Lon will be displayed. A second press of the S2 Key will again show the amount of compensation.

To return to a zero value compensation while in the CMP 99 mode, press the CL Key. The amount of compensation will show as all zeros.

Example of positive Compensation added to the S1 secondary

Press: [-/R] [9] [1/N] [1/N] [2/S] [ENT]

Figure 55 Positive Compensation

The second method of manually adding compensation will automatically correct both the LOP position and the Lat/Lon coordinate readouts.

> CAUTION: WHEN THIS METHOD IS USED, DO NOT COMPENSATE USING LAT/LON METHOD.

In the Course Computer mode, use the keyboard to enter: -/R, 9, and 1/N. The S1 Secondary will be displayed in the upper Display Area with the current correction factor displayed in the lower Display Area. A (-) in front of the first zero, indicates a negative correction.

To add correction, key in the two-digit correction value and then press the -/R Key or the +/M Key to indicate negative or positive correction, followed by pressing the ENT Key.

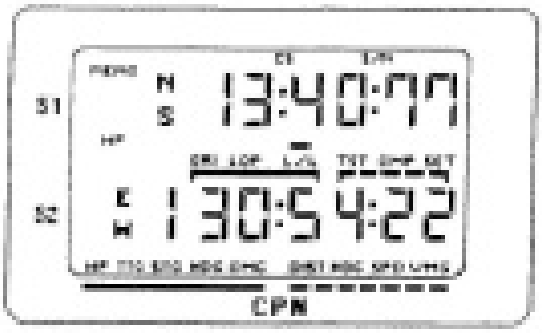
The amount of correction will then be displayed in the lower half of the Display Area while the corrected S1 LOP is displayed in the upper half.

This correction value may be cleared by pressing the CL Key at this point.

Corrections to the S2 Secondary are accomplished in the same manner after pressing the -/R Key, 9, and 2/S Key.

NOTE: THE SECOND METHOD OF ENTERING COMPENSATION VALUES IS BEST SUITED TO ENTERING VALUES DIRECTLY FROM THE ASF CORRECTION TABLES PUBLISHED BY THE DEFENSE MAPPING AGENCY.

NOTE: WHEN COMPENSATION HAS BEEN ENTERED INTO THE SS-97, THE DECIMAL POINT (.) IN THE LOP MODE, AND THE COLONS (:) IN THE L/L MODE WILL BLINK PERIODICALLY--APPROXIMATELY EVERY 12 TO 20 SECONDS.



Sample display showing a Non-valid Complementary Latitude/Longitude Solution.

Figure 56 Non-valid Complementary Display

COMPLEMENTARY LAT/LON SOLUTIONS

Because of the hyperbolic (curving) nature of Loran lines plotted on a chart, it is possible in some cases for one LOP to cross another LOP at two different locations. Normally, the Loran unit automatically selects the primary correct crossing point of the two LOP's. The resulting conversion to Lat/Lon will provide a correct, primary Lat/Lon position display. The user/operator may, however, choose to display the second complementary solution.

To display the complementary solution, place the Mode Indicator Bar over L/L, then press the S2 Key. In approximately five seconds, the complementary solution will be displayed.

> NOTE: IF ALL FOUR DIRECTION INDICATORS ARE DISPLAYED, THE SELECTED SOLUTION IS NOT A VALID SOLUTION.

Press the S1 Key to again display the primary solution.

ENTERING COMPENSATION FOR HEADING AND BEARING

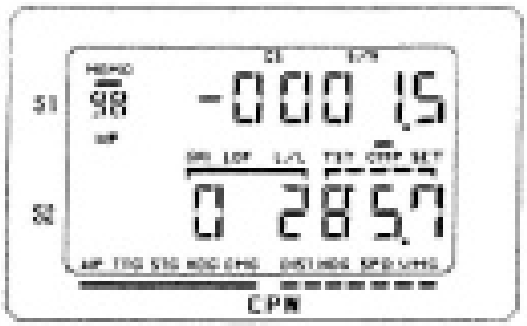
The current variation and deviation correction already entered into the EZ-97 may be reviewed by first placing it into the Course Computer mode. Next, press the -/R Key, followed by 9 and 8 Numerical Keys. The current compensation value will then be displayed in the upper half of the Display Area.

At this point, a new value, to a maximum of plus or minus 30 degrees, may be entered into the EZ-97 using the numerical keyboard. The new value must be followed by either the +/M Key, or the -/R Key which tells the EZ-97 whether the compensation is to be added or subtracted. Follow by pressing the ENT Key to enter the data.

It takes approximately ten seconds for the EZ-97 to reflect the corrected information. Both Heading (HDG) and Bearing (STG) are compensated by this single operation.

At this point, the amount of compensation will be displayed in the upper Display Area. The corrected HDG information will display in the lower Display Area. An entered compensation value is indicated in the L/L mode by blinking colons (:), and in the LOP mode by blinking decimal points(.).

To cancel HDG/STG compensation, go to the Course Computer mode, press the -/R key, followed by 9 and 8 numerical keys. Follow by pressing the CL Key. Clearing the HDG/STG compensation in this manner does not affect position compensation.



This display is showing Negative Heading and Bearing Compensation of 1.5 Degrees
NOTE: "CMP" mode and the Recall number.

Press: -/R 9 8 1/M 5 -/R ENT

Figure 57 Heading and Bearing Compensation

CHANGING SET MODE LIMITS

SET mode default values will be found in Section Six. To change the SET mode values, first move the Mode Indicator Bar over SET. Recall the function number desired by first pressing the -/M Key and the two-digit address code (90, and 93-97). The Numerical Keys may then be used to input new values from 0.1 nautical mile to 9.9 nautical miles. Complete the input of new values by pressing the ENT Key.

The two-digit address codes are as follows:

- 90 L/L Data Output Format
- 91 Speed Average Constant
- 94 Imaginary Course Distance and Bearing
- 95 Anchor Watch Alarm Limit
- 96 Arrival Alarm Limit
- 97 Cross Track Error Alarm Limit

Setting and cancelling of Anchor Watch Alarm, Arrival Alarm, and Off Course (Cross Track Error) Alarm, and Alarm Functions are also covered in detail in Section Six.

"WP" display after entry of Anchor Watch (95) mode. Present position is entered automatically to establish the Anchor Watch area.

Press: [0] [ENT]

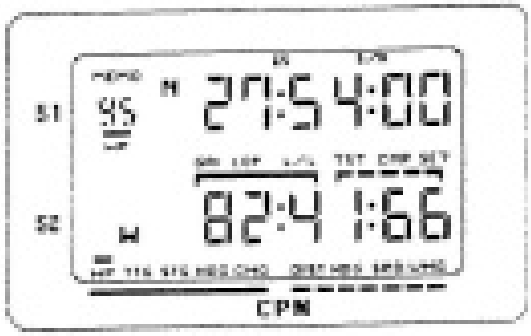


Figure 58 Anchor Watch Activation

SECTION TEN

SKYWAVE OPERATION

Skywave Loran signals differ from normal groundwave signals in two important areas. First, skywaves may be received well beyond the range of groundwaves, and will extend the range of Loran by a substantial margin. Second, because groundwaves follow the curvature of the earth, and skywaves bounce off the ionosphere and reflect back to the earth, skywaves cover more distance and take a longer time to reach the receiver.

CAUTION

SKYWAVE POSITIONS ARE ALWAYS LESS ACCURATE THAN GROUNDWAVE POSITIONS. SKYWAVE POSITIONS SHOULD ONLY BE USED WHEN AN APPROXIMATE LORAN POSITION IS DESIRED.

The EZ-97 provides the means to activate cycle selection for skywave operation. The standard point on the Loran C pulse for cycle selection is 30 microseconds after the start of the transmitted pulse. Skywaves may arrive 40 microseconds, or more, later in time. If the cycle tracking point in the EZ-97 is increased by that amount of time, it will attempt to synchronize on the skywave pulse, rather than the groundwave pulse.

Since arrival time for the skywave is determined by distance from the transmitting station and altitude of the ionosphere, the operator will have to estimate distance to the Loran transmitter, and enter the appropriate delay factor. As a general rule, at a distance of 1,000 miles from the transmitting station, skywaves will arrive approximately 35 microseconds later than groundwaves.

In the LOP mode the CS and/or S/N alarms (colons) will stay on if the unit is having trouble settling on the Loran signals.

Press [←] to return to the GRI mode then press [CL] to restart the signal tracking process.

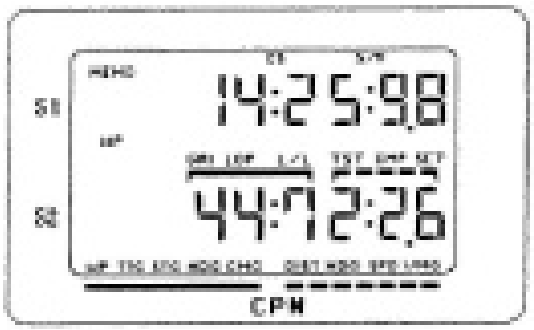


Figure 59 Reinitializing

SKYWAVE OPERATION (CONTINUED)

For EZ-97 skywave operation on the Master Station:

1. Use the ◄— Key or the —► Key to move the Mode Indicator Bar to GRI. This will activate cycle selection for all stations. The cycle tracking of the Master Station can be decreased in ten-microsecond increments, which also increases the TD of both Secondary LOP's.
2. Press the -/R Key 3 (three) times to decrease the tracking point 30 microseconds. The CS status/alarms will illuminate.
3. Immediately set function mode to LOP and wait for tracking to occur. This may require several minutes.
4. TD readings should appear in the Display Area. They may fluctuate somewhat, but should begin to stabilize on the skywave signal. CS status/alarms may continue to be illuminated during skywave operation.

If the EZ-97 does not synchronize with a 30 microsecond delay, return to Step 1, and press the -/R Key 4, 5, or 6 times to increase tracking points 40, 50, or 60 microseconds. Immediately return the Mode Indicator Bar to a position over LOP, and again wait for tracking to occur.

NOTE: SUBTRACT THE APPROPRIATE DELAY FACTOR (30-60 MICROSECONDS) FROM DISPLAYED LOP'S TO MAXIMIZE POSITION ACCURACY WHEN USING SKYWAVES.

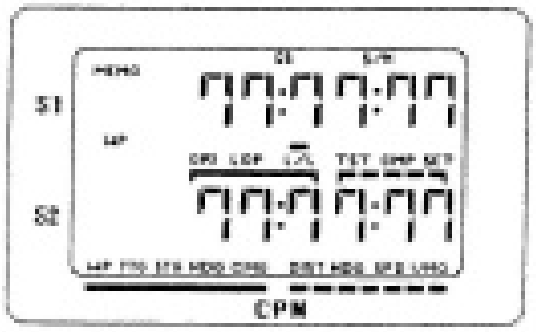
SECTION ELEVEN

TROUBLESHOOTING

The EZ-97 was designed to be an easy-to-use, trouble-free aid to navigation. When problems occur, they may often be remedied by simple procedures available to the user/operator. The following information provides solutions to most common problems.

THE EZ-97 SEEMS TO BE HAVING TROUBLE SETTLING AFTER "POWER-ON."

Reinitializing (restarting signal acquisition) will often correct this problem. *See Section Four for procedure.*



Resulting Latitude/Longitude display if the S1 and S2 secondaries are not properly selected.

Figure 60 Display Area (All 7's Displayed)

ALL 7'S ARE DISPLAYED IN LAT/LON MODE.

S1 and S2 Secondaries have not been locked in. Return to the GRI mode and use the S1 Key and/or the S2 Key to lock in the Secondaries. Then, return to the L/L mode.

THE EZ-97 DISPLAYS NOTHING BUT 9'S.

This occurs when there is no GRI in memory. Place the Mode Indicator Bar over GRI, and enter the correct GRI code.

THE DISPLAY IS "FROZEN."

Some "hard" failures, which require the attention of a qualified service technician, may cause a frozen display. There are also several possible external causes:

1. Starting the boat engine with the EZ-97 turned on;
2. Large amount of ambient R.F. noise;
3. Loss of signal;
4. Incorrect operating mode.

Turn the EZ-97 off, and wait 60 seconds before re-energizing. Re-initialize using the instructions in SECTION FIVE.

CS AND S/N ALARMS ARE ALWAYS ON.

Some "hard" failures, which require the attention of a qualified service technician, may cause the CS and/or S/N alarms to stay on. There are also external causes:

1. Loss of signal;
2. Excessive R.F. noise;
3. Poor R.F. grounding;
4. Power interruption;
5. Poor antenna installation.

Check for the noted conditions.

ERRATIC CROSS TRACK

If the EZ-97 position readout is functioning properly, the cause of Cross Track Error display is most likely one of the following:

1. Poor R.F. grounding;
2. Excessive R.F. noise;
3. Operator unfamiliarity with Cross Track Error function;
4. Comparing Cross Track information to visual references;
5. Comparing Cross Track information to compass reference;
6. Programming errors in WP or destination;
7. LOP gradients and crossing angles.

NOTE: IF THE EZ-97 HAS NOT SETTLED OUT, THE CROSS TRACK ERROR FUNCTION MAY NOT BE USABLE.

DISPLAYED SPEED AND READING DIFFERENT FROM SPEEDOMETER AND COMPASS INFORMATION.

Both SPD and HDG readouts are based on historical data--what HAS been the direction, what HAS been the speed. The readouts should not be used as either compass or speed log. These functions may also be affected by the following external causes:

1. LOP gradients and crossing angles;
2. Poor grounding;
3. Poor antenna placement;
4. Improper setting of Speed Averaging in SET mode;
5. Excessive R.F. noise;
6. Erratic course and speed;

EZ-97 DISPLAYS WRONG LOP'S.

The following problems may cause the EZ-97 to display incorrect LOP's:

1. Poor grounding;
2. Excessive R.F. noise;
3. Poor antenna placement;
4. Compensation left in memory;
5. Incorrect operating mode.

EZ-97 DISPLAYS WRONG LAT/LON READOUTS.

Lat/Lon readings are computed from LOP's. Problems associated with incorrect LOP's, therefore, also affect Lat/Lon displays. In addition, the following may also contribute to incorrect Lat/Lon position readouts:

1. Compensation left in memory;
2. ASF Factors;
3. Wrong complementary solution;
4. Incorrect LOP pair.

THE EZ-97 WILL NOT POWER UP.

Power source, cables, and connections should be checked first. Next, ensure that the fuse has not blown. See Section Two for fuse replacement instructions.

In the event that you are unable to obtain satisfactory results from the EZ-97, contact the selling dealer to resolve the difficulty.

If the dealer is unable to resolve the problem, contact the SI-TEX Customer Service Department at (813) 535-4681 during business hours, EST, Monday through Friday. Have the following information ready:

1. Model number;
2. Serial number;
3. Description of installation;
4. Concise and accurate description of difficulty;
5. Local GMT;
6. Type of vessel on which EZ-97 is installed.

SECTION TWELVE

INTERFACING EZ-97 WITH OTHER NAV-AIDS

The EZ-97 may be easily interfaced with other SI-TEX electronic aids to navigation through its serial data output via a BNC connector located on the back panel.

The EZ-97 offer four different serial data formats corresponding to the connected equipment via a BNC connector on the back panel. The serial data output format from the EZ-97 are as follows:

1. T-717 Type Serial Data;
2. NMEA-0182 Type Serial Data;
3. NMEA-0183 TYPE 1;
4. NMEA-0180 (Simple + Complex) Type Serial Data;
5. NMEA-0183 TYPE 2.

There are two types of NMEA-0183 outputs. Selection procedure is as follows: While in the SET mode, press the -/R Key, 9, and 0. This will call up the format selection information. Pressing the 3 Key, followed by pressing the ENT Key selects NMEA-0183 TYPE 1. Similarly, after calling up the format selection information, pressing the 9 Key, followed by pressing the ENT Key selects NMEA-0183 TYPE 2.

REMOTE INTERFACING

The EZ-97 may be interfaced with the SI-TEX model CR-7 Remote. All data displayed in the main Display Area will be displayed in the remote Display.

PLOTTER INTERFACING

The EZ-97 may be interfaced with the SEA-TEX VP-877, and CP-878 Video Plotters. The type of data the plotter will accept is user selectable in the option mode of the message pages.

SAT-NAV INTERFACING

The SI-TEX model 747 Sat-Nav Receiver will interface directly with the EZ-97. While using the 747 Sat-Nav, the EZ-97 must be in the L/L display mode.

AUTOPILOT INTERFACING

The EZ-97 will interface with most autopilots. Confer with the autopilot manufacturer to determine which of the above listed serial data formats the autopilot will accept.

APPENDIX A

APPLICABLE LORAN C CHAINS

GRI	M/S	STATION	CHAIN	CODING DELAY
4990	M	JOHNSTON IS	CENTRAL PACIFIC	
	X	UPOLO PT, HAWAII		11,000 μ sec
	Y	KURE IS, HAWAII		29,000 μ sec
5990	M	WILLIAMS LAKE, BC	CANADIAN WEST	
	X	SHOAL COVE, AK	COAST	11,000 μ sec
	Y	GEORGE, WA		27,000 μ sec
	Z	PORT HARDY		41,000 μ sec
7930	M	ANGISSOQ, GREENLAND	NORTH ATLANTIC	
	W	SANDUR, ICELAND		11,000 μ sec
	X	EJDE, FAROE ISLANDS		21,000 μ sec
	Z	CAPE RACE, NEWFOUNDLAND		43,000 μ sec
7960	M	TOK, AK	GULF OF ALASKA	
	X	NARROW CAPE, AK		11,000 μ sec
	Y	SHAOL COVE, AK		29,000 μ sec
7970	M	EJDE, FAROE ISLANDS	NORWEGIAN SEA	
	X	BO, NORWAY		11,000 μ sec
	W	SELT, GERMANY		26,000 μ sec
	Y	SANDUR, ICELAND		46,000 μ sec
	Z	JAN MAYEN, NORWAY		62,000 μ sec
7980	M	MALONE, FL	SOUTHEAST U.S.	
	W	GRANGEVILLE, LA		11,000 μ sec
	X	RAYMONDVILLE, TX		25,000 μ sec
	Y	JUPITER, FL		43,000 μ sec
	Z	CAROLINA BEACH, NC		59,000 μ sec

APPLICABLE LORAN C CHAINS (CONT)

GRI	M/S	STATION	CHAIN	CODING DELAY
7990	M	SIMERI CRICHI, ITALY	MEDITERRANEAN SEA	
	X	LAMPEDUSA, ITALY		11,000 μ sec
	Y	KARGABARUN, TURKEY		29,000 μ sec
	Z	ESTARTIT, SPAIN		47,000 μ sec
8970	M	DANA, IN	GREAT LAKES	
	W	MALONE, FL		11,000 μ sec
	X	SENECA, NY		28,000 μ sec
	Y	BAUDETTE, MN		44,000 μ sec
9940	M	FALLON, NV	U.S. WEST COAST	
	W	GEORGE, WA		11,000 μ sec
	X	MIDDLETOWN, CA		27,000 μ sec
	Y	SEARCHLIGHT, NV		40,000 μ sec
9960	M	SENECA, NY	NORTHEAST U.S.	
	W	CARIBOU, ME		11,000 μ sec
	X	NANTUCKET, MA		29,000 μ sec
	Y	CAROLINA BEACH, NC		39,000 μ sec
	Z	DANA, IN		54,000 μ sec
9970	M	IWO JIMA, VOLCANO ISLAND	NORTHWEST PACIFIC	
	W	MARCUS ISLAND, JAPAN		11,000 μ sec
	X	HOKKAIDO, JAPAN		30,000 μ sec
	Y	GESASHI, JAPAN		55,000 μ sec
	Z	YAP ISLAND, U.S.A. TRUST		75,000 μ sec

APPLICABLE LORAN C CHAINS (CONT)

GRI	M/S	STATION	CHAIN	CODING DELAY
5930	M	CARIBOU, ME	NEW CANADIAN	
	X	NANTUCKET, MA		11,000 μ sec
	Y	CAPE RACE, NEWFOUNDLAND		25,000 μ sec
	Z			38,000 μ sec
9990	M	ST PAUL PRIBILOFF IS, AK	NORTH PACIFIC	
	X	ATTU, AK		11,000 μ sec
	Y	PORT CLARENCE, AK		29,000 μ sec
	Z	NARROW CAPE, AK		43,000 μ sec
5000	M	SAKHALIN		
	X	KAMCHATKA??		11,000 μ sec
	Y	VLADIVOSTOK		30,000 μ sec

APPENDIX B

COURSE COMPUTER NAVIGATION PROBLEM

This example will demonstrate the use of the Course Computer operation. Refer to Figure 61. We begin with the boat tied to the dock. While warming up the engine, the skipper can take this time to enter the coordinates of the waypoint into the memory of his Loran by pressing:

▼▲ to move the Mode Indicator Bar down to the Course Computer function.

◀▬ to select WP (Waypoint) function.

The waypoint may be entered as either Loran C LOP's (Lines of Position) or Latitude/Longitude coordinates.

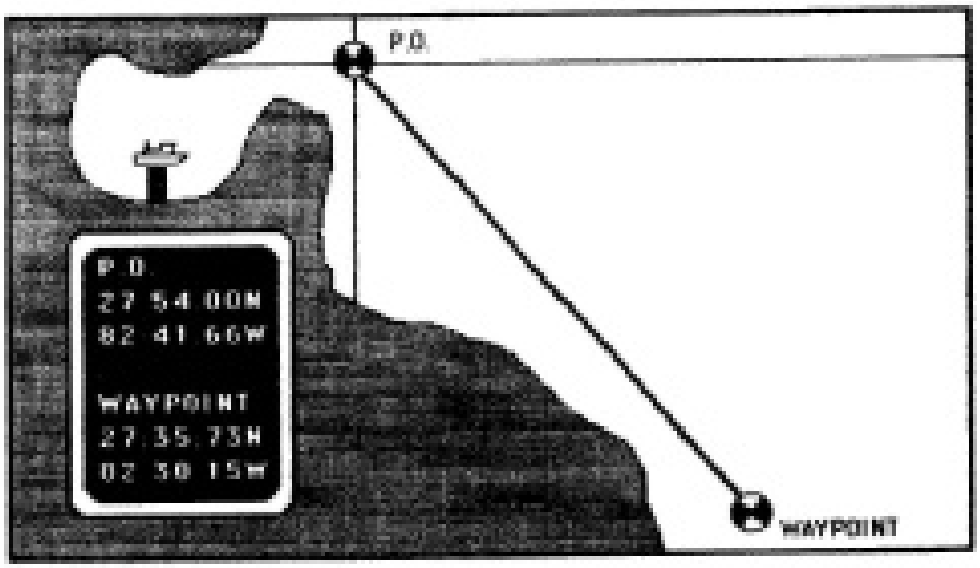


Figure 61. Vessel before trip begins.

For this example, we will use Latitude/Longitude coordinates, which will be abbreviated L/L. Press the following keys to enter the waypoint.

For Latitude 27:35:73 N

For Longitude 82:30:15 W

Next, the skipper will store this information into memory number 05 by

Next, the skipper will store this information into memory number 05 by
pressing

Next, the waypoint is recalled and entered into the Course Computer by pressing:

The Display will then give the following results:

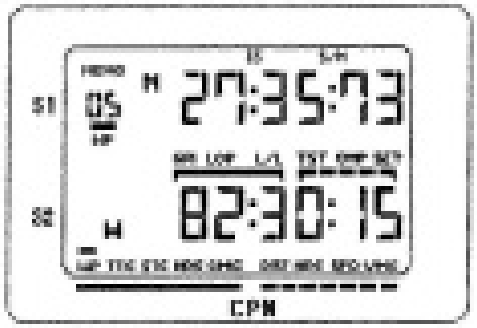


Figure 62

To activate the Course Computer, use the ◄—Key to move the Mode Indicator Bar over to STG (Steering or Bearing). This is the direction to steer to the waypoint. Next, the skipper will use the►—Key to move the Mode Indicator Bar on the right side over DIST (Distance to the Waypoint). This display now looks like this:

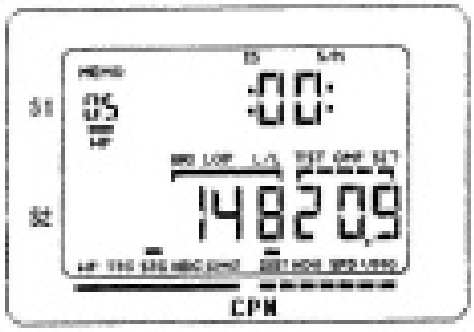


Figure 63

Once the boat has arrived at the end of the channel (Point of Origin=P.O.) the skipper will then reenter the point of origin. This is done by pressing the 1/N and ENT Keys to set the new point of origin into the Loran to begin navigation. This resets the Cross Track display to 00.

Now the display will look like this with the vessel at point P.O. as in figure 63. Note--the bearing (STG) and distance (DIST) information has changed.

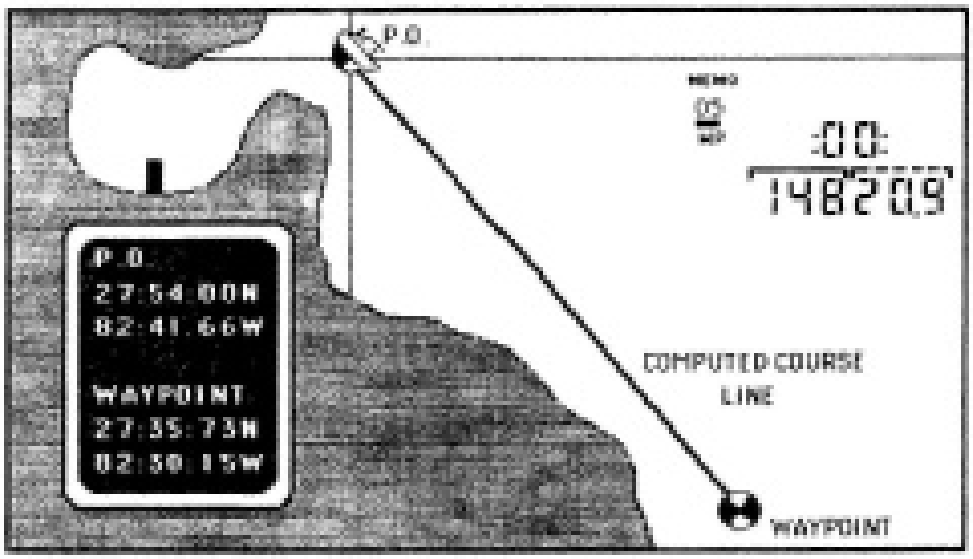


Figure 64. Vessel at Point of Origin

The following series of figures will show the progress of the vessel and what the skipper should see in the Loran Display Area.

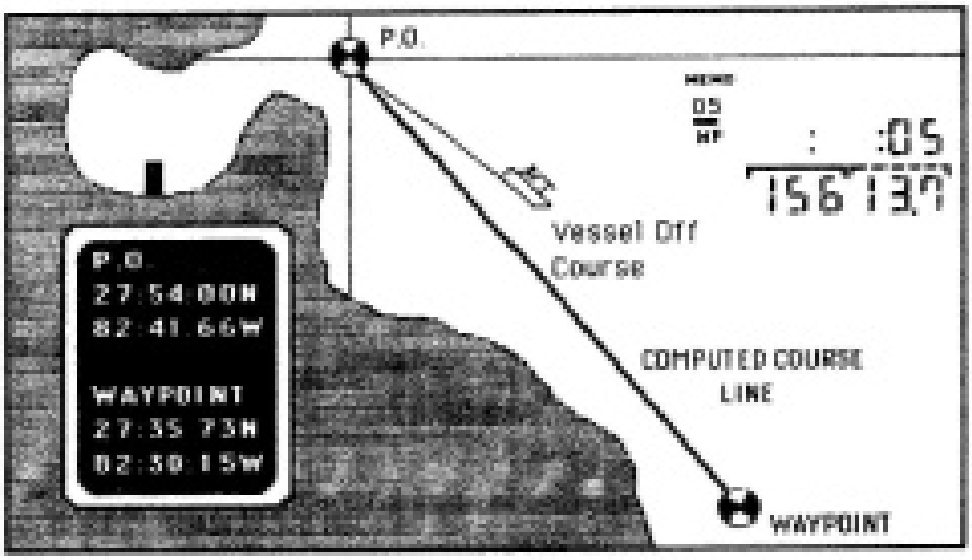


Figure 65. Vessel Off Course.

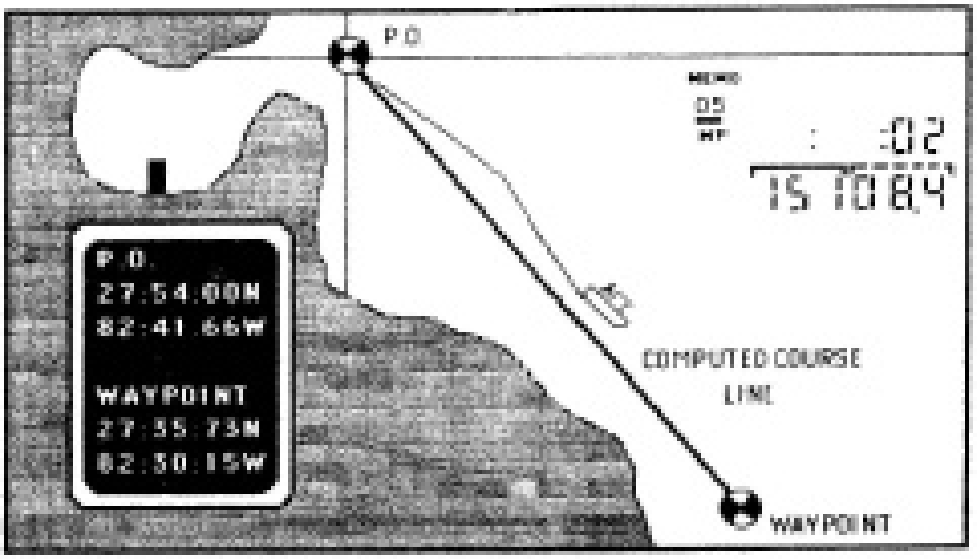


Figure 66. Vessel returning to Computed Course.

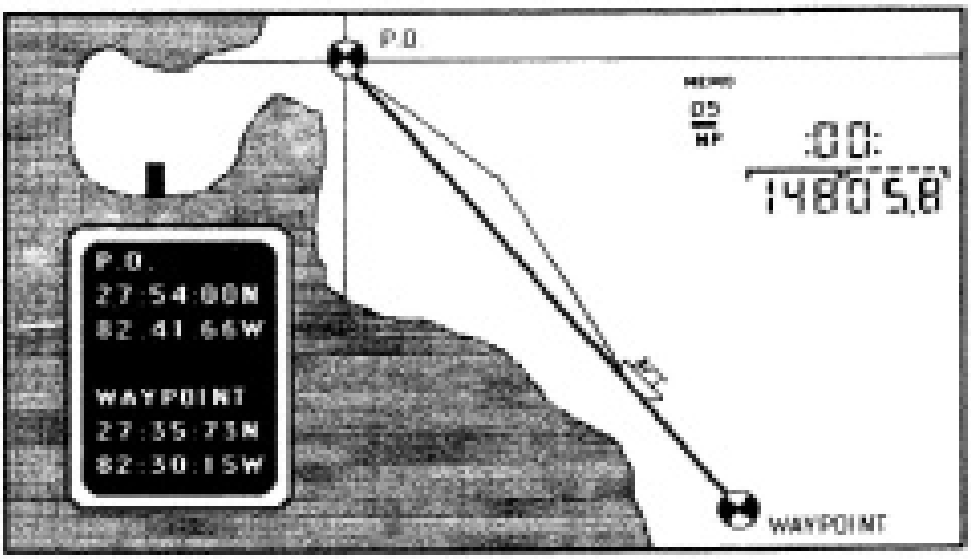


Figure 67. Vessel back On Course.

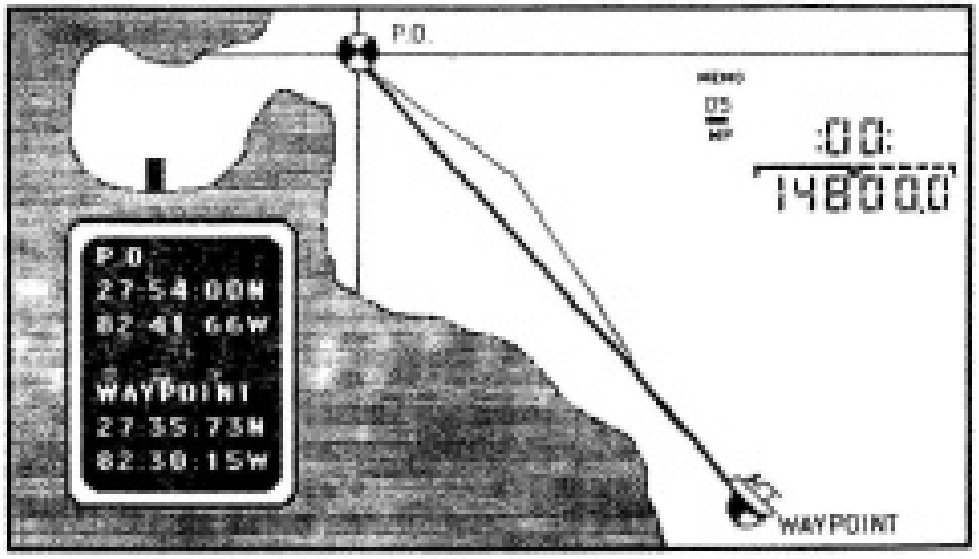


Figure 68. Trip completed.

It should be noted that this is an example of only one method of using the navigation or Course Computer functions. You are limited only by your own knowledge of Loran C, and your imagination.

APPENDIX C

GLOSSARY OF TERMS

A partial list of terms used with Loran C is presented herein. Additional information can be obtained from the sources referenced in this manual.

Accuracy. Absolute position accuracy as opposed to repeatable accuracy.

Acquisition. (Or search) is the process of establishing the approximate location in time of the Master and each of the selected secondaries with sufficient accuracy to permit subsequent settling and tracking.

Additional Secondary Factors - ASF. Factors accounting for variations in Loran signal velocity caused by changes in the conductivity of the earth's surface.

Antenna. A device that converts electromagnetic waves to electrical signals.

Antenna Coupler. A device that converts and pre-processes the electrical output of the antenna to the signal level and impedance necessary to drive the receiver.

Baseline. A projection of the great circle line joining the Master and secondary stations.

Baseline Extension. An extension of the Baseline formed by projecting the Baseline through the Master and secondary stations in either direction.

Blink. A Loran system alarm warning the operator of technical problems or faulty timing at any of the Loran transmitters.

Chain. A group of Loran C transmitting stations identified by a specific GRI.

Coding Delay. The difference in time of transmission between the Master and secondary station.

Conductivity. The electrical properties of the earth's surface which affects the speed at which Loran signals travel over ground paths. See ASF Additional Secondary Factors.

CPN (Compunav). The Course Computer or navigation functions of SI-TEX Marine Electronics Loran C receivers that provides distance, heading, bearing, speed, time-to-go and cross track information.

Crossing Angle. The angle - from 0 to 90 degrees - at which the two Lines of Position (LOPs) intersect.

Cross-Rate/Cross-Chain Interference. Loran signal interference crossed by signals from another chain.

Cross Track Error. The computed off-course deviation (to left or right) from the course between the Point of Origin (PO) and the desired destination or waypoint.

Cycle Slip. Failure of the receiver to maintain synchronization and alignment of the phase code of the Loran C pulses which can cause time difference measurement errors in multiples of 10 microseconds.

Desired Destination - DD. A Waypoint - a position or location to which the Loran C user wishes to travel consisting of the intersection of two Lines of Position (LOPs).

Dual Rated Station. A loran station which operates in two loran chains.

Fully Automatic Loran Receiver. Equipment that, after the initial selection of the chain, automatically acquires the master and secondaries, settles, cycle selects, tracks the signals, and periodically updates the lines of position without manual manipulation of knobs or panel controls.

Gradient. The Time Difference separation between Lines of Position, (specified in microseconds). Gradients vary accordingly with selection of Master-Secondary pairs.

GRI - Group Repetition Interval. The time coded delay, a 4 digit number used to identify the group of transmitter stations in a specified Loran C chain.

Ground Wave. The path along the curvature of the earth which

Ground Wave. The path along the curvature of the earth which
the Loran C signals follow.

In-Band-Noise. Any electrical interference which occurs within the Loran C band of 90 KHz to 110 KHz.

Ionosphere. An atmospheric layer above the earth's surface, varying in altitude between 25 and 250 miles, which reflects radio waves.

Land Path Variable. The factor used to compensate for the difference in Loran C signal velocity over seawater, flat land, mountains and various terrain.

Latitude-Longitude. Grid system used in Mercator projection charts in which the parallel lines which run east (right side of chart) and west (left side of chart) denote latitude--from 0 degrees at the Equator to 90 degrees North or South at the poles. Lines of longitude run north (top) and south (bottom)--from 1 degree to 180 degrees East or West.

Line of Position--LOP. A graphical plot of all observation points having the same constant measured time difference (TD) between the Master station and Secondary stations. The graphical plot forms the Line of Position printed on the Loran C Chart.

Loran C System. A long range navigation system that operates at an assigned frequency of 100 KHz. It utilizes pulsed signals from widely spaced transmitting stations and measures the difference in arrival times of the pulses to determine position relative to the transmitting station.

Loran Fix. The position or location established by the intersection of two LOP's.

Maximum Operating Range. The maximum distance within the prime coverage area where Loran reception is possible within a specified accuracy and a specified signal to noise ratio.

M--Master Station. The controlling station of the Loran C chain which transmits the reference timing signals.

Minimum Operating Range. The range, 5 to 20 miles, wherein the receiver may not track the desired cycle, thus causing displayed errors in increments of 10 microseconds.

Notch Filters. A narrow band noise filter used to tune out interference near the Loran C band.

Point of Origin. A starting point of a navigational operation. The position or location at the intersection of two LOPs, indicated by the receiver at the instant the ComPuNav (CPN) mode is initialized.

Receiver. A device that processes loran signals from the antenna coupler and measures the difference in arrival time of the selected signals representing the measured parameter.

Repeatability. The ability to return to a particular position or location using Loran C navigation aids.

Secondary Station. Any transmitting station in the chain that is not the master station. Secondaries are usually designated W, X, Y and Z and referenced to the master (M) station GRI.

Settle. Is the process of automatically aligning the phase codes, identifying the correct cycle zero-crossing, establishing ground wave tracking, and indicating that time differences are valid.

Signal to Noise Ratio. The ratio of loran signal strength, at the TIMING point, to the in-band noise.

Skywave. A Loran C signal transmission which is reflected by the ionosphere. These signals are less accurate than the ground wave signals.

Time Difference - TD. Time Difference is the time of arrival of the secondary signal minus the time of arrival of the master signal, as observed on a single receiver.

Tracking. Is the process of maintaining the synchronization of the receiver with the selected signals.

Waypoint. A destination, position or location, to which the Loran C user wishes to travel, consisting of the intersection of two Lines of Position (LOPs).

EZ-97 SPECIFICATIONS

EZ-97 SPECIFICATIONS

Frequency	:	100 KHz
Sensitivity	:	Less than 1 microvolts/meter
Maximum Input Level	:	0.3 volts RMS
Maximum Tracking Speed	:	40 knots
Settling Time	:	3 min. at 0dB (nominal)
Ambient Temperature	:	0 to 50°C
Power Supply	:	11 to 15 VDC, 0.5 amp., negative ground
Notch Filter	:	4 internal, built-in, pre-set
Display Element	:	LCD backlighted with dimmer control
Operating Device	:	Membrane type keypad laminated to front face, backlighted
Memory	:	Instant: 10 points Waypoint: 50
CompuNav Course Computer	:	Built-in for TD and L/L operation
Coordinate Converter	:	Built-in
Display Information	:	TD, L/L, cross track error, time to go, elapsed time, distance to go, speed heading, bearing to steer, course made good, velocity made good
Audible Alarm	:	Proximity, anchor watch, cross track error
Visual Alarm	:	Cycle, S/N, Station blink
Output	:	T-717, NMEA-0182, T-757 or NMEA-0180 plus NMEA-0183 selectable
Antenna Coupler	:	Provided with antenna cable of 15 m.
Position Correction	:	Manual for L/L
ASF Correction	:	Manual for TD or L/L
Magnetic Compass Correction	:	Manual for heading and bearing
Case Construction	:	Die-cast aluminum
Dimension	:	115 (H) x 170 (W) x 74 (D) m/m
Memory Back-up	:	Lithium Battery

Specifications are subject to change without notice.

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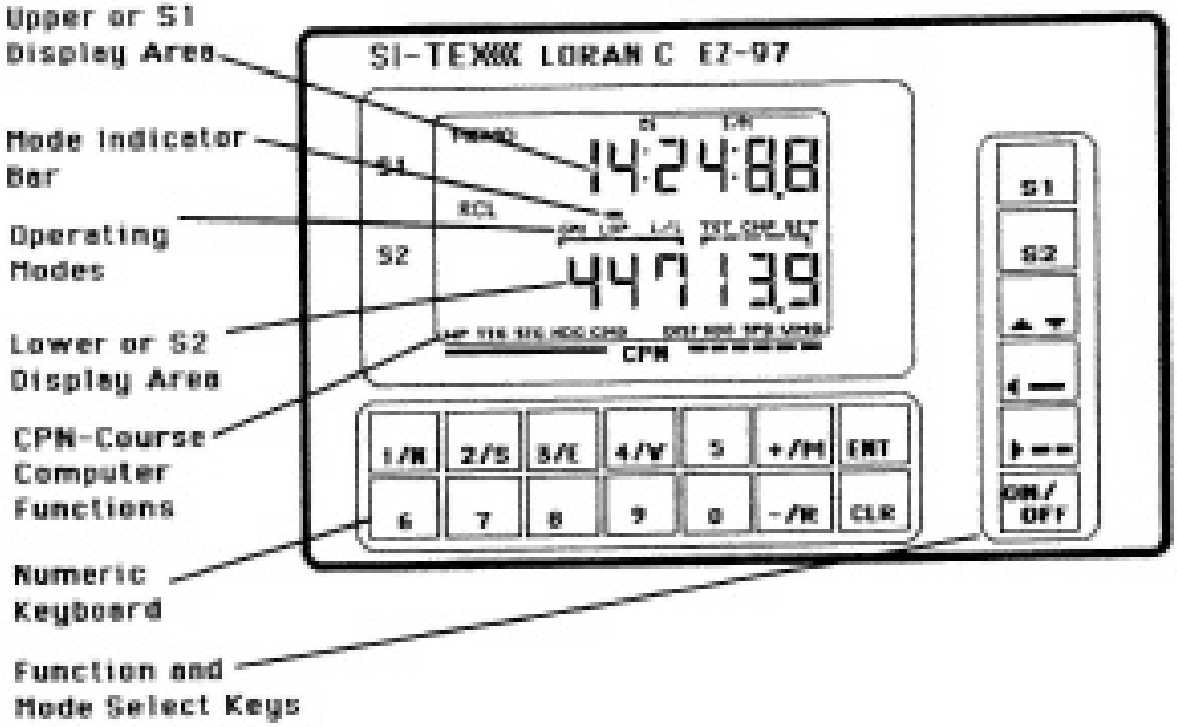
APPENDICES

ILLUSTRATIONS



OPERATING MODES

GRI-Group Repetition Interval

LOP-Lines of Position

L/L-Latitude/Longitude

TST-Test Mode

CMP-Compensation Mode

SET-Set mode

WP-Waypoint

CPN-Course Computer mode

TTG-Time To Go

STG-Steering(or Bearing)

HDG-Heading

CMG-Course Made Good

DIST-Distance To Waypoint

SPD-Speed

VMG-Velocity Made Good

Figure 1. Front Panel Displays and Keyboard