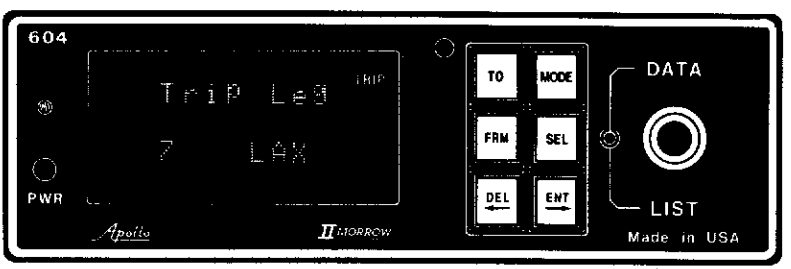
PILOT'S
OPERATING HANDBOOK

Apollo®

MODEL 604
LORAN-C RECEIVER



MORROW INC. TM

SALEM, OREGON U.S.A.

A UNITED PARCEL SERVICE COMPANY

Manufacturer of Quality Navigation and Communication Equipment

November 1989

560-0038D
REV 4

II MORROW INC.
Limited Warranty
(Avionic Loran Products)

1. Scope of Limited Warranty

II Morrow warrants to the original consumer purchaser that II Morrow products will be free of defects in materials and workmanship, under normal use, for the periods described below. The warranty begins on the original retail delivery date, or on the date of first use, whichever occurs earlier. Avionic Loran receivers are covered for 26 months after delivery or first use, whichever is earlier. Antennas and antenna preamplifiers are covered for a period of 12 months after delivery or first use, whichever is earlier. This warranty shall be effective only if and when (i) II Morrow receives a completed warranty registration card with respect to the specific product unit found to be defective; (ii) the unit was installed by personnel certified by the FAA to install avionic equipment and copy of FAA Form 337 documenting the installation is provided to II Morrow (except for homebuilts); (iii) II Morrow receives notice of such defect during the period of the warranty; and (iv) the consumer purchases the unit in the United States or Canada. (II Morrow's sole and exclusive liability for breach of warranty shall be (at II Morrow's option) to repair or replace the defective II Morrow products or return the purchase price for any defective products that are returned during the warranty period. II Morrow products repaired or replaced under this warranty are subsequently warranted only for the remaining, unexpired portion of the warranty period applicable to the original product. If II Morrow elects to repair or replace the product, II Morrow shall have a reasonable time to do so.

2.Limitation of Implied Warranties

TO THE EXTENT ALLOWED BY LAW, ANY IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE APPLICABLE TO II MORROW PRODUCTS ARE LIMITED IN DURATION TO THE DURATION OF THESE WRITTEN WARRANTIES. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

3.Exclusion of Remedies and Liability

IN NO EVENT SHALL II MORROW, ANY DISTRIBUTOR, OR THE SELLING DEALER BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING LOSS OF PROFITS, LOSS OF TIME, OR INCONVENIENCE) WHETHER BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER LEGAL THEORY EVEN IF II MORROW, SUCH DISTRIBUTOR, OR THE SELLING DEALER WAS ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Some states do not all limitations of incidental or consequential damages, so the above limitation may not apply to you.

4.Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from (a) improper or inadequate maintenance; (b) unauthorized modification of the products; (c) operation of the products outside of their environmental specifications; (d) improper installation; (e) neglect, misuse or abuse of the products; (f) integration with other products not covered by a II Morrow warranty; or (g) exposure to corrosive environments. This warranty shall not apply to any products not manufactured by II Morrow. No one is authorized to change or add to this warranty.

5.Technical Assistance

The warranty set forth above shall not be enlarged, diminished or affected by, and no obligation or liability shall arise from II Morrow, any authorized dealer or any other person rendering of technical advice, assistance or service in connection with the selection, purchase or use of any II Morrow products.

6.Installation

II Morrow makes no warranty with respect to any installation of II Morrow products by II Morrow, any authorized dealer or any other person.

7.Other Rights

This warranty gives you specific legal rights. You may also have other rights which vary from state to state.

8.Place of Repair or Replacement

In order to obtain the benefits of this warranty, the defective II Morrow products must be returned to II Morrow at its plant at 2345 Turner Road, S.E., Salem, Oregon 97302, II Morrow Service Center, or to an authorized dealer, with transportation charges prepaid. II Morrow shall pay for the return of the repaired or replaced II Morrow products to you by surface transportation.

A message to our customers:

This manual is intended to supply you with information to help you operate and obtain the most from your II Morrow equipment. By following the instructions contained in this manual you will be able to take advantage of the many features offered in this unit.

II Morrow is committed to designing quality aviation navigation products that will supply our customers with years of maintenance free operation. Your experienced II Morrow dealer can provide quick service or answer any questions concerning the APOLLO® Model 604 should the need arise.

The design engineers and I are pilots, and as a result our aviation products are designed with the needs of the pilot in mind. The APOLLO® Model 604 is designed to be an easy to use, reliable, and accurate method of navigation. I've always felt that people were the most important factor in the development, manufacturing, and technical support of our products. As a result of this belief, our relationship with our customers and support of our products does not end with the sale of the product. I wish to personally thank you for purchasing a II Morrow, Inc. product.

While the APOLLO® Model 604 LORAN-C receiver with the FLYBRARY® database provides a powerful tool for direct point-to-point navigation in the prime coverage areas, the pilot is urged to also utilize current and appropriate navigation charts and information. II Morrow, Inc. makes every effort to provide the most up-to-date and accurate information available in the creation of the FLYBRARY® database. However, you should never rely solely on any single aid to navigation or source of information.

Ray E. Morrow, Jr., President
II MORROW Inc.

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OP141-04

INTRODUCTION

This manual is intended to provide you with a thorough knowledge of the APOLLO® Model 604s' operations and displayed information. This manual is divided into nine sections. The first section, "Getting Started," introduces you to the controls and some of the basic operations. There are six sections that deal in detail with each of the operating modes. On the back cover of each of the mode section dividers there is a road map of the contents of the operating mode. The section on LORAN-C provides you with a little theory on how LORAN-C works and detailed maps of each of the LORAN-C chains included with your APOLLO® 604. The Appendices section includes advice for care and installation, FLYBRARY® cartridge replacement, a glossary of terms, a troubleshooting guide, and an index.

The LORAN-C system is intended to be used as a radio navigation aid. The APOLLO® Model 604 receives the transmitted signals, computes your location, and other navigation information. Because of the use of Low Frequency (LF) radio waves LORAN-C coverage is very good over all types of terrain and is not limited, like VORs or DME, to line-of-sight transmission.

All NAV displays are based on Great Circle (the shortest distance across the earth's surface) navigation providing you with direct enroute information including Bearing and Range (BRG & RGE), Track Angle (TRK), Ground Speed (GS), Estimated Time Enroute (ETE), and Cross Track Distance (XTD) to the destination and from the point of origin. Point-to-Point Desired Track (DTK) and the distance between any two predefined waypoints, and many other capabilities are present in the APOLLO® Model 604. Of special interest is the optional FLYBRARY® with nearly 10,000 waypoints already present in the APOLLO® Model 604s' nonvolatile memory. These waypoints hold the locations of many airports, and all VORs and NDBs within the continental United States, Alaska, and Canada, along with their official designations to allow simple flight planning. The INFO Mode contains detailed information for each airport: City, State, Name, Identifier, Tower frequency, Ground frequency, ATIS, ILS, CTAF, Clearance Delivery, Approach frequency, Localizer frequency, Unicom frequency, Elevation, Runways (number, length, and lights), and if Services are available. INFO Mode provides the Identifier and frequency for all VORs and NBDs. One hundred vacant waypoints are available to the user for individualized entry. The APOLLO® Model 604 will allow you to enter the present position and reference navigation information either TO or FROM present position. The APOLLO® Model 604 will automatically select the proper triad and magnetic variation for your location. In the TRIP Mode you may easily set up a flight plan of up to nine legs that will automatically sequence to each leg.

The state-of-the-art design of the APOLLO® Model 604 possesses many more features to make navigation and flight planning reliable and quick for the pilot. This manual provides easy to understand instructions to allow the operator the ability to utilize the many features available in the APOLLO® Model 604.

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APPENDICES

HISTORY OF REVISIONS

Revision 0 (First Release) — February 1987 (0287)

Revision 1 — May 1987 (0587)

Pages changed: Table of Contents, i, A-2, TRIP Mode section cover, B-1, C-1, C-13, C-15, D-6, E-1, E-10, E-11, E-12, E-13,F-1, F-8, and G-8.

Revision 2 — October 1987 (1087)

Pages changed: Cover, Table of Contents, i, A-2, A-5, B-1, B-4, B-5, Section D, G-1, G-8, and G-27 through G-47.

Revision 3 — October 1988 (1088)

Pages changed: Cover, Introduction, i, A-2, A-3, B-1, B-2, B-6, B-8, C-1, C-4, C-8, C-10, C-13, D-1, D-5, G-2, G-4, G-13, G-16, G-17, G-18, G-20, G-21, G-22, G-23, G-24, G-25, G-41, G-42, and the Index.

Revision 4 October 1989 (1089)
Complete Manual Revised

SECTION A

GETTING STARTED

GETTING STARTED

The APOLLO® Model 604 will provide you with years of reliable service as an accurate navigation device. The keys to the successful use of the APOLLO® Model 604 are proper installation and proper operation. Installation of the receiver and antenna system should be performed by qualified service personnel following the installation instructions, applicable regulations, and standards. Proper operation is the responsibility of you, the pilot, and is accomplished by a thorough working knowledge of the equipment, including its abilities and limitations. This knowledge is best obtained by reading the manual and practicing with the unit before using it in flight.

Before you get started with your APOLLO® Model 604 there are a few points to remember. The FLYBRARY® and INFO Mode data are in permanent memory and cannot be damaged by the operator. The LIST knob is the large outer knob and the DATA knob is the small inner knob. You may turn the knobs in either direction to get to information. Remember that one nautical mile (nm) is approximately 1.15 statute miles (or 6076 feet).

Note that the displays have two sizes of numbers. The larger size numbers are whole numbers. The smaller size numbers mean that they follow a decimal point. For example, the Range (RGE) shown as RGE 3557 is 355.7 nm. The smaller "7" meaning 0.70 nm.

Operation of the APOLLO® Model 604 is quick and easy when the proper procedures are followed. This section provides a summary of the most used procedures. A full explanation of operating functions is provided in the other sections of the manual and should be read. A checklist of the steps for normal operation is given on the next page. When the aircraft is operated by different people over a period of time, the preflight checklist should be followed to insure that the unit is properly set up. The Model 604 will prompt you for information when it is required or when you request something by pressing SEL. The digits for the required data will flash. Turn the DATA knob to display the needed information (data). Pressing the ENT button provides an affirmative (YES) response. Pressing another button or turning one of the knobs implies a negative (NO) response. Most data entered by pressing the ENT button will remain in memory even after the power is turned off (exceptions will be noted in the appropriate section). For instance, to select a new GRI, the request is made by pressing SEL while viewing the GRI display in SETUP Mode. The GRI number will flash to let you know that this is the value to be changed. Turn the DATA knob to show the desired GRI. Then, press ENT. The GRI will be held in memory until you change it.

BASIC STARTUP STEPS

Most operations of your APOLLO® Model 604 are automatic after you have entered a few basic pieces of information. Many other features are available as you wish to use them. The main purpose of your Model 604 is to navigate accurately and simply.

1. Enter the GRI (Group Repetition Interval) that provides the best signal coverage for your area. The APOLLO® Model 604 will keep this in memory until you change it. As you can see from the LORAN-C coverage maps in Section H, you probably will not have to change your GRI very often.

2. Enter the waypoints into the TRIP Mode. Select the waypoints from either the FLYBRARY® or the operator entered (USER) waypoint regions.

3. Activate TRIP, switch to NAV Mode, and you are ready to fly.

PREFLIGHT CHECKLIST

1. POWER-UP. Turn the unit on by pushing in the power switch. The WARN light will then appear during the warm-up period. Remember that POS and most NAV Mode information will not be accurate. However, you may still perform many functions while the WARN light is on. You can, for instance, enter your TO and FROM waypoints, check the desired track and distance between waypoints (DTK and distance), and use most of the functions in SETUP Mode.

2. SETUP. Press the MODE button to reach SETUP Mode.

3. CHECK GRI. Check that the GRI is correct for your area. Use the map on pages A-8 and A-9 or the LORAN-C coverage maps in Section H to select the best GRI for your area.

4. CHECK ADVISORY. Turn the LIST knob one position clockwise (cw) and check the ADVISORY pages for any problems. If everything is OK, continue. If not, see page G-7.

5. CHECK AUTO-NAV. Turn the LIST knob three positions cw, press ENT, and then turn the AUTONAV function on or off as you desire by pressing SEL, turning, the DATA knob (for "ON" or "OFF"), and then pressing ENT.

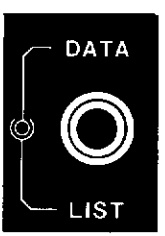
6. CHECK COURSE OFFSET. Push MODE button back into SETUP. Turn the LIST (large) knob five positions cw and make sure Course Offset (OFST) is set to 0.0.

7. CHECK CROSS TRACK DISTANCE SENSITIVITY. Turn the LIST knob one position cw and check the Cross Track Distance (XTD) Sensitivity for your desired value (0.20 nm is a good start).

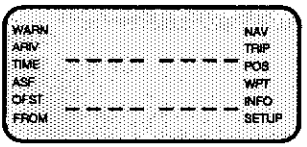
8. SETUP AIRSPACE. Turn the LIST knob one position cw and then press ENT to view Airspace Setup status. Then turn the AIRSPACE Warning function on or off as you desire by pressing SEL, turning, the DATA knob (for "ON" or "OFF"), and then pressing ENT. Now, turn the LIST knob to view the Warning Distance. Press SEL, turn the DATA knob to the desired Distance (0 - 99 nm) and press ENT.

FRONT PANEL CONTROLS

PUSH BUTTONS	DESCRIPTION
MODE	Pressing the MODE button will allow you to gain access to the operating modes (NAV, TRIP, POS, WPT, INFO, & SETUP). The current mode will be noted by the appropriate lighted annunciator on the right side of the display panel.
SEL	Pressing SEL enables the displayed value to be changed. The selected value will flash. SEL is also used as a "NO" response.
ENT →	ENT must be pressed after the selected data has been changed, unless otherwise noted. ENT is also used as a "YES" response. The ENT arrow key will provide horizontal scrolling to the left or move the display to view information that is longer than can be shown in one display panel.
TO	Pressing TO while in TRIP, WPT, POS, or INFO Mode will set the displayed waypoint as the destination.The unit will then automatically switch to NAV Mode.
FRM	Pressing FRM while in TRIP, POS (coordinate display only), WPT, or INFO Mode will set the displayed waypoint as the origin (point of departure).
DEL ←	Pressing DEL (Delete) will remove an unwanted waypoint from your TRIP. The DEL key will also provide cursor movement to the left, move the display to view information that is longer than can be shown in one display panel, or backstep to the previous display in some features.

ROTARY SWITCHES	DESCRIPTION
	The DATA knob is the SMALLER INSIDE knob of the rotary switch. The DATA knob is used in conjunction with the SEL button to change displayed values. The DATA knob may be turned in either direction. The LIST knob is the LARGER OUTSIDE knob of the rotary switch. Turning the LIST knob will provide different groups of information to the display panel. The LIST knob may be turned in either direction.

DISPLAY PANEL



STATUS ANNUNCIATORS

Annunciators located on the left side of the display panel light to indicate signal or receiver operating information.

WARN The red WARN annunciator appears when possible signal problems exist. The WARN annunciator will also light immediately when the APOLLO® Model 604 is turned on, indicating that the unit is searching for tracking points. See page G-19.

ARIV The green ARIV annunciator lights when the aircraft has arrived near the destination waypoint at a rate of one nautical mile for each 100 kts of ground speed (i.e. ARIV will light when you are within 2 nm of the destination when you are traveling at 200 kts or 3 nm for 300 kts). See page B-5.

TIME The TIME annunciator will flash continuously as an alarm for the Timer function. See page B-6.

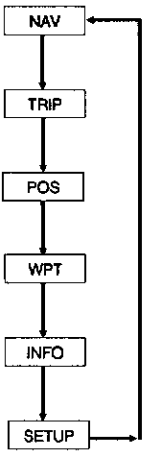
ASF The ASF annunciator lights when LAT/LONG calibration factors have been entered by the operator. See page G-16.

OFST The OFST annunciator lights when the Course Offset function has been selected. Course offset is selected in SETUP Mode. See page G-9.

FROM The FROM annunciator lights when the information displayed in NAV Mode is relative to the departure waypoint. see page B-5.

MODE ANNUNCIATORS

Six annunciators on the right side of the display panel indicate which operating mode of the APOLLO® Model 604 has been selected. Pressing the MODE push button will advance through the modes from top (NAV) to bottom (SETUP) and then back to the top (NAV) again.



The NAV annunciator lights when Navigation Mode information is displayed.

The TRIP annunciator lights when TRIP Mode information is displayed.

The POS annunciator lights when Position Mode information is displayed.

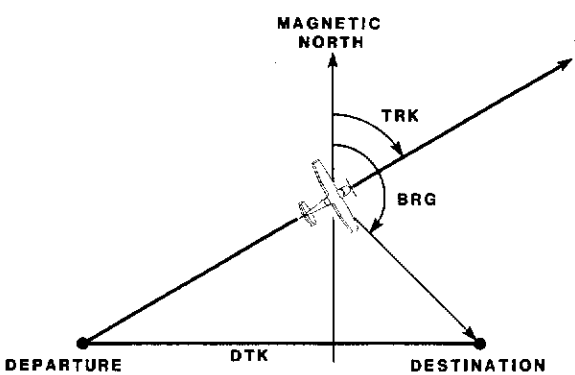
The WPT annunciator lights when Waypoint Mode information is displayed.

The INFO annunciator lights when INFO Mode information is displayed.

The SETUP annunciator lights when SETUP Mode information is displayed.

NAV TERM SUMMARY

BRG - Bearing destination
TRK - TRACK (current ground track)
RGE - RANGE (distance to destination)
GS - GROUND SPEED in nautical miles per hour (This can be preset by the factory, to statute miles or kilometers / hr. See authorized Dealer for details.)
DTK - Bearing from departure to destination, using magnetic variation at the departure waypoint
XTD - CROSS TRACK DISTANCE (distance error from DTK)



SETTING UP A TRIP

1 Press MODE to reach TRIP MODE.

2. Turn the LIST knob to reach the Waypoint Retrieval page and press SEL to retrieve the first waypoint for your TRIP from the FLYBRARY.® The first position will flash.

3. Turn the DATA knob to select the first digit (letter or number) of the waypoint you want and then press ENT. The letter you selected will remain and the next position will flash. Press ENT to pass over the last space if a three character waypoint identifier is used. If an unwanted character is present turn the DATA knob to insert a blank space (the space is after the "9" character).

4. Continue to enter the characters for the waypoint. If the waypoint is in the FLYBRARY®, the Model 604 will indicate "FOUND WPT PDX." Now continue to step 5. If the waypoint is not in the FLYBRARY®, the Model 604 will indicate "No Such" and you must reenter another waypoint identifier.

5. Turn the LIST knob to reach the TRIP LEG display.

6. Turn the DATA knob to reach the position in the TRIP to insert the waypoint you just retrieved. If you are entering the waypoints in sequence, you must turn the DATA knob one position cw to the Trip End page.

7. Press ENT to enter the retrieved waypoint into the TRIP.

8. Continue for the required legs of your TRIP.

ACTIVATING A TRIP

1. Press the MODE button to reach TRIP Mode.

2. If you have already entered the waypoints for your TRIP, turn the LIST (large) knob to the Trip Status page and then press SEL.

3. Turn the DATA knob, if required, to display "Activate Plan?". Press ENT. Your TRIP (flight plan) will now be activated and the unit will automatically switch to NAV Mode.

4. When the WARN light goes out (2 to 5 min.), you may use the NAV Mode information to navigate. Turn the LIST knob to use the different NAV Mode displays.

EDITING A TRIP

INSERTING A NEW WPT

1. In TRIP Mode turn the LIST knob to reach the "Retrieve Wpt" display.
2. The first character position will flash.
3. Select the appropriate characters as described on the previous page (steps 3 and 4 - "Setting Up a Trip").
4. Turn the LIST knob to reach the Trip Leg display.
5. Turn the DATA knob to reach the leg you want the new waypoint moved into.
6. Press ENT to place the new waypoint in the leg that will be in front of the displayed leg.

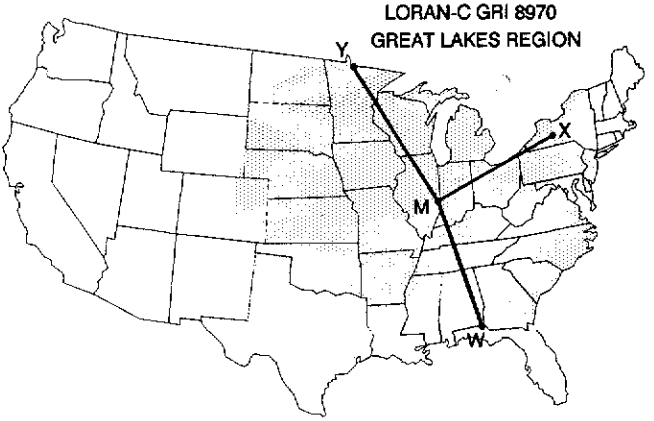
MOVING A TRIP LEG

1. Turn the DATA knob to reach the leg you want to move.
2. Press the DEL button. This removes the waypoint from that leg of the TRIP and holds it.
3. Turn the DATA knob to show the leg you want the old waypoint moved into.
4. Press ENT to place the old waypoint in the leg that will be in front of the displayed leg.

VFR LORAN-C COVERAGE FOR CONTINENTAL U.S.

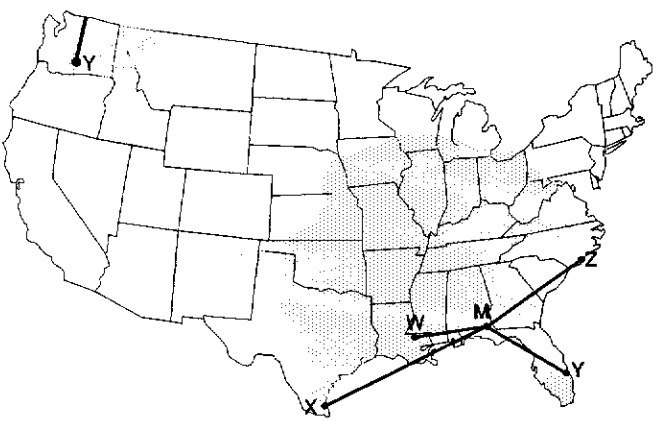
VFR COVERAGE AREA

LORAN-C GRI 8970
GREAT LAKES REGION



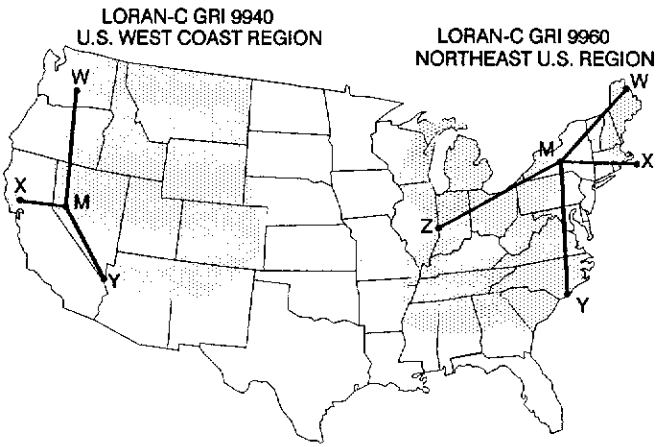
VFR COVERAGE AREA

LORAN-C GRI 5990
CANADIAN WEST COAST REGION



LORAN-C GRI 7980
SOUTHEAST U.S. REGION

VFR COVERAGE AREAS



CONTINENTAL FLYBRARY REGIONS

SECTION B

NAVIGATION MODE

NAVIGATION (NAV) MODE

The APOLLO® Model 604 displays a variety of navigation information when in NAV Mode. This information is available by pressing MODE to enter NAV Mode, and then turning the LIST knob to view the different NAV displays. Full navigation information is displayed only when TO and FROM waypoints have been selected or a TRIP is activated. Correct NAV Mode information will not be displayed until the WARN light has gone out (see page G-19). The AUTO-NAV feature will automatically sequence the NAV displays at a rate of about 2 seconds per page (see page G-39). When AUTO-NAV has been activated, pressing SEL in NAV Mode will start or stop scrolling. Only displays 1-9 may be shown when AUTO-NAV is active.

This section will describe the NAV displays and how to define a course. The information displayed refers to the destination except in the NAV-FROM display. You may reference Bearing and Range to the point of origin from your present position by turning the LIST knob until the FROM indicator appears on the left side of the display panel. All course information is automatically based on magnetic north unless changed by the operator.

The available displays in NAV Mode are:

1) Bearing (BRG) in degrees and Range (RGE) in nautical miles to the destination. (AUTO-NAV)
2) Track (TRK) in degrees and Ground Speed (GS) in knots.(AUTO-NAV)
3) Bearing (BRG) in degrees and Track (TRK)in degrees.(AUTO-NAV)
4) Range (RGE) in nautical miles to the destination and Cross Track Distance (XTD) graphically. Bar graph sensitivity is selected by the operator. (AUTO-NAV)
5) Range (RGE) in nautical miles and Estimated Time Enroute (ETE) in hours and minutes to the destination. (AUTO-NAV)
6) Display of the FROM (Departure) and TO (Destination) waypoints. (AUTO-NAV)
7) Desired Track (DTK) and the distance between waypoints. (AUTO-NAV)
8) Cross Track Distance (XTD) numerically and direction away from the desired track. Bar graph of XTD. (AUTO-NAV)
9) Bearing-From and Range-From your present position to the point of origin. (AUTO-NAV)
10) Flight Time in hours, minutes and seconds since power on, or reset.
11) Time to waypoint. Operator set countdown timer in hours, minutes, and seconds. Arrival noted by flashing annunciator.

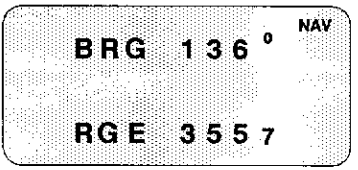
DEFINING A COURSE

Defining a course, refers to assigning FROM (Departure) and TO (Destination) waypoints. You may establish TO or FROM waypoints in WPT (see page E-1), TRIP (see page C-1), POS (see page D-8), or INFO Mode (see page F-1). The TO and FROM waypoints may be in different Regions. Course information is determined by comparing your present position to the defined course. This information is then displayed in NAV Mode. A course may be altered by changing the TO waypoint, FROM waypoint, or both. The TO and FROM waypoints may be entered in any order. When FRM or TO are pressed the display will immediately switch to NAV Mode. In TRIP Mode, you may enter a group of 10 TO and FROM waypoints.

NAV DISPLAYS

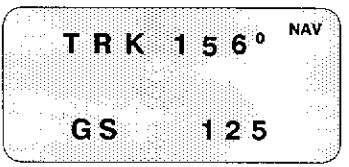
The following illustrations are examples of typical displays seen in the NAV Mode. In this case the LIST knob is turned clockwise, However, you may turn the LIST knob either way. Auto-Nav will rotate through as many as nine displays.

(1) Bearing and Range to the Destination waypoint from your present position.



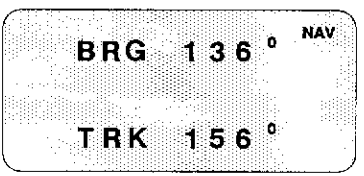
----------Turn LIST ----------

(2) Track (direction of travel) and Ground Speed.



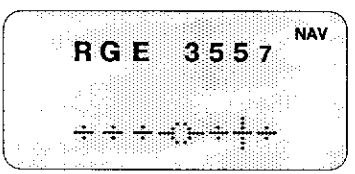
----------Turn LIST ----------

(3) Bearing to the Destination waypoint from your present position and Track (direction of travel).



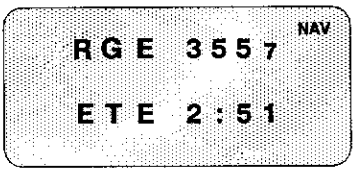
----------Turn LIST ----------

(4) Range (RGE) to the destination and the Cross Track Distance (XTD). RGE is shown numerically and XTD by a bar graph. With the XTD sensitivity set to 0.10 nm per dot, you must turn 1.3 nm to the right to return to your original "fly to" indicator. There are five columns of dots in each bar, or in this case 13 dot columns making two full and one partial bar.



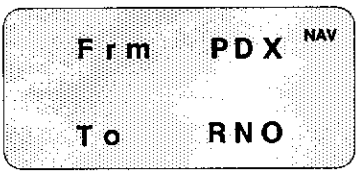
---------- Turn LIST ----------

(5) Range and Estimated Time Enroute to Destination waypoint from your present position.



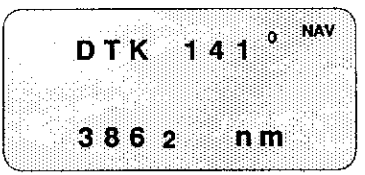
---------- Turn LIST ----------

(6) The waypoint identifiers for the Departure (FROM) and Destination (TO) waypoints are shown. Auto-Nav. This course may be set separately from your flight plan. Auto-Nav.



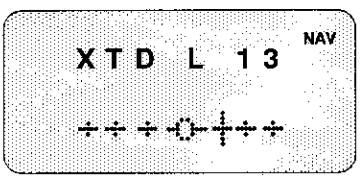
---------- Turn LIST ----------

(7) Desired Track (DTK) and the Distance between the Departure and Destination waypoints.



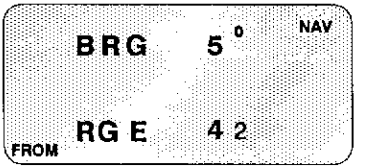
----------Turn LIST----------

(8) The numeric distance and position (L or R) of desired course, along, with the XTD bar graph are shown.



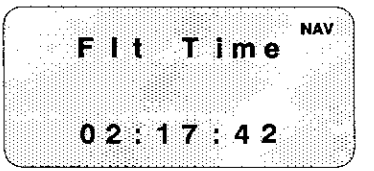
---------- Turn LIST ----------

(9) Bearing and Range FROM your present position to the Departure (Origin) waypoint.



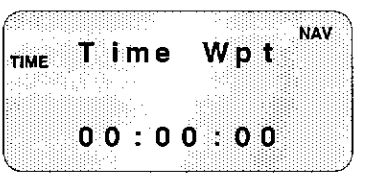
---------- Turn LIST ----------

(10) Flight Time since the Model 604 was turned on or reset. Auto-Nav will not select this page.



---------- Turn LIST ----------

(11) Time to a waypoint in Hours, Minutes, and seconds. Time annunciator is illuminated only when the timer reaches zero. Auto-Nav will not select this page,

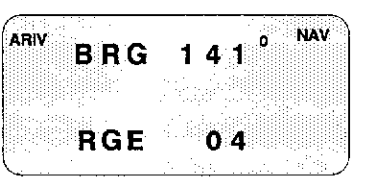


---------- Turn LIST ----------

Turn the LIST knob to return to the beginning of the NAV displays.

WAYPOINT ARRIVAL

When you are within one nautical mile of the destination waypoint for each 100 kts of ground speed, the ARIV indicator will light(i.e. ARIV will light when you are within 2 nm of the destination when you are traveling at 200 kts or 3 nm for 300 kts).

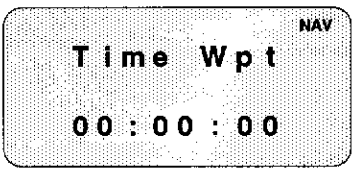


Note: You do not need to be in NAV Mode for ARIV indicator to light.

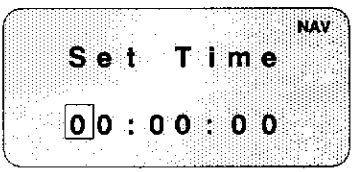
SETTING THE TIME-TO-WAYPOINT ALARM

The APOLLO® Model 604 allows you to set a "countdown" timer for a period of time to trigger an alarm. You set the time in hours, minutes, and seconds from the moment the Time To Waypoint Alert function is activated. When that time elapses, the "TIME" annunciator on the left side of the front panel will flash until acknowledged ("Ack") by the pilot pressing the ENT button in NAV Mode. Cancelling the alarm will suspend the timer and hold the remaining time shown. Activating the alarm will continue countdown timing from the value shown.

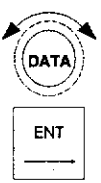
1) Press MODE to reach NAV Mode and turn the LIST knob to show the "Time Wpt" display.

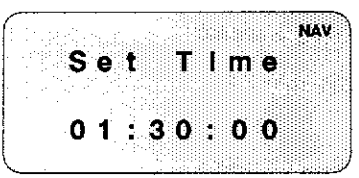


2) Press SEL to enable the hours digits for selection. The hours digits will flash.



3) Turn the DATA knob to the value you want and press ENT. The next digits will flash. Continue for the minutes and seconds values desired.

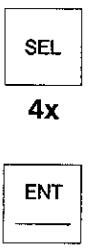


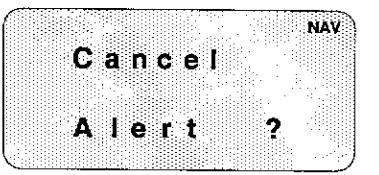


4) Press ENT to activate the timer.

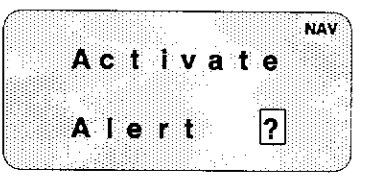
5) When the time waypoint is reached the"TIME" annunciator will flash. The annunciator is turned off by acknowledging the alarm. Press ENT in NAV Mode.

6) If you want to cancel a timing operation in progress press SEL (4x). "Cancel Alert ?" will be displayed. Press ENT to cancel the countdown timing in progress. Reactivating the alarm will start the count where it was stopped.





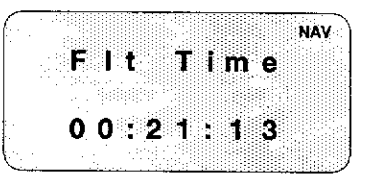
7) When either the "Cancel Alert ?" or "Activate Alert ?" page is displayed, turning the DATA knob will display the other choice.



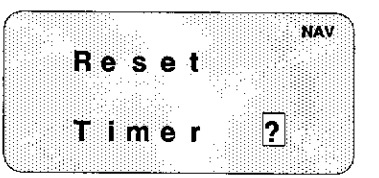
RESETTING THE FLIGHT TIME

The APOLLO® Model 604 keeps track of the time elapsed from when the unit was turned on or last reset. You may reset the timer while viewing the "Flt Time" display.

1) Press MODE to reach NAV Mode.



2) Now, press SEL. The Model 604 will ask if you want to reset the timer. If you do, press ENT. When reset the Flt Time will restart from zero time.



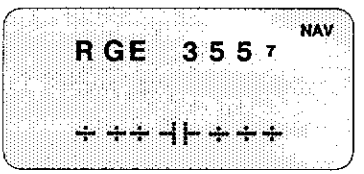
CROSS TRACK DISTANCE (XTD)

When a course to fly has been defined by choosing TO and FROM waypoints, the APOLLO® Model 604 internally draws a course line between the two points. The Cross Track Distance (XTD) display provides a graphic indication of whether you are on or off course, and if you are off course, which direction to turn to return on course, by flying towards the long vertical bar. There are two XTD displays: one shows the Range to the destination and the graphic XTD, the second shows the direction and distance off-course along with the graphic XTD. Your external CDI will show the same resolution (0.4 to 40 nm full scale)as you have set for your 604 internal XTD display (Software Version 1.3 or later).

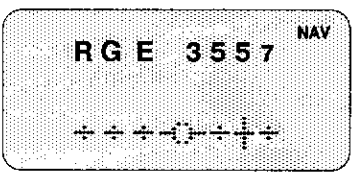
The XTD display represents the aircraft's position relative to the selected course by a moving vertical bar against a horizontal bar graph. The vertical bar will be aligned with the center bar when the aircraft is on-course. When the aircraft is off course, the bar will move to either side of the center bar. This indicates the direction you must turn to return on course. If the bar is to the right of center, then the aircraft must fly to the right. The dots in the horizontal graph represent the distance selected for the XTD sensitivity in SETUP Mode (page G-5). Each bar segment has five dots arranged horizontally in each display segment. A short vertical bar is centered in each display segment. For instance, if you are off course 1.3 nm to the left and the XTD Sensitivity is set at 0.1 nm, the XTD display will show the tall vertical aircraft indicator bar positioned on the 13th dot to the right (the direction to turn) of the center.

Examples of Cross Track Distance displays are given below.

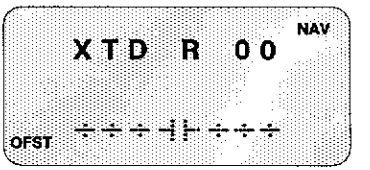
The display indicates that you are on course. The Range (RGE) to your current destination is also shown.



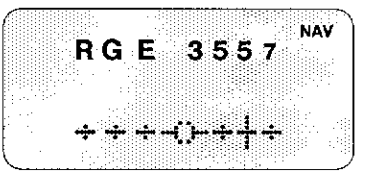
The bar graph display indicates that you are off course (to the left of the DTK by 1.3 nm with the sensitivity set to 0.10 nm). Turn right. The Range (RGE) to your current destination is also shown.



The display indicates that you are on course.



The bar graph display indicates that you are off-course (to the left of the DTK by 1.3 nm with the sensitivity set to 0.10 nm). Turn right.



NAVIGATION (NAV) MODE INFORMATION

When a course to fly has been defined, press MODE to enter NAV Mode. NAV information is referenced to your present position. The following information will be displayed by turning the LIST knob.

BRG: Displays bearing to your destination in degrees from 0 to 359.

RGE: Displays the range to your destination in nautical miles.

TRK: Displays Track Angle in degrees from 0 to 359. This display shows the actual direction of travel for your aircraft. If you are on course the TRK and Bearing (and DTK)displays will be the same value.

GS: Displays Ground Speed in Knots and represents your actual speed over the ground.

ETE: Represents the Estimated Time Enroute to reach your destination (in hours and minutes).

XTD: The Cross Track Distance display is a visual indication of which direction to turn to stay (or return) to the course line (DTK) between the FROM and TO waypoints. The sensitivity is selectable as described in the SETUP Mode section (page G-13). There are two XTD displays: one shows the Range to the destination and the graphic XTD, the second shows the direction and distance off-course along with the graphic XTD.

BRG: (FROM) Displays bearing from your present position to the point of origin in degrees from 0 to 359.

RGE: (FROM) Displays the range from your present position to the point of origin in nautical miles.

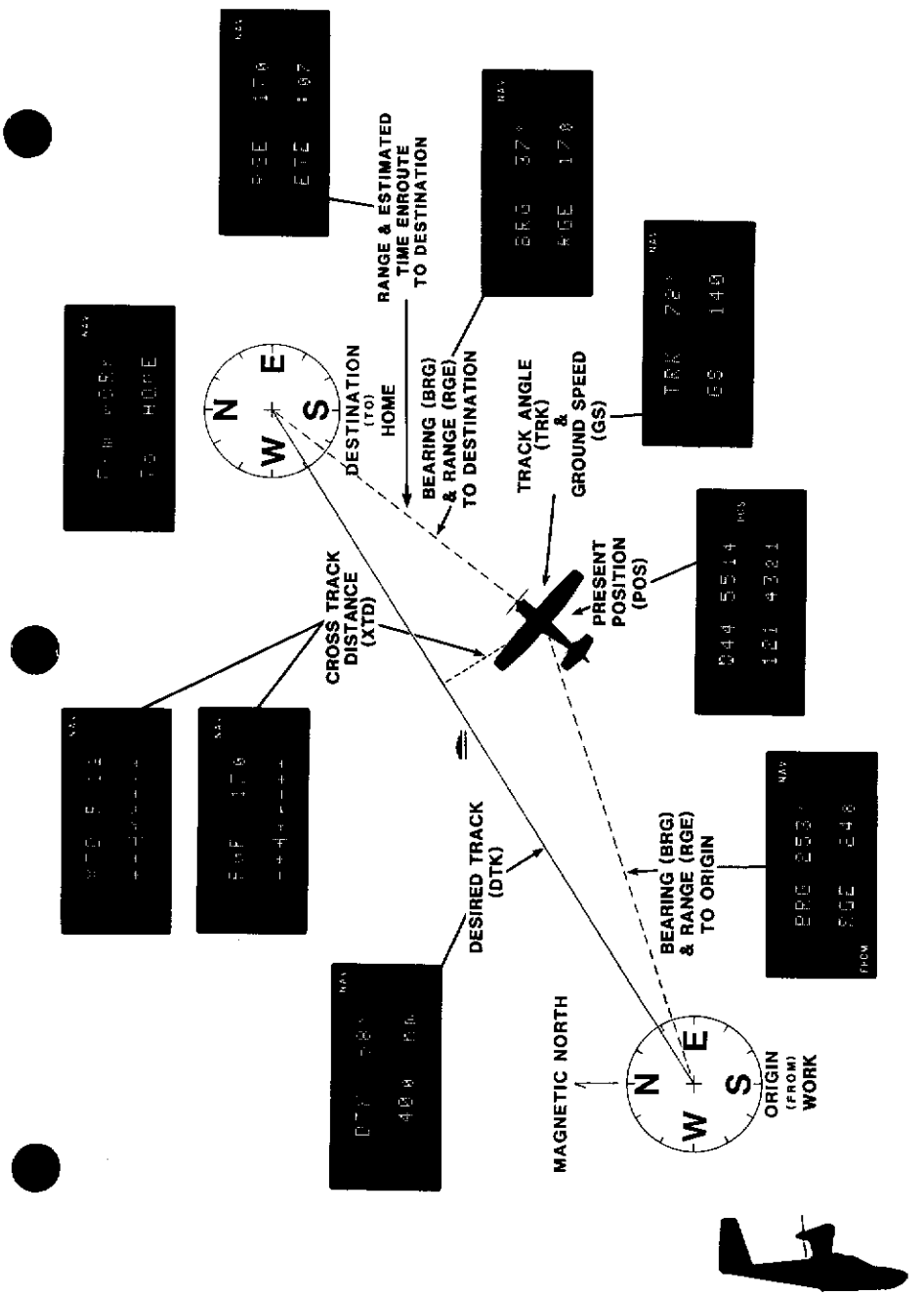
DTK: Displays the Desired Track between waypoints.

Distance (nm): Displays the distance between waypoints in nautical miles (nm).

Flight Time: Displays elapsed time since the unit was turned on. This is a count-up timer.

Time Wpt: Displays the time to reach a waypoint in time and flashes the TIME annunciator when the time-waypoint is reached. This is a count-down timer.

NAVIGATION MODE INFORMATION



SECTION C

TRIP MODE

TRIP MODE

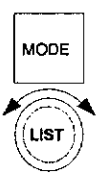
The TRIP Mode allows you to program and then navigate along a course that includes up to 10 waypoints. When your TRIP is activated, your APOLLO® Model 604 will then automatically sequence to the next leg of your flight plan as you reach the end of each leg. Your TRIP will be held in memory until you change it. The TRIP Mode operation is separate from a course you may have set in WPT, POS, or INFO Modes.

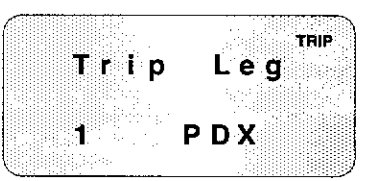
Each of the TRIP waypoints is chosen (Retrieved) from the Waypoint Mode regions and then inserted into the desired position in the TRIP. You may add, delete, or move your TRIP waypoints to customize the plan to your needs. A waypoint is always inserted in front of the displayed Trip Leg.

There are five basic pages in the TRIP Mode: the TRIP Leg display, Waypoint Retrieval, Trip Status, Trip Length, and Erase Plan. The TRIP Leg display will show the identifiers of each of the waypoints stored in the TRIP. Each of the waypoints for the TRIP Legs are displayed by turning the DATA knob. In the Waypoint Retrieval page you select a waypoint by its identifier. The waypoint retrieved is then used for editing the TRIP. The Trip Status pages allow you to Activate, Suspend, Reverse, or cancel the operation your flight plan in TRIP Mode. The Trip Length page shows the number of legs and the total distance of your flight plan. Activating the Erase Plan page will remove all of the trip legs.

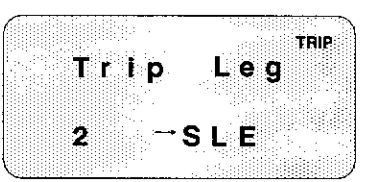
VIEWING YOUR TRIP

1. Press MODE to reach TRIP Mode. Now turn the LIST knob until "Trip Leg" is displayed.

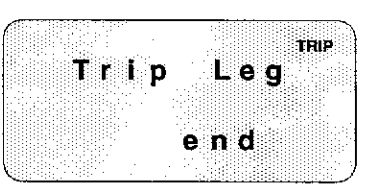




2. Turn the DATA knob clockwise (cw) to view each of the waypoints in the TRIP in order. A pointer will indicate your current Trip Leg.



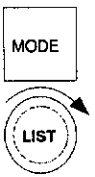
3. Continue to turn the DATA knob until you reach the end of your trip.

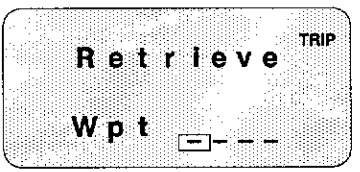


RETRIEVING A WAYPOINT

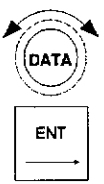
The Model 604 will retrieve any waypoint that is in Waypoint Mode. You can then insert the retrieved waypoint into a Trip Leg of your flight plan. Retrieving or deleting a waypoint stores it in a buffer (a kind of note pad). The last waypoint retrieved or deleted stays in the buffer until it is replaced by another waypoint by retrieving or deleting. You can now insert the contents of the buffer anywhere in your TRIP and as many times as you wish by pressing ENT. When the Wpt is found, you may also set it as a departure or destination waypoint of a single leg course separate from the TRIP Mode flight plan by pressing TO or FRM. If the retrieved waypoint is used for one circumstance, you must use search to use it again.

1. Press MODE to reach TRIP Mode. Turn the LIST knob one position cw to reach the "Retrieve Wpt" display. The first of the four spaces for the waypoint identifier will flash.





2. Turn the DATA knob to display the first character of the waypoint identifier and then press ENT. Repeat for the needed characters.



3. When the three or four characters of the waypoint are displayed, pressing ENT the last time will cause the unit to search the FLYBRARY® and USER waypoints for the displayed identifier.

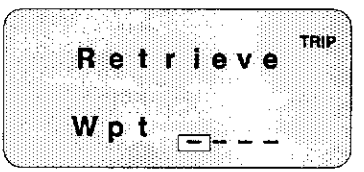
4. If the waypoint is found, turn the LIST knob ccw to reach the TRIP Leg display to add this waypoint in the required location. Repeat for each leg.

SETTING UP A TRIP

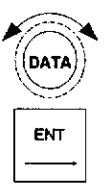
The Model 604 makes flight planning simple with the TRIP Mode. You retrieve each of the waypoints in your flight plan and insert them as Trip Legs in the order that you wish to travel. As an example, let's set up a flight plan with seven legs from Portland, Oregon (PDX) to Los Angeles, California (LAX). Our trip will go in the following order:
(1) PDX, (2) SLE, (3) LKV, (4) RNO, (5) SFO, (6) FAT, (7) LAX.

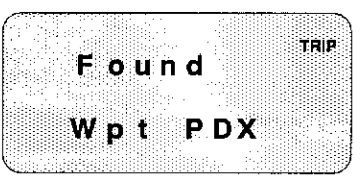
BEFORE PROCEEDING, ERASE PREVIOUS FLIGHT PLAN

1. Press MODE to reach TRIP Mode. Turn the LIST knob one position clockwise (cw) to reach the "Retrieve Wpt" display. The first of the four spaces for the waypoint identifier will flash.

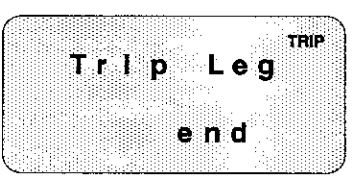


2. Turn the DATA knob to display "P" and then press ENT. Continue to enter "D" and "X." Press once more to pass over the fourth, blank space. The display will read "Found Wpt PDX" after searching the data base. "PDX" is now loaded into the buffer.

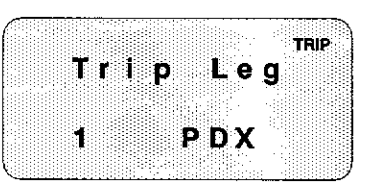




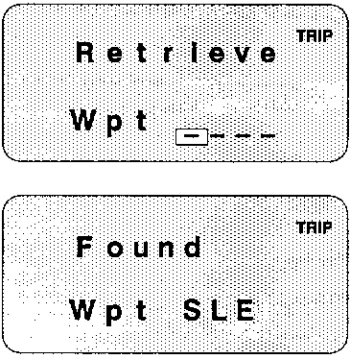
3. Now, turn the LIST knob counterclockwise (ccw) one position. "Trip Leg end" is displayed.



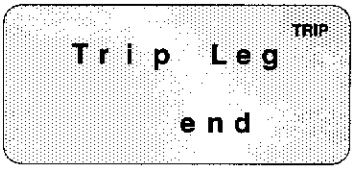
4. Press ENT. PDX is now entered as Trip Leg 1, your initial departure waypoint.



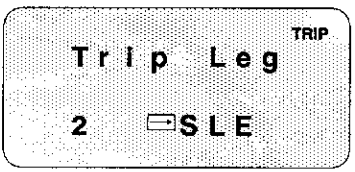
5. Turn the LIST knob one position cw to reach the "Retrieve Wpt" display. Press SEL. Turn the DATA knob to reach "S" and then press ENT. Enter "L" and "E", then press ENT one more time to retrieve SLE."



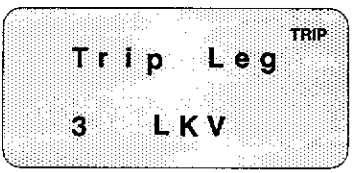
6. Now, turn the LIST knob counterclockwise (ccw) one position. "Trip Leg 1 PDX" is displayed. Turn the DATA knob cw one position so "Trip Leg end" is displayed.



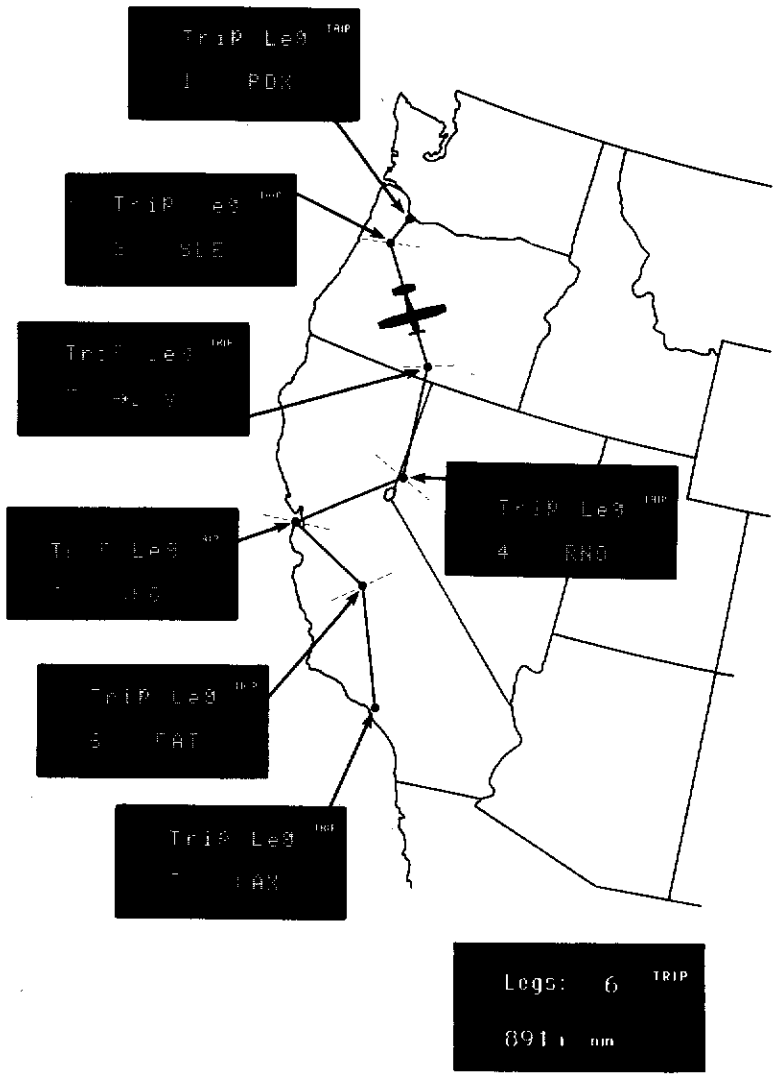
7. Press ENT. SLE is now entered as Trip Leg 2 and has been placed in front of "Trip End."



8. Continue to Retrieve and enter the other five waypoints into the Trip Legs.



TRIP NAVIGATION

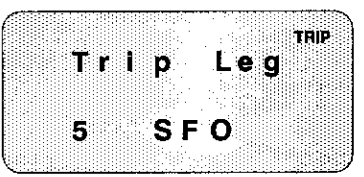


EDITING THE TRIP

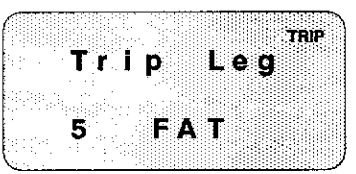
The Model 604 allows you to easily edit the waypoints in the TRIP to quickly modify it. You may add, delete, or move the waypoints to quickly create the TRIP for your needs. "Retrieving A Waypoint" showed you how to add a waypoint to the TRIP. You can delete a waypoint by dialing to it with the DATA knob and then pressing the DEL button. Retrieving or deleting a waypoint stores it in a buffer (a kind of note pad). The last waypoint retrieved or deleted stays in the buffer until it is replaced by another waypoint by retrieving or deleting. You can now insert the contents of the buffer anywhere in your TRIP by pressing ENT. The waypoint will be entered in front (or before) the TRIP waypoint displayed. A TRIP waypoint may be removed by pressing the DEL button when that waypoint is displayed. Pressing ENT will insert the waypoint. Any change to a TRIP that has been activated will cause the TRIP to resequence. The current leg being used will remain intact.

As an example let's move a Trip Leg in the flight plan that was just entered. We will move SFO from waypoint 5 to waypoint 4, in front of RNO. RNO will then become waypoint 5.

1. Turn the DATA knob to Trip Leg 5, SFO.

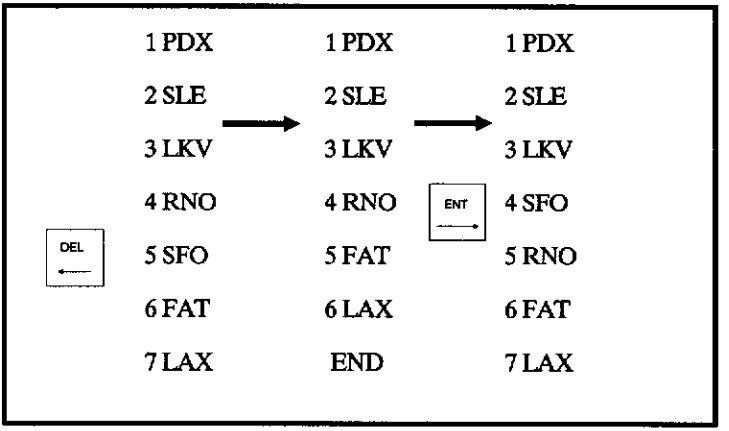


2. Press DEL. FAT now moves up one position and will be shown as Trip Leg 5. SFO is now loaded into the buffer.



3. Turn the DATA knob ccw to Trip Leg 4, RNO.

4. Press ENT. SFO has now replaced RNO as Trip Leg 4. RNO is now Trip Leg 5.

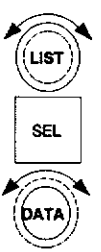


TRIP STATUS

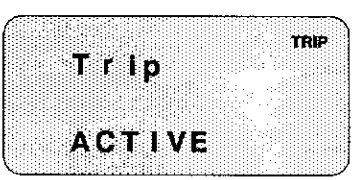
You control the status of your flight plan in the TRIP Mode with the Trip Status pages. You can "Activate", "Suspend", "Reverse", or "Cancel" a trip. If the TRIP is cancelled, the current leg in use will remain intact. You can view the choices available for Trip Status by turning to this page with the LIST knob, press SEL, then turn the DATA knob and press ENT.

ACTIVATE PLAN

1. In the TRIP Mode turn the LIST knob to reach the Trip Status page. Press SEL and turn the DATA knob, if required, so "Trip Inactive" is shown.



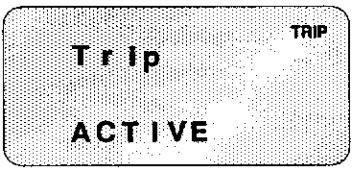
2. Press SEL. The unit will ask if you want to activate your flight plan. Press ENT for "Yes." After you press ENT the unit will go to NAV Mode and display the BRG- RGE page.



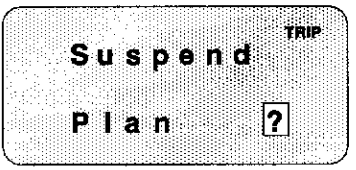
SUSPEND PLAN

Suspending your flight plan will temporarily place it on hold.

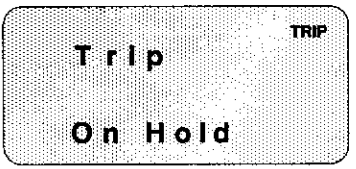
1. In the TRIP Mode turn the LIST knob to reach the Trip Status page. In this case "Trip Active" is shown.



2. Press SEL and turn the DATA knob, if required, to reach the "Suspend Plan?" page. The unit will ask if you want to suspend your flight plan. Press ENT for "Yes."



3. After you press ENT the flight plan will be placed on hold.



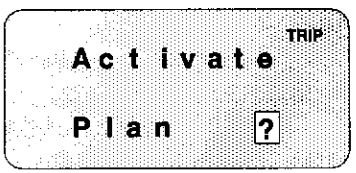
4. You can restart your flight plan by:

   a) Press SEL.

   b) Turning the DATA knob two clicks right to the "Activate Plan" display.

   c) Then press ENT.

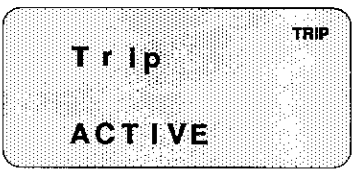
   d) The unit will now switch to NAV Mode.



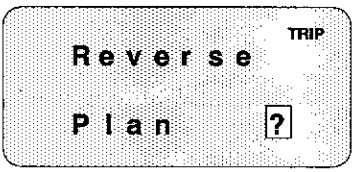
REVERSING THE FLIGHT PLAN

You can retrace your trip easily by reversing the flight plan with the Trip Status pages. When a trip is reversed the Trip Status is set to "Inactive."

1. In the TRIP Mode turn the LIST knob to reach the Trip Status page. In this case "Trip Active" is shown.



2. Press SEL and turn the DATA knob, if required, to reach the "Reverse Plan?" page. The unit will ask if you want to reverse your flight plan. Press ENT for "Yes." After you press ENT the flight plan will be reversed. To activate your newly reversed flight plan, press SEL and ENT.

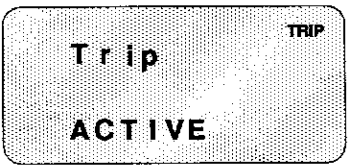


1 - PDX	1 - LAX
2 - SLE	2 - FAT
3 - LKV	3 - SFO
REVERSE →	
4 - RNO	4 - RNO
5 - SFO	5 - LKV
6 - FAT	6 - SLE
7 - LAX	7 - PDX

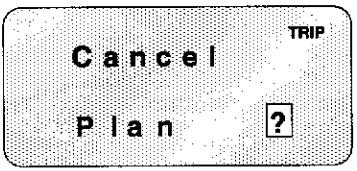
CANCEL PLAN

An active flight plan in Trip Mode can be cancelled. The current Trip Leg will remain active. When a flight plan is cancelled the Trip Status will read "Inactive."

1. In the TRIP Mode turn the LIST knob to reach the Trip Status page. In this case "Trip Active" is shown.



2. Press SEL and turn the DATA knob, if required, to reach the "Cancel Plan?" page. The unit will ask if you want to cancel your flight plan. Press ENT for "Yes."



3.
After you press ENT the flight plan will be cancelled. You can restart your flight plan by turning the DATA knob to the "Activate Plan" display and pressing ENT.

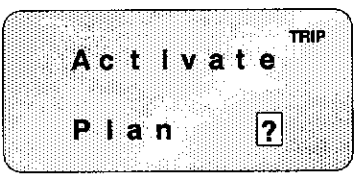
4. You can restart your flight plan by:

   a) Press SEL.

   b) The "Activate Plan" display will flash.

   c) Then press ENT.

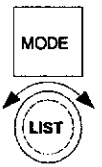
   d) The unit will now switch to NAV Mode.

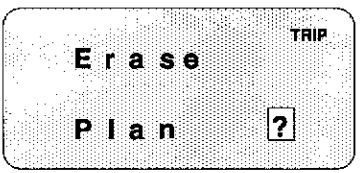


ERASE PLAN

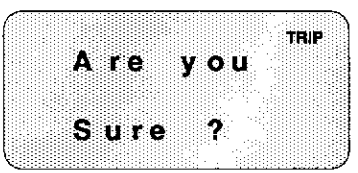
This page in the TRIP Mode allows you to totally erase the contents of the Trip Legs. You cannot recover a flight plan that has been erased except by individually reentering each Trip Leg, so be sure before erasing a plan that this is what you want to do.

1) Press MODE to reach TRIP Mode. Turn the LIST knob to the "Erase Plan?" page.

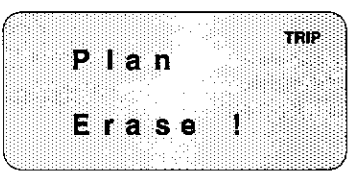




2) Press ENT if you want to erase the current contents of the Trip Legs. Your Model 604 will ask you to verify that this is what you want to do.



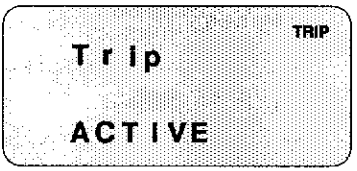
3) If you want to erase the Trip Legs, press ENT for a "YES" response. All Trip Legs will now be erased. Using any other button or knob is equivalent to a "NO" response.



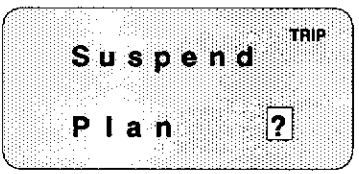
FORCING TRIP LEG SEQUENCING

You may bypass intermediate Trip Legs and force the unit to navigate along a later leg of your flight plan. Trip leg sequencing is forced by: 1) suspend the flight plan, 2) moving the pointer that indicates the current destination waypoint to your new intended destination, 3) and then reactivating the flight plan.

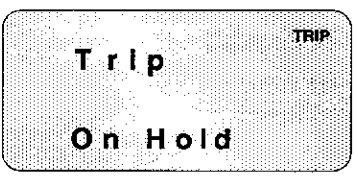
1) Press MODE to reach TRIP Mode and then turn the LIST knob two positions cw to the Trip Status page.



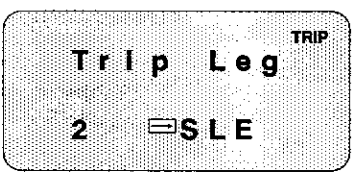
2) Press SEL to enable selection of your Trip Status. Turn the DATA knob, if required, to display "Suspend Plan?".



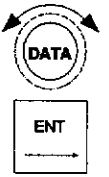
3) Press ENT to suspend the flight plan and place it on hold.

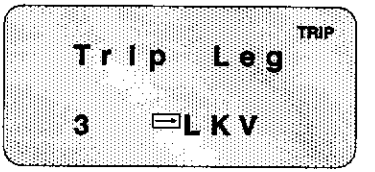


4) Turn the LIST knob two positions ccw to the Trip Leg display. Now, turn the DATA knob to the leg with the pointer. Now, press SEL. The pointer will flash.

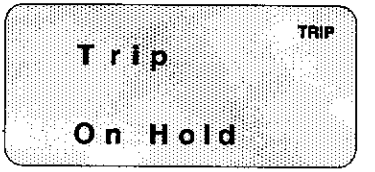


5) Now turn the DATA knob to display the new destination waypoint. Press ENT. This is your new destination.



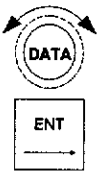


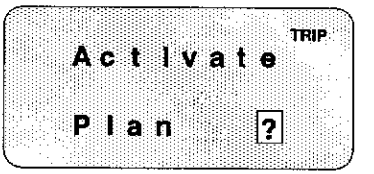
6) Turn the LIST knob to the Trip Status page, 2 clicks cw.



7) Now press SEL.

8) Now turn the DATA knob to Activate Plan. Now press ENT.



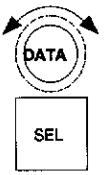


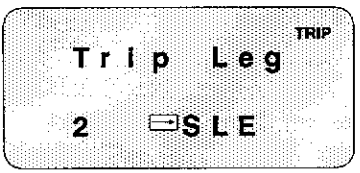
9) The unit will switch to NAV Mode.

TRIP LEG ADJUSTMENT

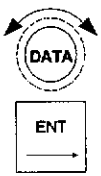
You may bypass intermediate waypoints and force the unit to navigate direct from your present position towards a later waypoint in your flight plan. Move the pointer that indicates the current destination waypoint to your new intended destination.

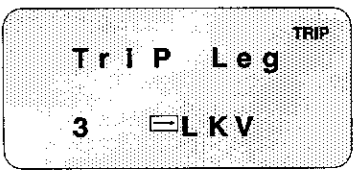
1. In the Trip Leg display turn the DATA knob to the leg with the pointer. Now, press SEL. The pointer will flash.



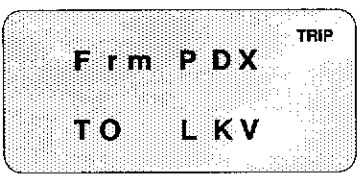


3. Now turn the DATA knob to display the new destination waypoint. Press ENT.





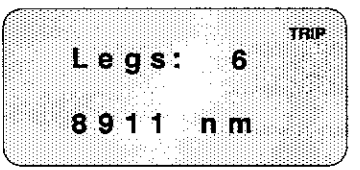
4. This is your new destination. The unit will switch to NAV Mode and show the current leg



TRIP LENGTH

The Trip Length page shows you the number of legs in your flight plan and its total length. A trip leg is the course between two waypoints, such as between PDX and SLE. So, if there are no waypoints or only one waypoint entered into the Trip Leg pages the number of legs and distance will read as "0".

1) Press MODE to reach TRIP Mode and then turn the LIST knob to the Trip Length page. The values are for the example flight plan that is entered in this section. So, there are six trip legs between the seven waypoints and the total distance is 891.1 nm.



ONE-LEG FLIGHT PLANS

Flight Plans that contain only one-leg (two waypoints) are a special case. While you may navigate using the single leg as you normally would, and your NAV Mode information will be current, the Trip Status page of TRIP Mode will state "Trip Inactive." This is because an active flight plan implies that waypoint sequencing will take place. As no waypoint sequencing may take place in a one-leg course, a flight plan may not be "active."

SECTION D

POSITION MODE

POSITION (POS) MODE

The POS Mode is used to display your current LAT/LON coordinates, display the Special Use Airspace Warning, and check your closest waypoint. In POS Mode you may also navigate from your present position or select the alternate LAT/LON position solution. The Special Use Airspace Warning will alert you to the five closest Prohibited, Restricted, TCAs, MOAs, ARSAs, TRSAs, Alert areas, Canadian CYA, CYD, CYR, and Class C Control Zones. You can check the Range and Bearing to the nearest five FLYBRARY® airports or USER region waypoints, or the Radial and Distance to the nearest five VORs.

POS MODE DISPLAY

Press MODE to reach POS Mode whenever it is desired to view present position coordinates. The POS indicator will appear on the right side of the display. The Latitude is in the upper display and the Longitude is in the lower display.

SPECIAL USE AIRSPACE WARNING

The Special Use Airspace Warning feature will display information on the nearest five areas and alert you prior to entry. The warning alert distance is user-selectable from 0 to 99 miles. Special Use Airspace is activated and the warning time is set in SETUP Mode. Information provided includes: Bearing and Range to each airspace, the name, identification and type with appropriate controlling agency's frequencies, the controlling agency, low and high altitude limits for each area, and the relative bearing indication to the nearest airspace boundary.

AIRSPACE WARNING

WARN
* Area 1
90 ° 10 0 POS

WARN
Hi Alt 1 POS
4200 ft

WARN
* Area 1
IN ← POS

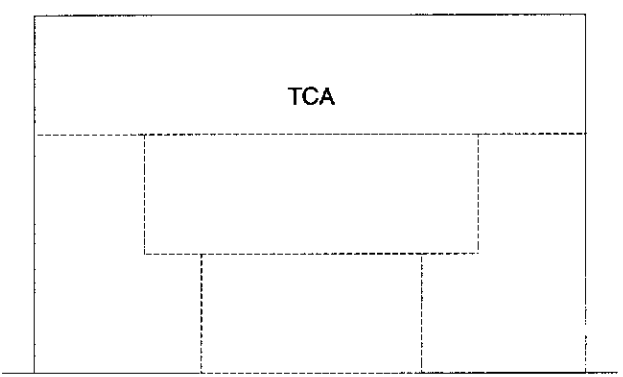
WARN
Freq 1 POS
127 15

WARN
* Area 1 POS
Monterey

WARN
Agency 1 POS
APP CON

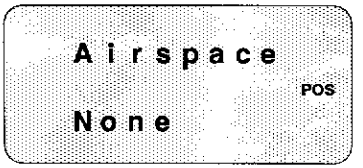
WARN
Lo Alt 1 POS
SFC

The Apollo® 604 recognizes the outer, lower, and upper limits of Special Use Airspace. It does not recognize the internal segments (dashed lines).

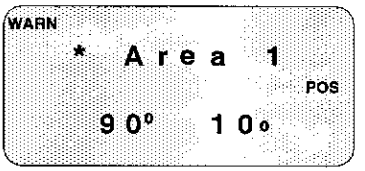


SIDE VIEW

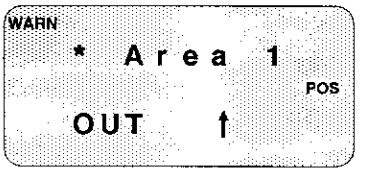
1 Press the MODE button to reach POS Mode. Turn the LIST knob one position cw to display the status of the Special Use Airspace Warning feature.



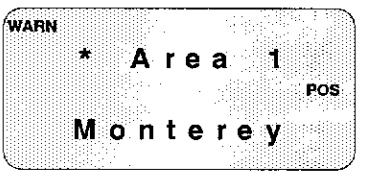
2. The Area number, Range, and Bearing are displayed if Special use Airspace has been detected.



3. Turn the DATA knob one position cw to view the relative bearing.

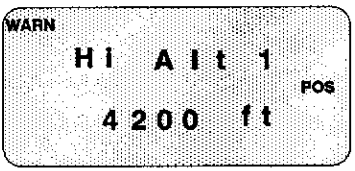


4. Turn the DATA knob one position cw to view the Name of the Special Airspace.

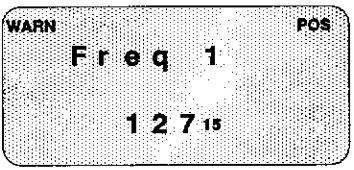


5. Turn the DATA knob one position cw to view the Low Altitude of the airspace.

6. Turn the DATA knob one position cw to view the Hi Altitude of the nearest block of the airspace.

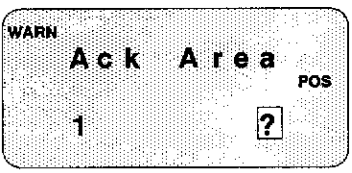


7. Turn the DATA knob one position cw to view the appropriate controlling agency's frequencies (up to 8).



8. Turn the DATA knob one position cw to view the Agency Name to contact.

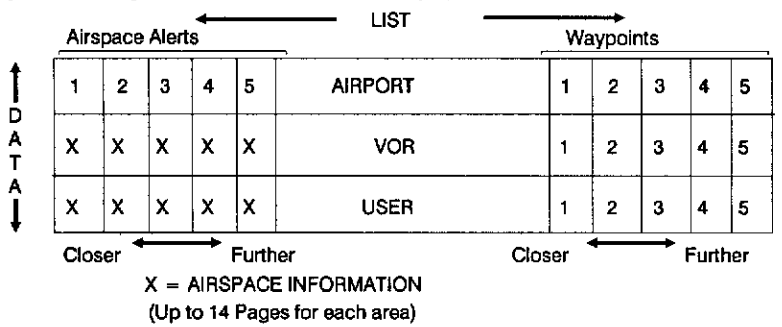
9. Turn the DATA knob one position cw to view the Acknowledge display. Press ENT to disable the warning indication. If all areas have been acknowledged then the WARN and POS annunciators will quit flashing and the asterisk will disappear from the Area number).

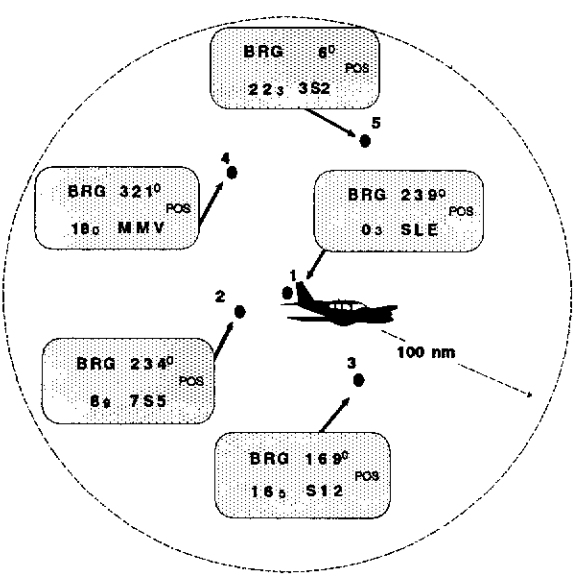


AUTOMATIC WAYPOINT REFERENCE (AUTO-TRACK)

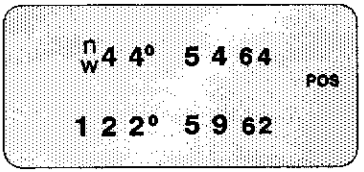
The APOLLO® 604 automatically keeps track of the nearest five waypoints in three categories: FLYBRARY® airports, VORs, and USER waypoints. This gives you a potential total of 15 waypoints to reference your position or in navigating instantly to an alternate waypoint. These waypoints must be within 100 nm of your position to be listed. Dashes will replace the waypoint name if less than five waypoints are available. While viewing any of these waypoints, you may directly reach INFO Mode to get the information for the waypoint displayed. While in POS Mode, turn the LIST knob to view the Special Use Airspace (Page D-3) and waypoint positions one through five. Use the DATA knob to display the Airport, VOR, and USER wpts for each position. When the desired wpt is displayed, press SEL, then press ENT. The unit will then automatically switch to INFO Mode. Information about the selected wpt can then be viewed by turning the DATA knob.

Remember: the WARN light must be out for this feature to work. If the Warn light is on, "Wpts NOT Reliable" will be displayed.

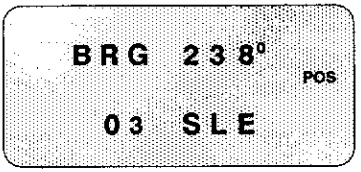




1) Press MODE to reach POS Mode. Your Present Position coordinates are displayed.

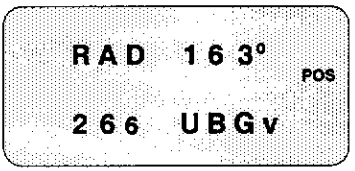


2) Turn the LIST knob clockwise (cw) until the nearest airport in the FLYBRARY® will is displayed. The Bearing, Range, and airport designator will be displayed.

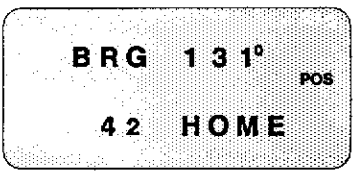


3)Turn the LIST knob (cw) to view the next four nearest FLYBRARY® airports. The second airport is farther away than the first, and the third (cw) is farther away than the second, etc.

4) Turn the DATA knob one position clockwise (cw). The nearest VOR will be displayed. The Radial, Distance, and VOR name will be shown. Turning the LIST knob will show the next four closest VORs.



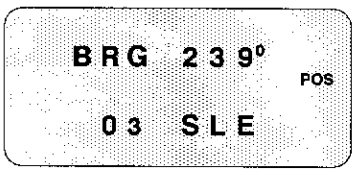
5) Turn the DATA knob one position clockwise (cw). The nearest waypoint in the USER waypoint region will be displayed. Turn the LIST knob to view the other four nearest USER region waypoints.



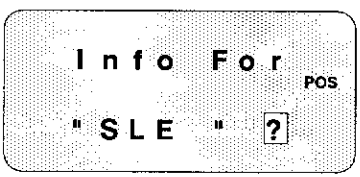
INFORMATION FOR NEAREST WAYPOINTS

The APOLLO® 604 allows you to quickly find information in the FLYBRARY® about any of the nearest waypoints that are viewed while in POS Mode.

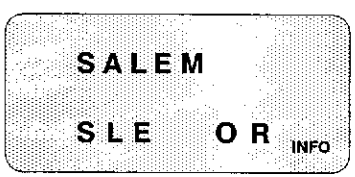
1) Press MODE to reach POS Mode. Turn the LIST and/or DATA knobs to reach the waypoint of interest.



2) Press SEL. The unit will ask if you want information for that waypoint. Press ENT for "yes.



3) The unit will switch directly to the waypoint of interest in INFO Mode. Turn the DATA knob to view the information. See page F-2 for a detailed description of INFO Mode.



NAVIGATION FROM PRESENT POSITION

The APOLLO© 604 allows the user to navigate from your present position. Pressing the TO or FRM push buttons while in POS Mode will reference the NAV displays to your present position and store your present position in the USER waypoint library as waypoints PPTO or PPFR. PPFR may only be created from the POS Mode Lat/Lon display.

When FRM is pressed in POS Mode, the present position at the time the FRM button was pressed is entered as the origin waypoint (the destination waypoint will remain the same). This function is useful for creating a new course (DTK) from your present position.

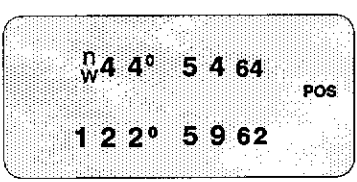
When TO is pressed in POS Mode, the position displayed at the time the TO button was pressed, is entered as the destination waypoint.

The present position coordinates are stored in the USER region of the FLYBRARY®. These coordinates are named as PPTO (Present Position TO) or PPFR (Present Position FROM) depending on whether TO or FRM was selected. The stored present waypoints are located between waypoints 99** and 00** in the USER waypoint Region. You may rotate the LIST knob counter-clockwise to reach these waypoints from 00**.

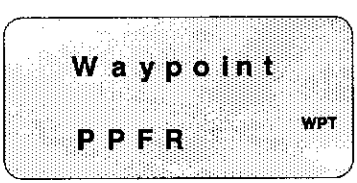
Note:

Trip mode flight plan is unaffected, but the To and From waypoints in NAV mode will be changed.

1) Press MODE to reach POS Mode. Press either TO or FRM. NAV Mode is now automatically displayed. Select the desired NAV function by turning the LIST knob. See Page B-1 for NAV Mode information. In this case FRM was used.



2) Press MODE to reach WPT Mode. Select the USER region of WPT Mode (see page E-3). Turn the LIST knob to display the present position waypoint (either PPTO or PPFR). Turn the DATA knob to see the LAT/LON coordinates.

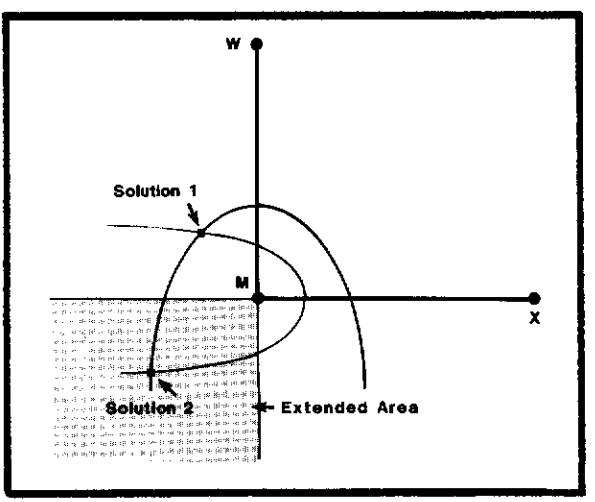


PRIMARY AND ALTERNATE LAT/LON SOLUTIONS

When a LORAN-C receiver calculates its position, two LAT/LON solutions are found: PRIMARY and ALTERNATE. The PRIMARY solution is within the Primary coverage area. The ALTERNATE solution is located outside of the Primary coverage area. For the correct triad, an alternate for one triad may be in primary coverage for another in the same chain. The APOLLO® Model 604 will automatically select the correct solution in LORAN-C chains when three or more secondaries are present.

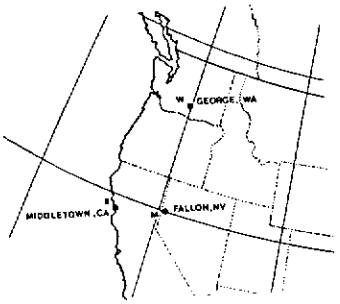
When only two secondary stations are received, you may need to choose between the PRIMARY and the ALTERNATE solution. As an added feature, the APOLLO® Model 604 allows you to select the correct solution based on your knowledge of your location.

The position difference between the PRIMARY and ALTERNATE LAT/LON solution can be several hundred miles. Usually it is obvious which LAT/LON solution to use for navigation. The choice may be more confusing when you are navigating near a Baseline Extension or in the Extended area. The Baseline Extensions and Extended areas are shown on the LORAN-C coverage maps to help you evaluate your position. An explanation of Baseline Extensions and LOPs are provided in the Description of LORAN-C section of this manual.

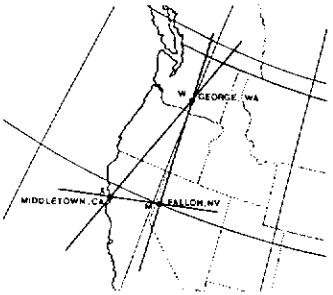


You may use either the LORAN-C coverage maps in this manual or the following procedure to determine the PRIMARY and ALTERNATE solution.

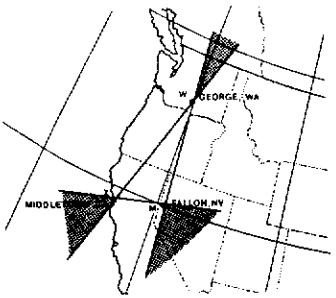
1) Using an actual map or chart, place the triad (Master and the two secondary stations) used in their geographical location.



2) Connect the transmitters by the Baseline and "extend" the lines through each transmitter as shown.



3) Shade in the area between the extensions. This shading shows the EXTENDED areas. The non-shaded portion of the map will use the PRIMARY solution.

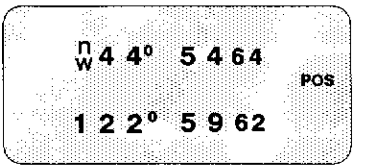


HOW TO DISPLAY THE ALTERNATE SOLUTION

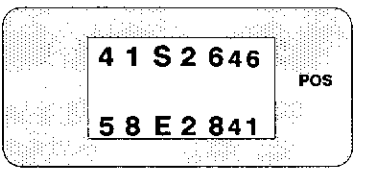
You may only activate the ALTERNATE solution while using Manual Triad Selection. See the Manual Triad Selection section of this manual (See page G-6). Use the LORAN-C coverage maps to determine the best triad for your location. After selecting the proper triad, use the following procedure to navigate by the ALTERNATE LAT/LON solution.

As far as the APOLLO® Model 604 is concerned there are two solutions for your present position: the currently used position and the alternate position. No distinction is made between the primary or alternate LAT/LON solution for navigation purposes. The APOLLO® Model 604 only recognizes the currently used present position for navigation. You must choose the correct solution based on your actual position.

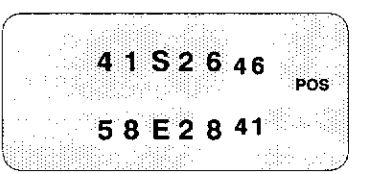
1) Press the MODE button to reach POS Mode. The PRESENT LAT/LON solution is displayed.



2) Press the SEL button to display the ALTERNATE LAT/LON solution. The coordinates will flash. You must have manually selected the current triad in SETUP Mode.(see page G-6).



3) Activate the Alternate solution position by pressing the ENT button. The display will no longer flash. The new position selected is not activated until the ENT button is pressed.



4) You may restore the PRESENT solution by pressing the SEL and ENT buttons again.

NOTE:
Selecting the ALTERNATE solution may cause the APOLLO© Model 604 to automatically sequence to a different leg of a Flight Plan course. So be sure to check your course after selecting the ALTERNATE solution.

SECTION E

WAYPOINT MODE

WAYPOINT (WPT) MODE

The APOLLO® Model 604 provides access to thousands of established waypoints in the CONTINENTAL FLYBRARY® (permanent memory) by LAT/LON coordinates and the official identifier listed in alphabetical order within each region. Within the continental United States, District of Columbia, Alaska, and Canada the CONTINENTAL FLYBRARY® holds the locations of: 1) all federally-designated airports with three or four alpha-numeric character designators, 2) all VORs, 3) one and three character NDBs, and 4) all public use airports. VORs are shown by a lower case "v" after the location identifier. NDBs are shown by a lower case "n" after the location identifier. Note that zeros have a slash through them while the letter "O" does not.

Waypoint memory contains two parts: the CONTINENTAL FLYBRARY® which is divided into 10 Regions and USER memory. These regions are set according to geographic area as shown in the Airport/Facilities Directory. The FLYBRARY® Regions are: EC (East Central), NC (North Central), NE (Northeast), NW (Northwest), SC (South Central), SE (Southeast), SW (Southwest), AK (Alaska), CW (Canada West), and CE (Canada East). The other part of Waypoint memory is the Region called USER which possesses up to 100 user-programmable waypoints for personalized use by the operator plus PPTO (Present Position TO) and PPFR (Present Position From). The FLYBRARY® information cannot be damaged by the user, no matter what buttons are pushed, so don't worry. You can, of course, change the information in the USER waypoints, so a certain amount of care should be taken when using the waypoints that you have created.

The Model 604 allows you to enter and name up to 100 waypoints in the USER region in Waypoint Mode. Waypoints that you enter into the USER Region will be automatically placed in alphabetical order. Each of the USER region waypoints may be created as "Phantom Waypoints" that are located by radial and distance from a Reference Waypoint. PPTO and PPFR are set from POS Mode (see page D-8).

Finding a particular waypoint or group of waypoints is made faster and easier by using the "wild card" function. Press SEL at the waypoint region identifier (NW, NE, etc.), dial in the waypoint name or letters to start with followed by a question mark ("?"), press ENT, and you will start viewing waypoints at that spot.

The TO and FROM function buttons may be used in WPT, TRIP, POS, or INFO Modes to define a course to fly (Desired Track), which will provide the basis for the NAV Mode displays. The procedures for finding your way around the CONTINENTAL FLYBRARY®, waypoint naming and selection are described in the following pages.

CONTINENTAL FLYBRARY® REGIONS

The CONTINENTAL FLYBRARY® geographically covers the continental United States, Alaska, the District of Columbia, and Canada. The CONTINENTAL FLYBRARY® holds the locations of:

1) all federally-designated airports with three or four alpha-numeric character designators.

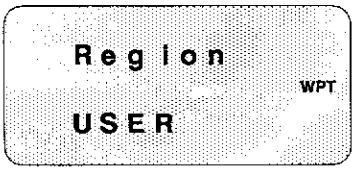
2) all VORs. VORs are denoted by a lower case "v" after the location identifier.

3) all one and three character NDBs. NDBs are denoted by a lower case "n" after the location identifier

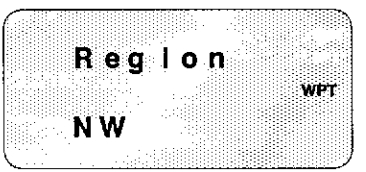
4) all public-use airports.

VIEWING WAYPOINTS IN A REGION

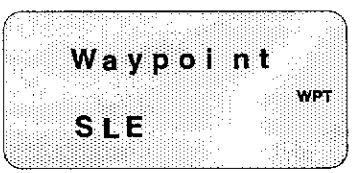
1) Press MODE to reach Waypoint Mode. The WPT indicator will appear on the right side of the display panel.



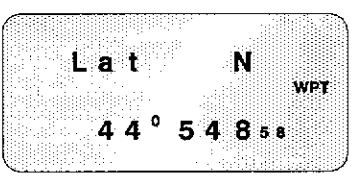
2) Choose the desired Region (USER, EC, NC, NE, NW, SE, SC, etc.) by turning the DATA knob.



3) Now, turn the LIST knob to list the available waypoints by name.

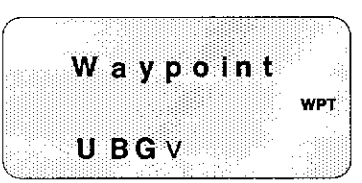


4) Turn the DATA knob clockwise (cw) one position to show the LAT coordinates. Turn the DATA knob cw again to view the LON coordinates.



5) A VOR site will have a lower case "v" after the location identifier.

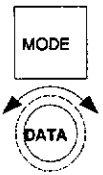
6) An NDB site will have a lower case "n" after the location identifier.

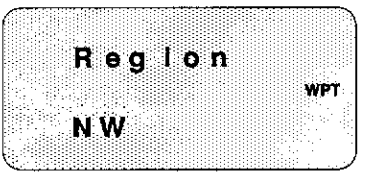


REACHING A STARTING POINT IN A REGION

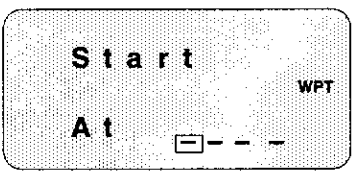
The APOLLO® Model 604 will let you start at any point in a waypoint region. You can start at a certain waypoint identifier by entering that identifier name or you can enter only a portion of a name for a starting point followed by a question mark ("?"). If desired you may start at "S", "S1", etc. The starting point is up to you.

1) Press MODE to reach Waypoint Mode and choose the desired Region (USER, EC, NC, NE, NW, SC, SE, etc.) by turning the DATA knob.

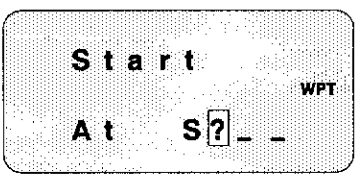




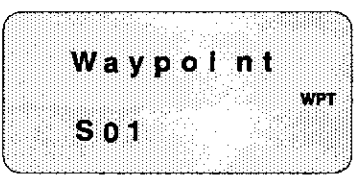
2) Now, press SEL. The display will request a starting point. The starting point may be from 1 to four characters. The first space for the waypoint name will flash. Turn the DATA knob to display the first character of the starting point.



3) Now, press ENT. The next space will flash. Enter the required characters. Then, at the end of the characters that you want to start at select the question mark ("?") and press ENT.



4) The display of the waypoint region will start at the waypoint identifier with the character or combination of characters that you entered. Turn the LIST knob either direction to view available waypoints.



USER DEFINED WAYPOINTS

The APOLLO® Model 604 allows the operator to enter up to 100 waypoints in the USER Region for individualized use. Only numbers and upper case letters may be used in naming a waypoint. Waypoints are entered as LAT/LON coordinates. There are three methods for entering a waypoint into the USER region: automatic direct entry of your present position, manual selection of each value, or creating a Phantom Waypoint. Each waypoint in the USER region may be defined as a Phantom Waypoint. Two additional waypoints in the USER region are called PPTO and PPFR. These are entered into USER waypoint memory by pressing the TO or FROM buttons while viewing the POS Mode present position display and record your Present Position. Only the waypoints you have entered and the next empty spot will be shown so that you do not have to dial through empty waypoint positions.

When you enter each value the correct quadrant indication must be selected and will be displayed with the LAT/LON coordinates. If you use the direct entry method, the correct quadrant is automatically selected. The northwest quadrant will be indicated by an upper case "N" in line with the Latitude coordinate on one page and an upper case "W" in line with the Longitude coordinate on the next page.

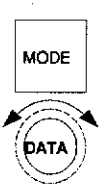
The APOLLO® Model 604 displays LAT/LON coordinates to the hundredth of a minute. Some published references supply LAT/LON coordinates to the tenth of a minute. When using these references, round to nearest tenth of a minute, the hundredth of a minute display to read zero. Some published references list LAT/LON coordinates in Degrees, Minutes, and Seconds. You will need to convert the seconds to hundredths of a minute to enter these coordinates into the APOLLO® Model 604.

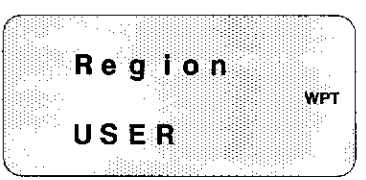
Convert seconds to hundredths of a minute by dividing the seconds by 60.

Example: LAT = N 27^0 31' 43"
43/60 = 0.72
LAT = N 27^0 31.72'

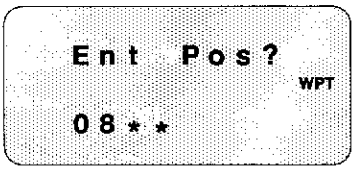
AUTOMATIC DIRECT ENTRY OF YOUR PRESENT POSITION

1) Press MODE to reach WPT Mode. The last Region viewed will be displayed. Now turn the DATA knob to reach the USER Region.

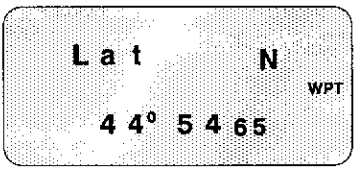




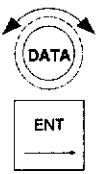
2) Turn the LIST knob to the desired waypoint number. Press SEL. "ENT POS?" will appear in the display and "ENT" will flash. Press ENT to enter your present position coordinates or press SEL to leave the coordinate values zeroed.

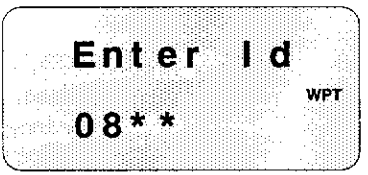


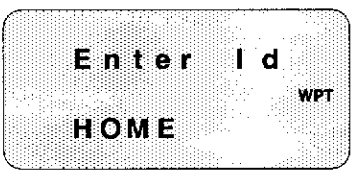
3) After pressing ENT the LAT/LON coordinates for your present position will be automatically entered into that waypoint.



4) Turn the DATA knob to the desired character. Press ENT. This will enter the character and automatically enable selection of the next character. Up to four characters may be entered as a waypoint name. Names of two or less characters will be followed by an asterisk (*) to show that it has been added by the operator. The unit will warn you if the same name for this waypoint exists in USER region or in the FLYBRARY®.





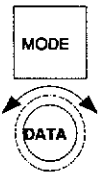


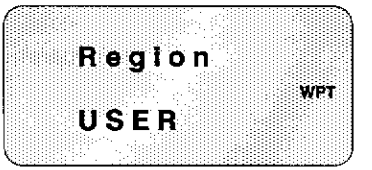
5) After entering the waypoint name the Model 604 will ask if you want to create a Phantom Waypoint. The question mark will flash.

6) If you want to just enter your present position as a normal waypoint continue with step 5 of the MANUAL USER WAYPOINT ENTRY procedure. If you want to create a Phantom Waypoint, turn to the following section (E-10) on the "Phantom Waypoint." **It is not recommended to name user waypoints the same as FLYBRARY® wpts.**

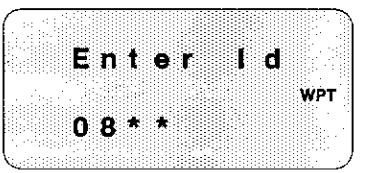
MANUAL USER WAYPOINT ENTRY

1) Press MODE to reach WPT Mode. The last Region viewed will be displayed. Now turn the DATA knob to reach the USER Region.

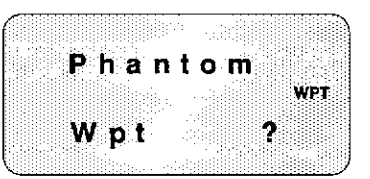




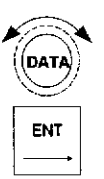
2) Turn the LIST knob to the desired waypoint number. Press SEL twice to enable name selection. The first character of the waypoint name will flash. If you do not want to change a value, press SEL or ENT to enable the next value for selection. Complete waypoint naming as described on the previous page.

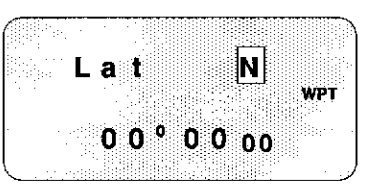


3) Press SEL (No) in response to "Phantom Wpt?". This will enable the LAT coordinate for selection.

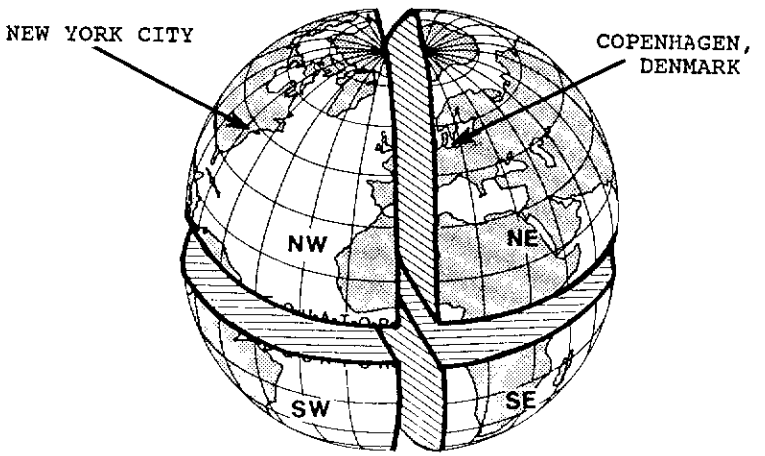


4) Select the desired hemisphere with the DATA knob and then press ENT.

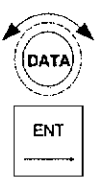


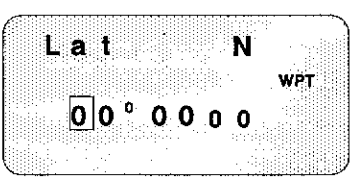


NOTE: Do not use the FLYBRARY® region initials in the hemisphere positions. You must choose hemispheres (N/S and E/W) to select a quadrant based on LAT/LON position. For instance, New York City would be in the NW quadrant and Copenhagen, Denmark would be in the NE quadrant. All of the United States is in the NW quadrant (North and West hemispheres).

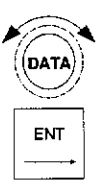


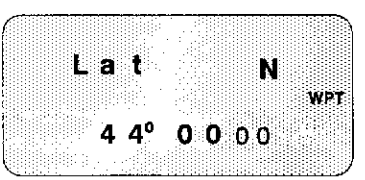
5) The degrees digits will flash. Turn the DATA knob to select the desired value and press ENT.



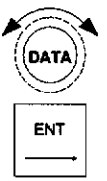


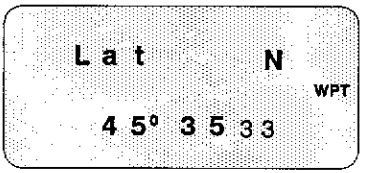
6) The minutes digits will now flash. Turn the DATA knob to select the desired value and press ENT.



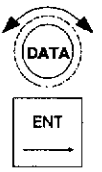


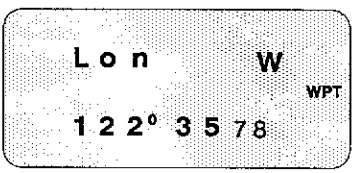
7) Continue for the remaining LAT components. Seconds are displayed in hundredths of a minute.





8) Repeat for the Longitude coordinate values.





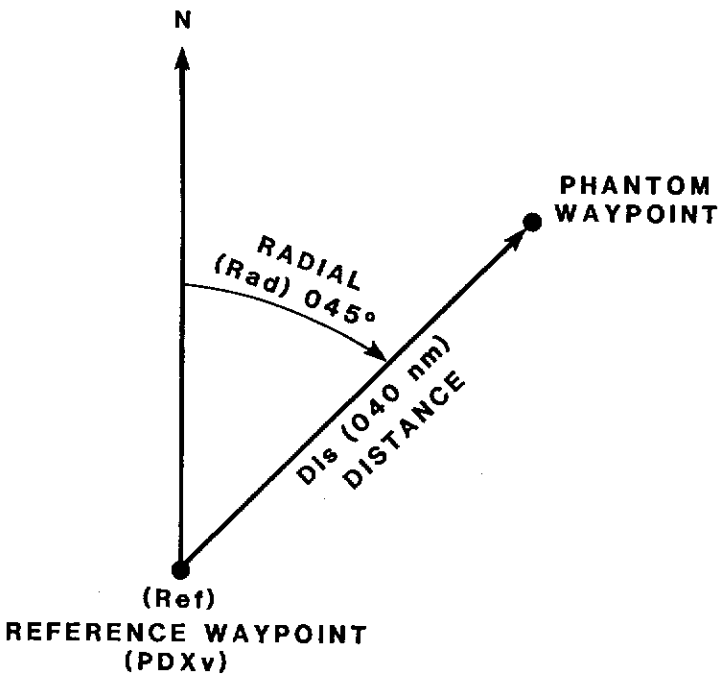
You may also use this procedure to modify the LAT/LON coordinates of established USER waypoints. Pass over values that you do not want to change by pressing SEL.

PHANTOM WAYPOINT

The APOLLO® Model 604 will allow you to create a PHANTOM WAYPOINT based on a Radial and Distance from a waypoint in either the CONTINENTAL FLYBRARY® or from the USER waypoint region. The PHANTOM WAYPOINT is stored in the USER Region and may be used just as any other waypoint is for navigation.

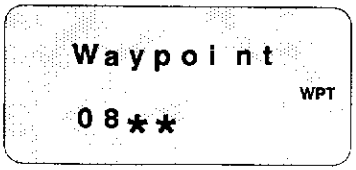
You create your PHANTOM WAYPOINT in WAYPOINT Mode by first naming your Reference Waypoint (Ref), then entering the Radial (Rad) and Distance (Dis) from that Reference Waypoint. The Radial from the Reference Waypoint may be any value from 0 to 359 in 1 increments. The Distance from the Reference Waypoint may be any value from 0.0 nm to 999.9 nm in 0.1 nm increments. The Reference Waypoint, may be selected from any waypoint memory (FLYBRARY® or USER).

When you create a phantom waypoint it may be useful to use a special method of naming them or notation. This will help you to know that they are phantom waypoints to avoid confusion with waypoints that were created for actual locations.

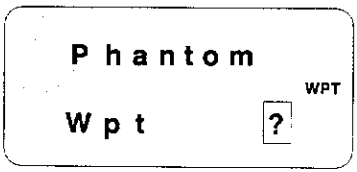


CREATING A PHANTOM WAYPOINT

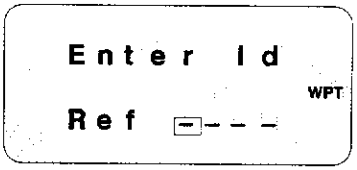
1) Press MODE to reach WPT Mode and turn the LIST knob to select the Waypoint position number where you want to store the Phantom Waypoint.



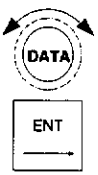
2) Press SEL six times to use the same name. The Model 604 will ask if you want to create a Phantom Waypoint. The question mark will flash.

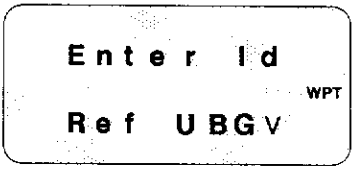


3) Answer "yes" by pressing ENT. The Model 604 will now ask for the Reference Waypoint name. The last used reference point will be shown on the bottom of the display. Press SEL to enable name selection. The first space will flash.

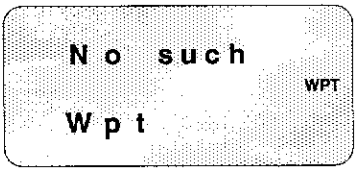


4) Turn the DATA knob to display the first character of the desired Reference Waypoint and then press ENT. The next space will flash. Continue until the Reference Waypoint name has been entered. If there are only three characters in the name, press ENT for the last blank space.

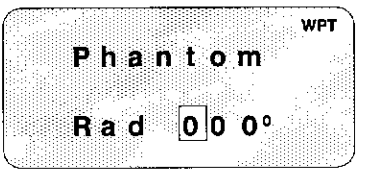




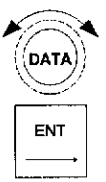
5) If there is no waypoint in memory by that name, the Model 604 will display "No Such Wpt." Check your entry and try again. If the waypoint was found, continue.

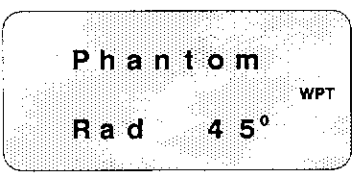


6) Now, press SEL and choose the Radial (Rad) from the Reference Waypoint. This will enable selection of the first digit of the Radial value.

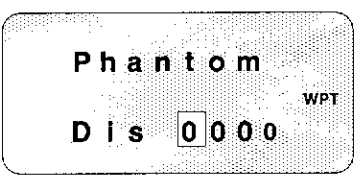


7) Turn the DATA knob to the desired value and then press ENT. The next digit will then automatically be enabled. Continue until all three digits are set to the intended value. The Radial is set to 45 in this case.

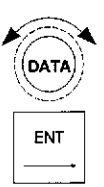


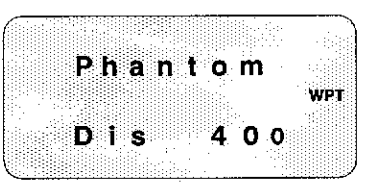


8) Now, press SEL to reach the Distance (Dis) value from the Reference Waypoint. The first distance digit will flash.

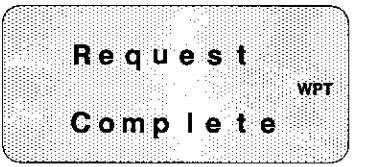


9) Turn the DATA knob to show the desired value and then press ENT. The second digit will be automatically enabled for selection. Continue until all three digits are set to the intended value. In this case the Distance is set to 40.0 nm.





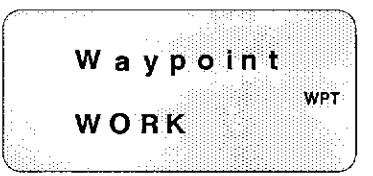
10) When finished "Request Complete" will be displayed. Your Phantom Waypoint has been created and you can now continue with other operations.



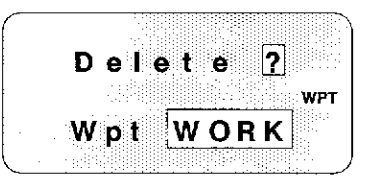
DELETING USER-DEFINED WAYPOINTS

You may easily delete a waypoint from the USER Region by pressing the DEL button. After pressing the DEL button, the unit will ask if the waypoint is to be deleted and the waypoint name will flash. Pressing ENT will zero the coordinates, erase the name, and reset the name to its numerical position in the USER Region.

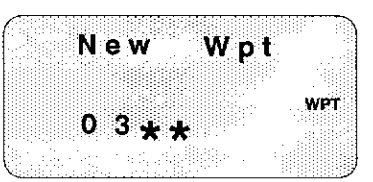
1. Turn the LIST knob to the waypoint in the USER Region of Waypoint Mode that you want to delete.



2. Press DEL. The unit will ask if you want to delete this waypoint. The waypoint name will flash.



3. Press ENT to delete the waypoint. The waypoint is removed from the user region and the next available USER wpt will be displayed.



HELPFUL HINTS FOR USER-DEFINED WAYPOINTS

Be careful when entering hemispheres to set your quadrant. The only quadrants are: NW, NE, SW, and SE. All of North America is in the NW quadrant. If you enter the wrong quadrant your NAV Mode information will be inaccurate.

A user defined waypoint may also be deleted by entering an asterisk (*) into the four positions used for the waypoint name (****) and then pressing ENT. The LAT/LON coordinates will be zeroed and the waypoint name will be removed from user region.

SECTION F

INFORMATION MODE

INFORMATION (INFO) MODE

The APOLLO® Model 604 will provide you with several items of important information on each of the waypoints in the FLYBRARY®. You may view this information in the INFO Mode. VORs and NDBs will show the Identifier and LAT/LON Frequency. Airports will have the City, State, Identifier, Airport Name, Tower frequency, Ground frequency, ATIS frequency, Approach frequency, Localizer frequency, UNICOM frequency, Airport Elevation, the longest two physical (giving four runway numbers) Runways available (plus Length and if Lights are available), if Services are available, and the LAT/LON coordinates. Services include: fuel, oxygen, and engine or airframe repair. While this information is as up-to-date and as accurate as possible, you should always check more than one source of information. Your responsibility remains with you, the pilot.

Initially upon entering INFO Mode you will see information for your destination. However, you may also easily reach into the large data base to view information for any waypoint in the FLYBRARY®. No INFO Mode information will be available for USER entered waypoints. You may retrieve (Look For) Waypoint Information by searching for the city, airport name, or the identifier. If you don't remember the full name you can select 1-8 characters to search for as the starting point. You may look at a certain region; starting at the beginning or at any point within the region by selecting 1-4 characters of a waypoint identifier as the starting point. You may retrieve the departure (origin), destination, last waypoint, or the last region viewed. Note that zeros have a slash through them while the letter "O" does not.

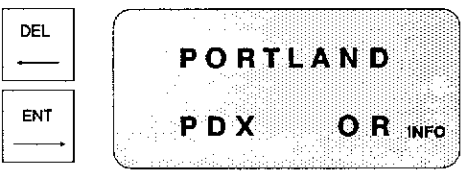
You may alter your course from within the INFO Mode. You may set any of the waypoints viewed as a TO or FROM waypoint by pressing the TO or FROM buttons, after searching or scrolling. So, you do need to be careful while viewing your waypoints in INFO mode.

WAYPOINT INFORMATION

A variety of information is available on each of the waypoints in the FLYBRARY. Once you have located the waypoint of interest turn the DATA knob to view the information available. The city nearest the airport is shown in each display. In the Location and Runway displays, press the cursor movement (DEL, scrolls backwards - ENT, scrolls forwards) buttons to move the display so you can view the full name or other information available. DEL searches backward and ENT searches forward. If a service item is not listed then it is unavailable. For instance, many airports will not have ATIS or Localizer frequencies. Frequencies are shown in MHz for VORs and kHz for NDBs.

VORs will only show the identifier and the LAT/ LON frequency.

1) City, Identifier, and the State are shown. Press DEL or ENT to scroll the display if the full name is longer than the display segments allow.



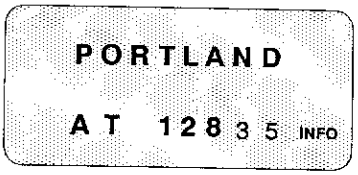
NOTE:
To scroll the display during a SEARCH, you must either push SEL 4 times, or push MODE, back into INFO

2) City and the Airport Name. The first five characters of the airport name will be shown.

3) City and the Tower (T) frequency in MHz.

4) City and the Ground (G) control frequency (in MHz).

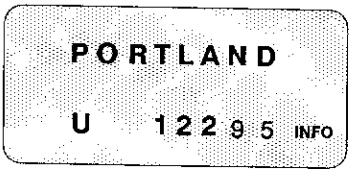
5) City and the ATIS (AT) frequency (in MHz).



6) City and Approach (AP) frequency (in MHz).

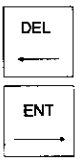
7) City and Localizer (L) frequency (in MHz).

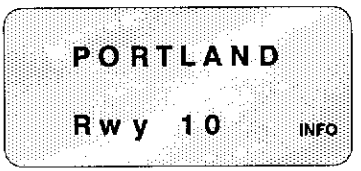
8) City and UNICOM(U) frequency (in MHz).



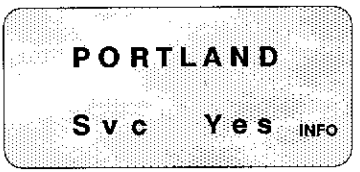
9) City and airport Elevation (Elv) (in feet).

10) City and Runways (Rwy). The length (Len) of each runway, and if it is lighted, are shown. Press ENT or DEL to move the display to see the full information available. The longest two physical runways will be shown.

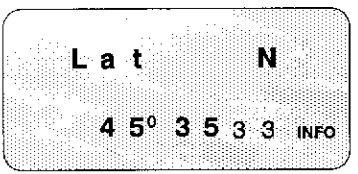




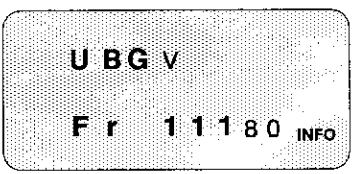
11) City and Services (Svc) (Yes or No). Having any repair, oxygen, or fuel services available will show a "Yes" response. Be sure to check other sources of information for availability of the services you may require.



12) The Latitude (Lat) of the airport is shown. Turn the DATA knob one more position cw to view the Longitude (Lon).



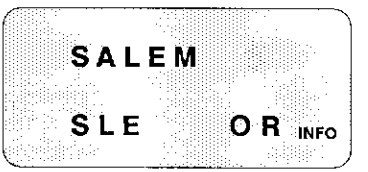
A VOR will be described by its identifier (with a small "v") and frequency (in MHz). An NDB will be described by its identifier (with a small "n") and frequency (in kHz).



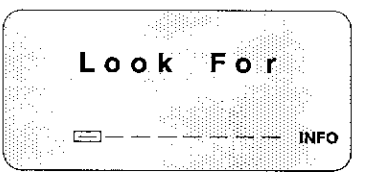
LOOKING FOR A WAYPOINT

When you first reach INFO Mode, the Destination waypoint is shown. If you would like to look at the information on another waypoint, select the "Look For" function by pressing SEL. The last searched for waypoint will be shown with the first character flashing. This indicates that the first character space is enabled for selection. If you are looking for a particular item use the DATA knob as described in the next step. Otherwise, use the section below to select the method for searching for a waypoint.

1) Press MODE to reach INFO Mode. The Destination waypoint City, Identifier, and State will be shown.



2) Press SEL. "Look For" will be displayed. The first character position is enabled for selection and is flashing.

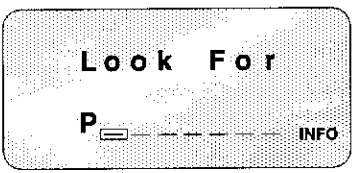


3) Choose the appropriate following section for the method to reach waypoint information of your choice.

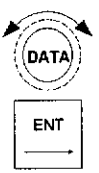
LOOKING FOR AN ITEM

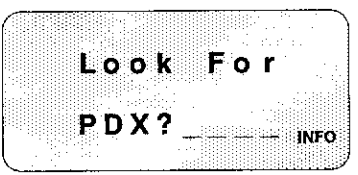
You can select waypoint information by city, airport name, or identifier. Use the DATA knob to select the characters for the search item followed by a question mark ("?").

1) From the "Look For" display, press SEL and turn the DATA knob to display the first character and then press ENT. The next character will now flash.



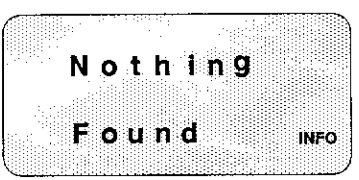
2) Enter the required characters. If the complete item name is used, press ENT. If only part of an item name is used you must now select a question mark ("?") and then press ENT.



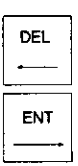


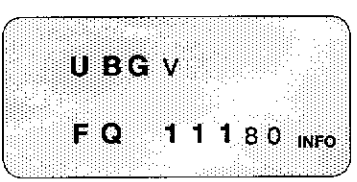
3) The waypoint City, Identifier, and State will now be shown for the first item that fits the characters that you selected.

4). If the item you asked for is not in the FLYBRARY®, "Nothing Found" will be displayed. Press SEL again and start over.



5.) Pressing the cursor movement (DEL or ENT) buttons will allow you to view waypoints that also meet the selected criteria.

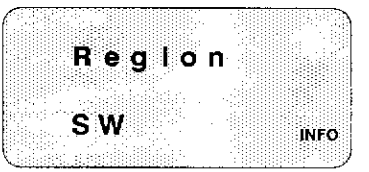




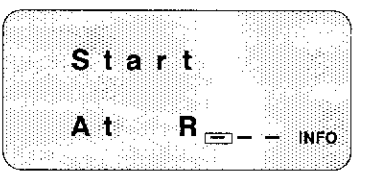
LOOKING FOR A STARTING POINT IN A REGION

The APOLLO® Model 604 will let you start at any point in a waypoint region. After selecting the FLYBRARY waypoint region you can start at a certain waypoint identifier by entering that identifier name or you can enter only a portion of a name for a starting point followed by a question mark ("?"). If desired you may start at "S", "S1", etc. The starting point is up to you.

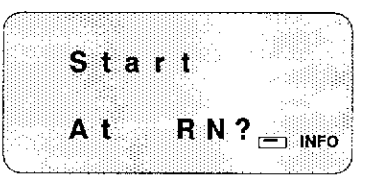
1) From the "Look For" display, press SEL to reach the region choices. Choose the desired Region (EC, NC, NE, NW, SC, SE, etc.) by turning the DATA knob and then press ENT.



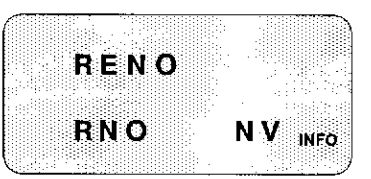
2) The display will request a starting point. The starting point may be from 1 to four characters. The first space for the waypoint name will flash. Turn the DATA knob to display the first character of the starting point.



3) Now, press ENT. The next space will flash. Enter the required characters. Then select a question mark ("?"). Press ENT.

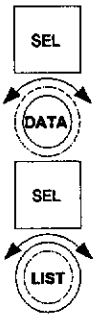


4) The unit will start at the waypoint identifier with the character or combination of characters that you entered. Now, turn the DATA knob to view the information.



LOOKING FOR A REGION

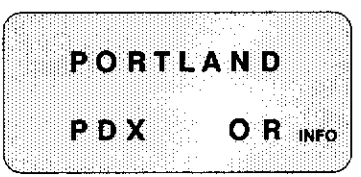
1) While viewing the "Look For" display, press SEL to reach the region choices. Choose the desired Region (EC, NC, NE, NW, SC, SE, etc.) by turning the DATA knob. Press SEL to reach the last waypoint viewed or turn the LIST knob to reach the first waypoint in the region selected.



2) Turn the DATA knob to view the information or turn the LIST knob to reach another waypoint within that region.

LOOKING FOR THE DEPARTURE (ORIGIN) WAYPOINT

1) While viewing the "Look For" display, press FROM to reach the origin (departure) waypoint information. Turn the DATA knob to view the information.



LOOKING FOR THE DESTINATION WAYPOINT

1) While viewing the "Look For" display, press TO to reach the destination waypoint information. Turn the DATA knob to view the information.

CAUTION:
You must be on the "LOOK FOR" page. Otherwise, pressing TO or FROM will change your destination or departure waypoint

SECTION G

SETUP MODE

SETUP MODE

The initial start-up conditions and calibration factors for the APOLLO® Model 604 are entered in the SETUP Mode. The information available in SETUP Mode is divided into two groups: Normal Start-up Calibration Information and Receiver Data. Normal Start-up Calibration Information for the APOLLO® Model 604 are items such as: the GRI, Advisory information, E-6B Internal Flight Computer, Remote Range Computer, Auto-Nav, Offset, XTD Sensitivity, Special Use Airspace Setup, and Dead Reckoning Computer Setup. Receiver Data includes information such as: Magnetic Variation, LAT/LONG Calibration Factors, TDs, (Time Differences), Signal-To-Noise Ratio, Signal Level, ECDs, the Extended Range feature, the Service Displays, and the Magnetic Variation Year. You normally only need to refer to the first group of displays. The second group of displays is only viewed if you specifically request them from the unit. The only feature in the SETUP Mode that must be entered for the APOLLO® Model 604 to operate is the GRI, or LORAN-C chain, for your area. The other features allow you to manually adjust magnetic variation, adjust the receiver for local signal conditions, set XTD sensitivity, set the Course Offset (OFST), and view signal information. Manual triad selection may also be performed.

This section will describe each of the functions in the SETUP Mode and illustrate their use. SETUP Mode is reached by pressing the MODE button until the SETUP indicator lights. Each of the features in SETUP Mode is reached by turning the LIST knob. Further information in a particular function may then be reached, or altered, by turning the DATA knob.

For normal operation, only the GRI need be entered. The additional features available in the SETUP Mode may be used by the more experienced operator as need or desire dictate.

When viewing Receiver Data pages that contain information on each station (M, W, etc), turning the LIST knob will show the same station in the Receiver Data page shown. For instance, if you were viewing the SNR value for the "W" secondary and turned the LIST knob to the ECD values you will see the ECD value for the "W" secondary.

NORMAL START-UP INFORMATION

GROUP REPETITION INTERVAL (GRI)

The first step in setting up the APOLLO® Model 604 for operation is to select the GRI, or LORAN-C chain, for your area. There may be more than one chain that provides coverage for your area, so you should consider the chain that will give the best coverage for your entire intended flight. The APOLLO® Model 604 will then automatically select the secondary transmitting stations based on the best geometry relating to the aircraft position. This combination of a master and two secondary stations is called a TRIAD. The APOLLO® Model 604 also allows the operator to manually select the secondaries. Check the LORAN-C Coverage Maps in Section H to determine the appropriate Chain and secondary choices for your area. A following map (page G-5) shows the chain configurations in the Northern Hemisphere. The dotted line on the map shows the extent of the ground wave coverage. The shaded area of the map shows the primary, or best, coverage areas. Other maps are available on pages A-8, A-9, and in Section H. A table below lists the available worldwide LORAN-C chains.

AVAILABLE LORAN-C CHAINS

GRI	CHAIN	GRI	CHAIN
4990	Central Pacific	7990	Mediterranean
5930	Canadian East Coast	8940	Western Europe
5970	Commando Lion(Korea)	8970	Great Lakes
5990	Canadian West Coast	8990	Saudi Arabia (NE)
7170	Saudi Arabia (South)	8991	Saudi Arabia (NW)
7930	Labrador Sea	9940	U.S. West Coast
7960	Gulf of Alaska	9960	U.S. Northeast
7970	Norwegian Sea	9970	Northwest Pacific
7980	U.S. Southeast	9980	Iceland
		9990	North Pacific

Information for each LORAN-C chain is available in Section H. An example of the LORAN-C data tables is shown on the following page. The LORAN-C chain is selected by the first four digits of the GRI. The U.S. West Coast GRI is 9940. The Master and Secondary stations are displayed and selected by the first letter for that station, as shown below.

LOCATION	NAME	TIME DELAY
Fallon,Nev.	Master	
George,Wa.	Whiskey	11,000
Middleton,Ca	Xray	27,000
Searchlight,Nev	Yankee	40,000

In this case the secondary station choices will be displayed as W, X, and Y. The fourth secondary position, Z, will have a blank space to indicate that this secondary is not present in this chain.

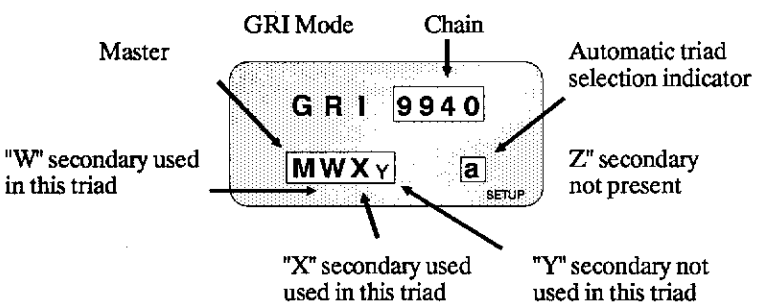
U.S. WEST COAST LORAN-C CHAIN - GRI 9940 (old rate 5S8)

STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Fallon, NV	Master	39 33 06.6 N 118 49 56.4 W		400	Two pulse comms installed.
George, WA	Whiskey	47 03 48.0 N 119 44 39.5 W	11000/ 2796.90	1600	Two pulse comms installed. Dual-rated to West Coast Canada Chain.
Middletown, CA	Xray	38 46 57.0 N 122 29 44.5 W	27000/ 1094.50	400	Exercises operational control of chain. Control for W, X, and Y. Two pulse comms installed.
Searchlight, NV	Yankee	35 19 18.2 N 114 48 17.4 W	40000/ .1967.30	540	
North Bend, OR	Monsite	43 24 36.2 N 124 14 27.9 W			Unmanned receiver site.
Pt. Pinos, CA	Monsite	36 37 59.0 N 121 56 05.6 W			Unmanned receiver site.

GRI and Triad Display

1) Turn on the APOLLO® Model 604 and press MODE to reach SETUP Mode.

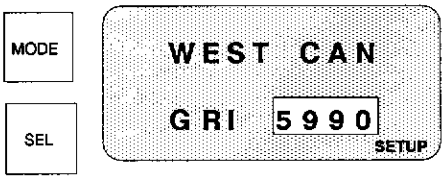
2) The APOLLO® Model 604 will display the previously selected GRI and automatically select the proper secondaries. The available secondaries for the chain selected and the current triad used for navigation calculations are displayed. The stations used in the current triad are in upper case letters (i.e. "X"). A secondary available in that chain but not used for the current triad will be in lower case letters (i.e. "y"). The Master transmitting station is shown as M. The secondaries are listed as V (Victor), W (Whiskey), X (Xray), Y (Yankee), and Z (Zulu). A lower case "a" or "m" on the right side of the display will indicate whether the current triad is selected automatically or manually.



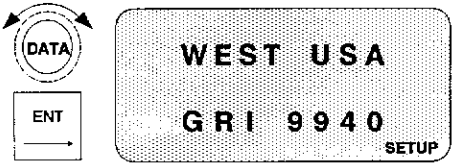
GRI SELECTION

This section describes the procedure for selecting a new GRI. In this example, the method of GRI selection will be illustrated by changing from the 5990 Canadian West Coast Chain to the 9940 U.S. West Coast Chain.

1) Press MODE until you reach SETUP Mode. The previously selected GRI and triad will be displayed. Press SEL to enable GRI selection. The GRI will flash.



2) Turn the DATA knob to select the desired chain. Only chains included in the software for your unit will be available for display. Press ENT to enter the displayed chain into memory.



3) The small "a" will flash. Press ENT again.

NOTE:
The WARN indicator may light when the unit is acquiring a new GRI or triad.

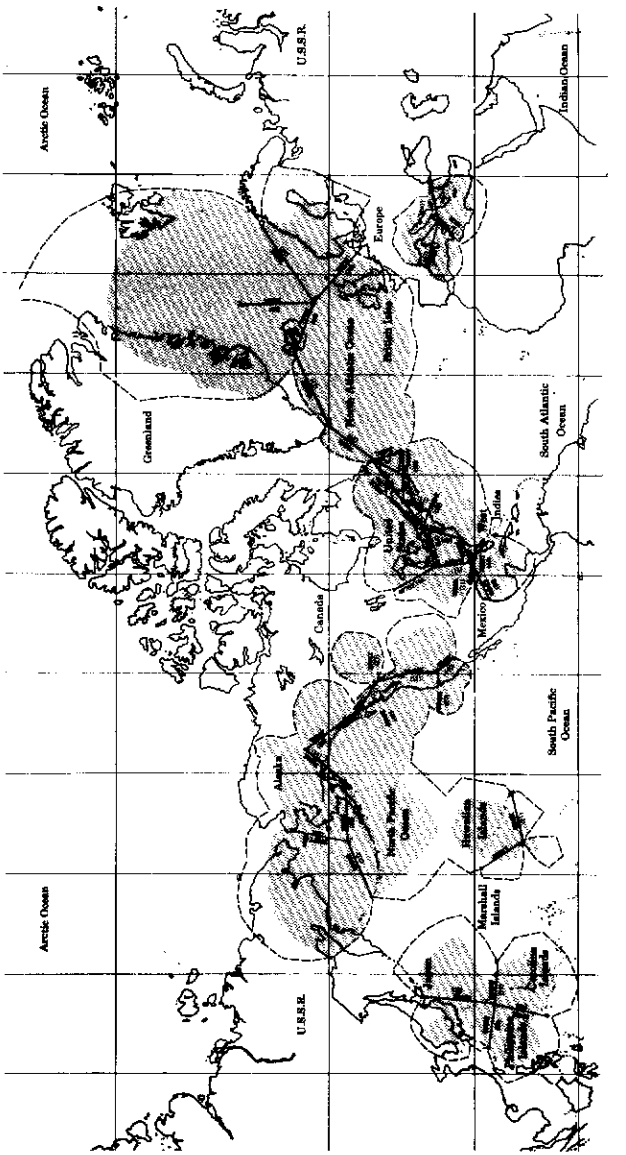
The GRI selected will be retained in memory after the unit is turned off. The APOLLO® Model 604 will automatically select the best triad based on the geometry of the LORAN-C chain chosen in relation to your position. If you are using automatic triad selection, you may now go to another function or mode. If manual triad selection is desired, continue with the procedure following on page G-6.

GRI DISPLAY ON STARTUP

When the unit is first turned on an "s" will appear for each station to note that searching is taking place. As each station is acquired the identifying letter will appear. An upper case letter will appear for a station used in the triad. A lower case letter will appear for a station being tracked but not used in the triad. The WARN indicator will turn off when the master station and two secondaries are acquired.

WORLDWIDE LORAN-C COVERAGE AREAS

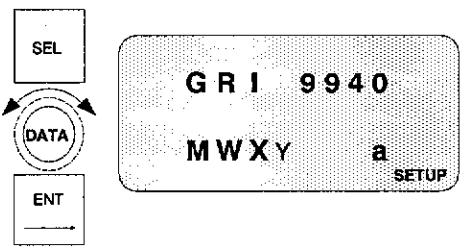
The map below shows the worldwide LORAN-C coverage areas. The shaded areas show the prime coverage areas. The dotted lines show the ground wave limits.



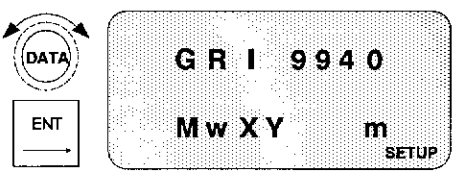
MANUAL TRIAD SELECTION

Under normal conditions the APOLLO® Model 604 will automatically choose the best triad (master-secondary combinations) for your position. However, under some circumstances the pilot may want to manually override this feature. When secondaries are manually selected a small "m" will appear on right side of the GRI display. A small "a" will appear on the right side of the GRI display when the secondaries are selected automatically. The WARN light may appear temporarily while you are changing a triad.

1) Press SEL twice to enable manual or auto triad selection. The letter will flash. Turn the DATA knob to "m" (manual) and press ENT.



2) The secondaries will flash. Turn the DATA knob to select the desired triad and then press ENT. An upper case secondary is used in the triad, a lower case secondary is not.



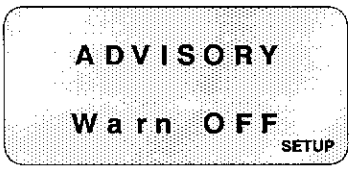
Whenever the APOLLO® Model 604 is turned on, the last GRI entered into memory will be used for calculating current position. The Master and all secondary stations within the last chosen chain will be used for signal search and acquisition.

The APOLLO® Model 604 triad selection will return to automatic mode whenever the unit has been turned off and then back on.

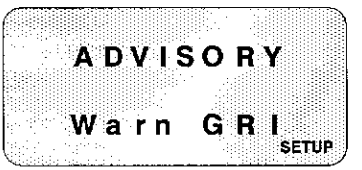
ADVISORY INFORMATION

The APOLLO® Model 604 provides a number of diagnostic messages headed "ADVISORY" at the end of the SETUP Mode. These messages will provide information about why the WARN light or external annunciator has appeared. The diagnostic pages that may appear and the problem that initiated the message is provided below. In SETUP Mode turn the LIST knob to the diagnostic (ADVISORY) function and then use the DATA knob to view the different pages.

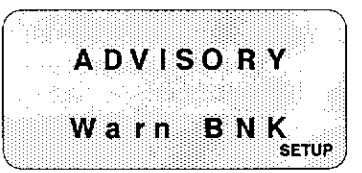
"Warn OFF" is shown when the WARN indicator is extinguished.



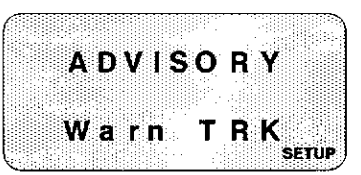
"Warn GRI" is shown when insufficient transmitters (fewer than the master and two secondaries) are being tracked, or the automatic triad selection process has not been completed. The WARN indicator will also be lighted. See page G-19.



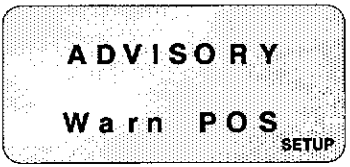
"Warn BNK" is shown when a secondary blink condition is detected by the APOLLO® Model 604 in the selected triad. The WARN indicator will also be lighted.



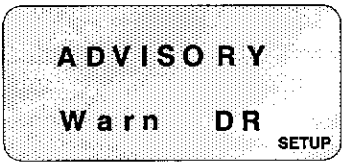
"Warn TRK" is shown when the master station is not tracked. The WARN indicator will also be lighted.



"Warn POS" is shown when Dead Reckoning mode is activated. When DR mode is on, the unit is using manually entered information instead of LORAN signals, to determine the aircraft's LAT/LON position (see Page G-43).



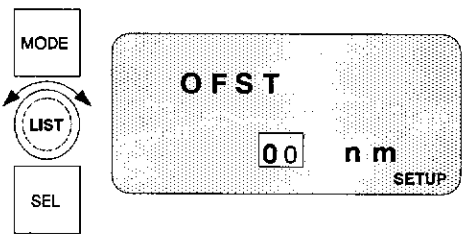
"Warn DR" is shown when the Dead Reckoning Computer has been activated.



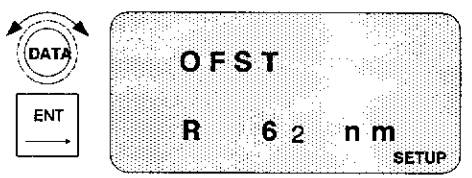
COURSE OFFSET (OFST)

The Course Offset function allows the pilot to offset the aircraft course to fly parallel to the original course. While using Course Offset all course navigation information will still be referenced to the TO waypoint. The Cross Track Distance (XTD) display in NAV Mode and the external CDI will now refer to the Course Offset flight path. The OFST indicator on the left side of the display will light to indicate that this function is being used. The amount of course offset distance and direction in relation to the original course is selected in SETUP Mode. OFST is selectable between 0 and 20 nm in 0.1 nm increments to the left (L) or right (R) of the original course. Your Course Offset will be retained in memory after the unit is turned off. Course Offset is useful for modifying a course for conditions, surveying, or search procedures.

1) Press MODE to reach SETUP Mode and turn the LIST knob to reach the Course Offset (OFST) function. Press SEL to enable OFST selection. The distance value will flash.



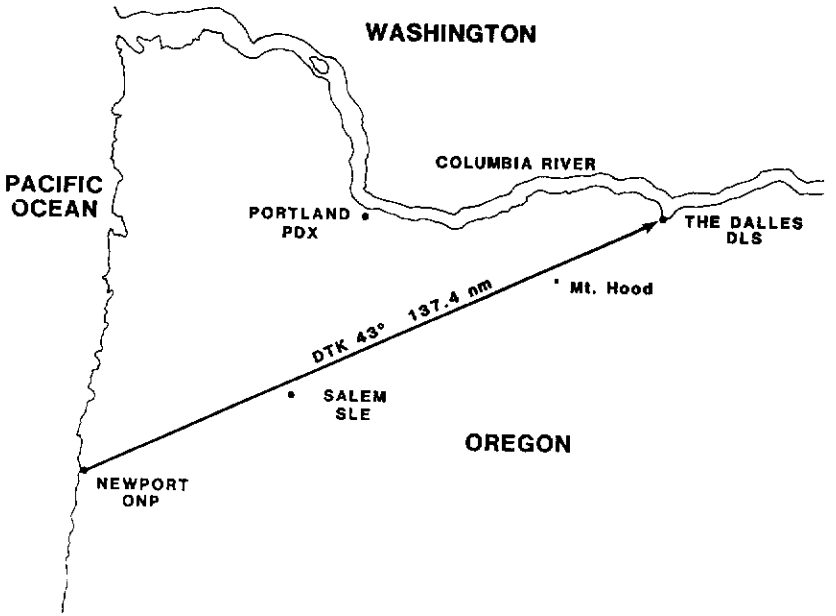
2) Turn the DATA knob in the direction of the desired OFST (L/R) to the desired value and then press ENT.

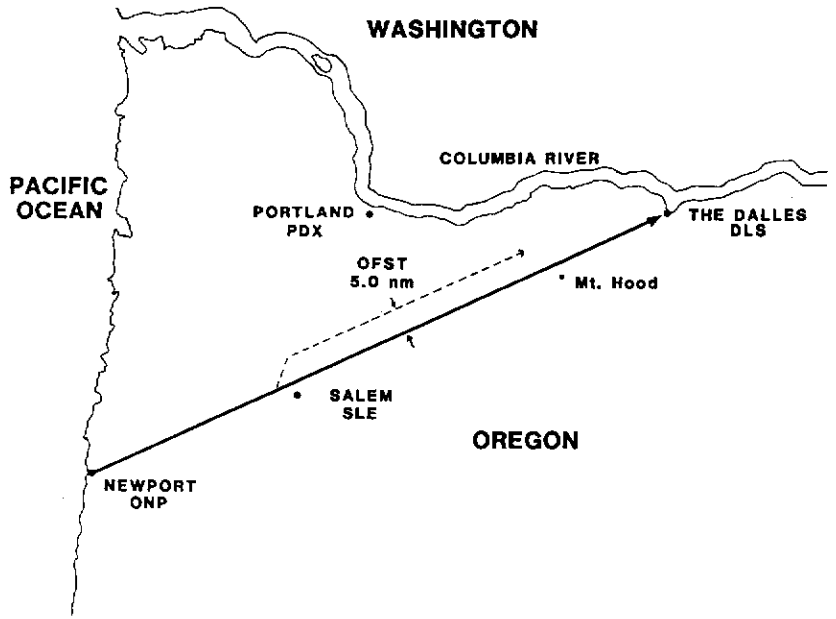


TYPICAL USE OF COURSE OFFSET (OFST)

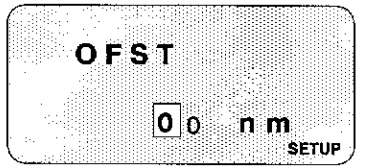
The following example will demonstrate a use of the OFST function. In this example a flight plan has been made for a trip from Newport, Oregon to the Dalles, Oregon. While enroute a few miles west of Salem, Oregon thunderclouds are noted above Salem and to the south. You then enter a five mile Course Offset (OFST) into your APOLLO® Model 604 that will take you north of the bad weather and still maintain your intended course to The Dalles. After entering the 5.0 nm OFST to the Left of your original flight path, you follow the indication of either your external CDI or the XTD display in the NAV Mode of your APOLLO® Model 604 which will now guide you to the new course line. The new course line is 5.0 nm to the left of and parallel to your original course. After you have passed the storm activity or are approaching your destination, remove the Course Offset (reset it to 0.0 nm) or draw a new course line from your present position to navigate directly to the destination.

COURSE OFFSET EXAMPLE

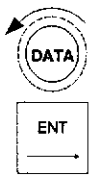


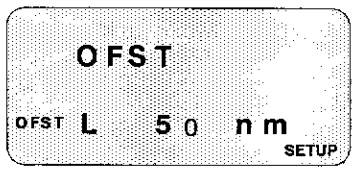


1) Press Mode to reach SETUP Mode. Turn the LIST knob to reach the OFST function. Then press SEL to enable selection of OFST (the distance digits will flash).

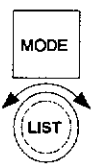


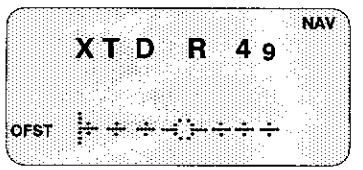
2) Turn the DATA knob counter-clockwise (ccw) until "L 5.0 nm" is displayed and then press ENT. The OFST status indicator will now appear on the lower left side of the display panel.



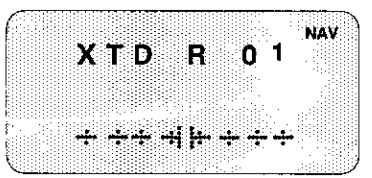


3) Press MODE once to reach NAV Mode and then turn the LIST knob to show the Cross Track Distance (XTD) display.





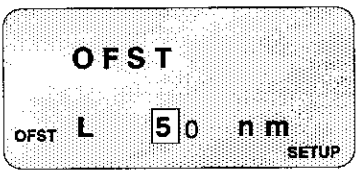
4) Turn left until the XTD display shows that you are again on-course (the new course that is offset 5.0 nm of your original course).



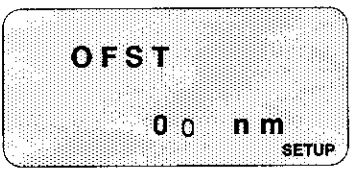
NOTE:
Steps 5-7 must be completed. Step 8 is an option.

Use steps 5-7 after you have passed the storm activity to remove the course offset. Steps 5-7 show how to return to your original course. Use step 8 to plot a new course line from your present position to the destination.

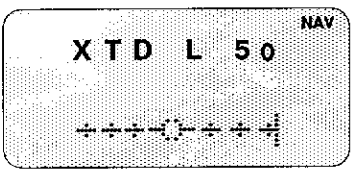
5) Remove the Course Offset. Press MODE to reach SETUP Mode and turn the LIST knob to reach the OFST function. Press SEL to enable OFST selection (the number will flash).



6) Turn the DATA knob clockwise (cw) until 0.0 nm is displayed and then press ENT. The OFST indicator will go out.

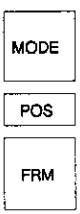


7) Press MODE to reach NAV Mode. Turn the LIST knob to show the XTD display. Turn right to return to your original course.



OPTIONAL

8) Press MODE to reach POS Mode and press FRM. This will allow you to navigate directly to your destination without turning back to your original course. Remember to remove your Course Offset.



CROSS TRACK DISTANCE SENSITIVITY

(XTD SENS)

The Cross Track Distance is displayed in NAV Mode and is a visual indication of the direction to turn to travel on-course. The course-to-fly (Desired Track) is an imaginary line between the origin (FROM) and destination (TO) waypoints.

Cross Track Distance is displayed as a scale with a moving pointer (vertical bar) to indicate whether you are on- or off-course, and if off-course, the distance off-course and the direction to turn to return on-course. The Range to your destination, in nautical miles, is also shown.

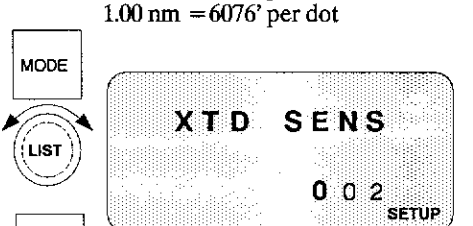
NOTE:

The aircraft is the center of the display. The "moving pointer" is the desired track

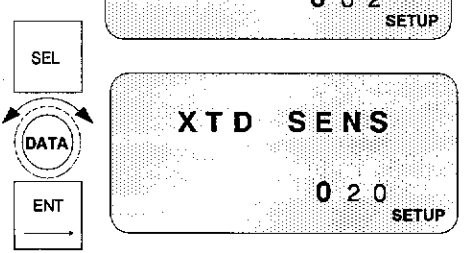
Cross Track Distance Sensitivity is selectable between 0.01 nm and 1.00 nm in 0.01 nm increments. The value selected refers to the distance represented by each dot in each display segment of the scale. There are five dots horizontally in each display segment. The XTD SENS value you select remains in memory after the unit is turned off. The value set for the internal 604 XTD display will also set the resolution for your external CDI.

0.01 nm = 61' per dot	0.20 nm = 1215' per dot
0.02 nm = 122' per dot	0.25 nm = 1519' per dot
0.05 nm = 304' per dot	0.50 nm = 3038' per dot
0.10 nm = 608' per dot	0.75 nm = 4557' per dot
0.15 nm = 911' per dot	1.00 nm = 6076' per dot

1) Press MODE to reach SETUP Mode and turn the LIST knob to display the XTD sensitivity. 0.02 nm is shown here.



2) Press SEL to enable selection. The value will flash. Turn the DATA knob to select the desired value and press ENT. 0.20 nm is shown here.



NOTE:

A XTD Sensitivity value that may prove useful for a quick visual indication is 0.20 nm. This value will move the aircraft pointer by one group of five horizontal dots in the scale for each mile of distance from your desired course.

RECEIVER DATA

The topics shown previously for SETUP Mode cover the information most often used. However, the APOLLO® Model 604 provides the choice if you wish to view more detailed information on receiver functions, software versions, to activate the Extended Range (X_Range) function or set the Magnetic Year.

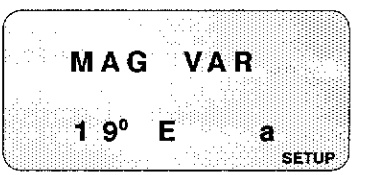
1) In SETUP Mode turn the LIST knob one position ccw. The display will ask if you want more Receiver Data. The question mark will flash. Press ENT for a "yes" response or continue turning the LIST knob to bypass the display.

MAGNETIC VARIATION

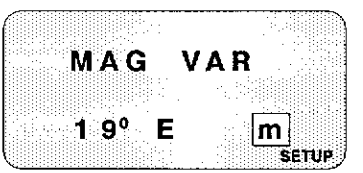
The APOLLO® Model 604 references the NAV displays to either magnetic or true north. The APOLLO® Model 604 will select the proper Magnetic Variation automatically for your area to reference the NAV displays in magnetic headings. Worldwide coverage is provided for Automatic Magnetic Variation. You may also manually enter Magnetic Variation. If the Magnetic Variation is set to 0, NAV information will be referenced to true north. The APOLLO® Model 604 comes from the factory set for automatic Magnetic Variation. Automatic or Manual MAG VAR selection is made by choosing "a" or "m" with the DATA knob. The auto or manual setting will be retained when the unit is turned off. Easterly or westerly variations are made by choosing "E" or "W" with the DATA knob. The amount of variation is also chosen with the DATA knob. See page G-25 for Magnetic Year.

AUTOMATIC MAGNETIC VARIATION

1) In the Receiver Data portion of SETUP Mode, turn the LIST knob to the MAG VAR display.



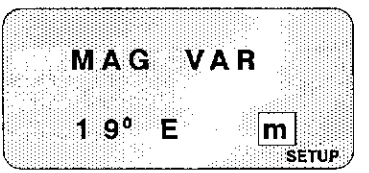
2) Press SEL to enable selection of manual "m" or automatic "a" MAG VAR. The letter will flash. Turn the DATA knob to choose automatic or manual MAG VAR and then press ENT.



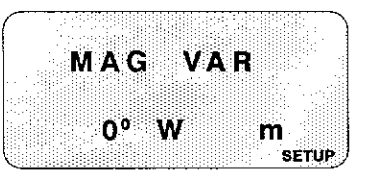
MANUAL MAGNETIC VARIATION

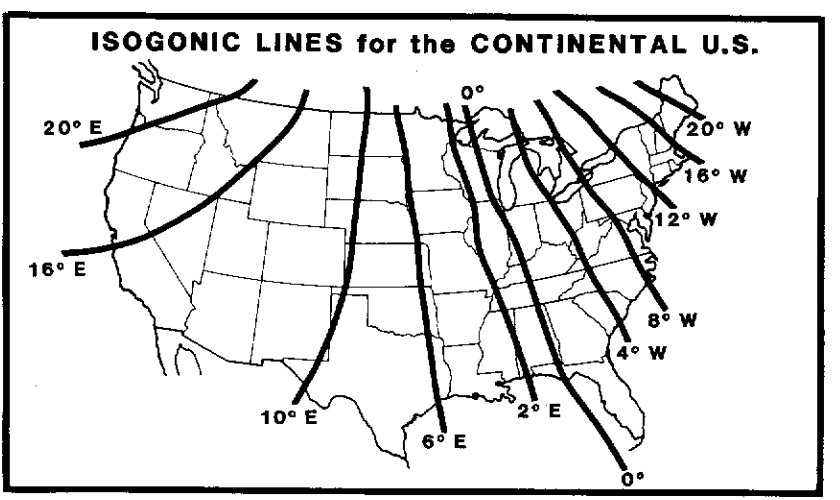
The APOLLO® Model 604 also allows you to manually select Magnetic Variation. The illustration below shows the magnetic variations for the Continental United States. You can also refer to WAC, Sectional Charts, and Approach plates to determine the magnetic variation for your area. Manually setting the Magnetic Variation to 0 will reference NAV data to True North. The procedure for manually entering the Magnetic Variation Factor is shown below.

1) In the Receiver Data portion of SETUP Mode, turn the LIST knob to the MAG VAR function. Press SEL (the "a" will flash) and then turn the DATA knob to select manual ("m") MAG VAR. Press ENT.



2) Press SEL to enable Magnetic Variation value entry. The degrees digits will flash. Turn the DATA knob to the desired value and direction of Magnetic Variation. Then, press ENT. Rotating the DATA knob cw will reach westerly values, and ccw will reach easterly values.





LATITUDE AND LONGITUDE CALIBRATION (ASF) FACTORS

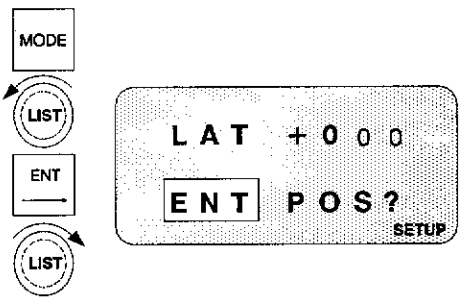
Very slight errors in the LAT/LON display of your current position may occur due to the propagation characteristics of the LORAN-C signal at a particular location. The speed, or velocity, of the LORAN-C signal will vary as it passes over different types of terrain, such as water, glaciers, mountains, cities, etc. Also, seasonal changes will have an effect on LORAN-C signals. Velocity changes cause distortion in the LORAN-C grids and slight inaccuracies in LAT/LON conversions. Normally no calibration factors are needed in the APOLLO® Model 604, however, obtaining the greatest degree of accuracy in POS and NAV displays in some areas may require the entry of LAT/LON calibration factors.

Calibration factors, or ASFs (Additional Secondary Phase Factors), are entered to compensate for propagation variations in the LORAN-C signal unique to a particular locality. When calibration factors are entered, the LAT/LON coordinates will change to reflect the entered values. In normal operation values of 9.99 uS (microseconds) may be entered. While in the Extended Range function ASF values of +/- 99.9 uS may be entered (see page G-23). The ASF indicator on the left side of the display panel will light to indicate when calibration factors have been entered. ASF values of less than +/- 9.99 uS will remain stored in memory after the unit is turned off.

ENTERING CALIBRATION (ASF) FACTORS

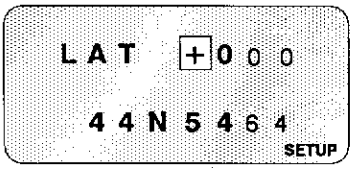
The APOLLO® Model 604 allows the entry of LAT/LON calibration values. Calibration values are entered to add a bias to the LAT/LON coordinates for more accurate navigation. Enter calibration factors that will change your LAT/LON coordinates to match those of a known position. This may be accomplished by flying over a point where the LAT/LON coordinates are known, such as a VOR or Airport Reference Point (ARP). Press the SEL and then the ENT buttons to load the uncalibrated present position into the LAT/LON calibration displays. Then compare the displayed values with the published coordinates, and make any adjustments necessary with the DATA knob. When you select a new GRI or travel a great distance from the location where the calibration factors were entered, new calibration factors may need to be entered. The method for entering the calibration values is described below.

1) Press Mode to reach SETUP Mode. Now turn the LIST knob left one click. Press ENT. Turn the LIST knob right one click. Press SEL to enable entry. "ENT Pos?" will appear. "ENT" will flash.

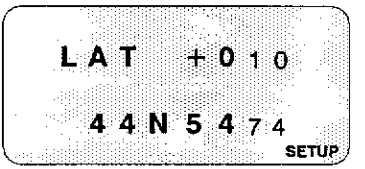


2) Press ENT to load your current position coordinates into the LAT/LON displays.

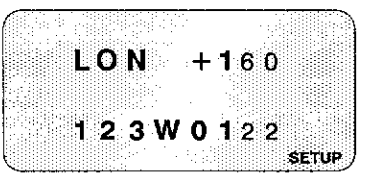
The calibration factor will now flash.

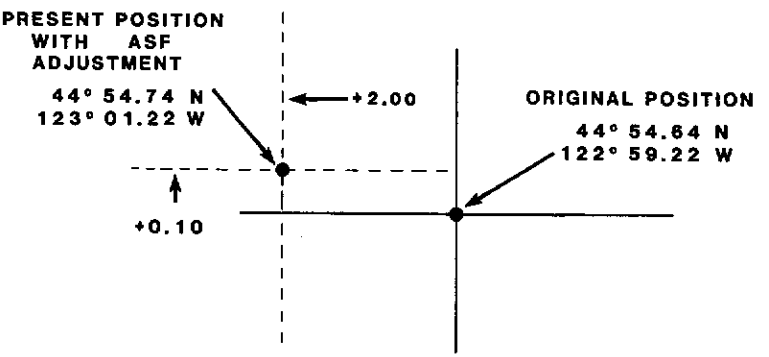


3) Turn the DATA knob to select the LAT calibration factor (cw for + and ccw for -). The LAT coordinate will change to match the amount of bias, calibration factor, that you have selected. Press ENT when you have selected the desired value. The ASF indicator will light when calibration factors have been entered.



4) Turn the LIST knob to the LON display. Repeat the above procedure for the LON calibration factor.





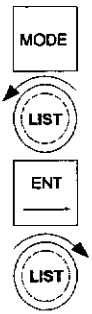
TIME DIFFERENCES (TDs)

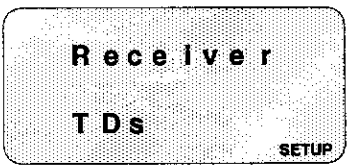
LORAN-C is a synchronized radio navigation system based on time of arrival measurements. The time measurements correspond to the distance a LORAN-C receiver is from the transmitting stations. These time measurements are referred to as time differences (TDs). Each TD is measured in microseconds (millionths of a second), and can be plotted on a curved line between the two stations called a hyperbola. The hyperbolic lines are referred to as a Line Of Position (LOP).

The TD between the Master and a secondary transmitting station form one LOP. A second LOP formed between the Master and another secondary is necessary to provide a fix on your position. Where the two LOPs cross is your actual geographic position. LAT/LON coordinates in all LORAN-C receivers are calculated from the crossing points of LOPs.

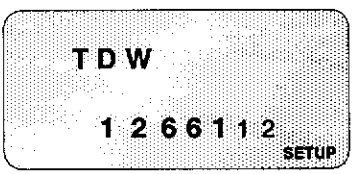
The APOLLO® Model 604 provides you with the TD measurements. These values may be used with maps which provide LOPs to fix your position. The TD Displays

1) Press Mode to reach SETUP. Turn the LIST knob left one click. Press ENT. Turn the LIST knob right 3 clicks.

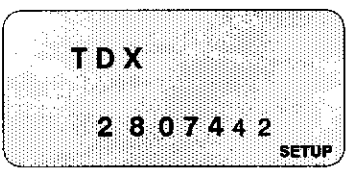




2) Turn the DATA knob right one click.



3) Turn the DATA knob right one click to view the next TD, TDX. Turn the DATA knob to view the TDs in succession.



SIGNAL INFORMATION

The signal information features are important to you for monitoring signal conditions and other receiver information. Information available is: Signal-to-Noise Ratio (SNR) values, Envelope-to-Cycle Difference (ECD) values, and Signal Levels.

WARN INDICATOR

The WARN indicator appears in the upper display panel to notify you of possible signal problems. The WARN indicator will also appear when the APOLLO® Model 604 is first turned on, indicating that the unit is searching for the proper tracking points, and will go out after the unit has warmed up and settled. If the WARN indicator remains on for over 10 minutes or reappears after normal operations, a problem may exist.

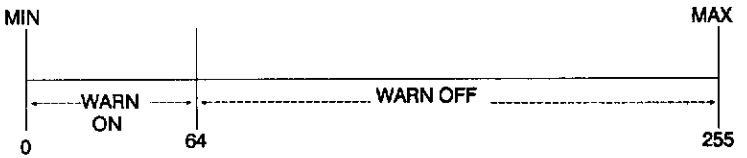
Possible signal problems that will turn the WARN indicator on are: 1) any station in the selected triad that has not cycle selected or has slipped off the proper cycle, 2) a low SNR value for any station in the selected triad, and 3) secondary blink in the selected triad. Secondary blink occurs when one, or more, of the secondary stations send a signal that indicates possible problems with LORAN-C transmissions in that area.

SIGNAL TO NOISE RATIO (SNR) VALUES

(Signal-to-Noise Ratio) values are displayed on the display as numbers from 0 to 255. A higher value indicates a stronger signal in relation to the noise present. For most applications a value of 100 or higher will represent good signal conditions and tracking ability. A reference is given below to help evaluate SNR values.

225 . .Excellent
200 . .Excellent
175 . .Excellent
150 . .Good
125 . .Good
100 . .Good
75 . .Fair
50 . .Poor
25 . .Poor
0 . .No Signal

SIGNAL-TO-NOISE RATIO



If the SNR values drop too low (less than 64), the WARN indicator on the display panel will appear. Low SNR values can be caused by one or more of the following factors:

1) A position in, or approaching, a fringe coverage area.

2) Improper installation of the antenna, power cables, or grounding.

3) Atmospheric interference caused by storms, lightning, sunspots, etc.

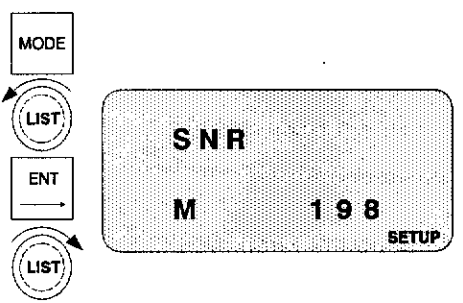
4) Military installations, or other strong Low Frequency, transmissions.

5) Noisy local conditions with interference being generated by industrial switching equipment, or local telephone transmission, precipitation static, etc.

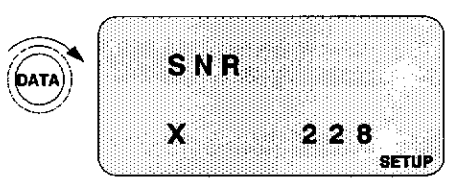
6) Operating in a shielded area, such as in a hangar, or near power lines.

The following procedure is used to view the SNR values for the Master and all secondaries available within the LORAN-C chain being used.

1) Receiver SNRs. Press MODE to reach SETUP. Turn the LIST knob left one click. Press ENT. Turn the LIST knob right 4 clicks.



2) Turn the DATA knob right to view the SNR values for each of the secondaries available in the chain being used.



SIGNAL LEVEL DISPLAY

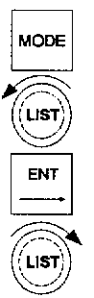
The APOLLO® Model 604 will display Signal Level values for all Master and secondary stations available in the chain selected.

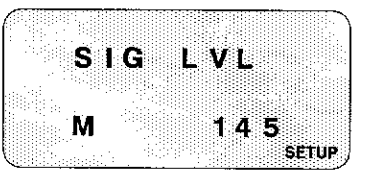
The Signal Level has a 100 dB range and will display values from 0 to 255. The SIG LVL values may drop very low and still provide accurate NAV information as long as the unit has locked onto the signal and the SNR values are adequate

SIGNAL LEVEL VALUE

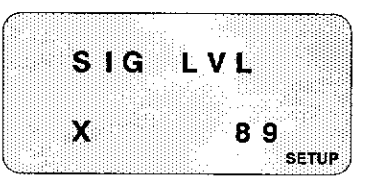
Signal Level is displayed by:

1) Press MODE to reach SETUP. Turn the LIST knob left one click. Press ENT. Turn the LIST knob right 5 clicks.





2) Turn the DATA knob right to view the signal levels for each of the secondary stations in turn.



ENVELOPE-TO-CYCLE DIFFERENCE (ECD) VALUES

The distance your position is from the transmitting stations has a direct effect on the ECD values. The closer you are to a station the higher the ECD value. The farther you are from a station the lower the ECD value. This condition is a result of the wave propagation characteristics of the LORAN-C signal. If you are close to a station, or if the SNR values are reading 175 or higher, do not be alarmed by high ECD values. The ECD should read fairly constant with an SNR value of 175, or higher.

When the APOLLO® Model 604 is first turned on, a settling time of approximately two minutes is required. During this time the APOLLO® Model 604 is performing the cycle selection process to determine the proper tracking point. The ECD values will not stabilize until the cycle selection is complete.

The WARN indicator will be lighted until the cycle selection is complete and the ECD values have stabilized. If the WARN indicator comes on while enroute, check the Signal Level, SNR, and ECD status. You may have to change to a new LORAN-C chain or a new secondary station.

ECD (Envelope-to-Cycle Difference) values are shown on the lower display as numbers from +5 to -5. The values represent the tracking point on the LORAN-C signal for the Master and secondary stations. The ECD values can be used to monitor the distortion of the LORAN-C signal.

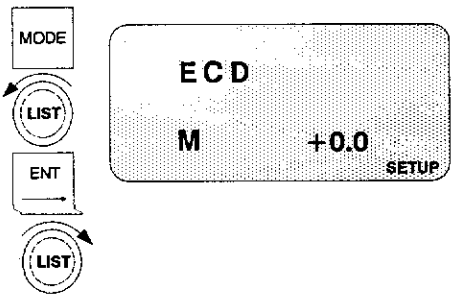
A reference is given below to help evaluate ECD values.

+5 - Unreliable
+4 - Poor
+3
+2
+1
0
- 1
- 2
- 3
- 4 - Poor
- 5 - Unreliable

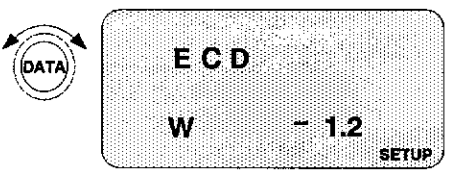
Normal range - values will vary with distance from transmitter

ECD Value Display

1) Press MODE to reach SETUP. Turn the LIST knob left one click. Press ENT. Turn the LIST knob right 6 clicks.



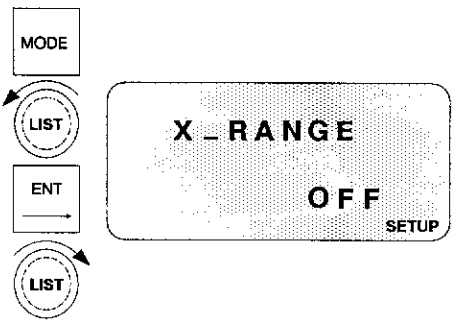
2) Turn the DATA knob to view each of the available secondary station ECD values in turn.



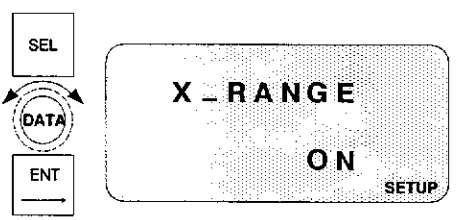
EXTENDED RANGE

The EXTENDED RANGE function allows you to use the APOLLO® Model 604 for navigation into the fringe LORAN-C coverage areas. When you use this function the APOLLO will lock onto the current tracking point of the LORAN-C pulses and allow you to continue navigation into deep fringe areas where the signal is very weak or into areas that are electrically very noisy. You should activate this function in an area that has adequate LORAN-C signal coverage before you fly to areas on the edges of the LORAN-C coverage areas. You should not activate the Extended Range function if you will not be entering a fringe coverage area as your accuracy may be decreased slightly.

1) Press MODE to reach SETUP. Turn the LIST knob left one click. Press ENT. Turn the LIST knob right 8 clicks.



2) Press SEL to enable selection of the function. Now, turn the DATA knob and then press ENT.



When the Extended Range function has been activated, the LAT/LON (ASF) Calibration Factors (see page G-16) may now adjust the LAT/LON coordinates within a range of 99.9 minutes, instead of the normal range of 9.99 minutes.

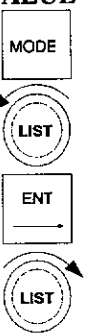
When you turn the unit off, the EXTENDED RANGE function will be reset to the "OFF" condition and LAT/LON calibration factors will be reset to zero if they were beyond 9.99. LAT/LON calibration factors within 9.99 will be retained. If EXTENDED RANGE is turned off, with the unit still on, any LAT/LON calibration factors exceeding 9.99 will be set to 9.99 and any LAT/LON calibration factors within 9.99 will be retained.

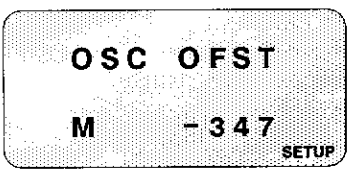
SERVICE DISPLAYS

The Service Displays allow the operator or service personnel to easily evaluate certain internal operations of the unit. The Service Displays are available in the SETUP Mode. These values are useful for servicing the unit and provide information that must be relayed to service personnel, or the factory, when referring to your particular unit.

OSCILLATOR OFFSET VALUE

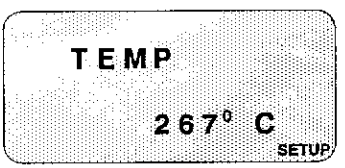
Press MODE to reach SETUP. Turn the LIST knob left one click. Press ENT. Turn the LIST knob right 7 clicks. These numbers will be different each time the unit is turned on and as the internal temperature changes.





CRYSTAL TEMPERATURE

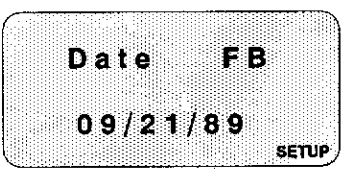
Turn the LIST knob two positions clockwise to display the Crystal Temperature. This is the internal temperature of the unit. The temperature is listed in degrees Celsius.



SOFTWARE VERSIONS

The APOLLO® Model 604 provides displays which indicate the Software Version for the FLYBRARY® and Operating System. The numbers displayed refer to the Software Versions in your particular APOLLO® Model 604. This information is necessary when the factory or dealer is contacted concerning your particular unit.

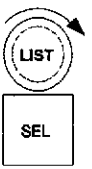
Turn the LIST knob one position clockwise to display the date code for the FLYBRARY®. The number shown indicates the 9th month and the 21st day of 1989. Your display may differ from the one shown. Turn the DATA knob cw for airspace date. Turn DATA cw again, for software version.

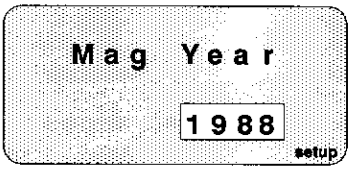


MAGNETIC VARIATION YEAR

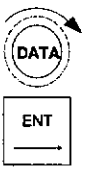
The APOLLO® Model 604 allows you to set the year value for Magnetic Variation between the year 1975 and 2020. The value you enter will be retained in memory.

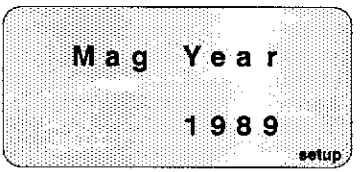
1. In the Receiver data portion of SETUP Mode turn the LIST knob to reach Mag Year. Press SEL to enable selection.





2. Turn the DATA knob to display the desired year and then press ENT.

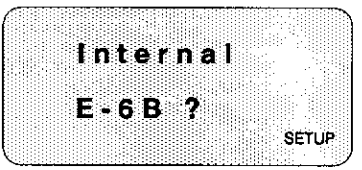




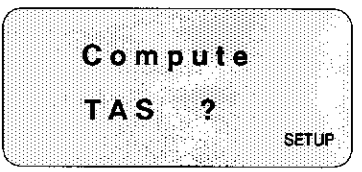
E-6B INTERNAL FLIGHT COMPUTER

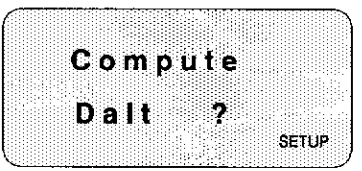
The E-6B Internal Flight Computer will allow you to calculate your True Airspeed (TAS), Density Altitude (DALT), and Winds Aloft (WIND) using your APOLLO 604. These will make your in-flight computations simple to achieve and will not interfere with any navigation functions.

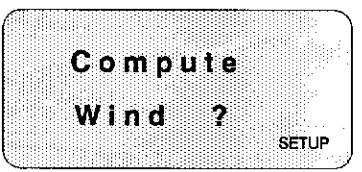
1) In SETUP Mode turn the LIST knob to reach the E-6B function. Press ENT to activate the function.



2) You may now turn the LIST knob to choose the True Airspeed, Density Altitude, or Winds Aloft computations. Press ENT to activate your choice.

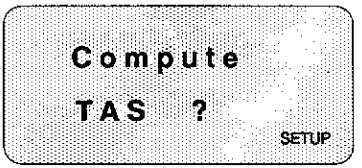




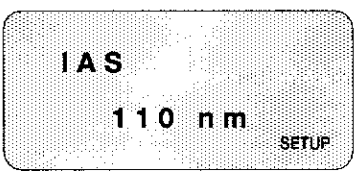


TRUE AIRSPEED (TAS)

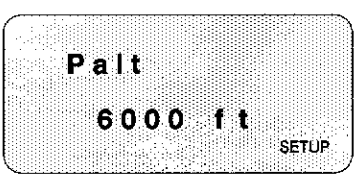
1) After enabling the E-6B feature, turn the LIST knob to reach the True Airspeed (TAS) function. Press ENT to activate the function.



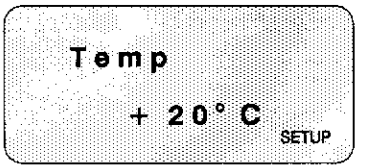
2) Press SEL to enable the Indicated Airspeed (IAS) value. The first of the three IAS value digits will flash. Now, turn the DATA knob to the value for the first digit and then press ENT. Continue for the required digits.



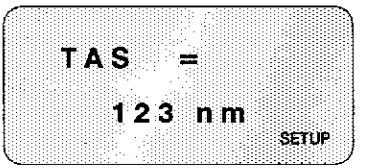
3) After entering the IAS, turn the LIST knob clockwise (cw) one position to reach the Pressure Altitude (PALT) value. Press SEL to enable the first of the PALT value digits. Now, turn the DATA knob to the value for the first digit and then press ENT. Continue for the required digits.



4) After entering the PALT, turn the LIST knob cw one position to reach the Temperature (TEMP) value. Press SEL to enable the sign (+/-) for the TEMP value. Now, turn the DATA knob to the sign for the TEMP and then press ENT. Continue for the required digits.

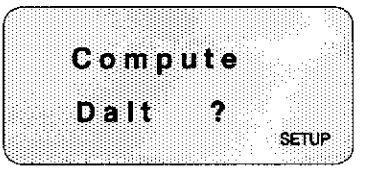


5) Now, turn the LIST knob cw one position to view your TAS.

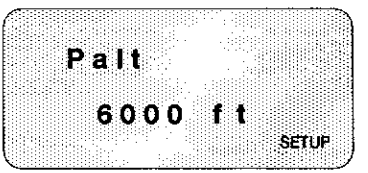


DENSITY ALTITUDE (DALT)

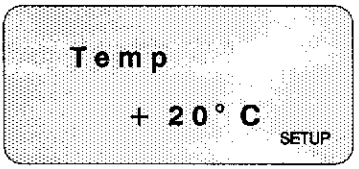
1) After enabling the E-6B feature, turn the LIST knob to reach the Density Altitude (DALT) function. Press ENT to activate the function.



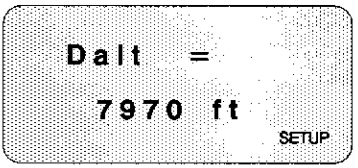
2) Press SEL to enable the Pressure Altitude (PALT) value. The first of the PALT digits will flash. Now, turn the DATA knob to the value for the first digit and then press ENT. Continue for the required digits.



3) After entering the PALT, turn the LIST knob cw one position to reach the Temperature (TEMP) value. Press SEL to enable the sign (+/-) for the TEMP value. Now, turn the DATA knob to the sign for the TEMP and then press ENT. Continue for the required digits.

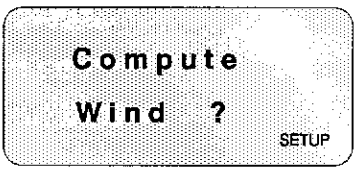


4) Now, turn the LIST knob cw one position to view your DALT.

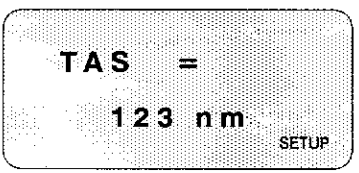


WINDS ALOFT (WIND)

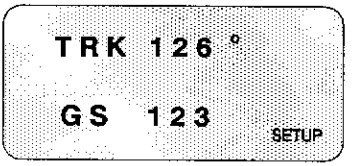
1) After enabling the E-6B feature, turn the LIST knob to reach the Winds Aloft (WIND) function. Press ENT to activate the function.



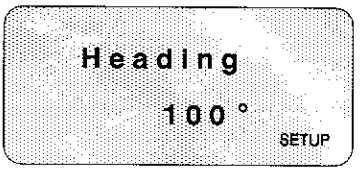
2) The True Airspeed (TAS) value will be displayed if you have performed the compute TAS function. If not, turn the LIST knob to the Palt display and enter the required values to compute your TAS.



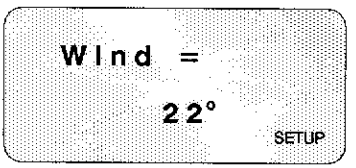
3) Turn the LIST knob one position cw to view the Track (TRK) and Ground Speed(GS) display.



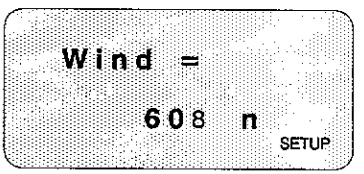
4) Turn the List knob one more position to view the Heading display. Press SEL to enable the Heading value. The first of the Heading digits will flash. Now, turn the DATA knob to the value for the first digit and then press ENT. Continue for the required digits.



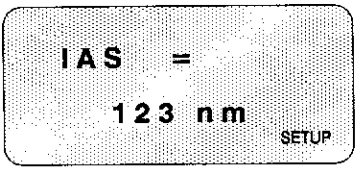
5) Turn the LIST knob one postion cw to view the Wind Direction Display.



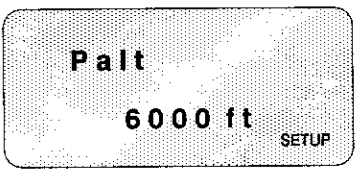
6) Turn the List knob one position cw to view the Wind Speed Display. Wind Speed is shown in nautical miles per hour



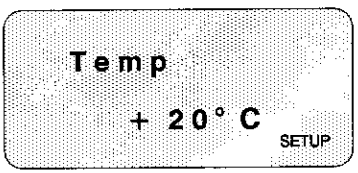
7) Press SEL to enable the Indicated Airspeed (IAS) value. The first of the three IAS digits will flash. Now turn the DATA knob to the value for the first digit and then press ENT. Continue for the required digits.



8) Press SEL to enaable the Pressure Altitude (PALT) value. The first ot the PALT digits will flash. Now turn the DATA knob to the value for the first digit and then press ENT. Continue for the required digits.



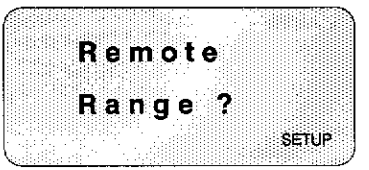
9) After entering the PALT, turn the LIST knob cw one position to reach the Temperature (Temp) value. Press SEL to enable the sign (+or -) for theTemp value. Now, turn the DATA knob to the sign for the Temp then press ENT. Continue for the required digits.



REMOTE RANGE COMPUTER

The Remote Range Computer allows you to display the range between any two waypoints without interfering with current navigation functions. The Remote Range may be calculated between any waypoint such as: Present Position, a Phantom Waypoint, any LAT/LON coordinate, or waypoints retrieved from the FLYBRARY® or user waypoints. The first procedure is to select the two waypoints, Location #1 and Location #2. Then you may view the Range and Bearing from Location #1 to #2, your Present Position (pp) to Location #1, and from your Present Position (pp) to Location #2.

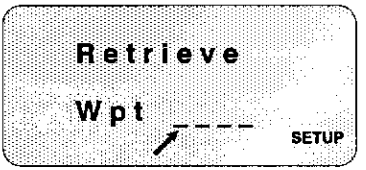
1) Press MODE to reach SETUP Mode. Turn the LIST knob to reach the Remote Range display. Press ENT to activate the function.



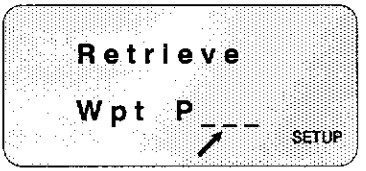
2) Enter Location #1.

START FROM A WAYPOINT RETRIEVED FROM MEMORY

1) Press SEL until you reach the Waypoint Retrieval choice. Then press SEL once more to enable selection of the first character of the waypoint name.

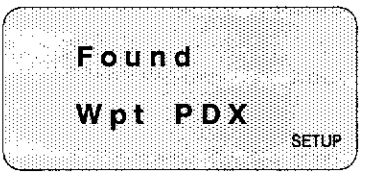


2) Turn the DATA knob to display the first character and then press ENT.

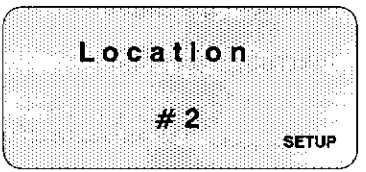


3) Continue for the required characters.

4) Then press ENT one final time to retrieve the waypoint.



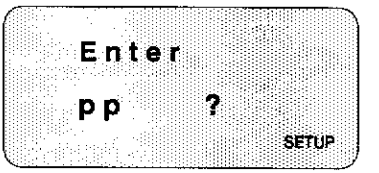
5) Now, turn the LIST knob one position cw and repeat the preceding procedures for Location #2.



START FROM YOUR PRESENT POSITION

1) Press SEL to enable the Starting Position choice.

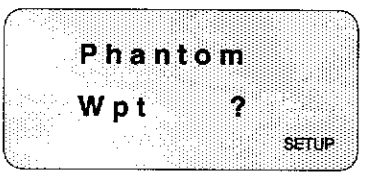
2) Press ENT.



START FROM A PHANTOM WAYPOINT

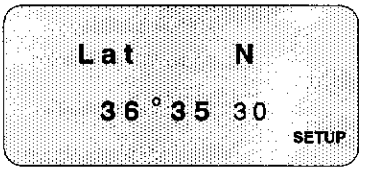
1) Press SEL until you reach the Phantom Waypoint choice. Press ENT.

2) Follow the prompts to enter the Phantom Waypoint position.



START FROM A LAT/LON COORDINATE

1) Press SEL until you reach the LAT/LON editing choice. Press ENT.

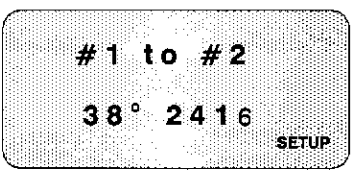


2) Follow the prompts to enter the Latitude and Longitude coordinate values.

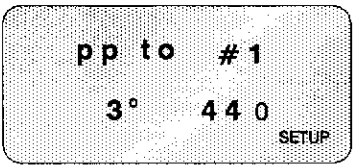
VIEWING RANGE AND BEARING CALCULATIONS

After setting your Location #1 and Location #2 waypoints you can view the Range and Bearing from Location #1 to #2, your Present Position (pp) to Location #1, and from your Present Position (pp) to Location #2.

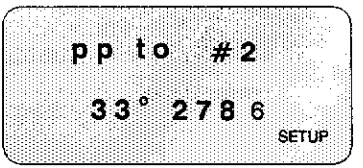
1) After you have set the final Location waypoint, turn the LIST knob to view the Range and Bearing from Location #1 to Location #2.



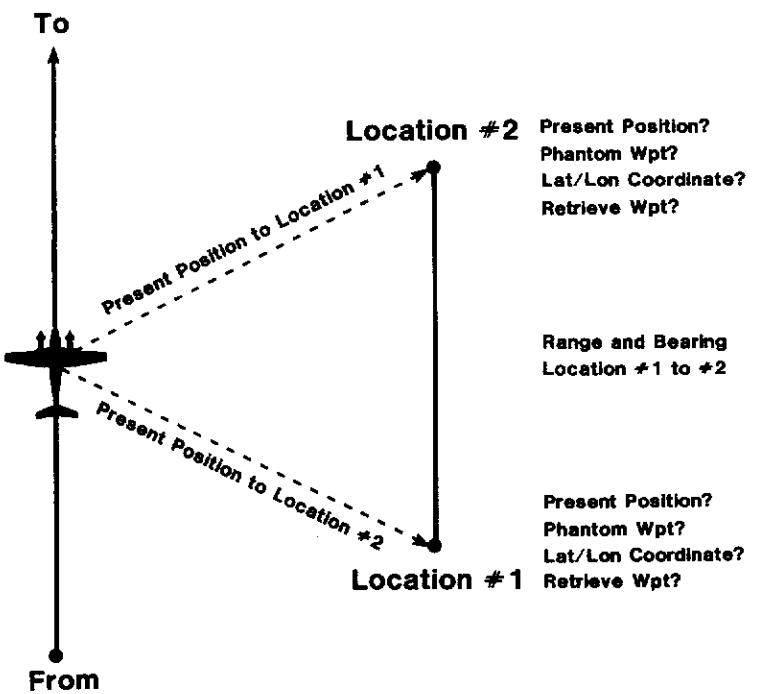
2) Turn the LIST knob one position cw to view the Range and Bearing from your Present Position (pp) to Location #1.



3) Turn the LIST knob one position cw to view the Range and Bearing from your Present Position (pp) to Location #2.



Remote Range Computer



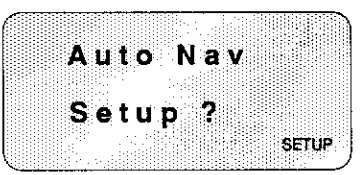
AUTO-NAV SETUP

The APOLLO® 604 allows you to customize your NAV Mode displays by letting you choose which of the available displays will be shown. You may choose up to nine pages for display during the Auto-Nav rotation. You will be able to view all eleven available displays when the Auto-Nav feature is disabled.

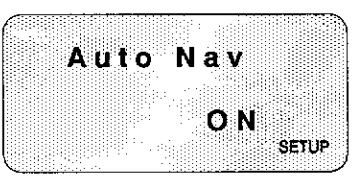
The Auto-Nav function of the APOLLO® 604 will allow you to set the unit to automatically rotate through the first nine pages (displays) in NAV Mode or to select the pages viewed. The Auto-Nav function will retain the state that you set it to (ON/OFF) even when the unit is turned off. With Auto-Nav turned on, press MODE to reach NAV Mode. Turn the LIST knob to one of the scroll pages selected in Auto Nav Setup, and press SEL. This will activate the rotation of the selected NAV pages. Pressing SEL again will stop the scrolling.

NAV Mode pages not available for viewing with the Auto-Nav function are: Flight Time and Time To Waypoint.

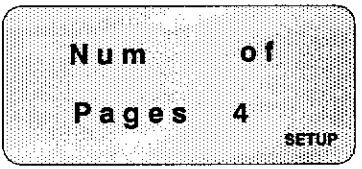
1. Press MODE to reach SETUP Mode. Turn the LIST knob to reach the Auto-Nav Setup display. Press ENT to reach the Auto-Nav Setup functions.



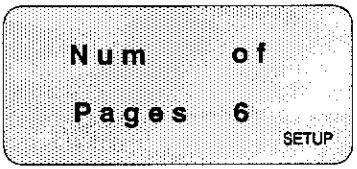
2. The Auto-Nav ON/OFF display is shown. When Auto-Nav is off, press SEL to enable selection, turn the DATA knob to ON, and then press ENT.



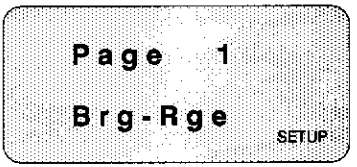
3. Turn the LIST knob one position cw and press SEL. You may now choose the number of pages to be displayed in NAV Mode. The number value for the pages will flash.



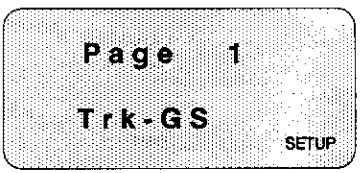
4. Turn the DATA knob to show the number of pages to be shown in NAV Mode and then press ENT.



5. Now, turn the LIST knob cw one position and choose the pages to be shown in NAV Mode and their order. The information shown for Page 1 will now be shown flashing in the bottom row (such as BRG-RGE TRK-GS, BRG-TRK, etc.).



6. Turn the DATA knob to show the information desired for Page 1 of the NAV Mode displays and then press ENT.



7. Continue for the rest of the required pages.

SPECIAL USE AIRSPACE

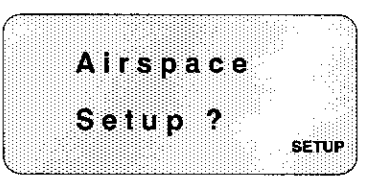
The Special Use Airspace Warning feature provides you with a warning indication that you are approaching a special use airspace. The warning distance is user-selectable within a range of 0 to 99 nautical miles. The WARN and POS annunciators will flash when you reach the warning distance boundary.

IMPORTANT

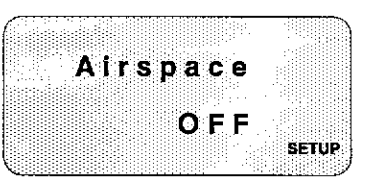
The Apollo® 604 is **NOT** intended to be the sole navigational aid. To accurately determine special use airspace, it is the responsibility of the pilot to consult additional means of navigation and flight planning

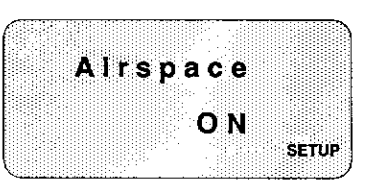
ACTIVATING THE SPECIAL USE AIRSPACE FEATURE

1) In Setup Mode turn the LIST knob to reach the Special Use Airspace Warning feature. Press ENT to get into the feature.



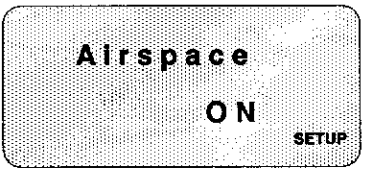
2) Turn the feature ON/OFF by pressing SEL, turning the DATA knob to the desired state, and then pressing ENT. The selection will remain in memory after the unit is turned off.





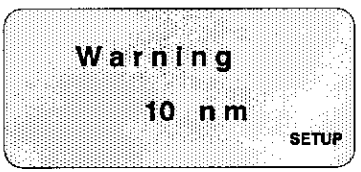
SETTING THE SPECIAL USE AIRSPACE WARNING DISTANCE

1) In Setup Mode turn the LIST knob to reach the Special Use Airspace Warning feature. Press ENT to get into the feature.



2) Turn the LIST knob to reach the warning distance display.

3) Press SEL to enable selection of the warning distance. Turn the DATA knob to the desired warning distance and then press ENT. This distance will be retained after the unit is turned off.

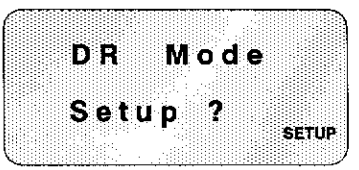


To leave Airspace Setup and remain in SETUP Mode, press DEL.

DEAD RECKONING COMPUTER

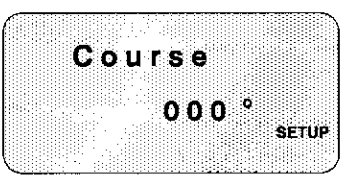
The Dead Reckoning (DR) Computer allows you to navigate in areas where LORAN-C or other types of modern navigation signal coverage is not available. The DR Computer will provide you with the familiar navigation information with your LORAN-C receiver. You may navigate by the DR computer after you enter your Course, Speed, and Starting Position. Your Starting Position may be entered as your: Present Position, a Phantom Waypoint, any LAT/LON coordinate, or a waypoint retrieved from the FLYBRARY® or USER waypoints.

1) Press MODE to reach SETUP Mode. Then, turn the LIST knob to reach the DEAD RECKONING Setup display.

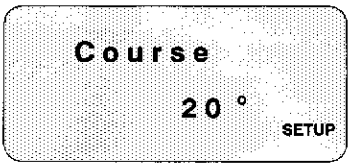


2) Press ENT to reach the setup displays for DR operation.

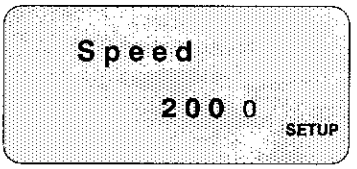
3) Enter your Course. Press SEL to enable selection of your Course values. The first digit of the Course value will flash. Press SEL a second or third time if you need to start with the second or third digits.



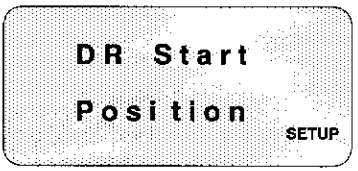
4) Turn the DATA knob to the required value and press ENT. Continue for the required values.



5) Enter your Speed. Turn the LIST knob one position clockwise (cw) to reach the Speed value. Press SEL to enable selection of your Speed values. The first digit of the Speed value will flash. Press SEL a second or third time if you need to start with the second or third digits.

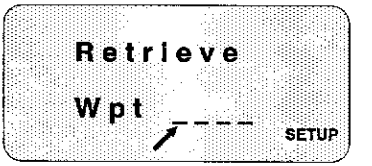


6) Enter your Starting Position. Turn the LIST knob one position clockwise (cw) to reach the DR Starting Position display. Press SEL to view and then press ENT to choose the type of Starting Position: Retrieve a waypoint from the FLYBRARY® Present Position, Phantom Waypoint, or a LAT/LON coordinate.

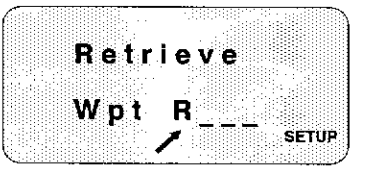


START FROM A WAYPOINT RETRIEVED FROM MEMORY

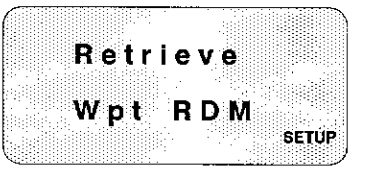
1) Press SEL until you reach the Waypoint Retrieval choice. Press ENT. Now, press SEL to enable selection of the first character of the waypoint name.



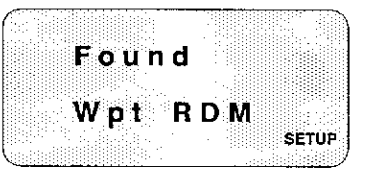
2) Turn the DATA knob to display the first character and then press ENT.



3) Continue for the required characters



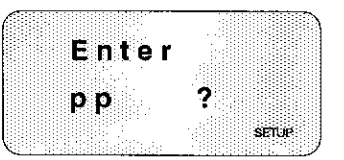
4) Then press ENT one final time to retrieve the waypoint.



START FROM YOUR PRESENT POSITION

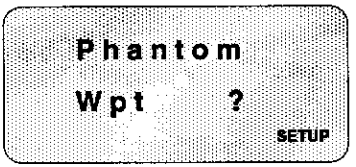
1) Press SEL to enable the Starting Position choice.

2) Press ENT.



START FROM A PHANTOM WAYPOINT

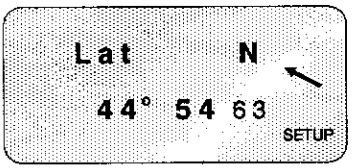
1) Press SEL until you reach the Phantom Waypoint choice. Press ENT.



2) Follow the prompts to enter the Phantom Waypoint position.

START FROM A LAT/LON COORDINATE

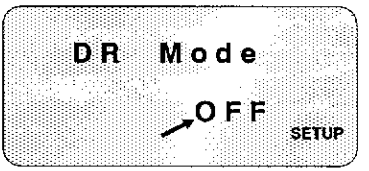
1) Press SEL until you reach the LAT/LON editing choice. Press ENT.



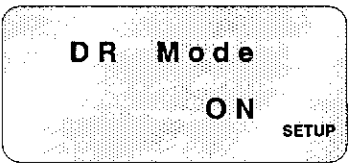
2) Follow the prompts to enter the Latitude and Longitude coordinate values.

ACTIVATING THE DEAD RECKONING COMPUTER

1) Turn the LIST knob to reach the DR Mode ON/OFF display and then press ENT



2) Turn the Data knob to choose ON or OFF and then press ENT.

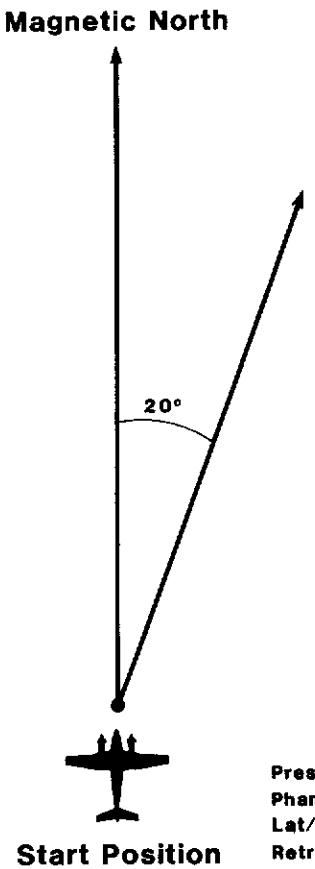


3) Press the DEL key or press MODE to get out of the DR Setup Mode.

NOTE

When DR is ON, the WARN light will remain on. All position and navigational data are being calculated by the DR computer instead of LORAN signals. Track and ground speed will now take approximately 20 seconds, using the new DR position data

Dead Reckoning Setup



SECTION H

LORAN-C

SECTION H

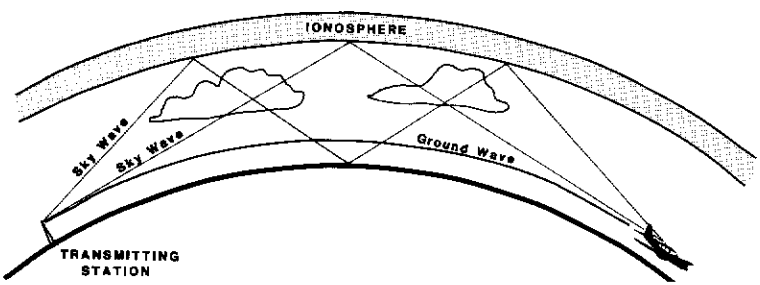
LORAN-C

DESCRIPTION OF THE LORAN-C SYSTEM

LORAN is an acronym for LOng RAnge Navigation. The "C" refers to the version of LORAN. A previous version of LORAN was called LORAN-A and a military version is LORAN-D. LORAN-C is a radio navigation aid that utilizes pulsed radio transmissions on a frequency of 100 kHz. LORAN-C receivers may be used in the air, on water, or on land within the coverage area of a chain.

The LORAN-C stations transmit with a carrier frequency of 100 kHz which is within the Low Frequency (LF) radio band. The LF radio band is propagated by means of the Ground Wave which means that these radio waves closely follow the surface of the Earth (see Figure 1). Use of ground wave signals allow for a high degree of accuracy and long range coverage. LORAN-C signals that are reflected back to the earth from the ionosphere are called sky waves. Sky waves are not consistent and are subject to so many variables that they may not be used for accurate navigation. High quality LORAN-C receivers reject sky wave contamination.

LORAN-C SIGNAL PROPAGATION



LORAN-C coverage is determined by the power of the station transmitters, distance between stations, station configuration, weather, and the type of terrain the signal must pass over. The signal travels farther and with less distortion over sea water in clear weather. Different types of terrain, power lines, and mineral deposits affect the speed and hence the accuracy of the LORAN-C signal.

LORAN-C TRANSMITTING STATIONS

The LORAN-C system consists of fixed land-based transmitters that are organized into groups called "chains" that provide signal coverage for a certain geographical area. Each LORAN-C chain is comprised of one Master station and up to four Secondary stations.

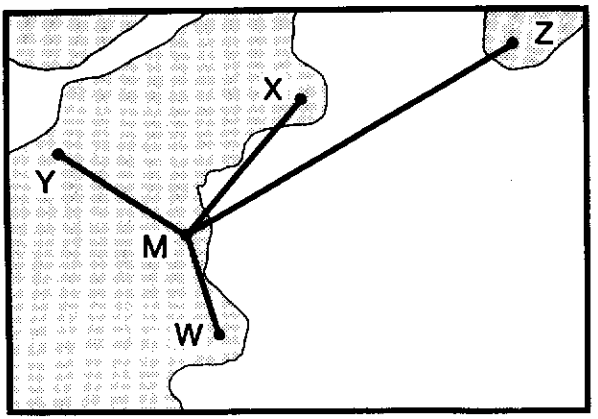
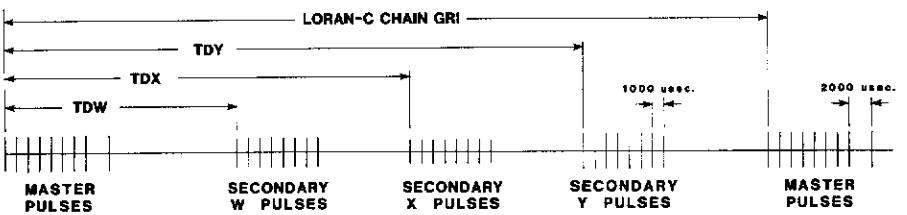


Figure 2 The Secondary stations are designated as Whiskey (W), Xray (X), Yankee (Y), or Zulu (Z) (see Figure 2). Each chain is assigned a unique time code called a Group Repetition Interval (GRI). The GRI is the time between the start of the Master station pulses and the beginning of the next series of Master pulses. The GRI is measured in microseconds (usec.). For instance, the U.S. West Coast chain is 9940. The GRI length of the U.S. West Coast chain from the beginning of the Master station pulse group to the start of the next one is 99,400 usec.

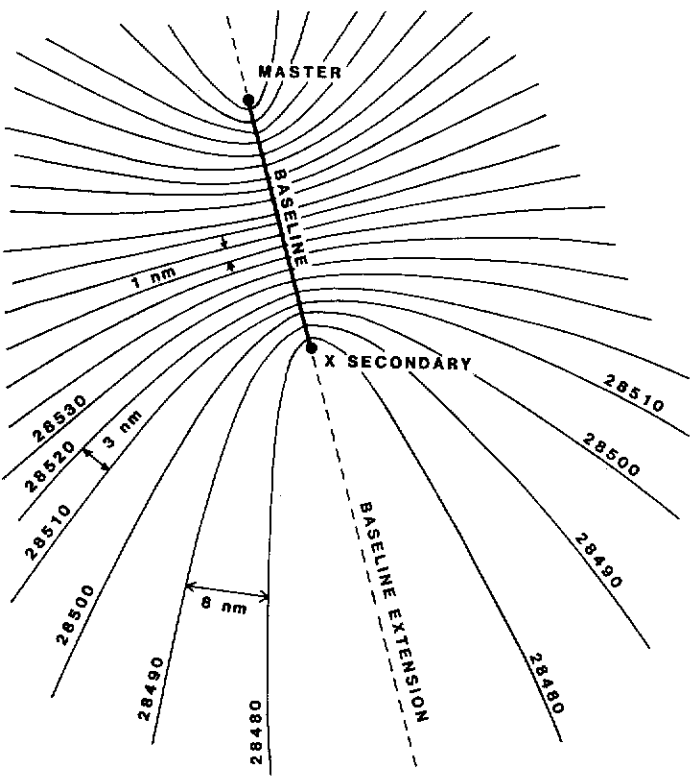


Each station transmits one pulse group in each GRI (see Figure 3). Each secondary station pulse group consists of eight pulses spaced 1 millisecond (ms.) apart. The master station transmits a group of eight pulses 1 ms. apart and then a ninth pulse 2 ms. after the group of eight to identify it as the master pulse. The master station transmits its pulse group and then each secondary station will transmit its group of pulses in turn after a precise predetermined time interval called a "coding delay". A coding delay is the time from the start of the master pulse group to the start of each secondary pulse group. Each secondary station within a chain is assigned its own separate coding delay.

HOW LORAN-C WORKS

The LORAN-C system is based on time measurement. Radio waves travel at the speed of light (approx. 186,000 miles per second) and will travel one nautical mile in approximately 6.18 micro-seconds (usec). The LORAN-C receiver is a precise time difference measuring instrument which processes the received information to determine a position fix.

The LORAN-C receiver monitors the signals from all stations within the LORAN-C chain selected by the operator. The receiver uses data from a triad (the master and two secondary stations) to provide a position fix. The receiver processes the data and measures the arrival time difference between the radio signals from the master and each of the secondary stations. The time difference (TD) is displayed by the LORAN-C receiver. All of the points that have the same TD from the master and that one secondary station when plotted on a chart will produce a hyperbola that is referred to as a Line Of Position (LOP) (see Figure 4). A second TD is found from the master and another secondary which now places the craft on a second LOP. Where the two LOPs cross is the exact position of the craft and establishes a fix.



HOW A LORAN-C RECEIVER OPERATES

When the LORAN-C receiver is turned on it is confronted with a variety of signals. The receiver follows a selection process to determine the correct signal.

1. The receiver examines the stored information to determine what it is looking for (GRI, secondaries, and internal values).

2. The signals are examined for phase coding to identify the correct signals.

3. The leading edge of the pulse envelope is examined and the proper tracking point is defined.

4. The cycle nearest the tracking point is selected and measurements are made from that cycle.

When this sequence has been completed, the WARN light will turn off and the receiver will then begin making calculations on navigation data. LORAN-C receivers are position determining devices. All navigation data is calculated from the constant updating of position fixes.

POSITION FINDING

The receiver processes the signal data and measures the arrival time difference (TD) between the LORAN-C signals from the master and each of the secondary transmitters. Each of the TDs is displayed by a digital readout as TDW, TDX, TDY, or TDZ. In this example the time difference between the master and the "W" secondary (TDW) is 13370 usec. This places the plane's location somewhere along the 13370 LOP (see Figure 5). The TD between the master and the "X" secondary (TDX) is 32200 usec. This places the airplane somewhere along the 32200 LOP (see Figure 6). Where the two LOPs cross is the location of the airplane (see Figure 7).

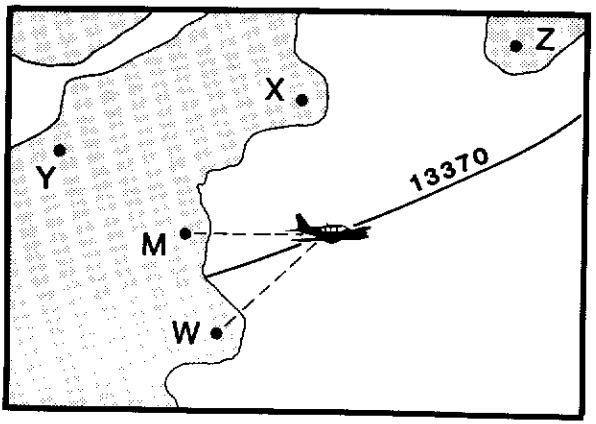


Figure 5

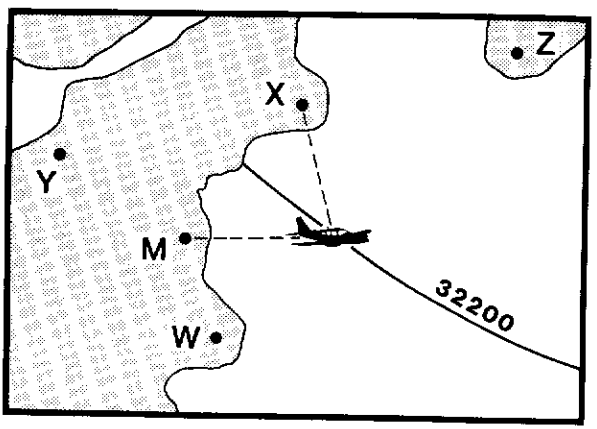


Figure 6

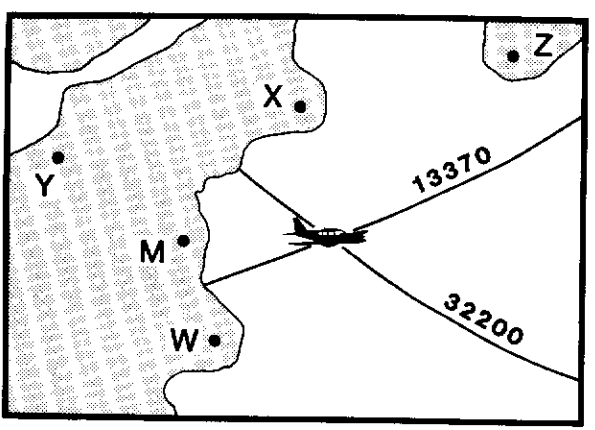


Figure 7

LAT/LON CONVERSION

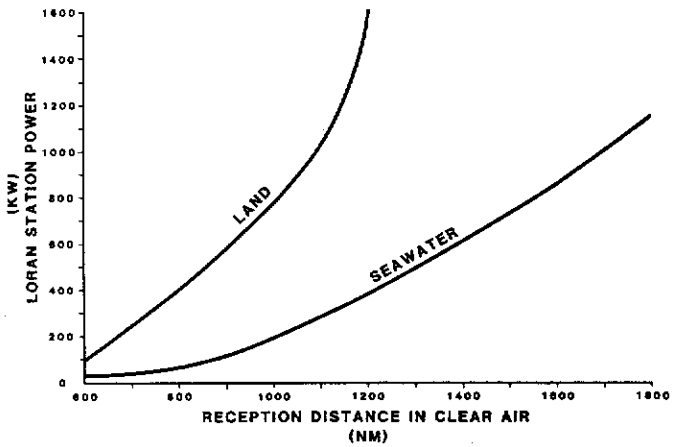
Most LORAN-C receivers have the ability to convert LOPs directly to Latitude and Longitude coordinates. Both LOPs and LAT/LON values are provided so that a variety of charts may be used for navigation. Latitude is an angular distance north and south of the equator and is measured in degrees, minutes, and seconds. The equator is 0^0 Latitude. The north pole is 90^0 N. Latitude and the south pole is 90^0 S. Latitude. Seconds are usually converted to hundredths of a minute. Convert seconds to 1/100s of a minute by dividing the seconds by sixty. For instance, LAT N $27^031'43"$ is converted to LAT N $27^031.72'$ by dividing 43" by 60. Each minute of Latitude is equal to one nautical mile (6076.115 feet) from the equator to the poles. Each minute of Longitude is equal to one nautical mile at the equator but is reduced in length as the poles are approached due to convergence.

ACCURACY

The accuracy of a position fix is determined by the combination of receiver limitations, signal condition, and the operator. Accuracy may refer to "absolute" accuracy or to "repeatable" accuracy.

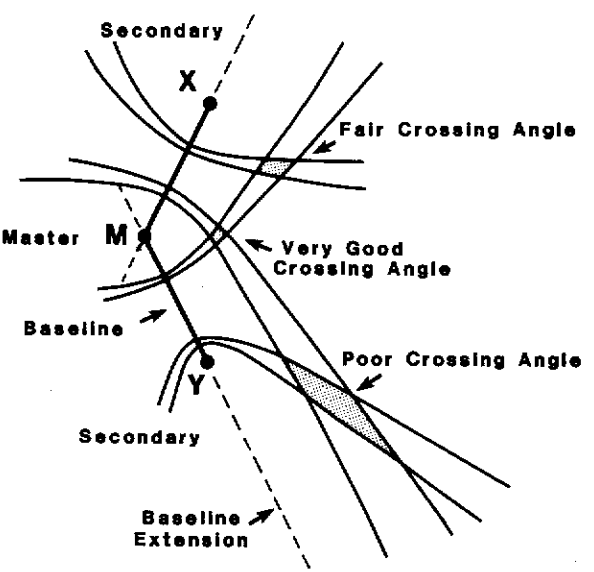
Absolute accuracy is the measure of the ability of the navigation system to determine your geographic position. The absolute accuracy of the LORAN-C system varies from 0.1 nm to 2.5 nm depending on the location within the coverage area and environmental conditions. A nautical mile equals 6076.115 feet (1852 meters) or 1.15 statute miles.

Repeatable accuracy is the measure of the ability of the navigation system to return to a position. The repeatable accuracy variance is typically less than 0.01 nm. It can be less or more depending on the location within the coverage area and environmental conditions.



Location within the coverage area determines, to a large degree, the accuracy of a position fix. Gradient, Baseline Extension, Crossing Angle, and LAT/LON solution all have an effect on the accuracy of the position determination. Gradient is the measure of the spacing between the LOPs (see Figure 4). Very close to transmitting stations the gradient is relatively small. Farther away from the stations or closer to the baseline extension the gradient gets larger. A location with a large gradient will have a correspondingly greater change in position for a small change in a TD value than would be seen for a location with a small gradient. This is one reason that position fixes are not as accurate on the fringe of coverage areas or near baseline extensions. The straight line between the master and a secondary station is a baseline. Good position accuracy is available near a baseline. The extensions of baselines beyond each station are called baseline extensions (see Figure 4). Position fixes very close to a baseline extension are unreliable. The crossing angle of the two LOPs provides a range for a position to be located (see Figure 9).

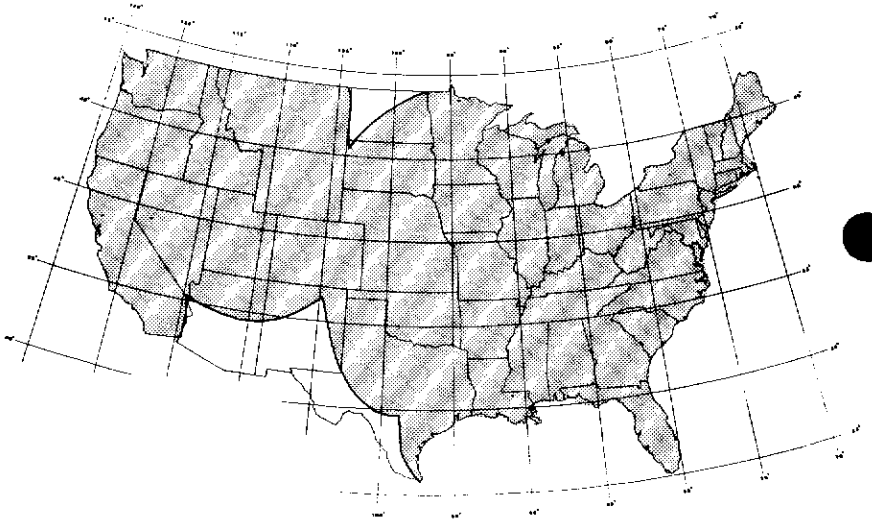
Crossing angles that are closest to 90^0 provide the most accurate position fixes. Crossing angles less than 20^0 are not reliable. All LORAN-C receivers initially determine a position fix based on LOPs and then produce a LAT/LON solution based on a mathematical formula referred to as an algorithm. LORAN-C receivers of different makes that would provide the same LOPs for a given position may give different LAT/LON coordinates due to the number of variables used in the algorithm.



ABOUT LORAN-C COVERAGE

The maps on the following pages are a guide to the LORAN-C coverage for each chain available. These maps are approximate as the actual coverage may vary by season or due to other signal considerations. Also, the accuracy and tracking ability vary with the LORAN-C receiver used. Your APOLLO® Model 604 will provide accurate navigation capability where most others will not. The VFR coverage areas provide accuracy of 3.5 nm (typically 0.6 nm or better). This is without entering any ASF values. Your actual VFR coverage is determined by the WARN annunciator.

COMPOSITE U.S. CONTINENTAL VFR COVERAGE

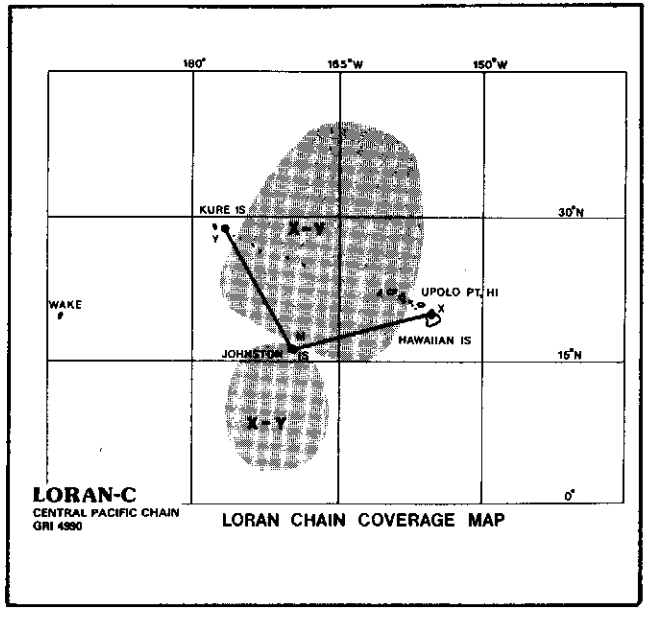


ADDITIONAL INFORMATION

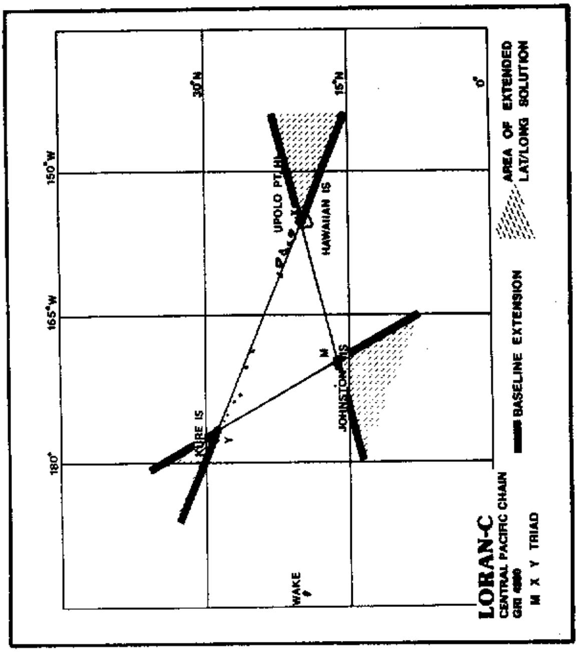
The LORAN-C USER HANDBOOK, COMDTINST M16562.4, printed by the U.S. Coast Guard, Department of Transportation, gives more detailed information and is an excellent reference. The HANDBOOK is no longer available from the U.S. Coast Guard but may be obtained from your LORAN-C receiver dealer, or Government bookstore.

CENTRAL PACIFIC LORAN-C CHAIN - GRI 4990 (old rate S1)

STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Johnston Is, HI	Master	16 44 44.0 N 169 30 31.0 W		275	
Upolu Pt, HI	Xray	20 14 49.2 N 155 53 09.7 W	11000/ 4972.23	275	Time service monitor.
Kure Is, HI	Yankee	28 23 41.8 N 178 17 30.2 W	29000/ 5253.17	275	
Lormonsite Johnston Is, HI	Monitor	16 43 19.5 N 169 32 36.8 W			
Lormonsta Honolulu, HI	Control				Controls X and Y.

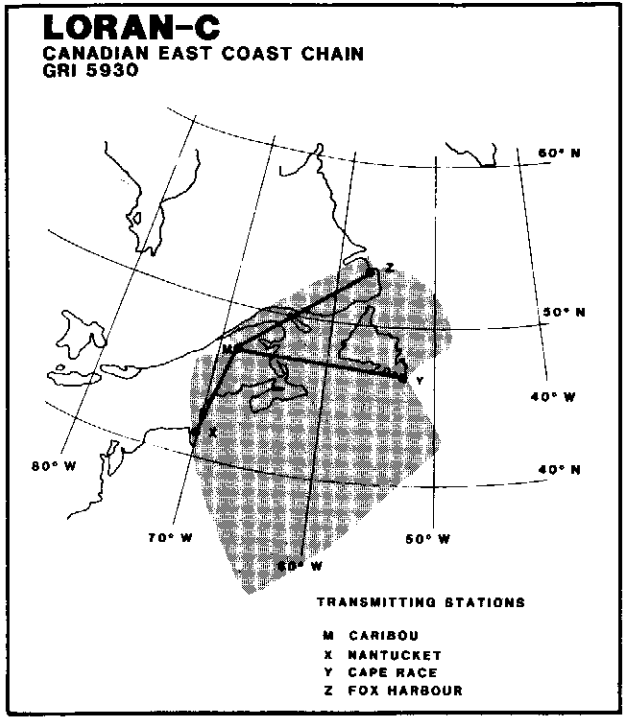


CENTRAL PACIFIC - 4990

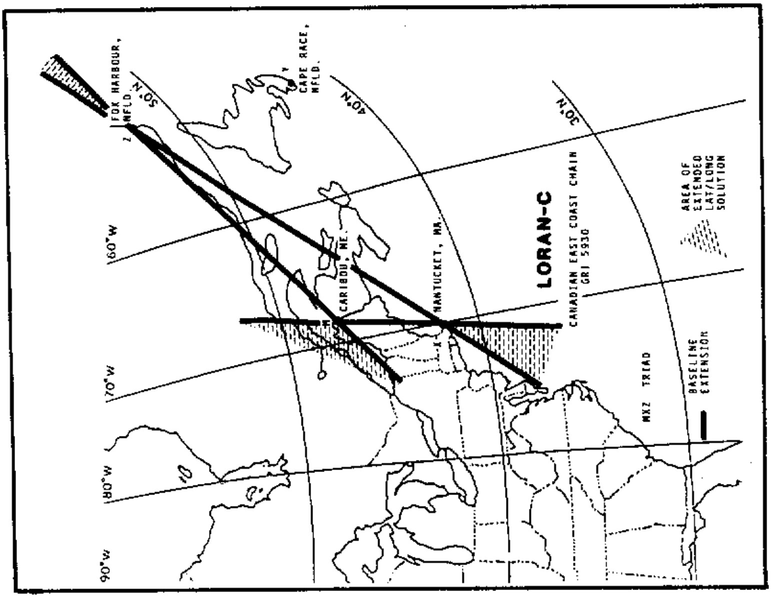

LORAN-C
CENTRAL PACIFIC CHAIN
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
180°
165°W
150°W
30°N
15°N
0°
KURE IS
JOHNSTON IS
UPOLO PT HI
HAWAIIAN IS
WAKE
M
X
Y

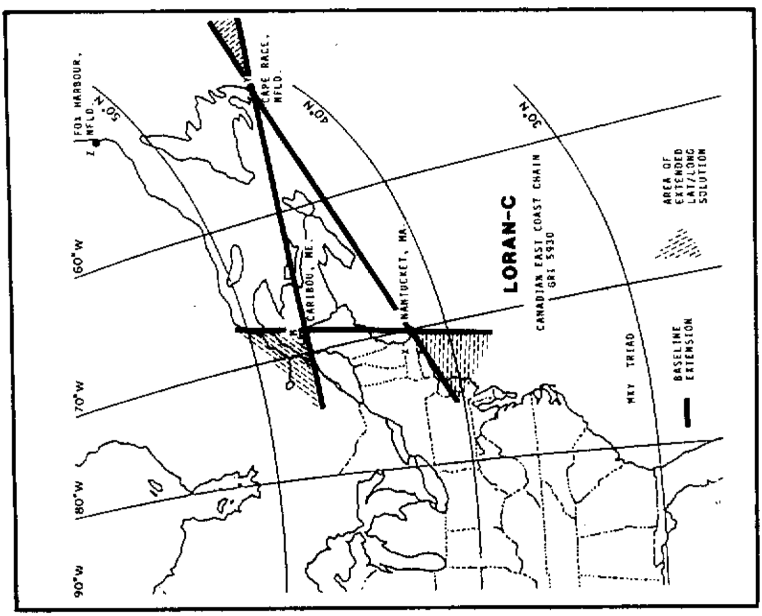
CANADIAN EAST COAST LORAN-C CHAIN - GRI 5930

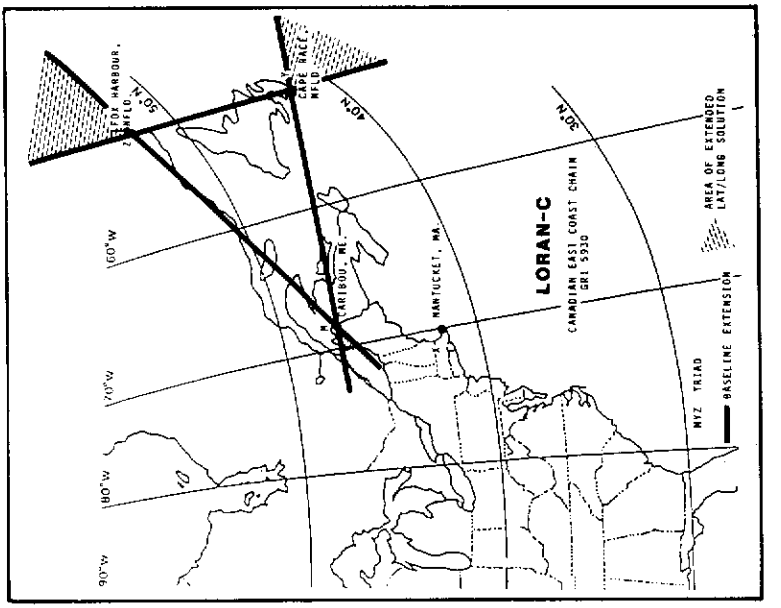
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Caribou, ME	Master	46°48'27.2"N 67°55'37.7"W		350	Dual-Rated to North-east U.S. Chain.
Nantucket, MA	Xray	41°15'11.9"N 69°58'39.1"W	11000/ 2131.88	275	Dual-Rated to North-east U.S. Chain.
Cape Race, NFLD	Yankee	46°46'32.2"N 53°10'28.2"W	25000/ 3755.02	1500	Dual-Rated to Labrador Sea Chain.
Fox Harbour, Labrador	Zulu	52°22'35.2"N 55°42'28.4"W	38000/ 3594.58	800	Dual-Rated to Lab-rador Sea Chain.
Cape Elizabeth, ME	Monitor	43°33'54.8"N 70°11'58.5"W			Unmanned Receiver Site.
Montague, P.E.I.	Monitor	46°11'40.0"N 62°39'37.0"W			Unmanned Receiver Site.
St. Anthony, NFLD	Monitor/ Control	51°21'37.0"N 55°37'28.0"W			Exercises Operational Control of the Chain.



CANADIAN EAST COAST - 5930

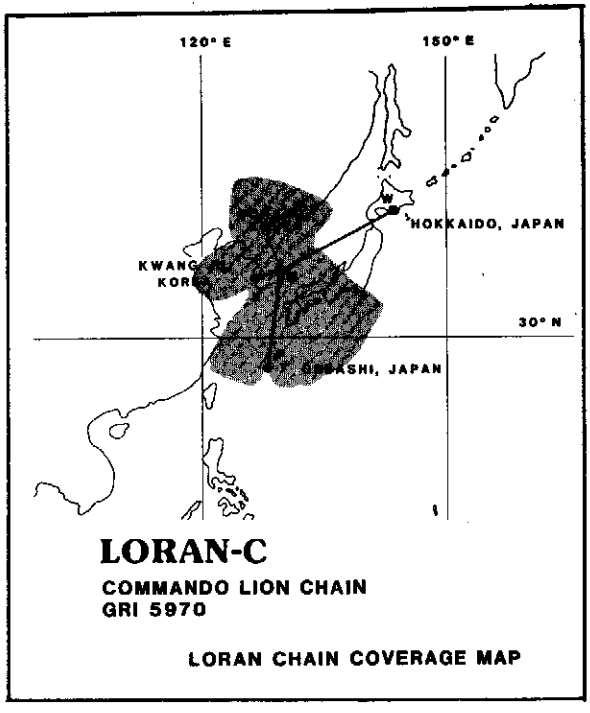

90°W
80°W
70°W
60°W
50°N
40°N
30°N
Z
FOX HARBOUR, NFLD.
Y
CAPE RACE, NFLD.
M
CARIBOU, ME.
X
NANTUCKET, MA.
LORAN-C
CANADIAN EAST COAST CHAIN
GRI 5930
MXZ TRIAD
AREA OF EXTENDED LAT/LONG SOLUTION
BASELINE EXTENSION


90°W
80°W
70°W
60°W
50°N
40°N
30°N
Z
FOX HARBOUR, NFLD.
Y
CAPE RACE, NFLD.
M
CARIBOU, ME.
X
NANTUCKET, MA.
LORAN-C
CANADIAN EAST COAST CHAIN
GRI 5930
MXY TRIAD
AREA OF EXTENDED LAT/LONG SOLUTION
BASELINE EXTENSION

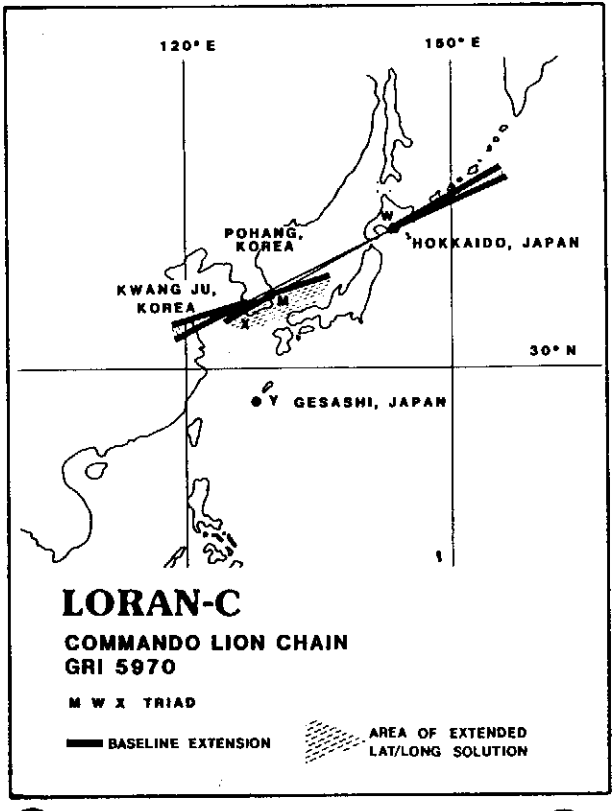

LORAN-C
CANADIAN EAST COAST CHAIN
GRI 5930
MYZ TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
CAPE RACE, NFLD.
FOX HARBOUR, LABRADOR
NANTUCKET, MA.
50°N
40°N
30°N
60°W
70°W
80°W
90°W

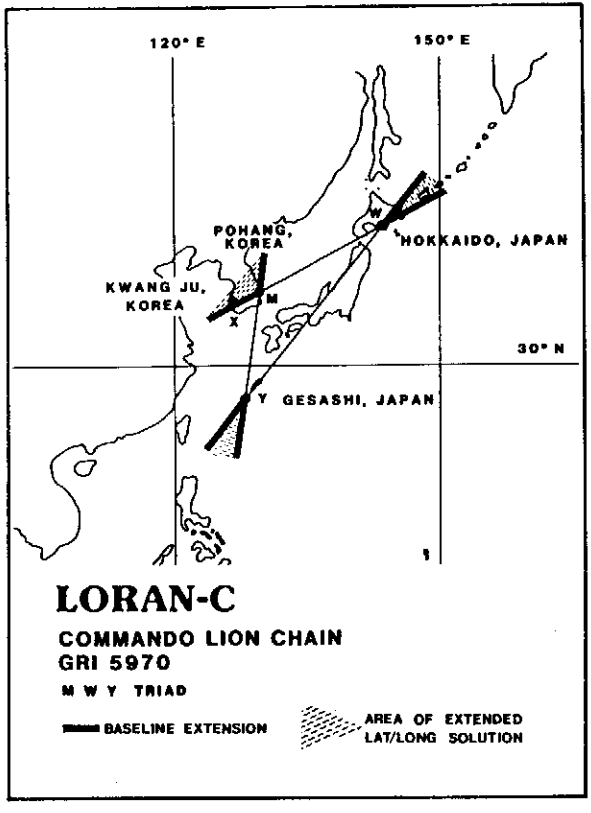
COMMANDO LION LORAN-C CHAIN - GRI 5970

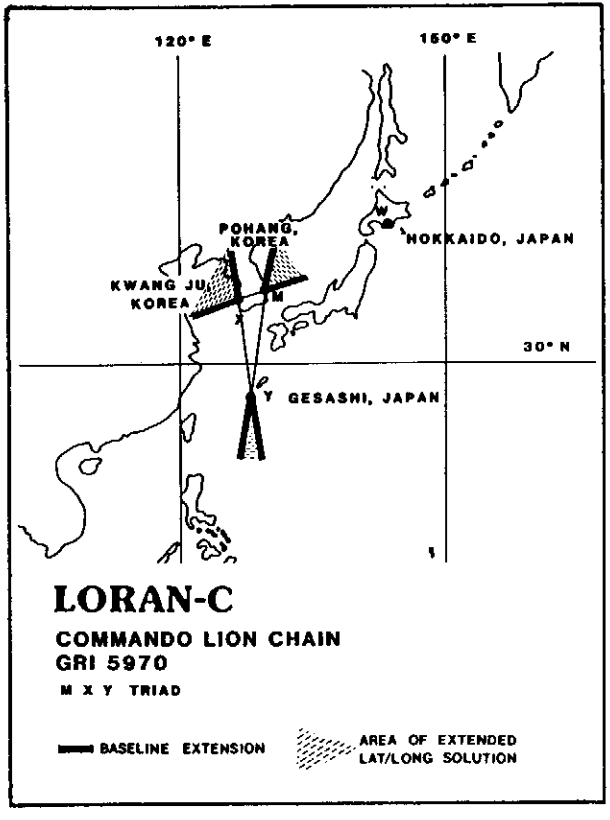
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER (kW)	REMARKS
Pohang, Korea	Master	36°11'05.8" N 129°20'27.3" E		35	
Hokkaido, Japan	Whisky	42°44'37.1" N 143°43'09.2" E	11000 4783.69	1000	Dual rated to Northwest Pacific Chain
Kwang Ju, Korea	Xray	35°02'23.9" N 126°32'26.7" E	31000 947.02	35	
Gesashi, Japan	Zulu	26°36'25.0" N 128°08'56.4" E	42000 3565.56	1000	Dual rated to Northwest Pacific Chain



COMMANDO LION - 5970

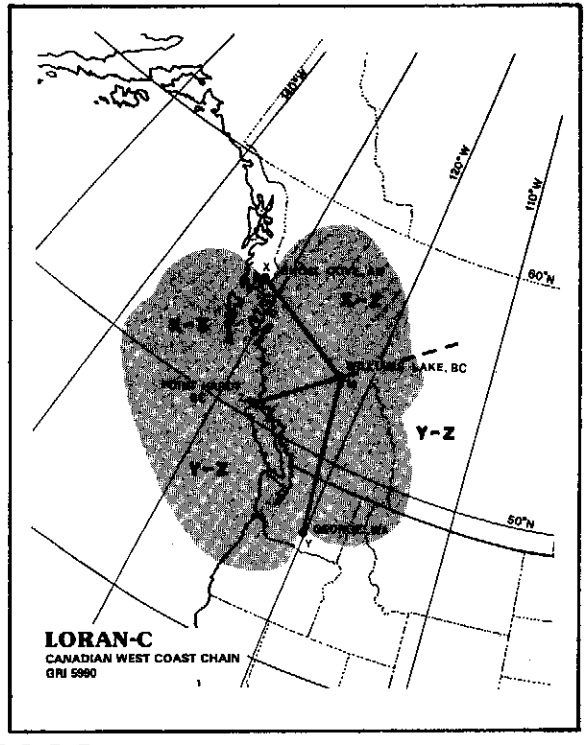

120° E
150° E
POHANG, KOREA
HOKKAIDO, JAPAN
KWANG JU, KOREA
M
W
X
30° N
Y GESASHI, JAPAN
LORAN-C
COMMANDO LION CHAIN
GRI 5970
M W X TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


120° E
150° E
POHANG, KOREA
HOKKAIDO, JAPAN
KWANG JU, KOREA
M
W
X
30° N
Y GESASHI, JAPAN
LORAN-C
COMMANDO LION CHAIN
GRI 5970
M W Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

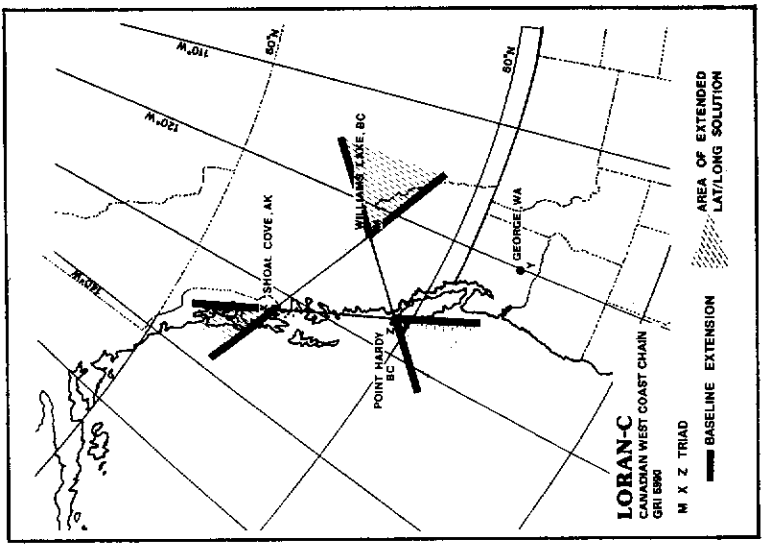

120° E
150° E
POHANG, KOREA
KWANG JU KOREA
W
NOKKAIDO, JAPAN
M
X
30° N
Y GESASHI, JAPAN
LORAN-C
COMMANDO LION CHAIN
GRI 5970
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

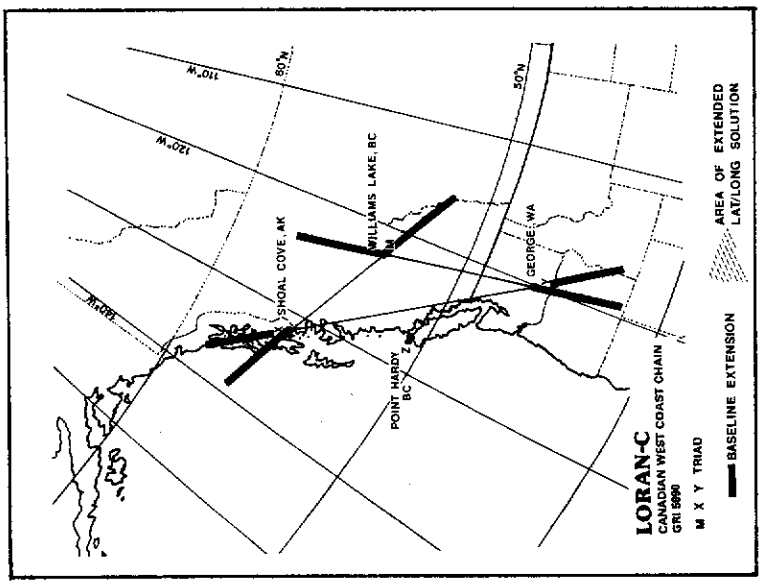
CANADIAN WEST COAST LORAN-C CHAIN - GRI 5990 (old rate SH1)

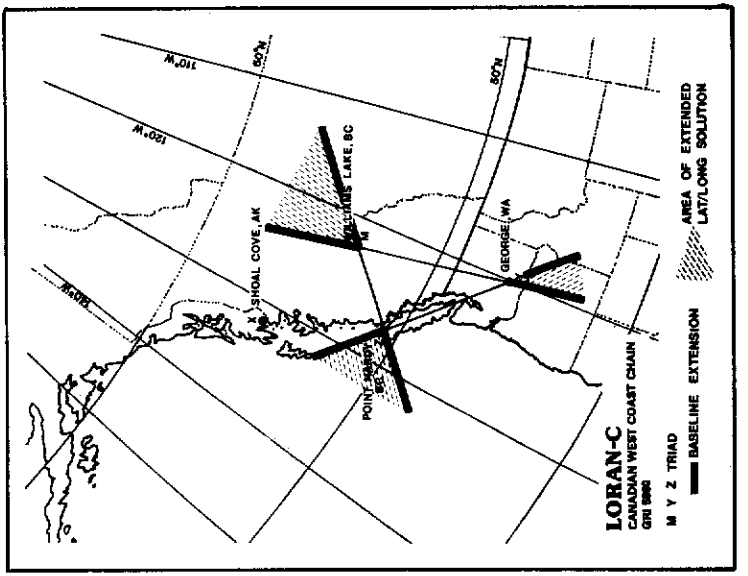
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Williams Lake, BC, Canada	Master	51 57 58.8 N 122 22 02.2 W		400	Control for X and Y. Two pulse comms installed.
Shoal Cove, AK	Xray	55 26 20.9 N 131 15 19.7 W	11000/ 2343.60	540	Two pulse comms installed. Dual-rated to Gulf of Alaska Chain.
George, WA	Yankee	47 03 48.0 N 119 44 39.5 W	27000/ 1927.36	1600	Two pulse comms installed. Dual-rated to U.S. West Coast Chain.
Port Hardy, BC, Canada	Zulu	50 36 29.7 N 127 21 29.4 W	41000/ 1266.63	400	Scheduled to be operational June 1980.
Alert Bay, Canada	Monitor	50 35 01 N 126 54 39 W			Unmanned receiver site.
Whidbey Is, WA	Monitor	48 17 39 N 124 33 55 W			Unmanned receiver site.



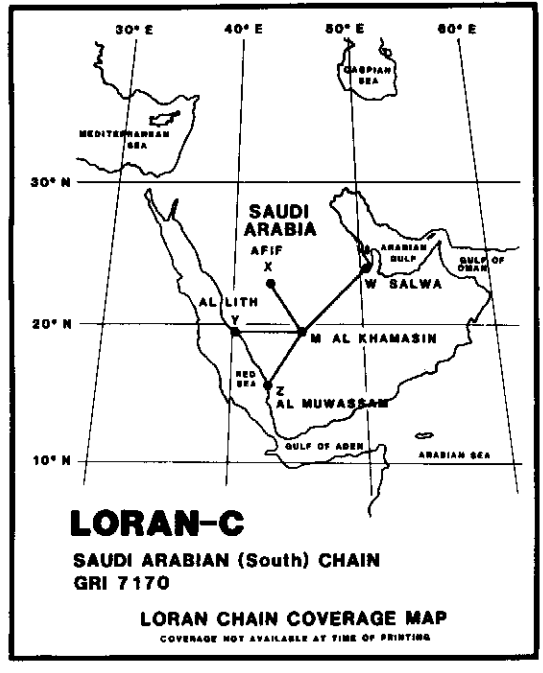
CANADIAN WEST COAST - 5990


LORAN-C
CANADIAN WEST COAST CHAIN
GRI 5990
M X Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
SHOAL COVE, AK
WILLIAMS LAKE, BC
POINT HARDY BC
GEORGE, WA
M
X
Z
110°W
120°W
130°W
80°N
50°N

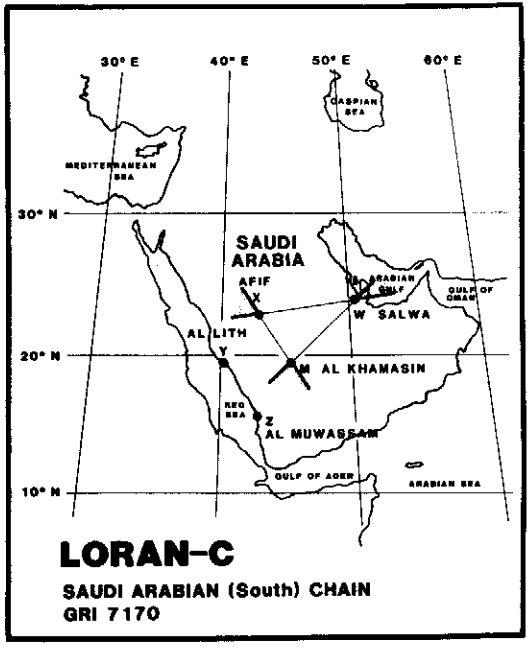

LORAN-C
CANADIAN WEST COAST CHAIN
GRI 5990
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
SHOAL COVE, AK
WILLIAMS LAKE, BC
POINT HARDY BC
GEORGE, WA
M
X
Y
110°W
120°W
130°W
80°N
50°N

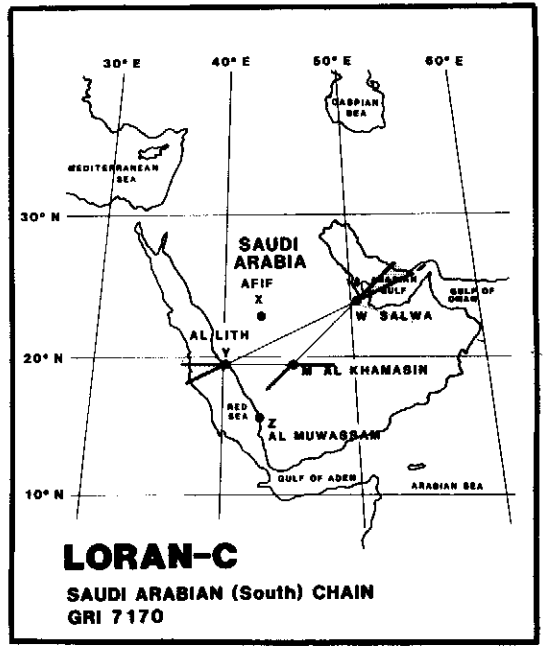

LORAN-C
CANADIAN WEST COAST CHAIN
GRI 9960
M Y Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
SHOAL COVE, AK
WILLIAMS LAKE, BC
GEORGE, WA
POINT AMEY, BC
50°N
130°W
110°W

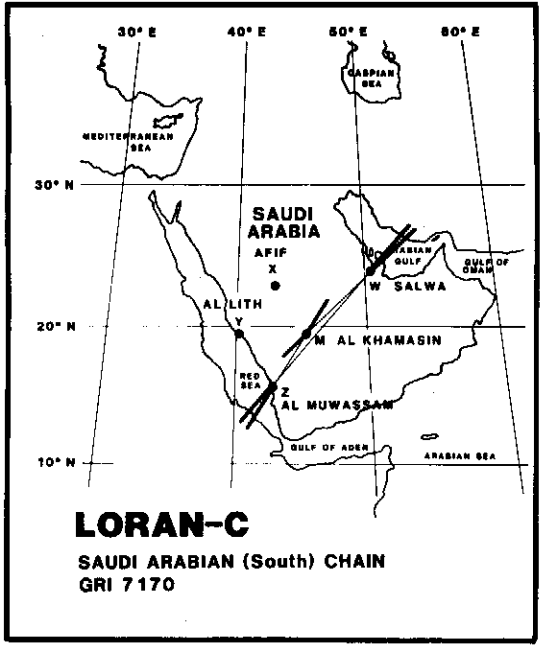
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER (kW)
Al Khamasin	Master	20°28'01.89" N 44°34'52.34" E		800
Salwa	Whisky	24°50'01.50" N 50°34'12.02" E	11000 2612.55	800
Afif	Xray	23°48'36.82" N 42°51'17.63" E	26000 1371.23	800
Al Lith	Yankee	20°13'58.31" N 40°12'31.02" E	39000 1526.50	200
Al Muwassam	Zulu	16°25'55.89" N 42°48'04.33" E	52000 1617.59	800

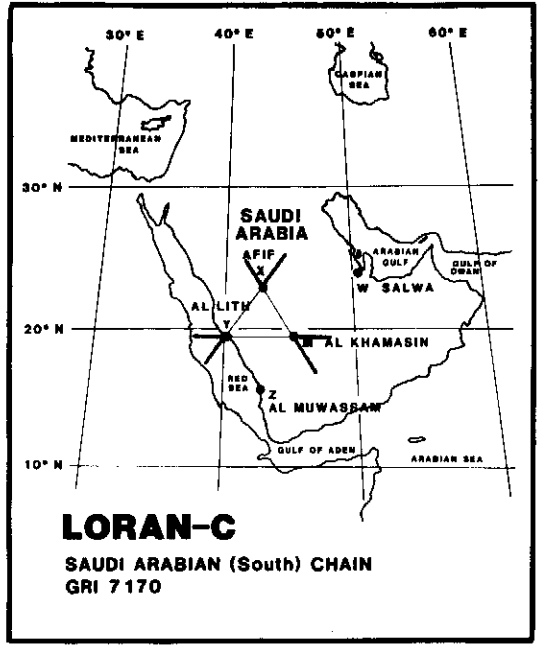


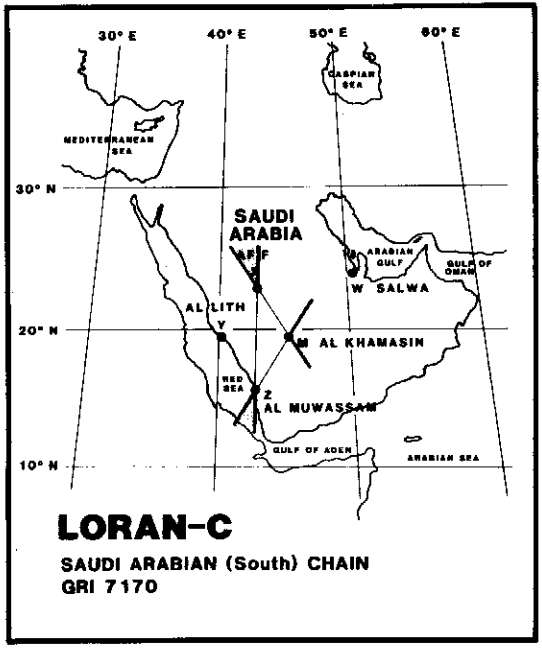
SAUDI ARABIA (South) - 7170

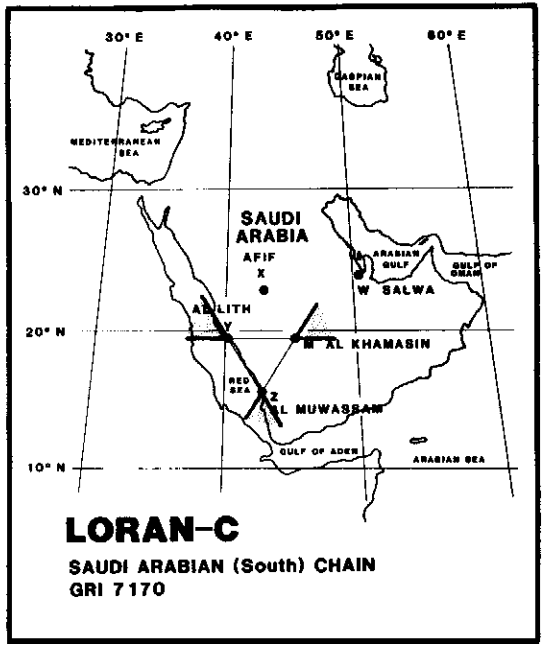

30° E
40° E
50° E
60° E
CASPIAN SEA
MEDITERRANEAN SEA
30° N
SAUDI ARABIA
AFIF
X
ARABIAN GULF
GULF OF OMAN
W SALWA
AL LITH
Y
20° N
M AL KHAMASIN
RED SEA
Z
AL MUWASSAM
GULF OF ADEN
ARABIAN SEA
10° N
LORAN-C
SAUDI ARABIAN (South) CHAIN
GRI 7170


30° E
40° E
50° E
60° E
CASPIAN SEA
MEDITERRANEAN SEA
30° N
SAUDI ARABIA
AFIF
X
ARABIAN GULF
GULF OF OMAN
W SALWA
AL LITH
Y
20° N
M AL KHAMASIN
RED SEA
Z
AL MUWASSAM
GULF OF ADEN
ARABIAN SEA
10° N
LORAN-C
SAUDI ARABIAN (South) CHAIN
GRI 7170


30° E
40° E
50° E
60° E
CASPIAN SEA
MEDITERRANEAN SEA
30° N
SAUDI ARABIA
AFIF
X
ARABIAN GULF
GULF OF OMAN
W SALWA
AL LITH
Y
20° N
M AL KHAMASIN
RED SEA
Z
AL MUWASSAM
GULF OF ADEN
ARABIAN SEA
10° N
LORAN-C
SAUDI ARABIAN (South) CHAIN
GRI 7170

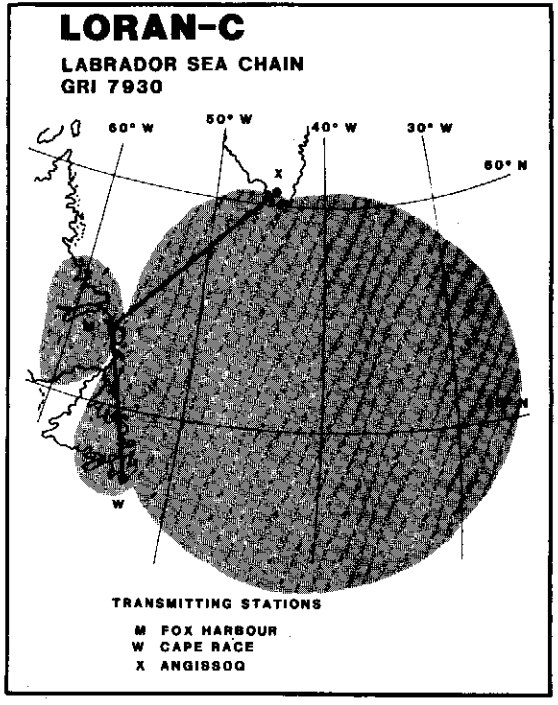

30° E
40° E
50° E
60° E
CASPIAN SEA
MEDITERRANEAN SEA
30° N
SAUDI ARABIA
AFIF
X
ARABIAN GULF
GULF OF OMAN
W SALWA
AL LITH
Y
20° N
M AL KHAMASIN
RED SEA
Z
AL MUWASSAM
GULF OF ADEN
ARABIAN SEA
10° N
LORAN-C
SAUDI ARABIAN (South) CHAIN
GRI 7170


30° E
40° E
50° E
60° E
CASPIAN SEA
MEDITERRANEAN SEA
30° N
SAUDI ARABIA
AFIF
ARABIAN GULF
GULF OF OMAN
W SALWA
AL LITH
Y
M AL KHAMASIN
RED SEA
Z
AL MUWASSAM
20° N
GULF OF ADEN
ARABIAN SEA
10° N
LORAN-C
SAUDI ARABIAN (South) CHAIN
GRI 7170

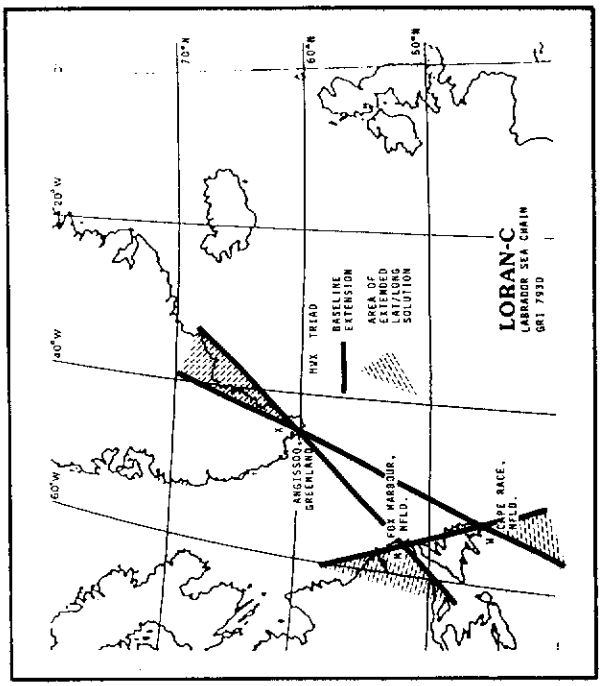

30° E
40° E
50° E
60° E
CASPIAN SEA
MEDITERRANEAN SEA
30° N
SAUDI ARABIA
AFIF
X
ARABIAN GULF
GULF OF OMAN
W SALWA
AL LITH
Y
M AL KHAMASIN
RED SEA
Z
AL MUWASSAM
20° N
GULF OF ADEN
ARABIAN SEA
10° N
LORAN-C
SAUDI ARABIAN (South) CHAIN
GRI 7170

LABRADOR SEA LORAN-C CHAIN - GRI 7930

STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Fox Harbour, Labrador	Master	52°22'35.2"N 55°42'28.4"W		800	Dual-Rated to Canadian East Coast Chain.
Cape Race, NFLD	Whiskey	46°46'32.2"N 53°10'28.2"W	11000/ ?167.30	1500	Dual-Rated to Canadian East Coast Chain.
Angissoq, Greenland	Xray	59°59'17.3"N 46°10'27.5"W	26000/ 3565.38	760	Dual-Rated to Icelandic Chain.
St. Anthony, NFLD	Monitor	51°21'37.0"N 55°37'28.0"W			



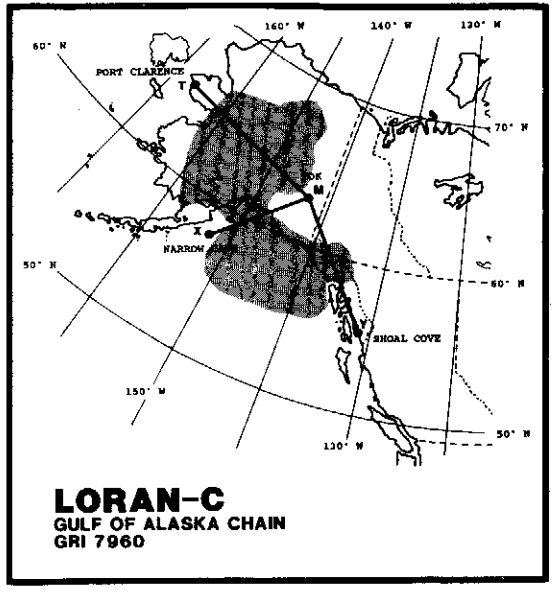
LABRADOR SEA - 7930


70°N
60°N
50°N
120°W
100°W
80°W
60°W
HVX TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
LORAN-C
LABRADOR SEA CHAIN
GRI 7930
ANGISSOQ, GREENLAND
FOX HARBOUR, NFLD.
CAPE RACE, NFLD.

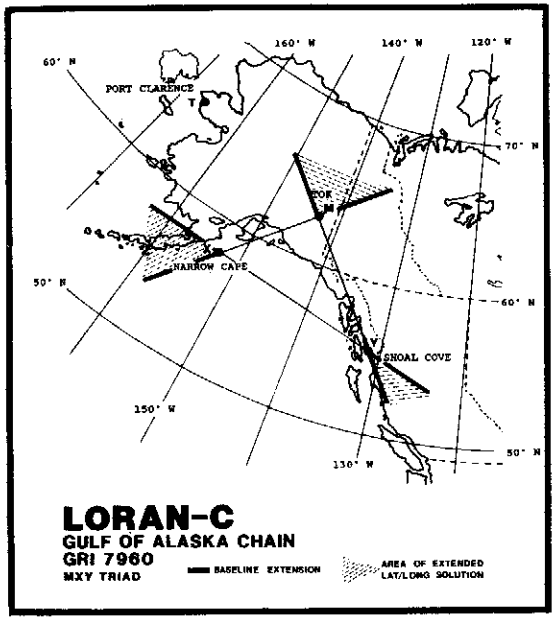
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER (kW)	REMARKS
Tok, AK	Master	63° 19 42.8 N 142° 48 31.9 W		540	Two pulse comms installed
Narrow Cape, Kodiak Is., AK	Xray	57° 26 20.2 N 152° 22 11.3 W	11000/ 2804.45	400	Two pulse comms installed. Dual rated to North Pacific chain.
Shoal Cove, AK	Yankee	55° 26 20.9 N 131° 15 19.7 W	26000/ 3651.14	540	Two pulse comms installed. Dual rated to Canadian West Coast chain.
Port Clarence, AK	Tango	65° 14 40.3 N 166° 53 12.6 W	44000/ 3932.52	1000	Dual rated to North Pacific chain.
Kodiak, AK	Monitor/ Control	57° 44 00.7 N 152° 30 20.4 W			Exercises operational control of chain, control for X and Y.
Juneau, AK	Monitor	58° 17 54.8 N 134° 24 45.4 W			Unmanned receiver site.

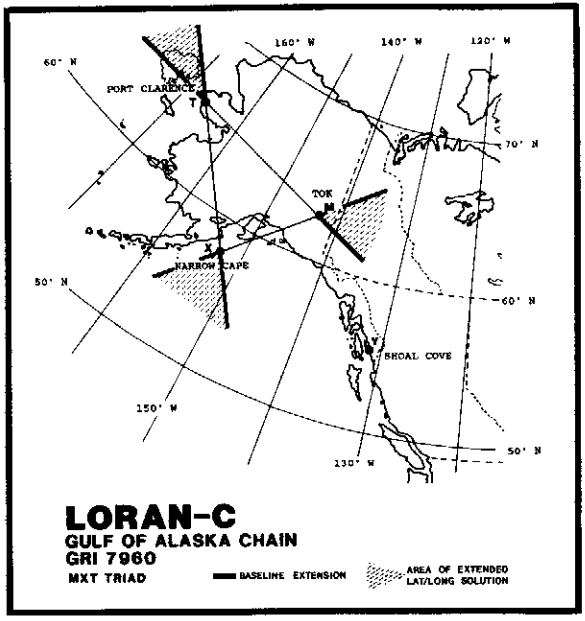
All numbers for the Tango secondary are approximate and preliminary as provided by the U.S. Coast Guard. After the test and evaluation period, the Tango secondary may be named as Zulu. The maritime coverage of 7960 will not be affected. The coverage diagram shown on this page does not reflect any additional coverage that may be available with the use of the Tango secondary.

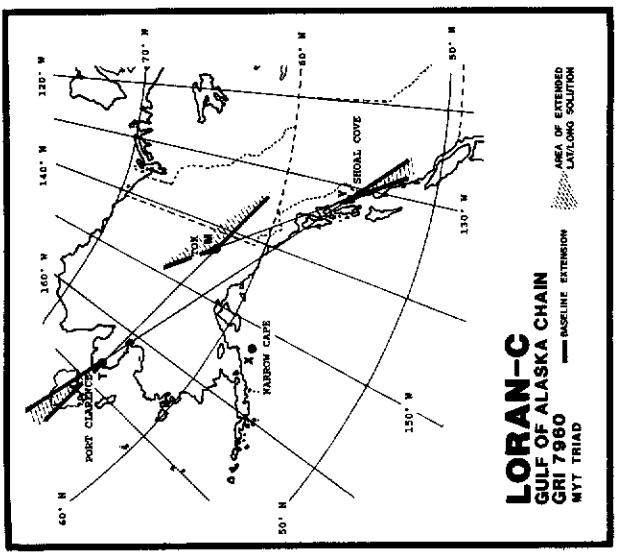
Transmitted signals of the 7960T baseline are, at the time of printing, used for government testing only and not for operational use until further notice. The signals from the 7960T baseline are subject to change without advance warning, may transmit unusable, altered signals for government testing, and may be turned on and off at any time. Any use of the 7960T baseline signal information is not authorized by the U.S. Government and will be at the risk of the user.



GULF OF ALASKA - 7960

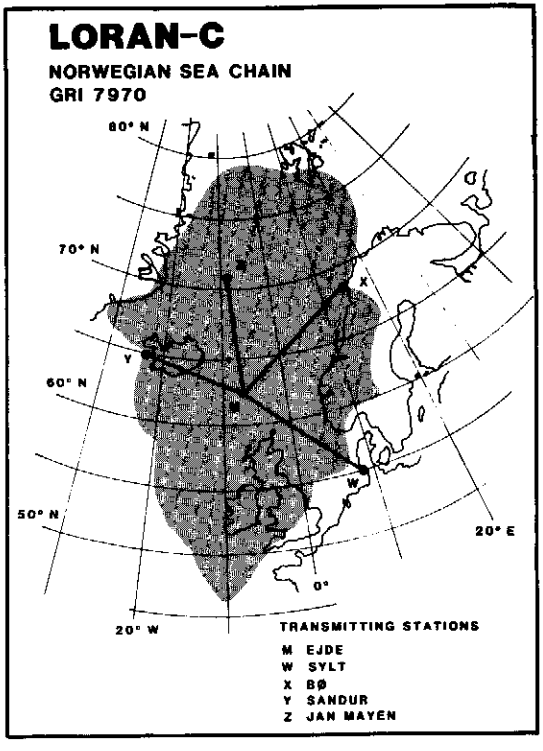

160° W
140° W
120° W
60° N
70° N
50° N
60° N
150° W
130° W
50° N
PORT CLARENCE
TOK
NARROW CAPE
SHOAL COVE
LORAN-C
GULF OF ALASKA CHAIN
GRI 7960
MXY TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


160° W
140° W
120° W
60° N
70° N
50° N
60° N
150° W
130° W
50° N
PORT CLARENCE
TOK
NARROW CAPE
SHOAL COVE
LORAN-C
GULF OF ALASKA CHAIN
GRI 7960
MXT TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

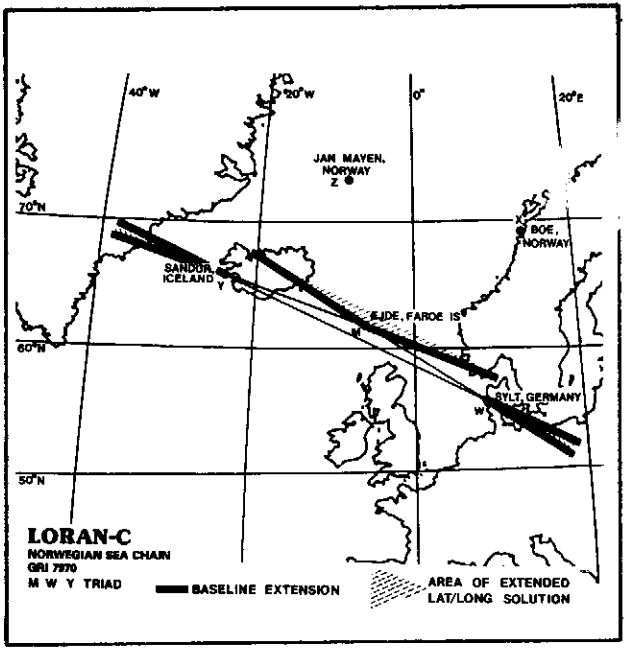

LORAN-C
GULF OF ALASKA CHAIN
GRI 7960
MYT TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
SHOAL COVE
NARROW CAPE
PORT CLARENCE
60° N
50° N
120° W
130° W
140° W
150° W
160° W
170° W

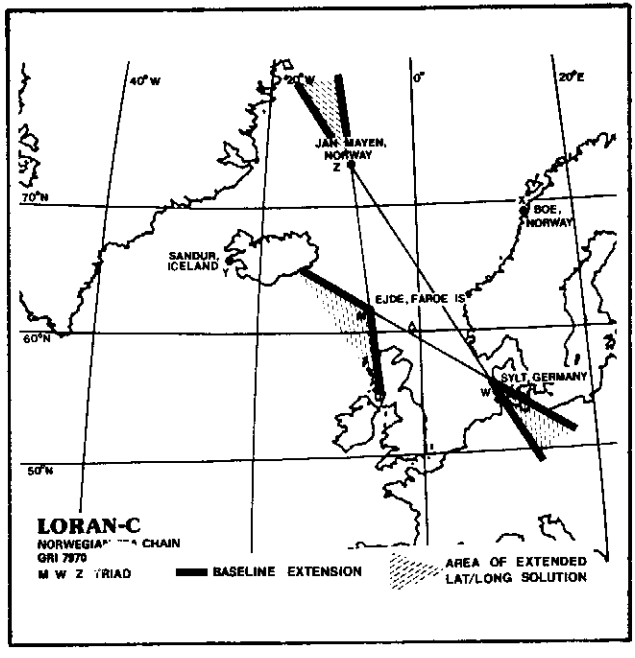
NORWEGIAN SEA LORAN-C CHAIN - GRI 7970 (old rate SL3)

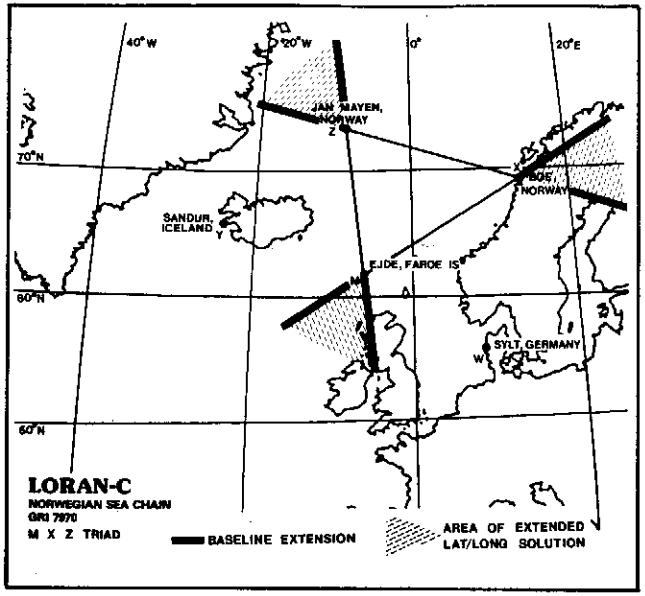
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Ejde, Faeroe Is. Denmark	Master	62 17 59.7 N 07 04 26.7 W		325	Host Nation Manned, Dual-rated to North Atlantic Chain.
Bø, Norway	Xray	68 38 06.2 N 14 27 47.0 E	11000/ 4048.10	165	Host Nation Manned.
Sylt, Germany	Whiskey	54 48 29.8 N 08 17 36.3 E	26000/ 4065.64	325	
Sandur, Iceland	Yankee	64 54 26.6 N 23 55 21.8 W	46000/ 2944.53	1500	Host Nation Manned, dual-rated to North Atlantic Chain.
Jan Mayen, Norway	Zulu	70 54 52.6 N 08 43 58.7 W	60000/ 3216.30	165	Host Nation Manned.
Shetland Is., U.K.	Monitor/ Control	60 25 25.3 N 01 18 05.7 W			Control for X, W, Y, and Z

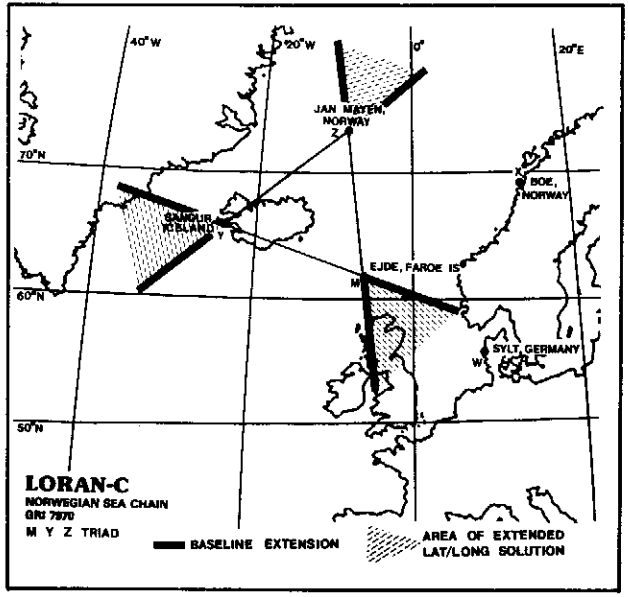


NORWEGIAN SEA - 7970

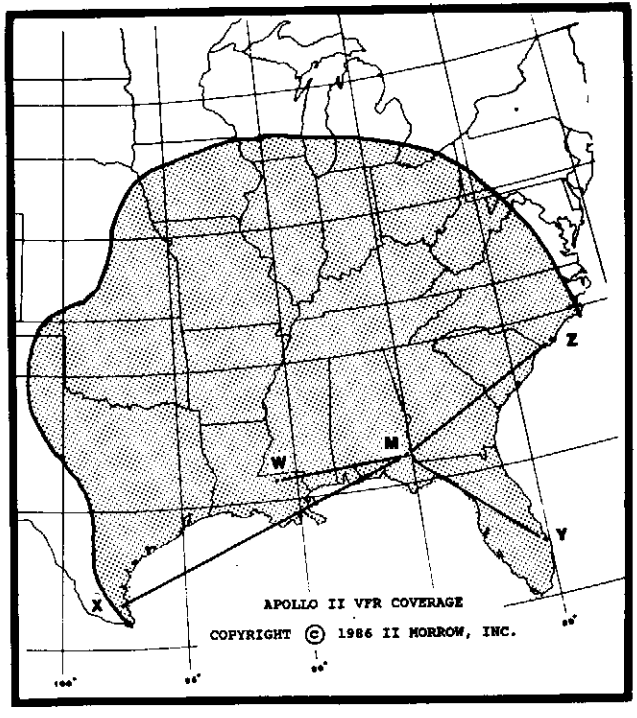

40°W
20°W
0°
20°E
70°N
60°N
50°N
JAN MAYEN, NORWAY
Z
BOE, NORWAY
X
SANDUR, ICELAND
Y
EJDE, FAROE IS
M
SYLT, GERMANY
W
LORAN-C
NORWEGIAN SEA CHAIN
GRI 7970
M W Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


40°W
20°W
0°
20°E
70°N
60°N
50°N
JAN MAYEN, NORWAY
Z
BOE, NORWAY
X
SANDUR, ICELAND
Y
EJDE, FAROE IS
M
SYLT, GERMANY
W
LORAN-C
GRI 7970
M W Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

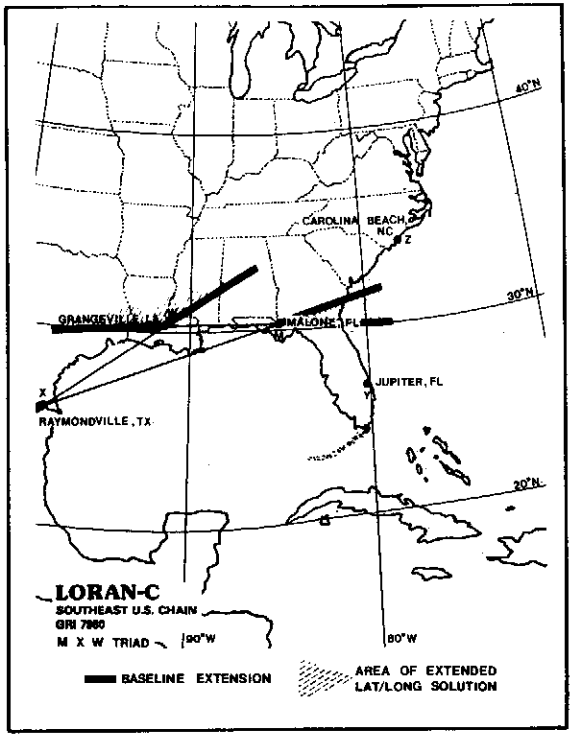

40°W
20°W
0°
20°E
70°N
60°N
JAN MAYEN, NORWAY
Z
BOE, NORWAY
X
SANDUR, ICELAND
Y
EJDE, FAROE IS
M
SYLT, GERMANY
W
LORAN-C
NORWEGIAN SEA CHAIN
GRI 7970
M X Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

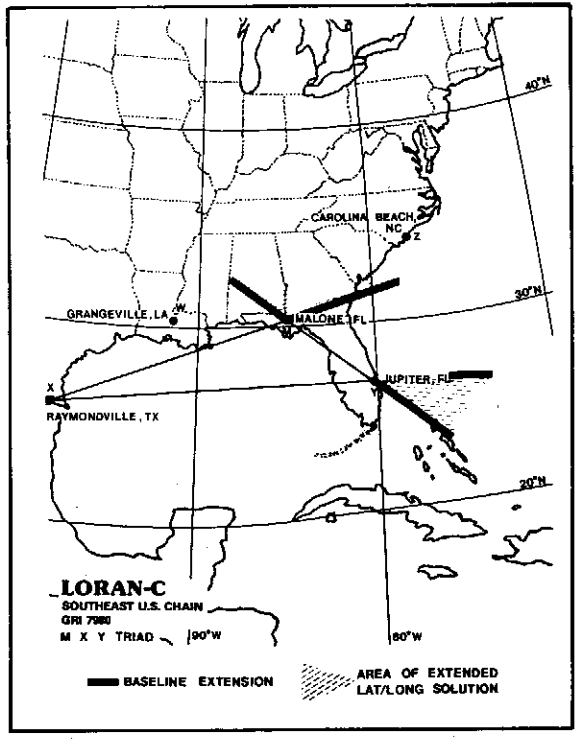

40°W
20°W
0°
20°E
70°N
60°N
50°N
JAN MAYEN, NORWAY
Z
BOE, NORWAY
X
SANDUR, ICELAND
Y
EJDE, FAROE IS
M
SYLT, GERMANY
W
LORAN-C
NORWEGIAN SEA CHAIN
GRI 7970
M Y Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

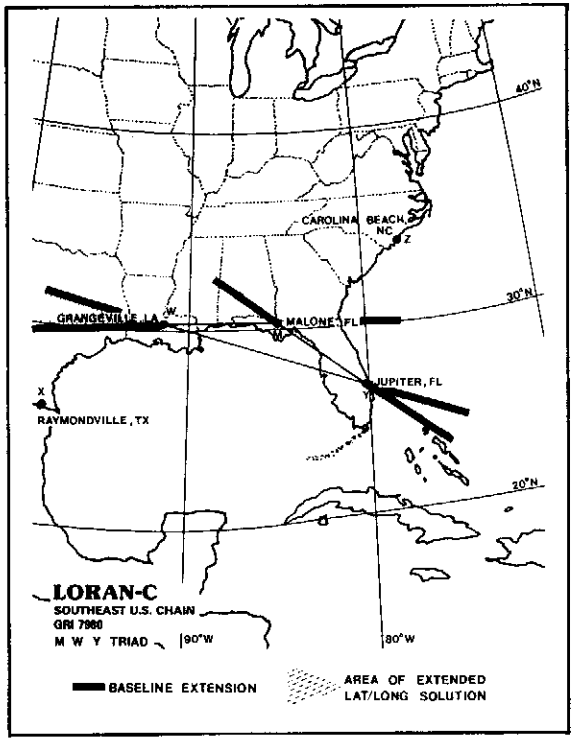
STATION	FUNCTION	COORDINATES	CODING DELAY-BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Malone, FL	Master	30 59 38.7 N 85 10 09.3 W		800	Control for W, X, Y, and Z. Dual-rated to Great Lakes Chain.
Grangeville, LA	Whiskey	30 43 33.0 N 90 49 43.6 W	11000/ 1809.54	800	
Raymondville, TX	Xray	26 31 55.0 N 97 50 00.1 W	23000/ 4443.38	400	
Jupiter, FL	Yankee	27 01 58.5 N 80 06 53.5 W	43000/ 2201.88	275	
Carolina Beach, NC	Zulu	34 03 46.0 N 77 54 46.8 W	59000/ 2542.72	550	
Mayport, FL	Monitor	30 22 58.9 N 81 25 13.1 W			Unmanned receiver site.
Eglin, FL	Monitor	30 35 05.3 N 86 36 54.4 W			Unmanned reciever site.
New Orleans, LA	Monitor	29 49 17.5 N 90 01 44.2 W			Unmanned receiver site.

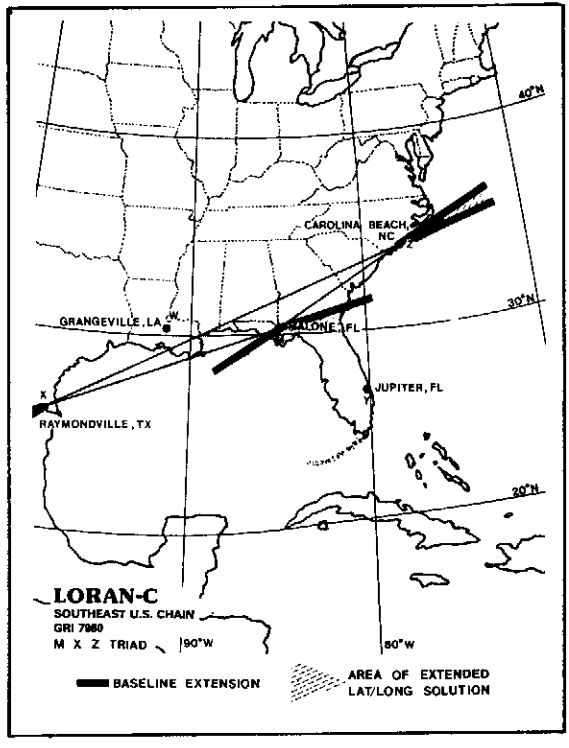


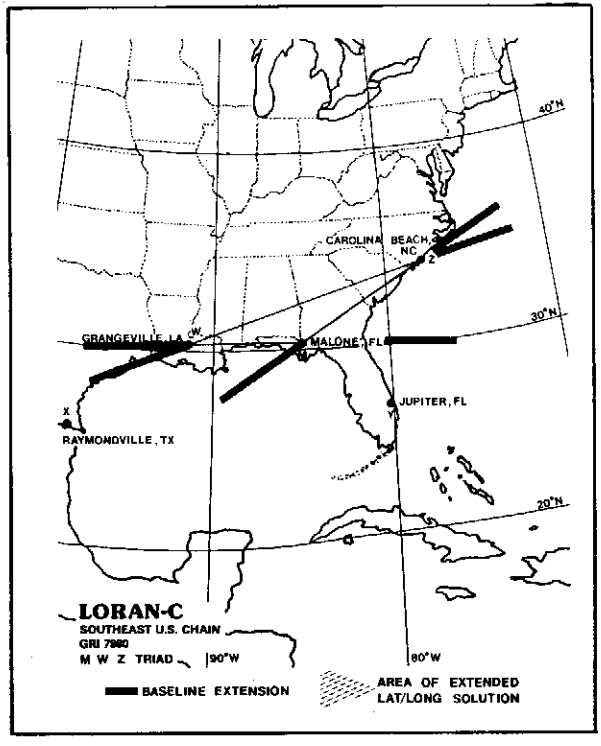
SOUTHEAST U.S. - 7980

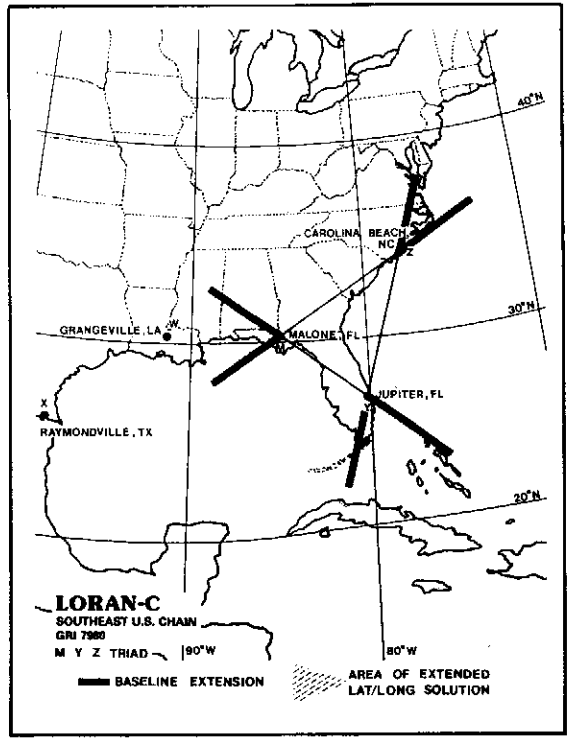

40°N
30°N
20°N
90°W
80°W
CAROLINA BEACH, NC
GRANGEVILLE, LA
MALONE, FL
JUPITER, FL
RAYMONDVILLE, TX
LORAN-C
SOUTHEAST U.S. CHAIN
GRI 7980
M X W TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


40°N
30°N
20°N
90°W
80°W
CAROLINA BEACH, NC
GRANGEVILLE, LA
MALONE, FL
JUPITER, FL
RAYMONDVILLE, TX
LORAN-C
SOUTHEAST U.S. CHAIN
GRI 7980
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


40°N
30°N
20°N
CAROLINA BEACH, NC
Z
GRANGEVILLE, LA
W
MALONE, FL
JUPITER, FL
Y
X
RAYMONDVILLE, TX
LORAN-C
SOUTHEAST U.S. CHAIN
GRI 7980
M W Y TRIAD
90°W
80°W
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

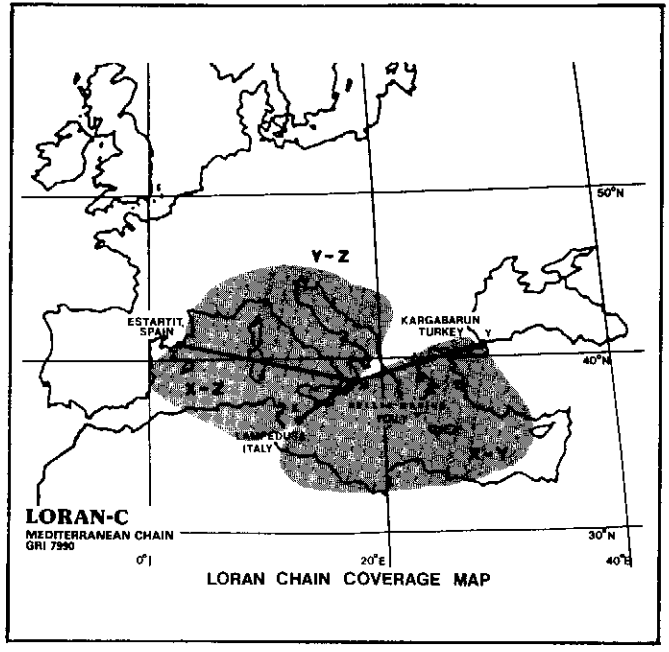

40°N
30°N
20°N
CAROLINA BEACH, NC
Z
GRANGEVILLE, LA
W
MALONE, FL
JUPITER, FL
X
RAYMONDVILLE, TX
LORAN-C
SOUTHEAST U.S. CHAIN
GRI 7980
M X Z TRIAD
90°W
80°W
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


40°N
30°N
20°N
CAROLINA BEACH, NC
Z
GRANGEVILLE, LA
W
MALONE, FL
JUPITER, FL
Y
X
RAYMONDVILLE, TX
LORAN-C
SOUTHEAST U.S. CHAIN
GRI 7980
M W Z TRIAD
90°W
80°W
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


40°N
30°N
20°N
CAROLINA BEACH, NC
Z
GRANGEVILLE, LA
W
MALONE, FL
JUPITER, FL
Y
X
RAYMONDVILLE, TX
LORAN-C
SOUTHEAST U.S. CHAIN
GRI 7980
M Y Z TRIAD
90°W
80°W
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

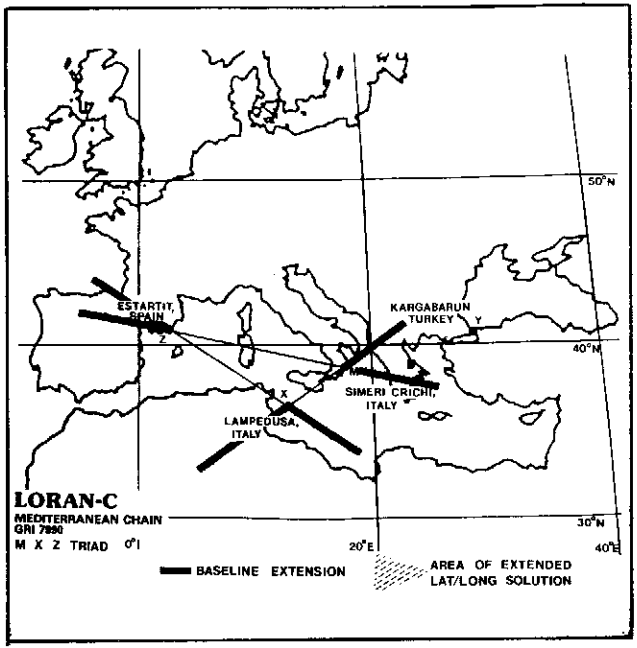
MEDITERRANEAN SEA LORAN-C CHAIN - GRI 7990 (old rate SL1)

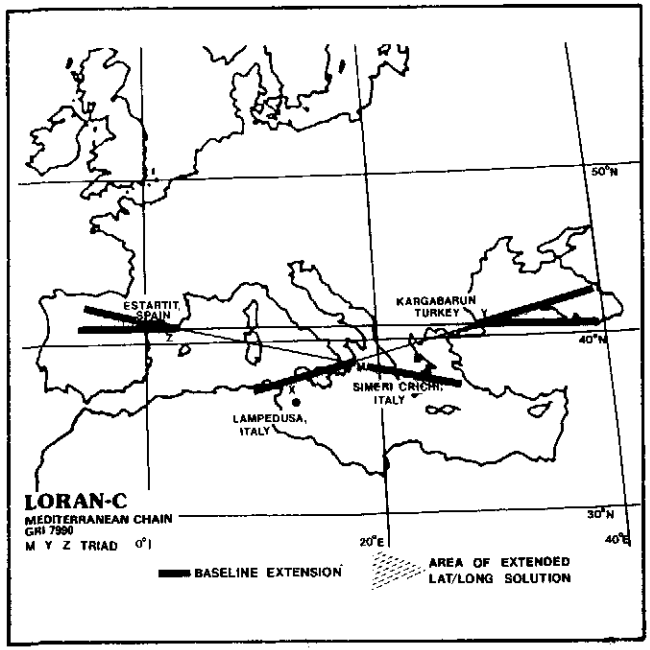
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Sellia Marina, Italy	Master	38 52 20.6 N 16 43 08.2 E		165	Exercises operational control of chain.
Lampedusa, Italy	Xray	35 31 20.8 N 12 31 30.2 E	11000/ 1755.98	325	Atis station.
Kargabarun, Turkey	Yankee	40 58 21.0 N 27 52 01.5 E	29000/ 3273.29	165	
Estartit, Spain	Zulu	42 03 36.5 N 03 12 15.9 E	47000/ 3999.71	165	

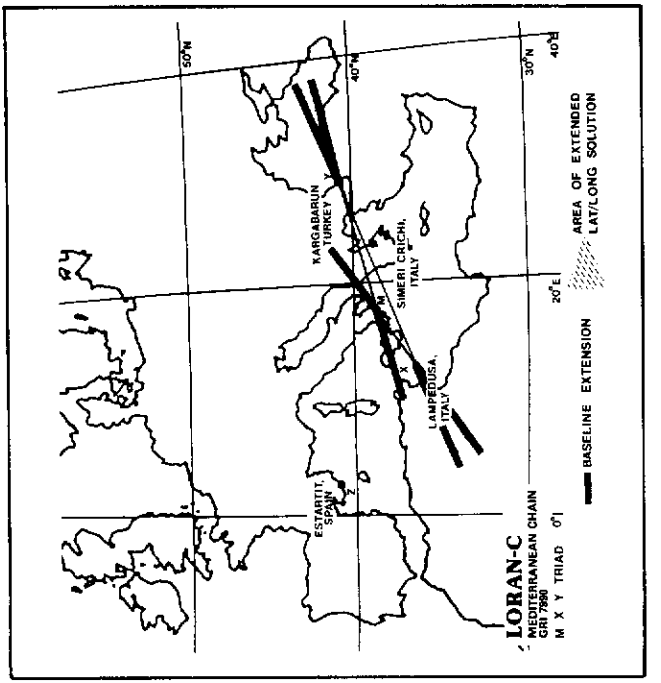


LORAN CHAIN COVERAGE MAP

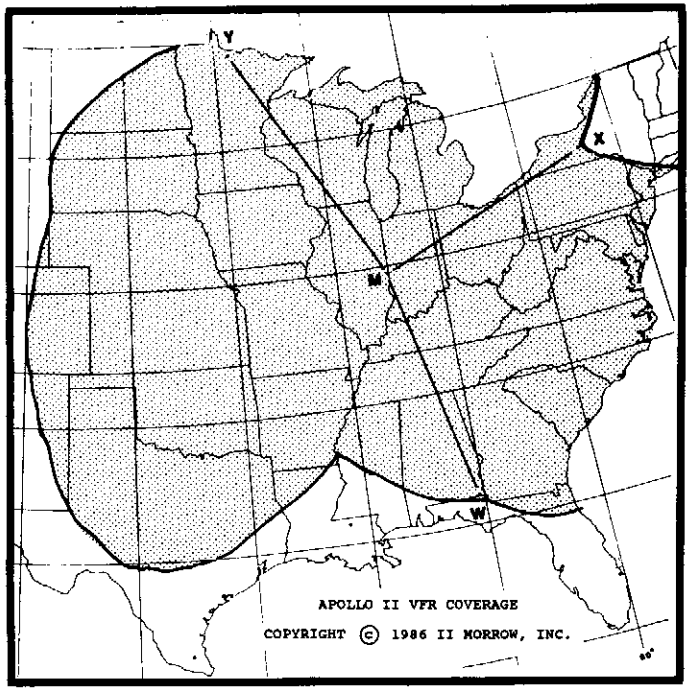
MEDITERRANEAN - 7990


50°N
40°N
30°N
20°E
40°E
ESTARTIT, SPAIN
Z
KARGABARUN TURKEY
Y
M
SIMERI CRICHI, ITALY
X
LAMPEDUSA, ITALY
LORAN-C
MEDITERRANEAN CHAIN
GRI 7990
M X Z TRIAD 0°I
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

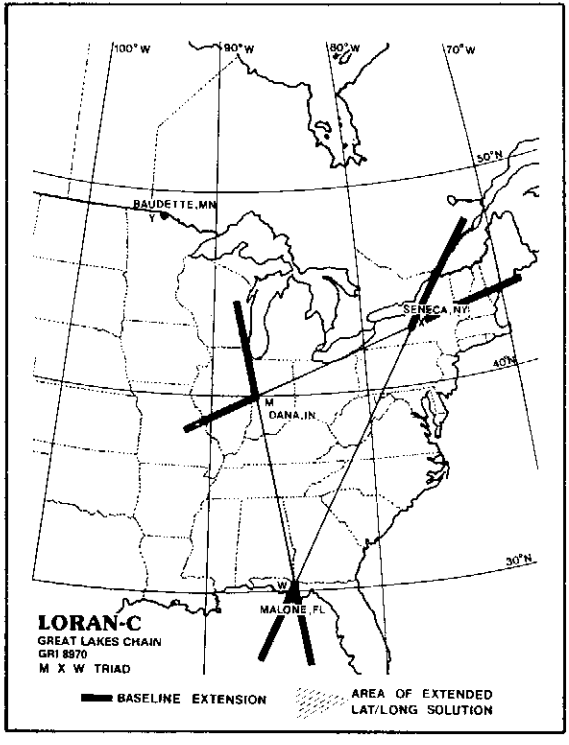

50°N
40°N
30°N
20°E
40°E
ESTARTIT, SPAIN
Z
KARGABARUN TURKEY
Y
M
SIMERI CRICHI, ITALY
X
LAMPEDUSA, ITALY
LORAN-C
MEDITERRANEAN CHAIN
GRI 7990
M Y Z TRIAD 0°I
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

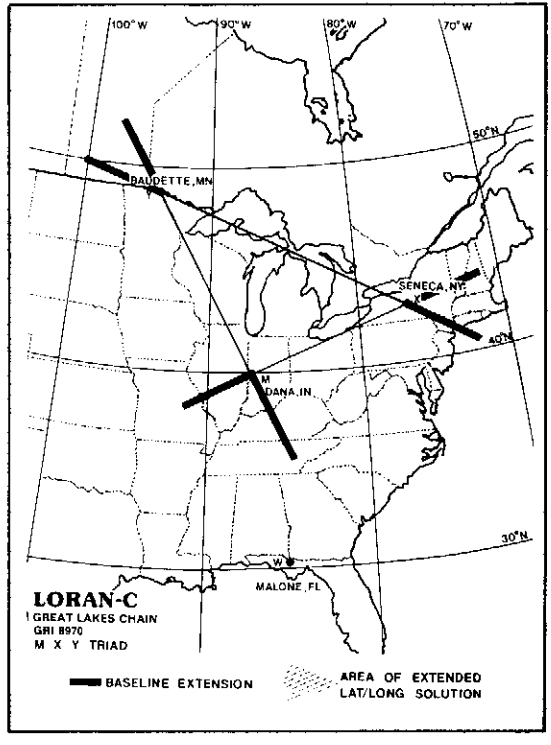

LORAN-C
MEDITERRANEAN CHAIN
GRI 7980
M X Y TRIAD 0'I
KARGABARUN TURKEY
SIMERI CRICHI, ITALY
LAMPEDUSA, ITALY
ESTARTIT, SPAIN
50°N
40°N
30°N
40°E
20°E
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

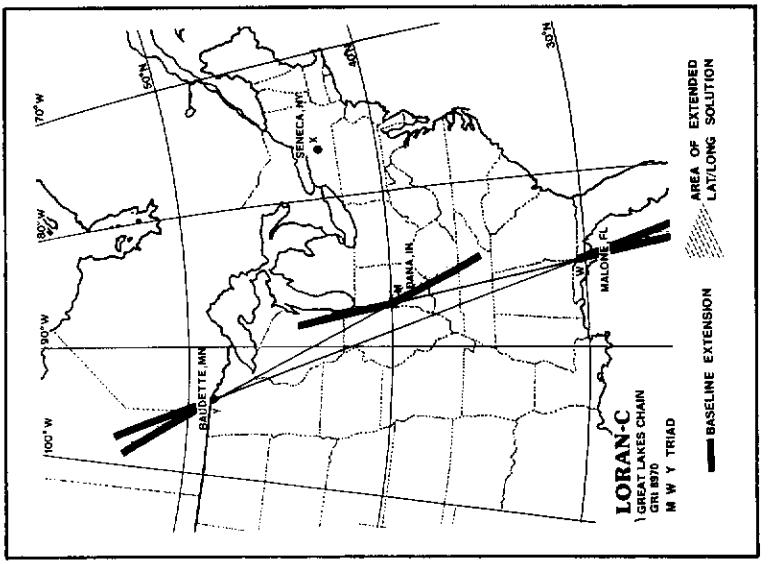
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Dana, IN	Master	39 51 07.5 N 87 29 12.1 W		400	Dual-rated to North-east U.S. Chain.
Malone, FL	Whiskey	30 59 38.7 N 85 10 09.3 W	11000/ 3355.11	800	Dual-rated to South east U.S. Chain.
Seneca, NY	Xray	42 42 50.6 N 76 49 33.9 W	28000/ 3162.06	800	Dual-rated to North-east U.S. Chain. Exer-cises operational con-trol of chain.
Baudette, MN	Yankee	48 36 49.8 N 94 33 18.5 W	44000/ 3753.74	400	
Eecen Wildwood, NJ	Tango	38 56 58.2 N 74 52 01.6 W	72000/ 1617.92	Various	Experimental station, not to be used for navigation.
Claybanks, MI	Monitor	N W			
Plumbrook, OH	Monitor	44 22 47.0 N 82 39 38.5 W			Unmanned receiver site.
Eglin, FL	Monitor	30 35 05.3 N 86 36 54.4 W			Unmanned receiver site.
Mayport, FL	Monitor	30 22 58.9 N 81 25 13.1 W			Unmanned receiver site.



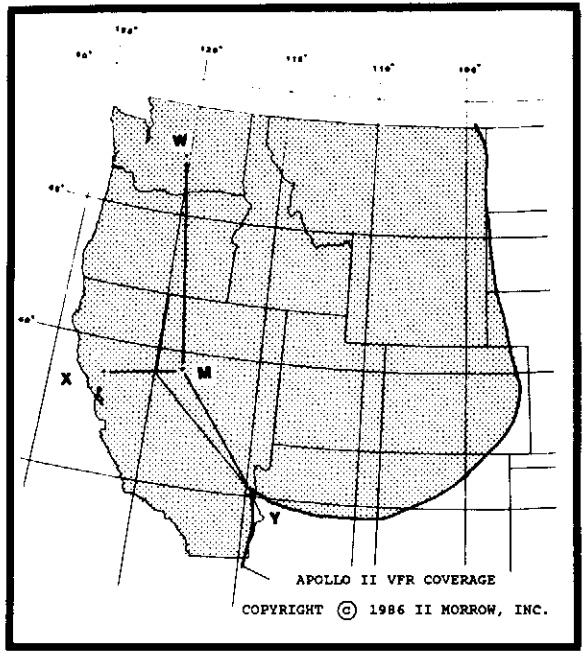
GREAT LAKES - 8970


100° W
90° W
80° W
70° W
50° N
40° N
30° N
BAUDETTE, MN
Y
SENECA, NY
X
M
DANA, IN
W
MALONE, FL
LORAN-C
GREAT LAKES CHAIN
GRI 8970
M X W TRIAD
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION

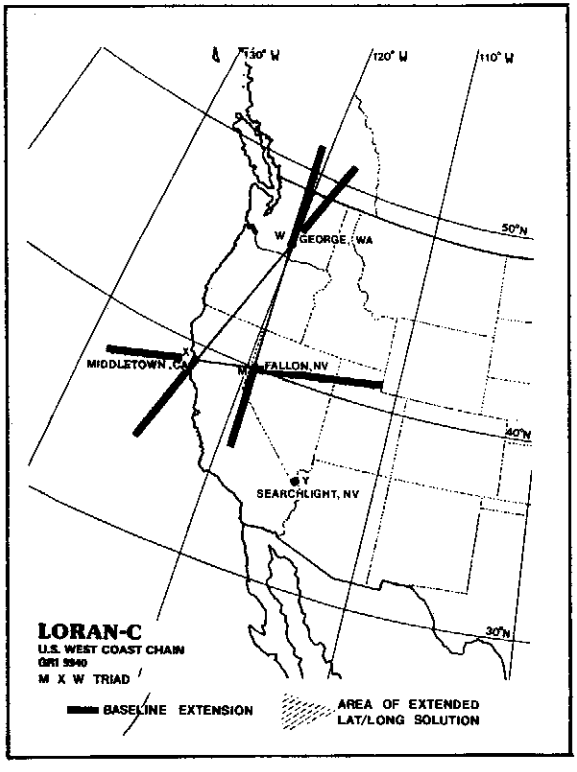

100° W
90° W
80° W
70° W
50° N
40° N
30° N
BAUDETTE, MN
SENECA, NY
M
DANA, IN
W
MALONE, FL
LORAN-C
GREAT LAKES CHAIN
GRI 8970
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION

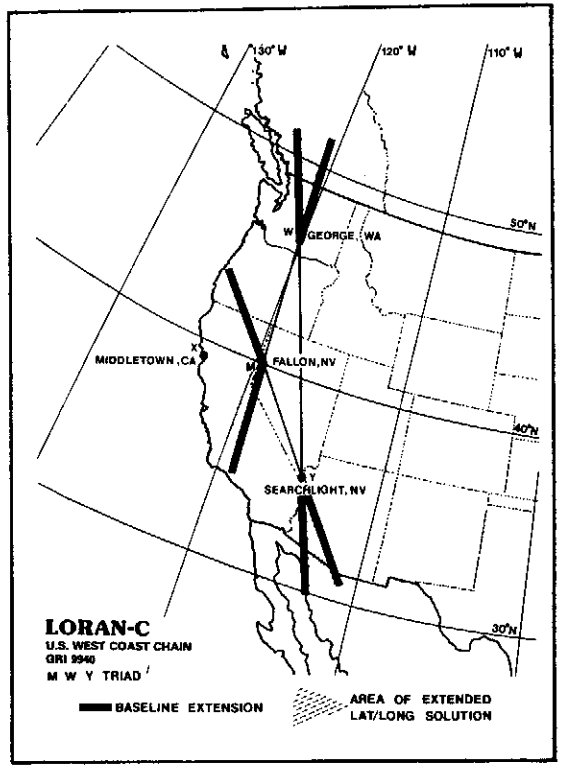

LORAN-C
GREAT LAKES CHAIN
GRI 8970
M W Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
BAUDETTE, MN
SENECA, NY
W
Y
M
DANA, IN
W
MALONE, FL
170° W
180° W
90° W
100° W
50° N
40° N
30° N

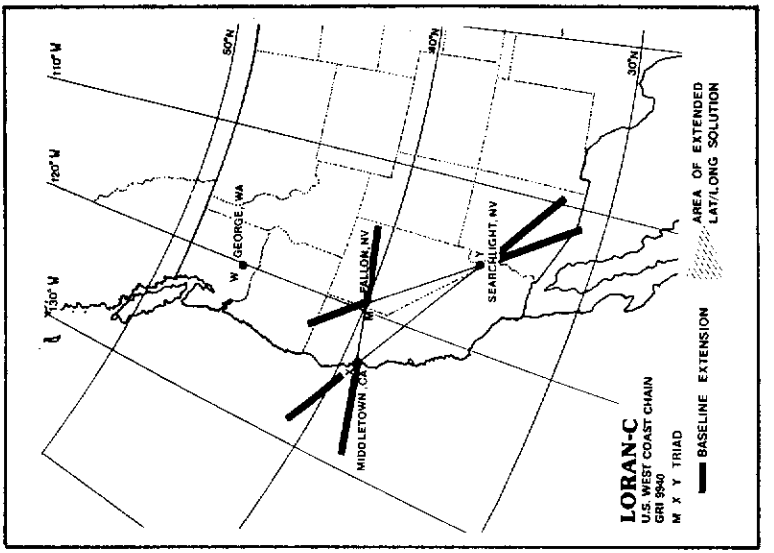
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Fallon, NV	Master	39 33 06.6 N 118 49 56.4 W		400	Two pulse comms installed.
George, WA	Whiskey	47 03 48.0 N 119 44 39.5 W	11000/ 2796.90	1600	Two pulse comms installed. Dual-rated to West Coast Canada Chain.
Middletown, CA	Xray	38 46 57.0 N 122 29 44.5 W	27000/ 1094.50	400	Exercises operational control of chain. Control for W, X, and Y. Two pulse comms installed.
Searchlight, NV	Yankee	35 19 18.2 N 114 48 17.4 W	40000/ 1967.30	540	
North Bend, OR	Monsite	43 24 36.2 N 124 14 27.9 W			Unmanned receiver site.
Pt. Pinos, CA	Monsite	36 37 59.0 N 121 56 05.6 W			Unmanned receiver site.



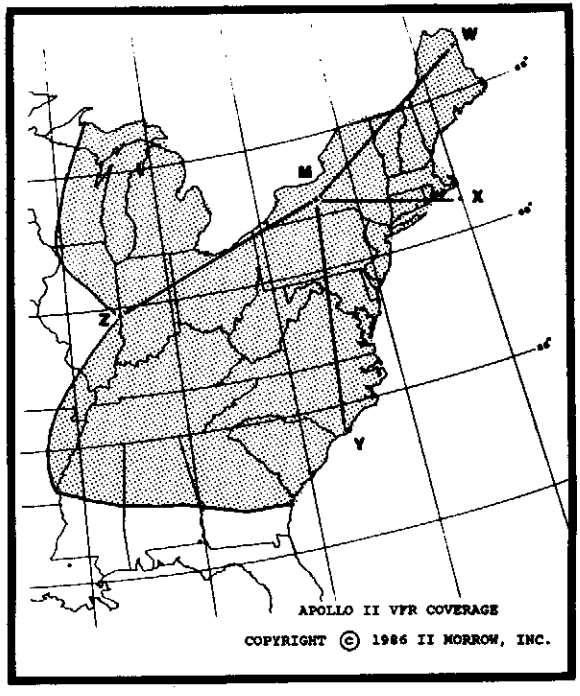
U.S. WEST COAST - 9940


130° W
120° W
110° W
50°N
40°N
30°N
W GEORGE, WA
X
MIDDLETOWN, CA
M FALLON, NV
Y
SEARCHLIGHT, NV
LORAN-C
U.S. WEST COAST CHAIN
GRI 9940
M X W TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

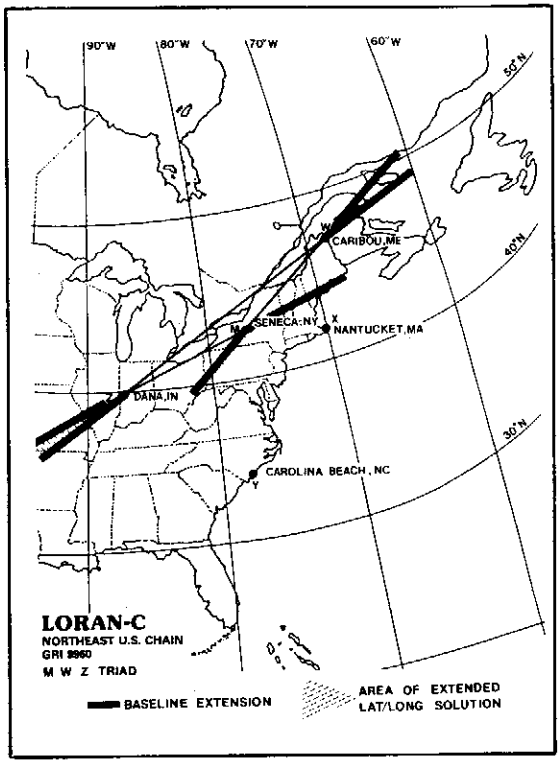

130° W
120° W
110° W
50°N
40°N
30°N
W GEORGE, WA
X
MIDDLETOWN, CA
M FALLON, NV
Y
SEARCHLIGHT, NV
LORAN-C
U.S. WEST COAST CHAIN
GRI 9940
M W Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

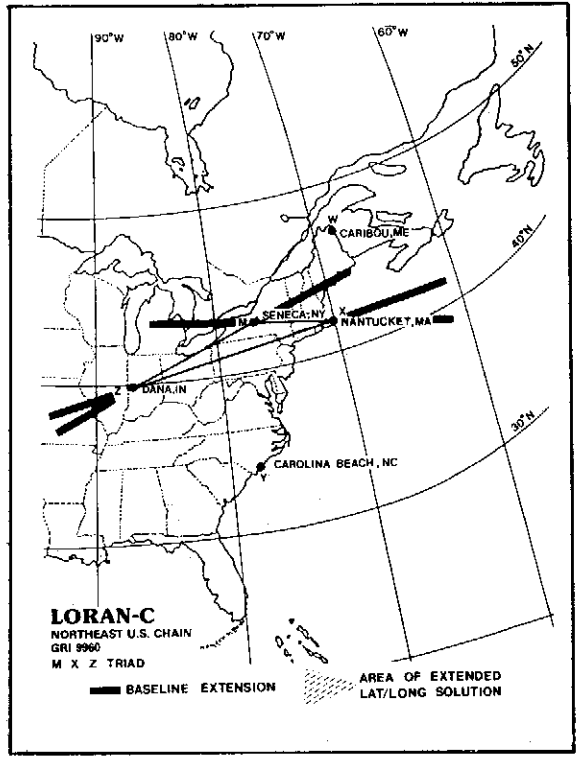

LORAN-C
U.S. WEST COAST CHAIN
GRI 9940
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
GEORGE, WA
FALLON, NV
SEARCHLIGHT, NV
MIDDLETOWN, CA
50°N
40°N
30°N
110° W
120° W
130° W

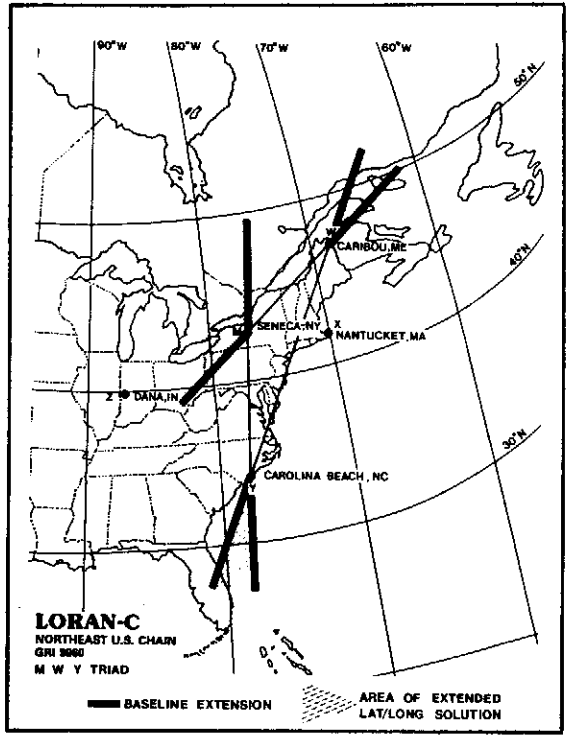
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Seneca, NY	Master	42 42 50.6 N 76 49 33.9 W		800	Control for W, X, Y, and Z. Exercises operational control of Chain.
Caribou, ME	Whiskey	46 48 27.2 N 67 55 37.7 W	11000/ 2797.20	350	
Nantucket, MA	Xray	41 15 11.9 N 69 58 39.1 W	25000/ 1969.93	275	
Carolina Beach, NC	Yankee	34 03 46.0 N 77 54 46.8 W	39000/ 3221.65	550	
Dana, IN	Zulu	39 51 07.5 N 87 29 12.1 W	54000/ 3162.06	400	
Eocen Wildwood, NJ	Tango	38 56 58.2 N 74 52 01.6 W	81500.49	Various	Experimental station, not to be used for navigation.
Cape Elizabeth, ME	Monitor	43 33 54.8 N 70 11 58.5 W			Unmanned receiver site.
Sandy Hook, NJ	Monitor	40 28 17.0 N 74 01 03.7 W			Unmanned receiver site.
Plumbrook, OH	Monitor	41 22 47.0 N 82 39 38.5 W			Unmanned reciever site.
Claybanks, MI	Monitor	43 31 48.0 N 86 29 01.0 W			Unmanned receiver site.

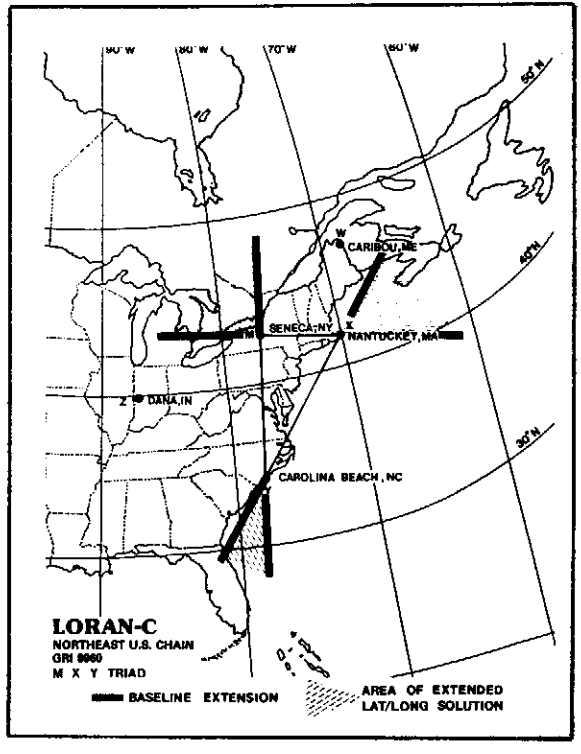


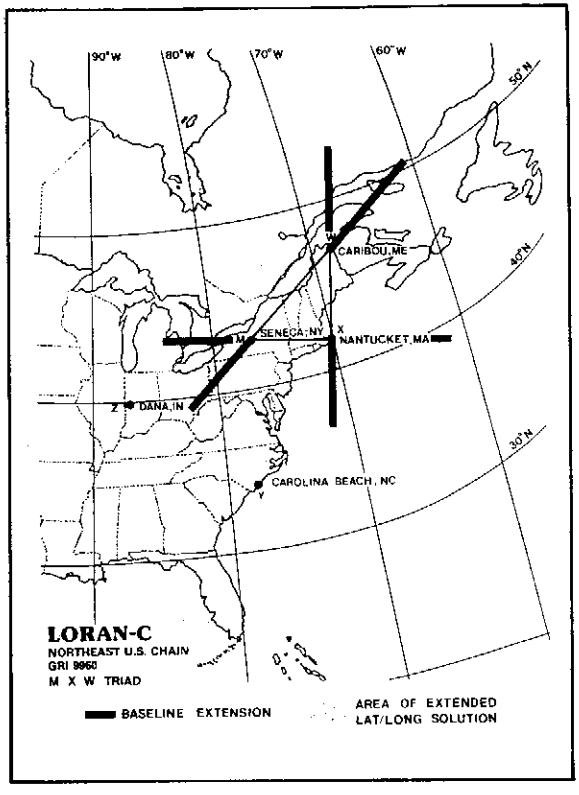
NORTHEAST U.S. - 9960

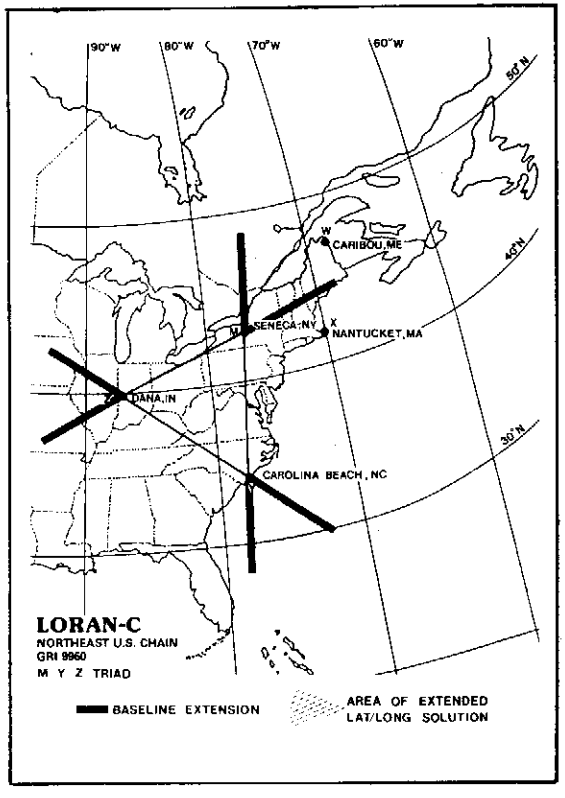

90°W
80°W
70°W
60°W
50°N
40°N
30°N
W
CARIBOU,ME
M
SENECA,NY
X
NANTUCKET,MA
DANA,IN
Y
CAROLINA BEACH,NC
LORAN-C
NORTHEAST U.S. CHAIN
GRI 9960
M W Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION


90°W
80°W
70°W
60°W
50°N
40°N
30°N
W
CARIBOU,ME
M
SENECA,NY
X
NANTUCKET,MA
Z
DANA,IN
Y
CAROLINA BEACH,NC
LORAN-C
NORTHEAST U.S. CHAIN
GRI 9960
M X Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION


90°W
80°W
70°W
60°W
50°N
40°N
30°N
W
CARIBOU,ME
SENECA,NY
X
NANTUCKET,MA
Z
DANA,IN
Y
CAROLINA BEACH, NC
LORAN-C
NORTHEAST U.S. CHAIN
GRI 9960
M W Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION

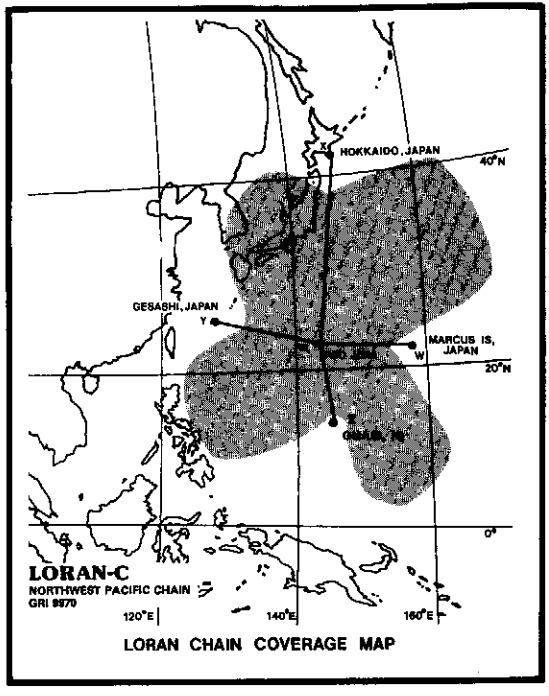

70°W
50°N
40°N
30°N
W
CARIBOU,ME
M
SENECA,NY
X
NANTUCKET,MA
Z
DANA,IN
Y
CAROLINA BEACH, NC
LORAN-C
NORTHEAST U.S. CHAIN
GRI 9960
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION


90°W
80°W
70°W
60°W
50°N
40°N
30°N
W
CARIBOU,ME
M
SENECA,NY
X
NANTUCKET,MA
Z
DANA,IN
Y
CAROLINA BEACH, NC
LORAN-C
NORTHEAST U.S. CHAIN
GRI 9960
M X W TRIAD
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION


90°W
80°W
70°W
60°W
50°N
40°N
30°N
W
CARIBOU,ME
M
SENECA,NY
X
NANTUCKET,MA
DANA,IN
CAROLINA BEACH, NC
LORAN-C
NORTHEAST U.S. CHAIN
GRI 9960
M Y Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION

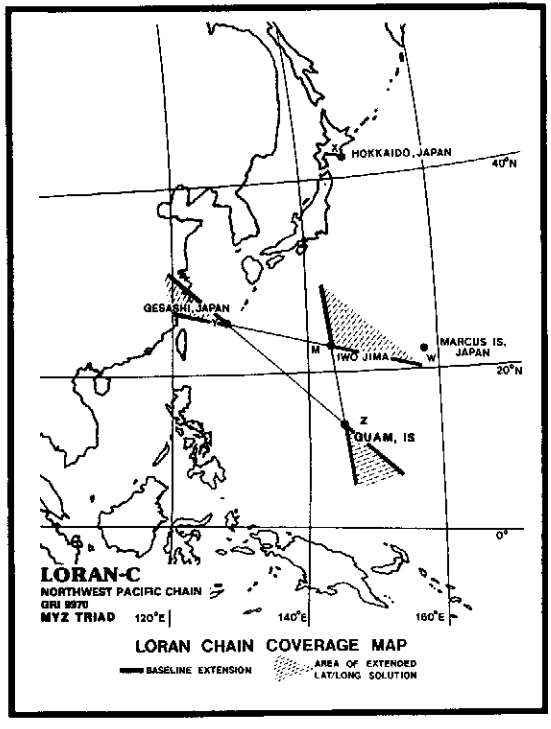
NORTHWEST PACIFIC LORAN-C - GRI 9970

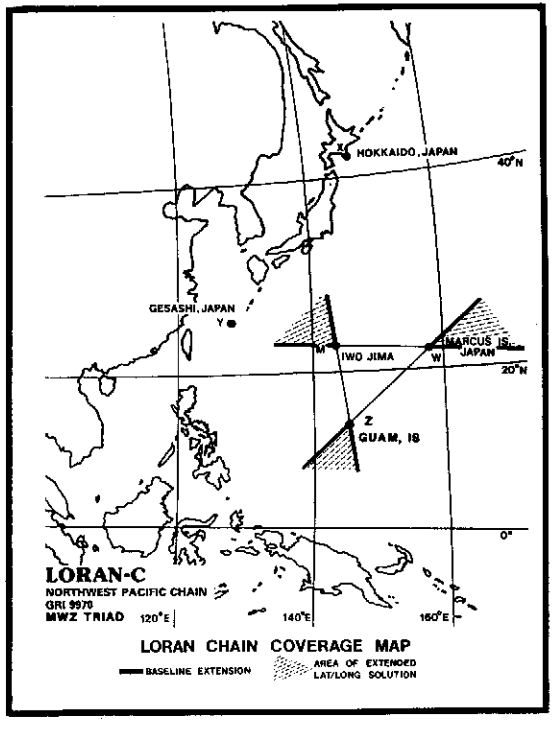
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER (kW)	REMARKS
Iwo Jima, Japan	Master	24° 48 03.6 N 141° 19 30.3 E		540	Clarinet Pilgrim TTY2
Marcus Is Japan	Whiskey	24° 17 07.9 N 153° 58 53.2 E	11,000/ 4283.94	1800	Clarinet Pilgrim TTY2 installed
Hokkaido, Japan	Xray	42° 44 37.1 N 143° 43 09.2 E	30,000/ 6685.12	1000	Clarinet Pilgrim TTY2 installed
Gesashi, Japan	Yankee	26° 36 25.0 N 128° 08 56.4 E	55,000/ 4463.18	1000	Clarinet Pilgrim TTY2 installed
Guam Is., USA	Zulu	13° 27 83.3 N 144° 49 54.1 E	81,000/ 4365.84	750	Replaces Yap Is.
Saipan, U.S.A.	Monitor/ Control	15° 07 46.8 N 145° 41 38.6 E			Controls W and Z
Tokota, Japan	Monitor/ Control	35° 44 34.6 N 139° 21 41.3 E			Controls X and Y
Chanaan, Korea	Monitor	35° 11 26.0 N 128° 08 48.0 E			

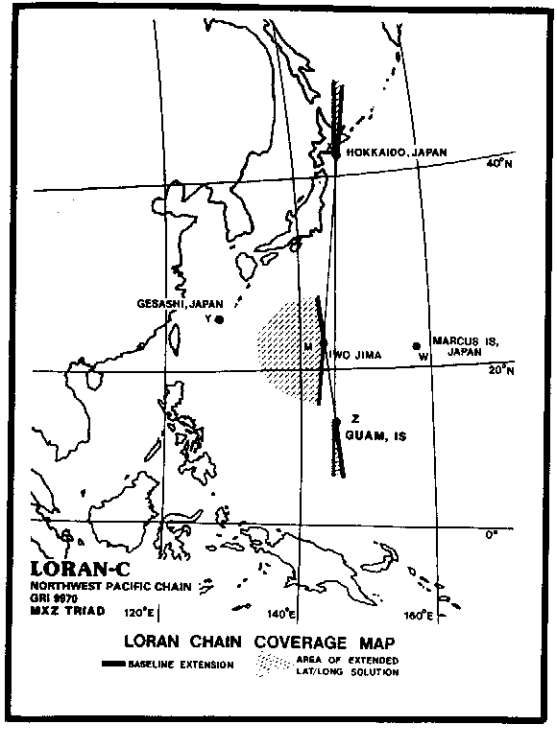


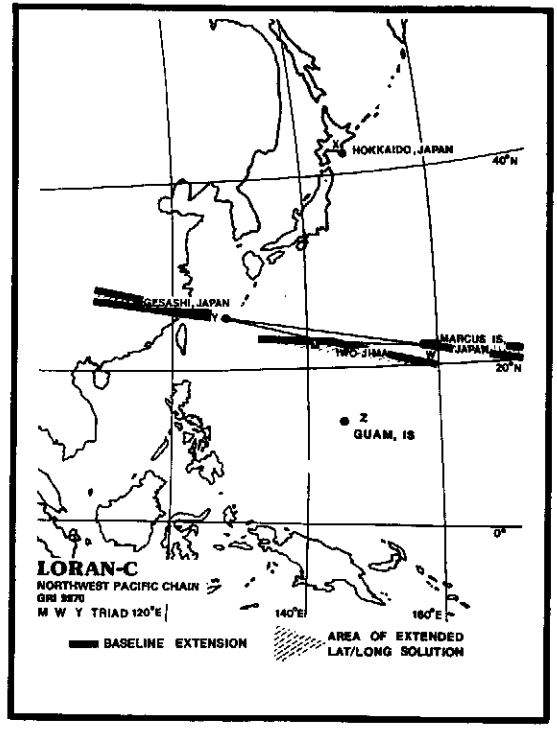
LORAN CHAIN COVERAGE MAP

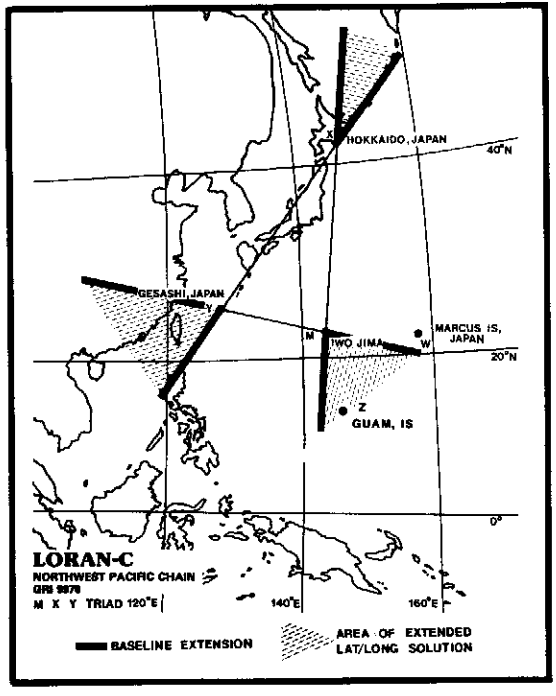
NORTHWEST PACIFIC - 9970

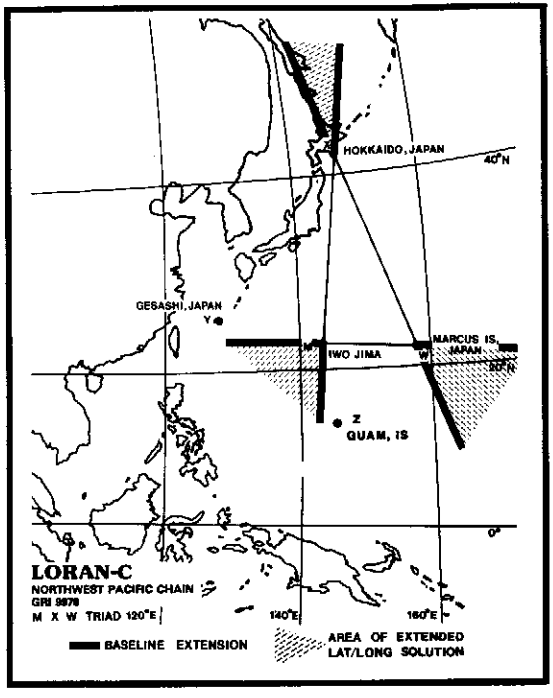

HOKKAIDO, JAPAN
40°N
GESASHI, JAPAN
M
IWO JIMA
W
MARCUS IS.
JAPAN
20°N
Z
GUAM, IS
0°
LORAN-C
NORTHWEST PACIFIC CHAIN
GRI 9970
MYZ TRIAD
120°E
140°E
160°E
LORAN CHAIN COVERAGE MAP
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


HOKKAIDO, JAPAN
40°N
GESASHI, JAPAN
Y
M
IWO JIMA
W
MARCUS IS.
JAPAN
20°N
Z
GUAM, IS
0°
LORAN-C
NORTHWEST PACIFIC CHAIN
GRI 9970
MWZ TRIAD
120°E
140°E
160°E
LORAN CHAIN COVERAGE MAP
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


HOKKAIDO, JAPAN
40°N
GESASHI, JAPAN
Y
M
IWO JIMA
W
MARCUS IS, JAPAN
20°N
Z
GUAM, IS
0°
LORAN-C
NORTHWEST PACIFIC CHAIN
GRI 9970
MXZ TRIAD
120°E
140°E
160°E
LORAN CHAIN COVERAGE MAP
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

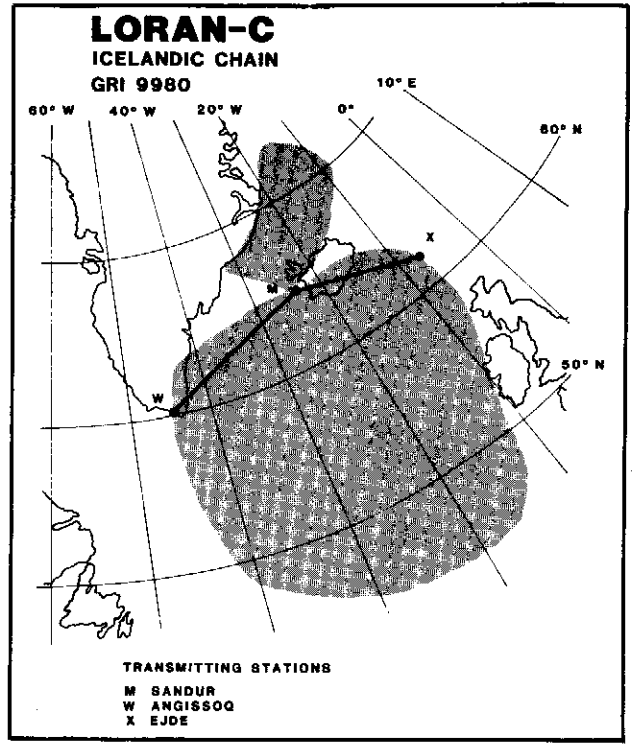

HOKKAIDO, JAPAN
40°N
GESASHI, JAPAN
Y
IWO JIMA
W
MARCUS IS, JAPAN
20°N
Z
GUAM, IS
0°
LORAN-C
NORTHWEST PACIFIC CHAIN
GRI 9970
M W Y TRIAD
120°E
140°E
160°E
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


HOKKAIDO, JAPAN
40°N
GESASHI, JAPAN
Y
M
IWO JIMA
W
MARCUS IS, JAPAN
20°N
Z
GUAM, IS
0°
LORAN-C
NORTHWEST PACIFIC CHAIN
GRI 9970
M X Y TRIAD 120°E
140°E
160°E
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

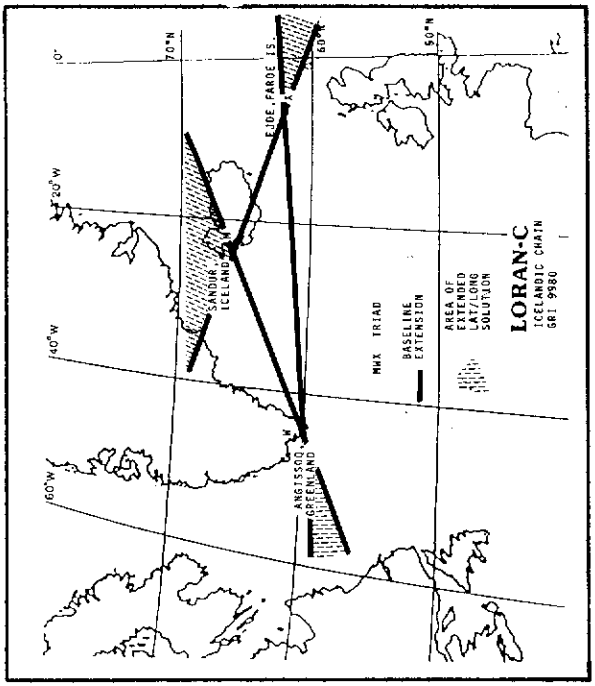

HOKKAIDO, JAPAN
40°N
GESASHI, JAPAN
Y
M
IWO JIMA
W
MARCUS IS, JAPAN
20°N
Z
GUAM, IS
0°
LORAN-C
NORTHWEST PACIFIC CHAIN
GRI 9970
M X W TRIAD 120°E
140°E
160°E
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

ICELANDIC LORAN-C CHAIN - GRI 9980

STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Sandur, Iceland	Master	64°54'26.6"N 23°55'21.8"W		1500	
Angissoq, Greenland	Whiskey	59°59'17.3"N 45°10'27.5"W	11000/ 4068.03	760	Dual-Rated to Labrador Sea Chain
Ejde, Faeroe Is., Denmark	Xray	62°17'59.6"N 07°04'26.5"W	30000/ 2944.54	325	Dual-Rated to Norwegian Sea Chain.
Keflavik, Iceland	Monitor	63°57'23.0"N 22°43'21.0"W			

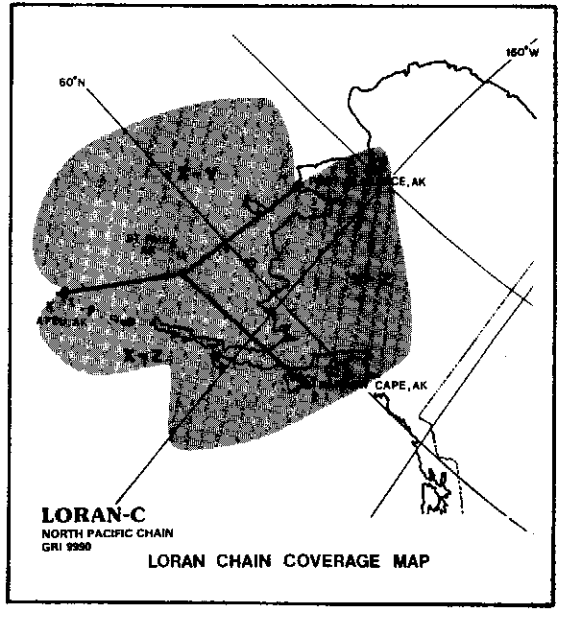


ICELAND - 9980

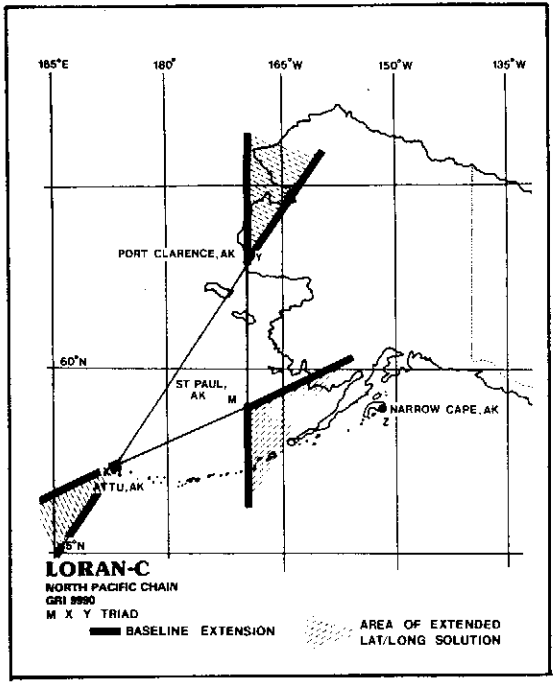

0°
70°N
60°N
50°N
20°W
40°W
60°W
SANDUR
ICELAND
EIDE, FAROE IS.
ANGISSOQ
GREENLAND
MWK TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
LORAN-C
ICELANDIC CHAIN
GRI 9980

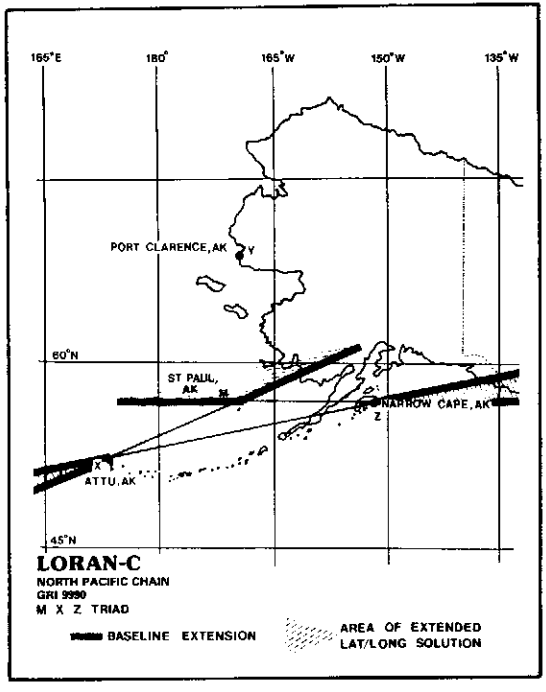
NORTH PACIFIC LORAN-C CHAIN - GRI 9990 (old rate SS1)

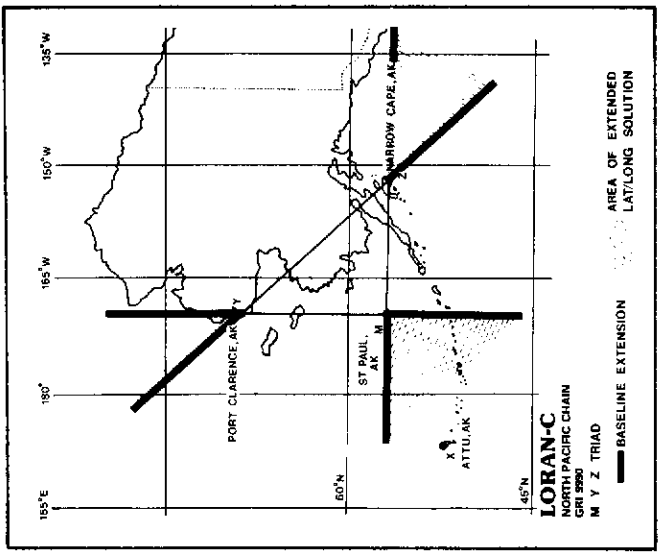
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
St. Paul, AK	Master	57 09 12.3 N 170 15 06.8 W		275	Controls X and Y, exercises operational control of chain, two pulse comms installed.
Attu, AK	Xray	52 49 44.0 N 173 10 49.0 E	11000/ 3875.25	275	
Port Clarence, AK	Yankee	65 14 40.3 N 166 53 12.6 W	29000/ 3068.95	1000	
Narrow Cape, AK	Zulu	57 25 20.2 N 152 22 11.3 W	43000/ 3590.45	400	Two pulse comms installed. Dual-rated to Gulf of Alaska Chain.
Kodiak, AK	Monitor/ Control	57 44 00.7 N 152 30 20.4 W			Control for Z.



NORTH PACIFIC - 9990


165°E
180°
165°W
150°W
135°W
PORT CLARENCE, AK
Y
60°N
ST PAUL, AK
M
NARROW CAPE, AK
Z
X
ATTU, AK
45°N
LORAN-C
NORTH PACIFIC CHAIN
GRI 9990
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

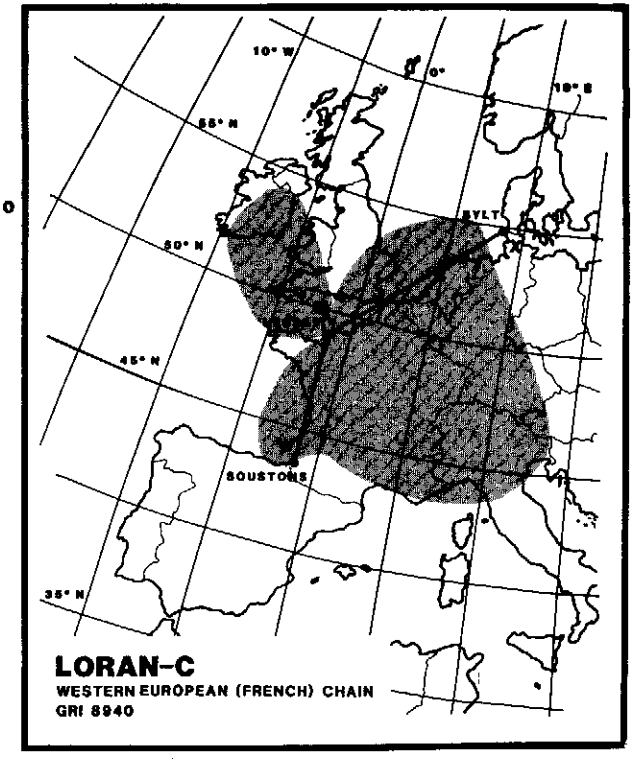

165°E
180°
165°W
150°W
135°W
PORT CLARENCE, AK
Y
60°N
ST PAUL, AK
M
NARROW CAPE, AK
Z
X
ATTU, AK
45°N
LORAN-C
NORTH PACIFIC CHAIN
GRI 9990
M X Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


135°W
150°W
165°W
180°
165°E
60°N
45°N
PORT CLARENCE, AK
ST PAUL, AK
NARROW CAPE, AK
ATTU, AK
LORAN-C
NORTH PACIFIC CHAIN
GRI 9990
M Y Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

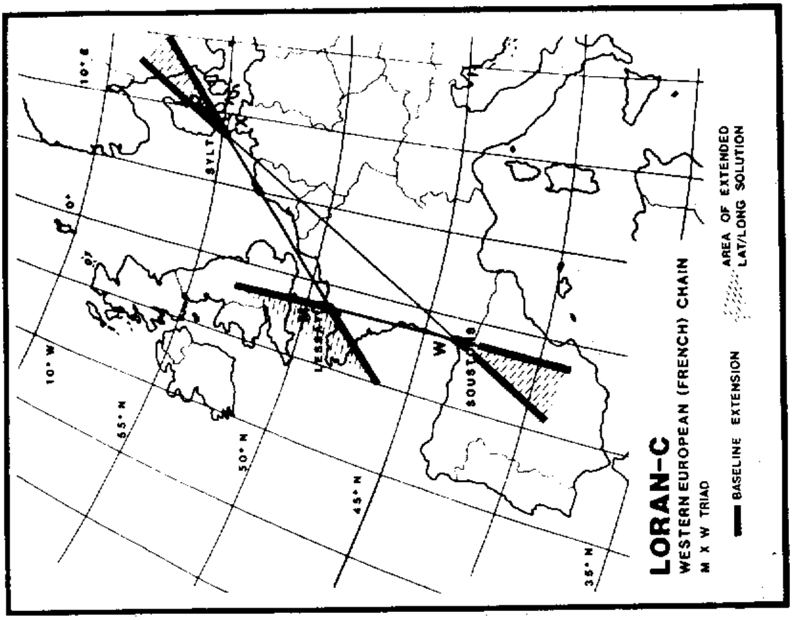
WESTERN EUROPEAN (FRENCH) LORAN-C CHAIN - GRI 8940

STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER (kW)	REMARKS
Lessay, France	Master	49°08'55.1" N 01°30'17.6" W		NA	
Soustons, France	Whisky	43°44'22.9" N 01°22'50.1" W	14000 2008.27	NA	
Sylt, Germany	Xray	54°48'29.9" N 08°17'36.3" W	33000 3072.46	NA	
Shetlands	Monitor	60°26'25.3" N 01°18'05.2" W			

All numbers are approximate and preliminary.



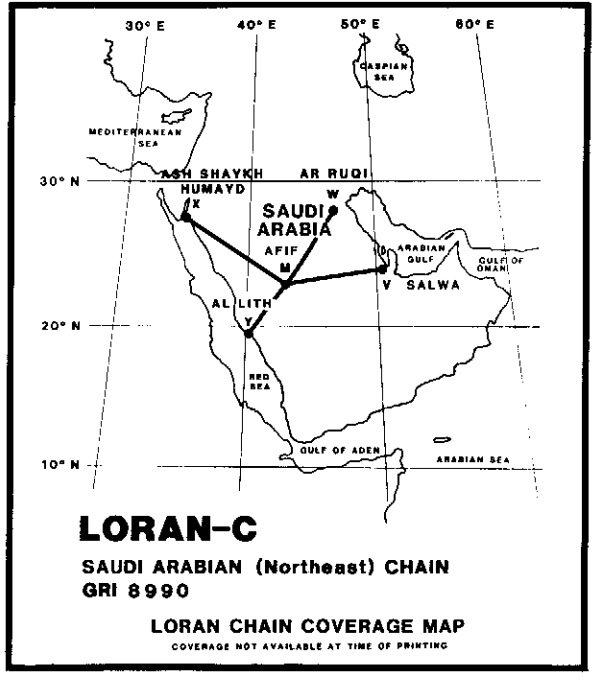
WESTERN EUROPE (FRANCE) - 8940



LORAN-C
WESTERN EUROPEAN (FRENCH) CHAIN
M X W TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
SYLT
LESSAY
SOUSTONS
W
10° E
0°
10° W
55° N
50° N
45° N
35° N

STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER (kW)
Afif	Master	23°48'36.82" N 42°51'17.63" E		800
Salwa	Victor	24°50'01.50" N 50°34'12.02" E	11000 2641.09	800
Ar Ruqi	Whiskey	29°01'04.61" N 46°37'21.96" E	25000 2298.51	200
Ash Shaykh Humayd	Xray	28°09'15.87" N 34°45'39.99" E	40000 3145.53	400
Al Lith	Yankee	20°13'58.31" N 40°12'31.02" E	56000 1606.26	200
Jubail	Monitor	27°19'36.40" N 49°28'30.67" E		
Yanbu	Monitor	24°04'14.14" N 38°02'35.90" E		
Al Qunfuddah	Monitor	19°08'48.27" N 41°03'40.69" E		

* The Saudi Arabian chains are not operated or controlled by the United States Coast Guard.

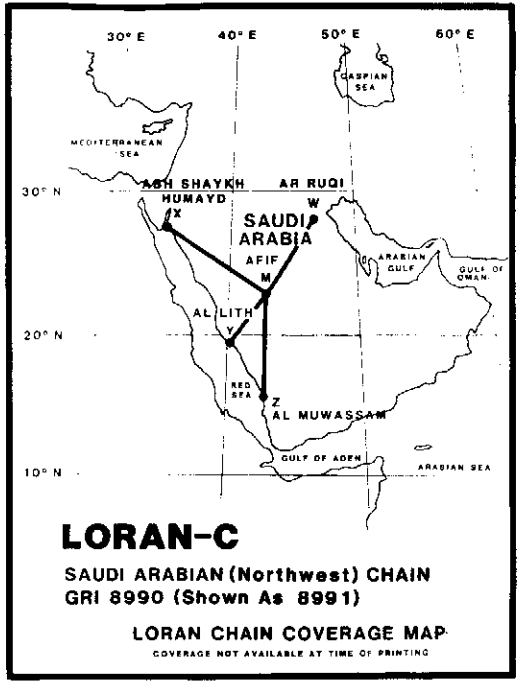


NORTHEAST SAUDI ARABIA - GRI 8990

SAUDI ARABIAN (NORTHWEST) LORAN-C CHAIN* - GRI 899

STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER (kW)
Afif	Master	23°48'36.82" N 42°51'17.63" E		800
Ar Ruqi	Whisky	29°01'04.61" N 46°37'21.96" E	25000 2298.51	200
Ash Shaykh Humayd	Xray	28°09'15.87" N 34°45'39.99" E	40000 3145.53	400
Al Lith	Yankee	20°13'58.31" N 40°12'31.02" E	56000 1606.26	200
Al Muwassam	Zulu	16°25'55.89" N 42°48'04.33" E	69000 2726.94	800
Jubail	Monitor	27°19'36.40" N 49°28'30.67" E		
Yanbu	Monitor	24°04'14.14" N 38°02'35.90" E		
Al Qunfuddah	Monitor	19°08'48.27" N 41°03'40.69" E		

* The Saudi Arabian chains are not operated or controlled by the United States Coast Guard.



NORTHWEST SAUDI ARABIA - GRI 8991

SECTION I

APPENDICES

APPENDIX A

CARE and MAINTENANCE

This section provides a little advice on how to get the most from your APOLLO® Model 604 from the first day you use it through the years ahead. The first piece of advice is to read this manual thoroughly so that you will be familiar with its functions and capabilities. After reading the manual, perform a cockpit checkout of the functions you plan on using most so that you are comfortable with these operations before an actual flight.

Remember that while the APOLLO® Model 604 is an easy-to-use and reliable navigation instrument utilizing the LORAN-C system, you should never rely on only one method of navigation.

INSTALLATION ADVICE

Have your APOLLO® Model 604 installed only by a qualified conscientious certified facility. The best performance and longest life for your APOLLO® Model 604 will occur with air cooling. Fan cooling is recommended over ram air. The cockpit temperature of an aircraft not in use is also a factor in the longevity of avionics. A thermal shield of an appropriate type is highly recommended.

MAINTENANCE

There are no routine maintenance procedures to be performed by the user. Use a clean soft cloth and furniture polish to remove any collection of dust or other from the front panel. Do NOT use chemical cleaning agents, solvents, or harsh detergents to clean the front panel.

Periodically check all antenna, interface, power, and ground connections to make sure that the connections are clean and free of corrosion. Do not wax an antenna as this will reduce its performance. NEVER paint an antenna; doing so may render it inoperative.

BATTERY REPLACEMENT

The APOLLO® Model 604 memory is maintained by a Lithium battery. The expected service life of this type of battery is approximately 5 years. This is not a user replaceable item. The Lithium battery must be replaced by the factory or an authorized dealer.

A low battery level may be indicated by one of the following:

1) User waypoint memory and other operator entered values may be lost. For instance, the GRI may change to 4990.

2) The Oscillator Offset Values may be out of tolerance.

3) The unit may not search and acquire the signal properly.

FLYBRARY® CARTRIDGE REPLACEMENT

The APOLLO® Model 604 allows for the replacement of the FLYBRARY® EPROMs by the user. The FLYBRARY® EPROMs are located in a cartridge. The cartridge is plugged into a slot in the back panel of the Model 604. The unit will function properly as a LORAN-C receiver with or without the FLYBRARY® cartridge in place. The FLYBRARY® waypoints will only be available with the FLYBRARY® cartridge inserted.

1. Turn the power off to the unit.

2. Use a flat head screwdriver and loosen the locking screw on the upper center of the front panel.

3. Pull the unit out of the mounting tube.

4. Locate the FLYBRARY® cartridge on the upper left corner of the back panel.

5. Use a phillips screwdriver and loosen the two screws on either side of the cartridge.

6. Pull the cartridge out of the unit.

DO NOT TOUCH THE PINS IN THE CARTRIDGE HOUSING.

7. Carefully slide the new FLYBRARY® cartridge into the slot.

8. Replace the screws that hold the cartridge in place.

9. Return the unit into the mounting tube and tighten the locking screw on the front panel.

10. Perform the checkout of the new FLYBRARY® cartridge as described in the installation sheet that came with it.

SPECIFICATIONS

PHYSICAL SPECIFICATIONS

Power Requirements: 6.5 to 48 VDC negative ground 9 W nom.

Size: H - 2" (5.08 cm), W - 6.25" (15.9 cm), D - 11.2" (28.5 cm)

Weight: 3.19 lbs. (1.45 kg)

Operating Temperature Range: -20C to +55C

Maximum Operating Humidity: 95% at 50C

Maximum Operating Altitude: 50,000 feet (15,240 m)

Notch Filters: 8 Internal (Factory Preset)

Displays: Large easy to read high intensity dot matrix alphanumeric LEDs with automatic brightness control.

Push Buttons: Backlighted

The APOLLO® Model 604 meets Environmental Categories (DO-160B):

Temperature and Altitude	A1,B1
Humidity	A
Vibration	PKS
Magnetic Effect	.Z
Power Input	.BZ
Voltage Spikes	A
AF Susceptibility	.Z
Electromagnetic Compatibility	.Z

FEATURES

Cross Track Distance (XTD) Resolution: 0.01 nm (60 ft.)

XTD Display Sensitivity: Selectable in 0.01 nm increments up to 1.00 nm

OFST Resolution: Selectable in 0.1 nm increments up to 20.0 nm

Memory: Continuous, supplied by internal Lithium battery (5 yr. nominal life)

Waypoints: 100 user programmable waypoints plus present position (PPTO and PPFR).

Optional Data Base:
All federally designated airports with 3 or 4 alpha-numeric characters, VORs, and NDBs in the continental U.S., Alaska, and Canada. All public use hard and soft surface airports in the continental U.S., Alaska, and Canada.

Status Annunciators: WARN, ARIV, TIME, AFS, OFST, and FROM.

Mode Annunciators: NAV, TRIP, POS, WPT, INFO, and SETUP.

Automatic Triad Selection: Secondary transmitting stations are automatically selected for the best triad geometry.

Automatic Magnetic Variation: Magnetic Variation for your location is automatically selected worldwide

Magnetic Year: Update magnetic year between 1975 and 2020.

Trip (Flight Planning): Allows up to 10 user-programmed waypoints with automatic leg sequencing.

Flight Time: Keeps track of time since power on.

Time To Waypoint: Sets an alarm for enroute times.

Auto-Nav: Sequences through six of the NAV Mode pages at a rate of approximately 2 seconds per page when selected.

Waypoint Search: The nearest five waypoints in the FLYBRARY®, five VORs, and five waypoints in USER memory.

INFO Mode: Detailed information on each FLYBRARY® waypoint (i.e. frequencies, airport elevation, runway length, etc.).

RECEIVER SPECIFICATIONS

Dynamic Range: 110 dB

Noise Bandwidth: 23 kHz at receiver output

Sensitivity: 1 uV nominal (atmospheric noise limited)

Track Speed: 400 knots in prime coverage areas at 0 dB SNR.

Time to Track (GRI 9940): 2 minutes at 0 dB SNR typical 3-1/2 minutes at -10 dB SNR typical
Last Location: approximately 30 seconds

Update Rate of Current Position: 0.8 seconds nominally
Position Repeatability: 0.01 nm typical for primary LORAN-C coverage areas.

Range Resolution: 0.1 nm (600 ft.)

Minimum Signal-Noise-Ratio (SNR)
Acquisition: -10 dB
Track: -30 dB
Position Display: -30 dB

ANTENNA SPECIFICATIONS

A-16 WHIP ANTENNA

Environmental Categories (DO-160A)

- Temperature and Altitude D2
- Humidity . . . . . A
- Vibration . . . . . YJLM
- Electromagnetic Compatibility . . . . . Z

Physical Characteristics

- Weight: 0.56 lbs (0.25 kg) Height: 17.75 in (45.09cm)

Operational Characteristics

- Operating Temperature Range -55C to +70°C
- Maximum Operating Altitude 50,000 feet (15,240 m)
- Maximum Speed 350 kts (402 mph) TAS

A-17 BLADE ANTENNA (DO-160A)

Environmental Categories

- Temperature and Altitude D2
- Humidity . . . . . A
- Vibration . . . . . YJLM
- Electromagnetic Compatibility . . . . . Z

Physical Characteristics

- Weight: 0.70 lbs (0.32 kg) Height: 8.2 in (20.83 cm)

Operational Characteristics

- Operating Temperature Range -55C to +70°C
- Maximum Operating Altitude 50,000 feet (15,240 m)
- Maximum Speed 521 kts (600 mph) TAS

A-23 LORAN-C BENT WHIP ANTENNA (DO-160A)

Environmental Categories

- Temperature and Altitude D2
- Humidity . . . . . A
- Vibration . . . . . YJLM
- Salt Spray . . . . . S
- Electromagnetic Compatibility . . . . . Z

Physical Characteristics

- Weight: 0.413lbs (0.187kg) Height- .25 inches (20.96cm)

Operational Characteristics

- Operating Temperature Range -55C to +70°C
- Operating Altitude 50,000 feet (15,240 m)
- Maximum Speed 350 kts (402 mph) TAS

Due to II Morrow's commitment to constantly improve the quality and performance of our equipment, all specifications and features are subject to change without notice.

APPENDIX B

TROUBLESHOOTING

First of all, don't panic. Relax a minute. Think about what the problem is and the functions you have performed. If the solution does not come to mind, read the instructions again for the desired function. Also, check your GRI, automatic features, and calibration factors. Check the troubleshooting charts. If this does not help, turn the unit off. Wait a couple of minutes. Turn the unit back on and try again. If you are still having trouble, call your dealer or the factory for advice. A few of the most common problems encountered are described with solutions to help remedy them.

INDICATION	PROBLEM	ACTION REQUIRED
1. ARIV light comes on and stays on after start-up.	A. You are within 1 mile of the TO waypoint last selected.	A. None (normal operation)
2. WARN light won't go out after start-up.	A. Wrong GRI selected	A. Check GRI for correct LORAN-C chain.
	B. A required secondary station is shut down.	B. Check GRI triad display to see if secondary stations are being received. Also check TD display to see if you are receiving any signal from each secondary. Select another suitable GRI or triad (manually), if possible.
	C. A distant manually selected secondary that worked last flight will not acquire now.	C. If you are using manual triad selection, be sure you have the correct secondaries selected.
	D. You may be parked near something interfering with the LORAN-C signal. (APU, hangar, high voltage lines)	D. Check SNR & ECD values in SETUP Mode. If the SNR values are very low, or the ECD values are high or changing rapidly, move the aircraft to a different position on the ramp.
	E. Signal is very weak due to distance from transmitters.	E. Check SIG LVL. If it is very low, you may not acquire the signal until after takeoff.

INDICATION	PROBLEM	ACTION REQUIRED
3. LAT/LONG display of your present position is not correct.	A. You may be more than a mile from the airport reference point, which could make the coordinates look wrong until you check closely.	A. Double check your distance from the airport reference point. Be sure the display is really incorrect before looking further.
	B. Calibration factors are inserted which are not correct for your position.	B. Check the ASF indicator on the lower right of the Information Display. If the ASF light is on, you may need to remove or adjust the calibration factors.
	C. LORAN-C is not able to fix your position accurately because you are in a baseline extension area.	C. Check the GRI coverage map to see if you are near a baseline extension; if so, change to another triad or chain if possible. Use another method of navigation to confirm your position until you leave the baseline extension area.
4. After programming TO and FROM waypoints, the BRG & RGE are obviously wrong.	A. Wrong TO or FROM position. An error of one digit in LAT/LONG coordinates may produce a huge error.	A. Double check your waypoints to be sure they are correct, especially if you have inserted LAT/LONG coordinates as a USER waypoint. Also, check quadrant identifier.
	B. The computer may have acquired a distorted signal.	B. If the computer doesn't correct the problem in a few minutes, turn the power switch off and back on.

INDICATION	PROBLEM	ACTION REQUIRED
5. WARN light comes on in heavy precipitation.	A. Thunderstorms or heavy precipitation produce static electricity which can cause this problem.	A. Check SNR values in SETUP Mode. If values are below 64, static electricity may be interfering with the LORAN-C signal. Fly out of the disturbance area (change course, climb or descend). The WARN light will go out when you leave the area of heavy precipitation.
This problem should not normally occur unless the precipitation is very heavy. If the WARN light comes on frequently in light or moderate precipitation, have your mechanic check the static bonding of: 1. The LORAN-C antenna. 2. The aircraft static discharge wicks. 3. The control surface bonding straps. Another collector of static electricity is the windshield; if all else fails, bond the windshield to the aircraft with static bonding paint according to the aircraft manufacturer's recommendations.		
6. LAT/LONG is displayed but GS is changing rapidly & position is not updating properly as you fly. WARN light is out. Secondary stations in the triad are changing continuously.	A. You are probably flying in a baseline extension area.	A. Check TDs. If TDs for one of the selected secondaries are not constantly changing as you fly, you are most likely near a baseline extension. Confirm this by checking the appropriate LORAN-C chain chart. Change to another chain, if possible, or manually select the best secondary station to prevent continuous changing of the triad. Use an alternative navigation method to confirm your position.

INDICATION	PROBLEM	ACTION REQUIRED
7. WARN light comes on enroute.	A. One of the triad stations has gone off the air or may be shut down for maintenance temporarily.	A. Use an alternate means of navigation to confirm your position. Check GRI in SETUP Mode. If a station is off the air, its letter identifier will be blank. Wait a few minutes; the station may come back on the air soon.
	B. Minimum signal quality criteria is not being met.	B. Confirm your position by using an alternate means of navigation. Check TDs, SNR, SIG LVL & ECDs for each secondary station in SETUP Mode. If you are getting TD displays and the ECD values are 4 or less, the signal may still be usable but less reliable.
	C. A Blink is occuring. This is a warning transmitted by one of the stations in the triad to indicate a possible signal problem.	C. Confirm your position by using an alternate means of navigation. TDs, SNR, SIG LVL & ECDs will appear normal. (The SNR will be slightly lower, but you will not notice it unless you have recently checked it.) When the problem clears, the WARN light will go out.
8. SYSTEM FAILURE is displayed and the WARN light is on.	A. Internal computer malfunction or a transient fault may have occured.	A. Turn the power switch off and back on. This will give the computer a fresh start at the the navigation process.
9. TRIAD will not select.	A. Extremely poor geometric	A. Set Triad selection to manual ("m"). Select the appropriate Triad manually after referring to the LORAN-C charts in the LORAN-C section. After the Triad is selected, reset Triad selection to automatic ("a").

APPENDIX C

GLOSSARY

ACCURACY (Absolute): a measure of the ability to determine true geographic position (Latitude and Longitude).

ACCURACY (Repeatable): a measure of the ability to return to a particular position or location.

ACQUISITION:the process of establishing the location in time for the master and each of the selected secondaries with sufficient accuracy to permit subsequent settling time and tracking.

ALPHANUMERIC: a character that is either a number or letter.

ALTERNATE SOLUTION AREA: the area located outside of the primary coverage area where two LAT/LON solutions are possible due to the geometry of the LORAN-C LOPs.

AREA CALIBRATION: area calibration is a manual mode of operation requiring pilot input to the LORAN-C receiver intended to reduce the effect of local area propagation anomalies.

AREA NAVIGATION: a method of navigation that permits the selection of any course within the coverage area of the system used.

ARP: Airport Reference Point.

ASF: Additional Secondary Phase Factor. ASFs are calibration factors entered by the operator into a LORAN-C receiver to compensate for propagation variations in the LORAN-C signal unique to a particular locality.

AUTO-NAV: the function when activated that causes the NAV Mode displays to sequence automatically so that all NAV displays may be routinely monitored without manually selecting them.

BASELINE: the great circle line connecting the master transmitting station and a secondary transmitting station.

BASELINE EXTENSION: the extension of the baseline beyond either the master or secondary transmitting station. Do not use LORAN-C readings in the vicinity of the baseline extension, because of low accuracy as well as the difficulty in determining which side of the baseline extension your true position is located.

BEARING: the direction from your present position to your destination in degrees.

BLINK: secondary station blink is used to indicate that signal information from that station may be inaccurate or missing. A blink condition will cause the WARN indicator to appear. The Master station will sometimes blink the ninth pulse for internal Coast Guard communications.

CALIBRATION FACTORS: see ASF.

CHAIN: a LORAN-C network consisting of the master transmitting station and the two to four secondary transmitting stations.

CODING DELAY: the time difference between the master station and secondary station transmitted pulse groups.

CONTROL/MONITOR STATION: a station within a LORAN-C chain used to monitor and control the transmissions from one or more Master-Secondary pairs to insure proper signal transmission and tolerances. Control/Monitor stations may be at unmanned sites or at a transmitting station.

COURSE OFFSET (OFST): a method by which you may navigate parallel to the originally defined course.

CROSSING ANGLE: the angle from 0 to 90^0 degrees at which the two LOPs intersect. As you get closer to a crossing angle of 90 the accuracy for your position will be greater.

CROSS-RATE INTERFERENCE: signal interference caused by overlapping coverage areas from two or more LORAN-C chains.

CROSS TRACK ERROR (DISTANCE): the computed distance, left or right, away from the desired path of travel.

CYCLE SELECTION: the process where the computer selects the proper tracking points on the LORAN-C signal.

CYCLE SLIP: failure of the receiver to maintain synchronization of the Zero Crossing Tracking Points and phase coding of the LORAN-C pulses. Time measurement errors occur due to this and appear in multiples of 10 usec.

DESIRED TRACK (DTK): the point-to-point bearing between your departure point and destination.

DUAL RATED STATION: a LORAN-C transmitting station that operates in two LORAN-C chains.

EMISSION DELAY: the sum of the time of travel of the master signal to the secondary station (baseline length in time) and the secondary coding delay.

ENVELOPE-TO-CYCLE DIFFERENCE (ECD): a measure of signal distortion determined by the phase shift between the pulse envelope and the 100 kHz carrier.

EXTENDED SOLUTION AREA: see ALTERNATE SOLUTION AREA.

FIX: determination of navigational position, using two or more lines of position.

FLIGHT TIME: the elapsed time since the Model 604 was turned on or reset.

FLYBRARY: the list of federally designated airports and VORs that are present in the permanent memory of the APOLLO® LORAN-C receiver. FLYBRARY® is a registered trademark of II Morrow Inc.

FRINGE AREA: locations that are beyond prime LORAN-C coverage but where navigation is possible though position accuracy will be degraded.

GEOMETRIC DILUTION OF PRECISION (GDOP): a factor used to express all geometric causes of navigational error at a position fix isolated from errors associated with measurement uncertainties.

GMT: Greenwich Mean Time as used in navigation systems.

GRADIENT: a measure of the spacing between adjacent LORAN-C lines. As with all hyperbolic navigation systems, the LORAN-C gradient varies, depending on your location with respect to transmitting stations. When the gradient is large, small changes in time difference correspond to large changes in indicated position.

GREAT CIRCLE ROUTE: the route followed along a route on the surface of the earth which is made of a circle where an arc which connects two points is the shortest path across the surface of the earth between those two points.

GROUND SPEED: your actual speed over the ground.

GROUND TRACK: your actual direction of travel over the ground in degrees.

GROUND WAVE: a radio wave that travels near or along the Earth's surface.

GROUP REPETITION INTERVAL (GRI): the number used to identify the group of transmitter stations in a particular LORAN-C chain. The four digit number indicates the time coded delay. For instance, the West Coast chain GRI is denoted as 9940 and refers to a time interval length of 99,400 usec.

HEMISPHERE: the north or south half of the earth as divided by the equator, or the east or west half of the earth as divided by a meridian.

HERTZ: cycles per second, used to describe radio frequencies; usually with the prefix k-, kilo (thousands), or M-, mega (millions).

ID REFERENCE: the waypoint from which the phantom waypoint created in the USER region of Waypoint Mode is referenced.

IFR: Instrument Flight Rules.

IONOSPHERE: the atmospheric layer that exists approximately between 25 and 250 miles above the Earth's surface. This layer changes in thickness, density, and in elevation at different times of the day and reflects radio waves.

ISOGONIC LINE: a line containing the points on the earth's surface where the magnetic declination is the same.

LATITUDE: The angular distance north or south from the earth's equator measured through 90^0. Lines of Latitude are also referred to as parallels (meaning parallel to the equator).

LED: Light Emitting Diode.

LINE OF POSITION (LOP): a line on which position is determined by a single navigational observation. This line represents the series of locations of constant time difference between the master and a secondary station. The intersection of two or more LOPs result in a fix.

LONGITUDE: the angular distance measured on a great circle of reference from the intersection of the adopted Prime meridian (Greenwich, England) with this reference circle to the similar intersection of the meridian passing through the object. Longitude is expressed in degrees from 0 at Greenwich to 180 on the opposite side of the earth. Direction is referenced as east or west of the Prime Meridian (0). Lines of Longitude are also referred to as Meridians.

LORAN: LOng RAnge Navigation.

LORAN-C: a long range navigation system operating in the Low Frequency (LF) radio band. LORAN-C utilizes a carrier frequency of 100 kHz with groups of pulsed signals from geographically separated transmitting stations. The time difference (TD) in arrival of the pulses from the stations of one chain determine the relative position to those transmitting stations.

LOW FREQUENCY: the Low Frequency (LF) radio band covers from 30 kHz to 300 kHz.

MAGNETIC VARIATION: compensation for the magnetic declination from a position on the earth's surface and true north.

MASTER STATION: the controlling station of a particular LORAN-C chain which transmits the reference timing signals based on the GRI of that chain.

MICROPROCESSOR: usually a single integrated circuit (IC) used as the central processing unit (CPU) to control the internal functions of a computer.

MONITOR: see Control/Monitor Station.

NAUTICAL MILE: the length of a minute of Longitude along the equator or a minute of Latitude. The international unit is equal to 6076.115 feet or 1852 meters (approx. 1.15 statute miles). A statute mile is 5280 feet.

NDB: Nondirectional Beacon. NDBs are used by ADFs (Automatic Direction Finders) as a supplemental aid to navigation.

NONVOLATILE: describes digital memory, which retains information through system shutdown.

NOTCH FILTER: a circuit used to reject a particular range or band of frequencies to reduce interference.

OFST: see COURSE OFFSET.

OSCILLATOR OFFSET: the amount of clock cycles that the oscillator frequency is offset to compensate for variations in temperature.

PHASE CODING: the phase of the 100 kHz carrier is changed in each pulse group in a particular pattern to provide protection from skywaves arriving out of time, or phase, and affecting the TD measurements. The master and secondary station phase codes are different and each has two different codes which alternate in time. Automatic receivers (such as the APOLLO® I, II, or AVENGER III) use phase coding to identify the master and secondary stations.

PPFR: a waypoint in the USER region of Waypoint Mode based on your present position. This waypoint is created when the FROM button is pressed while in POS Mode.

PPTO: a waypoint in the USER region of Waypoint Mode based on your present position. This waypoint is created when the TO button is pressed while in POS Mode.

PRECIPITATION STATIC (P-STATIC): electromagnetic noise created by the rapid discharge of static electricity. An aircraft builds up a static electric charge by passing through charged particles (such as rain, ice, snow, or dust). The problem of precipitation static may be reduced by the use of static discharge wicks, proper fuselage grounding, and special antenna coatings. Good installation practices will help reduce P-STATIC problems.

QUADRANT: a quartering of a circle or of the earth into four quadrants (i.e. NW, NE, SE, and SW). The earth is divided into quadrants by the Equator and the Prime Meridian.

RADIAL: a magnetic direction from a VOR station or to a Phantom Waypoint.

SECONDARY STATIONS: the two to four secondary transmitting stations in a LORAN-C chain which transmit in sequence after the master station at fixed, predetermined, intervals. Secondaries are referenced to the master (M) station GRI and are designated as W (Whiskey), X (X-ray), Y (Yankee), and Z (Zulu).

SETUP: startup, calibration, and service display information.

SIGNAL-TO-NOISE RATIO (SNR): the ratio of the LORAN-C signal level to the level of background noise.

SKYWAVE: an indirect radio wave that reflects off of the ionosphere, rather than following a direct path from the transmitter to the receiver. This longer path causes an increase in distance, and hence in time, of the LORAN-C signal and is the chief cause of distortion. The skywave is often much stronger than the groundwave. Low quality LORAN-C receivers have difficulty in rejecting the skywave.

SOFTWARE: computer programs or sets of instructions.

STC: Supplementary Type Certificate. An FAA approved installation, operation of certain equipment, or methods of operation in a particular aircraft model.

TIME DIFFERENCE (TD): the difference in time of arrival of two LORAN-C signals, one from the master station and the other from one of the secondary stations. TDs are indicated in microseconds. The hyperbolic lines formed by points having the same TDs are called LOPs (Lines of Position).

TRACK: see GROUND TRACK

TRACKING: the process of maintaining synchronization of the receiver with the selected signals.

TRIAD: in LORAN-C, the Master and two secondary transmitting station combination used to fix a position.

TSO: Technical Standard Order, a performance specification and production compliance criteria applied to avionics and defined by Federal Aviation Regulations (FAR) and the Radio Technical Commission for Aeronautics (RTCA).

VFR: Visual Flight Rules.

VOR: Very high frequency Omni Range. A radio direction locating system located near airports.

WARN: warning of potential signal reception problems or the initial indication that the signal has not been acquired yet upon startup.

WAYPOINT: a point of reference, or location of interest, chosen by the user by Latitude and Longitude.

ZULU TIME: Greenwich Mean Time.

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