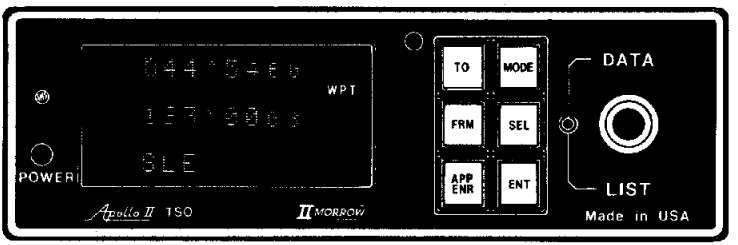
PILOT'S
OPERATING HANDBOOK

Apollo II

MODEL 612B



MORROW INC.

SALEM, OREGON U.S.A.

MANUFACTURER OF QUALITY NAVIGATION AND COMMUNICATION SYSTEMS

September 1987

560-0061D
Rev 4.0

26 MONTH LIMITED WARRANTY

II MORROW INC. warrants the APOLLO LORAN-C receiver for 26 months and the antenna/preamplifier for one year from the date of original retail purchase in the United States to be free of any manufacturing and material defects.

PARTS and LABOR

II MORROW, INC. will provide the necessary parts and labor to repair the receiver at no charge to the customer for 26 months and the antenna/preamplifier for one year after the original retail purchase.

WARRANTY SERVICE

Warranty service may be obtained by shipping the product prepaid to the II Morrow factory, II Morrow's East Coast Service Center, or authorized II Morrow dealer. The product will be repaired and returned prepaid via surface transportation to the customer.

EXCLUSIONS

This warranty covers normal customer use and does not cover damage which occurs in shipment or failures which result from alteration, accident, misuse, abuse, installation, aircraft fire, improper maintenance, undue exposure to corrosive environments, or handling deemed improper by II MORROW, INC. Some states do not allow for exclusion of incidental or consequential damages, so the above exclusion may not apply to you.

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

II MORROW, INC. reserves the right of continuous product development without obligation to install changes in previously manufactured products.

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 II should the need arise.

The design engineers and myself are pilots, and as a result our aviation products are designed with the needs of the pilot in mind. The APOLLO II 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.

The LORAN-C system is a valuable tool for direct point-to-point navigation in the prime coverage areas. However, you need to consider that it is never safe to rely solely on any single aid of navigation.

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

2345 Turner Rd., S.E.
Salem, Oregon 97302 USA
(503) 581-8101

OP120-00

INTRODUCTION

This manual is intended to provide you with a thorough knowledge of the operations and displayed information available in the APOLLO II Model 612B. Included in this manual are a detailed description of operations and the Theory of LORAN-C.

The LORAN-C system is intended to be used as a radio navigation aid. The APOLLO II 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 II. Of special interest is the CONTINENTAL FLYBRARY with thousands of waypoints already present in the APOLLO II's nonvolatile memory. The CONTINENTAL FLYBRARY holds the locations of many airports, VORs, heliports, and seaplane bases along with their official designations to allow simple flight planning. The CONTINENTAL FLYBRARY holds the locations of airports, VORs, heliports, and seaplane bases within the continental United States and Alaska according to the following criteria: 1) all federally designated public use airports with three alpha-character designators, 2) all VORs, 3) all public use heliports and seaplane bases, and 4) all public use airports that have hard-surface runways which are at least 2500 feet long and 40 feet wide. One hundred user-programmable waypoints are available to the user for individualized entry and are automatically sorted alphabetically. The USA Region allows you quick access to all of the FLYBRARY waypoints, except the USER region, and lets you set up a special group of 10 waypoints for flight planning. The APOLLO II will allow you to enter the present position and reference navigation information either TO or FROM present position. You may also create a PHANTOM WAYPOINT to use for navigation. The APOLLO II will automatically select the proper triad and magnetic variation for your location. The APOLLO II also may be used to guide you to the nearest waypoint in the CONTINENTAL FLYBRARY in the case of an in-flight emergency with the use of the AIRPORT/VOR SEARCH function; you select airport, VOR, or PRIVATE SEARCH (USER waypoints). If you select VOR, the Radial and Range from the VOR are provided. The APOLLO II also has an EXTENDED RANGE feature to help continue navigation into fringe coverage areas.

The state-of-the-art design of the APOLLO II 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 II. Some features included in this manual may not be present in all versions of the 612B such as: Canadian Flybrary and VNAV.

While the APOLLO II Model 612B series LORAN-C receivers with the FLYBRARY database provide a powerful tool in direct point-to-point navigation, 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.

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for the

Apollo II **MODEL 612B**

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HISTORY OF REVISIONS

Revision 0 December 1985 (1285)
(First Release)

Revision 1.0 August 1986 (0886)

Revision 2.0 October 1986 (1086)

Pages changed: cover, Table of Contents, i, A-12, C-5, D-1, D-4, D-7, D-14, D-15, D-16, E-8, E-9, E-12, E-31, and Index.

Revision 3.0 December 1986 (1286)

Manual revised to include the VNAV and Canadian Flybrary options in the standard 612B manual.

Pages changed: cover, Table of Contents, i, A-4, A-5, A-9, C-1, C-2, D-1, D-2, D-17, E-12, E-29, E-30, Section G, and Index.

Revision 4.0 September 1987 (0987)

Manual revised to include a change the the AUTONAV feature, a new NAV display page (CDI-XTD), ECD resolution is shown to tenths, the addition of Port Clarence (T) to GRI 7960, and the move of the Zulu secondary of GRI 9970 from Yap to Guam.

Pages changed: cover, Table of Contents, i, A-12, D-1, D-11, D-13, E-19, F-29, F-30, and F-55 to F-58.

SPECIFICATIONS and FEATURES
for the
Apollo II MODEL 612B LORAN-C RECEIVER

Power Requirements: 6.5 to 48 VDC negative ground 15 W nom.

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

Weight: 3.68 lbs. (1.67 kg)

Operating Temperature Range: -15°C to +55°C

Maximum Operating Humidity: 95% at 50°C

Maximum Operating Altitude: 35,000 feet (6,096 m)

Track Speed: 600 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

Update Rate of Current Position: 0.5 seconds nominally

Position Repeatability: 0.01 nm typical for primary LORAN-C coverage areas.

Range Resolution: 0.1 nm (600 ft.)

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: All federally designated airports with 3-alpha characters, VORs, and public use heliports and seaplane bases in the continental U.S., Alaska, and Canada (612BC and 612BCV only).
All public use hard-surface airports that have runways at least 2500 ft. long and 40 ft. wide in the continental U.S., Canada (BC & BCV only), and Alaska.
100 user programmable waypoints plus present position (PPTO, PPFR, and PHTM)

Notch Filters: 8 Internal (Factory Preset)

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

Push Buttons: Backlighted

Internal Status Indicators: LORAN WARN, ARIV, APP, OFST, FROM, and ASF.

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 in the continental U.S., Canada, and Alaska.

AIRPORT/VOR SEARCH: Locates nearest FLYBRARY airport within approx. 100 nm of your present position and sets a course automatically. You may also select a VOR or USER waypoint.

AUTO-NAV: Sequences through each of the NAV Mode pages at a rate of 1½ seconds per page when selected.

Vertical Navigation (VNAV): Shows target altitude for a preset glideslope angle from your present position to the destination waypoint. (612BV and 612BCV only)

RECEIVER SPECIFICATIONS

Dynamic Range: 110 dB

Noise Bandwidth: 23 kHz at receiver output

Sensitivity: 1 uV nominal (atmospheric noise limited)

Minimum Signal-Noise-Ratio (SNR)

Acquisition:	-10 dB
Track:	-30 dB
Position Display:	-30 dB

The APOLLO II is designed to meet Environmental Categories (DO-160A)

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

LORAN-C 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 (45.09 cm)

Operational Characteristics

Operating Temperature Range - -55°C to +70°C

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

Maximum Speed - 350 kts (402 mph) TAS

A-17 BLADE ANTENNA

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 - -55°C 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 SPECIFICATIONS

Environmental Categories

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

Physical Characteristics

Weight: 0.413 lbs (0.187 kg)

Size: Height - 8.25 inches (20.96 cm)

Operational Characteristics

Operating Temperature - -55°C to +70°C

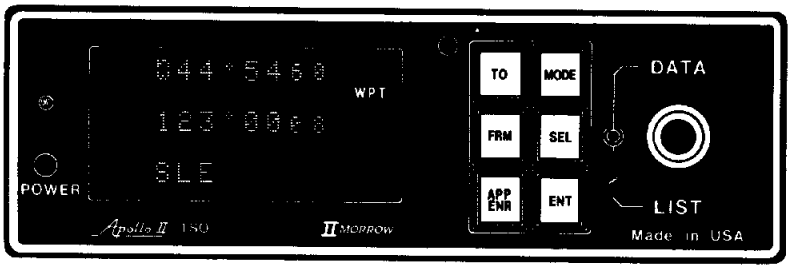
Operating Altitude - 50,000 feet (15,240 m)

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.

SECTION A

GETTING STARTED



GETTING STARTED WITH YOUR *Apollo II*

The APOLLO II will provide you with years of reliable service as an accurate navigation device. The keys to the successful use of the APOLLO II 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 II there are a few points to remember. The FLYBRARY is permanent memory and cannot be changed 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 a nautical mile (nm) is approximately 6076 feet (or 1.15 statute miles).

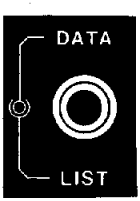
Note that the displays have two sizes of numbers. The larger size numbers are whole numbers. The smaller size numbers mean that they follow a decimal point. For example, in the display at the top of this page the Latitude would read 44°54.60'. The smaller "60" reading as .60.

Operation of the APOLLO II is quick and easy when the proper procedures are followed. A checklist of the steps for normal operation is given on the next page. A full explanation of operating functions is provided in this manual and should be read. 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.

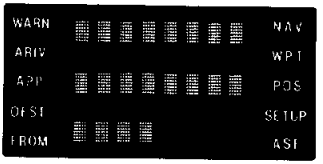
In the case of an in-flight emergency, the AIRPORT/VOR SEARCH function may be used as an aid in finding an airport. You may choose airports or VORs from the FLYBRARY (see page D-14).

FRONT PANEL CONTROLS

CONTROL BUTTONS	OPERATION
MODE	Pressing the MODE button will allow you to gain access to the operating modes (NAV, WPT, POS, & SETUP). The current mode will be noted by the appropriate lighted indicator on the right side of the display panel.
SEL	Pressing SEL enables the selection of a displayed value to be changed. The selected value will flash.
ENT	ENT must be pressed after selected data has been changed, unless otherwise noted.
TO	Pressing TO while in WPT Mode will set the displayed waypoint as the destination and the unit will automatically go to NAV Mode.
FRM	Pressing FRM while in WPT Mode will set the displayed waypoint as the origin (point of departure) and the unit will automatically go to NAV Mode.
APR ENR	Pressing the APP/ENR button allows you to choose between two sets of CDI resolution: one for Enroute navigation (5.0 nm full scale deflection) and one for Approach navigation (1.25 nm full scale deflection). The Enroute (ENR) setting is used unless the APP (Approach) is selected and is then indicated by the APP annunciator on the left side of the display. These positions only affect an external CDI. Automatic triad selection is disabled when Approach sensitivity is used.
APR ENR + ENT	Pressing the APP/ENR and ENT buttons simultaneously will activate the AIRPORT/VOR SEARCH function. See page D-14.

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.

INDICATORS



STATUS INDICATORS

Indicators located on the left side (and ASF on the right) of the display panel light to indicate signal or receiver operating information.

WARN The red WARN indicator appears when possible signal problems exist. The WARN indicator will also light immediately when the APOLLO II is turned on, indicating that the unit has not settled. See page E-16.

ARIV The green ARIV indicator 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).

APP The APP indicator lights when the external CDI resolution is set to the finer degree needed for approach.

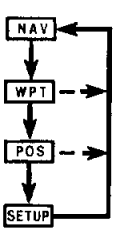
OFST The OFST indicator lights when the Course Offset function has been selected. Course offset is selected in SETUP Mode. See page E-1.

FROM The FROM indicator lights when the information displayed in NAV Mode is relative to the origin waypoint. The origin (or FROM) waypoint identifier is displayed.

ASF The ASF indicator lights when LAT/LONG calibration factors have been entered by the operator. See page E-8.

MODE INDICATORS

Four indicators on the right side of the display panel indicate which operating mode of the APOLLO II 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 indicator lights when Navigation Mode information is displayed.

The WPT indicator lights when Waypoint Mode information is displayed.

The POS indicator lights when Position Mode information is displayed.

The SETUP indicator lights when SETUP Mode information is displayed.

CONTROL SUMMARY

MODE	ROTARY SWITCH	FUNCTION
NAV	LIST	View NAV Mode information. 1. Bearing and Range. 2. Track Angle and Ground Speed. 3. Bearing and Track Angle. 4. Range and Estimated Time to your destination. 5. Cross Track Distance and Range. 6. Bearing and Range (FROM) back to your departure point. 7. The point-to-point Desired Track and Distance. 8. FROM, TO, and NEXT waypoints. 9. VNAV Altitude (612BV and 612BCV).
	DATA	Choose FROM, TO, and NEXT waypoints.
WPT	LIST	View waypoints.
	DATA	Choose Region (USER, USA, EC, NC, NE, NW, SC, SE, SW, AK, CW, CE, and HS). The CW and CE regions are in the Model 612BC and 612BCV versions only. In the USER and USA Regions the DATA knob is used to select characters for entering into a waypoint.
POS	LIST	None
	DATA	None
SETUP	LIST	View groups of information (OFST, MAG VAR, XTD SENS, GRI, etc.).
	DATA	View further within some groups of information. Select or change values in some groups of information.

PREFLIGHT CHECKLIST

1. Turn the unit on by pushing in the power switch. The unit will run through a short self-test. The WARN light will then appear during the warm-up period. You may still perform many functions while the WARN light is on. Remember that POS and most NAV Mode information will not be accurate until the WARN light is off. The unit will briefly show the GRI.

   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. Press the MODE button three times to reach SETUP Mode and turn the LIST knob cw to reach Course Offset (OFST).

3. Make sure Course Offset (OFST) is set to 0.0.

4. Turn the LIST (large) knob one position clockwise (CW) and check the Cross Track Distance (XTD) Sensitivity for your desired value (0.20 nm is a good starting point).

5. Turn the LIST (large) knob one position clockwise (CW) and check that Magnetic Variation (MAG VAR) is set to automatic (a). Auto MAG VAR works in the continental U.S., Canada, and Alaska.

6. Turn the LIST knob one position CW and check that the Latitude Calibration Factor (ASF value) is set to 0.00. Turn the LIST knob CW one position and check that the Longitude Calibration factor is set to 0.00.

7. Turn the LIST knob one position CW and check that the GRI is correct for your area. Use the map on pages A-9 and A-10 to select the best GRI for your area.

8. Check that the Triad selection is on automatic (a).

BEFORE TAKE-OFF

1. Press the MODE button to reach WPT Mode.

2. Turn the DATA (small) knob to select the Region (USA, AK, HS, EC, NC, NE, USER, etc.) that contains your departure and/or destination waypoints.

3. Turn the LIST knob (CW or CCW) to the waypoint that is your destination and press the TO button. The unit will switch to NAV Mode. Press the MODE button once to return to WPT Mode.

4. Turn the LIST knob (CW or CCW) to the waypoint that is your departure point (your present position) and press the FROM button. The unit will switch to NAV Mode. You may also use your present position as the departure point by pressing FROM while in POS Mode after the WARN light is out.

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

NAVIGATION POINT-TO-POINT

1. MODE button (press to reach WPT) . . . . . WPT

2. LIST (lg) knob . . . . . (if necessary) select REGION
   DATA (sm) knob . . . . . select Desired Region

IF YOU SELECT A SPECIFIC REGION (NW, SW, etc.)

3. LIST (lg) knob . . . . . select Departure Point

   (Either departure or destination may be programed first)

4. FRM button (press) . . . . . NAV

5. MODE button (press once) . . . . . WPT

6. DATA (sm) knob . . . . . (if necessary) select REGION

7. LIST (lg) knob . . . . . select Destination

8. TO button (press) . . . . . NAV

IF YOU SELECT THE USA REGION

3. LIST (lg) knob, turn counterclockwise . . Enter New WPT

4. SEL button (press) . . . . . first character will flash

5. DATA (sm) knob . . . select first character of the WPT

6. ENT button (press) . . . . second character will flash
   Continue by pressing ENT after selecting each character.

7. LIST (lg) knob, turn clockwise . . . enter 2nd WPT, etc.
   Enter waypoints in the order to be flown for a convenient reference (departure first).

When the WARN light goes out, use NAV mode information to navigate. Select various NAV data with the LIST (lg) knob.

NAVIGATION FROM PRESENT POSITION

1. MODE button (press twice) . . . . . POS

2. FROM button (press) . . . . . NAV

IF YOU ALSO NEED TO CHANGE YOUR DESTINATION

3. MODE button (press once) . . . . . WPT

4. Proceed as shown in NAVIGATION POINT-TO-POINT above to program your new destination.

NOTE

On a typical IFR departure you may be required to follow a procedure which will take you a few miles off your desired airport-to-airport course. When Departure Control or ATC Center clears you on course, be sure you understand your clearance. If you are cleared DIRECT to a waypoint or your destination, it means you are cleared DIRECT FROM YOUR PRESENT POSITION, and the controller will insert that new course into the ATC system computer (not the airport-to-airport course you flight planned) In this case you should press the MODE button twice to reach POS mode and then press the FRM button to program the new origin waypoint for the course you have been cleared to fly.

NAVIGATION ON A THREE WAYPOINT COURSE

When you have entered the FROM, TO, and NEXT waypoints in NAV Mode, the APOLLO II will automatically sequence to the second leg of a course after you pass the first destination (or TO) waypoint.

The waypoints you may select with the DATA knob are from the Region shown when you look at WPT Mode. If you want to select a waypoint from another Region, you will have to go to WPT Mode and turn the DATA knob to show the Region (NE, EC, NW, etc) that you need.

1. Mode button (Press to reach NAV) . . . . . NAV
2. LIST (lg) knob . . reach FROM, TO, NEXT WAYPOINT Page
3. SEL button (Press) . . . . first waypoint will flash
4. DATA (sm) knob . . . . . select departure waypoint
5. ENT button (Press) . . second (1st Destination or TO) waypoint will flash
6. DATA (sm) knob . select 1st Destination (TO) waypoint
7. ENT button (Press) . . third (2nd Destination or NEXT) waypoint will flash
8. DATA (sm) knob select 2nd Destination (NEXT) waypoint
9. ENT button (Press)

PHANTOM WAYPOINT

When it is necessary to navigate to a point that does not exist in your current waypoint memory, you may create a PHANTOM WAYPOINT that is referenced as a Radial and Distance from an existing waypoint. See page E-25.

You first select the Reference Waypoint from the currently used waypoint region. Then, enter the Radial and Distance from the reference waypoint. You may then use the PHANTOM WAYPOINT as you would any other waypoint for navigation.

1. Press MODE to reach WPT MODE . . . . . WPT
2. Turn the DATA knob to the desired region . . . REGION
3. Press MODE to reach SETUP MODE . . . . . SETUP
4. Press SEL to enable Reference Waypoint selection . . . . . the Reference WPT will flash
5. Turn the DATA (sm) knob . . select Reference Waypoint
6. Press ENT . . . . . Reference Waypoint is entered
7. Turn the LIST knob cw . . . . . Radial
8. Press SEL to enable Radial (Rad) selection . . . . . the Radial value will flash
9. Turn DATA (sm) knob . . . . . select Radial values
10. Press ENT . . . . . Radial values are entered
11. Turn the LIST knob cw . . . . . Distance
12. Press SEL to enable Distance (Dis) selection . . . . . the Distance value will flash
13. Turn DATA (sm) knob . . . . . select Distance values
14. Press ENT . . . . . Distance values are entered
15. Press MODE twice . . . . . WPT
16. Turn the DATA knob . . . . . USER
17. Turn the LIST knob ccw one position . . . . . PHTM
18. Press TO . . . . . NAV
19. Navigate to the PHTM WPT (Press FRM in POS Mode if you want to use the Cross Track Distance display in NAV Mode)

AIRPORT/VOR SEARCH

The AIRPORT/VOR SEARCH (ARPT/VOR SEARCH) function will allow you to locate and navigate to the nearest CONTINENTAL FLYBRARY airport, VOR, or USER (PRIVATE) waypoint. Enable AIRPORT/VOR SEARCH by simultaneously pressing the APR/ENR and ENT buttons. The APOLLO II will automatically set a course from your present position to the new destination waypoint. The new destination waypoint will flash to let you know that the AIRPORT/VOR SEARCH function is activated. Select the type of destination by turning the DATA knob while you are in NAV Mode. AIRPORT/VOR SEARCH is deactivated by pressing APR/ENR and ENT simultaneously again.

1. Simultaneously press APR/ENR and ENT . . . . AIRPORT/VOR SEARCH is activated and the unit will go to NAV MODE. The destination waypoint will flash and a new course is set from your present position to the new destination

2. Turn the DATA (sm) knob while in NAV mode . . destination waypoint type is selected

3. Simultaneously press APR/ENR and ENT . . . AIRPORT/VOR SEARCH is deactivated and the original course is reinstated

EXTENDED RANGE

The APOLLO II will allow you to better navigate on the fringe of the LORAN-C coverage or in electrically noisy areas with the use of the EXTENDED RANGE function. You should activate this function before leaving the good coverage area

1. Press MODE to reach SETUP Mode . . . . . SETUP

2. Turn the LIST (lg) knob . . . . . X_RANGE

3. Press SEL to enable selection . . . . status value will flash

4. Turn the DATA (sm) knob . . . . . "ON"

5. Press ENT . . . . . X_RANGE is activated

VERTICAL NAVIGATION (VNAV) 612BV and 612BCV Only

Select an angle of descent to set a glideslope for your destination.

1. Press MODE to reach SETUP Mode . . . . . SETUP

2. Turn the LIST (lg) knob . . . . . VNAV

3. Press SEL to enable selection . . . . . GSA value will flash

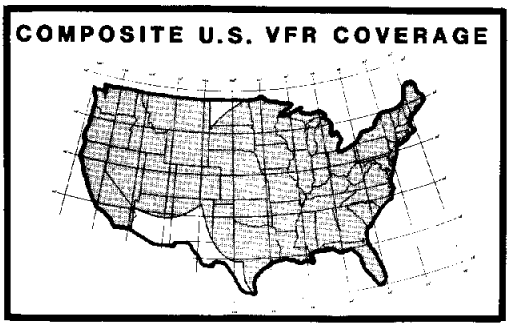
4. Turn the DATA (sm) knob . . . . . GSA value

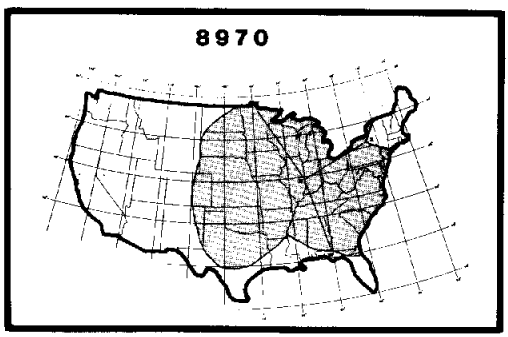
5. Press ENT . . . . . GSA value is entered

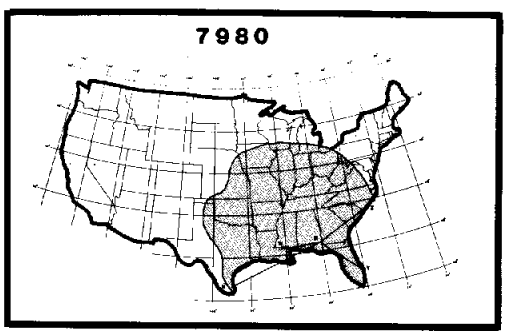
6. The destination elevation (EL) value will flash . . EL value

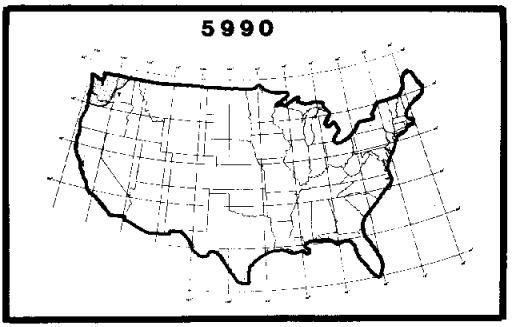
7. Turn the DATA (sm) knob and press ENT for each EL digit required.

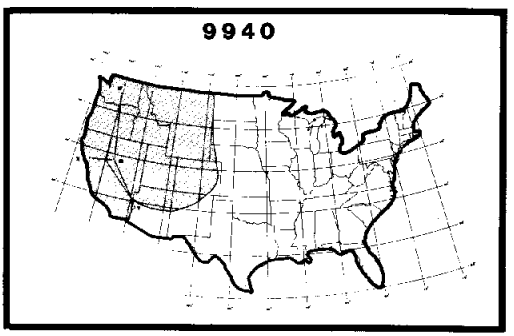
VFR LORAN-C COVERAGE for the CONTINENTAL U.S.

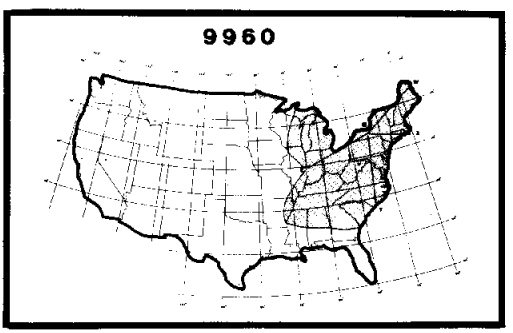







5990


9940


9960

AUTO-NAV

When selected, the AUTO-NAV feature will automatically cause each of the NAV Mode pages to sequence at a rate of about 1½ seconds. Once the AUTO-NAV feature has been enabled, while in NAV Mode you may press the SEL button to either start or stop the scrolling of the NAV Mode displays.

1. Press MODE to reach SETUP Mode . . . . . SETUP
2. Press SEL to enable selection . status value will flash
3. Turn the DATA (sm) knob . . . . . "ON"
4. Press ENT . . . . . AUTO-NAV is activated

SECTION B

POSITION MODE

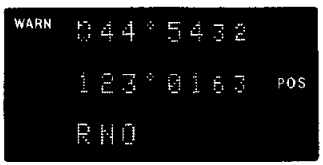
POSITION (POS) MODE

The POS Mode is used to display the current LAT/LONG coordinates. In POS Mode you may also navigate from your present position or select the alternate (extended) LAT/LON position solution.

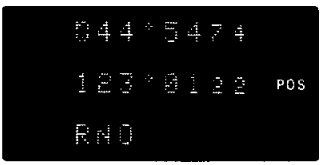
POS MODE DISPLAY ON STARTUP

When the master station and at least two secondaries are acquired, the APOLLO II will begin to calculate the current LAT/LON position. The correct LAT/LON position may not appear until cycle selection is complete and the WARN indicator has gone out. Cycle selection takes approximately two to five minutes depending on signal conditions.

a) Cycle Select occurring.



b) Settled display.



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 destination waypoint last chosen will remain in the lower display.

NAVIGATION FROM YOUR PRESENT POSITION

The APOLLO II 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.

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 present position at the time the TO button was pressed is entered as the destination waypoint and the destination waypoint shown at the bottom of the display panel will change to PPTO. This function is useful for returning to an airport after local flights.

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**.

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 D-1 for NAV Mode information. In this case FRM was used.

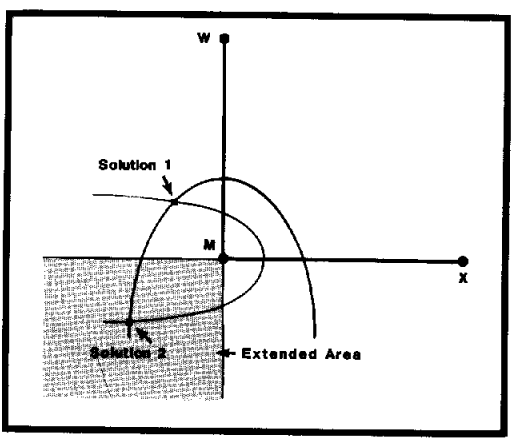
2) Press MODE to reach WPT Mode. Select the USER region of WPT Mode (see page C-3). Turn the LIST knob to display the present position waypoint (either PPTO or PPFR).

PRIMARY and EXTENDED LAT/LON SOLUTIONS

When a LORAN-C receiver calculates its position two LAT/LON solutions are found: PRIMARY and EXTENDED. The PRIMARY solution is within the Primary coverage area. The EXTENDED (or ALTERNATE) solution is located outside of the Primary coverage area. The APOLLO II will automatically select the correct solution in LORAN-C chains when three or more secondaries are present.

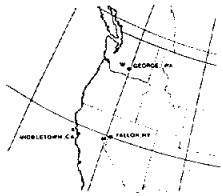
In chains where two secondaries are present, you may need to choose between the PRIMARY and the EXTENDED (or ALTERNATE) solution. As an added feature, the APOLLO II allows you to select the correct solution based on your knowledge of your location.

The position difference between the PRIMARY and EXTENDED 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.

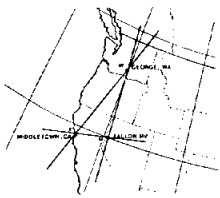


You may use either the LORAN-C coverage maps in this manual or the following procedure to determine the PRIMARY and EXTENDED solution areas.

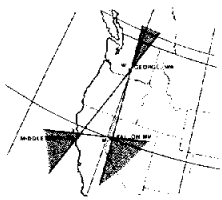
1) Using an actual map or chart, place the Master and the two secondary stations used in their geographical location.



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.



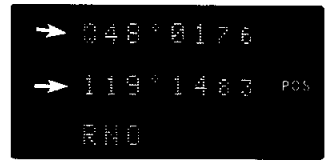
HOW TO DISPLAY THE ALTERNATE SOLUTION

You may only activate the ALTERNATE solution while using Manual Triad Selection. See the Manual Triad Selection section of this manual. 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.

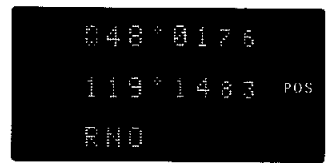
As far as the APOLLO II is concerned there are two solutions for your present position: the currently used position and the alternate position. No distinction is made between the primary or extended LAT/LON solution for navigation purposes. The APOLLO II only recognizes the currently used present position 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.

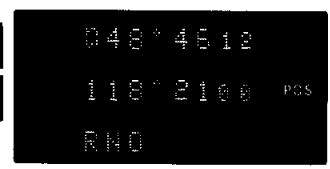
2) Press the SEL button to display the ALTERNATE LAT/LON solution. The coordinates will flash.



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 II to automatically sequence to the second leg of a two-leg course. So be sure to check your course after selecting the ALTERNATE solution.

SECTION C

WAYPOINT MODE

WAYPOINT (WPT) MODE

The APOLLO II provides access to thousands of established waypoints in the CONTINENTAL FLYBRARY (permanent memory) by LAT/LONG coordinates and the official identifier listed in alphabetical order within each region. Within the continental United States, District of Columbia, Canada (612BC and 612BCV Only), and Alaska the CONTINENTAL FLYBRARY holds the locations of: 1) all federally-designated airports with three alpha-character designators, 2) all VORs, 3) all public-use heliports, and seaplane bases, and 4) all public use airports that have hard-surface runways which are at least 2500 feet long and 40 feet wide. VORs are denoted by a lower case "v" after the location identifier.

The CONTINENTAL FLYBRARY is divided into 11 Regions. Eight of the Regions are set according to geographic area as shown in the Airport/Facilities Directory. These Regions are: EC (East Central), NC (North Central), NE (Northeast), NW (Northwest), SC (South Central), SE (Southeast), SW (Southwest), CW (Canada West - 612BC and 612BCV Only), CE (Canada East - 612BC and 612BCV Only), and AK (Alaska). The other three Regions (USER, USA, and HS) expand the capabilities of the APOLLO II. The Region called USER possesses 100 user-programmable waypoints for personalized use by the operator. The USA Region allows you quick access to all of the waypoints and lets you set up a special group of 10 waypoints for flight planning. The HS Region contains all federally-designated public-use heliports and seaplane bases.

The FLYBRARY information cannot be altered 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. Waypoints that you enter into the USER Region will be automatically placed in alphabetical order.

The TO and FROM function buttons are used in Waypoint or POS Mode to define a course to steer (Desired Track) which will provide the basis for the NAV Mode displays. The procedures for finding your way around the FLYBRARY, waypoint naming and selection are described in the following pages.

Details on setting a course are in the NAV Mode section.

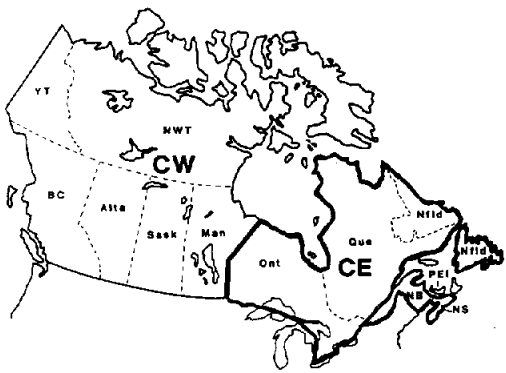
CONTINENTAL FLYBRARY

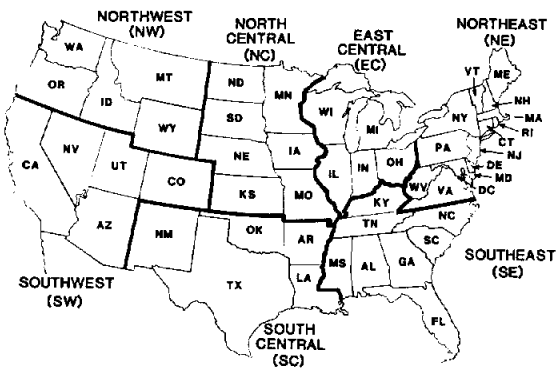
The CONTINENTAL FLYBRARY geographically covers the continental United States, Alaska, the District of Columbia, and Canada (612BC and 612BCV Only). The FLYBRARY holds the locations of:

1) all federally-designated airports with three alpha-character designators.
2) all VORs. VORs are denoted by a lower case "v" after the location identifier.
3) all public-use heliports and seaplane bases.
4) all public-use airports that have hard-surface runways which are at least 2500 feet long and 40 feet wide.

CONTINENTAL FLYBRARY REGIONS

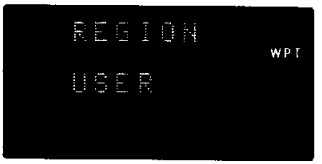
612BC and 612BCV Only





FINDING A WAYPOINT

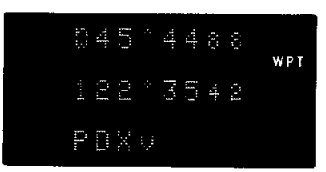
1) Press MODE to reach Waypoint Mode. The WPT indicator will appear on the right side of the display panel.



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

3) Turn the LIST knob to list the available waypoints. The LAT/LONG coordinates and location identifier will appear in the display.

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



SETTING WAYPOINTS IN THE USA REGION

The USA Region consists of ten waypoints selected from the entire CONTINENTAL FLYBRARY and is provided for the convenience of operators who fly long trips frequently. A simplified selection procedure is used to call up and list any of the many waypoints in the FLYBRARY.

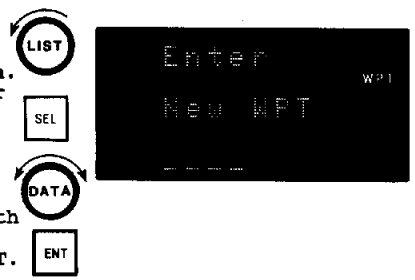
The ten USA Region waypoints are stored in nonvolatile memory and will be retained after system shutdown. A waypoint must be listed in the ten waypoint memory before you can navigate with it using this Region. When you enter an 11th waypoint, the first one listed will be dropped from memory. These ten waypoints can be used in any order.

Use the following procedure to list waypoints:

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

2. Select the USA Region using the DATA knob. The set will remain in the same Region until a new one is selected, or the unit is turned off.

3. Turn the LIST knob 1 click counterclockwise (ccw) to display "Enter New WPT". Press SEL and the first character blank will flash. Select the first character of your desired waypoint with the DATA knob and press ENT. Select the remaining characters pressing ENT after each selection. Leave the fourth character blank, if appropriate, and press ENT.



NOTE: If "WPT NOT FOUND" is now displayed after entering the last character, press SEL and start over. You may have entered the wrong identifier, or it does not exist.

4. Now turn the LIST knob clockwise (cw) one click to display "Enter New WPT" again. Enter the next waypoint using the same procedure. Continue until all desired waypoints are entered. You can enter up to 10 waypoints.

USER-DEFINED WAYPOINTS

The USER Region of the APOLLO II contains up to 100 waypoints entered by the operator, PPTO (see page B-2), PPFR (see page B-2), and the Phantom Waypoint (see page E-25). Only numbers and upper case letters may be used in naming a waypoint. Waypoints are entered as LAT/LON coordinates. There are two methods for entering a waypoint into the USER region: automatic direct entry of your present position or manual selection of each value. Your USER Region waypoints are automatically sorted and listed alphabetically and numerically. The last USER region waypoint number will show how many waypoints are left.

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 a lower case "n" and "w" in front of the Latitude coordinate. The other quadrants will be indicated by upper case letters between the degrees and minutes of the LAT/LON coordinates.

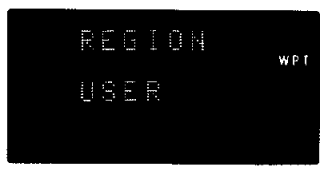
The APOLLO II displays LAT/LON coordinates to one hundredth of a minute. Some published references supply LAT/LON coordinates to one tenth of a minute. When using these references, round to nearest tenth of a minute, the hundredth of a minute display to read zero. Some published references list LAT/LON 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 II.

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

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

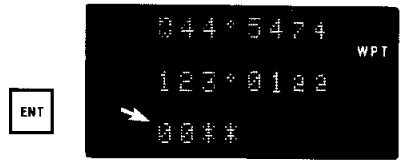
AUTOMATIC DIRECT ENTRY OF YOUR PRESENT POSITION

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.

3) Press ENT. The LAT/LON coordinates for your present position will be automatically entered into that waypoint. The first character of the waypoint name will now flash. You may now go to any other feature. If you wish to enter a name for the waypoint use step 2 of the MANUAL USER WAYPOINT ENTRY procedure.



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.

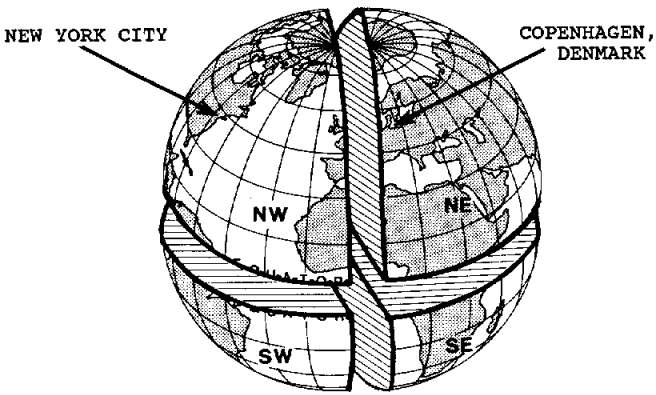
3) Turn the DATA knob to the desired character. Press ENT. This will enter the character and automatically enable selection of the next character. Up to four characters may be entered as a waypoint name. Names of three or less characters will be followed by an asterisk (*) to show that it has been added by the operator.

4) The LAT coordinate selection has been enabled. The degrees digits will flash. Turn the DATA knob to select the desired value and press ENT.

5) The minutes digits will now flash. Turn the DATA knob to select the desired value and press ENT. Continue for the remaining LAT/LON coordinates.

6) After the coordinates have been entered select the desired quadrant with the DATA knob and then press ENT.

NOTE: Do not use the FLYBRARY region initials in the quadrant positions. You must select a quadrant based on LAT/LONG 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.



A user defined waypoint in a quadrant other than NW would appear as shown below. This waypoint is the location of Genoa, Italy which is East of the Prime Meridian and North of the Equator (i.e. the NE quadrant). The coordinates for this waypoint are N 44°23.80' and E 8°56.25'.

HELPFUL HINTS FOR USER-DEFINED WAYPOINTS

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

A user defined waypoint may be cleared by entering an asterisk (*) into the four positions used for the waypoint name (****) and then pressing ENT. The LAT/LONG coordinates will be zeroed and the waypoint name will now return to the original waypoint position number (00** - 99**).

Altering the first two characters of the USER waypoint identifier to a number value has been intentionally set to require additional keystrokes. This means that you must make a conscious decision to change waypoint numbering. This protects you from accidentally overwriting information that may already exist. Changing the first two characters to other than the assigned position number (00** - 99**) requires that you: change one of the first two characters to a letter or enter a value (a letter or number) into the third or fourth characters of the waypoint identifier. The third and fourth characters are initially set as asterisks (i.e. 35**, 36**, etc).

SECTION D

NAVIGATION MODE

NAVIGATION MODE

The APOLLO II displays a variety of navigation information when in NAV Mode. Turning the LIST knob allows you to view the NAV displays. Full navigation information is displayed only when TO and FROM waypoints have been selected which defines a course to steer. The last NAV functions displayed will be shown on the return to NAV Mode from any other mode. Correct NAV Mode information will not be displayed until the WARN light has gone out. See page E-18 on ECD displays. AUTO-NAV will automatically sequence the NAV displays (see page E-31).

NAV Mode also allows the operator to establish a two leg course by setting FROM, TO, and NEXT waypoints. The APOLLO II will automatically advance to the second leg when the first TO waypoint has been reached, unless the APRT/VOR SEARCH feature is activated.

This section will describe the NAV displays and how to define a course to steer. 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 based on magnetic north unless changed by the operator.

The available displays in NAV Mode are:

1) Bearing (BRG) in degrees to the destination (True or magnetic).
2) Range (RGE) in nautical miles to the destination.
3) Track (TRK) in degrees (True or magnetic).
4) Ground Speed (GS) in knots.
5) Estimated Time Enroute (ETE) in hours and minutes to the destination.
6) Cross Track Distance (XTD) is shown graphically and Range numerically. Bar graph sensitivity is selected by the operator.
7) Bearing-From (True or magnetic) and Range-From your present position to the point of origin.
8) Desired Track (DTK) (True or magnetic) and the distance between waypoints.
9) FROM, TO, and NEXT waypoints.
10) VNAV Altitude (Models 612BV and 612BCV only).
11) Cross Track Distance (XTD) bar graph. Distance and direction off-course.

DEFINING A COURSE TO STEER

Defining a course to steer refers to assigning a FROM waypoint and TO waypoints. You may establish TO or FROM waypoints in NAV (see page D-3), WPT (see page D-2), or POS Mode (see page B-2). The TO and FROM waypoints may be in different Regions. Course and steering 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.

Examples for defining a course to steer and the related NAV information follow. The illustrations of typical NAV Mode displays will be given following the procedure for course definition to provide a more logical and meaningful explanation.

DEFINING A TWO WAYPOINT (ONE LEG) COURSE TO STEER

1) Press MODE to reach Waypoint Mode. The last region used (EC, NW, etc) will be displayed. Turn the LIST knob CW one position to display the last waypoint viewed.

2) Turn the LIST knob to select the desired origin waypoint. Press FROM to define that waypoint as the point of origin.

or

Press MODE to reach POS Mode and then press FRM to enter your present position as the point of origin.

NOTE

NAV Mode is displayed automatically whenever a TO or FROM waypoint has been selected. Return to WPT Mode by pressing MODE.

4) Select the desired destination waypoint. Press TO to define that waypoint as the destination.

NOTE

When a single leg (two waypoint) course is selected, your external CDI will show a FROM flag if you pass your destination.

DEFINING A THREE WAYPOINT (TWO LEG) COURSE

1) Press MODE to reach WPT Mode. Turn the DATA knob to reach the region where your desired waypoints are located (USER, SW, NW, etc).

2) Press MODE (3x) to reach NAV Mode. Turn the LIST knob to the "TO, FROM, and NEXT waypoint" display.

3) Press SEL to enable selection of the FROM waypoint (point of origin). The identifier will flash. Turn the DATA knob to select the desired FROM waypoint.

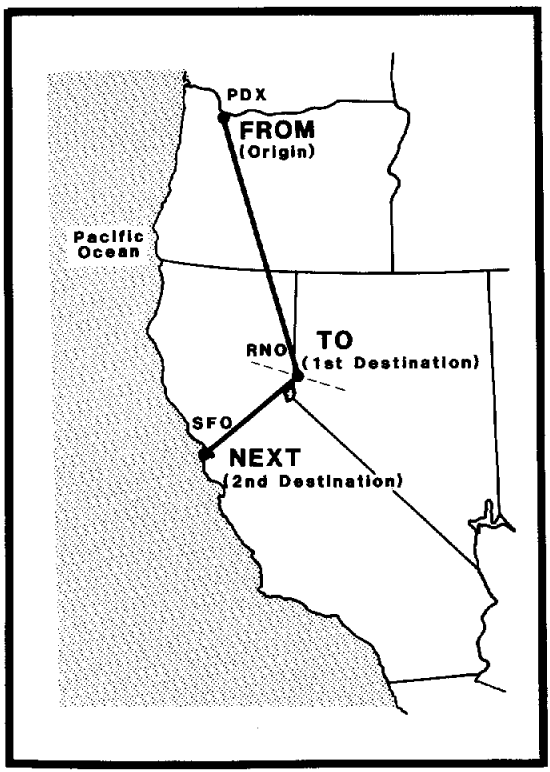
4) Press ENT to enter the FROM waypoint. The TO or second waypoint position will now flash. Turn the DATA knob to select the desired TO waypoint. If the TO waypoint is in another region you will have to press the MODE button to reach WPT Mode and then select the desired region with the DATA knob.

5) Press ENT to enter the TO waypoint. The NEXT, or second leg TO, waypoint position will now flash. Turn the DATA knob to select the desired NEXT waypoint and then press ENT.

Your three waypoint two-leg course is now set. The APOLLO II will automatically sequence to the second leg when you reach your first destination (TO) waypoint. Remember to press SEL and not ENT to advance without changing the waypoints.

THREE WAYPOINT (TWO LEG) NAVIGATION

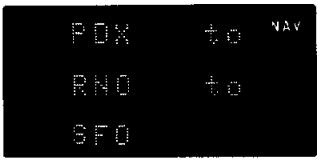
After you have entered your three waypoint course in NAV Mode, you may navigate as you normally would on a course from PDX to RNO. When you cross the dotted line, the APOLLO II will automatically set your course from RNO to SFO. Sequencing will be disabled when the APRT/VOR SEARCH feature is activated.



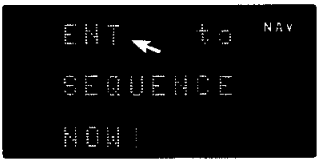
You may alter the three waypoint two-leg course after it has been entered. Two functions are available to do this: immediate manual trip leg sequencing and clearing the third waypoint.

MANUAL TRIP LEG SEQUENCING

1) In NAV Mode turn the LIST knob to the FROM, TO, NEXT waypoint page. Your three waypoint, two leg course is displayed.



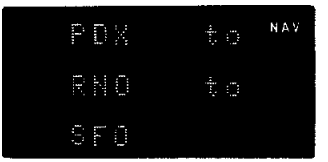
2) Press SEL four times (4x). "ENT to SEQUENCE NOW!" is displayed and "ENT" is flashing.



3) Press the ENT button to immediately begin navigation using the second leg of your flight. The display will show the second leg and the first (FROM) waypoint will be removed.

REMOVING THE THIRD (NEXT) WAYPOINT

1) In NAV Mode turn the LIST knob to the FROM, TO, NEXT waypoint page. Your three waypoint, two leg course is displayed.



2) Press SEL five times (5x). "ENT to VOID 3rd WPT" is displayed and the "ENT" flashes.

3) Press the ENT button to remove the 3rd (or NEXT) waypoint. The FROM, TO, NEXT display will now show only the first leg.

"FLIGHTPLANNING" A MULTIPLE WAYPOINT COURSE IN THE USA REGION

If you want to preset waypoints for a multiple leg trip, you should insert them in the proper sequence to simplify their use. Program your departure point first and destination last. After you have programmed your last waypoint, set up your first NAV leg using the following procedure:

1. Rotate the LIST knob (ccw) to your departure waypoint and press FRM.
2. Press MODE to return to WPT mode.
3. Rotate the LIST knob two positions (cw) to the second waypoint and press TO. The first leg of your trip is now programmed.

When you arrive at each waypoint, programming the next leg of your trip is a simple process:

1. Press MODE to reach WPT mode.
2. Press FRM to insert this as the new FRM waypoint.
3. Press MODE again to reach WPT mode.
4. Rotate the LIST knob two positions (cw) to your next waypoint.
5. Press TO to insert your new TO waypoint.

Enter each succeeding leg in the same manner when you arrive at the TO waypoint.

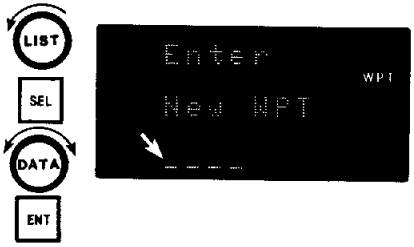
Rotate the LIST knob for desired NAV displays.

This feature will be very handy if you are making several landings with minimum ground time at each stop. You can probably preset your entire day's flying before you leave home.

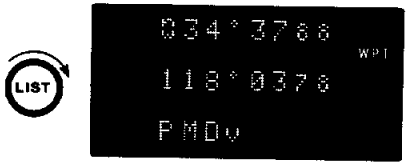
EXAMPLE:
Let's assume you want to fly from San Francisco direct to El Paso, but you know you will have to fly south of the restricted area at Edwards Air Force Base. You decide to fly from SFO direct to PMDv then direct to ELP.

1. Press MODE to reach WPT Mode. If you have just turned the set on, USA REGION will be displayed, if not, the last selected Region will be displayed. Select the USA REGION, if necessary, with the DATA knob.

2. Turn the LIST knob (ccw) to reach "Enter New WPT." Press SEL to enable selection of the first character Select "S" with the DATA knob and press ENT. Select "F" and "O" in the same manner pressing ENT after each letter. Leave the fourth space blank and press ENT.

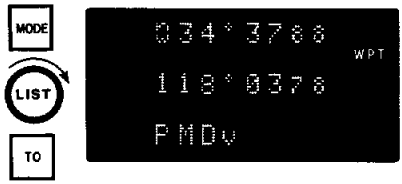


3. Now rotate the LIST knob (cw) to reach "Enter New WPT" again and insert PMDv as your next waypoint in the same manner as above. Remember that a lower case "v" is used to indicate a VOR.

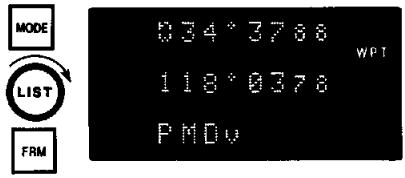


4. After inserting your last waypoint, ELP, rotate the LIST knob (ccw) to SFO and press FRM.

5. Press MODE to return to WPT mode, turn the LIST knob two positions (cw) and press TO to insert PMDv as the next waypoint.

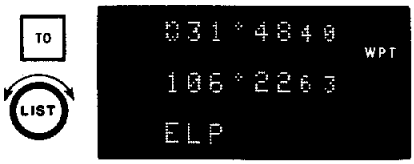


6. At PMDv, press MODE to to reach WPT (USA Region will be displayed). Turn the LIST knob one position (cw). Press the FRM button to make PMDv your FROM waypoint.



7. Press MODE to reach WPT and turn the LIST knob (cw) two positions to reach the ELP waypoint.

8. Press the TO button to set ELP as your TO waypoint. Turn the LIST knob to select NAV data.



NAV MODE DISPLAYS

The following illustrations are examples of typical displays seen in the NAV Mode. The information shown refers to the previous example on Defining a Course to Steer. In this case the LIST knob is turned clockwise, you of course may turn the LIST knob either way. The Destination Waypoint identifier is also displayed except where noted.

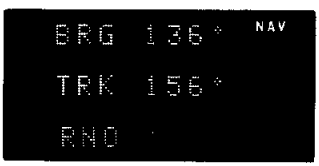
Bearing and Range to the Destination waypoint from your present position.

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

Track (direction of travel) and Ground Speed.

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

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



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

Range and Estimated Time Enroute to the Destination waypoint from your present position.

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

Cross Track Distance (XTD) is shown by a bar graph. With the XTD sensitivity set to 0.10 nm per dot, you must steer 1.3 nm to the left to return to your original course. There are five columns of dots in each bar, or in this case 13 columns of dots making two full and one partial bar. The Range (RGE) to the destination waypoint is also shown.

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

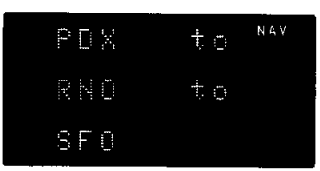
Bearing and Range FROM your present position to the Origin waypoint. The Origin waypoint identifier is displayed.

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

Desired Track and the Distance between the Origin and Destination waypoints.

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

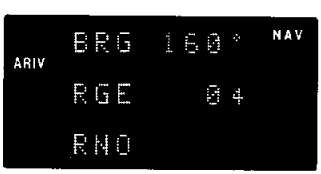
FROM, TO, and NEXT waypoints.



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

WAYPOINT ARRIVAL

When you are within one mile for each 100 kts of ground speed of the destination waypoint the ARIV indicator will light.



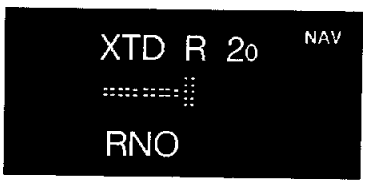
CROSS TRACK DISTANCE (XTD)

When a course to steer has been defined by choosing TO and FROM waypoints, the APOLLO II internally draws a course line between the two points. The Cross Track Distance (XTD) display provides a visual indication of whether you are on- or off-course, and if you are off-course which direction to steer to return on-course.

The XTD display indicates by a bar graph the distance the aircraft is off-course and the direction to steer to return to the correct course. The display will show only two center bars when the aircraft is on-course. When the aircraft is off-course, the bar graph will extend on either side of the center marks. This indicates the direction you must steer to return on-course. The bar graph length represents a distance selected for Cross Track Distance sensitivity in SETUP Mode (page E-5). Each bar segment has five columns of dots in two rows. A column of dots will light for each selected value of sensitivity that you are off-course. For instance, if you are off-course 1.3 nm to the right and the XTD Sensitivity is set at 0.1 nm, the XTD display will show 13 columns of dots to the left (the direction to steer). The Range to the destination waypoint is also shown. Another NAV display shows the XTD bar graph, the direction (L or R) that you are off-course, and the distance that you are off-course up to 99 nm.

Examples of Cross Track Distance displays are given below.

The bar graph display indicates that you are off-course (to the right of the DTK by 2.0 nm with the sensitivity set to 0.20 nm). Steer left.



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

REMEMBER . . . 1 Dot = XTD SENS distance
1 Bar = 5 times the XTD SENS distance

NAVIGATION (NAV) MODE INFORMATION

When a course to steer 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° (True or Magnetic).

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

TRK: Displays Track Angle in degrees from 0° to 359° (True or Magnetic). 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.

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 steer 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 E-5).

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

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

DTK: Displays the Desired Track between waypoints (True or Magnetic).

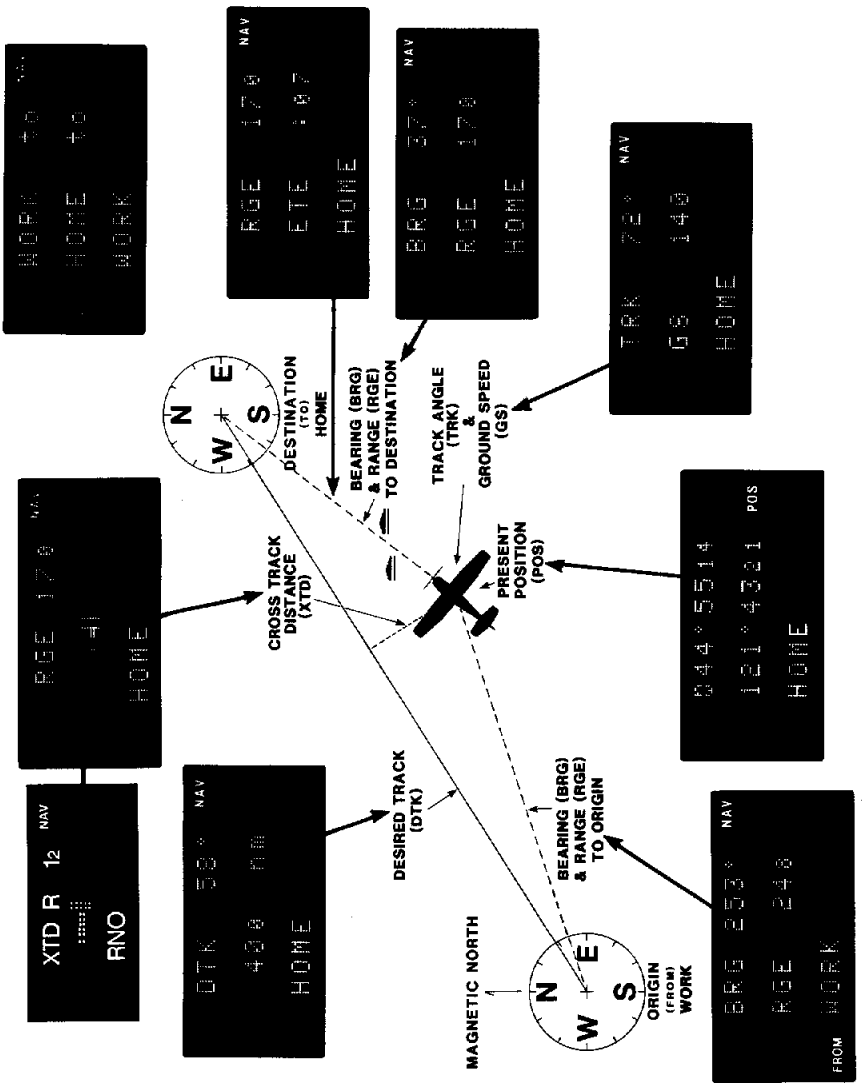
(Distance) nm: Displays the distance between waypoints in nautical miles (nm).

RAD: Displays the Radial you are on in relation to the VOR found by the AIRPORT/VOR SEARCH function.

VNAV ALT: Shows target altitude for a preset glideslope angle from your present position to the destination waypoint. (612BV and 612BCV Only)

NOTE: If a waypoint from the USER Region is used to plot a course to steer and the name or position for that waypoint is changed, it is necessary to redefine the course to steer.

NAVIGATION MODE INFORMATION



AIRPORT/VOR SEARCH

The APOLLO II will automatically search for the closest waypoint in the CONTINENTAL FLYBRARY or USER region to your present location and set a course (FROM and TO waypoints) to it with the simultaneous pressing of two buttons. This feature may be used to help in guiding you to an airport in an emergency situation, providing the Bearing and Range (or Radial and Range in relation to a VOR) to a position requested by an ATC or Center, or in merely showing you to the closest waypoint while on a routine flight. After the nearest FLYBRARY airport has been found by the APOLLO II you may then select the nearest VOR or USER region waypoint by turning the DATA knob while in NAV Mode. The APOLLO II will perform a PRIVATE SEARCH of USER region waypoints as a destination in the AIRPORT/VOR SEARCH Function.

The AIRPORT/VOR SEARCH function is activated by pressing the APP/ENR and ENT buttons at the same time. You may do this while in any mode. These two buttons are surrounded by a red ring to identify their use in activating the AIRPORT/VOR SEARCH function. The APOLLO II will then indicate that it is searching for an airport by "AIRPORT/VOR SEARCH.." appearing in the display. After finding the closest airport in the FLYBRARY within approximately a 100 nm radius, the APOLLO II will plot a course with your present position (PPFR) as the FROM waypoint and the AIRPORT/VOR SEARCH airport as your TO waypoint. The APOLLO II will then automatically switch to NAV Mode and display the Range (RGE) and Bearing (BRG) (or Radial and Range if it is a VOR) to the AIRPORT/VOR SEARCH airport. You may turn the LIST knob to view the other NAV information for your new course, or you may use any other function of the APOLLO II as you normally would. The airport identifier will flash to let you know the you are in the AIRPORT/VOR SEARCH function. If a FLYBRARY airport is not found, the APOLLO II display will indicate "No WAYPT found" and the waypoint identifier position will have flashing dashes. This means that there is no airport listed in the FLYBRARY that is within 100 nm of your present position. This does not mean that there are not any airports within 100 nm, only that you must refer to your charts or other means to determine a nearby landing area.

You may cancel the new course plotted to the AIRPORT/VOR airport by pressing the APP/ENR and ENT buttons at the same time once again. The APOLLO II will then navigate by your previously entered course. If you turn off the APOLLO II while in the AIRPORT/VOR SEARCH Function, you must then redefine your course with TO and FROM waypoints. The AUTO-NAV feature, TO and FROM buttons, and waypoint sequencing will all be disabled when the APRT/VOR SEARCH function is activated.

ACTIVATING THE AIRPORT/VOR SEARCH FUNCTION

1) Press the APP/ENR and ENT buttons at the same time. Your APOLLO II will begin to search for the closest airport in the FLYBRARY to your present position.

2) After finding the closest airport in the FLYBRARY to your present position, the APOLLO II will switch to NAV Mode. All NAV Mode information is referenced to your emergency course. The AIRPORT/VOR airport identifier will flash.

3) Turn the DATA knob one position cw to reference NAV data to the nearest VOR. The BRG and RGE display will instead show the Radial and Range from the nearest VOR.

PRIVATE SEARCH

4) Turn the DATA knob one position cw again to reference NAV data to the nearest USER Region waypoint.

IF A WAYPOINT IS NOT FOUND BY AIRPORT/VOR SEARCH

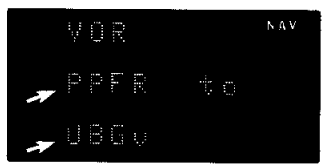
The APOLLO II display will indicate that no airport in the FLYBRARY is within 100 nm. The waypoint identifier position will contain four dashes that will flash.

AIRPORT/VOR SEARCH "FROM, TO, & NEXT WAYPOINT" NAV PAGE

When the AIRPORT/VOR SEARCH function has been activated the FROM, TO, & NEXT waypoint display in NAV Mode is replaced with a display indicating a course from the PPFR (Present Position From waypoint) to the AIRPORT/VOR airport chosen from the FLYBRARY. Automatic waypoint sequencing is disabled.

AIRPORT

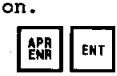
VOR



PRIVATE SEARCH

CANCELLING THE AIRPORT/VOR SEARCH FUNCTION

Press the APP/ENR and ENT buttons again to cancel the AIRPORT/VOR SEARCH function. The APOLLO II will now provide navigation information according to the course defined before the AIRPORT/VOR SEARCH Function was activated.

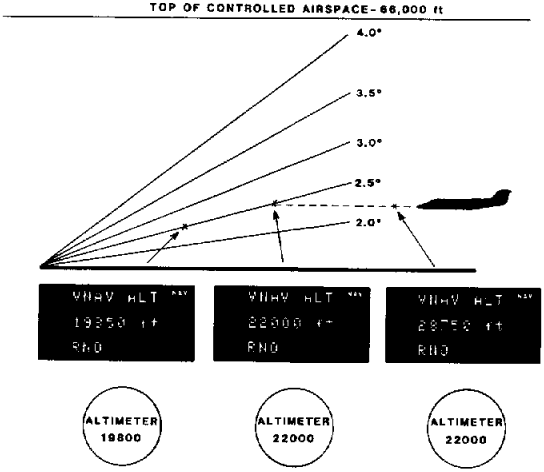


VERTICAL NAVIGATION (VNAV)

612BV and 612BCV Only

Ten preset angles of descent to your destination are available ranging from two to nine degrees. To use the VNAV, you will need to set the angle of descent desired and then enter the altitude you want to descend to.

The VNAV display is located in NAV mode and is entitled VNAV ALT. If you program the VNAV for descent well ahead of the required descent point, it will display an altitude above your cruise altitude up to 66000 feet (the maximum target altitude of the VNAV indicator).



Begin your descent when the VNAV target altitude reaches your cruise altitude. You should check your progress about every 1000 feet of descent. As your altimeter reaches even altitudes, check the VNAV display to see if you are above or below your target altitude. Adjust your rate of descent to keep your altitude matched with the VNAV target altitude.

SECTION E

SETUP MODE

SETUP (SETUP) MODE

The initial start-up conditions and calibration factors for the APOLLO II are entered in the SETUP Mode. The start-up calibration information for the APOLLO II are items such as: Course Offset, XTD Sensitivity, Magnetic Variation, LAT/LONG Calibration Factors, and the GRI. Also included in SETUP Mode are: TDs (Time Differences), Signal Information, Service Displays, and the diagnostic "ADVISORY" pages. The only feature in the SETUP Mode that must be entered for the APOLLO II 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 anomalies, set XTD sensitivity, set the Course Offset (OFST), create a PHANTOM WAYPOINT, and view signal information. Manual triad selection and the Extended Range function may also be set in this Mode.

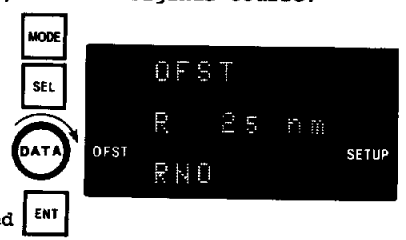
This section will describe each of the functions in the SETUP Mode and illustrate their use. SETUP Mode is reached by pressing the MODE button until the SETUP indicator lights. Each of the features in SETUP Mode is reached by turning the LIST knob. Further information in a particular function may then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

COURSE OFFSET (OFST)

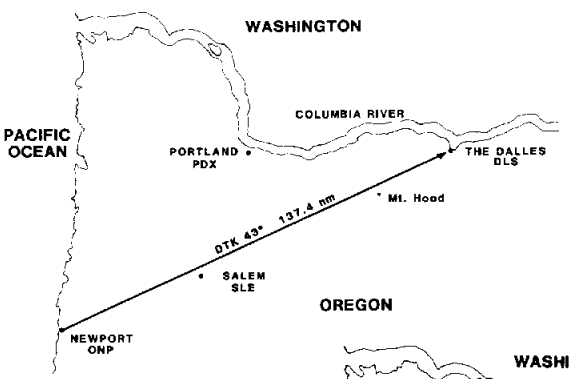
The Course Offset function allows the pilot to offset the aircraft course to fly parallel to the original course. While using Course Offset all course navigation information will still be referenced to the TO waypoint. The Cross Track Distance (XTD) display in NAV Mode and the external CDI will now refer 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.

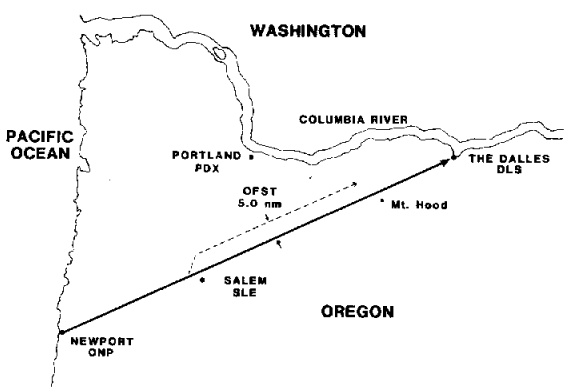
1) Press MODE to reach SETUP Mode and the Course Offset (OFST) function. Press SEL to enable OFST selection. The distance value will flash. Turn the DATA knob in the desired OFST direction to the desired value and press ENT.



TYPICAL USE OF COURSE OFFSET (OFST)

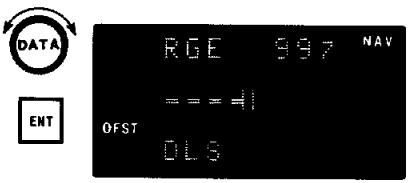
The following example will demonstrate a use of the OFST function. In this example a flight plan has been made for a trip from Newport, Oregon to the The Dalles, Oregon. While enroute a few miles west of Salem, Oregon thunderclouds are noted above Salem and to the south. You then enter a five mile Course Offset (OFST) into your APOLLO II 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 II 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.





1) Press Mode to reach SETUP Mode. The OFST function will be displayed. 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.

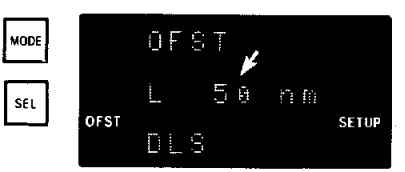


3) Press MODE once to reach NAV Mode and then turn the LIST knob to show the Cross Track Distance (XTD) display.

4) Steer 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).

Choose steps 5-7 or step 8 after you have passed the storm activity. Steps 5-7 show how to return to your original course. Step 8 plots a new course line from your present position to the destination.

5) Remove the Course Offset. Press MODE to reach SETUP Mode (the OFST function will be displayed). 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. Steer right to return to your original course.

or

8) Press MODE to reach POS Mode and press FRM. This will allow you to navigate directly to your destination without steering 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 steer to travel on-course. The course-to-steer (Desired Track) is an imaginary line between the origin (FROM) and destination (TO) waypoints.

Cross Track Distance is displayed as a bar graph to indicate whether you are on- or off-course, and if off-course the distance off-course and the direction to steer to return on-course. Range to the destination is also shown.

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 column of dots. There are five columns of dots in each group.

0.01 nm = 61' per column	0.25 nm = 1519' per column
0.02 nm = 122' per column	0.50 nm = 3038' per column
0.05 nm = 304' per column	0.75 nm = 4557' per column
0.10 nm = 608' per column	1.00 nm = 6076' per column

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. 0.10 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 show one group, or bar, of five dot columns for each mile of distance from your desired course. The example below shows a Cross Track Distance (XTD) of 3 nm when the XTD Sensitivity is set to 0.20 nm. The display indicates that you should steer left.

MAGNETIC VARIATION (MAG VAR)

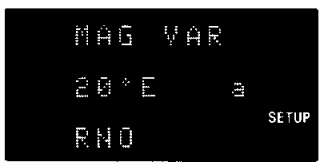
The APOLLO II references the NAV displays to either magnetic or true north. The APOLLO II will automatically select the proper Magnetic Variation for your area to reference the NAV displays in magnetic headings. You may also manually enter Magnetic Variation. If the Magnetic Variation is set to 0°, NAV information will be referenced to true north. The APOLLO II 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. 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.

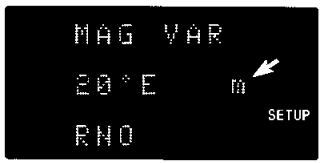
Automatic Magnetic Variation is only operative in the 48 contiguous states of the continental United States, Alaska, and Canada.

AUTOMATIC MAGNETIC VARIATION

1) In 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.

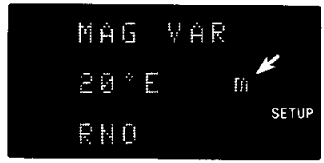


MANUAL MAGNETIC VARIATION

The APOLLO II also allows you to manually select Magnetic Variation. The illustration on the following page 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.

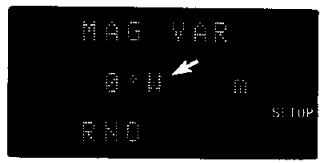
The procedure for manually entering the Magnetic Variation Factor is shown below.

1) In SETUP Mode turn the LIST knob until you reach the MAG VAR function. Press SEL (the "a" will flash) and then turn the DATA knob to select manual ("m") MAG VAR. Press ENT.

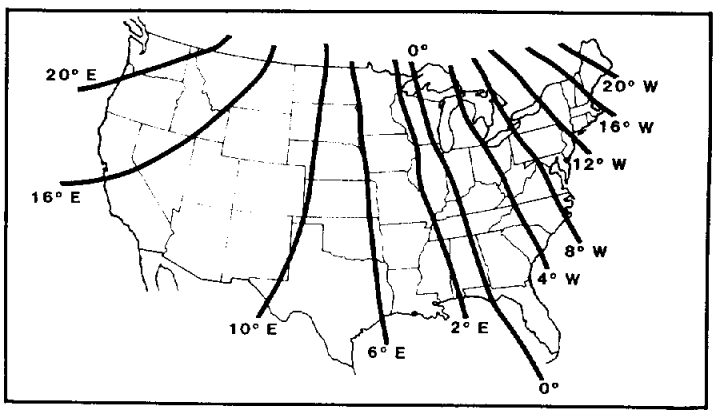


2) Press SEL to enable Magnetic Variation value entry. The degrees digits will flash. Turn the DATA knob to the desired value and press ENT.

3) Press SEL to enable selection of the direction of variation. The direction value will flash. Turn the DATA knob to select "E" or "W" and press ENT.



ISOGONIC LINES FOR THE CONTINENTAL U.S.



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 II, however, obtaining the greatest degree of accuracy in POS and NAV displays may require the entry of LAT/LON calibration factors.

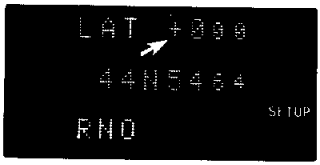
Calibration factors, or ASFs (Additional Secondary Phase Factors), are entered to compensate for propagation variations in the LORAN-C signal unique to a particular locality. When calibration factors are entered, the LAT/LON coordinates will change to reflect the entered values. The LAT/LON coordinates may be changed by ±9.99 minutes in normal operation. When the Extended Range feature is activated, the coordinates may be changed by ±99.9 minutes (see page E-28). The ASF indicator on the lower right side of the display panel will light to indicate when calibration factors have been entered.

ENTERING CALIBRATION (ASF) FACTORS

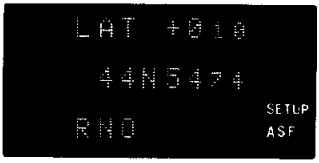
The APOLLO II allows the entry of LAT/LON calibration values. Calibration values are entered to add a bias to the LAT/LON coordinates for more accurate navigation. Enter calibration factors that will change your LAT/LON coordinates to match those of a known position. This may be accomplished by flying 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 until you reach SETUP Mode. Turn the LIST knob until the LAT cal factor and LAT coordinate are displayed. Press SEL to enable entry. "ENT Pos?" will appear. "ENT" will flash.

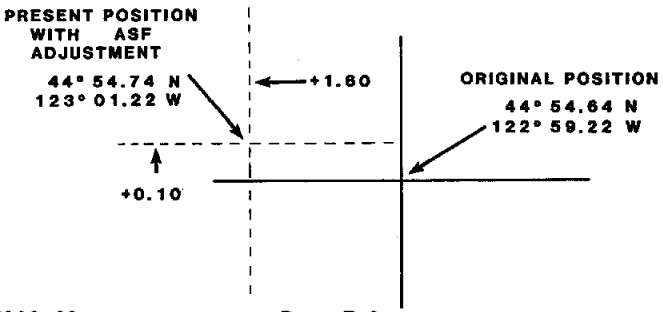
2) Press ENT to load your current position coordinates into the LAT/LON displays. The calibration factor will now flash.



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. Press SEL twice, turn the DATA knob to display the required LON calibration factor, and then press ENT.



GROUP REPETITION INTERVAL (GRI)

The first step in setting up the APOLLO II 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 II 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 II also allows the operator to manually select the secondaries. Check the LORAN-C Coverage Maps in Section F to determine the appropriate Chain and secondary choices for your area. A following map (page E-13) shows the chain configurations near North America. 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-10, A-11 and in Section F. A table below lists the worldwide LORAN-C chains available.

AVAILABLE LORAN-C CHAINS

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

Information for each LORAN-C chain is available in Section F. An example of the LORAN-C data tables is shown on the following page.

The LORAN-C chain is selected by the first three digits of the GRI. The U.S. West Coast GRI is 9940 and is shown in the APOLLO II display as 9940.

The secondary stations are displayed and selected by the first letter for that station, as shown below.

LOCATION	NAME	TIME DELAY
George, Wa.	**W**hiskey	11,000
Middleton, Ca	**X**ray	27,000
Searchlight, Nev.	**Y**ankee	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.

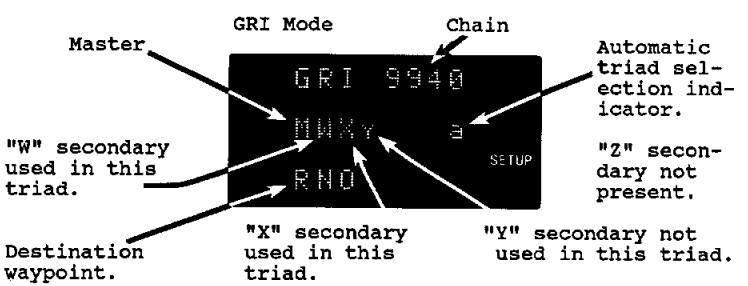
U.S. WEST COAST LORAN-C CHAIN - GRI 9940 (old rate 5S6)

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 II and press MODE to reach SETUP Mode.

2) Turn the LIST knob until you reach the GRI function. The APOLLO II 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. "x"). The Master transmitting station is shown as M. The secondaries are listed as 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. Turn the LIST knob to reach the GRI function. The previously selected GRI and triad will be displayed. Press SEL to enable GRI selection. The GRI will flash and chain name will be displayed.

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.

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

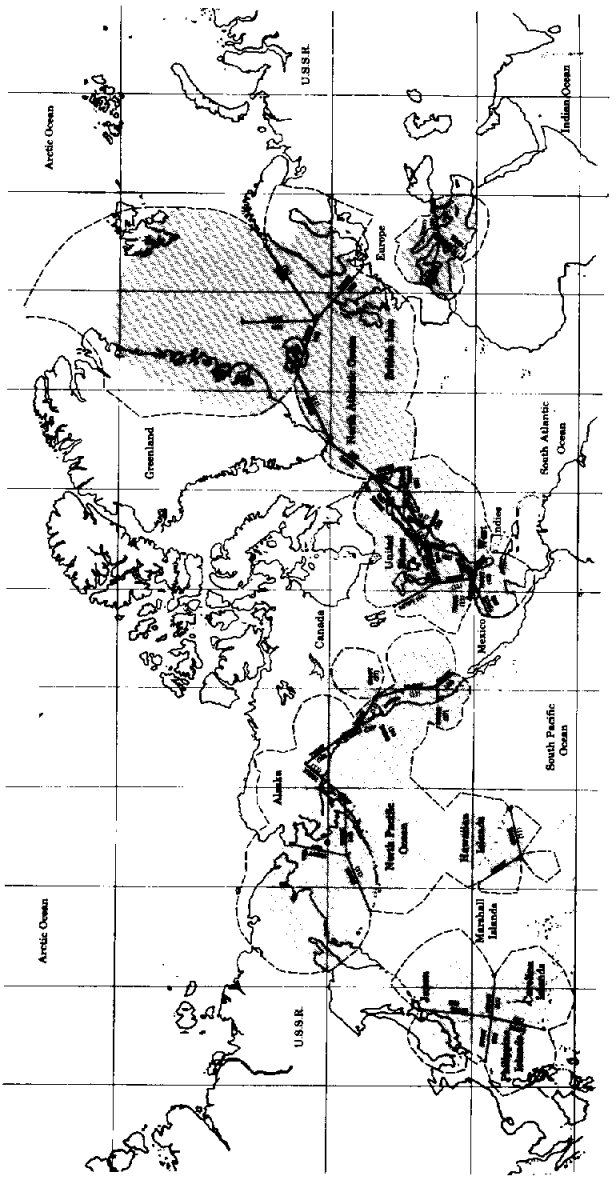
The GRI selected will be retained in memory. The APOLLO II will automatically select the best triad based on the geometry of the LORAN-C chain chosen in relation to your position. Triad selection is disabled when the APP (Approach) indicator is lighted. If you are using automatic triad selection, you may now go to another function or mode. If manual triad selection is desired, continue with the following procedure on page E-14.

GRI DISPLAY ON STARTUP

On power-up the unit will display the GRI and name of the chain. 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 a 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.

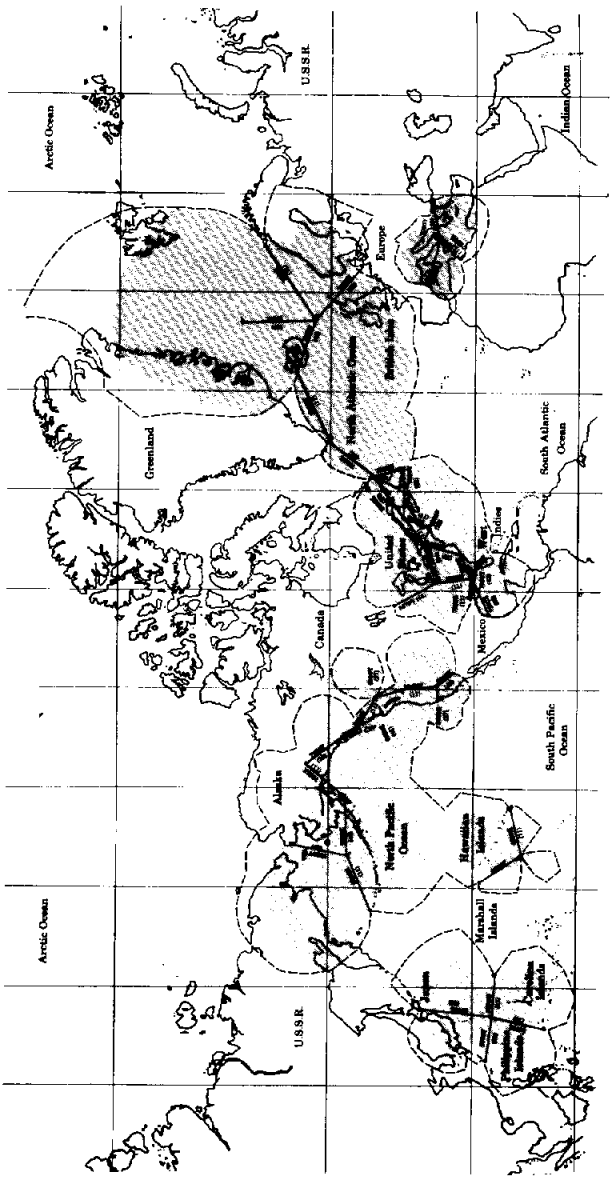
WORLDWIDE LORAN-C COVERAGE AREAS

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.



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 II will automatically choose the best triad (master-secondary combinations) for your position. However, under some circumstances the user may want to manually override this feature. When secondaries are manually selected a small "m" will appear on right side of the display. A small "a" will appear on the right side of the 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) Triad selection is automatically enabled. 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.

The GRI and triad selected will now be retained in memory. Whenever the APOLLO II 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 II will set triad selection to automatic whenever the unit has been turned off and then back on.

TIME DIFFERENCES (TDs)

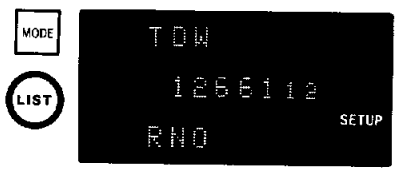
LORAN-C is a synchronized radio navigation system based on time of arrival measurements. The time measurements correspond to the distance a LORAN-C receiver is from the transmitting stations. These time measurements are referred to as time differences (TDs). Each TD is measured in microseconds (millionths 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/LONG coordinates in all LORAN-C receivers are calculated from the crossing points of LOPs.

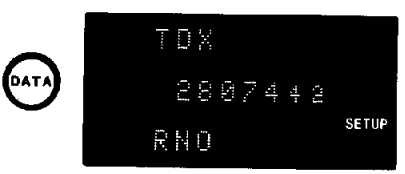
The APOLLO II provides you with the TD measurements. These values may be used with maps which provide LOPs to fix your position.

The TD Displays

1) Press the MODE button to reach SETUP Mode. Turn the LIST knob to view the TD formed with the first secondary. This is referred to as TDW.



2) Turn the DATA knob one position to view the next TD, TDX. Turn the DATA knob to view the TDs in succession.



3) No TD will be present for secondaries that do not exist in the chain selected.

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 II 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.

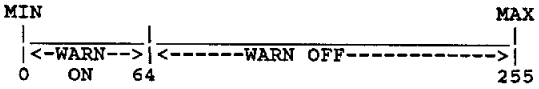
SNR VALUES

SNR (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.

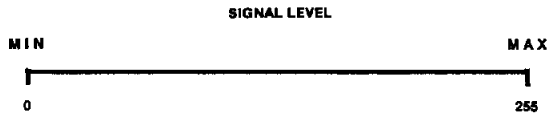
1) Press the MODE button to reach SETUP Mode. Turn the LIST knob to reach the SNR function. The Master SNR will be displayed first.

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

SIGNAL LEVEL (SIG LVL) DISPLAY

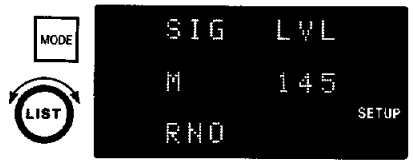
The APOLLO II will display Signal Level values for all Master and secondary stations available in the chain selected.

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 is displayed by:

1) Press MODE to reach SETUP Mode. Turn the LIST knob to view the Signal Level display. The Master station signal level will be displayed first.



2) Turn the DATA knob 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 II is first turned on, a settling time of approximately two minutes is required. During this time

the APOLLO II is performing the cycle select 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.

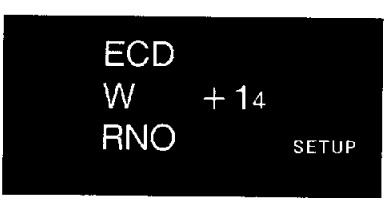
A reference is given below to help evaluate ECD values.

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

ECD Value Display

1) While in SETUP Mode turn the LIST knob to reach the ECD displays. The Master station ECD value will be displayed first.

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

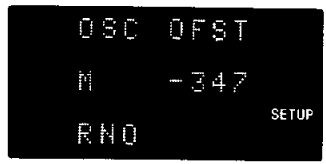


SERVICE DISPLAYS

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.

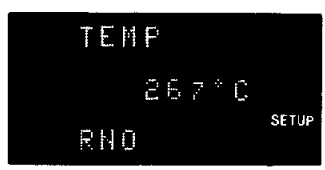
OSCILLATOR OFFSET VALUE

Press the MODE button to reach SETUP Mode. Turn the LIST knob to display the Oscillator Offset Value. Turn the DATA knob to display the value present for each station within the chain selected. These numbers will be different each time the unit is turned on and as the internal temperature changes.



CRYSTAL TEMPERATURE

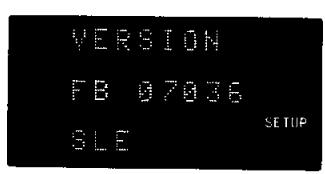
Turn the LIST knob one position clockwise to display the Crystal Temperature. This is the internal temperature of the unit. The temperature is listed in degrees Celsius.



SOFTWARE VERSIONS

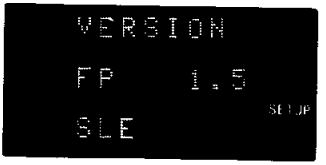
The APOLLO II provides displays which indicate the Software Version for the FLYBRARY, Operating System, and the Front Panel. The numbers displayed refer to the Software Versions in your particular APOLLO II. This information is necessary when the factory or dealer is contacted concerning your particular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

Turn the LIST knob one position clockwise to display the date code for the FLYBRARY Software Version. The number shown indicates the 7th month (July) and the 3rd day of 1986. Your display may differ from the one shown.



Turn the DATA knob one position CW to display Operating System Software Version. Your version may differ from the one shown.

Turn the DATA knob one position CW to display the Front Panel Software Version. Your version may differ from the one shown.

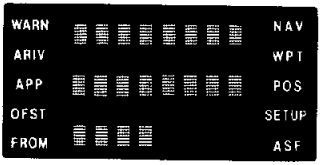


DISPLAY SELF-TEST

The APOLLO II will perform a self-test of the display at the request of the operator. All segments of the display are tested. A shorter version of this test is performed automatically every time the unit is turned on.

1) Press MODE to reach SETUP Mode. Turn the LIST knob to reach the Display Test page.

2) Press SEL. The APOLLO II will test all segments of the display panel.



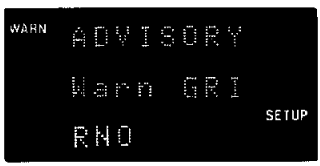
The Self-Test routine may be interrupted by pressing SEL, turning the LIST knob, or pressing the MODE button.

DIAGNOSTIC (ADVISORY) INFORMATION

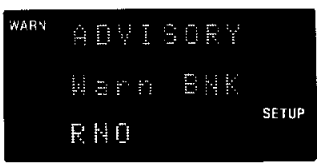
The APOLLO II provides a number of diagnostic messages headed "ADVISORY" at the end of the SETUP Mode. These messages will provide information about why the WARN light or external annunciator has appeared. The diagnostic pages that may appear and the problem that initiated the message is provided below. 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.

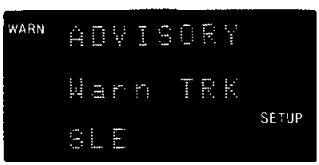
"Warn GRI" is shown when insufficient transmitters (fewer than the master and two secondaries) are being tracked, or the automatic triad selection process has not been completed. The WARN indicator will also be lighted.



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

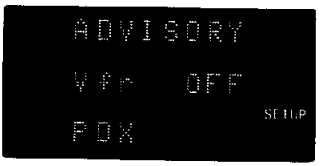


"Warn TRK" is shown when the master station is not tracked. The WARN indicator will also be lighted.



"Warn MTH" is shown when the computer has detected an error in its mathematic calculations.

"Vfr OFF" is shown when the external "LORAN VFR" annunciator is extinguished.



"Vfr ASF" is shown when LAT/LON (ASF) calibration factors have been entered. The external LORAN VFR annunciator will be lighted.

"Vfr APPR" is shown when the operator has selected Approach sensitivity for the external CDI. The external LORAN VFR annunciator will be lighted.

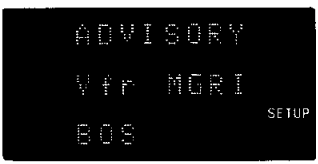
"Vfr OFST" is shown when the operator has selected a course offset. The external LORAN VFR annunciator will be lighted.

"Vfr GDOP" is shown when the GDOP (Geometric Dilution Of Precision) value is greater than 10.0 The external LORAN VFR annunciator will be lighted.

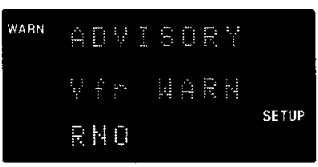
"Vfr AVAR" is shown when automatic magnetic variation has been selected and the aircraft is not in an area covered by the internal table of magnetic variation values. The external LORAN VFR annunciator will be lighted.

"Vfr MVAR" is shown when manual magnetic variation has been selected. The external LORAN VFR annunciator will be lighted.

"Vfr MGRI" is shown when manual triad selection has been chosen. The external LORAN VFR annunciator will be lighted.



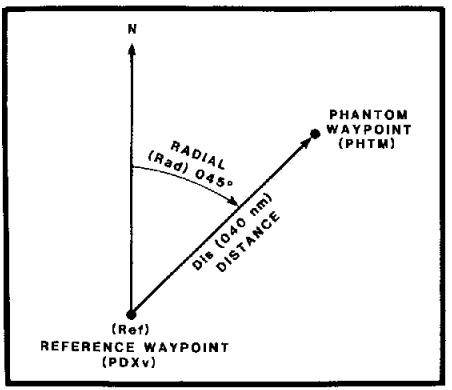
"Vfr WARN" is shown when the WARN indicator is lighted.



PHANTOM WAYPOINT

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

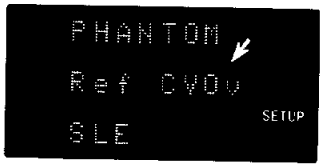
You create your PHANTOM WAYPOINT in SETUP MODE by first entering your Reference Waypoint (Ref), then entering the Radial (Rad) and Distance (Dis) from that Reference Waypoint. The Radial from the Reference Waypoint may be any value from 0° to 359° in 1° increments. The Distance from the Reference Waypoint may be any value from 0.0 nm to 999.9 nm in 0.1 nm increments. When selecting the Reference Waypoint, the current Region set in WPT Mode will provide the available waypoints. So, you will need to select the desired Region (USER, USA, EC, NW, HS, etc.) in WPT Mode before using the PHANTOM WAYPOINT function. While creating the Phantom Waypoint be sure to manually set the Magnetic Variation (see page E-6) to that of the Phantom Waypoint.



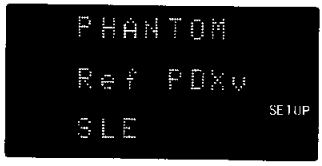
CREATING A PHANTOM WAYPOINT

1) Press MODE to reach WPT Mode and turn the DATA knob to select the Waypoint Region that you will choose the Reference Waypoint from (in this case NW is used).

2) Press MODE to reach SETUP Mode and then press SEL to enable selection of the Reference Waypoint.



3) Turn the DATA knob to display the desired Reference Waypoint and then press ENT.



4) Now, turn the LIST knob one position cw to choose the Radial (Rad) from the Reference Waypoint.

5) Press SEL to enable selection of the first digit of the Radial value. 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.

6) Now, turn the LIST knob one position cw to reach the Distance (Dis) value from the Reference Waypoint.

7) Press SEL to enable selection of the first distance digit. 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.

8) Now, press MODE to reach WPT Mode and turn the DATA knob (if necessary) to reach the USER region. Turn the LIST knob one position ccw and the LAT/LONG coordinates for the PHANTOM WAYPOINT (PHTM) will be displayed. You may now press TO and the APOLLO II will set course from your present position to the PHANTOM WAYPOINT.

EXTENDED RANGE

The EXTENDED RANGE function allows you to use the APOLLO II for navigation into the fringe LORAN-C coverage areas. When you activate this function the APOLLO II 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 Mode and turn the LIST knob to reach the EXTENDED RANGE (X_RANGE) function.

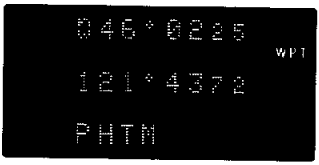
2) Press SEL to enable selection of the function. Now, turn the DATA knob and then press ENT.

When the Extended Range function has been activated, the LAT/LON (ASF) Calibration Factors (see page E-8) 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.

7) Press SEL to enable selection of the first distance digit. 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.

8) Now, press MODE to reach WPT Mode and turn the DATA knob (if necessary) to reach the USER region. Turn the LIST knob one position ccw and the LAT/LONG coordinates for the PHANTOM WAYPOINT (PHTM) will be displayed. You may now press TO and the APOLLO II will set course from your present position to the PHANTOM WAYPOINT.



EXTENDED RANGE

The EXTENDED RANGE function allows you to use the APOLLO II for navigation into the fringe LORAN-C coverage areas. When you activate this function the APOLLO II 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 Mode and turn the LIST knob to reach the EXTENDED RANGE (X_RANGE) function.

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 E-8) 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.

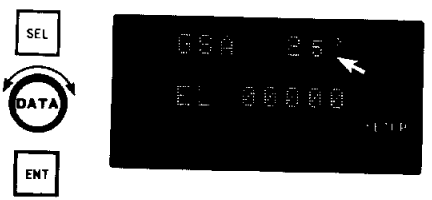
VERTICAL NAVIGATION (VNAV)

612BV and 612BCV Only

Use the following procedure to program your VNAV:

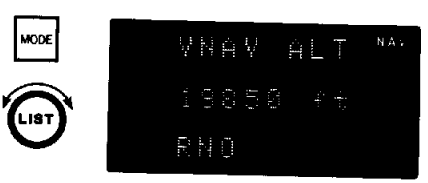
1. Press the MODE button to reach SETUP mode. Then, turn the LIST knob to reach the VNAV setup display.

2. Press SEL to enable the selection of Glideslope Angle (GSA); the degrees digits will flash. Set the desired Glideslope Angle with the DATA knob (2.0, 2.5, 3.0, 3.5, etc.) Press ENT.



3. The first Elevation (EL) digit will flash. Set the elevation you will descend to using the DATA knob to select each digit individually. Press ENT after setting each number. After entering the last digit, any unnecessary zeros will disappear.

4. Press MODE to return to NAV mode. View VNAV ALT as needed with the LIST knob.

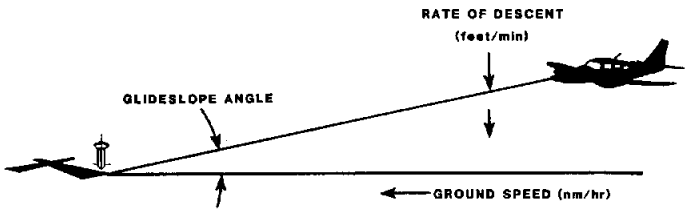


USING VNAV

612BV and 612BCV Only

MATCH YOUR GROUND SPEED TO A DESCENT RATE

You can use the VNAV feature in your APOLLO II to watch your approach by monitoring your descent rate, as well as matching the altitude on your altimeter to the VNAV Altitude display. A few example Ground Speeds and Glideslope Angles are provided in the table below for you to use as a guideline for matching your descent rate (feet/min) to your glideslope. Remember that the speed shown in the table is for Ground Speed (nm/hour) not your Indicated Airspeed (IAS). The Descent Rates listed in the chart are rounded off to the nearest 10 feet.



GROUND SPEED (nm/hr)

GLIDESLOPE ANGLE (°)	100	150	200	250
2°	350	530	710	880
3°	530	800	1060	1330
4°	710	1060	1420	1770
5°	890	1330	1770	2220
6°	1060	1600	2130	2660
7°	1240	1870	2490	3110
8°	1420	2140	2850	3560
9°	1600	2400	3210	4010

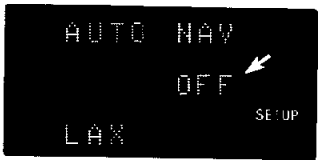
RATE OF DESCENT (feet/min)

As an example, if you have set a Glideslope Angle of 5° and you are traveling at a Ground Speed of 150 knots, your Descent Rate will be approximately 1330 ft/min.

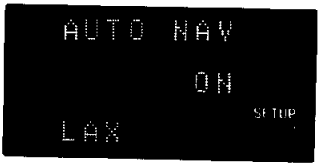
AUTO-NAV

The Auto-Nav function of the APOLLO II will allow you to set the unit to rotate through each of the pages (displays) in NAV Mode automatically at a preset viewing rate of approximately 1½ seconds per page.

1) Press MODE to reach SETUP Mode. Auto-Nav will be displayed. Press SEL to enable selection. The ON/OFF condition value will flash.



3) Turn the DATA knob and then press ENT.



The Auto-Nav function will automatically be set to OFF when the unit is turned off or if the the AIRPORT/VOR SEARCH feature is activated.

SECTION F

LORAN-C THEORY

MORROW INC.

SECTION F

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.

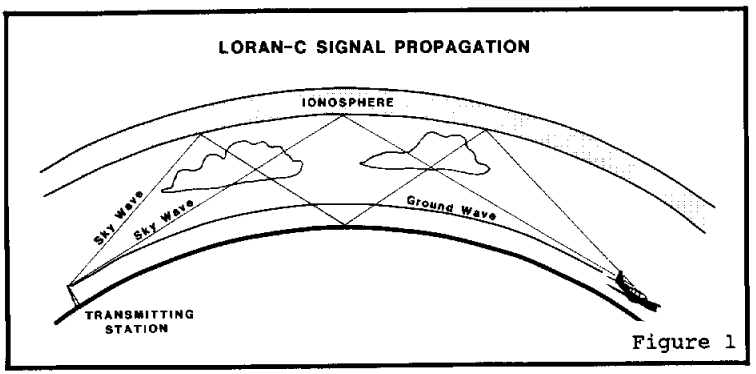


Figure 1

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.

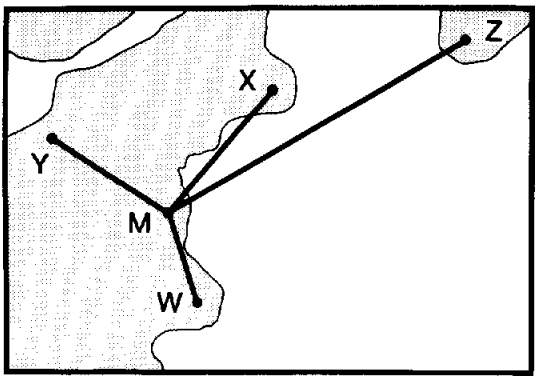


Figure 2

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.

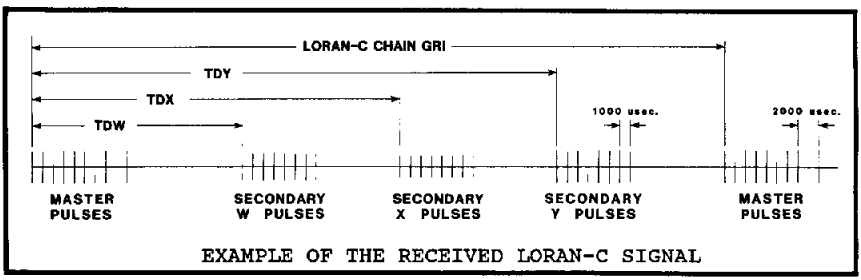


Figure 3

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 microseconds (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.

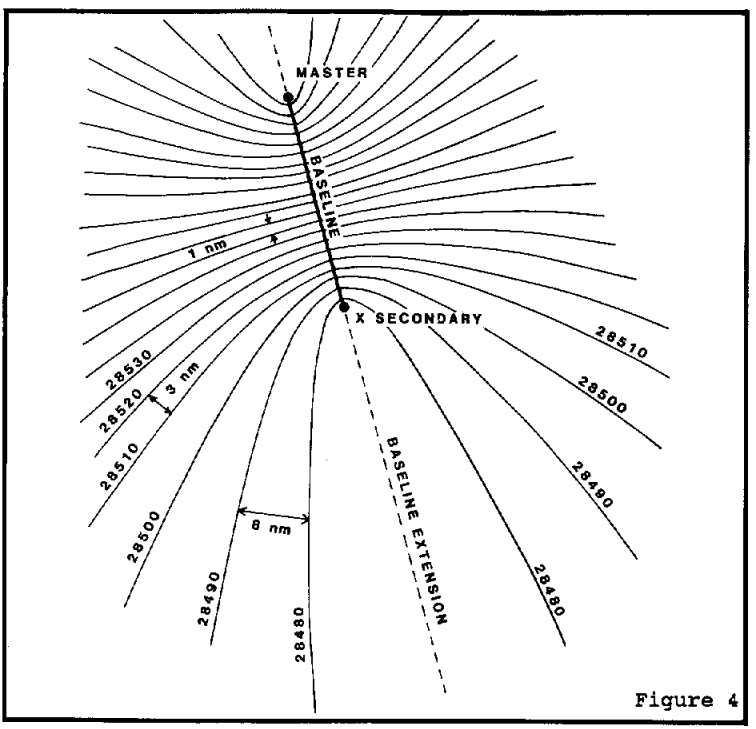


Figure 4

HOW A LORAN-C RECEIVER WORKS

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).

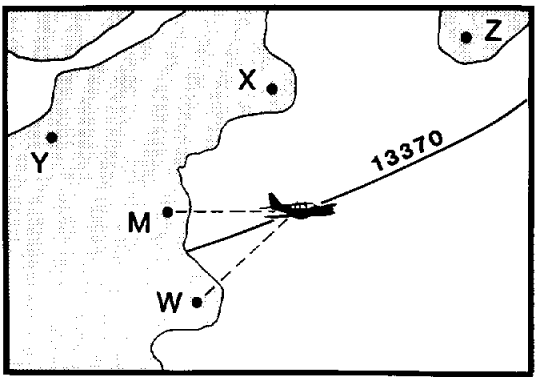


Figure 5

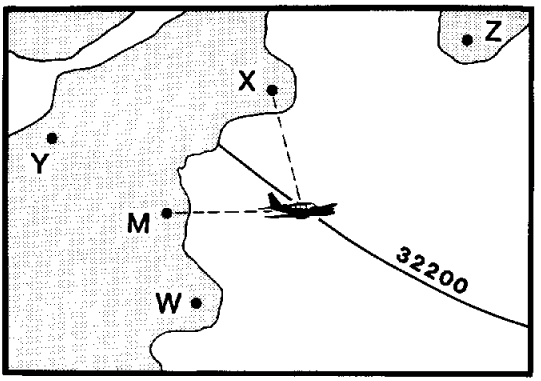


Figure 6

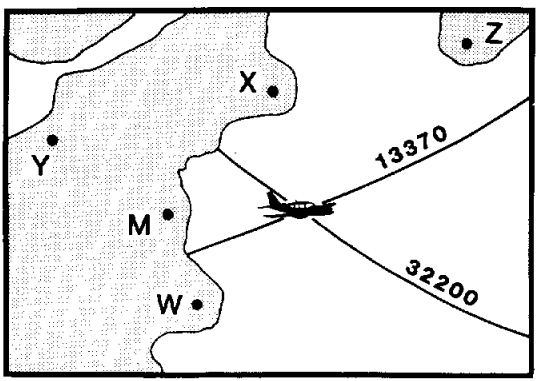


Figure 7

LAT/LON CONVERSION

Most LORAN-C receivers have the ability to convert LOPs directly to Latitude and Longitude coordinates. Both LOPs and LAT/LONG 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° Latitude. The north pole is 90° N. Latitude and the south pole is 90° 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°31'43" is converted to LAT N 27°31.72' 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.

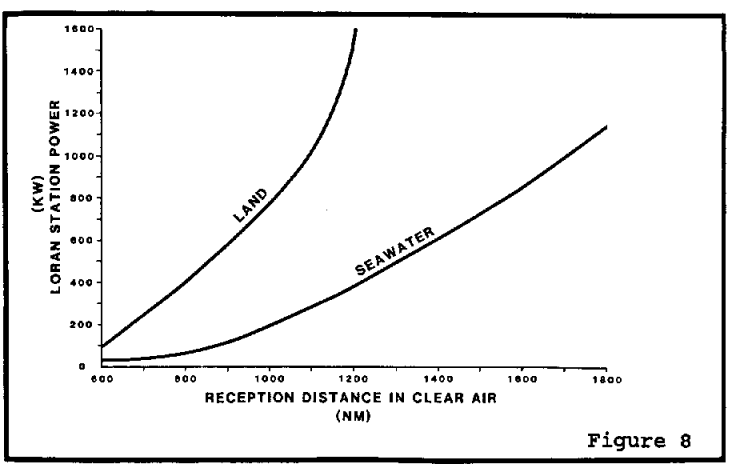


Figure 8

Location within the coverage area determines, to a large degree, the accuracy of a position fix. Gradient, Baseline Extension, Crossing Angle, and LAT/LONG 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° provide the most accurate position fixes. Crossing angles less than 20° are not reliable. All LORAN-C receivers initially determine a position fix based on LOPs and then produce a LAT/LONG 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/LONG coordinates due to the number of variables used in the algorithm.

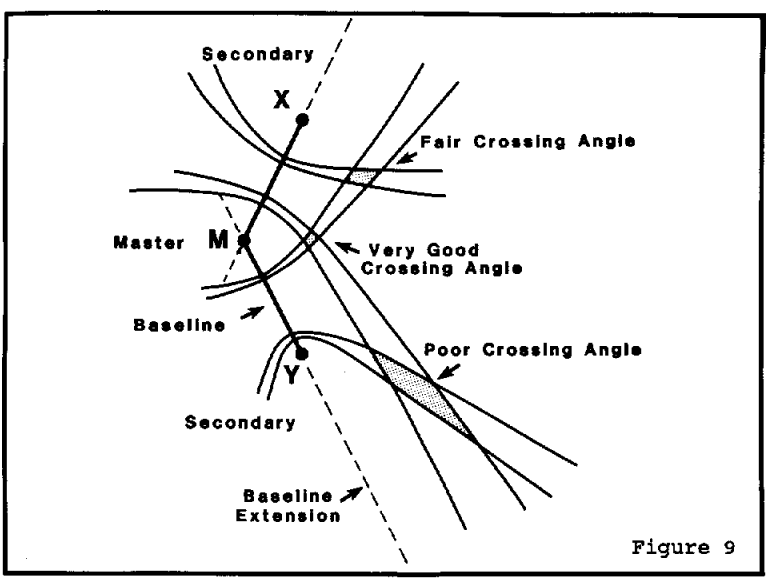
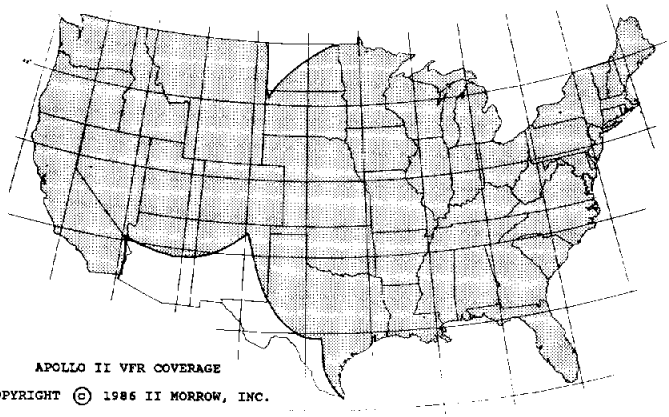


Figure 9

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 II will provide accurate navigation capability where most others will not. The VFR coverage areas provide accuracy of 3.5 nm, or better (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



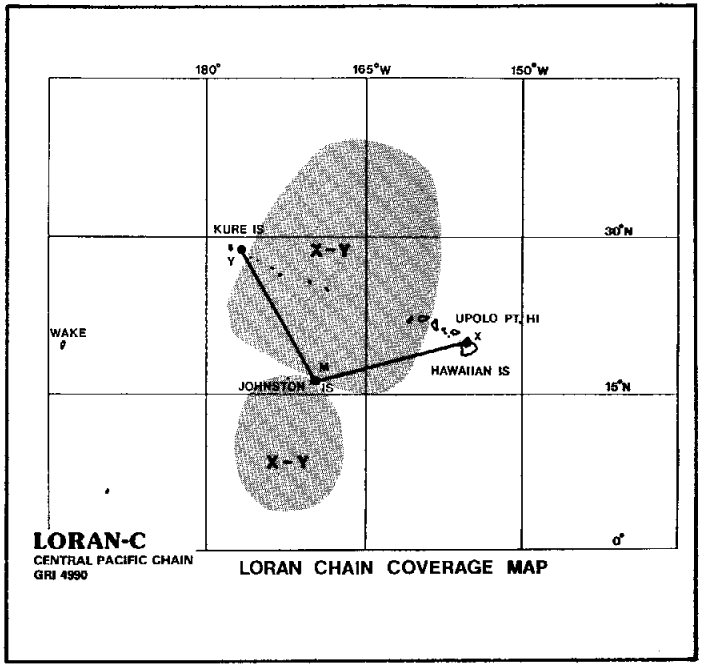
APOLLO II VFR COVERAGE

ADDITIONAL INFORMATION

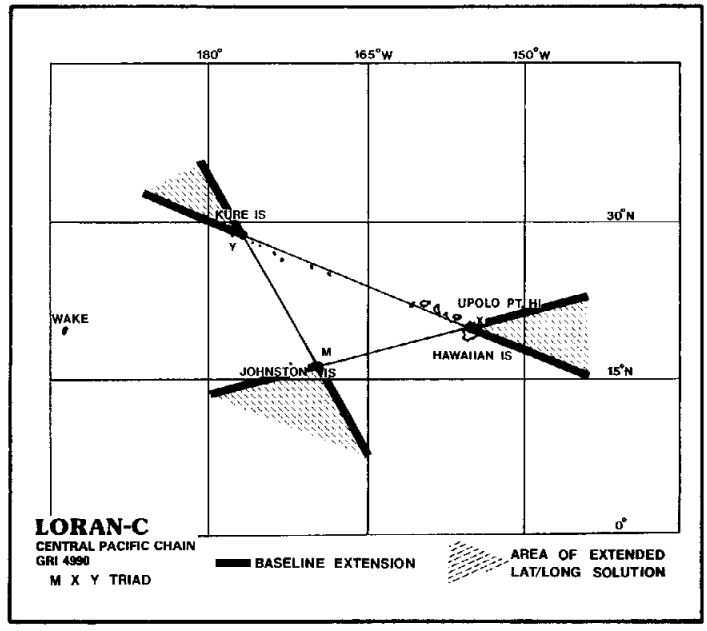
The LORAN-C USER HANDBOOK, COMDTINST M16562.4, printed by the U.S. Coast Guard, Department of Transportation, gives more detailed information and is an excellent reference. The HANDBOOK is no longer available from the U.S. Coast Guard but may be obtained from your LORAN-C receiver dealer, or Government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

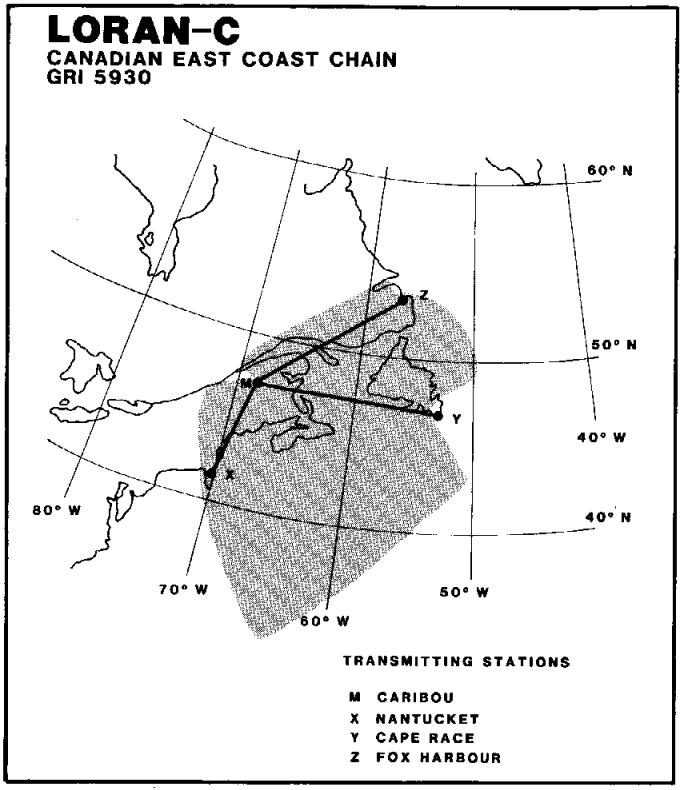


CENTRAL PACIFIC - 4990

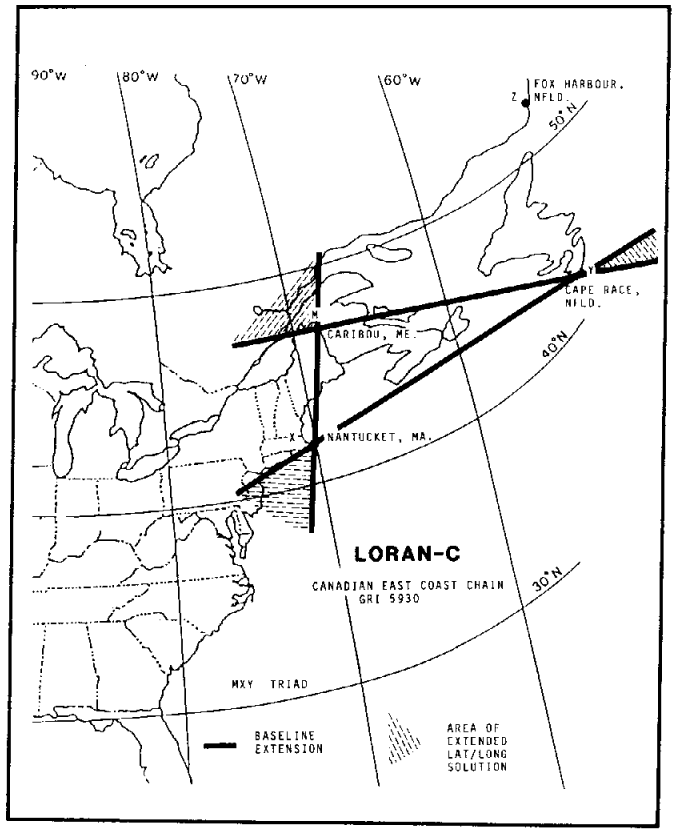

180°
165°W
150°W
30°N
15°N
0°
KURE IS
Y
WAKE
M
JOHNSTON IS
UPOLO PT HI
X
HAWAIIAN IS
LORAN-C
CENTRAL PACIFIC CHAIN
GRI 4990
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION

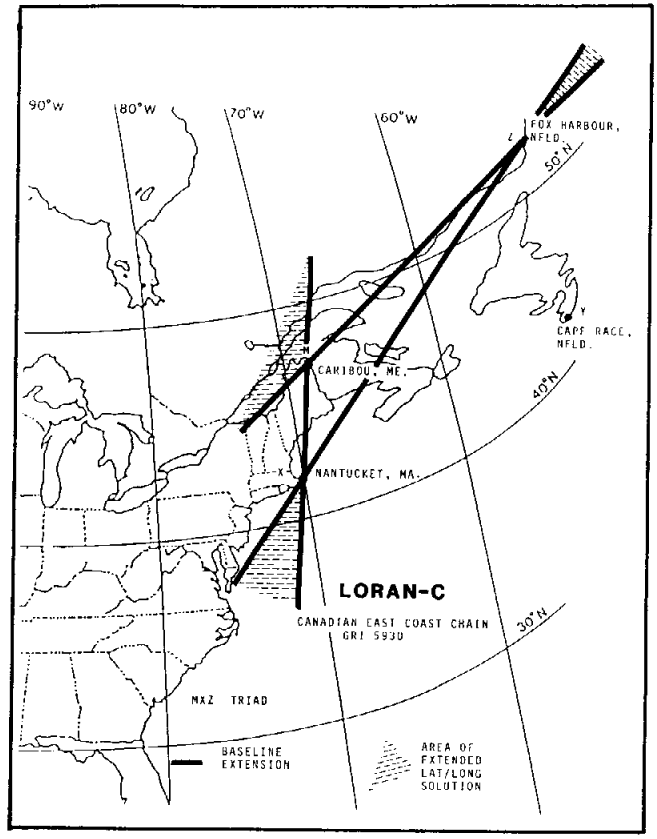
CANADIAN EAST COAST LORAN-C CHAIN - GRI 5930

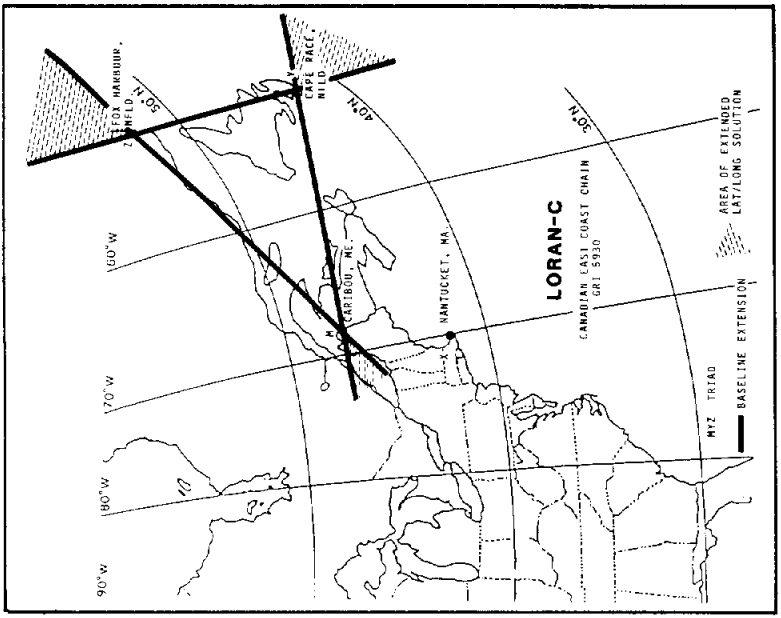
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Caribou, ME	Master	46°48'27.2"N 67°55'37.7"W		350	Dual-Rated to North-east U.S. Chain.
Nantucket, MA	Xray	41°15'11.9"N 69°58'39.1"W	11000/ 2131.88	275	Dual-Rated to North-east U.S. Chain.
Cape Race, NFLD	Yankee	46°46'32.2"N 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
FOX HARBOUR, NFLD.
Z
CAPE RACE, NFLD.
Y
CARIBOU, ME.
M
NANTUCKET, MA.
X
LORAN-C
CANADIAN EAST COAST CHAIN
GRI 5930
MXY TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


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



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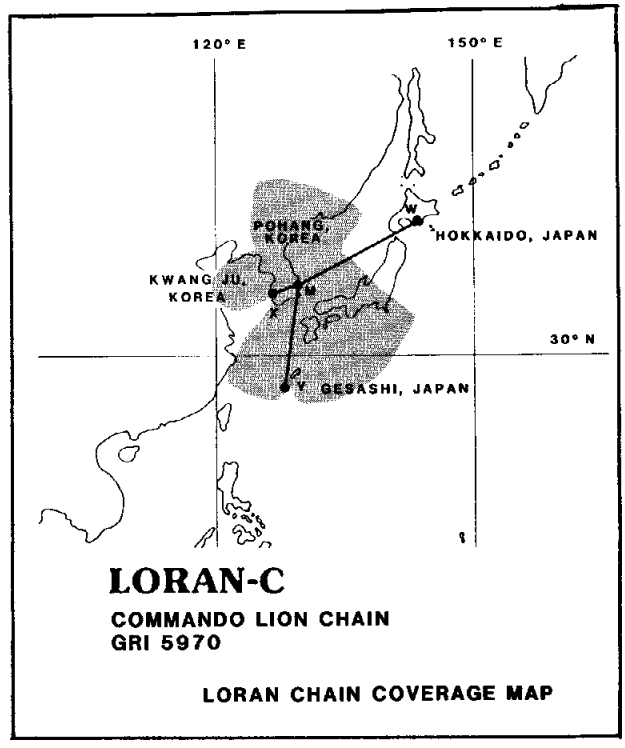
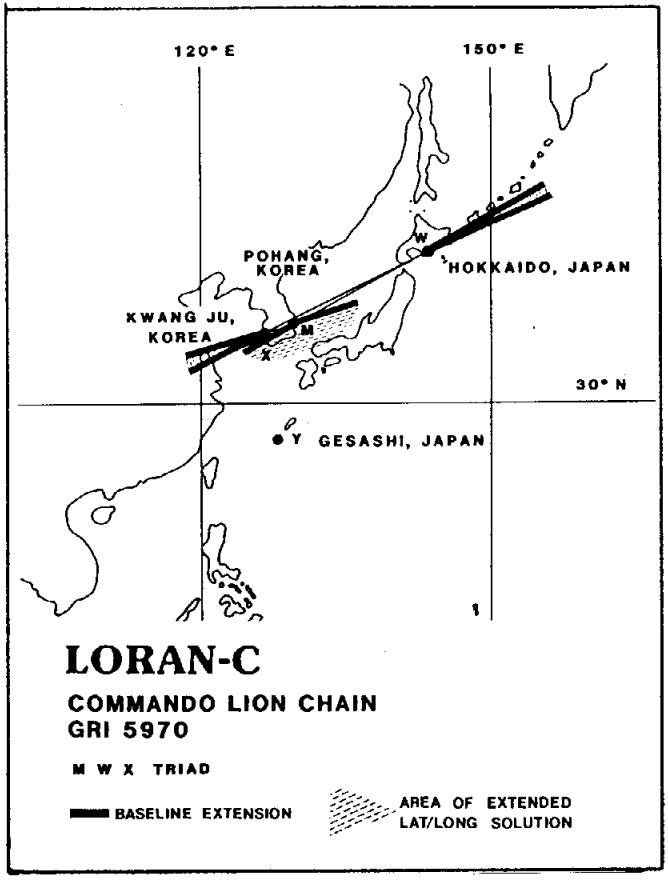
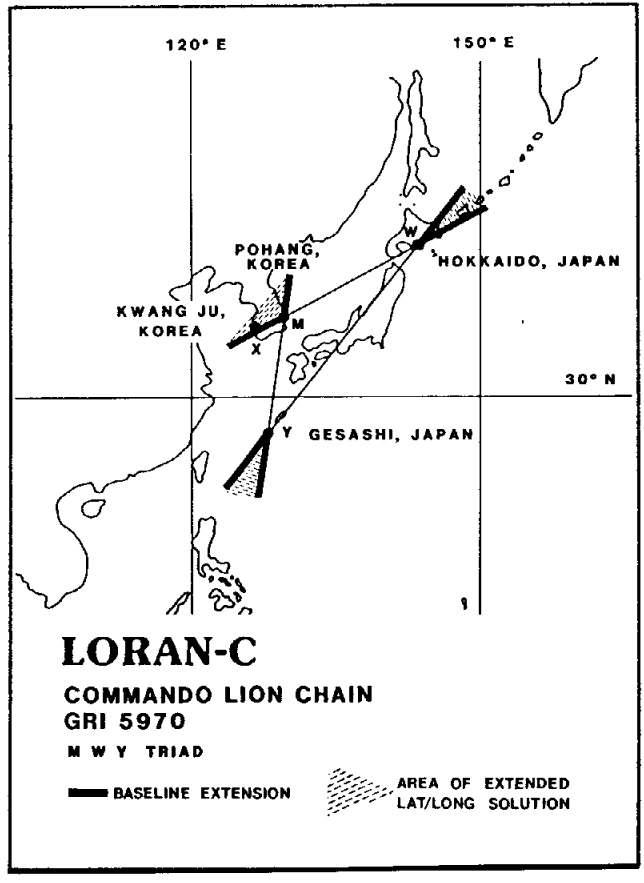
COMMANDO LION LORAN-C CHAIN - GRI 5970

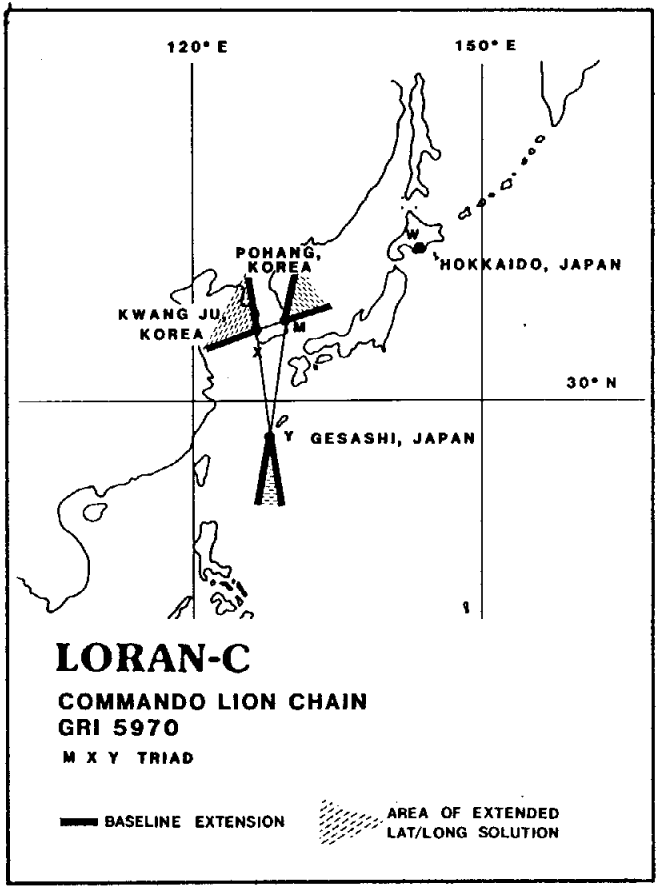
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER (kW)	REMARKS
Pohang, Korea	Master	36°11'05.8" N 129°20'27.3" E		35	
Hokkaido, Japan	Whisky	42°44'37.1" N 143°43'09.2" E	11000 4783.69	1000	Dual rated to Northwest Pacific Chain
Kwang Ju, Korea	Xray	35°02'23.9" N 126°32'26.7" E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

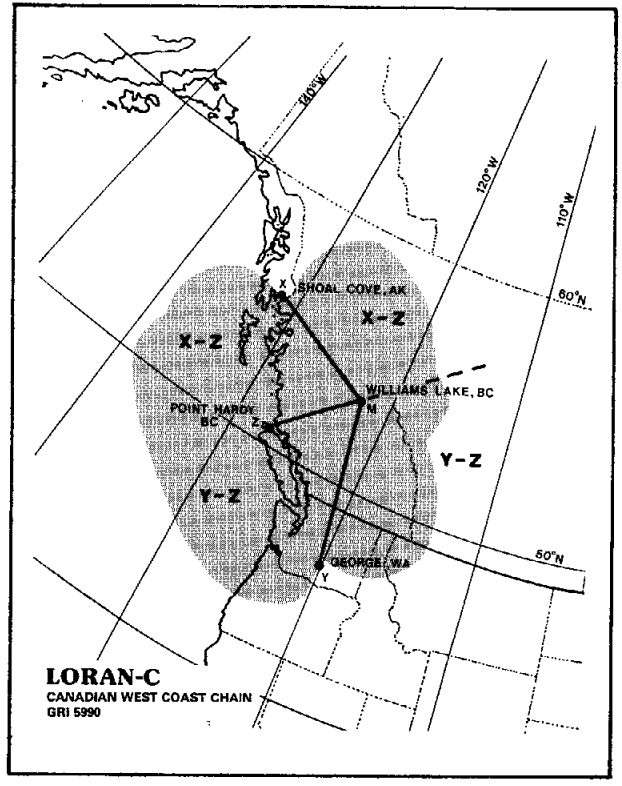

120° E
150° E
POHANG, KOREA
W
HOKKAIDO, JAPAN
KWANG JU, KOREA
M
X
30° N
Y GESASHI, JAPAN
LORAN-C
COMMANDO LION CHAIN
GRI 5970
M W X TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


120° E
150° E
POHANG, KOREA
W
HOKKAIDO, JAPAN
KWANG JU, KOREA
M
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

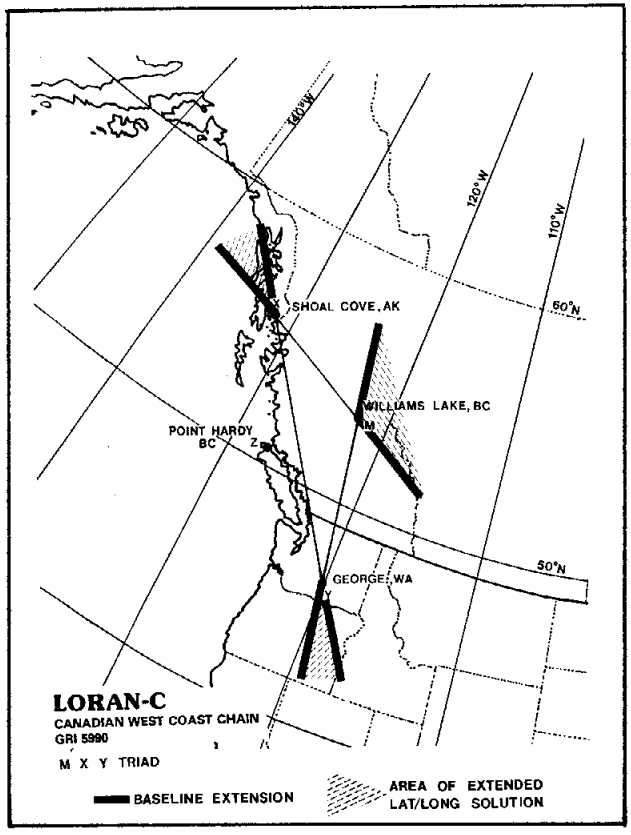

120° E
150° E
POHANG, KOREA
KWANG JU KOREA
W
HOKKAIDO, JAPAN
M
X
30° N
Y
GESASHI, JAPAN
LORAN-C
COMMANDO LION CHAIN
GRI 5970
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

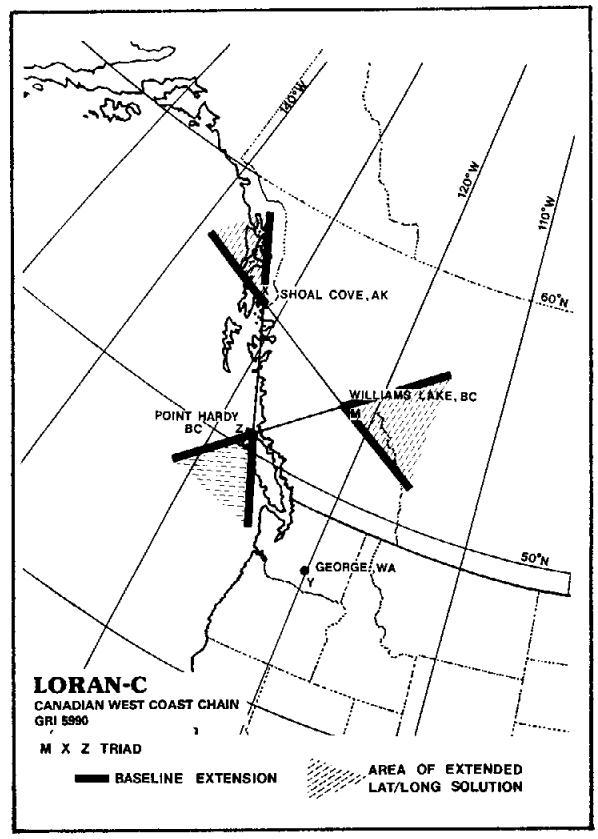
CANADIAN WEST COAST LORAN-C CHAIN - GRI 5990 (old rate SH1)

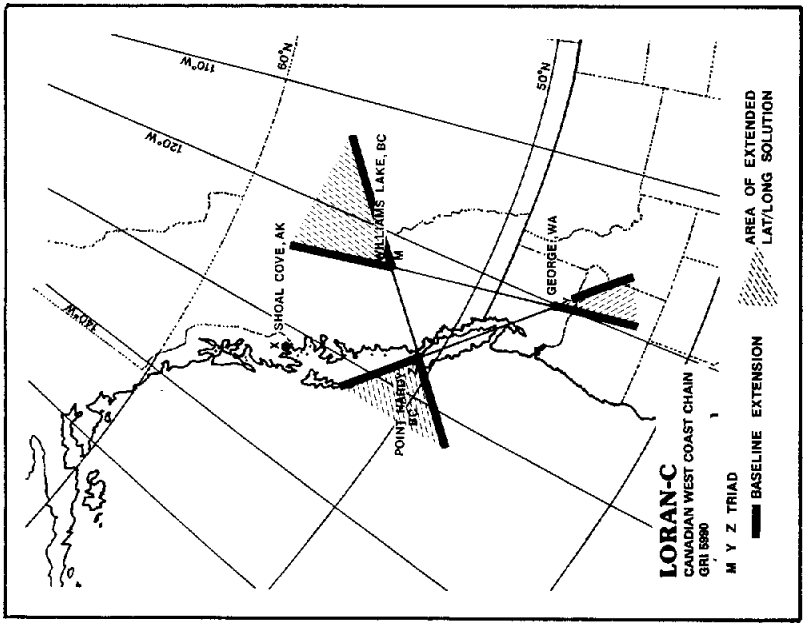
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Williams Lake, BC, Canada	Master	51 57 58.8 N 122 22 02.2 W		400	Control for X and Y. Two pulse comms installed.
Shoal Cove, AK	Xray	55 26 20.9 N 131 15 19.7 W	11000/ 2343.60	540	Two pulse comms installed. Dual-rated 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.



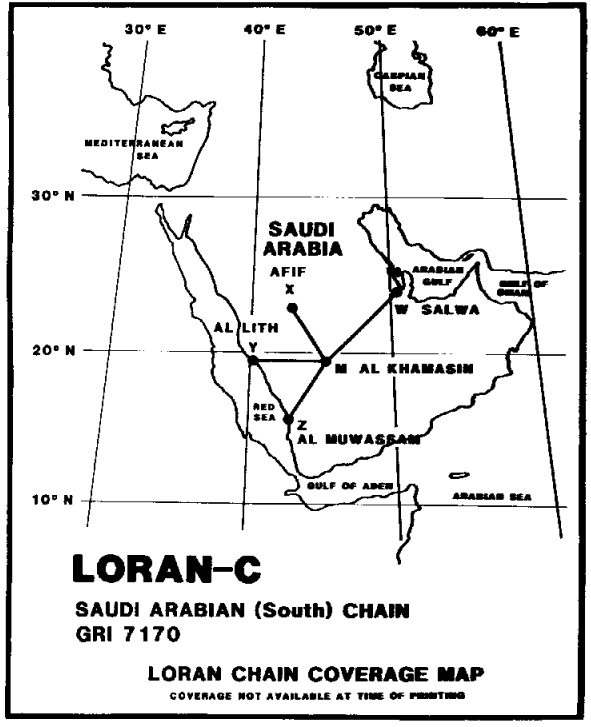
CANADIAN WEST COAST - 5990


140°W
120°W
110°W
60°N
50°N
SHOAL COVE, AK
WILLIAMS LAKE, BC
M
POINT HARDY
BC
Z
GEORGE, WA
Y
LORAN-C
CANADIAN WEST COAST CHAIN
GRI 5990
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION

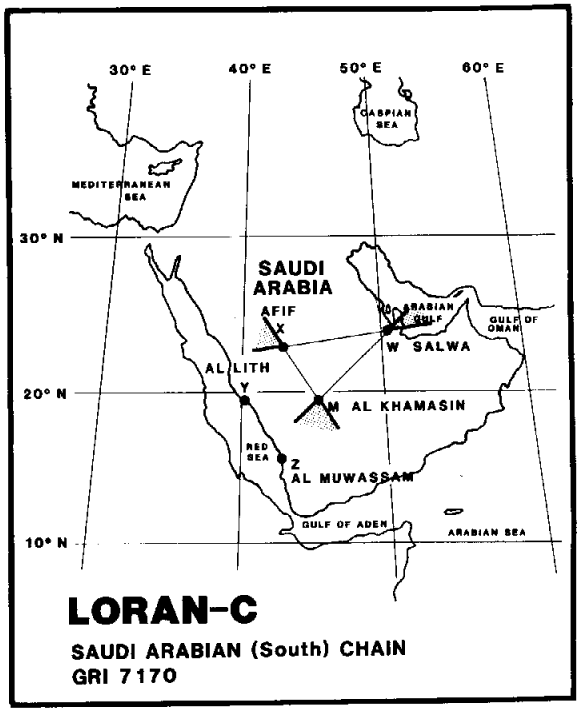

140°W
120°W
110°W
60°N
50°N
SHOAL COVE, AK
WILLIAMS LAKE, BC
M
POINT HARDY
BC
Z
GEORGE, WA
Y
LORAN-C
CANADIAN WEST COAST CHAIN
GRI 5990
M X Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION

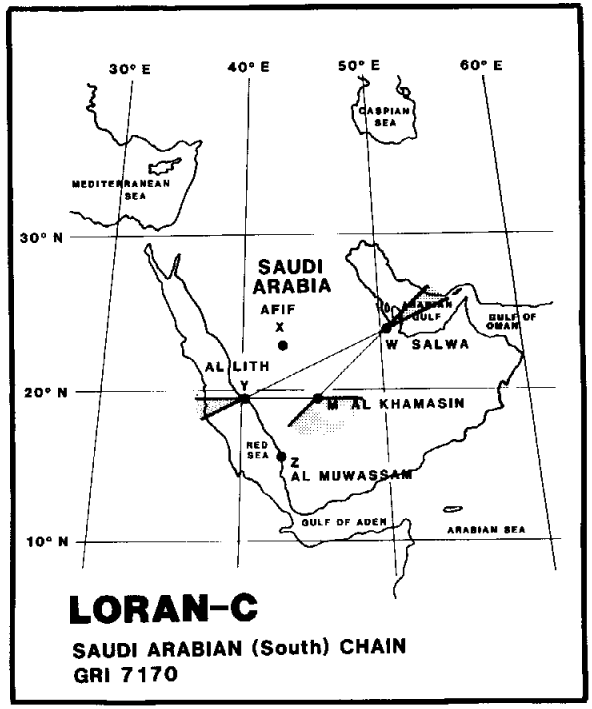

LORAN-C
CANADIAN WEST COAST CHAIN
GRI 5990
M Y Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
SHOAL COVE, AK
WILLIAMS LAKE, BC
GEORGE, WA
POINT MARSH, BC
60°N
50°N
110°W
120°W
130°W

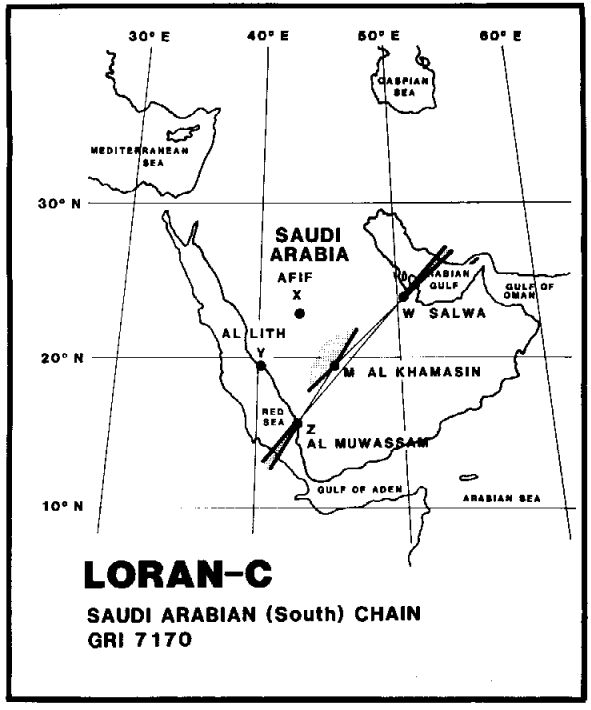
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER (kW)
Al Khamasin	Master	20°28'01.89" N 44°34'52.34" E		800
Salwa	Whisky	24°50'01.50" N 50°34'12.02" E	11000 2612.55	800
Afif	Xray	23°48'36.82" N 42°51'17.63" E	26000 1371.23	800
Al Lith	Yankee	20°13'58.31" N 40°12'31.02" E	39000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

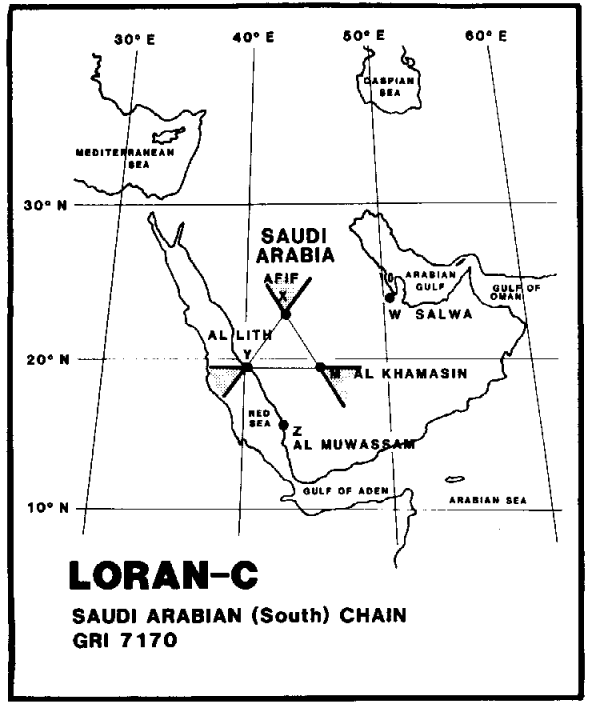


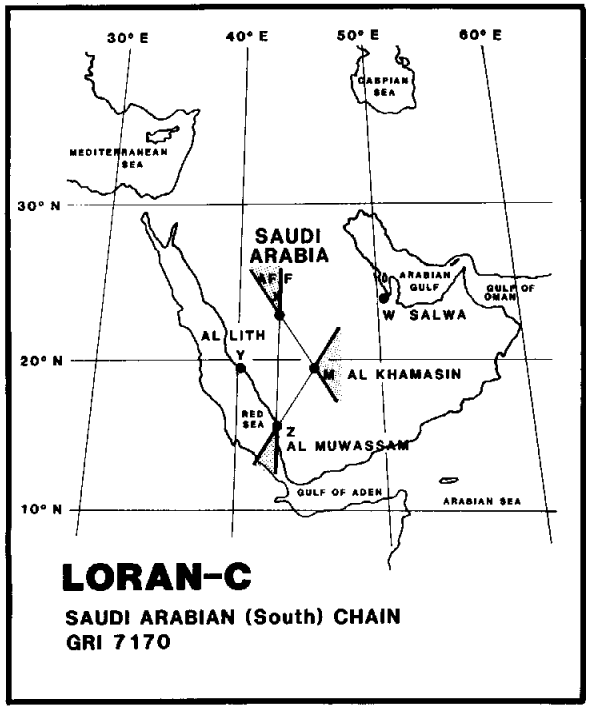
SAUDI ARABIA (South) - 7170

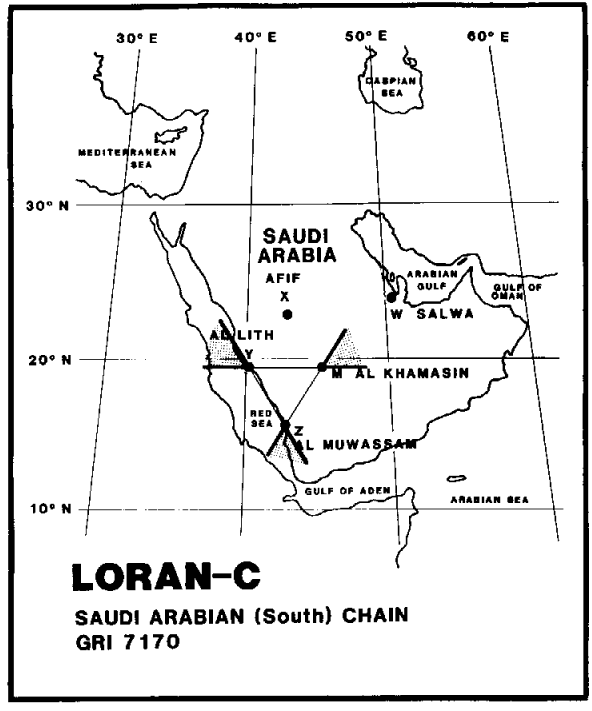

30° E
40° E
50° E
60° E
CASPIAN SEA
MEDITERRANEAN SEA
30° N
SAUDI ARABIA
AFIF
X
ARABIAN GULF
GULF OF OMAN
W SALWA
AL LITH
Y
20° N
M AL KHAMASIN
RED SEA
Z
AL MUWASSAM
GULF OF ADEN
ARABIAN SEA
10° N
LORAN-C
SAUDI ARABIAN (South) CHAIN
GRI 7170


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
M AL KHAMASIN
20° N
RED SEA
Z
AL MUWASSAM
GULF OF ADEN
ARABIAN SEA
10° N
LORAN-C
SAUDI ARABIAN (South) CHAIN
GRI 7170

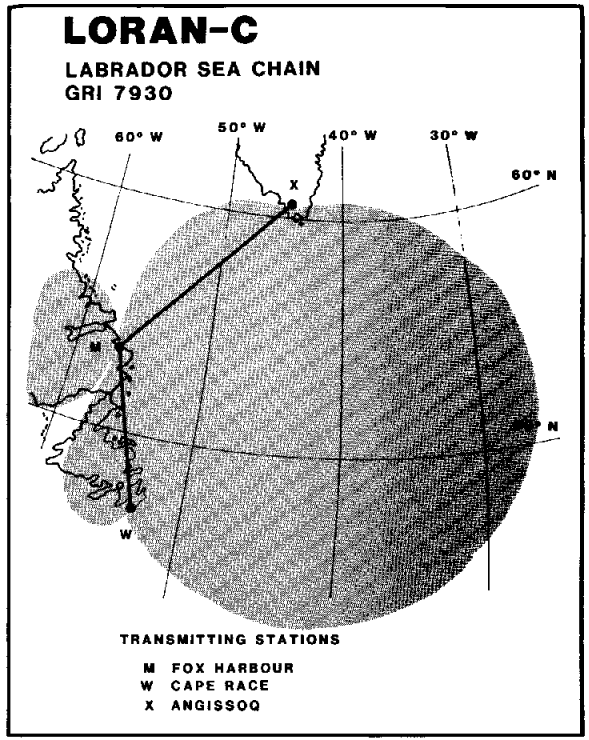

30° E
40° E
50° E
60° E
CASPIAN SEA
MEDITERRANEAN SEA
30° N
SAUDI ARABIA
AFIF
X
ARABIAN GULF
GULF OF OMAN
W SALWA
AL LITH
Y
M AL KHAMASIN
20° N
RED SEA
Z
AL MUWASSAM
GULF OF ADEN
ARABIAN SEA
10° N
LORAN-C
SAUDI ARABIAN (South) CHAIN
GRI 7170


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

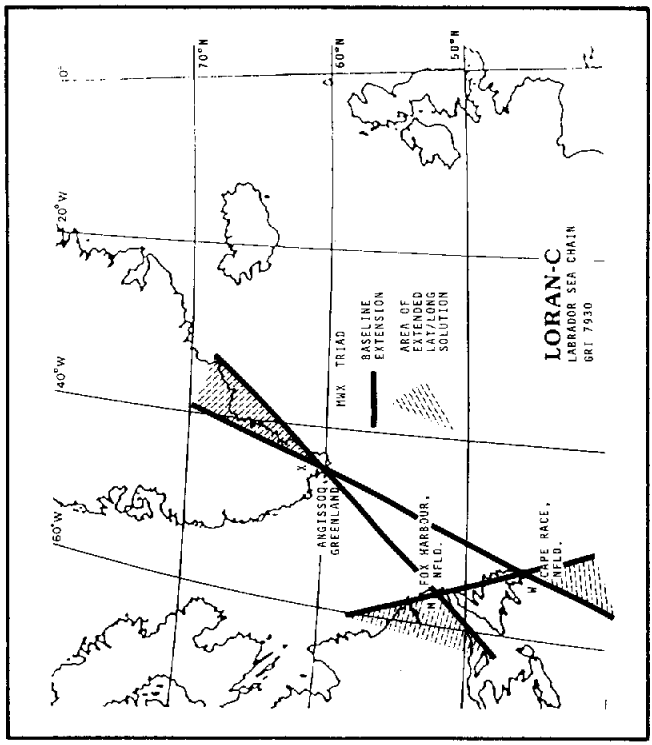

30° E
40° E
50° E
60° E
CASPIAN SEA
MEDITERRANEAN SEA
30° N
20° N
10° N
SAUDI ARABIA
AFIF
X
ARABIAN GULF
GULF OF OMAN
W SALWA
AL LITH
Y
M AL KHAMASIN
RED SEA
Z
AL MUWASSAM
GULF OF ADEN
ARABIAN SEA
LORAN-C
SAUDI ARABIAN (South) CHAIN
GRI 7170

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/ 2167.30	1500	Dual-Rated to Canadian East Coast Chain.
Angissoq, Greenland	Xray	59°59'17.3"N 45°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			



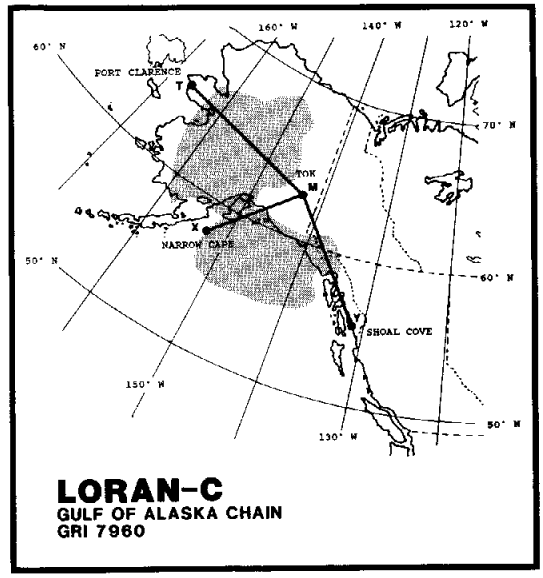
LABRADOR SEA - 7930


70°N
60°N
50°N
20°W
40°W
60°W
HWX TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
LORAN-C
LABRADOR SEA CHAIN
GRI 7930
ANGISSOQ, GREENLAND
FOX HARBOUR, NFLD.
CAPE RACE, NFLD.

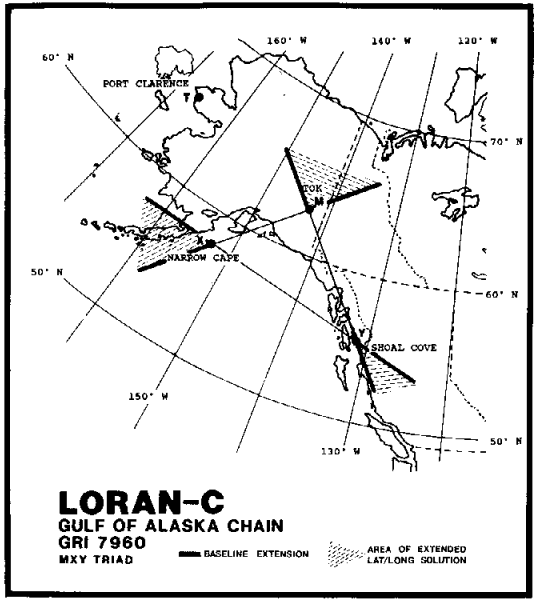
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER (kW)	REMARKS
Tok, AK	Master	63° 19 42.8 N 142° 48 31.9 W		540	Two pulse comms installed
Narrow Cape, Kodiak Is., AK	Xray	57° 26 20.2 N 152° 22 11.3 W	11000/ 2804.45	400	Two pulse comms installed. Dual rated to North Pacific chain.
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.

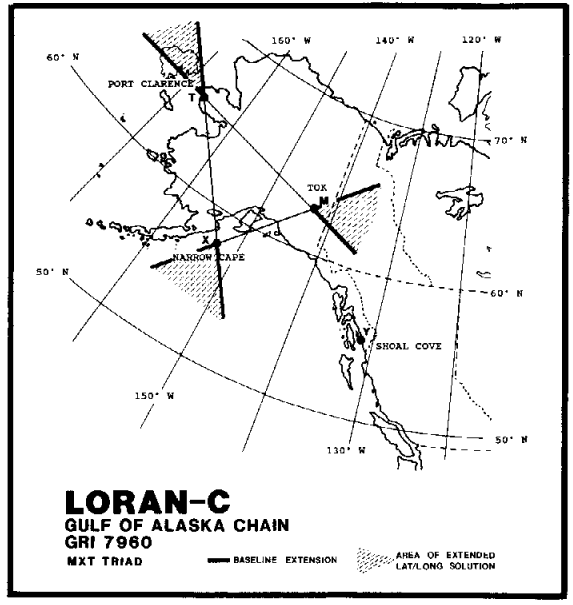
All numbers for the Tango secondary are approximate and preliminary as provided by the U.S. Coast Guard. After the test and evaluation period, the Tango secondary may be named as Zulu. The maritime coverage of 7960 will not be affected. The coverage diagram shown on this page does not reflect any additional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

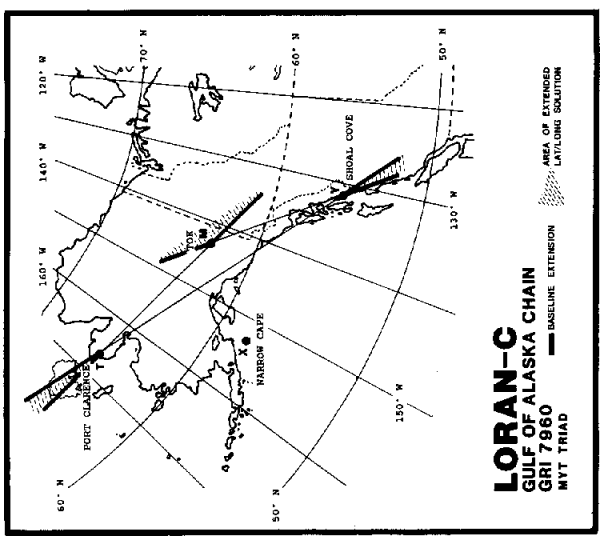
Transmitted signals of the 7960T baseline are, at the time of printing, used for government testing only and not for operational use until further notice. The signals from the 7960T baseline are subject to change without advance warning, may transmit unusable, altered signals for government testing, 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

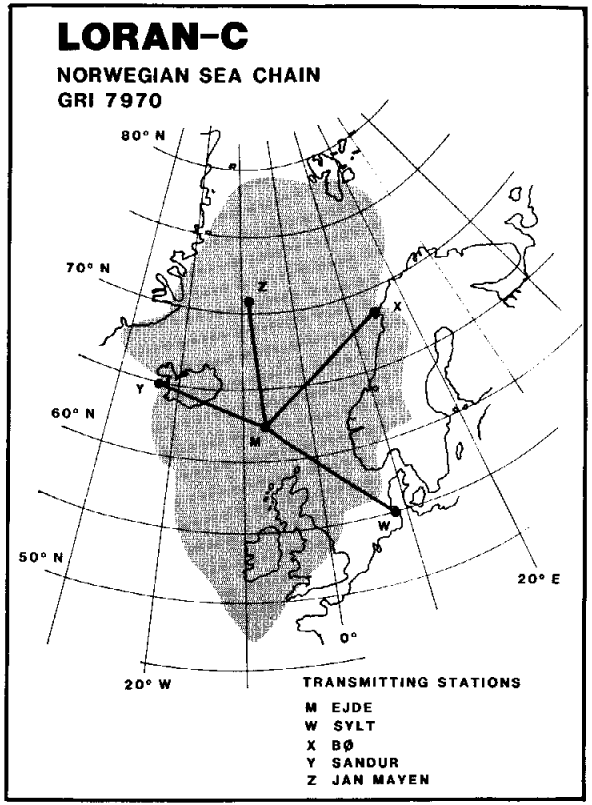

160° W
140° W
120° W
60° N
PORT CLARENCE
T
70° N
TOK
M
NARROW CAPE
X
50° N
60° N
SHOAL COVE
Y
150° W
130° W
50° N
LORAN-C
GULF OF ALASKA CHAIN
GRI 7960
MXY TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


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

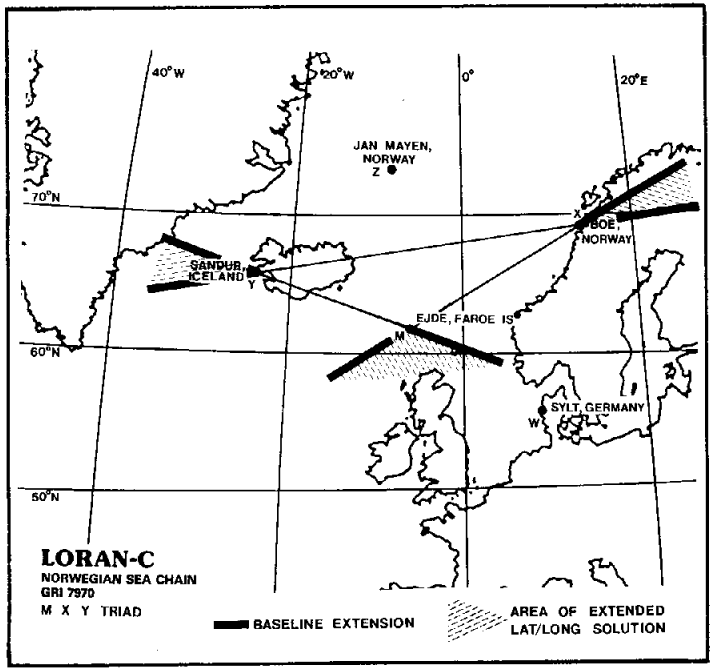

LORAN-C
GULF OF ALASKA CHAIN
GRI 7960
MYT TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
FORT CLARENCE
NARROW CAPE
FOX
SHOAL COVE
60° N
50° N
70° N
120° W
140° W
160° W
150° W
130° W

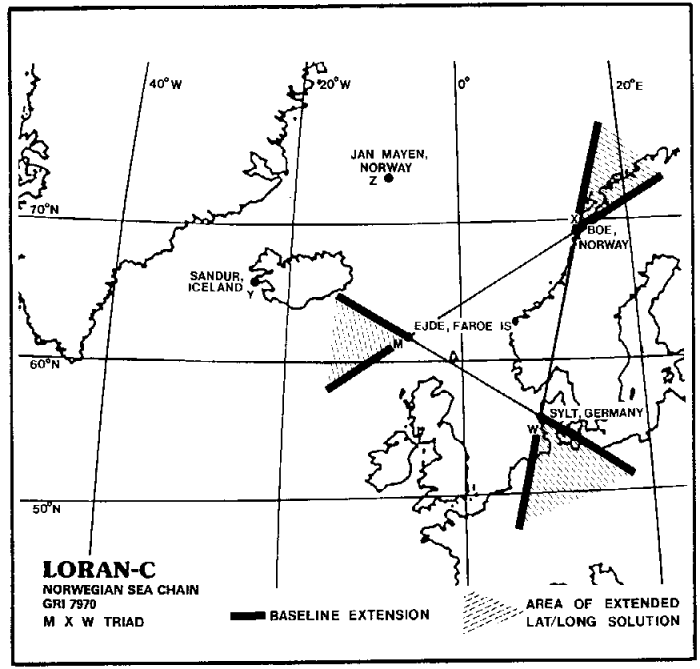
NORWEGIAN SEA LORAN-C CHAIN - GRI 7970 (old rate SL3)

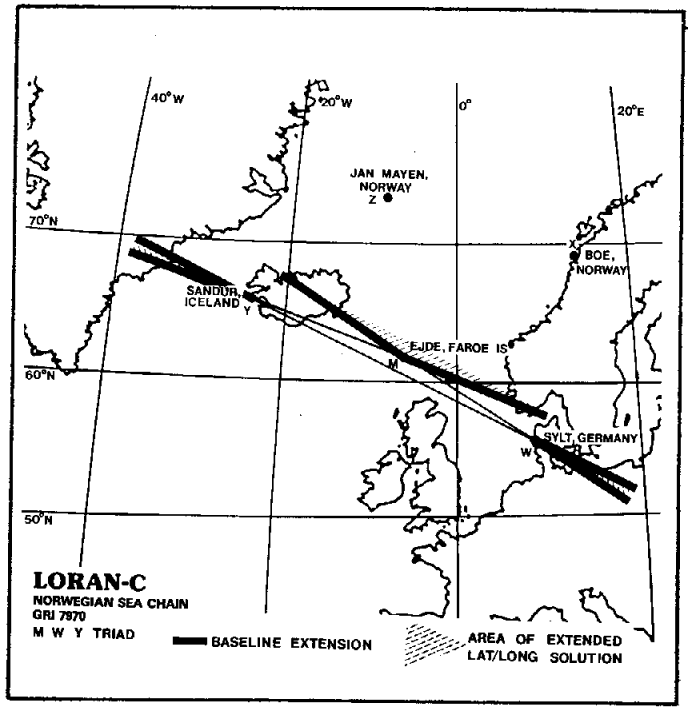
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Ejde, Faeroe Is. Denmark	Master	62 17 59.7 N 07 04 26.7 W		325	Host Nation Manned, Dual-rated to North Atlantic Chain.
BØ, Norway	Xray	68 38 06.2 N 14 27 47.0 E	11000/ 4048.10	165	Host Nation Manned.
Sylt, Germany	Whiskey	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 26 25.3 N 01 18 05.7 W			Control For X, W, Y, and Z

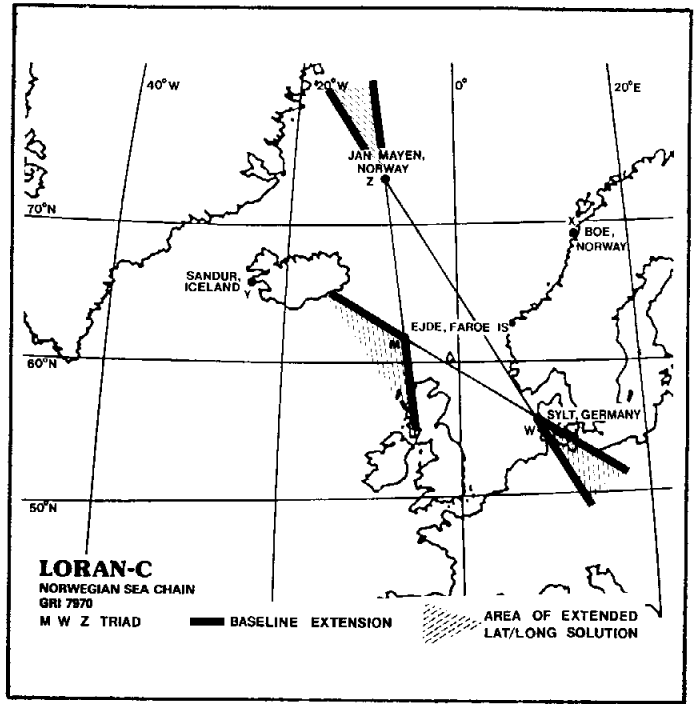


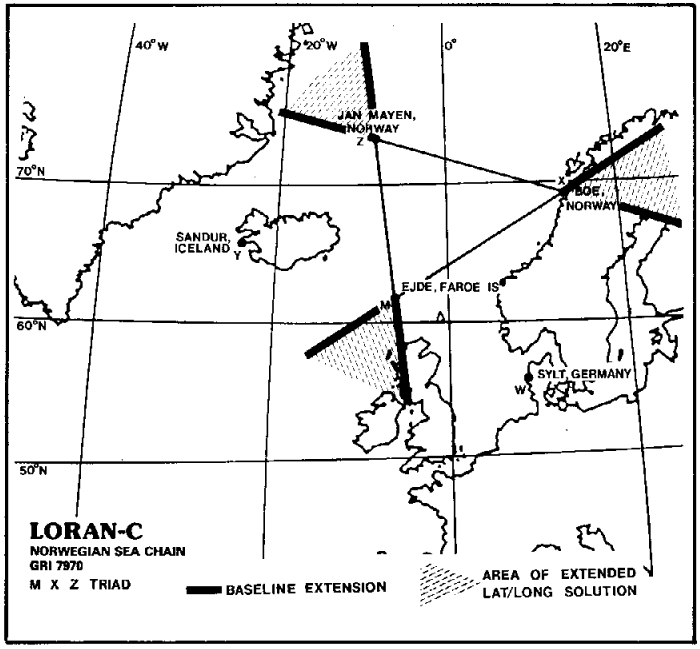
NORWEGIAN SEA - 7970

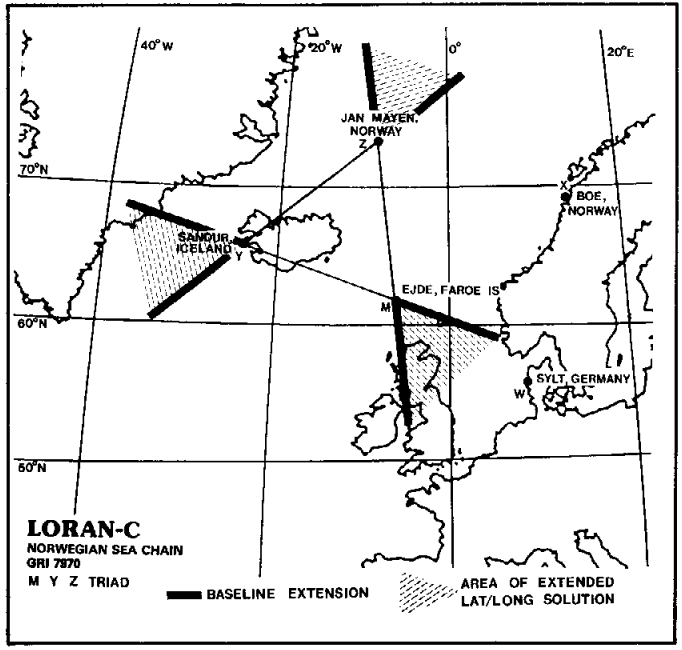

40°W
20°W
0°
20°E
70°N
60°N
50°N
JAN MAYEN, NORWAY
Z
BOE, NORWAY
X
SANDUR, ICELAND
Y
EJDE, FAROE IS
M
SYLT, GERMANY
W
LORAN-C
NORWEGIAN SEA CHAIN
GRI 7970
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


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
NORWEGIAN SEA CHAIN
GRI 7970
M X W TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

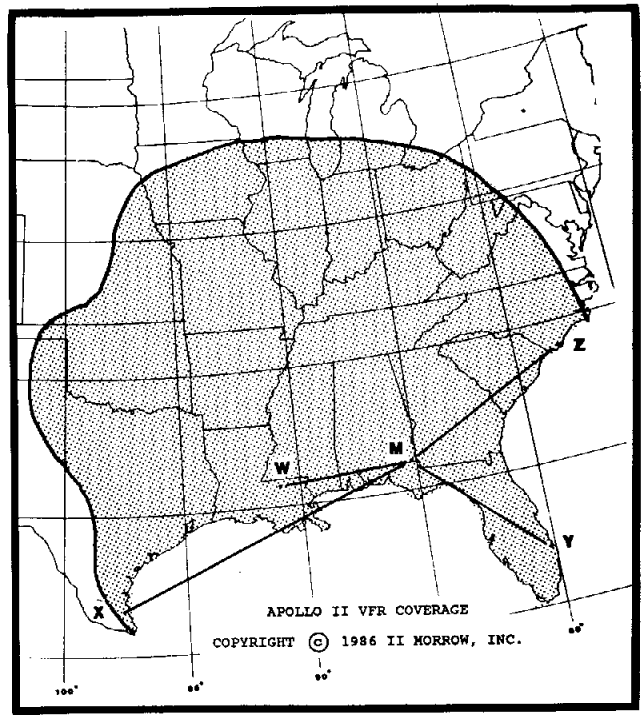

40°W
20°W
0°
20°E
70°N
60°N
50°N
JAN MAYEN, NORWAY
Z
BOE, NORWAY
X
SANDUR, ICELAND
Y
EJDE, FAROE IS
M
SYLT, GERMANY
W
LORAN-C
NORWEGIAN SEA CHAIN
GRI 7970
M W Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


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
NORWEGIAN SEA CHAIN
GRI 7970
M W Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

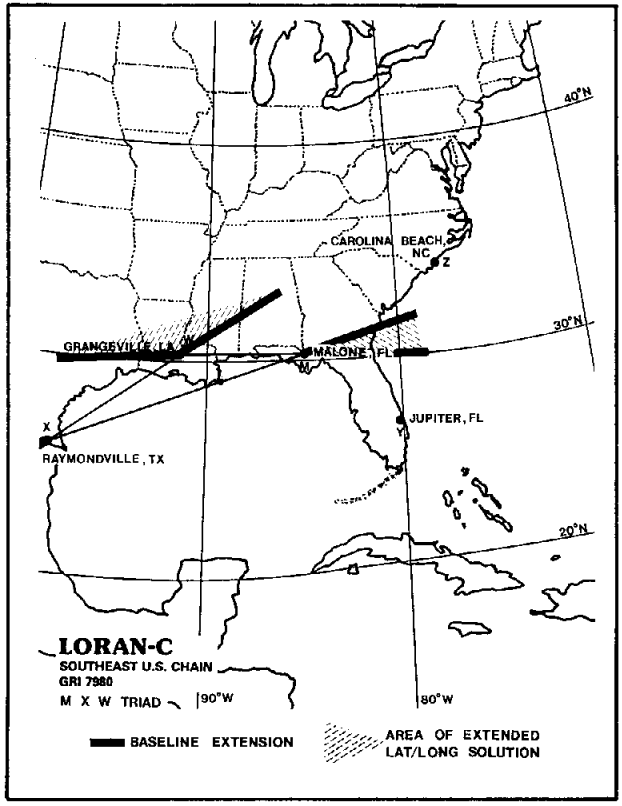

40°W
20°W
0°
20°E
70°N
60°N
50°N
JAN MAYEN, NORWAY
Z
BOE, NORWAY
X
SANDUR, ICELAND
Y
EJDE, FAROE IS
M
SYLT, GERMANY
W
LORAN-C
NORWEGIAN SEA CHAIN
GRI 7970
M X Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

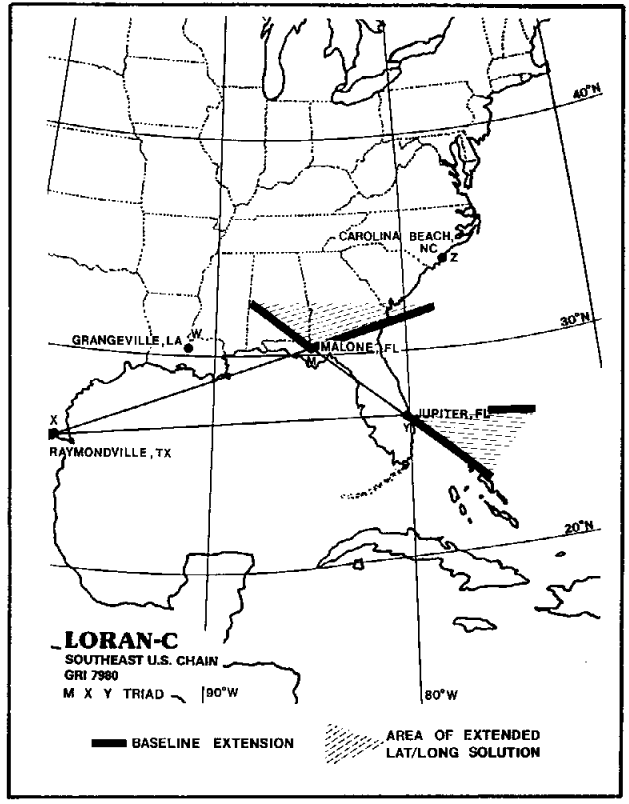

40°W
20°W
0°
20°E
70°N
60°N
50°N
JAN MAYEN, NORWAY
Z
BOE, NORWAY
X
SANDUR, ICELAND
Y
EJDE, FAROE IS
M
SYLT, GERMANY
W
LORAN-C
NORWEGIAN SEA CHAIN
GRI 7970
M Y Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

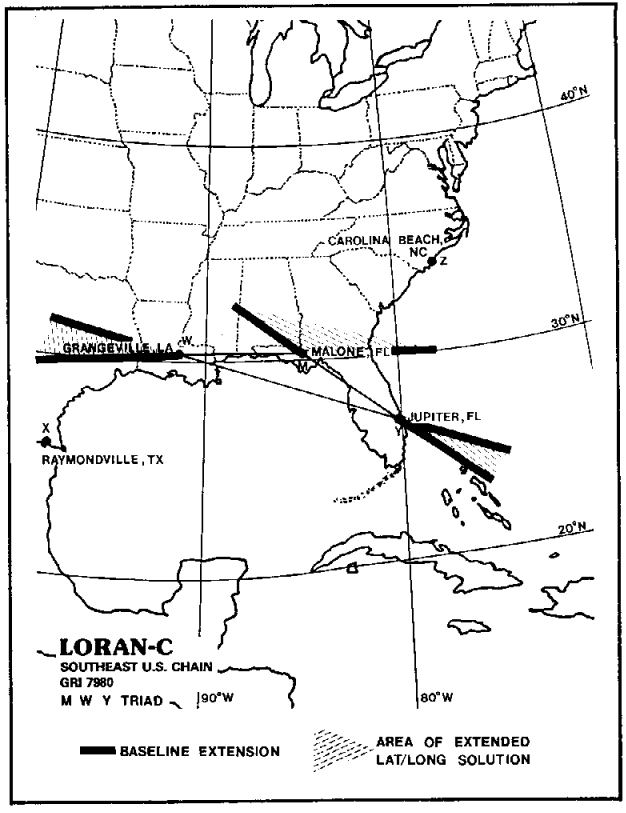
STATION	FUNCTION	COORDINATES	CODING DELAY-BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Malone, FL	Master	30 59 38.7 N 85 10 09.3 W		800	Control for W, X, Y, and Z. Dual-rated to Great Lakes Chain.
Grangeville, LA	Whiskey	30 43 33.0 N 90 49 43.6 W	11000/ 1809.54	800	
Raymondville, TX	Xray	26 31 55.0 N 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 recievr site.
New Orleans, LA	Monitor	29 49 17.5 N 90 01 44.2 W			Unmanned receiver site.

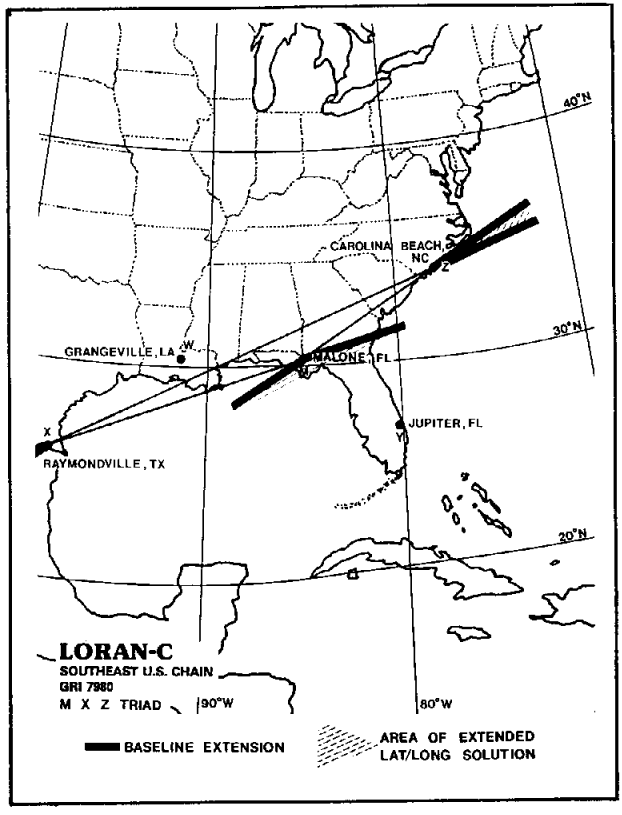


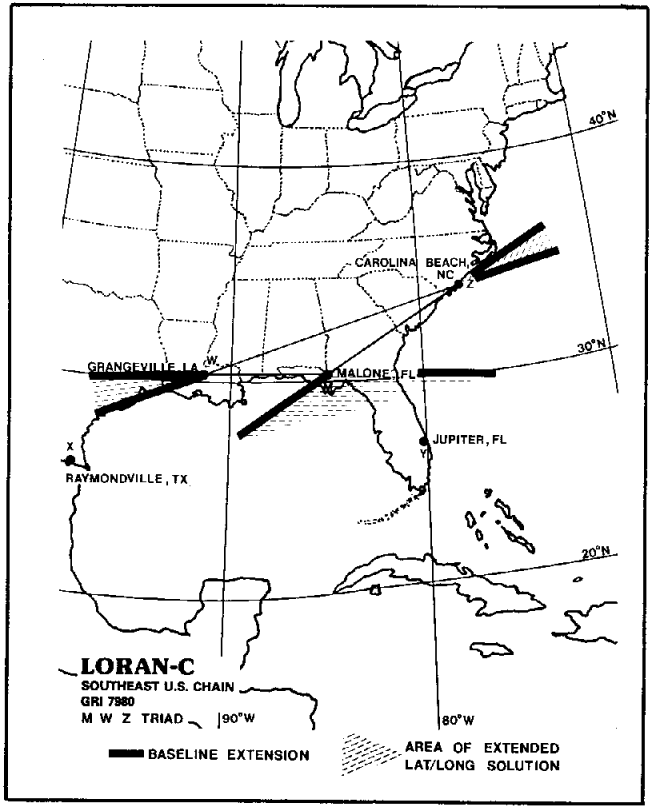
SOUTHEAST U.S. - 7980

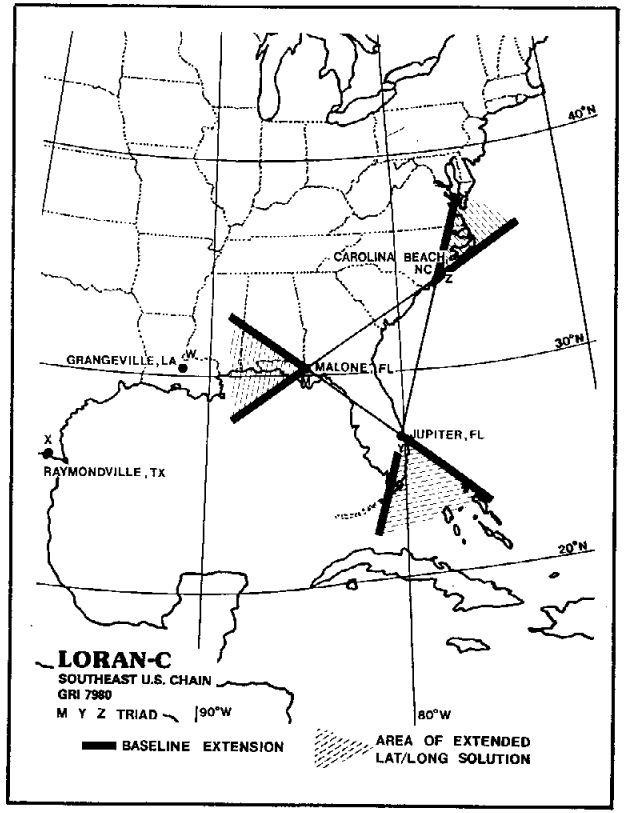

40°N
30°N
20°N
90°W
80°W
CAROLINA BEACH, NC
Z
GRANGEVILLE, LA
W
MALONE, FL
M
JUPITER, FL
Y
X
RAYMONDVILLE, TX
LORAN-C
SOUTHEAST U.S. CHAIN
GRI 7980
M X W TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


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

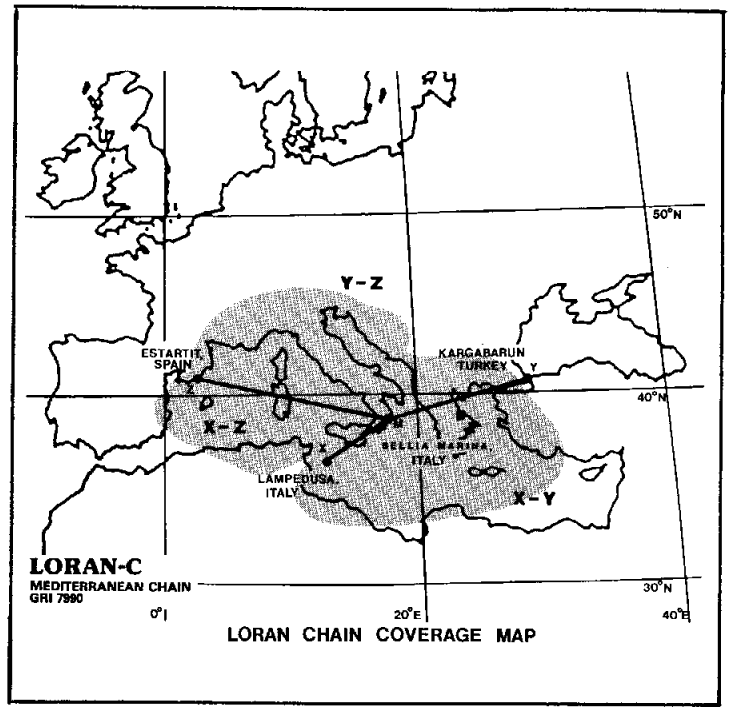

40°N
30°N
20°N
90°W
80°W
CAROLINA BEACH, NC
Z
GRANGEVILLE, LA
W
MALONE, FL
M
JUPITER, FL
Y
X
RAYMONDVILLE, TX
LORAN-C
SOUTHEAST U.S. CHAIN
GRI 7980
M X Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


40°N
30°N
20°N
90°W
80°W
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
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

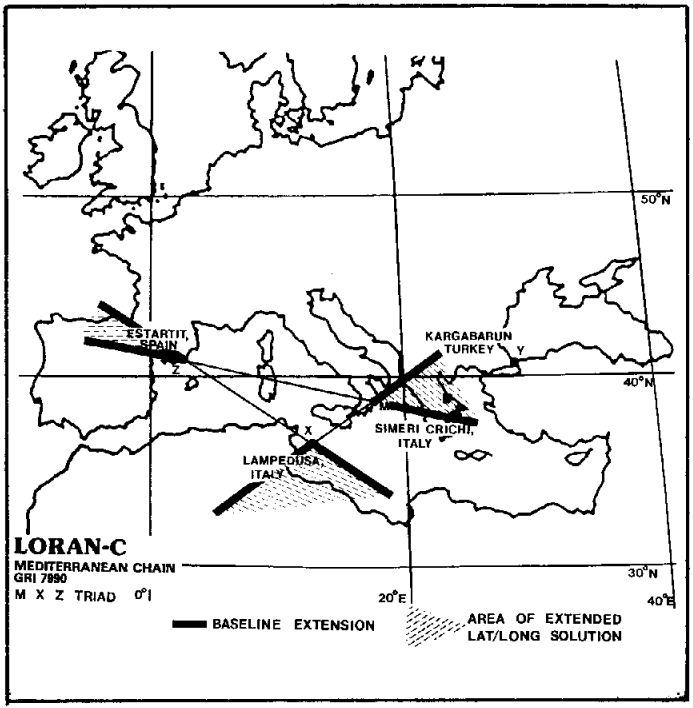

40°N
30°N
20°N
90°W
80°W
CAROLINA BEACH, NC
Z
GRANGEVILLE, LA
W
MALONE, FL
JUPITER, FL
X
RAYMONDVILLE, TX
LORAN-C
SOUTHEAST U.S. CHAIN
GRI 7980
M Y Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

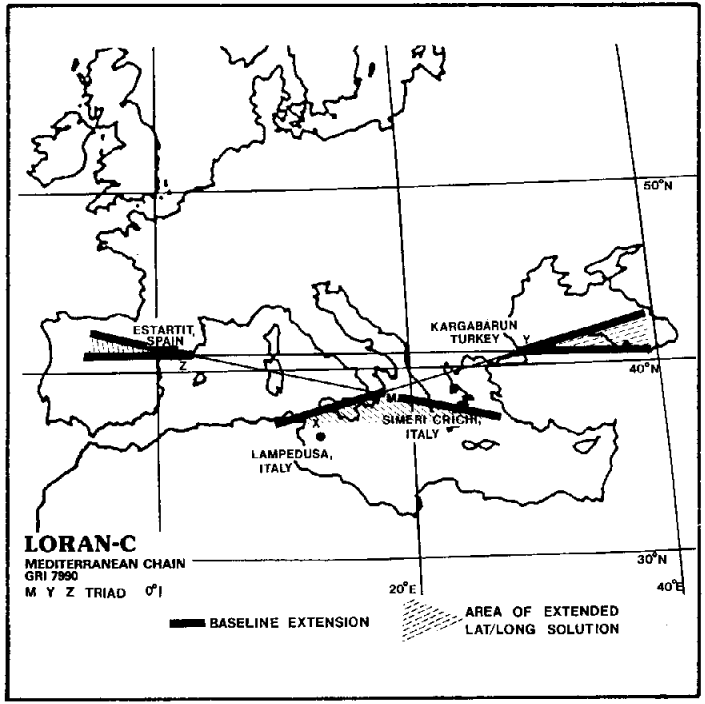
MEDITERRANEAN SEA LORAN-C CHAIN - GRI 7990 (old rate SL1)

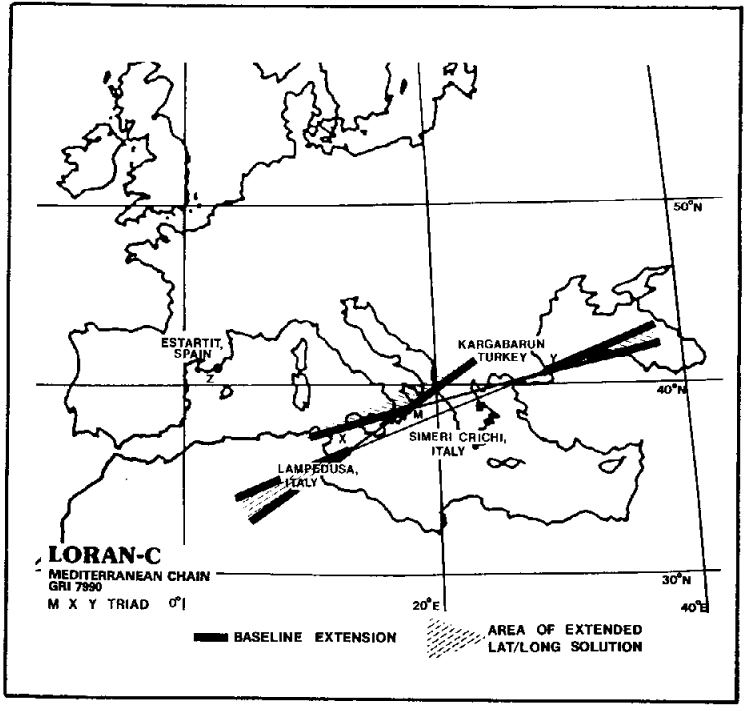
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Sellia Marina, Italy	Master	38 52 20.6 N 16 43 06.2 E		165	Exercises operational control of chain.
Lampedusa, Italy	Xray	35 31 20.8 N 12 31 30.2 E	11000/ 1755.98	325	Atis station.
Kargabarun, Turkey	Yankee	40 58 21.0 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	



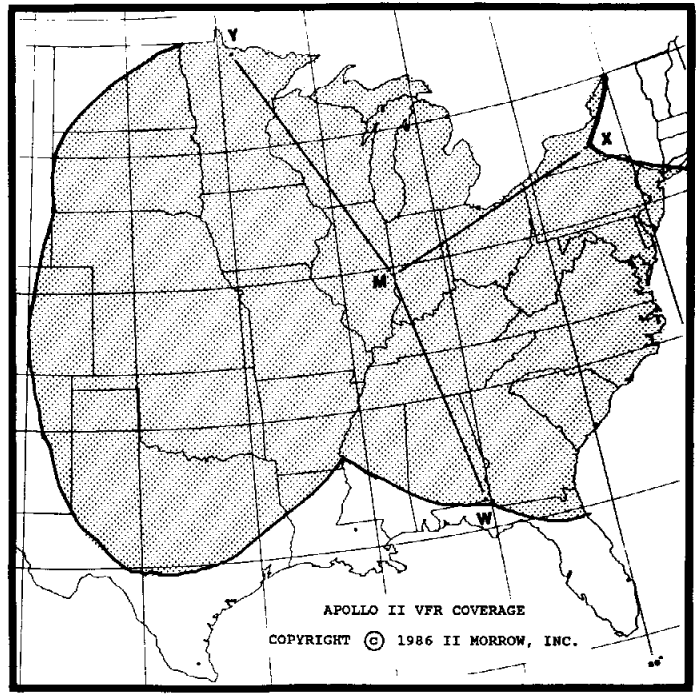
MEDITERRANEAN - 7990


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

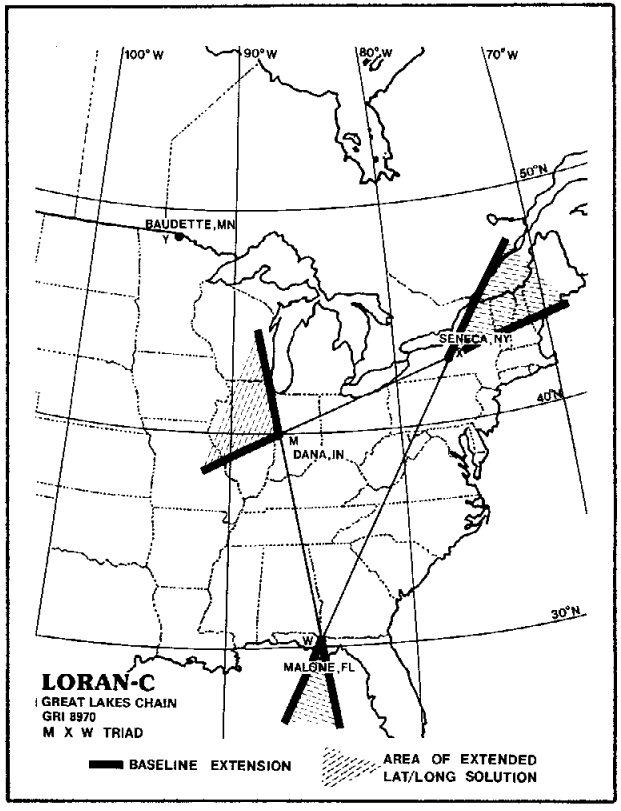

50°N
40°N
30°N
20°E
40°E
ESTARTIT, SPAIN
Z
KARGABARUN TURKEY
Y
M
SIMERI CRICHI, ITALY
X
LAMPEDUSA, ITALY
LORAN-C
MEDITERRANEAN CHAIN
GRI 7990
M Y Z TRIAD 0°I
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

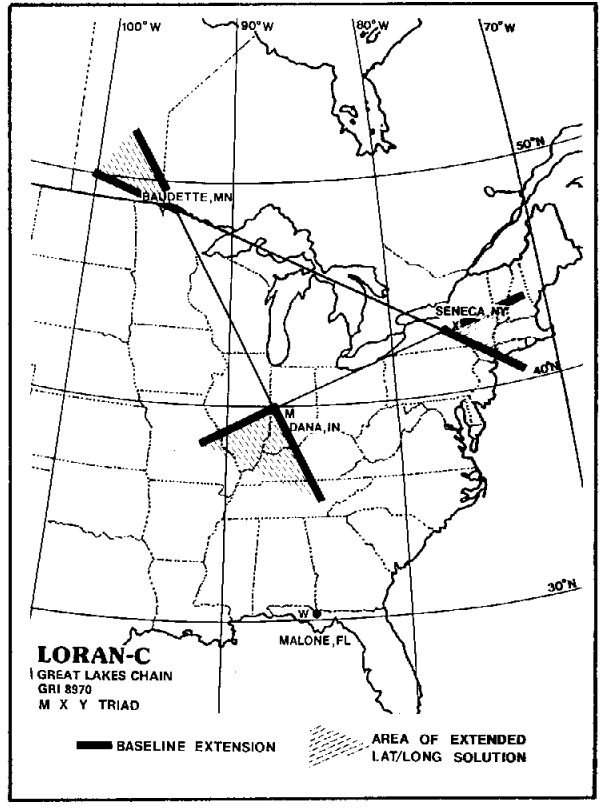

50°N
40°N
30°N
20°E
40°E
ESTARTIT, SPAIN
Z
KARGABARUN TURKEY
Y
M
X
SIMERI CRICHI, ITALY
LAMPEDUSA, ITALY
LORAN-C
MEDITERRANEAN CHAIN
GRI 7990
M X Y TRIAD 0°
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

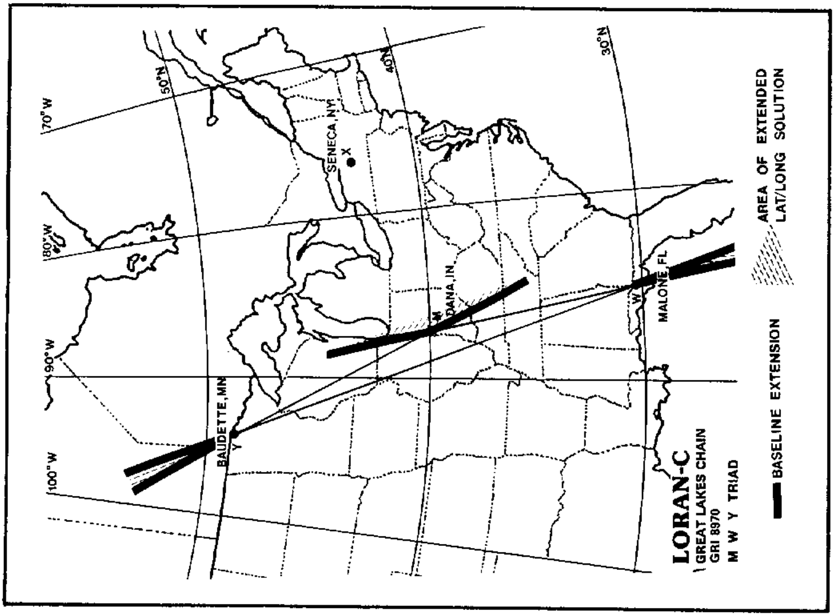
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Dana, IN	Master	39 51 07.5 N 87 29 12.1 W		400	Dual-rated to North-east U.S. Chain.
Malone, FL	Whiskey	30 59 38.7 N 85 10 09.3 W	11000/ 3355.11	800	Dual-rated to South east U.S. Chain.
Seneca, NY	Xray	42 42 50.6 N 76 49 33.9 W	28000/ 3162.06	800	Dual-rated to North-east U.S. Chain. Exercises operational control 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

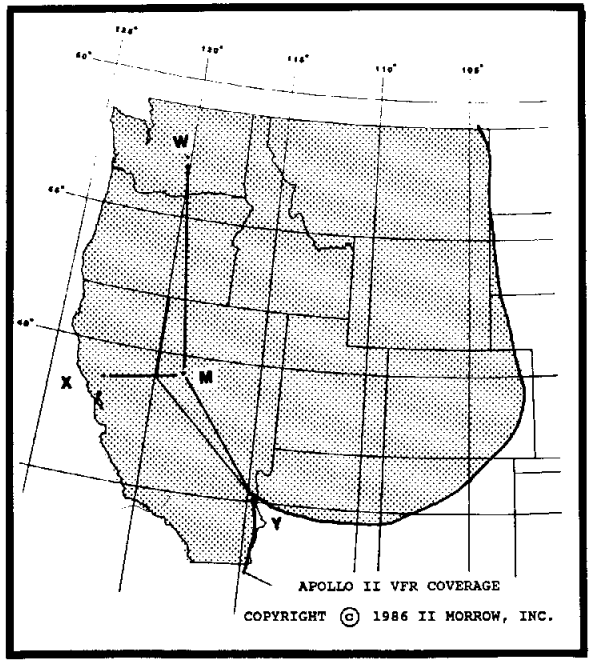

100° W
90° W
80° W
70° W
50° N
40° N
30° N
BAUDETTE, MN
SENECA, NY
M
DANA, IN
W
MALONE, FL
LORAN-C
GREAT LAKES CHAIN
GRI 8970
M X W TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


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

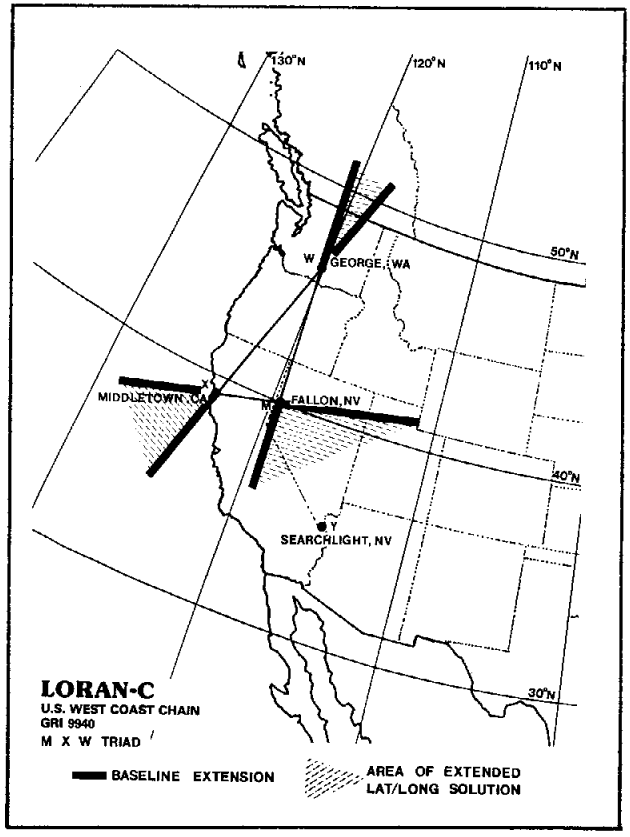


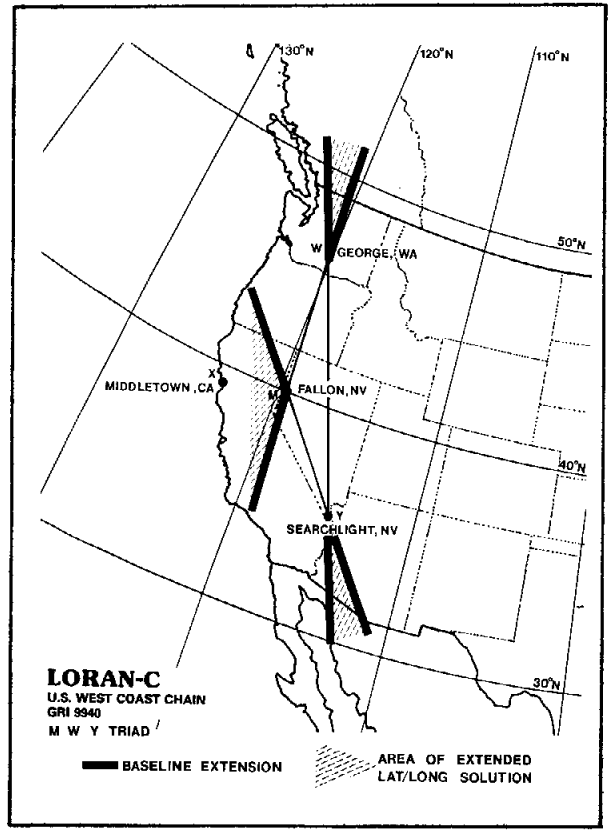
LORAN-C
GREAT LAKES CHAIN
GRI 8970
M W Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION
SENECA, NY
X
DANA, IN
M
MALONE, FL
W
BAUDETTE, MN
Y
70°W
80°W
90°W
100°W
50°N
40°N
30°N

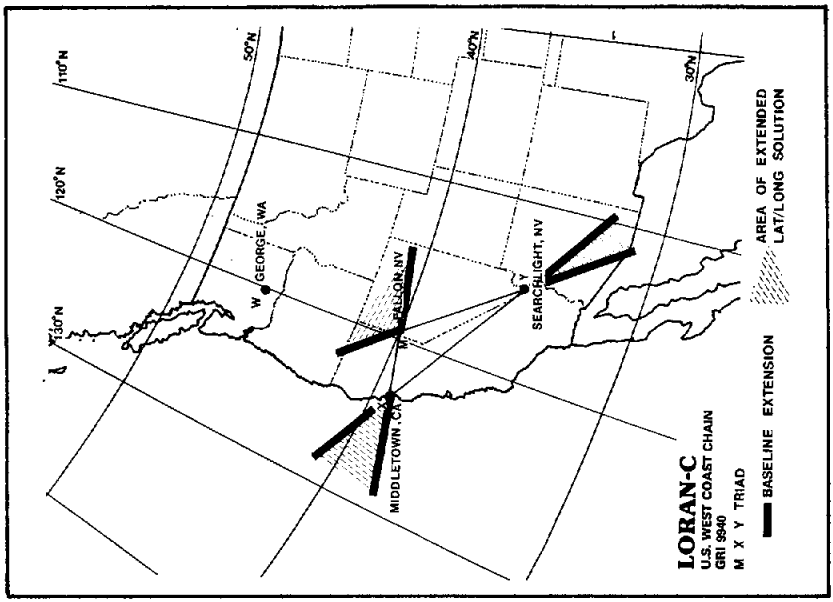
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Fallon, NV	Master	39 33 06.6 N 118 49 56.4 W		400	Two pulse comms installed.
George, WA	Whiskey	47 03 48.0 N 119 44 39.5 W	11000/ 2796.90	1600	Two pulse comms installed. Dual-rated to West Coast Canada Chain.
Middletown, 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.



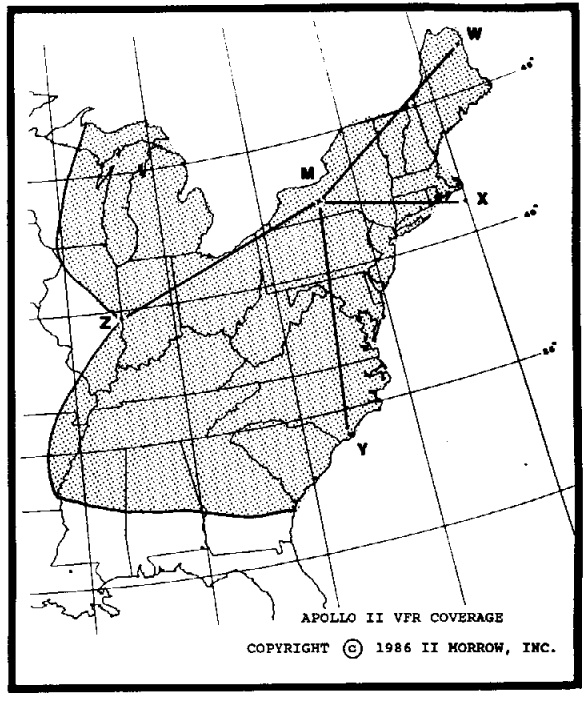
U.S. WEST COAST - 9940


130°N
120°N
110°N
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

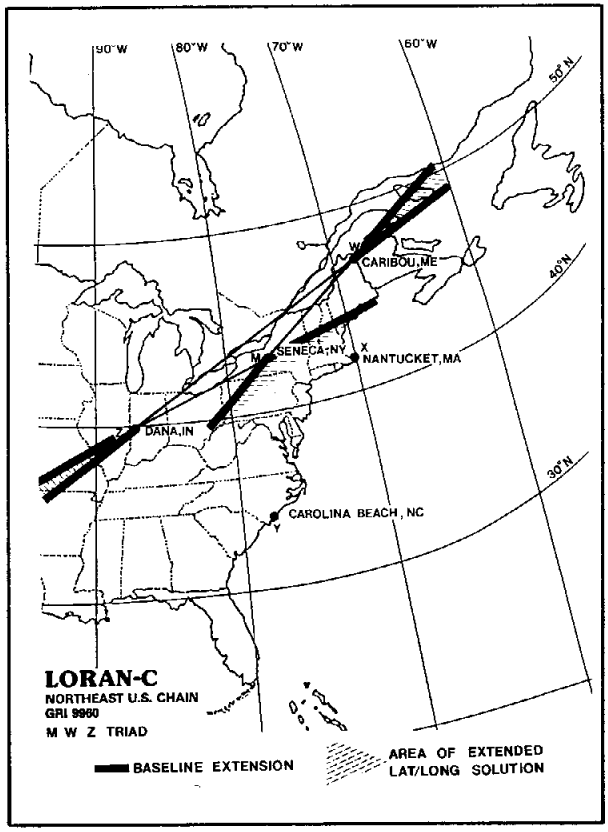

130°N
120°N
110°N
50°N
40°N
30°N
W
GEORGE, WA
X
MIDDLETOWN, CA
M
FALLON, NV
Y
SEARCHLIGHT, NV
LORAN-C
U.S. WEST COAST CHAIN
GRI 9940
M W Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

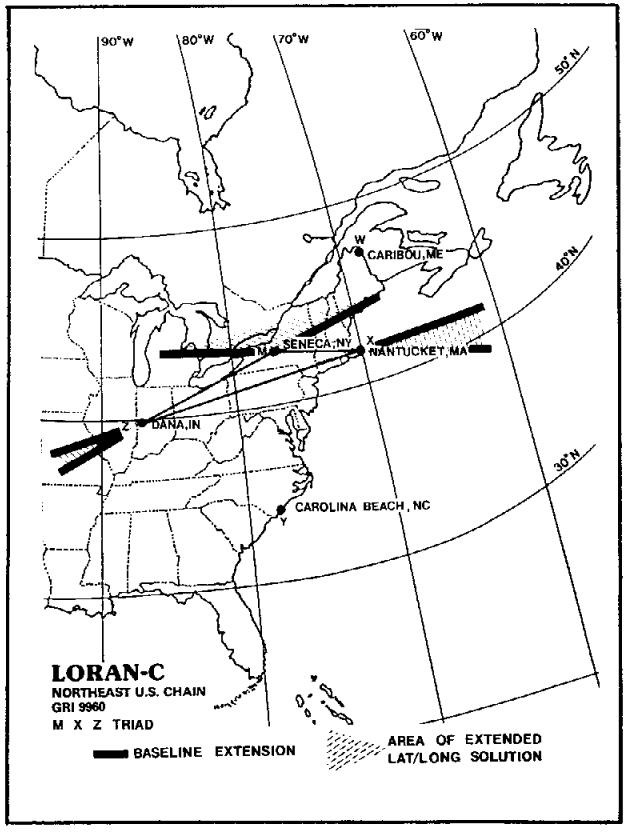

110°N
120°N
130°N
50°N
40°N
30°N
GEORGE, WA
W
PARSON, NV
M
SEARCHLIGHT, NV
Y
MIDDLETOWN, CA
X
LORAN-C
U.S. WEST COAST CHAIN
GRI 9940
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

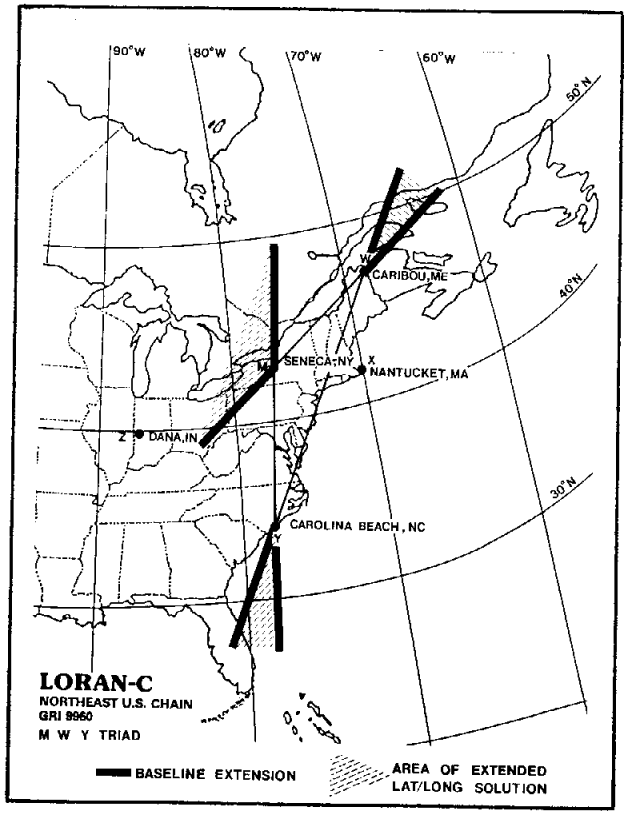
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
Seneca, NY	Master	42 42 50.6 N 76 49 33.9 W		800	Control for W, X, Y, and Z. Exercises operational control of Chain.
Caribou, ME	Whiskey	46 48 27.2 N 67 55 37.7 W	11000/ 2797.20	350	
Nantucket, MA	Xray	41 15 11.9 N 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	
Eecen 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 recievер site.
Claybanks, MI	Monitor	43 31 46.0 N 86 29 01.0 W			Unmanned receiver site.

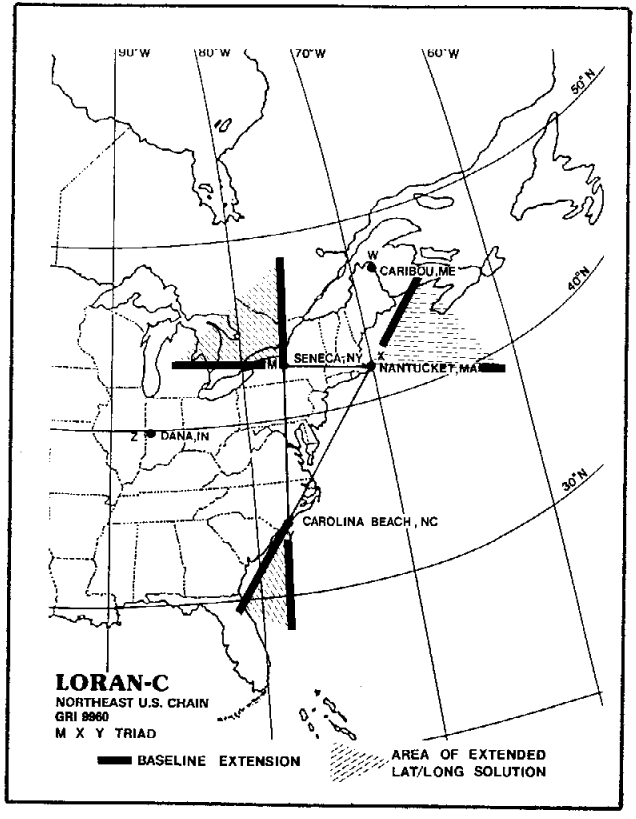


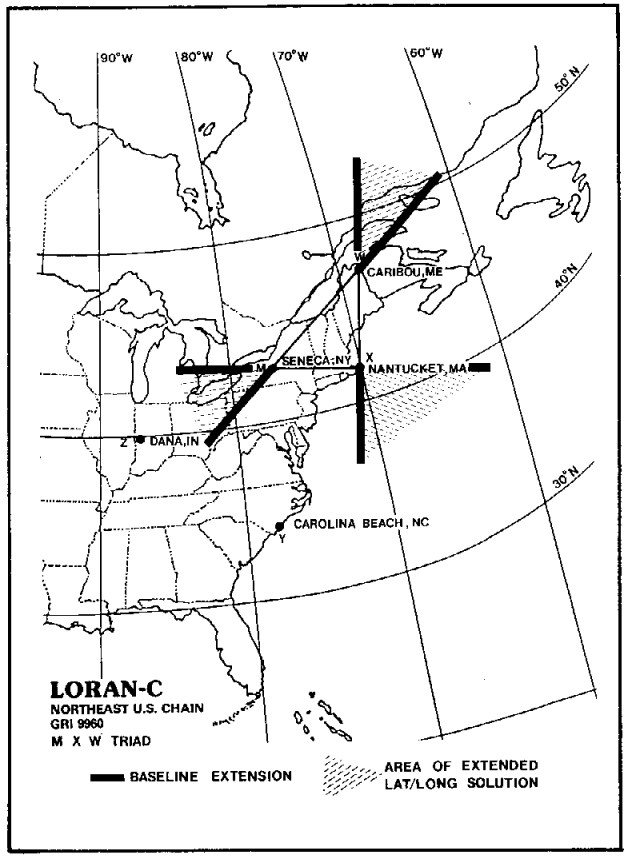
NORTHEAST U.S. - 9960

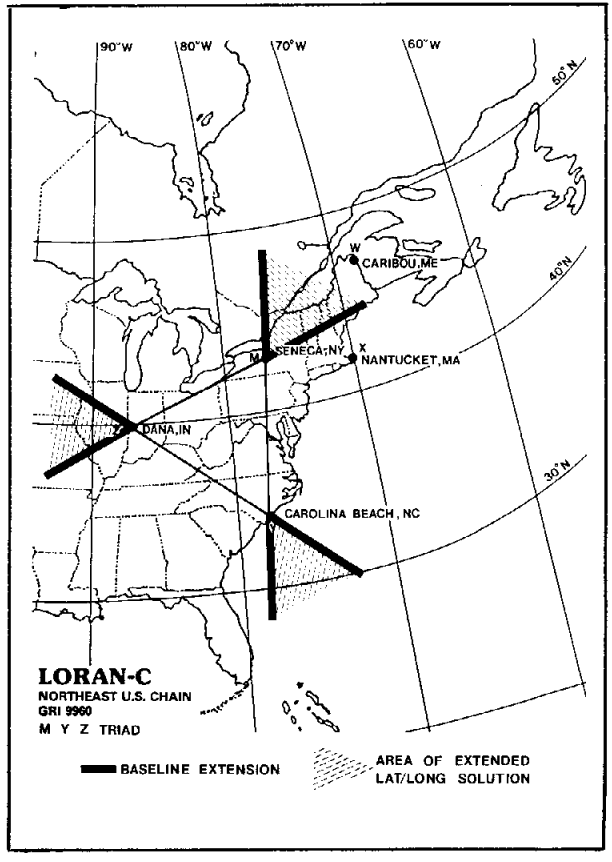

90°W
80°W
70°W
60°W
50°N
40°N
30°N
W
CARIBOU,ME
M
SENECA,NY
X
NANTUCKET,MA
Z
DANA,IN
Y
CAROLINA BEACH, NC
LORAN-C
NORTHEAST U.S. CHAIN
GRI 9960
M W Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION


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
M
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

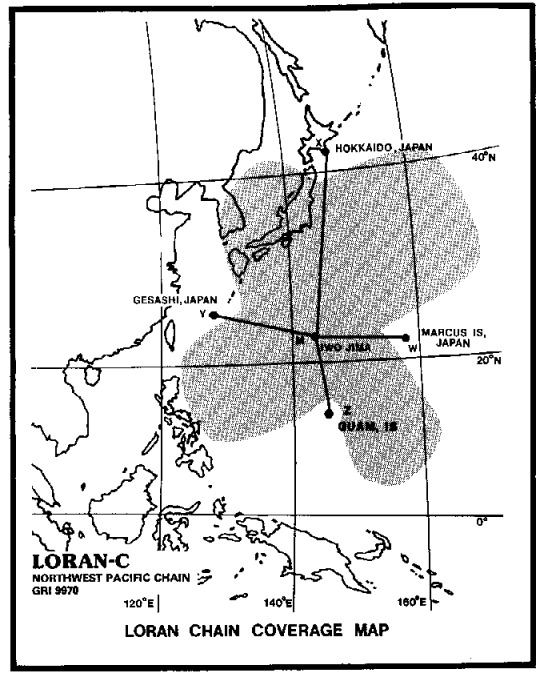

90°W
80°W
70°W
60°W
50°N
40°N
30°N
W
CARIBOU,ME
M
SENECA,NY
X
NANTUCKET,MA
Z
DANA,IN
CAROLINA BEACH, NC
LORAN-C
NORTHEAST U.S. CHAIN
GRI 9960
M X Y TRIAD
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION


90°W
80°W
70°W
60°W
50°N
40°N
30°N
W
CARIBOU,ME
Z
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

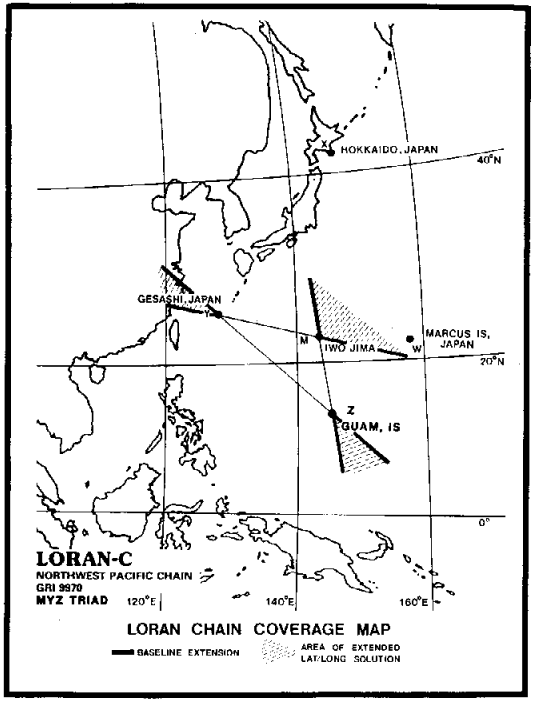
NORTHWEST PACIFIC LORAN-C - GRI 9970

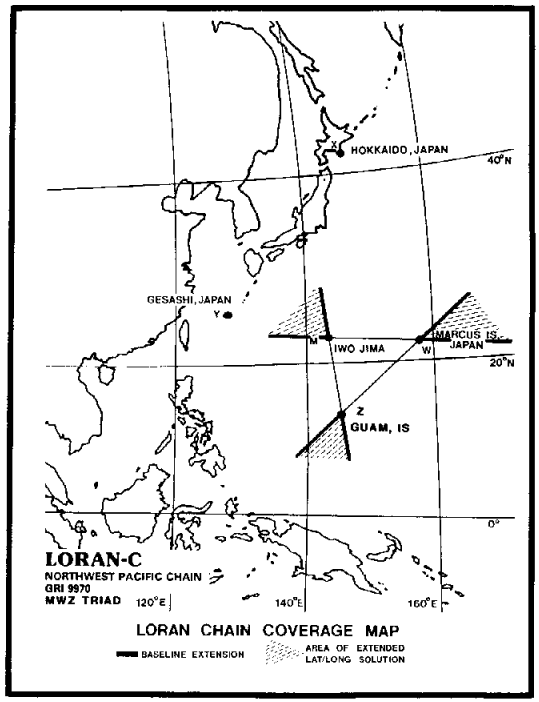
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER (kW)	REMARKS
Iwo Jima, Japan	Master	24° 48 03.6 N 141° 19 30.3 E		540	Clarinet Pilgrim TTY2
Marcus Is Japan	Whiskey	24° 17 07.9 N 153° 58 53.2 E	11,000/ 4283.94	1800	Clarinet Pilgrim TTY2 installed
Hokkaido, Japan	Xray	42° 44 37.1 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
Yokota, Japan	Monitor/ Control	35° 44 34.6 N 139° 21 41.3 E			Controls X and Y
Chansan, Korea	Monitor	35° 11 26.0 N 128° 08 48.0 E			

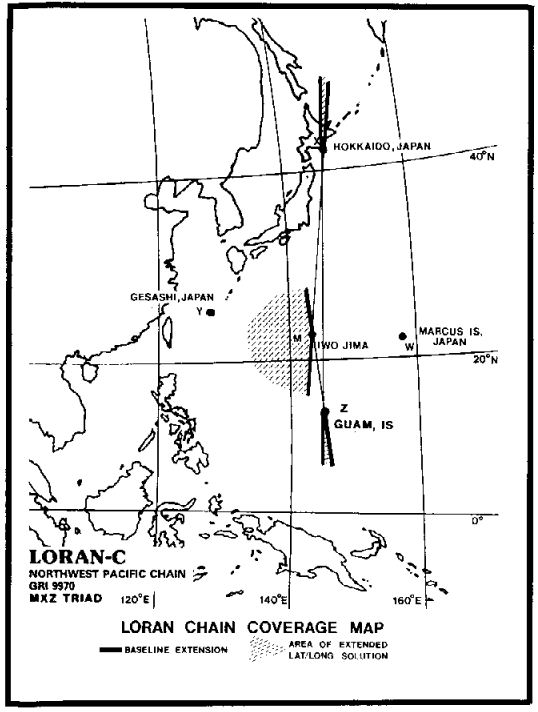


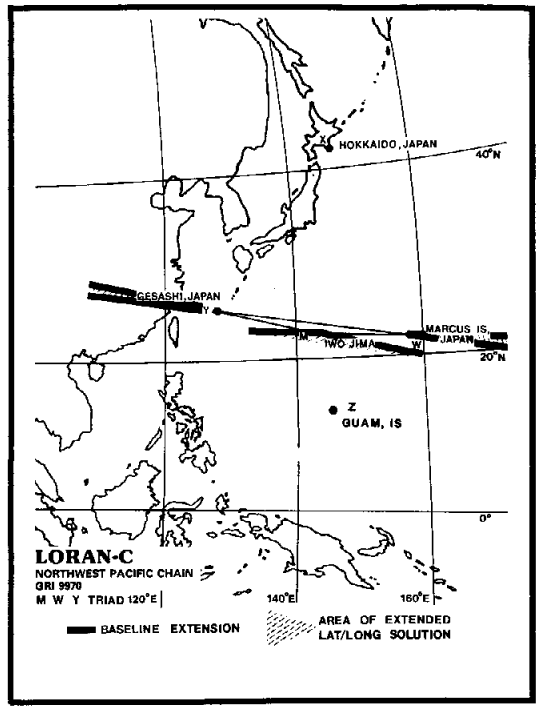
LORAN CHAIN COVERAGE MAP

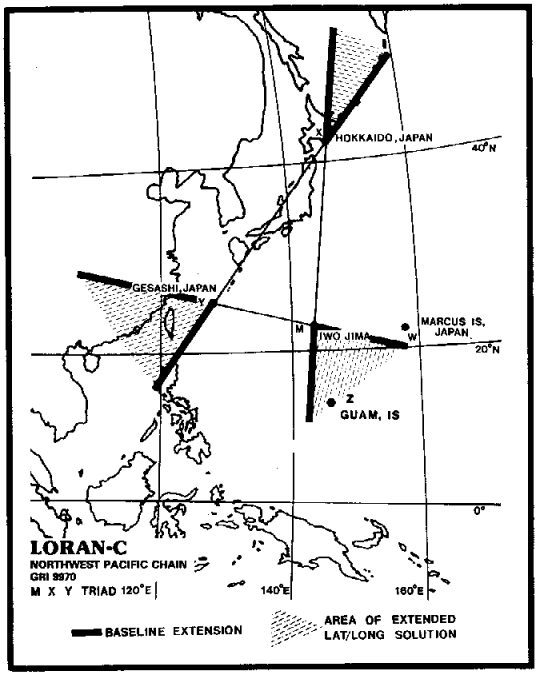
NORTHWEST PACIFIC - 9970

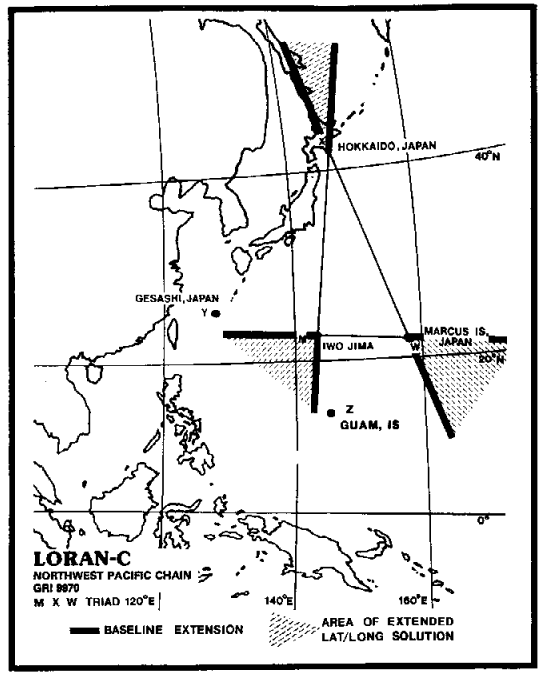

HOKKAIDO, JAPAN
40°N
GESASHI, JAPAN
N
IWO JIMA
W
MARCUS IS, JAPAN
20°N
Z
GUAM, IS
0°
LORAN-C
NORTHWEST PACIFIC CHAIN
GRI 9970
MYZ TRIAD
120°E
140°E
160°E
LORAN CHAIN COVERAGE MAP
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


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

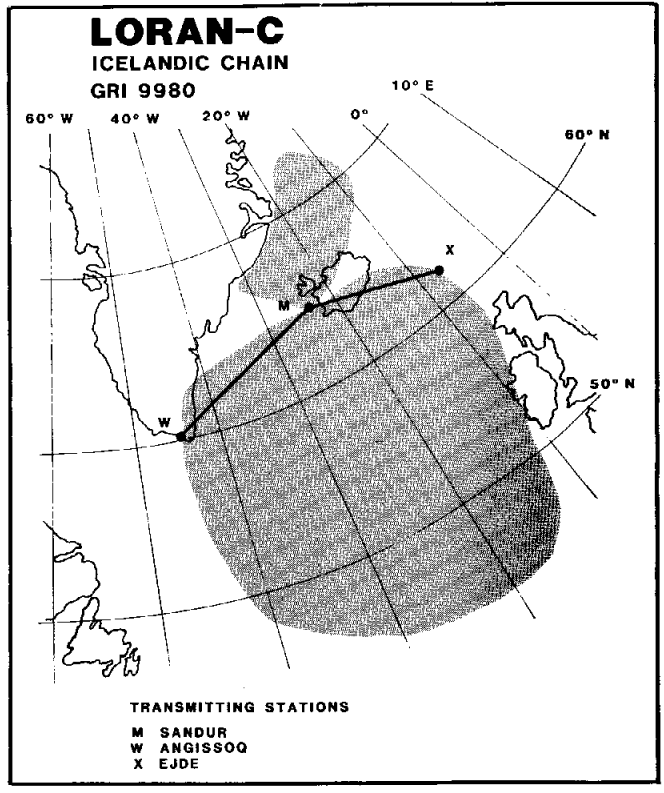

HOKKAIDO, JAPAN
40°N
GESASHI, JAPAN
Y
M
IWO JIMA
W
MARCUS IS.
JAPAN
20°N
Z
GUAM, IS
0°
LORAN-C
NORTHWEST PACIFIC CHAIN
GRI 9970
M W Y TRIAD
120°E
140°E
160°E
BASELINE EXTENSION
AREA OF EXTENDED
LAT/LONG SOLUTION


HOKKAIDO, JAPAN
40°N
GESASHI, JAPAN
Y
M
IWO JIMA
W
MARCUS IS, JAPAN
20°N
X
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

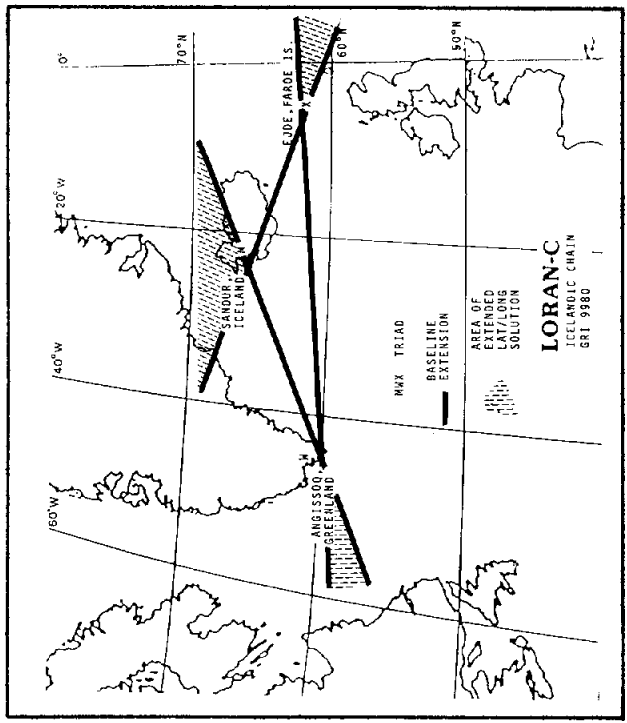

HOKKAIDO, JAPAN
40°N
GESASHI, JAPAN
Y
M
IWO JIMA
W
MARCUS IS, JAPAN
20°N
X
Z
GUAM, IS
0°
LORAN-C
NORTHWEST PACIFIC CHAIN
GRI 9970
M X W TRIAD 120°E
140°E
160°E
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION

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			

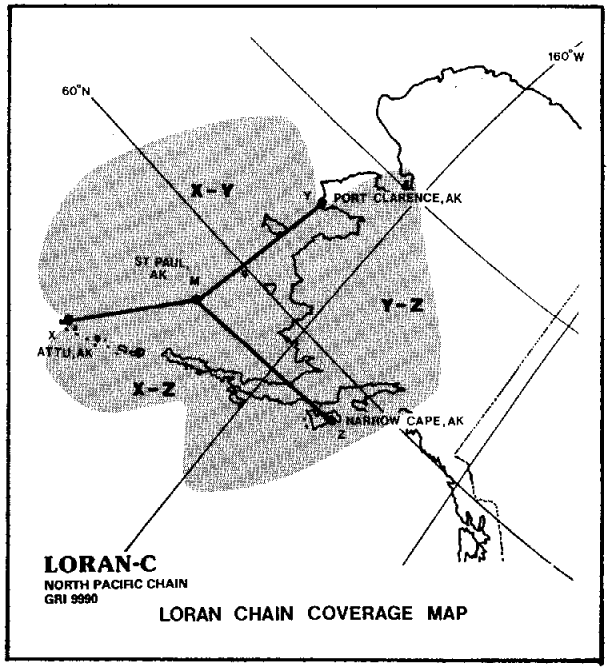


ICELAND - 9980

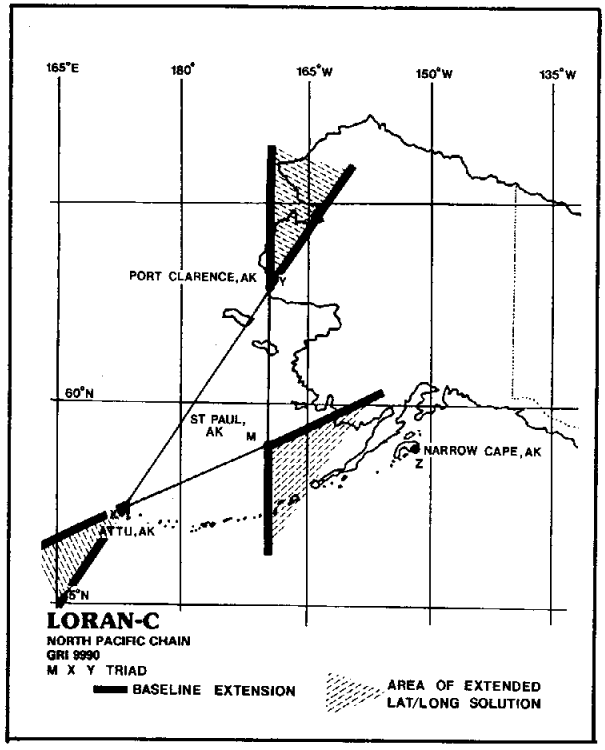

LORAN-C
ICELANDIC CHAIN
GRI 9980
AREA OF EXTENDED LAT/LONG SOLUTION
BASELINE EXTENSION
MWX TRIAD
SANDUR ICELAND
EJDE, FAROE IS.
ANGISSOQ GREENLAND
70°N
60°N
50°N
40°W
60°W

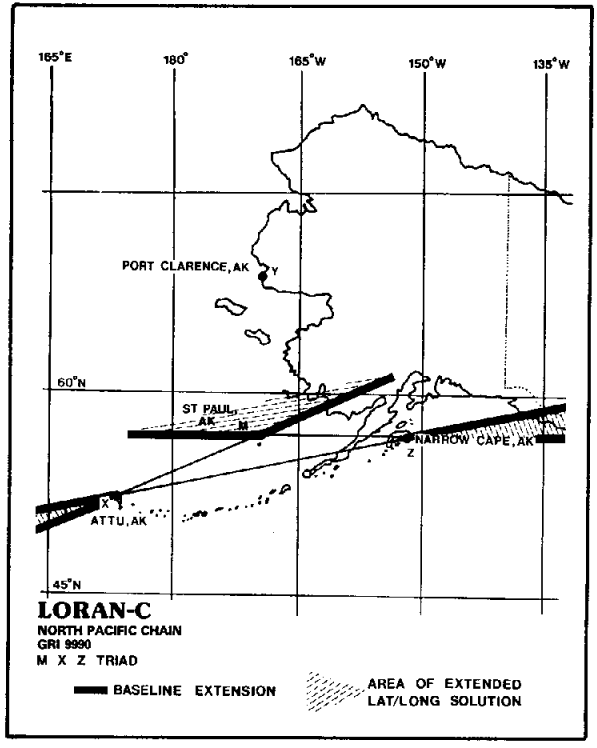
NORTH PACIFIC LORAN-C CHAIN - GRI 9990 (old rate SS1)

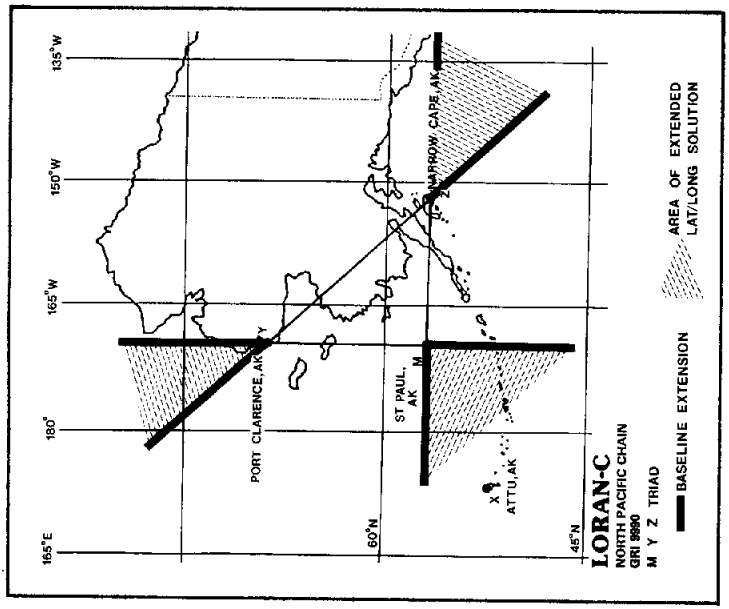
STATION	FUNCTION	COORDINATES	CODING DELAY/BASE-LINE LENGTH	RADIATED POWER(KW)	REMARKS
St. Paul, AK	Master	57 09 12.3 N 170 15 06.8 W		275	Controls X and Y, exercises operational control of chain, two pulse comms installed.
Attu, AK	Xray	52 49 44.0 N 173 10 49.0 E	11000/ 3875.25	275	
Port Clarence, AK	Yankee	65 14 40.3 N 166 53 12.6 W	29000/ 3068.95	1000	
Narrow Cape, AK	Zulu	57 26 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

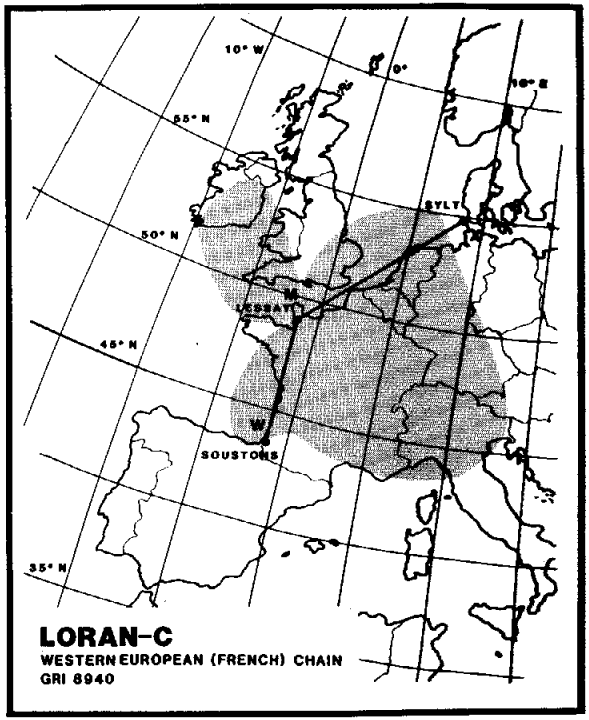

165°E
180°
165°W
150°W
135°W
PORT CLARENCE, AK
Y
60°N
ST PAUL, AK
M
NARROW CAPE, AK
Z
X
ATTU, AK
45°N
LORAN-C
NORTH PACIFIC CHAIN
GRI 9990
M X Z TRIAD
BASELINE EXTENSION
AREA OF EXTENDED LAT/LONG SOLUTION


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

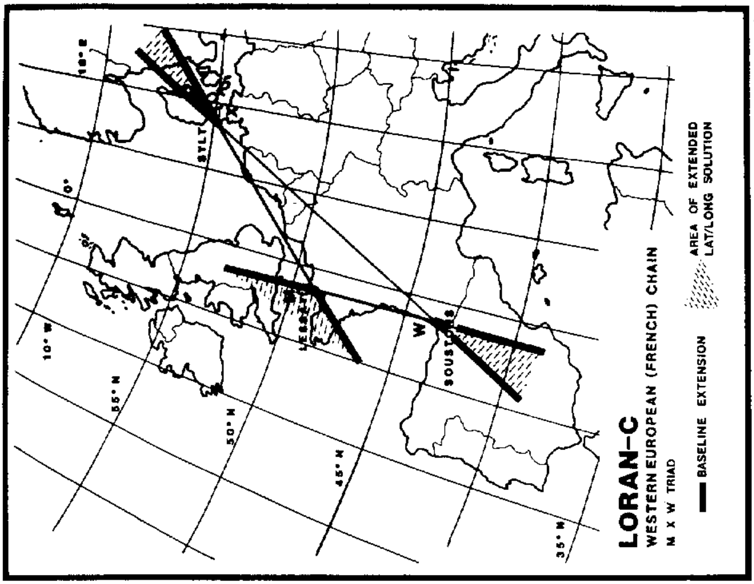
WESTERN EUROPEAN (FRENCH) LORAN-C CHAIN - GRI 8940

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° W
0°
10° E
55° N
50° N
45° N
35° N

SECTION G

CARE

AND

MAINTENANCE

SECTION G - CARE and MAINTENANCE

This section provides a little advice on how to get the most from your APOLLO II from the first day you use it thru 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 II 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 II installed only by a qualified conscientious certified facility. The best performance and longest life for your APOLLO II 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 the antenna as this will reduce its performance.

BATTERY REPLACEMENT

The APOLLO II 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.

HELP!

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. 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 below 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 distent 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 in the APOLLO IIR 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 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. automatically.	A. Extremely poor geometric position.	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").

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.

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. See Secondary Phase Factor.

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.

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.

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.

CROSSING ANGLE: the angle from 0 to 90 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 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.

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.

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

FLYBRARY: the list of federally designated airports and VORs that are present in the permanent memory of the APOLLO II (Models 612 and 614) FLYBRARY is a trademark of II Morrow Inc.

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 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.

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

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.

LATITUDE: The angular distance north or south from the earth's equator measured through 90°. 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.

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).

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.

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.

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.

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.

SOFTWARE: computer programs or instruction sets.

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).

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.

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.

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