DeltaFix LR Receiver
Type 90710

Operators Manual

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Chapter 1

System Description

1 DeltaFix LR System

The DeltaFix LR System is a long range, medium frequency data link intended primarily for use with a differential GPS system, although it may be used as a general purpose data link.

DeltaFix LR uses time and frequency diversity to ensure a reliable, error free link to a number of mobile.receivers. The data is transmitted using a dual-frequency MF transmitter whose installation and operation are described in manual STM 1306 (DeltaFix LR Operators Manual).

The data Is transmitted consecutively on two spot frequencies (Fl and F2) within the range 1.6 - 3.4MHz. A sync signal is also transmitted on both Fl and F2 to provide synchronisation between the receiver and transmitter. When the system Is operating in single frequency mode, the data is still transmitted consecutively in two slots but on the same frequency, i.e. Fl = F2 in the range 1.6-3.4MHz. However, the sync signal will only be transmitted on one of the two slots, ie. the slot normally allocated to that frequency. The signals are normally radiated from a 25m-high antenna to provide an operational working range of up to 600km from the reference station.

The receiver searches for and synchronises to the sync signal on either of the two frequencies and then decodes the transmitted data. The two copies, one on each frequency, and the error detection data are used to determine the correct output message. The error checking and correction methods used are the same for dual frequency and single frequency operation.

For DGPS applications, the received correction data is applied to a GPS receiver which may be either an external item or an integral unit within the DeltaFix LR Receiver.

2 GPS System Operation

2.1 Overview

The United States Department of Defence has deployed a satellite based navigation system known as the Global Positioning System or GPS. This system consists of 24 operational satellites. It will allow its users to monitor continuously position, velocity and time anywhere on or near the Earth's surface.

There are, however, sources of error within the GPS system, both inherent and deliberate which, without some means of correction, reduce its level of accuracy to an unacceptable level for offshore surveying.

The inherent accuracy of the GPS system is 10-15 metres but the U.S. Department of Defence has decided that such a level of accuracy should not be freely available to civilian users. They have, therefore, introduced a deliberate range degradation known as Selective Availability (SA) which
reduces the accuracy of GPS to approximately 100 metres (95%). To overcome this degradation and to further enhance the accuracy, differential techniques can be applied.

The GPS systems consists of three main subsystems as shown in Figure 1.1.

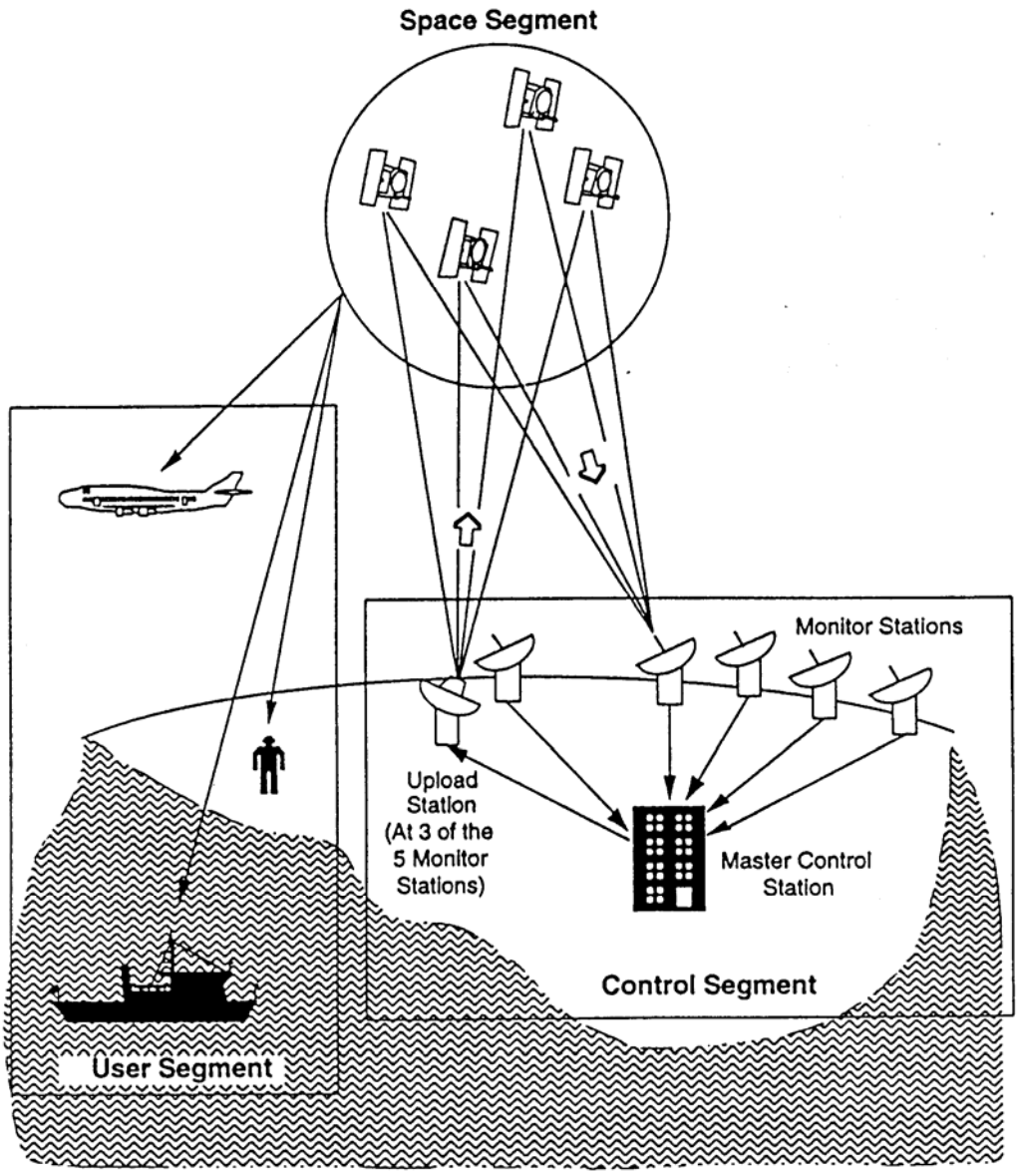


Figure 1.1 GPS System

2.2 Space Segment

The Space Segment comprises 24 satellites orbiting the earth every twelve hours. Three or four satellites are located in each of six different orbital planes at altitudes of about 11 000 nautical miles (20000 km). Each of the six orbital planes is inclined by 55° to the equatorial plane and is rotated by 60° from adjacent planes. Each satellite contains several high-precision frequency standards (atomic clocks).

2.3 Control Segment

The Control Segment consists of a group of four ground- based Monitor Stations, three Upload Stations and a Master Control Station. The Monitor Stations track the satellites continuously and provide data to the Master Control Station. The Master Control Station calculates satellite orbits, and clock correction coefficients and forwards them to an Upload Station. The Upload Station transmits (uploads) this data to each satellite at least once per day.

2.4 User Segment

The User Segment consists of various GPS receivers used on land, sea and In the air.

GPS satellites transmit two signals, Link One (L1) and Link Two (L2) at frequencies of 1575.42MHz and 1227.60MHz respectively. Ll is modulated with two pseudorandom codes; a protected (P) code and a coarse/acquisition (C/A) code. The P code is enerypted so that access is only granted to military users and is also the only ranging code broadcast on the L2 signal. Civilian receivers use the C/A code. Each satellite has its own unique pseudorandom code to allow its transmissions to be acquired and measured. The C/A code is 1023 bits long and repeats every millisecond.

GPS receivers receive the very weak signals from the satellite by correlating them against an internally generated copy of the satellite code. The receiver adjusts its internal code to maintain a maximum correlation and so the timing of the received signals can be obtained from the time offset of the code generated. This time measurement can be converted to a pseudorange which comprises the actual satellite to receiver range, the receiver clock offset and the satellite clock offset. Four satellite pseudoranges will enable the receiver to calculate its position using trigonometry. The fourth satellite range is required to eliminate the receiver clock offset. Satellite clock offsets are broadcast in the satellite data message.

The GPS signal is also modulated with NAVDATA. This consists of predicted satellite ephemerides, system time, satellite clock behaviour for the next day's operation and status information on all satellites. NAVDATA is updated each hour and each hourly segment is normally valid for four hours.

2.5 Differential GPS

Differential GPS, by means of applying error corrections to the GPS signals, can achieve accuracies in the order of a few metres. A differential GPS system works on the principle that if a receiver (referred to as the reference receiver) is located at a known position, then the error between its true position and the position derived from GPS system can be calculated. An error correction message can then be transmitted to any mobile GPS receiver in the local area which can use that error message to correct its position solution. Due to the distance of the satellites from the receivers the errors for one receiver will be almost exactly the same for any other receiver in the locality.

The DeltaFix LR System uses a dual-frequency MF transmitter at the reference station to communicate the correction messages to other users. The system also has the capability of single frequency operation so that it can still be used, at shorter ranges, in areas for which licences are difficult to obtain. A diagram illustrating the differential GPS principle is given in Figure 1.2.

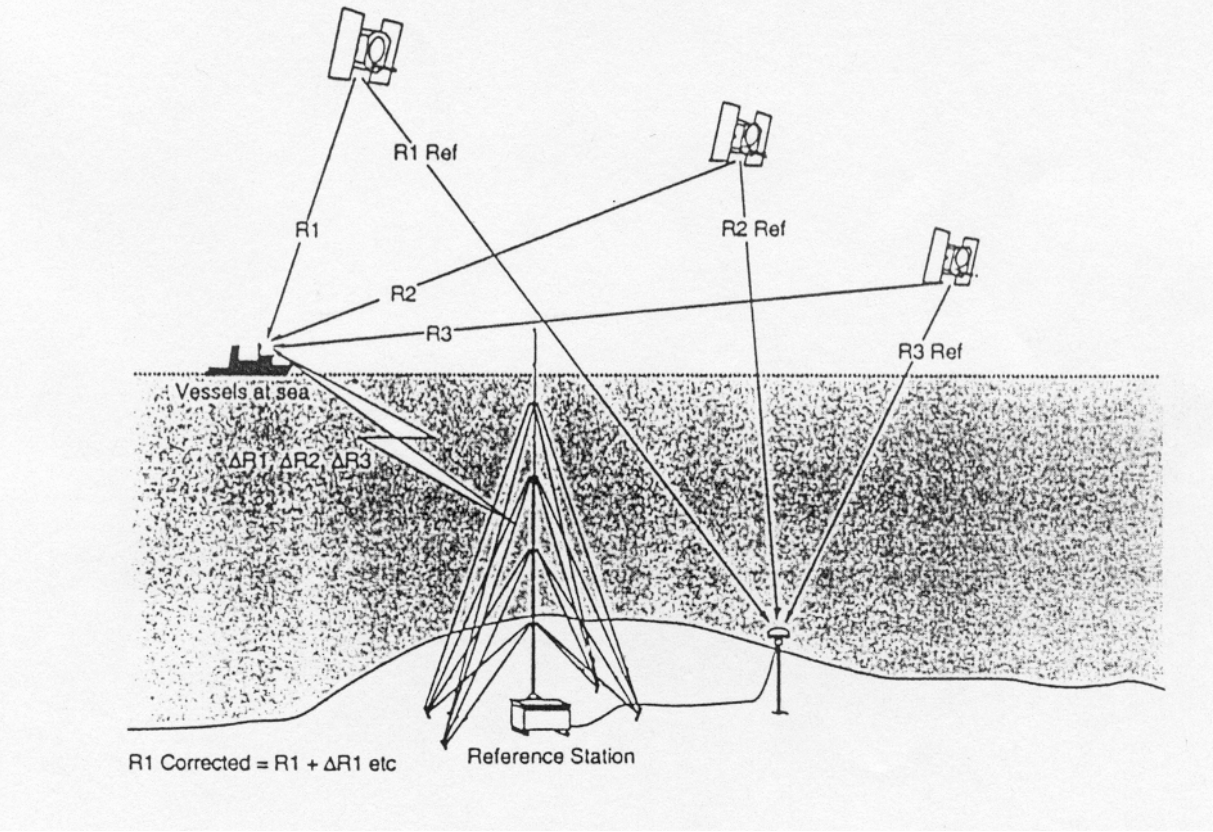


Figure 1.2 Differential GPS Concept

At the reference station the 1.575GHz (L1) satellite signals are detected by a GPS antenna and are fed to a GPS *reference* receiver. This in turn generates the differential corrections which are output as RS232 serial data to the MF transmitter.

The DeltaFix LR Receiver will receive and pass the corrections to a GPS receiver which applies them to its calculated pseudo-ranges to obtain a corrected position

3 Equipment Description

3.1 General

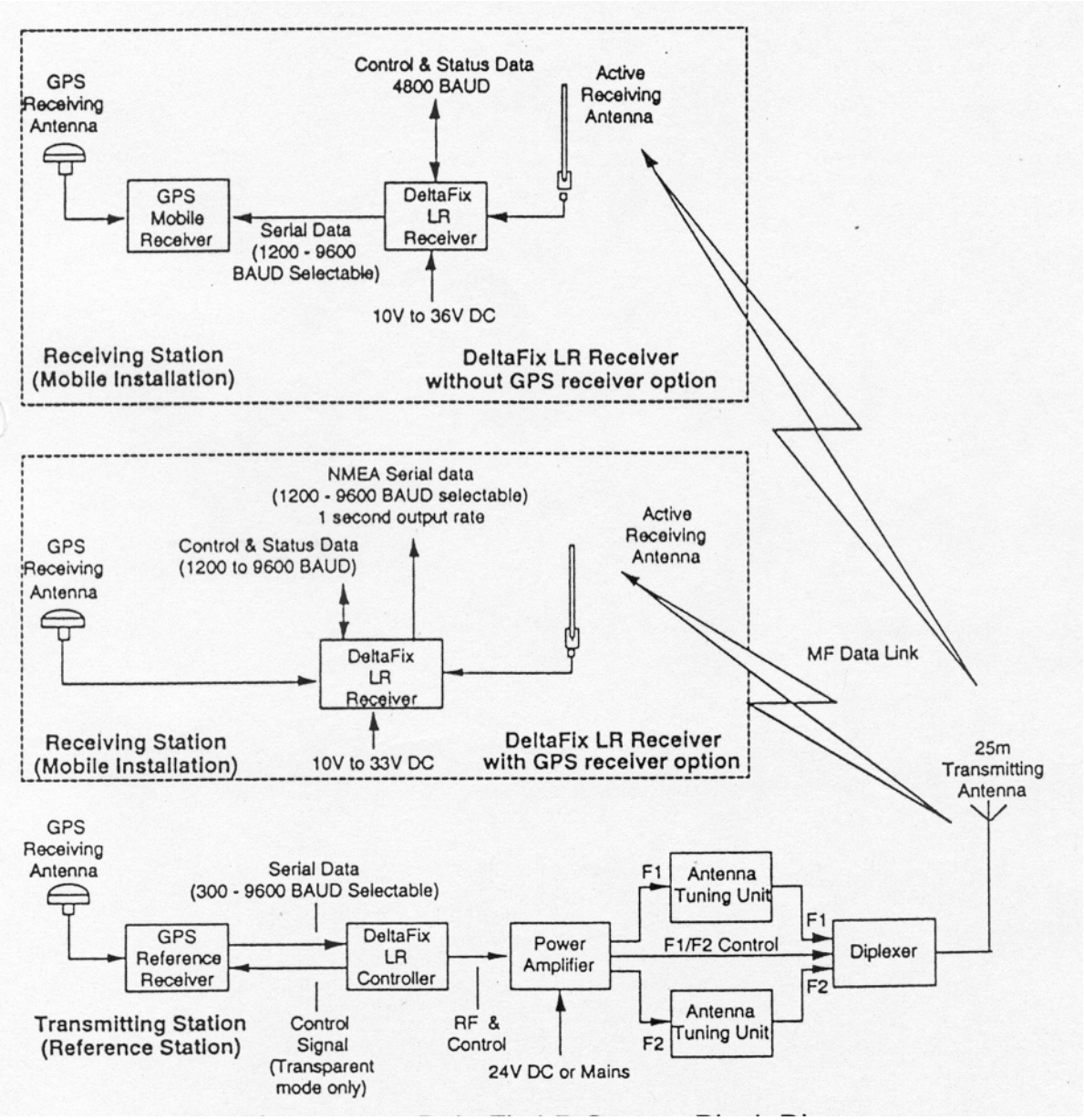


Figure 1.3 DeltaFix LR System Block Diagram

Note - The DeltaFix LR System will operate with appropriate GPS receiving equipment supplied by variousmanufacturers. 7heoperatorshould refer to that manufacturers instructions for operation of the GPS receivers.

The transmitting station equipment consists of two main elements; a GPS reference receiver and a MF data link transmitter. The MF transmitter equipment currently in use comprises a DeltaFix LR controller, a power amplifier (PA), two antenna tuning units (ATU's), a diplexer, a 25m-high guy-supported transmitting antenna and a 30m-radius 40- radial earth mat.

Note - For single frequency operation only one antenna tuning unit is required and the diplexer is omitted.

The mobile equipment consists of a GPS receiver and a MF receiver together with associated antenna. The GPS receiver can be an external (user-supplied) unit or an integral unit within the DeltaFix LR receiver. The integral device is a 12-channet CIA code (L1) receiver and is available in 4m or 1 m 95% accuracy versions.

The differential correction messages are transmitted consecutively on two spot frequencies by the MF transmitter.

The GPS mobile receiver processes GPS data and the differential corrections received from the reference station and automatically provides true 3-dimensional station coordinates (latitude, longitude, height) and velocity measurements.

Serial I/O lines allow the MF receiver to be set up and monitored and to provide either correction data (for installations with an external GPS receiver) or NMEA messages and 1 second timing pulses (units fitted with the GPS receiver card option).

3.2 Receiver Type 90710 Technical Sumrnary

Models

90710/3/1	DeltaFix LR receiver
90710/3/2	DeltaFix LR receiver with integral 4m GPS receiver.
90710/3/4	DeltaFix LR receiver with integral 1 m GPS receiver.

Dimensions and Weight

(Models 90710/3/1 and 90710/3/2)

Height	: 75 mm (including feet)
Width	: 150 mm
Depth	: 210 mm (excluding cables)
Weight	: 2.0 kg max.

(Model 90710/3/4)

Height	: 75 mm (including feet)
Width	: 150 mm
Depth	: 305mm (excluding cables)
Weight	: 2.8 kg max.

Power Requirements

Input Supply	10V to 36V d.c. (10V to 33V for units with integral GPS receiver)
Consumption	90710/3/1 : 8W (including antenna)
	90710/3/2 : 10W (including antenna)
	90710/3/4 : 12W (including antenna)

Environmental

OperatingTemperature :		-100 to + 50°C (cased unit)
		0°C to +60°C (OEM Card)
Humidity	:	Non-Condensing

I/O Ports
Dependant on GPS option.

For units without the integral GPS receiver card

2 x RS232 serial ports (STATUS/CONTROL and DATA).

STATUS/CONTROL Port:		Format 8-NONE-1 9 way D-type female connector.
Baud Rate set to 4800 Baud.		
DATA	:	Format 8-NONE-1 9 way D-type male connector. Baud rate selectable 1200 - 9600 baud.

For units with the integral GPS receiver card.

3 or 4 RS232 serial ports on one 9 way D-type male connector.

Format 8-NONE-1.
Baud rate selectable 1200 - 9600 baud.

MF Antenna
Broadband active monopole powered from Receiver. Supplied complete with 1.5m mounting tube, 4m earth cable and RF cable (length specified by user).

GPS Receiver Card 12-channel CIA code.

Model No.	*95% accuracy*
90710/3/2	4m
90710/3/4	1 m

4 Performance of the System

4.1 Update Time and Latency

The performance of the DeltaFix LR system is dependant upon the size of the data messages, the transfer mode chosen and the link data rate setting. The performance can be indicated using two parameters:

1. Update Time — This is the average time between consecutive data messages on the serial output port of the DeltaFix LR receiver.

2. Latency — This is the time between the start of the first character of the message appearing on the serial input port of the DeltaFix LR transmitter and the end of the last character of the message appearing on the serial output port of the DeltaFix LR receiver or being passed to the integral GPS receiver.

Note - The latency figures do not include any latency within the GPS receiver. Some receivers may add 2-3 seconds of latency due to internal computations. This should be considered for mobile installations with user-supplied GPS receivers.

The latency varies between a minimum and maximum value according to the synchronisation between the messages output from the GPS reference receiver and the DeltaFix LR transmission cycle. On average a latency midway between the minimum and maximum values is experienced.

	RTCM MODE 12 SV Message			TRANSPARENT MODE 640 bit Message		
		Latency			Latency	
Bits/s setting	Update (s)	Min (s)	Max (s)	Update (s)	Min (s)	Max (s)
51	8.4	8.6	8.8	12.6	12.7	18.2
104	4.0	4.1	4.3	6.1	7.8	12.9
152	2.7	2.9	3.1	4.2	5.4	8.9
199	2.0	2.2	2.4	3.2	4.0	6.6

Table 1.1 DeltaFix LR Update and Latency Times

4.2 Operating Range

The operating range of a DeltaFix LR system is dependant upon a number of parameters.

1. The efficiency of the radiating mast at the transmitter.
2. The propagation path.
3. The local noise level at the receiver.

A 25m mast with a good earth mat is advised for long range operation. The number of and size of the earth mat radials is to some extent dictated by the soil conditions. Poor soil requires as many radials as is possible. Shorter masts may be used for shorter range operation of the system.

The DeltaFix signals propagate via two modes. Short range and daytime paths use a groundwave signal which is most affected by the terrain between the transmitter and receiver. A sea path is the best and allows maximum operating range. A poor land path may significantly restrict daytime ranges. Long range night time paths rely on skywave propagation which is very frequency and solar activity dependent.

The quality of the receiver installation can have significant effects on range. Sources of local noise should be suppressed or reduced by careful antenna siting. The receiver typically requires signal-to-noise ratios in excess of those shown in Table 1.2 for reliable operation. Impulse noise may well have a more damaging effect than normal noise because the RTCM format requires that a complete error free message be received in order to use any part of the message. The iagnostic monitor display may underestimate the level of impulse noise.

Bits/s Setting	SNR
51	> 10dB
104	> 15dB
152	>21dB
199	>27dB

Table 1.2 Operating SNR

The Deltafix LR receiver should synchronise to the transmitter signals at SNR less than 10dB.

Chapter 2

Installation

1 Receiver Connections

The rear panel layout will depend on the integral G PS receiver option. Units without the GPS receiver have two serial data ports. Units fitted with the GPS receiver have a single data port and a GPS antenna connector

1.1 Receiver without GPS Option

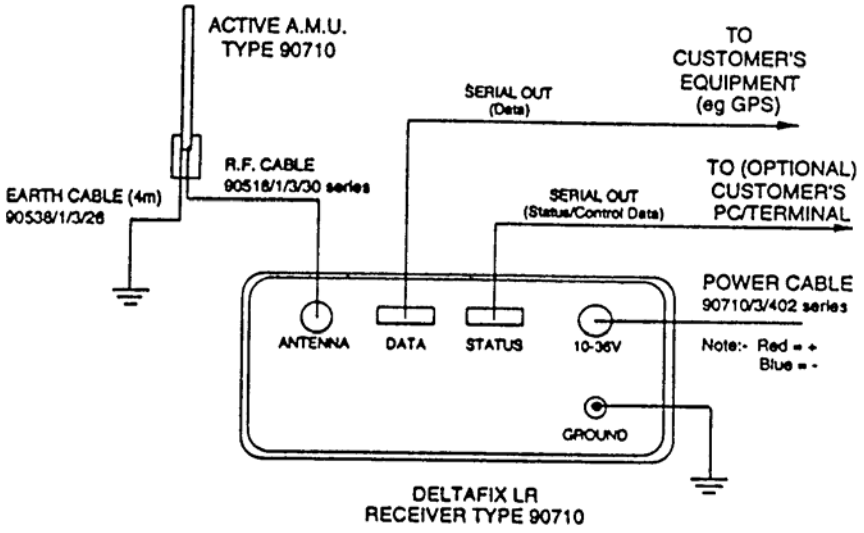


Figure 2.1 Receiving Station Equipment Interconnections (external GPS receiver option)

The following connectors are located on the rear panel:

10-36V	:	DC Power In (10-36V). Accepts cable 90710/3/402 series.
ANTENNA	:	Accepts RF cable 90518/3/30 series.
GROUND	:	Screw (M4).
STATUS	:	9 way D-type (female) connector.
DATA	:	9 way D-type (male) connector.

Pin No.	Function	Remarks
1	-	-
2	Tx Data (Out)	Monitor Data
3	Rx Data (In)	Control Data
4	-	-
5	Ground	-
6	-	-
7	-	-
8	-	-
9	-	-

Table 2.1 Status Connector

Pin No.	Function	Remarks
1	-	-
2	Tx Data (Out)	DATA output from receiver
3	Rx Data (In)	-
4	-	-
5	Ground	-
6	-	-
7	-	-
8	-	-
9	-	-

Table 2.2 Data Connector

Monitor data (Status port) is output every cycle (determined by Link Rate and no. of SVs - see Table 1.1) at 4800 Baud.

1.2 Receiver with GPS Option

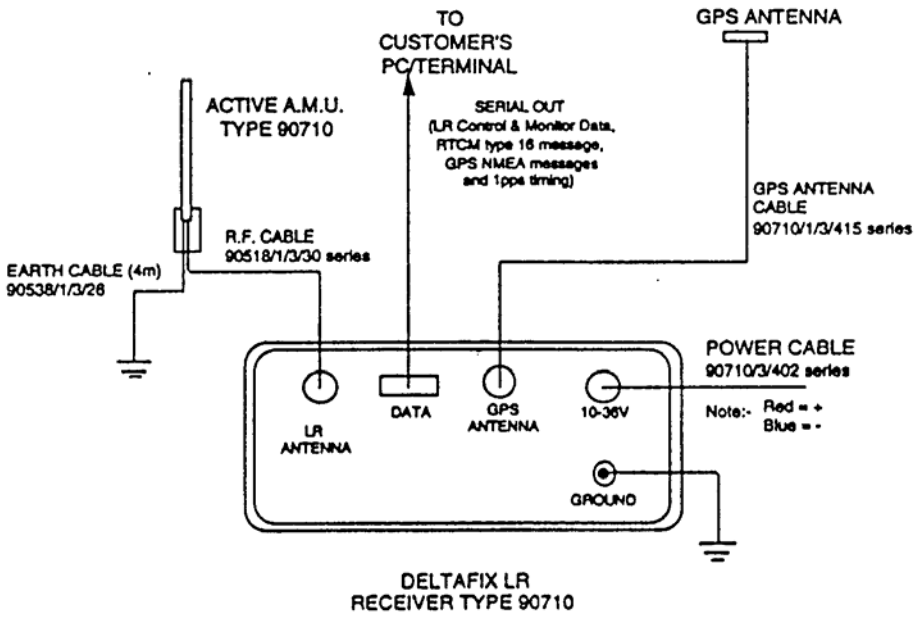


Figure 2.2 Receiving Station Equipment Interconnections (integral GPS receiver option)

The following connectors are located on the rear panel:

10-33v	:	DC Power In (10-33V). Accepts cable 90710/3/402 series.
LR ANTENNA	:	Accepts RF cable 90518/3/30 series.
GROUND	:	Screw (M4).
DATA	:	9 way D-type (male) connector.
GPS ANTENNA	:	TNC connector.

WARNING *- The TNC connector centre pin carries +5V supply for the GPS antenna. Shorting this supply to ground will damage the GPS receiver.*

Pin No.	Function	Remarks
1	LR Monitor Data Out	Status of LR links or Type 16
2	GPS NMEA Message Out (TxD)	-
3	LR Control Data In (RxD)	-
4	GPS Rx I/P Port 2	90710/3/4 only
5	Ground	-

6	LR RTCM Data Out (TxD)	-
7	GPS Rx O/P Port 2	90710/3/4 only
8	GPS 1pps Out	See below
9	Ground	90710/3/4 only

Baud rate selectable (1200-9600 baud).
NMEA rate fixed at 1 second (see also Appendix 1). LR monitor data is output every cycle (determined by Link Rate and no. of SVs - see Table 1.1)

The 1pps Out signal is synchronized with GPS time and has a 1 second period. The precision of of the 1 PPS signal is within 1µs and a position needs to be computed for this precision to be valid.
The PPS signal is a TTL signal into a 75 ohm impedence.
The signal is normally low and goes high 1 to 2 ms before the failing edge. The rising time is synchronised with GPS time.

1.2 Antenna Cabling

The receiver antenna is supplied with:

1.5m tube (O/D 25.4mm) for mounting
4m earth cable (90538/3/26)
Pair of cable supports for antenna cable cleating
Antenna Cable. Length specified by the user from:

2m	Cable 90518/1/3	/30
10m		/31
15m		/32
25m		/33
30m		/34
50m		/35
40m		/36
150m		/38
100m		/39

GPS antenna cable is supplied according to installation. A 1 Om cable (9071013141 SA) is available for short runs. This cable is terminated with TNC connectors.

Longer cable runs are possible using cable 90720131213 (1213A - 20m, 1213B - 30m). This cable will require N-TNC adaptors. Cable runs longer than 30m require an in-line amplifier to be used.

If cables are locally manufactured ensure that there is no continuity between the braid and centre core before connecting to the receiver. Heed the warning given below Figure 2.2.

2 Siting of Equipment

The active MF receiving antenna type 90710 should be mounted on the vessel's main mast such that all of the receiving element is above the top of the mast. In practice this is not always possible and will depend on the physical construction of individual vessels. However, the following points should be borne in mind.

1. If the antenna is mounted such that any portion of the receiving element is below the top of the mast then a minimum separation distance of 1 m from the mast must be maintained.
2. If the antenna is mounted closer than 1 m from the mast then all of the receiving element should be above the top of the mast.

The antenna should also be sited such that a general separation distance of 1 m from any sources of electrical interference is maintained. For optimum performance it is essential that the antenna is connected to a good earth point. The cheese-head screw adjacent to the antenna RF connector provides an earth connection point. Use cable 905381113126 (4m) (or 37/0.4mm sheathed)

The antenna clamp will allow fixing to horizontal or vertical structures. The antenna is supplied with a 1.5m mounting pole (OID 25.4mm) which may be used to achieve the requirements described above.

The GPS antenna should be mounted to give a clear 360 ° view of the sky down to the horizon. It should therefore be mounted above the vessel's superstructure and be sited away from any source of interference such as radar transmitters. GPS performance can suffer from the effects caused by multipaths so ensure that there are no objects/structures around the antenna which could cause signal reflections.

The DeltaFix LR receiver can be sited at any location convenient to the user as long as it is sited away from any source of Interference such as radar transmitters. It is essential that the DeltaFix receiver is connected to a good earth point. A ground screw is provided on the receiver rear panel.

Chapter 3

Setting Up Procedure

1 Introduction

Once the system equipment has been installed and set up as described in Chapter 2, the system should be set up according to the procedures given in this chapter. Any setting up procedures required for the customers GPS equipment should be carried out according to the manufacturers instructions. It should be set up for the same serial baud rate as the DeltaFix LR and the same serial data format i.e. 8-NONE-1.

The DeltaFix LR system can be operated in either of two modes (be set to the same mode as the transmitter. referred to as LINK TYPES), i.e. Transparent mode or RTCM104 mode. The receiver MUST be set up the same as the transmitter.

Transparent Mode
This mode allows direct transmission of data in any format. It may be used when a proprietary non-RTCM format is used or to transfer general purpose data.

Note that <null> characters cannot be transmitted in this mode.

RTCM104 Mode (RTCM SC-104 Version 2.0)
In this mode the RTCM message is compressed at the transmitter end of the link (by removing redundant bits of the message), and is reconstituted to the full RTCM format at the receiver end of the link. Error detecting codes added by DeltaFix LR ensure message integrity. Data compression reduces the data throughput time thus improving message latency.

***Note** - Receiver firmware releases E and Fare only compatible with transmitter firware releases D or E. Receiver firmware A, 9, C and D are not compatible with transmitter firmware releases D and E. Receiver firmware release G is compatible with all transmitter firmware releases*

Scramble Facility
This facility allows the data-bits of any message to be scrambled (encoded) at the transmitter end of the link, and unscrambled (decoded) at the receiver end of the link. Operators of the DeltaFix LR transmitter may therefore restrict the use of that transmitter to approved receivers who know the scramble code. Encoding and decoding are effected by means of a scrambler key generated from a 4- character Scramble Code entered by the operator. For obvious reasons, the same Scramble Code must be entered at the reference station controller and any mobile receiver using the link

Link Rate Setting
The DeltaFix LR link can be operated at one of 4 link settings (51, 104, 152 or 199 bits/second).The rate will have been chosen to suit the desired operational requirements. The receiver MUST be set to the same rate setting as that selected for the transmitter.

2 Switching On the Receiver

Note - Before switching on the Receiver ensure that the power cable connections are correct (ie. Red to DC+ and Blue to DC-). If the supply is wrongly connected, disconnect the power lead and allow the thermal fuses to cool and reset (approximately 20 seconds)

Press the ENTER ← key.

On power up the receiver will commence operation using the last set of operating parameters.

A receiver may be configured to require a Smart Card to be inserted before it will operate (refer to Section 5).

3 Setting Up the Receiver

3.1 Introduction

The Receiver can be set up by one of the following methods:

1. Using the front panel display and keypad. This will allow the LR receiver and GPS receiver (if option fitted) to be set up.
2. Using the serial port. Only the LR receiver can be set up b this method.
3. Using a Smart Card with pre-stored data. 'This will allow the LR receiver and GPS receiver (if option fitted) to be set up.

Note - The set up procedures given In this section assume that the user can view/change the operating parameters as required. However, the receiver may be configured to prevent or restrict access to this data

3.2 Setting Up Operating Parameters

3.2.1 Using the Front Panel Controls

A layout of the receiver front control panel is shown below in Figure 3.1

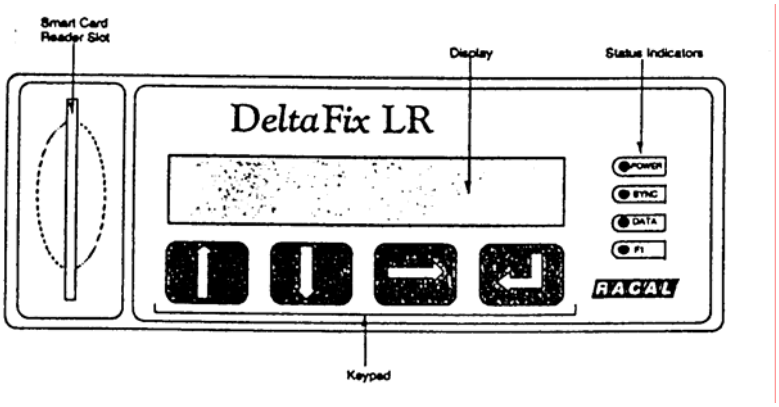


Figure 3.1 Deltafix LR Receiver Front Panel Layout

LED Indicators

The LED indicators provide status of the following system conditions:

Indicator	Colour	State	Conditions
POWER	Red	On	DeltaFix LR Receiver is powered up
SYNC	Green	On	FS1 or FS2 (Found Sync)
		Flashing	LS1 or LS2 (Lost Sync)
		Off	NS1 or NS2 (No Sync)
F1	Yellow	On	Receiving Fl
		Off	Receiving F2
DATA	Green	Steady On	Valid data being received
		Flashing	Valid data being received some of the time.
		Off	Interference, noise or weak signal present on either Fl or/and F2. Rigorous cheeks being applied to data. (Transparent mode: data may have errors, RTCM mode: data throughput will depend on the ability to re-constitute a good data set from the available Fl/F2 data and checksum information).

Display

This is a 2 line by 16 character LCD Module.

Keypad

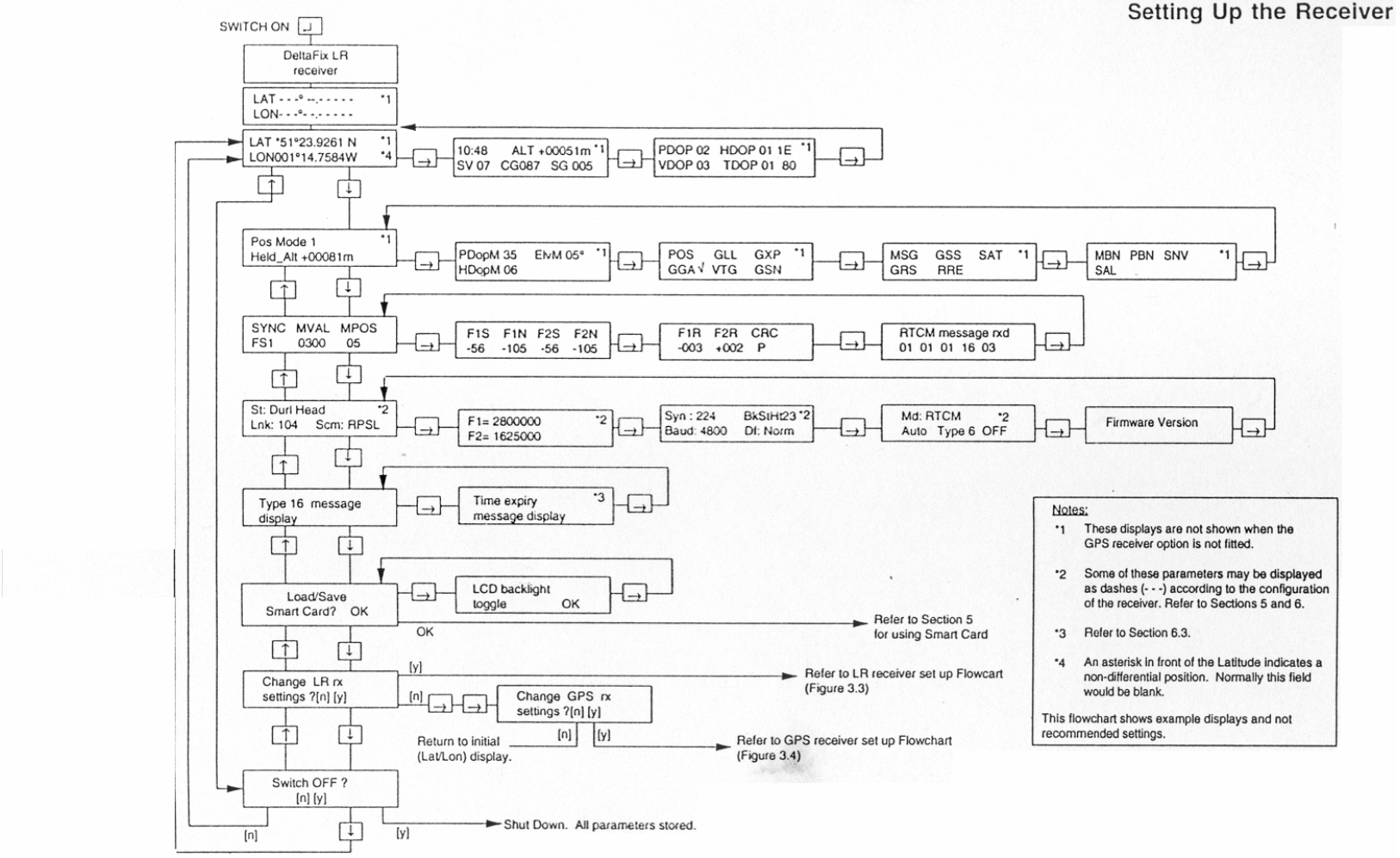
Comprises 4 keys: UP, DOWN, RIGHT SHIFT, ENTER.

UP/DOWN	These keys perform toggle functions. Initially they will allow the operator to step through the main display pages. Thereafter, they will toggle through the available data options.
RIGHT SHIFT	Initially, this key will allow operator to select pages associated with the main display pages. Also shifts the highlight cursor right. Other uses include set up of multiple field parameters such as frequency.
ENTER	Used to switch on the Receiver. Thereafter it is the Enter (or Accept) key

Display Selection

At switch on the receiver will normally recall and use the stored operating parameters. The receiver will show 'DeltaFix LR Receiver' whilst loading the stored parameters. When completed, the display will show dashes (---) for the Lat Long position if the receiver has not acquired the position (GPS option fitted) or the LR monitor data (GPS option not fitted) until the datalink is synchronised and established. The display flowchart (Figure 3.2) details the pages available for a unit fitted with the integral GPS receiver card. For units with firmware version C and above but without this option, the firmware will suppress the the pages associated with the GPS section.

Figure 3.2 Display Flowchart



Pressing the ↓ key will step through successive display pages to monitor current parameters in use and see the status of the unit in operation. The T key will step back through the displays; it will also allow the operator to go directly from the initial display to the Switch Off option.

The main displays have pages which can be accessed in turn by using the → key. These pages are usually associated with the main display, for example the LR receiver monitor data is contained in pages off the main display (SYNC, MVAL, MPOS). When in these pages, pressing the ↑ or ↓ keys will return you to the preceding or following main display.

On displays with a No-Yes option, the cursor will initially be on 'No'. Pressing ← will select this option otherwise use the
key to highlight 'Yes' and then press ← .

3.2. Using the Serial Port

A PC (or ASCII terminal) is connected to the serial data port (refer to Chapter 2). This port will allow the PC to display the current operating parameters of the LR receiver for confirmation / changing and also monitor data during on-line operation. It is not possible to set up and monitor the GPS receiver section by this method. The PC should be set as a terminal (e.g. running PROCOMM) a format of 8-NONE-1 and a baud rate set to match that of the receiver

At switch on, the receiver will recall and use the operating parameters stored internally. These will also be output to the PC (together with the unit firmware version) which should give a display similar to the following:

DeltaFix LR 90710/13/300G (Receiver / Firmware Version)
Durl Head (Transmitter Name)

F1 = 2800000 Hz F2 = 1625000 Hz
Link Rate = 104
Baud Rate = 4800
Synch Time = 224
Scramble Code = RPSL
Backup transmitter number = 2
Backup Switch Setting = 3
Monitor Port Format = Norm

(Parameters recalled and in use by receiver)
The parameter block may not be output according to the receiver configuration.

Check that these parameters are correct particularly those in use by the transmitting station. The Receiver will then output monitor data the format of which will depend on that previously selected.

Receiver operating parameters can be changed in two ways

1. By sending a command message containing all parameters needed to set up the receiver.
2. By the operator making up entries in reponse to information and prompts displayed on the PC. This is referred to as ‘Verbose Mode’

A set up command will cause the receiver to halt normal operation and enter into a set up phase. Normal operation is resumed on completion of the particular set up method. The display will show 'Serial Set up in progress!!' when using the Verbose Mode.

Use of these setting modes may be restricted by the receiver configuration.

2. Verbose mode

Type SET [ENTER]

Note SET must be uppercase.

The receiver will now be in a set up mode and normal operation is halted until completion of this routine

Operating parameters will be displayed in turn for viewing / changing. Pressing [ENTER] will step through the displayed data if it Is required to change only certain parameters whilst retaining all others.

Each current parameter is displayed together with brief instructions for making entries. Parameters are shown in the following order

STATION NAME

Name of transmitting station. Up to 12 characters allowed which Include 0-9, A-Z, a-z and <SPACE>. If an error is made press the SPACE bar until an underscore character is shown. The field is now clear to take 12 characters.

F1

The current value of Fl is displayed. If you wish to alter the value of Fl type in the required frequency. The new entry must be exactly 7 digits long. After the seventh digit has been entered a space is automatically inserted to complete the entry. However, the Fl frequency is not accepted until ENTER or RETURN is pressed so if a mistake is made in entering the digits, simply press DELETE and re-enter the frequency. If single frequency operation is required using F2, enter 'N' to switch Fl off. Note that if a non-valid
character is pressed in error, whilst entering the frequency, a question mark is displayed to signify that It is an
unacceptable entry and will therefore be ignored by the system. Fl must be appreciably greater than F2 and less than 3.41 MHz. If a value Is entered outside this range a message will Inform the operator of the fact and ask for the frequency to be entered again

F2

F2 is entered in exactly the same way as Fl. F2 must be appreciably less than Fl and greater than 1.59MHz. If single frequency operation is required using Fl, enter'N'to switch F2 off.

LINK RATE

On each press of the space bar the Link Rate (in bits per second) is toggled between 104, 152, 1 99 and 51. This is the rate at which data is transmitted over the data link. Each Link Rate setting can be directly selected by entering a number from 1 to 4, where 1 selects 51, 2 selects 104, 3 selects 152, 4 selects 199. Select the required rate then press [ENTER].

SERIAL LINE BAUD RATE

On each press of the space bar the Serial Line Baud Rate is toggled between 1200, 2400, 4800 and 9600. Each Serial Line Baud Rate setting can be selected directly by entering a number from 3 to 6, where 3 selects 1200, 4 selects 2400, 5 selects 4800 and 6 selects 9600.Select the required rate then press [ENTER].

SYNC SEARCH TIME

On each press of the space bar the Sync Search Time is toggled between 7, 14, 28, 56, 11.2, 224, 448. This is approximately the time period in seconds over which the receiver searches for the trigger signal in order to synchronize the received data with the transmitted data. Each Sync Search Time setting can be selected directly by entering a number from 1 to 7, where 1 selects 7, 2 selects 14, 3 selects 28, 4 selects 56, 5 selects 112, 6 selects 224 and 7 selects 448. It is suggested that a setting of 224 is used for normal operation. Note that a 7 should NOT be used in field conditions. Select the required setting then press [ENTER].

If the timing of the transmitter changes drastically (for example, it is switched off and on) the receiver will indicate lost sync for 2 of these periods before reverting to a search for the sync signal

LINK TYPE

Each press of the space bar will toggle the Link Type between Transparent and RTCM104; these being the two modes of operation available (refer to Section 1). Select the Link Type required and then press [ENTER].

AUTO 6

Some GPS receivers delay acting on a received RTCM message until the header of the next message is received. This introduces unnecessary delays and degrades message latency. To force such a receiver into acting sooner on the message received, an RTCM Type 6 message (a short NULL FRAME message) can be appended to every message passed to the GPS receiver. On receipt of the Type 6 message the GPS receiver will act on the previous message thus reducing the delays. The duration of the Type 6 message is extremely short in relation to other messages and contains no relevant data. The facility offered here allows a Type 6 message to be generated within the DeltaFix LR receiver and added automatically to all received messages passed to the GPS receiver. For units fitted with the GPS option this function can be set to OFF. Toggle the facility ON or OFF and then press [ENTER].

SCRAMBLE CODE

This relates to the data scramble facility (refer to Section 1). The last selected Scramble Code (or the default code) is displayed at the end of the caption. If this is the required code press [ENTER] to accept. To alter the code type in a new 4-character code. All printable ASCII characters are allowed. A space is automatically inserted after the fourth character is entered. Use the <DELETE> key to restart the code sequence if errors are made. When satisfied with the entered code press [ENTER] to accept.

3.3 Diagnostic Display

This information is continually available during on-line operation and is output from the status serial port unless the Type 16 output is selected.

When firmware release 'F' or 'G' is fitted, the receiver also outputs the compressed message format inside an RTCM Type 43 message which is inserted into the RTCM message output. This option is disabled if the Normal Monitor format is selected. This option may also be permanently

disabled .under Configuration Options (Section 6), if the mobile GPS receiver cannot accept undefined RTCM messages on its input.

SYNC. The indications NS (No Sync), FS (Found Sync) and LS (Lost Sync) relate to the current state of synchronisation, and the 1 or 2 indicate to which frequency (Fl or F2) sync signal the system is currently synchronised. Synchronisation to one frequency automatically infers that the second frequency is synchronised.

NS is the state where no sync signal has been found for at least 2 sync periods. Data cannot be decoded under this condition. The receiver will be in this state when first switched on until the sync signal has been located and synchronised.

FS is the normal operating state where the sync signal has been found by the receiver.

The receiver displays the LS state during the period when the sync signal cannot be found on either Fl or F2. The receiver is able to decode data during this period but the data is usually affected by the same interference or lack of signal which has caused the sync to be lost. The receiver will revert to NS state after 1 sync periods in this state.

Fl S and Fl N give the Fl signal and noise levels respectively in dBm. F2S and F2N give the F2 signal and noise levels respectively. Levels will be shown as 'High' or 'Low' if limits of -45dBm and -118dBm are exceeded.

MVAL is a measure of the quality of the sync signal. For a valid sync the value should be less than 1400. The value will normally be considerably less than 1400, i.e. less than half this value.

MPOS is a measure of the timing of the sync. The position of the received sync in time is compared with its expected position. When it is exactly in step it will be 05. If it is slightly out of step, i.e. in the range 03 to 07, the synchronisation is adjusted accordingly. Any value outside this range indicates that the trigger is invalid.

Fl R and F2R (the Fl and F2 rate term values respectively) are a measure of the difference between the oscillator at the DeltaFix reference station controller and the oscillator at the DeltaFix mobile receiver. The DeltaFix receiver makes automatic correction for any difference and will tolerate rate term values of up to ± 100. If the rate term is near ± 100 the source of the frequency error (transmitter or receiver) should be determined and an appropriate adjustment made to the oscillator.

CRC indicates the result of the Error Check applied to RTCM messages. The result is indicated by the letters N**,** P, F, T or M as follows:

N - Not detecting any reception of RTCM messages.

P – RTCM messaged received satisfactorily.
F – RTCM message received with errors.
T – Operating in Transparent mode.
M – Receiver is now generating RTCM messages.

Note – When M is observed in the CRC status, the type of message being output can be seen on the 'RTCM message rxd' monitor display. The display shows the types of the last 5 RTCM messages.

The diagnostic display repeats every cycle (approximately 3.5 seconds). A valid sync time will not be found until the Sync Search Time has elaped plus one extra cycle for synchronisation. The diagnostic line should then change to one similar to the example below (assuming that 'Normal' format is selected.

SYNC	F1S	F1N	F2S	F2N	MVAL	MPOS	F1R	F2R	CRC
FS1	-56	-105	-56	-105	0300	05	-003	+002	M

3.4 Getting the Station to Work

Assuming that the transmitter is working, the 'NS1' or 'NS2' shown in the diagnostic display in Section 3.2 should change to 'FS1' or 'FS2' after a few minutes. For example, if the Sync Search Time has been set to 22 then at least 224 seconds must elapse between the initial display of 'NS1' or 'NS2' and the subsequent display of 'FS1' or 'FS2'. If only one frequency is being received well, several periods of 224 seconds may elapse. If the range is not too great it may be worthwhile reducing the 224 seconds setting to 56 or even 14 and trying again.

Even if the receiver has lost sync or indeed if it has never found it, something may be learnt from the signal/noise levels. When 'NS1' or 'NS2' is displayed one or more of the level indicators should be reading the signal level. It may be assumed that the highest of the four (or two) values will be that of the signal. A quick and crude check on the antenna may be made by unplugging the RF input lead and seeing a drop in the displayed levels. A maximum reading of less than -100 indicates one of the following problems: an incorrect frequency setup, a failed transmitter or too great a range (assuming general receiver and antenna hardware is good).

After the first Sync Search Time has elapsed, the MVAL will change. In order to find the synchronisation signal it must be less than 1400.

By the time the datalink is established, the GPS receiver should have locked to the satellites in view and be giving a GPS position. An asterisk (*) prefixing the Latitude denotes a non-

differential operation. This will be present at start up as the GPS receiver has to establish non-differential operation before accepting corrections. Altering any of the LR receiver parameters will trigger the * during the subsequent re-lock period. Any other appearance of the * denotes a link problem which should be investigated.

4 Switching Off the Receiver

To switch off the Receiver, select the ‘Switch OFF?’ display. Use the RIGHT SHIFT key to position the cursor to [Y] and press ENTER.

The receiver will now power down.

Chapter 5

Trouble Shooting

1 General Information

Racal's DeltaFix LR equipment is designed and manufactured to exacting standards and, once installed and operated correctly, should provide prolonged trouble-free service. Any degradation in the performance of the reference station will be detected at an early stage by the system's monitoring station (if deployed), or will be signalled by persistent difficulties experienced at mobile receiving installations.

The information contained in this short chapter on trouble shooting is restricted to such testing that can be undertaken in the field.

There are no user-adjustable controls or user-serviceable items within the LR receiver. Units should be returned to the manufacturer for repair. To expedite repairs, the following information should be included with the returned unit:

Detailed fault description and operating conditions. Contact name with telephone/fax numbers.

2 The Reference Station

2.1 Antenna and Earth Connections

As with any transmitting and receiving equipment the importance of correct installation, in particular the integrity of the antenna and earthing arrangements, cannot be overstressed. So often the equipment can be functioning perfectly well but system performance is degraded because of poor earthing and antenna connections. These connections should be checked as a matter of course when dealing with any apparent faults, especially those connected with poor signal and noise levels.

2 The Mobile Installation

2.1 Antenna and Earth Connections

As with the reference station the integrity of the antenna and earth connections are of utmost importance, especially the connection at the active AMU's earth stud. Bad connections in these areas can give rise to faults associated with poor signal and noise levels.

2.2 Equipment Installation

Details of equipment installation are given in the earlier chapters of the manual. Check that all aspects of the installation (siting, cabling etc.) are correct

2.3 Deltafix Receiver Set-Up

If using a PC or ASCI I terminal to set up the LR receiver, ensure that parameters have been downloaded correctly. This can be achieved by type SET <ENTER> and then stepping through the set up pages to cheek the current parameters. Ensure that the PC is set to the correct baud rate and a format of 8 bits, no parity and 1 stop bit. Check that pin connections are correct (refer to Chapter 2).

2.4 Fault Finding Assistance

The mobile receiver end of the DeltaFix data link is a simple installation. Most reported faults can be overcome by changing either of the basic units. A distinct advantage at the mobile installation is access to the diagnostics display which is presented on the receiver front panel or users PC immediately after all input parameters have been accepted. This display gives a good indication of how the system is performing.

Parameter	Typical Readings
SYNC	FS1 or FS2 during normal operation.
F1S	The system will operate with sig/noise ration as low as 10dB.
F1N	-100dBm or lower (by day), 10 to 15 dB higher at night.
F2S	The system will oprate with sig/noise ration as low as 10dB.
F2N	-100dBm or lower (by day), 10 to 15 dB higher at night.
MVAL	Considerably less than 1400. Usually less than 700.
MPOS	In range 0003 to 0007 inclusive. Usually 0005
F1R	Between + and – 10 (system will tolerate readings of + or – 100)
F2R	Between + and – 10 (system will tolerate readings of + or – 100)
CRC (RTCM mode only)	Predominantly the letter M during good reception. The occasional letter P will be seen every 30 seconds (approximately)

Table 5.1 Typical Diagnostic Settings

DELTAFIX SETUP

WARNING !! - ENTERING SETUP STOPS RECEIVER FROM RECEIVING DATA

1) ENTER 'Change Settings'
2) SETUP is as follows:

F1 = (see table below)
F2 = (see table below)
LINK RATE = 104
BAUD RATE = 9600
SYNC TIME = 224
LINK MODE = RTCM104SC V2

AUTO TYPE 6 = OFF
SCRAMBLE CODE = (see below)
PORT FORMAT = NORMAL

3) When SETUP is complete the receiver will automatically reset. To check the setting simply toggle through the display. The receiver will take at least 5 to 10 mins before it aquires the signal.
4) Once locked on the F1S F1N F2S F2N screen should look something like:

F1S	F1N	F2S	F2N
-75	-101	-77	-105

5) Also once locked on the PWR, & SYNC LED's should be permanently on.
6) The DATA LED should be on almost continuously.
7) The F1 LED should FLASH on and off evenly.

Deltafix Problems

1) PWR LED OFF
a) Check PSU

2) SYNC, DATA, F1 = ALL OFF
a) Check DELTAFIX SETUP wait 5-10mins
b) If still all OFF contact RS USA

3) SYNC, DATA OFF (as previous)

4) DATA OFF (as previous)

Trimble Setup (Deltafix)

RTCM INPUTS: ON
PORT SELECT: PORT 2
FORMAT: VERSION 2
STATION SELECT: (insert stn. ID No.below)
BAUD RATE FORMAT: 9600-8-N-1
REMOTE PROTOCOL: 4000AS COMPAT.
ELEVATION MASK: 10 Degrees
PDOP MASK: 7.0
SV SYNC TIME: 1.0secs
WEIGHTED SOLUTION: ENABLED
LAT/LON OR LAT/LON/HEIGHT
(N.B. Every other option leave as default)

GILCHRIST, TX

F1 = 3231000
F2 = 1714000
SCRAMBLE CODE = GALV
STATION ID No. = 502
Lat = 029° 31' 09.31" N
Lon = 094° 28' 06.18" W

BOOTHVILLE, LA

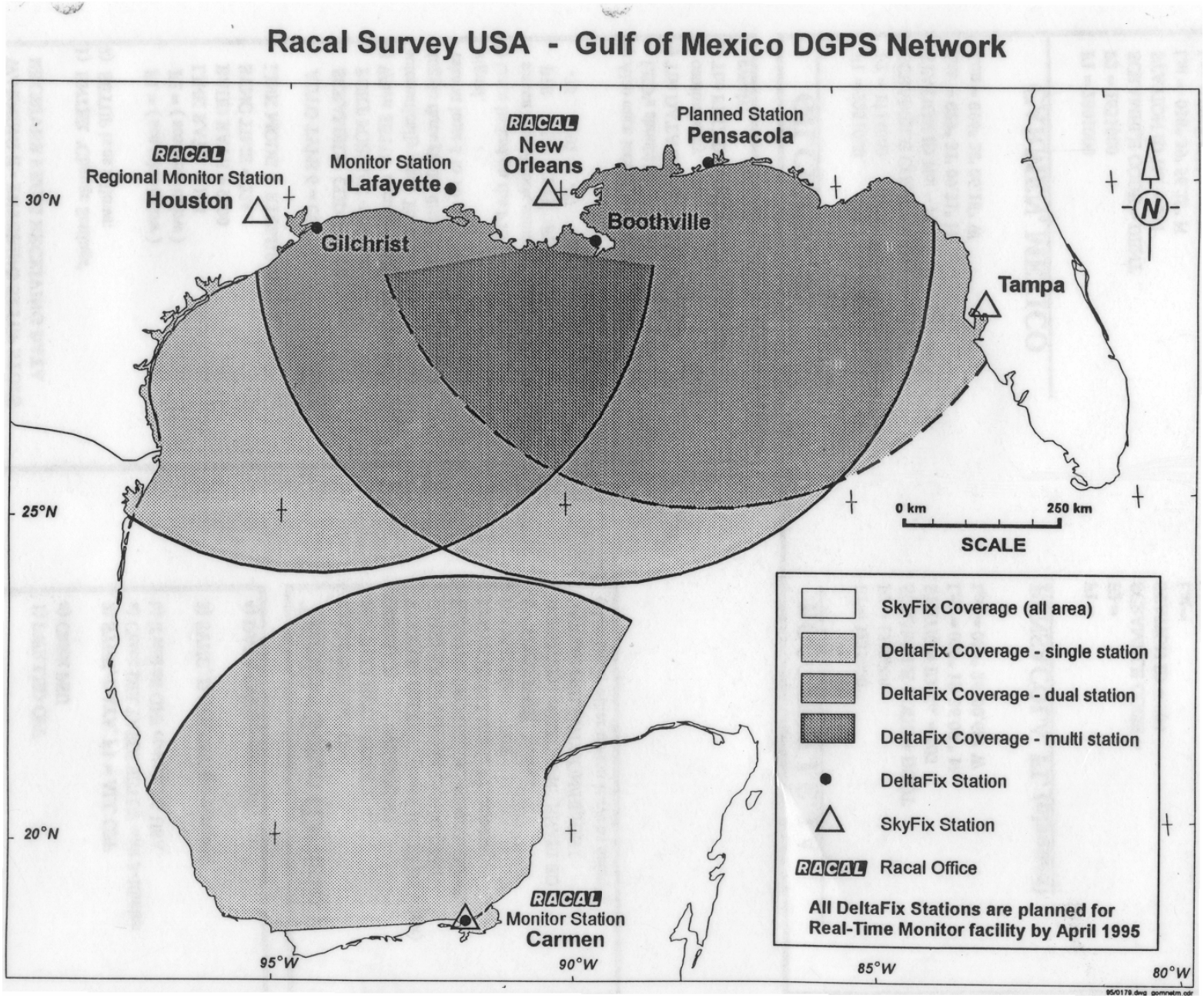
F1 = 3235000
F2 = 1718000
SCRAMBLE CODE = BOOT
STATION ID No. = 503
Lat = 029° 19' 36.08 " N
Lon = 089° 24' 00.68" W

CARMEN, MEXICO

F1 = 2801000
F2 = 1631000
SCRAMBLE CODE =
STATION ID No. = 551
Lat = 018° 39' 56.28" N
Lon = 091° 48' 08.92" W

PENSACOLA, FL (planned)

F1 =
F2 =
SCRAMBLE CODE =
STATION ID = 504
Lat =
Lon =


Racal Survey USA - Gulf of Mexico DGPS Network
RACAL
Regional Monitor Station
Houston
Monitor Station
Lafayette
RACAL
New
Orleans
Planned Station
Pensacola
Gilchrist
Boothville
Tampa
N
30°N
25°N
20°N
95°W
90°W
85°W
80°W
0 km
250 km
SCALE
SkyFix Coverage (all area)
DeltaFix Coverage - single station
DeltaFix Coverage - dual station
DeltaFix Coverage - multi station
DeltaFix Station
SkyFix Station
RACAL Racal Office
All DeltaFix Stations are planned for
Real-Time Monitor facility by April 1995
RACAL
Monitor Station
Carmen