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generate independent positions every second, and accept NMEA 0183 GPS input to apply additional secondary factors (ASFs) in real time, providing the highest accuracy regardless of location. Together, GPS/GNSS and Locus systems provide the most robust, reliable operations possible in all conditions. Locus' receivers operate with small H-field or e-field antennas, and the H-field can be combined with GNSS antennas within a single small radome.

Finally, Locus' receivers can demodulate Eurofix, which distributes differential GNSS corrections and integrity messages around Europe. For complete specifications or inquiries on Locus' product line, see www.locusinc.com, email sales@locusinc.com or call +1-608-270-0500.

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Reelektronika's new generation of LORADD receivers marks the start of a new era in eLoran receiver technology. Drawing from its long history of experience in the field of Loran, Reelektronika successfully implemented unprecedented digital signal processing algorithms on a newly designed, compact yet powerful DSP platform. LORADD receivers can output independent eLoran positions, enhanced by the use of ASF tables where available. However, LORADD technology can also take full advantage of an integrated or optionally externally connected GPS receiver. In this case, the GPS receiver provides additional raw measurements to the LORADD. The LORADD then combines its own eLoran measurements with the GPS measurements, and outputs a so-called 'integrated position solution', taking full advantage of the strong points of both navigation systems. Designed for high performance, the LORADD is capable of outputting independent measurements at user

selectable intervals. Choose a small interval for a high update rate; choosing a larger interval results in decreased noise on the measurements. Different intervals may be selected for different output ports. The receiver is fully customizable to output all required measurements on any of the serial ports. A Windows™ software package is supplied for easy interfacing. All commands and outputs are according to NMEA standards so that users can easily develop their own software to control the receiver.

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SI-TEX/KODEN is pleased to announce its partnership in the development program for the next generation navigation receivers capable of meeting Harbour Entrance and Approach requirements. The SI-TEX GPS-90/KODEN KGP-913 GPS receiver series have been selected to serve as the platform for a prototype GPS/WAAS/Loran receiver. The units will incorporate state of the art digital Loran receiver technology from Reelektronika b.v., a firm based in the Netherlands. The new receiver is designed to operate with a Loran "H" field antenna, carrying the same form as the present SI-TEX marine beacon antenna. These new receivers have been in evaluation testing for the USCG and FAA as part of the Loran Recapitalization Program. The Loran Recapitalization Program is a Department of Transportation and Department of Homeland Security (DOT/DHS) initiative to determine whether an enhanced Loran system can provide the accuracy, availability, continuity, and integrity to support GPS in both safety and economically critical applications.

1. Rugby (Dean Furber)
 2. Rugby (BT)
 3. Rugby (Dean Furber)
 4. Verlandet, Norway (Colin Day)
- Image of Receiver on front cover: SI-TEX/Koden



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Who can be contacted regarding the Loran-C service?

The General Lighthouse Authorities' (GLAs) Loran-C transmissions are provided on a trial basis, primarily for maritime users, in conjunction with British Telecom who operate the Rugby transmitter site. The GLAs will be evaluating Loran-C as a back up and complementary system to GNSS, especially in areas of high ship traffic and navigational importance. However it is noted that land mobile and timing users may also wish to conduct their own evaluations.

Problems with Loran-C receiver equipment should be taken up with the relevant equipment supplier. Users are encouraged to provide feedback on any aspect of the system by contacting the relevant GLA Monitoring Centre below:

Northern Lighthouse Board
(Scotland and the Isle of Man)
The Monitor Centre
Northern Lighthouse Board, 84 George Street, Edinburgh EH2 3DA
Tel: +44 (0)131 473 3198
Fax: +44 (0)131 220 2093
Email: navigation@nlb.org.uk
www.nlb.org.uk

Trinity House Lighthouse Service
(England, Wales and the Channel Islands)
The Duty Officer
Central Planning Unit, Trinity House Depot, The Quay, Harwich, Essex CO12 3JW
Tel: +44 (0)1255 245013
Fax: +44 (0)1255 245015
Email: cpu@thls.org
www.trinityhouse.co.uk

The Commissioners of Irish Lights
(All of Ireland)
Commissioners of Irish Lights
The Duty Officer
Harbour Road, Dun Laoghaire, Dublin
Tel: +353 (0)12145740
Fax: +353 (0)12803279
Email: info@cil.ie
www.cil.ie



Loran-C



Produced by the
General Lighthouse
Authorities
of the United Kingdom
and Ireland

What is Loran-C?

Loran-C is a low frequency electronic position-fixing system using pulsed transmissions at 100 kHz. The signals are broadcast from masts spaced several hundred miles apart and are currently available in North West Europe, North America and parts of the Middle and Far East.

Why do we need Loran-C?

The last two decades have seen a fundamental change in navigation techniques through the widespread use of Global Navigation Satellite Systems (GNSS), notably GPS, with their worldwide coverage and typical accuracies of some 10 metres.

There is, however, an increasing awareness that, because of the very low signal levels that reach receivers, GNSS is vulnerable to both intentional and unintentional interference. This renders total dependence on GNSS unwise.

GNSS systems themselves also suffer occasionally from undetected failures; for example, a satellite clock error on 1 January 2004 gave rise to errors in measured positions of up to 45 kilometres in Western Europe for a period of some three hours, resulting in onboard navigational failures.

What can Loran-C offer?

Loran-C can provide position information from a source entirely independent of a GNSS. The two systems' positions can be compared and an alarm generated if they diverge beyond a set limit. Several equipment manufacturers also supply combined GNSS/Loran-C receivers, which produce position information from either system, or both. Commonly, GNSS is used as the primary system, with Loran-C providing an automatic back-up.

Each Loran-C transmitter station has its own standard frequency clock, independent of GNSS. The Loran-C signal is transmitted at a much higher power and a lower frequency than GNSS, so making it much less vulnerable to interference.

Loran-C can produce position information in the same format as GNSS, so the two provide alternative inputs to electronic charts, GMDSS radios and other onboard systems.



Loran-C also gives a highly accurate (Stratum 1) timing service that can replace GNSS in its many applications as a source of timing for communications and computer networks.

Loran-C is already in Europe; what's new?

The General Lighthouse Authorities of the United Kingdom and Ireland, in conjunction with other European Administrations, are further developing the existing European Loran-C system. In the first instance, a Loran-C signal will be transmitted from the Rugby radio station on a trial basis. These new transmissions, synchronised with similar signals from stations in France and Germany, will result in much improved accuracy performance in the waters around the UK and Ireland.



The draft European Radio Navigation Plan study recommends that the EU should work with Member States to investigate the European-wide provision of Loran-C services in order to secure the transport and wider socio-economic policy benefits delivered by Loran-C. A provisional assessment of the impact of the introduction of the Rugby transmitter site on Loran-C worst-case accuracy levels in Northwest Europe is shown below.

What accuracy does Loran-C offer?

The principal use of Loran-C will be as part of an integrated system in which Loran-C and GNSS are continually monitoring and calibrating each other to produce a combined position output. With differential GNSS corrections this position accuracy will be around one metre.

How do I receive Loran-C?

If you already have a Loran-C receiver, you should contact your equipment supplier for upgraded firmware that can recognise the

new station. Contact details for a number of equipment suppliers are listed in this leaflet. Loran-C receivers can feed positional data into onboard bridge equipment in the NMEA-0183 format. Loran-C messages are prefixed with the letters LC.

What are the technical characteristics of the Rugby transmission?

| | |
|----------------------------|----------------------------|
| Station Identity: | 6731-Y (Lessay Chain) |
| Frequency: | 100 kHz |
| Latitude: | 52° 22' 00.562" N |
| Longitude: | 01° 11' 17.636" W |
| Group Repetition Interval: | 6731 (67,310 microseconds) |
| Emission Delay: | 27,300 microseconds |
| Power: | 250 kW nominal peak |

Loran-C transmissions are referenced to the World Geodetic System 1984 (WGS84) datum, so positions derived using Loran-C may be plotted directly onto charts that use the WGS84 datum. Most up-to-date Loran-C and other integrated electronic position-fixing receivers have the facility to transform positions from the WGS84 datum to the regional datum of a chart. However, since the resulting accuracy depends on the transformation parameters contained within the software of the user's receiver, it is advisable to keep the receiver referenced to WGS84 datum and then apply the position shift values denoted on the appropriate nautical chart when plotting a position.

What is Eurofix?

Eurofix is a method of transmitting differential GNSS corrections utilising the Loran-C signal but without corrupting it. An integrated Loran/Eurofix/GNSS receiver will improve the accuracy and integrity of a GNSS receiver as well as allow calibrated Loran-C to continue to provide a high accuracy position fix in the event of loss of GNSS signals. Eurofix data is currently broadcast via Loran-C stations in France, Germany and Norway.

Loran-C Equipment Suppliers

The following five manufacturing companies advertise Loran-C receivers for sale. Contact details are provided, together with a statement provided by the company. This list is not exhaustive.

The GLAs do not endorse any product and do not accept any responsibility for the accuracy of this information.

ATLAS ELEKTRONIK GmbH
Sebaldsbruecker Heerstrasse 235
28309 Bremen
GERMANY
Phone: +49 421 457-1335
Fax: +49 421 457-1573
sandhoevel@atlas.de
www.atlas.de

ATLAS ELEKTRONIK has taken the best of two worlds, combining the advantages of the satellite-based navigation and terrestrial radio navigation into a single, integrated hybrid system called GLEE (GPS - LORAN - Eurofix Environment).

The satellite-based data of the Global Positioning System (GPS) provide global high-precision positioning. As an independent backup, an all-in-view LORAN-C receiver is integrated into the system. Additionally, Eurofix correction data is extracted from the LORAN signal, providing differential corrections for the GPS/LORAN-C/Eurofix GLEE User. The resulting hybrid receiver features unsurpassed performance and features:

- differential GPS precision
- high position stability with low statistical error when operating in LORAN-only mode
- a smooth handover from DGPS to LORAN-C operation mode.

GLEE thus allows to continue operations during critical missions, e.g. running on a trackline. GLEE can be plugged into any existing navigation system. Using the universal NMEA 0183 V 2.3 standard, compatibility with all modern system solutions is ensured. Standard

outputs are position data, speed and course over ground, but also status messages and raw sensor data.

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Phone: +44 (0)2392 230303
Fax: +44 (0)2392 230101
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www.furuno.co.jp

The FURUNO LC-90 MARK-II is a sophisticated hyperbolic navigation receiver accommodating all features necessary for safe and efficient navigation. It covers most Loran-C and Chayka stations in the world, complying with IMO and US RTCM Loran-C standards. Carriage of Loran-C and GPS navigators increases the availability of electronic position-fixing systems for safety and efficiency at sea. The position is indicated in Lat/Long without use of the Loran charts or tables. Time Differences (TDs) from pre-selected master-secondary stations can be indicated. The display reads major system data. Various navigation data and parameters are marked with an index cursor. Parameters include cross-track error, waypoint numbers, time-to-go, speed and course. Up to 100 waypoints can be entered by Lat/Long, TD, or range and bearing from any position. Current Lat/Lon and TDs can be instantly stored as an event position by pressing the SAVE key (20 max). The stored event position may be recalled at any time and easily registered as a waypoint for permanent storage. The LC-90 MARK-II automatically selects the optimum master and secondaries, compensates for ASF for improved accuracy over a varying terrain and time of day. Automatic functions may be manually overridden by the operator.

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In business for over 25 years, Locus produces the highest performance enhanced or e-Loran receivers for navigation and time/frequency applications, and specially designed receivers for integration with GNSS systems. These all-in-view (i.e. 40+ station tracking) receivers

