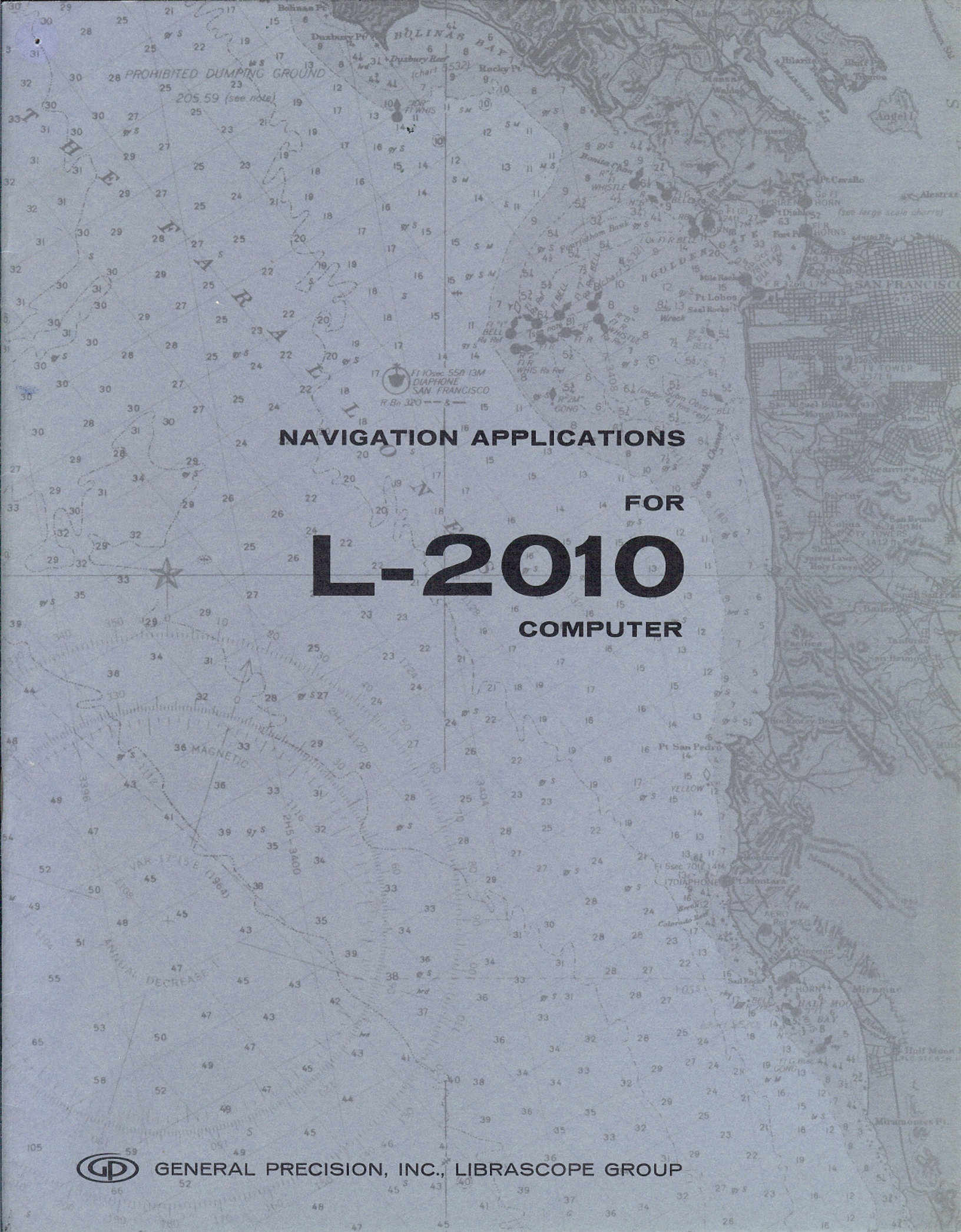


NAVIGATION APPLICATIONS

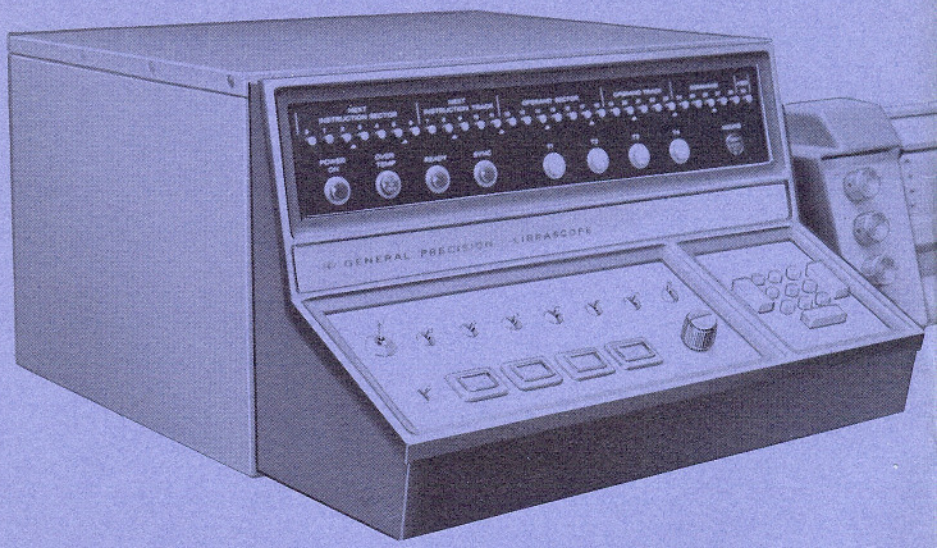
FOR

L-2010

COMPUTER

GENERAL PRECISION, INC., LIBRASCOPE GROUP

NAVIGATION AND THE



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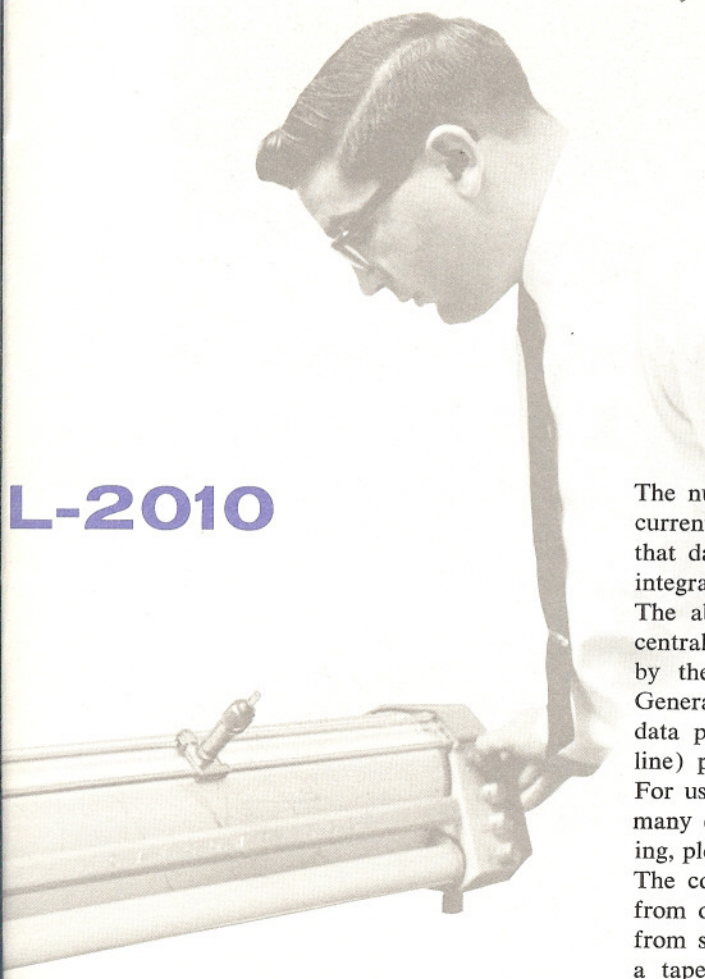


L-2010

The number and capabilities of navigational and sensory instruments currently available for use on surface ships has grown to such a degree that data can now be accumulated at a rate which surpasses manual integration and evaluation methods.

The ability to process these vast quantities of incoming data via a centralized and integrated computing system has been demonstrated by the L-2010 computer, produced by the Librascope Group of General Precision, Inc. The L-2010 is capable of performing these data processing operations through both real-time and delayed (off-line) problem-solving techniques.

For use on a rapid-response basis, the L-2010 can be interfaced with many existing electronic instruments for monitoring, printout-reporting, plotting, or automatic-control operations.

The computer's flexibility and capacity also permit switching rapidly from on-line to off-line functions. In off-line mode, navigational data from sensors can be entered into the computer through a typewriter, a tape reader, or direct keyboard. Other calculations and off-shift tasks can be performed easily with the computer in the off-line mode.

The basic need for a digital computer aboard surface vessels stems from the fact that modern sea navigation already utilizes many tools and resources to fulfill complex routine and special mission requirements. However, despite the high concentration of electronic navigational aids, the use of celestial and dead reckoning navigational methods are still prevalent.

The use of a digital computer aboard ship helps increase the accuracy and reliability of navigation. To illustrate:

> The L-2010 can be installed as part of an on-line navigation system operating directly from sensors and a stored program.
>
> The L-2010 can be operated as an off-line system to solve navigation problems under control of stored subroutines and keyboard inputs.
>
> The L-2010 can also be utilized both as a part of an on-line navigation system for automatic operation and switched to other computing and data processing tasks during off-shifts.

The L-2010 is qualified fully under applicable Military Specification standards to perform these support functions under most conditions of environment, vibration, and shock which may be encountered on any surface vessel.


439


289


490

L-2010 NAVIGATION APPLICATIONS

Most navigational functions for small surface vessels can either be performed automatically or greatly assisted by the application of an L-2010 computer. These areas include:

Sea Navigation — The computer can project estimated positions, headings, and times of arrival of a ship. These navigation findings are based on course, speed, current, wind and position sensors. The L-2010 can automatically log outputs at specified intervals and plot positions on charts.

Piloting — The computer directs the movements of a ship by reference to landmarks, electronic navigation aids, charts, and information on tides, current, danger areas, and weather.

Celestial Navigation — The L-2010 can fix position at sea, check accuracy of compasses and electronic navigation aids, and quickly solve navigational triangles.

Polar Navigation — Using celestial and dead reckoning methods, the L-2010 can check the accuracy of charted positions of landmarks. Polar navigation can be improved by the benefits of L-2010 capabilities.

Coordinate Conversion — Hyperbolic values can be converted to rectilinear coordinate values for plotting on charts. This is especially useful in offshore survey operations involving changes of master/slave transmitter sites.

Position Keeping — Position keeping calculations associated with plotting the ship and motion of a target ship can be performed. Logging of time, range, and bearing data is also generated.

Mine Hunting — The L-2010 converts range-bearing data of reference buoys or landmarks from radar, converts target location data from sonar, and plots positions of mines on charts automatically.

Ship Conning — The Computer is programmed to use dead reckoning and fixing aids to drive steering instruments on the bridge or other convenient locations and to display outputs at key remote locations.

Plotting — The L-2010 can conduct housekeeping functions (such as plotter activation) on an interval basis or when new data is available, mark symbols and alpha numeric data at geographic plot locations, and plot positions of ship at specified intervals.

ADDITIONAL NAVIGATION APPLICATIONS

Mine Laying
Buoy Tending
Hydrography
Search and Rescue
Naval Weapons, Test, and Range Instrumentation
Remote Displays (Distance-to-go, Deviation, and Gyro)
Ship Acceptance Trials
Automatic Steering Signals
Optimal Routine Navigation
Boat Sheet or Working Charts

CASEY PT.
SAUNDERSTOWN
DUTCH I.
Dutch I Hbr.
JAMESTOWN
OLD WINDMILL
Potter Cove
TAYLOR PT.
EAST
SOUTH FERRY
BEAVERHEAD
Mackerel Cove
STACK
Bull Pt.
THE DUMPLINGS
Fort Adams
Brenton Cove
Goat I.
Rose I.
COASTERS HARBOR I.
BISHOP RK
GULL RKS
THE BONNET
BONNET PT
Jones Ledge
WATSON PIER
PASSAGE
WEST
Austin Hollow
Hull Cove
BEAVERTAIL PT.
Newton Rk
WHALE RK
CLUMP RKS
Old Antonio
CASTLE HILL
NEWPORT NECK
BRENTON PT
BRENTON REEF
Seal Ledge
Haycock Ledge
ROARING BULL
GOOSEBERRY I.
Pettaquamscutt R.
LITTLE NECK
UPPER PIER
LOWER PIER
GUNNING RK
THE BROTHERS

L-2010 ACCEPTS A WIDE RANGE OF NAVIGATION INPUTS THROUGH SENSORS AND CONVERTERS

Loran A, B, C, D	Hyperbolic LOP
Lorac	Several Types Available
Raydist	Depends on Requirements
(*) Decca	Hyperbolic Fix
Dectra	Track LOPs
Omega	Hyperbolic Fix
(*) Hi-Fix	Hyperbolic or (x) Rho/Rho Fix
(*) Sea Fix	Hyperbolic Fix
(*) Mini-Fix	Hyperbolic Fix
Lambda	Hyperbolic Fix
Sonar Buoys	Distance LOPs
Radar Beacons	Rho/Theta
Tellurometer	Rho or Distance LOPs
(*) SINS	Self-Contained Dead Reckoning
Radar	Rho/Theta
Sonar	Rho/Theta
Celestial Fix	World-wide (in clear weather)

(*) Preferred for direct on-line input to L-2010 through shaft-to-digital encoder, and automatically providing navigation data to the system.

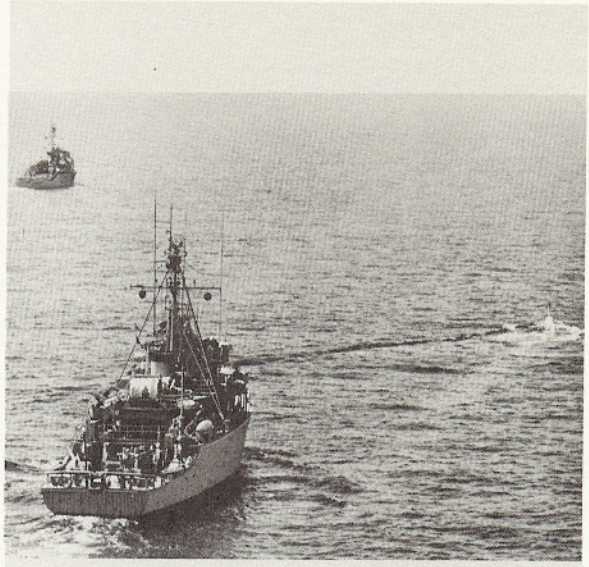
(x) In Rho/Rho (range/range) mode, system is limited to one user per set; in hyperbolic mode, the number of possible users is unlimited.

DIGITAL INPUTS AND SOURCES

- Computer Keyboard
- Computer Typewriter
- Paper-Tape Reader
- Incremental Magnetic-Tape Reader
- Card Reader
- Converters
- Shaft Position Encoders
- Scaled Voltage
- Register (1 per word)
- Sense Switches (30 per word)
- Digital Clock
- Digital Interval Timer

TYPICAL DATA HANDLED

- Course, speed, current
- Heading, Variations, time
- Tidal variation with time
- Current variation with time
- Water temperature
- Interval timer and intervalometer
- Buoy and landmark locations
- Shore station and danger areas
- Fathometer entry of water depths
- Ship covering programs
- Logs and records
- Housekeeping functions



L-2010 COORDINATE CONVERSION APPLICATIONS

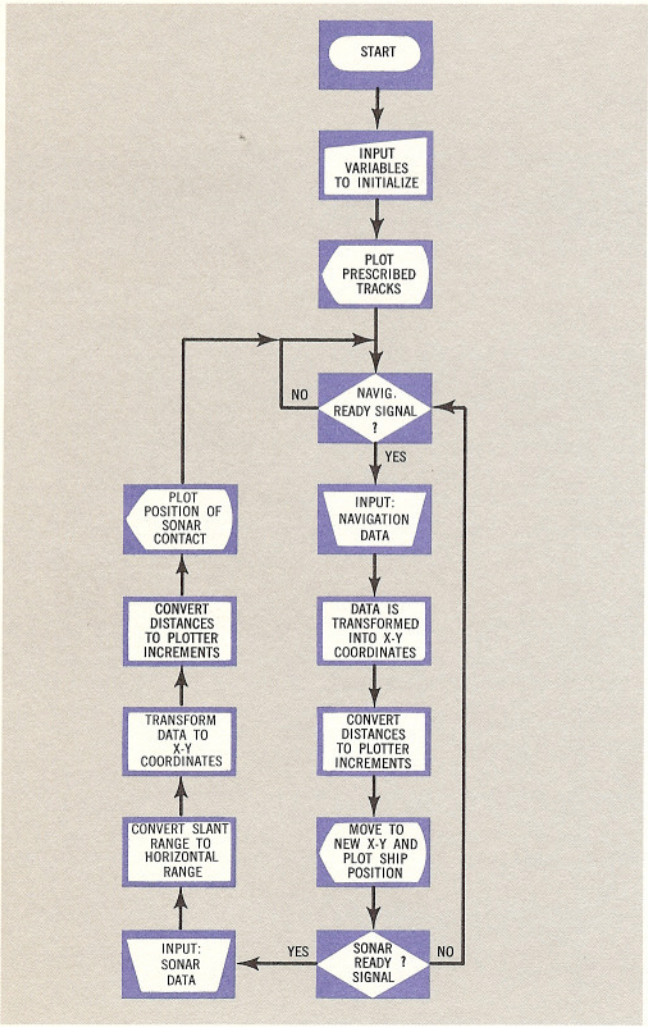
In functioning within navigational systems utilizing fixed landmarks, the L-2010 can compute the following conversions from digital data:

- Hyperbolic values to X-Y coordinates (plane).
- Hyperbolic values to latitude and longitude positions.
- Hyperbolic values to mercator or universal transverse mercator coordinates.
- Hyperbolic values to polyconic or lambert conformal coordinates.
- Rho/Rho or Rho/Rho/Rho coordinates to any coordinate of 1 through 4.
- Rho/Theta for radar or radar beacon to any coordinate of 1 through 4.
- Any coordinate of 1 through 6 converted to hyperbolic values.

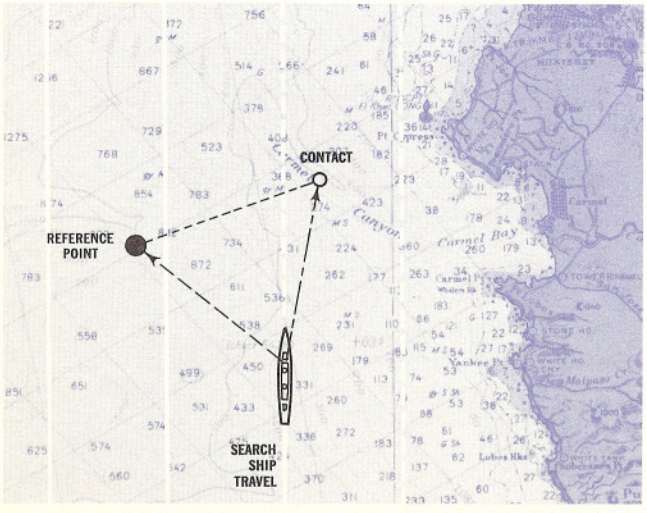
THE RUGGED L-2010 CAN BE USED IN MANY OTHER APPLICATIONS ABOARD SHIP, IN THE FIELD OR IN AN OFFICE OR WAREHOUSE.

Other functions which lend themselves well to assistance from an L-2010 computer include:

- Oil exploration missions
- Dredging operations
- Coastal surveys
- Land surveys
- Data logging
- Information retrieval
- Oceanographic data reduction
- Artillery fire control
- Matrix algebra
- Trigonometric functions
- Target-motion analysis
- Ballistic computation
- Flight-test control system
- Oil analysis and engine failure prediction
- Supply, maintenance, and general record keeping



Flow chart of minehunting program for L-2010 computer



Sketch shows how L-2010 computer, on search ship, determines and records mine position

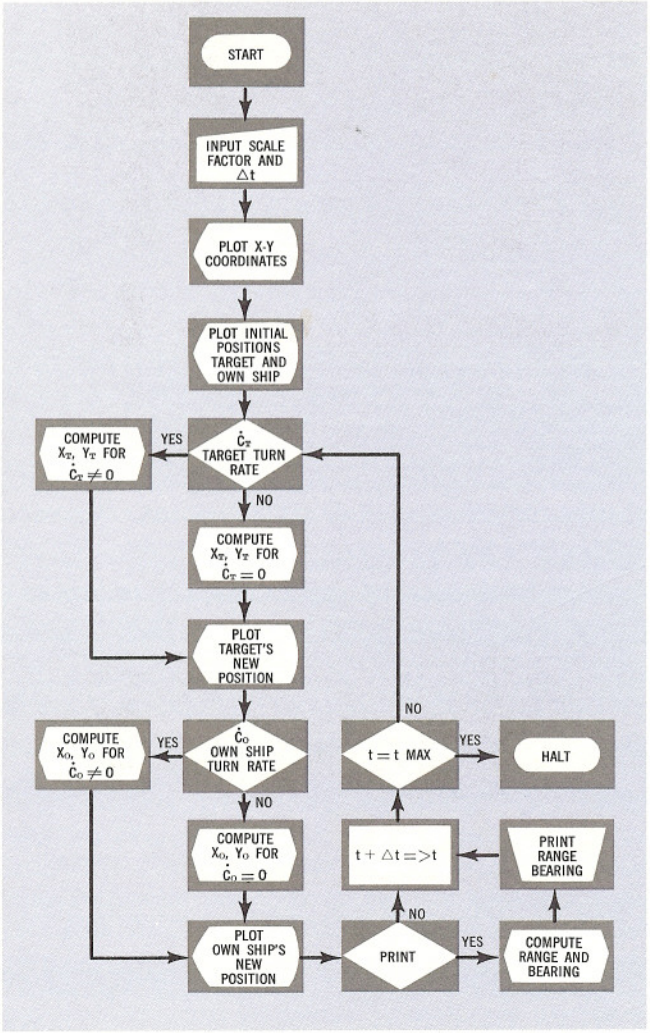
MINEHUNTING - L-2010

Typical Application

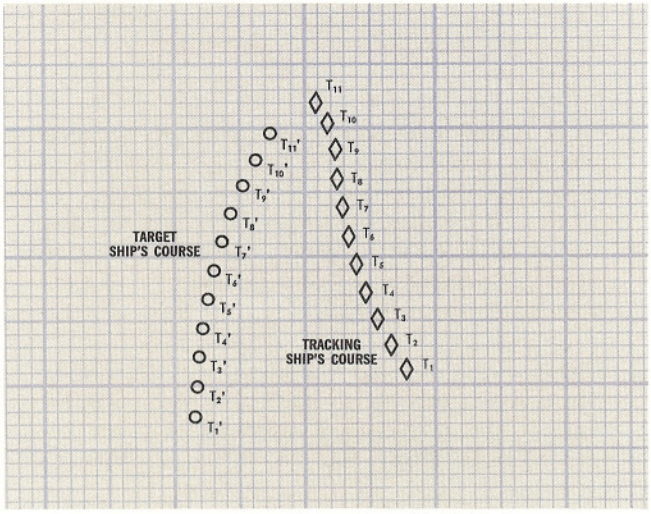
Mission achievement capabilities in operations such as mine countermeasure situations are greatly enhanced by the ability to input, compute, and plot situation data on a real-time basis. The L-2010 can accept input from navigational devices, perform necessary computations, and output the results on a plotter.

In a typical minehunting operation, the computer converts navigational data to X-Y coordinates and plots the ship's position on an incremental digital plotter. At the same time, the sonar contact information is fed into the computer, which converts range-bearing data to X-Y coordinates and plots the mine contacts on the plotter.

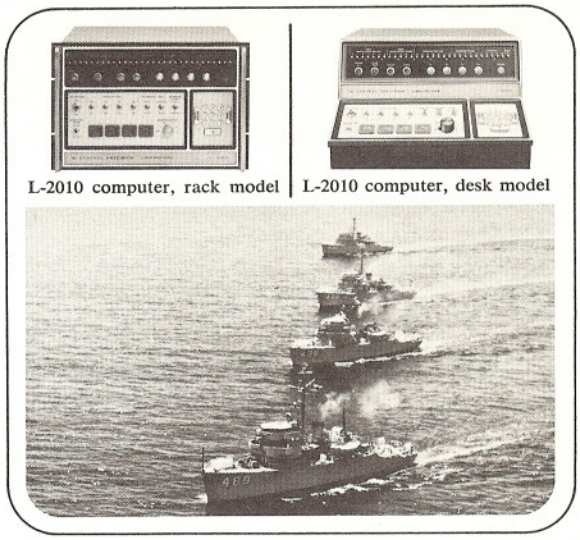
Factors such as ship's heading, the distance and angle between the radar antenna (navigational reference point) and the sonar transducer, and sonar slant range can be readily included in the computer program.



Flow chart of position-keeping program for L-2010 computer



L-2010 computer determines and graphically displays on a plotter the courses of target ship and tracking ship



L-2010 computer, rack model | L-2010 computer, desk model

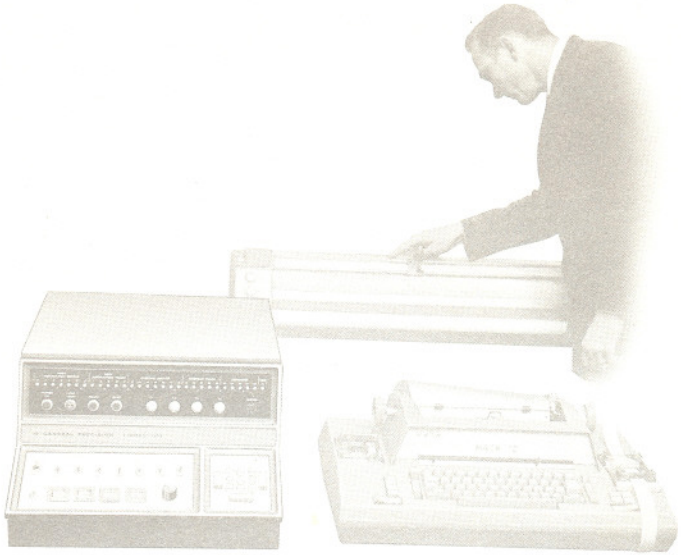
POSITION KEEPING - L-2010

Typical Application

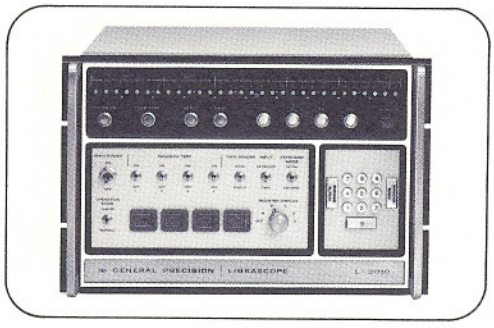
The L-2010 computer has the capability to perform position keeping calculations associated with own-ship and target-ship motion. The program accepts as inputs the following parameters:

- Range (Rh)
- Bearing (By)
- Speed of Own Ship (So)
- Speed of Target Ship (St)
- Course of Own Ship (Co)
- Course of Target Ship (Ct)
- Display time increment (△t)
- Scale factor to be used in plot (f)
- A steering list is input (Ti, Co, Ct) and designates the motion to be described by own ship and target ship. Ti specifies the time the own ship or target ship maneuver begins and Co and Ct specifies the associated turning rates.

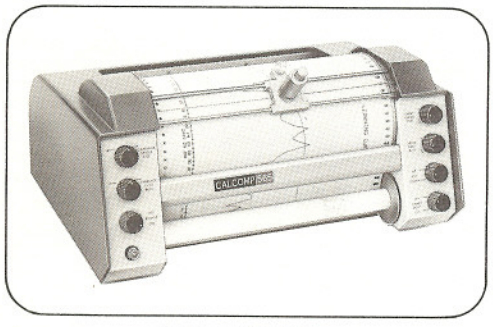
The output of the routine plots the motion of the target and own ship. Under breakpoint control, time, range, and bearing are printed on the typewriter.



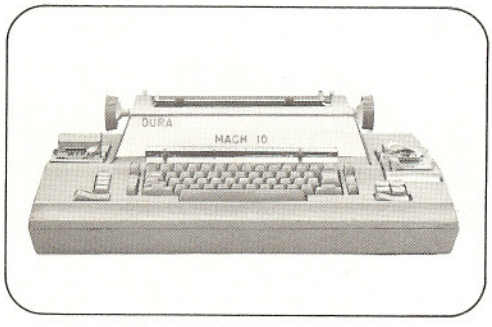
L-2010
COMPUTER AND PERIPHERAL EQUIPMENT



Front view of rack-mounted L-2010



CalComp 565 Plotter



Dura Mach 10 Typewriter

The L-2010 is a general-purpose digital computer developed especially for rugged military applications.

A portable computer, the L-2010 has a memory capacity of 4096 words, weighs less than 100 pounds, and occupies a volume of only two cubic feet.

The L-2010 can operate with either direct or buffered input-output. In the buffered input-output operation, one 128-word disc memory channel serves as the buffer. Allocation of these words to input or output devices is arbitrary and can be determined by the user. The sampling rate for input-output devices is normally 100 cps. However, higher rates are achievable through the use of recirculation techniques, with proportional reduction in buffered storage capacity. Typical buffered inputs include shaft position encoders (one per word), scaled voltage inputs, register inputs (one per word) and sense switches (30 per word). Typical buffered outputs include digital servo error signals, scaled voltage outputs, display registers (eight BCD-digits/word), relay drivers (30 per word), and cathode-ray tube display. In direct input-output mode, character-by-character operations are accomplished under program control via the arithmetic section. Typical direct inputs are from keyboard, either of two perforated tape readers, or an incremental magnetic tape reader. Typical direct outputs include typewriter or high-speed perforated-tape punch. Standard, high-performance peripheral devices available for shipboard use with the L-2010 include:

- Calcomp 565 and other on-line X-Y plotters.
- Dura Mach 10 tape-punching, tape-reading typewriter.
- Remex high-speed photoelectric tape reader.

The L-2010 computer is available either in rack mount (19″) or desk-top configurations, making the computer fully adaptable to requirements and conditions aboard any surface vessel. The controls and displays of the computer can be installed at locations remote from the main chassis.

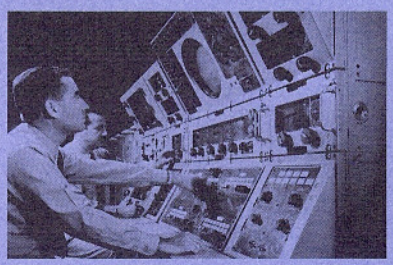
LIBRASCOPE GROUP, GENERAL PRECISION, INC.

The L-2010 is made by the same, highly trained engineering and production people at Librascope Group of General Precision, Inc., who supply digital, computerized navigational and fire control systems for the U.S. Navy. Successfully executed contracts on behalf of the Navy have included fire-control computer systems for the SUBROC and ASROC antisubmarine weapon systems.

Librascope also recently delivered the AN/FYQ-11 data-processing system for the U.S. Air Force's 473-L Command-and-Control system in the Pentagon. Librascope's data processing system will help the Air Force monitor and manipulate its world-wide defense and retaliatory forces with a split-second precision.

Headquartered in Glendale, California, Librascope was founded in 1937 and employs some 2,000 employees in 400,000 square feet of plant space.

Librascope's parent company, General Precision, Inc., is the principal operating subsidiary of General Precision Equipment Corporation, Tarrytown, N.Y. General Precision employs 14,000 people and has 15 major plant locations with a combined area of three million square feet. More than 90 percent of its business is in electronic products.



Fire-control technicians operate Mk 113 fire-control system produced by General Precision / Librascope for Navy's submarine-launched SUBROC weapon system

Deadly SUBROC antisubmarine missile bursts from water during tests in Pacific

Navy personnel operate Mk 111 fire-control system produced by General Precision / Librascope for the Navy's destroyer-launched ASROC antisubmarine missile

ASROC antisubmarine missile is fired from destroyer deck during tests

Model of AN/FYQ-11 Data Processor Set produced by General Precision / Librascope for USAF's 473L command-and-control system is viewed at manufacturing plant site

Air Force officers check operation of AN/FYQ-11 Data Processor Set prior to installation in the Command Post at Air Force headquarters in the Pentagon

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