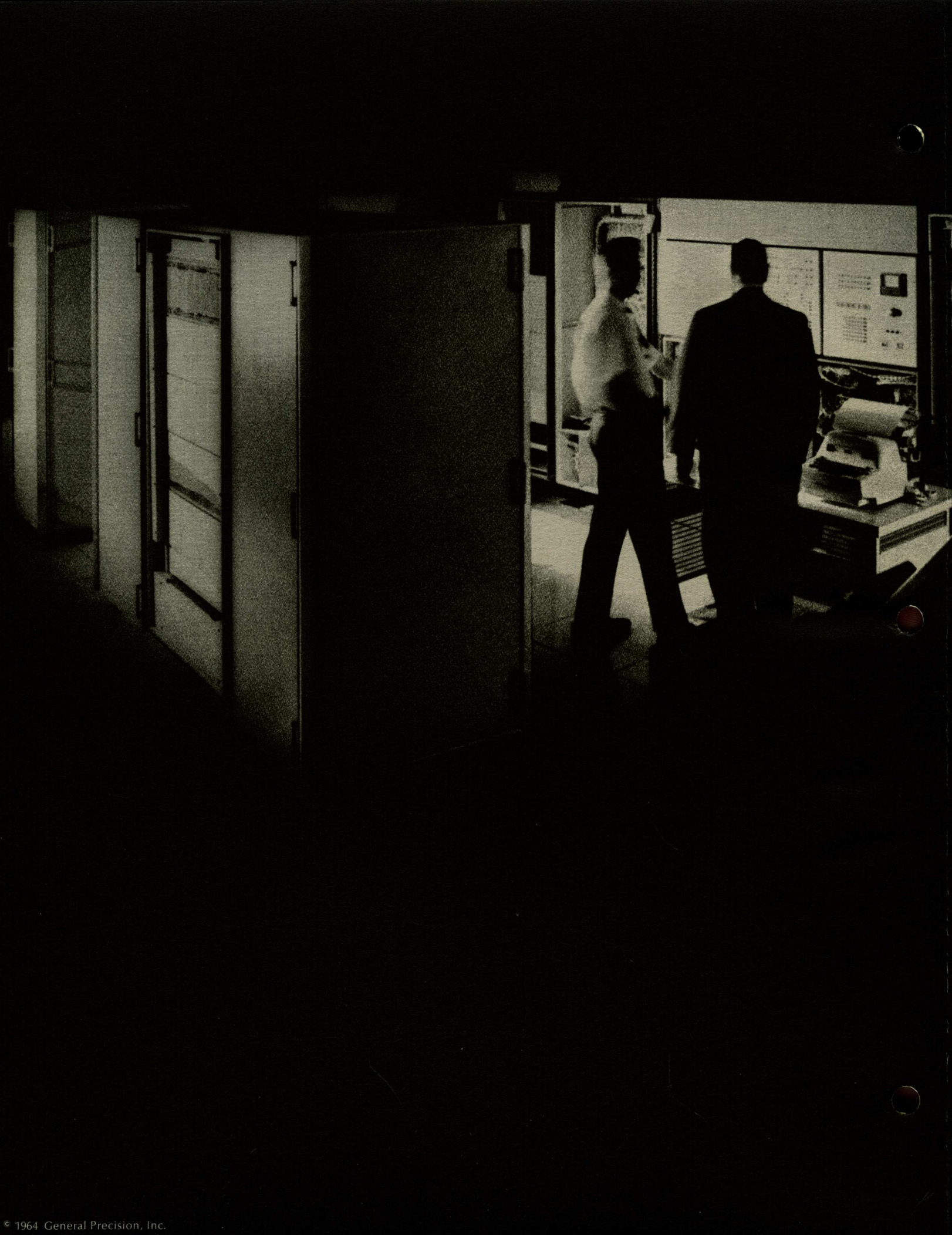




General Precision's real-time L-3055 data processing system





introducing...General Precision's L-3055 system...the second in a series of large-scale, on-line data processing systems enabling man to extend his capability to manage complex, real-time operations

introduction

To arm decision makers with the best control over all operations for which they are responsible, General Precision, Inc., offers the L-3055 Data Processing System.

The L-3055 answers the long-standing need for a real-time operational data processing system capable of feeding back timely, significant information which decision makers can evaluate with speed and ease. In assuring an unmatched processing efficiency, the L-3055 design uses a new concept: it places the information processor on-line in the operation itself, instead of relegating it to a "patchwork" position on the side lines. Further, the system is compatible with conventional communications equipment, can store massive amounts of data, and can exchange queries and responses with a virtually unlimited number of remote locations simultaneously.

Most executives today are pressured into making more and more complex decisions daily while having less and less time in which to deliberate. The L-3055 dispels much of the pressure of this stepped-up pace. Proved and reliable, it sorts out accurate answers within seconds from literally billions of bits of continuously updated and modified information. Here is how this capability assists the manager over the full range of his tasks:

First, efficient and effective twentieth-century management calls for sound planning. The competent manager guards against techniques that often result in costly confusion, personnel errors, inaccuracy, misinterpretation, and slow-downs. Initially, therefore, an L-3055 system sharply reduces (1) the need for manually handled records, procedures, and forms; (2) the juggling of magnetic tapes; (3) the handling of millions of punched cards; and (4) all the other time-consuming, expensive aspects of conventional data processing.

Configuration of L-3055 computing equipment (inside front cover) designed to provide on-line, real-time control, interpretation, and display of data for use by military decision makers in two principal application areas: (1) command and control, (2) management and logistics.

After traditional planning snarls are removed, one major problem common to all managers still remains.

With plans now drawn up and operations starting, each manager must ask himself: How do I stay constantly informed as to what decisions I must make so that operations match the plans and lead to the desired results?

The answer lies in having fast access to both planning data and operational data at any given point in time, and this is the job of the L-3055 system. Serving as a focal point of operations for the manager, the properly programmed L-3055 provides:

- 1. Planning assistance and data base storage and retrieval.*
- 2. Automatic comparison of operating data with planning data.*
- 3. Timely operational information periodically and on call.*
- 4. Reliable, repetitive processing of operational information.*
- 5. Simulation.*
- 6. Convenient means for changing reports and procedures.*
- 7. Automatic message routing.*

Through elemental querying methods, a manager using the L-3055 system can rapidly determine (1) the effectiveness of specified programmed plans; (2) whether execution of the plans is conforming with over-all objectives; and (3) what changes in plans or operations, if any, must be made.

Where the information is stored is of no concern to the manager; for the remotely situated L-3055 system runs its real-time, on-line search by record content. By activating a simple interrogation device in his own office, the manager receives critical decision-guiding data within seconds—no one other than he need enter the operation.

This and other characteristics described in these pages typify the quality of large-scale, real-time, on-line performance inherent only in L-3055 systems.

Two Librascope Group engineering staff members and a USAF officer inspect models of L-3055 computing equipment, shown in photo on page 3. Production units, some of which appear in background, will perform operational resources management functions in the USAF's 473L Command and Control System to be installed in the Pentagon.

areas of application

From a military viewpoint there are two basic applications at present for the L-3055 system:

Command and Control • Management and Logistics



Command and Control... In the generic sense, Command and Control is described as "that part of a military organization devoted to commanding the forces and controlling the weapons in order to execute the mission and perform the functions of the military entity involved." A command and control system may be described as a highly reliable, rapid-response communication and display system with problem-solving capability that helps the commander act promptly in controlling the forces and equipment at his disposal before, during, and after hostile action.

In a strategic or national command post sense, the elements covered are:

- Alerting*
- Damage assessment*
- Large-scale force coordination and deployment*
- Contingency planning*
- Logistics*
- Residual forces and target damage assessment*
- Weapons control*

In a tactical or theatre sense, the elements covered by such an operation are:

- Fire support*
- Intelligence*
- Logistics*
- Personnel*
- Weapons control*

Management and Logistics... A management and logistics system may be described as a medium-response-time, large-volume data storage and retrieval display and communication system operating normally in a strategic peace-time



environment to help managers and commanders conduct day-by-day operations (including movement and storage of supplies and equipment). The elements covered by this particular field of application are:

- Terminal and in-transit cargo shipment*
- Warehousing*
- Inventory control*
- Financial management*
- Personnel*
- Production planning and control*

In time of emergency the vital logistics data of a management and logistics system is fed to the various command and control systems for over-all decision-making purposes. Whether it be for command and control or management and logistics, a large-scale, computerized military system may be described as a group of five basic elements integrated into a functional entity addressed to a specific charter and designed for a given user. The five elements are:

- Man*
- Machines*
- Communications and displays*
- Data*
- Software (programs/procedures/plans)*

The L-3055 as a data processing hardware subsystem fills the requirements for the data and machine elements of the over-all system, taking into account the interface requirements for the remaining elements. The following pages illustrate the typical applications for which the L-3055 system is being considered.

Pictured here is assembly line at Librascope Group's Glendale plant where L-3055 systems are being produced. Rotating magnetic discs for Mass Memory Subsystem are housed in cabinets shown in foreground at left. Card cages (right foreground) house logic elements for huge, random-access, mass-memory storage units.

typical applications



As previously described, many of the normal activities and routine functions are predesigned into the L-3055 hardware itself. Many more are contained in the standard programming. The software and the hardware go hand in hand to create the technical capability that enhances the uses of the L-3055 system.

To the manager or commander, the significant aspect is how this combination solves operational problems. The two applications that are briefly discussed here serve to demonstrate the versatility of the approach.

example...for command and control applications

Place:

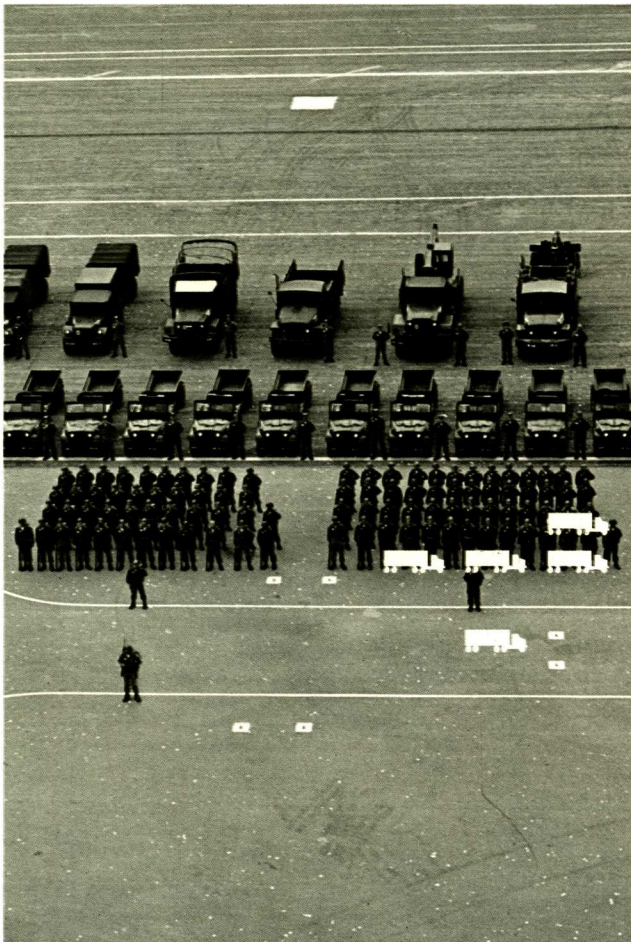
STRICOM HQ

Request:

How many 5th Division mechanized batallions are now available at Ft. Carson, Colorado?

Response:

0800, LOCAL TIME, 23 MAY: FOUR MECHANIZED BATTALIONS FROM 5th DIVISION ARE AVAILABLE AT FT. CARSON, COLORADO.



input/output data

Location and strength of hostile environments Relative movements

As a tool to aid the commander of a unified or specified command, an L-3055 system could store and process data which reflects—

- * Strength of major subordinate commands*

- * Location and strength of hostile environments*

- * Relative movements of interrelated joint forces*

- * Transport availability and loading characteristics of carriers and related function*

example...for warehousing
and inventory control—management
and logistics applications



Place:

ORDNANCE TANK AUTOMOTIVE COMMAND,
DETROIT

Request:

Request inventory status part No. 146533 EURCOM

Response:

FRANKFURT WHSE 643 ON HAND 55 CONDITION
A ON SHELF 2186, BIN 7; 617 CONDITION B ON
SHELF 1047, BIN 22; 1000 ON ORDER, P.O. 14B1877,
DUE IN 2 MONTHS.



input/output data



* Part stock number

Stored in the memory subsystem for an L-3055 system designed for a material warehousing application would be such typical pertinent information as—

* Part stock number

* Disposal item code

* Tech order series number

* Location condition, status, date code

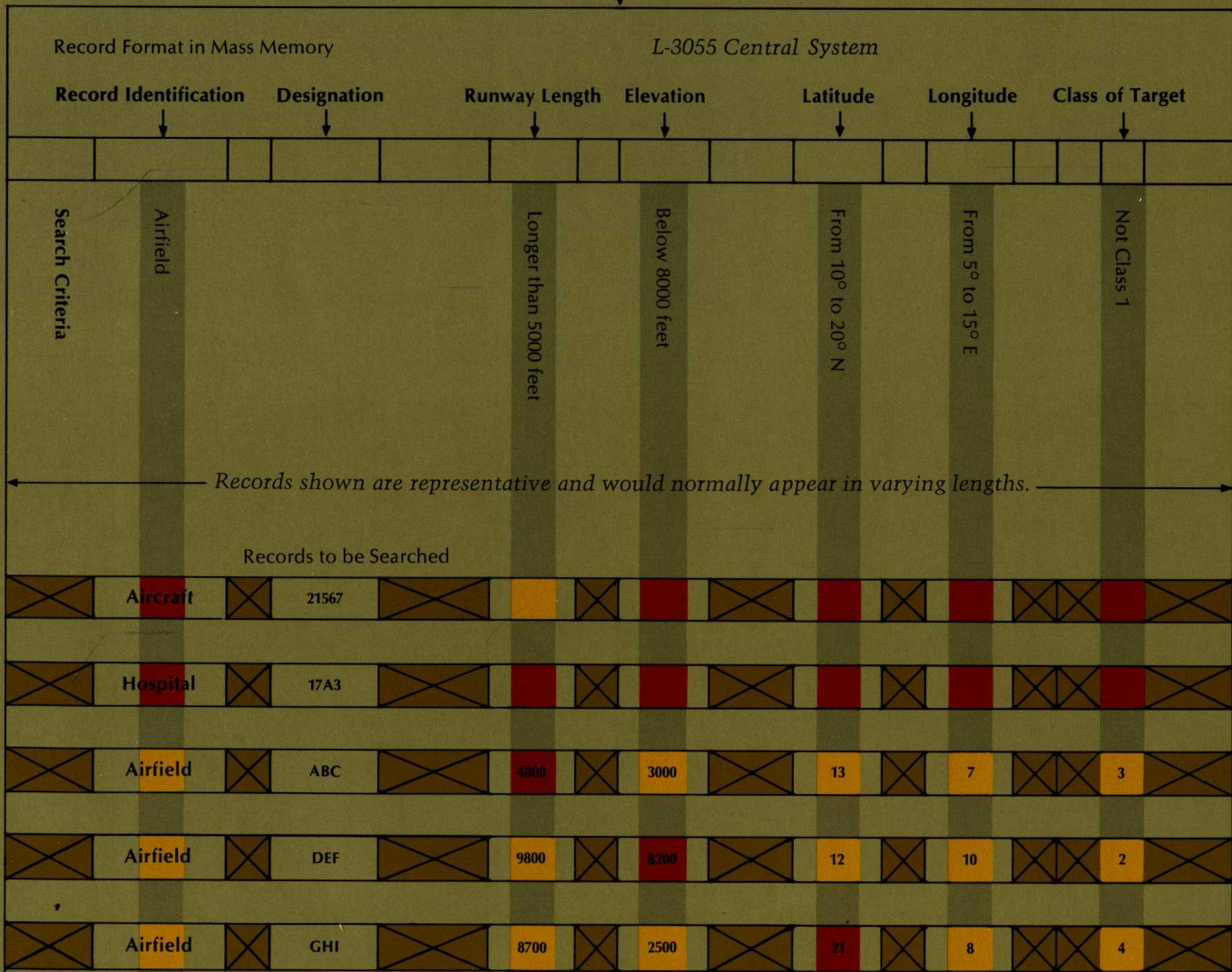
* Unit of issue

* Expendability repair code

Here is a general search problem and the method by which answers are obtained from the L-3055 main storage data base:

Find all airfields with a runway longer than 5000 feet, below an elevation of 8000 feet in the area from 10° to 20° North Latitude and 5° to 15° East Longitude which is not a Class 1 Target.

Communications Channel



Break indicates existence of thousands of records which were searched.

general search problem

Airfield	PQR	9000	3000	15	3	3
Airfield	STU	5030	7900	11	6	2
Airfield	VWX	9500	2200	19	11	1
Fuel	67511					

Record that will be retrieved

All records searched simultaneously

Airfield	STU	5030	7900	11	6	2
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Printout back to Interrogator.

Communications Channel

Airfield STU, Runway 5030 feet long, 7900 feet Elevation, 11° North Latitude, 6° East Longitude, Class 2 Target.

Retrieved record
 Data in field not concerned with this search
 No match
 Match

general description

General Precision's L-3055 system numbers among its major features (1) an expandable memory subsystem of virtually unlimited capacity, (2) solid-state construction for high system reliability, and (3) versatility which enables it to fulfill a wide variety of applications requirements. Complementing these features, a modular design approach makes the phasing in of new units and functions a relatively simple task. Tabular or pictorial displays, operator consoles, and input-output devices may be readily added to satisfy increasing system demands. The Executive Control program will automatically accommodate additional modules so that complete reprogramming is unnecessary.

Simply and generally stated, the system's three basic functions are input-output, data processing, and storage. These functions are performed by:

Four Modular Subsystems

- * Mass Memory Subsystem

- * Central Processor Unit Subsystem

- * Real-Time Buffer Processor (Input-Output) Subsystem

- * Unit Record Subsystem

Mass Memory Subsystem... provides inexpensive, readily accessible storage of tens of millions of characters of information.

Total memory exceeds two billion characters—equal to 25 million tab cards, enough to fill 25 freight cars. Records are retrievable randomly in 0.035 second on the basis of the record content alone or on the basis of any portion of the record. Searches can be conducted on five modes at one time: equal to, more than, less than, between limits, and not equal to.

Central Processor Unit (CPU) Subsystem, "nerve center" for the entire L-3055 system, is shown in center foreground of photo on page 13. Working in a real-time environment, the CPU synchronizes the simultaneous independent operations of all L-3055 subsystems.



The entire file is searched at one time, and the individual record desired is retrieved for output to the requestor.

At no time in the cycle is it necessary to know where the item of information is stored—all that is necessary is to know what you wish to find. Conventional search-by-location or file address can be accomplished by program control, however, if desired.

Search criteria can be individual bits, alphanumeric characters, eight-character variable-field words, or up to 128 characters. Search-by-content permits finding all records associated with a particular subject. All data transfers are self-checked. Dual-recording of any file data for added reliability is a program option. Mass memory modules are available in 20,000,000-character increments (40,000,000 optional).

Real-Time Buffer-Processor Modules Subsystem...programmable modules for fast, flexible communications.

The Buffer-Processor Modules (BPM) provide the link between the L-3055 system and the outside world of communications—AUTODIN, digital data links, microwave, Datacom, and other computer systems. The BPMs also serve to interface with communications within the L-3055 system itself—displays and peripheral equipments.

These self-contained, programmable buffer-processor modules—

-
- * Automatically synchronize the communications system

 - * Automatically perform code translation and speed conversion

 - * Preprocess input data

 - * Verify formats and reformat

 - * Edit inputs and outputs

 - * Reject and request retransmission of messages that do not conform to prescribed format.
-

All these functions are programmable and readily altered for changing requirements.

The BPMs relieve the central processor of 336 instructions, increasing the utilization of the system. The buffer-processor notifies the central processor automatically when the message is ready. Such operations conventionally are performed manually, thus consuming valuable time. An automatic operation reduces responsiveness from hours to seconds, allowing inquiries and responses without interruption of the processes in the outside world or within the data processing complex. Reliability is enhanced also by having machines perform repetitive routine tasks.

Unit Record Subsystem...peripheral equipment for both on-line and off-line operation.

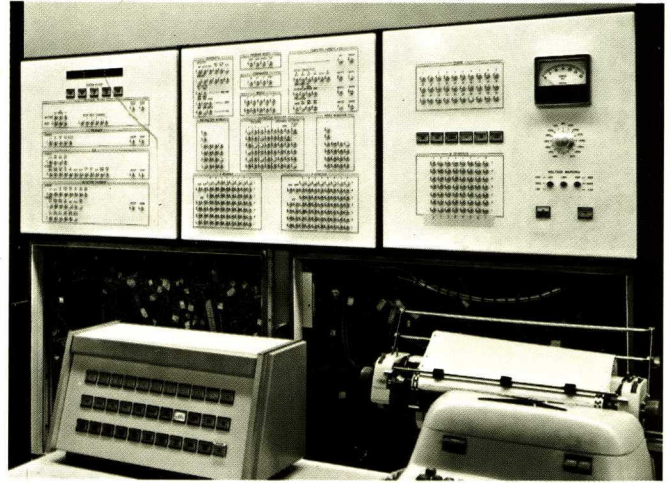
In the L-3055, magnetic tape—though it need not be used as a storage medium—proves valuable as an input-output medium and as a repository for historical data—audit trail, for example. The Unit Record Subsystem thus provides for 256 magnetic tape units.

This subsystem also contains various items of conventional record equipment such as card reader/punches and line printers. Each can be operated on-line to the Central Processor Unit Subsystem or off-line with magnetic tape units.

Central Processor Unit Subsystem...control center for simultaneous operation of all subsystems.

Although the Central Processor Unit (CPU) Subsystem has extensive computational capabilities (including built-in floating point arithmetic), primarily it serves as a “nerve center” for the entire L-3055 system. Working in a real-time environment, the CPU synchronizes the simultaneous independent operations of all subsystems. The manual operations usually associated with data processing centers are automatically accomplished by the CPU.

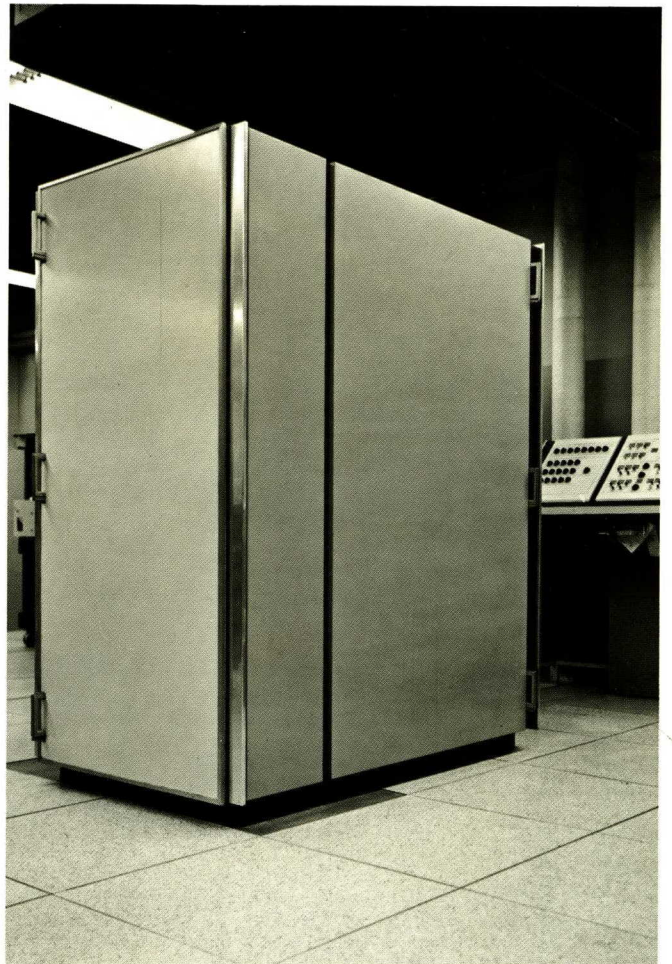
The hardware and a standard software supervisory routine completely eliminate the need for manual interruptions from input-output, Mass Memory or Unit Record



Close-up of control panels for CPU subsystem is shown in photo above. Controls on panel at right are arranged conveniently for use by operator. Banks of indicator lamps on other panels display status of peripheral devices and programs.

Technician (below, left) merely opens cabinet doors to gain access to read-write heads of memory storage units for making final adjustment. Most maintenance operations for L-3055 Mass Memory Subsystem may be performed with standard tools.

Buffer-Processor Modules (BPMs), housed in rugged, sheet metal cabinet (below), link the L-3055 system and the outside world. Self-contained and programmable, the BPMs also serve to interface communications functions within the L-3055 system itself. Switching control unit appears in background of photo.



Subsystems of the L-3055 system. The controllable, built-in interrupt hierarchy (a priority for operational instructions) permits automatic handling of (1) all internal communications between the central processors and peripheral equipments and (2) in conjunction with the buffer-processors, all external input-output traffic.

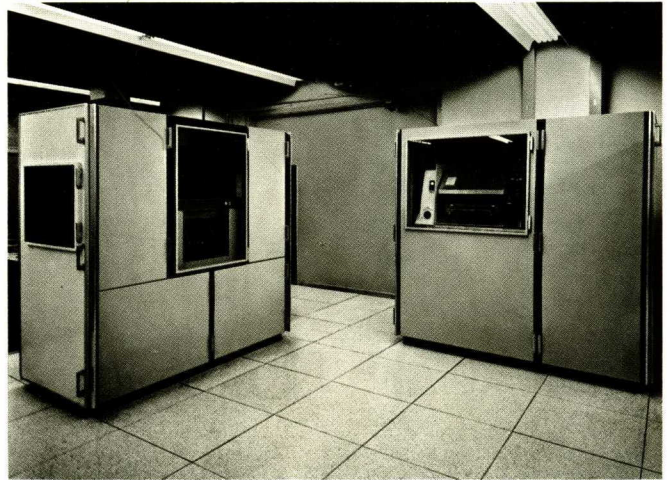
The operator need not concern himself with the occurrence of operational interrupts. All interrupts are performed automatically by the CPU hardware.

The design of the CPU permits duplexed (paired) installation either initially or later. Use of two CPUs greatly expands system capability and reliability. In a duplexed system, up to 64,000 words of core memory are available to each CPU; and either unit can generate a program-interrupt in the other.

Each CPU also contains a real-time clock and an intervalometer, relating system operation to the real-time world—like a pulse beat. The program can read the clock at any time (to record input messages, test program response time, etc.); and the intervalometer can be preset to cause a program-interrupt at the end of any period of time that may be specified.

The command structure of each CPU permits the programmer, at his option, to execute any arithmetic instruction in decimal, normalized or floating mode.

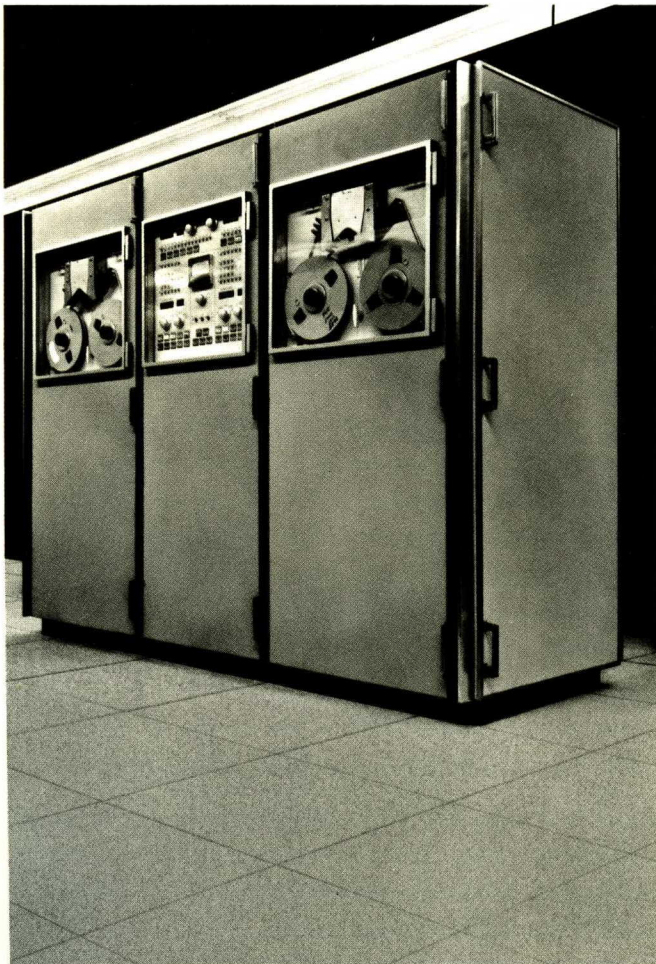
Data transfer, message parity, and many other automatic checking systems are also provided in each CPU. For example, parity checks are made for mass memory vertical and horizontal, core memory parity, upper and lower accumulators, and auxiliary registers. If desired, the processor can be programmed to enter an error mode of operation whenever a parity error is detected. Thus any conceivable system error within the system—whether it be caused by man or by machine—will be automatically detected and either automatically corrected or the system operator will be notified of the error condition.



Unit Record Subsystem of large-scale L-3055 Data Processing System consists, in part, of a magnetic tape unit (below, left) used both as an input-output medium and as a repository for historical data. Some 256 such units can be accommodated.

Conventional card reader/punch and line printer—left and right, respectively, in photo above—are also included in Unit Record Subsystem. Reader/punch reads 800 cards per minute, punches 250 cards per minute. Line printer prints 1000 lines per minute.

Maintenance technician (below) conducts tests on Central Processor Unit (CPU) which is in final production stages at Librascope's Surface Equipment Division in Glendale, Calif. Design of the CPU permits duplexed installation, resulting in greatly expanded over-all system capability and reliability.



L-3055 system advantages

Since the L-3055 system has been specifically designed to solve management information system and information retrieval system problems, it possesses unique capabilities not previously available. New techniques allow the system designer to approach his design from an entirely fresh viewpoint unhampered by the limitations of conventional processes. In summary, these advantages are:

Mass-Memory Random Access

An inexpensive storage of extremely large data bases offering on-line, parallel manipulation of data. Storage and retrieval of information is on the basis of the content of the record itself rather than its location in the file or specific address. Searches are made on any field of the record, not just the key—all this without operator intervention.

Real-Time Data Processing

The system can process action data as it occurs and return the results of the desired processing to the user as the activity progresses. Data does not have to be batched for subsequent processing during which time it is inaccessible for interrogation. Reports are complete as soon as the activity is complete.

Highly Responsive Intercommunications

The Buffer-Processor Module rapidly inputs remote site data of various codes and formats to the Central Processor Unit as though the query stations were on site with the central computer system. Answers may be received within seconds from any of a large number of remote stations. Also accomplished automatically are line synchronization, code translation, format editing, and error detection.

The L-3055 is compatible with the DCA AUTODIN portion of the National Communications System and can communicate with a variety of other computers in a real-time sense. This is accomplished without human intervention.

Distribution of Work Load and Interrupt Hierarchy

The central processor automatically distributes the processing workload to the various subsystems and components on the basis of demands of the data traffic and capability of each section to perform desired tasks.

An executive program establishes and automatically con-

trols the sequence of operations and distribution of work according to pre-established priority requirements.

Report Generator

When new or modified reports or other output products are needed, extensive reprogramming generally associated with conventional data processing systems is not required. The L-3055 report generator feature permits dramatic cost savings, increased reliability, and increased flexibility to meet constantly changing report requirements.

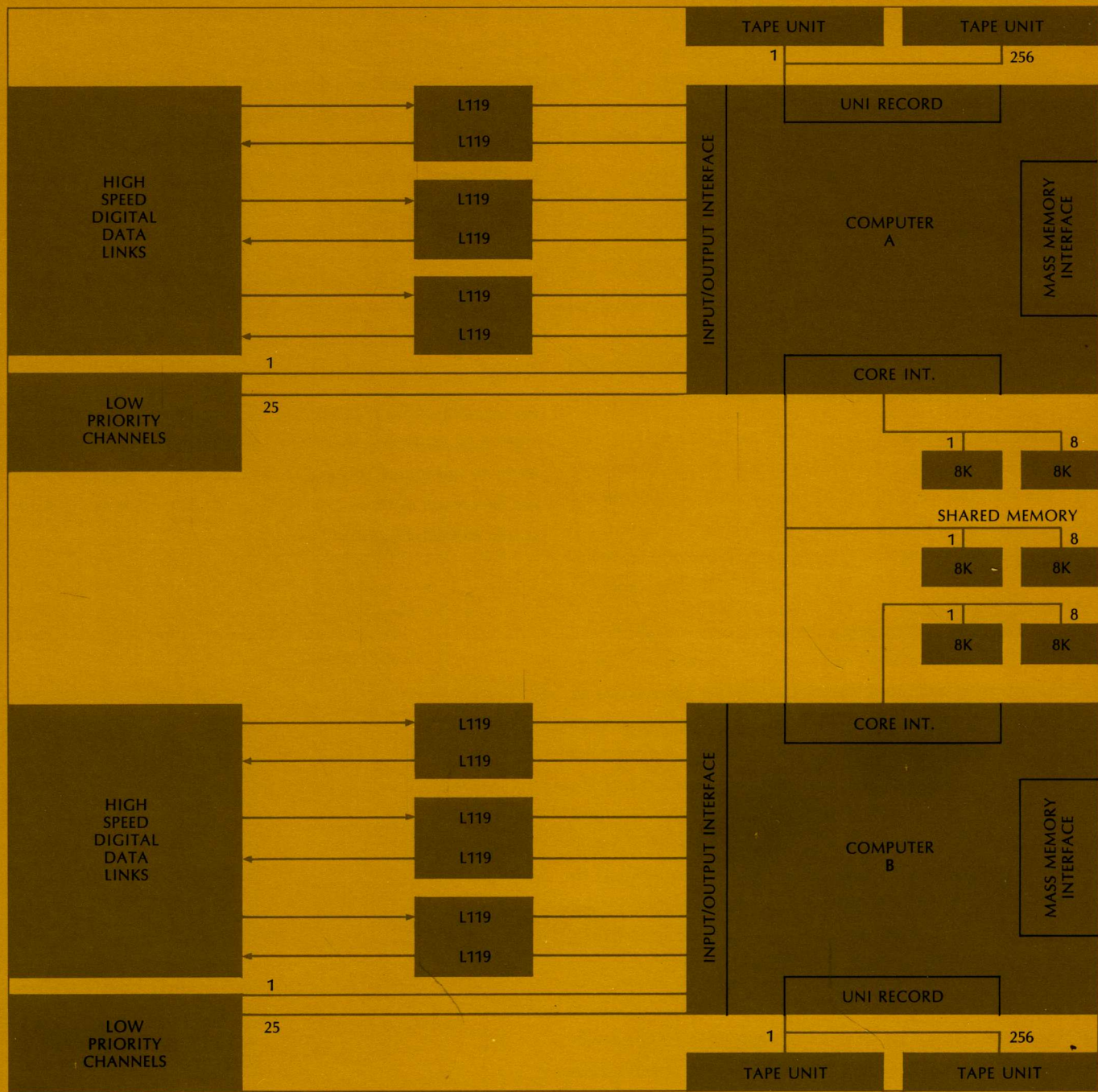
Decrease of Human Interfaces

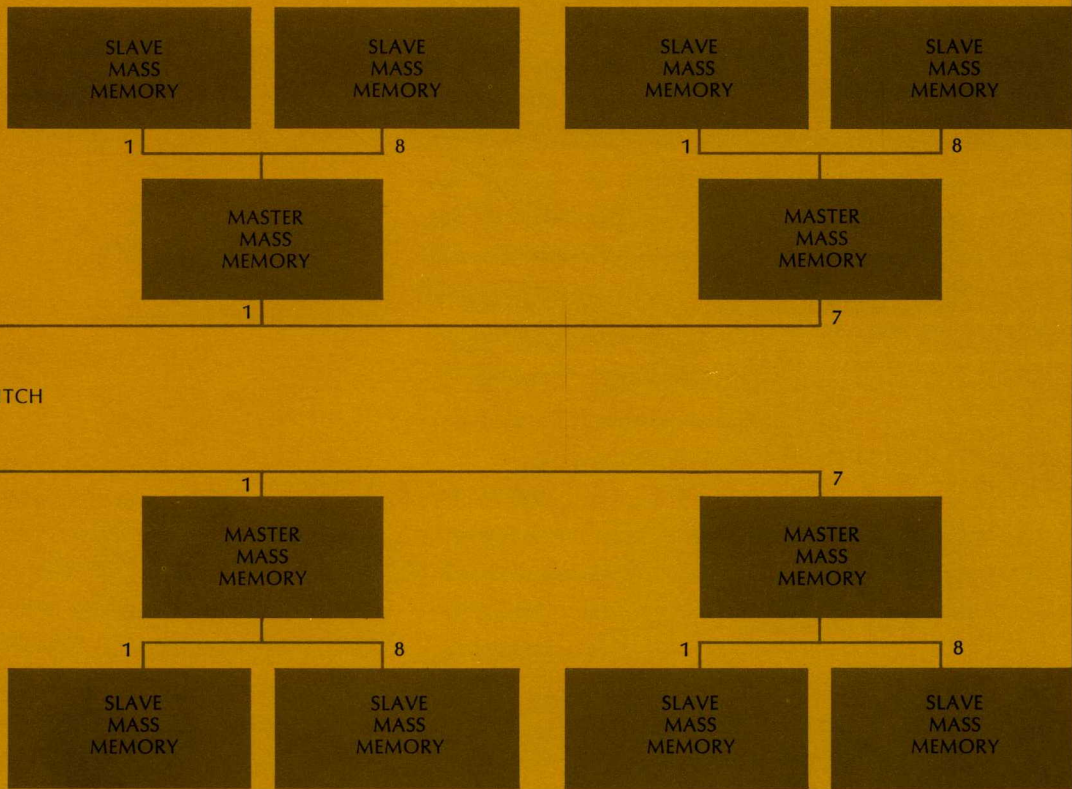
By mechanizing and automating the usual routine functions performed by operators in the mass handling of data, the L-3055 system provides lower operating cost, high reliability, and more accurate repeatability.

Software Support

To increase system flexibility and facilitate preparation of operating programs, a series of executive programs coupled with an advanced COBOL compiler will be supplied with the hardware system to give the user the completely integrated information processing tool.

duplex system





customer support

System Design... Librascope maintains a staff of experienced management systems engineers who have been trained specifically to apply the new and unique L-3055 system advantages to actual environmental conditions. In fact, it is largely as a result of their talent and broad experience that such a system evolved. This staff is available for problem consultation, evaluation, resolution, and specification.

Various computer specialists augment this staff and help tailor the equipment to fulfill operational requirements.

Programming... An extensive library of programs can be made available for each installation. These fall into three general categories: (1) machine-oriented—those instructions that are necessary to run the hardware; (2) applications-oriented—those programs necessary to fit the hardware into the operational environment to assure fulfilling the manager's needs; and (3) higher order common languages—compilers enabling programmers to prepare specific operational programs without having to learn a new machine language.

Machine-Oriented Programs

Assembly

Executive

Utility

Diagnostic

Report Generator

Acceptance Tests

Applications-Oriented Programs

Operational

Mathematical

Simulation

Higher Order Common Languages

COBOL

JOVIAL

FORTTRAN

Training... Certain customer agencies prefer to have their own personnel trained rather than to employ new personnel. For that reason, Librascope conducts L-3055 training courses for customer employees—as well as for its own personnel. These courses are lecture-, demonstration-, and observation-oriented at Librascope's Glendale, California, facility and are conducted during equipment fabrication. Operator, programmer, and maintenance training continues after equipment is delivered on-site.

Operator and programming courses include system orientation and introduction to digital concepts and operating procedures. Maintenance technicians are thoroughly schooled in equipment function, operation, and checkout plus basic programming concepts. Training facilities include the use of engineer-instructors, audio-visual aids, and standard and special test equipment.

L-3055 system characteristics

General Information

1. A large-scale, general-purpose modular data processing system—for use in real-time applications—featuring on-line telecommunications, display console interface, and a unique mass memory. Designed for high reliability performance.
2. Completely buffered operation of all peripheral units of the system.
3. Comprehensive interrupt/ignore system control.
4. Mass memory with associative, search-by-content, and fixed-address modes.
5. Alphanumeric number representation throughout.
6. Variable field operation.
7. Powerful instruction set for fixed-point, floating-point, and logical operations.
8. Separably programmable input/output telecommunications processor compatible with differing codes.

System Components

Central Processor Unit Subsystem

- * 56-bit word length (eight 7-bit characters).
- * 42 bits for floating-point arithmetic.
- * Core memory expandable to 128,000 words in 8000-word modules. Standard cycle time of 5 μ sec (3.3- μ sec cycle time optional). Nonvolatile if power fails.
- * 17 index registers.
- * Execution times (including all accesses)*

	Fixed Point	Floating Point
Add	10.5 μ sec	15 μ sec
Multiply	25 μ sec	27 μ sec
Divide	80 μ sec	84 μ sec

* Average for full words. Less for partial word fields.

- * Instruction set contains 107 commands of which 60 are

arithmetic and data handling; 25 are control; and 22 are for input and output.

- * Shared memory for high-speed intercomputer communication.
- * Indirect addressing with no limit on chaining.
- * Special features to facilitate list processing.

Mass Memory Subsystem

- * 120 million bits per module.
- * Up to 56 modules per computer.
- * Fixed heads—no moving arm—average access 35 msec.
- * Both search-by-content and fixed address under program control.
- * Fully buffered operation.

Buffer-Processor Modules

- * Internally stored program controlled for input or output.
- * 2400 bit/second total per module from data link or combination of multiplexed slower communications stations such as TTY, tape readers, etc.
- * Up to six consoles with four modules each per central processor.
- * Inexpensive, reliable disc storage for program and data.
- * Perform functions of buffering, code conversion, formatting, error checking, and handling data link coordination procedure.

Magnetic Tape Console

- * Two 50,000-character/second tape decks.
- * Control for card reader/punch console at 800/250 cards/minute.
- * Control for line printer console at 1000 lines/minute.
- * Partial overlap of I/O operations standard (complete overlap of two operations optional).
- * Attached to computer by I/O trunkline with capacity of 256 I/O devices.
- * Manual off-line modes provided.

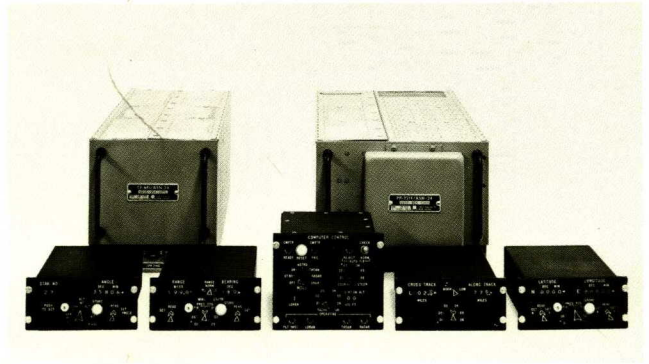
Librascope's credentials

A notable record of technical achievements

Founded in 1937, the Librascope organization has successfully completed many technical assignments affecting U.S. security. In completing these tasks, the group has steadily broadened its base of knowledge and capability in the design, development, and manufacture of complex electronic computing and information processing systems.

Shown here are several of Librascope Group's recent major accomplishments.





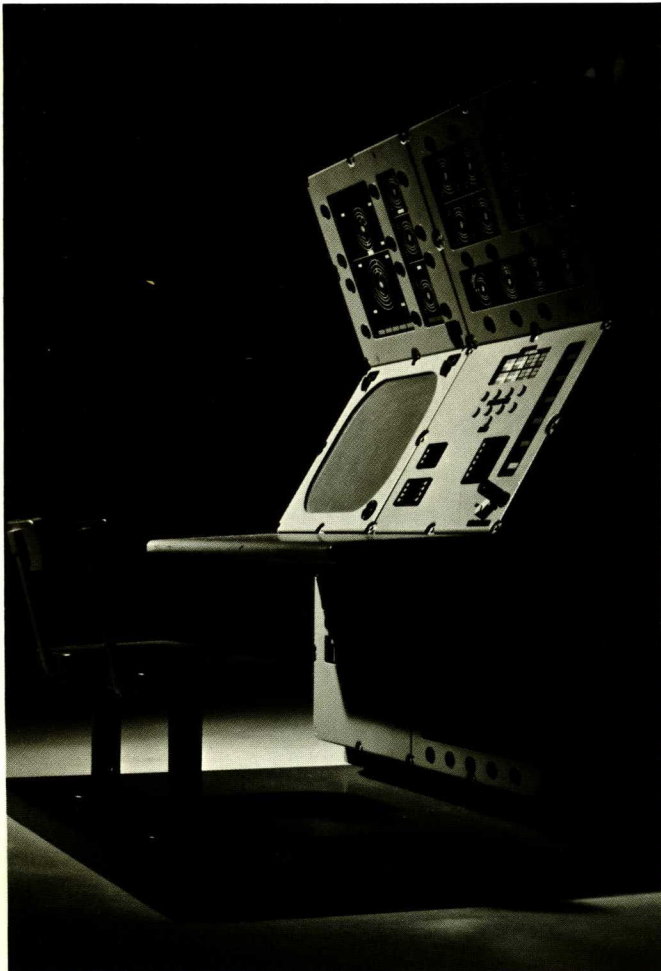
For the United States Air Force... AN/ASN-24(V) Navigation Computer Set (above) for automatic in-flight navigation of the USAF's new, globe-circling C-141 jet transport.

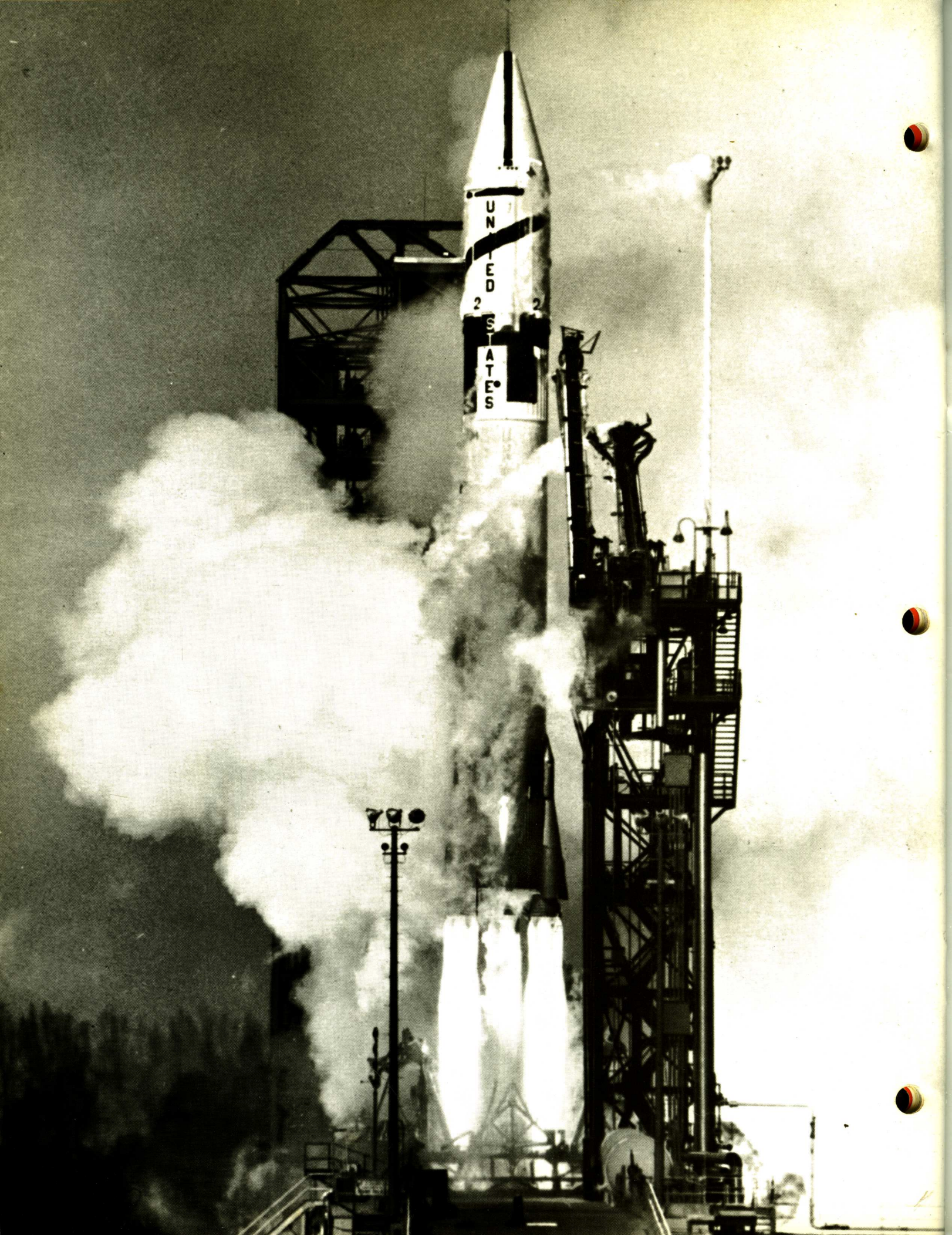
For the U.S. Navy... Underwater Fire Control System (UFCS) Mk 113, page 24, which directs the firing of the U.S. Navy's long-range SUBROC missile from a submerged submarine. UFCS Mk 113 is the first submarine-installed antisubmarine warfare (ASW) weapon control system with multiple-target capability.

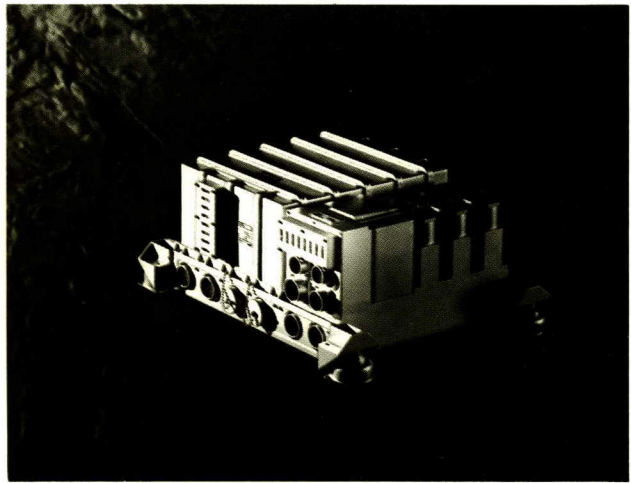
For the U.S. Navy... Underwater Fire Control Group (UFCG) Mk 111 which controls the U.S. Navy's deadly ASROC missile. Librascope-produced Attack Console Mk 38 (see model below at left) contains the first electronic digital computer developed specifically for ship-board use in ASW fire control.

For Business and Industry... LGP* 21 Electronic Computer (below), first full-capability, suitcase-sized, general-purpose, low-cost digital computer with a large disc memory.

*Trademark, General Precision, Inc.







For NASA's Centaur Spacecraft... the first digital computer specifically designed to guide a space vehicle with large payloads to the moon, Venus, and Mars. First successful launching of the hydrogen-powered Centaur is pictured on page 26.

For NASA's Centaur Spacecraft... Librascope's L-31 digital computer is shown (above) symbolically superimposed on a photo of the moon's surface. This 0.55 cubic-foot, 38-pound (excluding input-output system) computer will perform guidance functions on-board the powerful Centaur, America's first rocket powered by liquid hydrogen.

For the Federal Aviation Agency... an L-3020-type configuration of equipment (below)—first electronic computing subsystem designed specifically for semiautomatic control of jet-age air traffic.



company background

The Librascope Group of General Precision, Inc., joins the facilities and capabilities of an Avionic Equipment Division, a Commercial Computer Division, a Surface Equipment Division, and a Research and Systems Center into a single, unified entity.

Located on the West Coast—the nation's major center of aerospace and electronics activity—the group serves the growing needs of several important segments of the U.S. economy.

Within its Avionic Equipment Division and Surface Equipment Division, Librascope develops, produces, and markets a wide range of military and aerospace information processing systems, computers, controls, and components for application in the U. S. government and the nation's defense establishment. Responsibility for production, marketing, and installation of L-3055 systems, for example, rests with Librascope's Surface Equipment Division.

Librascope's Commercial Computer Division develops, produces, and markets electronic general-purpose computers, information-processing systems, components, and controls for application in science, business, and industry.

A well-balanced program conducted within the Research and Systems Center forms the basis for (1) determining Librascope's new areas of interest, (2) utilizing advanced technologies, and (3) broadening systems efforts.

Librascope activities are housed in modern, air-conditioned buildings covering 650,000 square feet of floor space. The group's payroll totals about 3000 people, with a high percent of technical, engineering, and scientific personnel. Facilities and employees of the Librascope Group are supplemented by the nationwide resources of General Precision, Inc., principal operating subsidiary of General Precision Equipment Corporation of Tarrytown, N.Y.

sales offices

California

808 Western Avenue
Glendale 1
Telephone: 213-245-8711

670 Arques Avenue
Sunnyvale
Telephone: 408-736-9290

Massachusetts

Wellesley Office Park
Wellesley Hills 81
Telephone: 235-8750

Ohio

Gateway Exchange Bldg.

3609 North Dixie Drive
Dayton 14
Telephone: 513-178-4833

District of Columbia

808—17th Street, N.W.
Washington 6
Telephone: 202-298-7126

