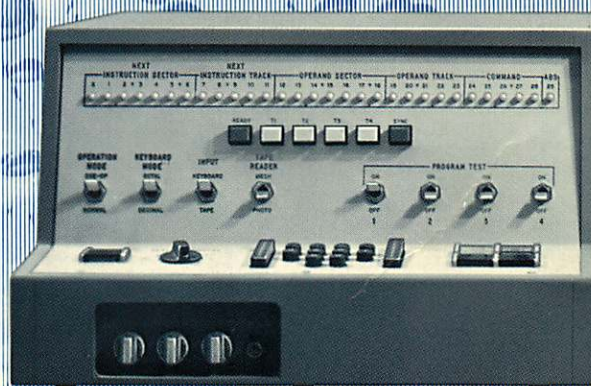A
PORTABLE
GENERAL-PURPOSE
DIGITAL
COMPUTER
FOR
RUGGED
MILITARY
USE:
THE

L-2010

BY
LIBRASCOPE

THE L-2010: Highly reliable, lightweight digital computer designed specifically for military applications. Performs most of the functions normally assigned to equipment several times its size and price. Takes shipboard and vehicle shock and vibration in stride without impairing operational efficiency.

A NEED FULFILLED ...ECONOMICALLY
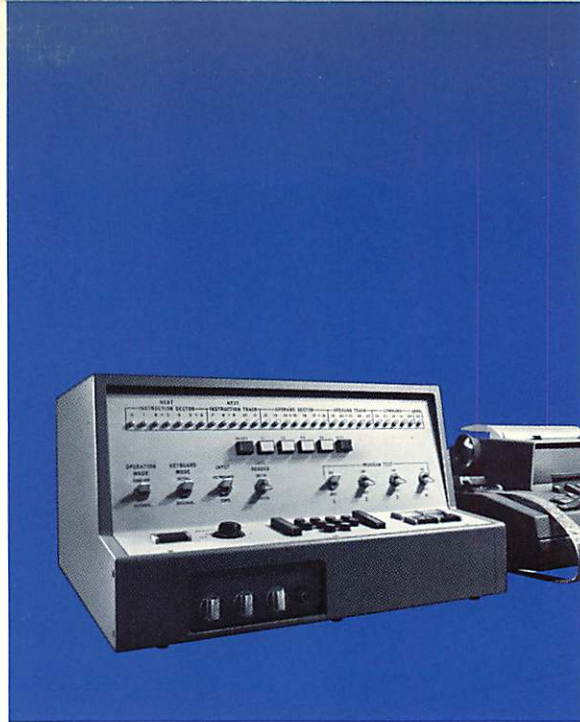
Librascope's L-2010 fulfills the growing need for a rugged, compact digital computer offering the data-processing capabilities of larger systems at a fraction of their cost.

Moderately priced, the L-2010 now makes the speed and efficiency of electronic computing economically attractive for many applications in which, previously, computer costs were prohibitive.

And many military problems, once considered too complex for small, general-purpose computers, fall well within L-2010 capability.

THE BASIC UNIT

The general-purpose L-2010 is a solid-state, stored-program digital computer designed to operate as a self-contained system or as a unit integrated into a computing complex. Its instruction repertoire of 32 commands plus variants and memory-storage capacity of 4096 30-bit binary words provide programming capability unsurpassed in its computer class.*

The L-2010 weighs only 60 pounds and occupies just 2.0 cubic feet in volume. It can be rack-mounted or placed on a desk.

Fully portable when equipped with a carrying case†, the L-2010 goes where it is needed. For field use, its carrying case can be fitted with removable legs. Inside and out, the L-2010 is built to ride in jeeps, trucks, vans, and other land vehicles, and on board ships.

*A FIELDATA code compatible unit is under development
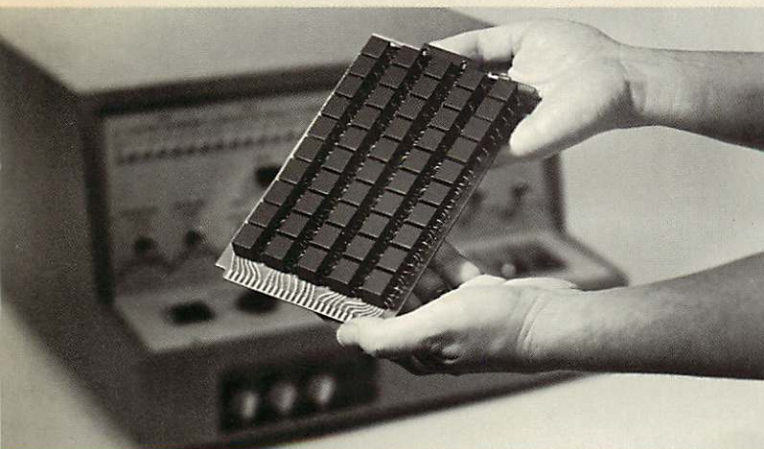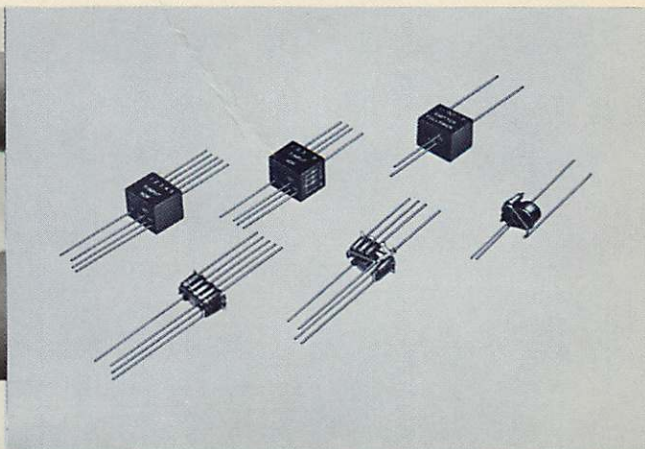†Optional.
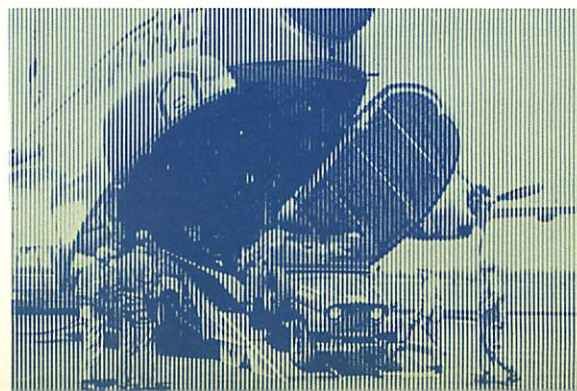
RUGGEDNESS AND RELIABILITY The L-2010 is designed to meet the requirements of MIL-E-16400C. Silicon semiconductors are used throughout the computer and wide tolerances are designed into all circuits.

Choice of components, materials, and processes for the L-2010 resulted from a comprehensive 2-year evaluation program at Librascope. Metallurgical, strength, and environmental tests dictated selection of a carefully controlled welding technique to assemble L-2010 circuit modules. Besides being a reliable joining method, welding increases reliability by eliminating failures associated with soldering techniques applied to miniaturized packaging.
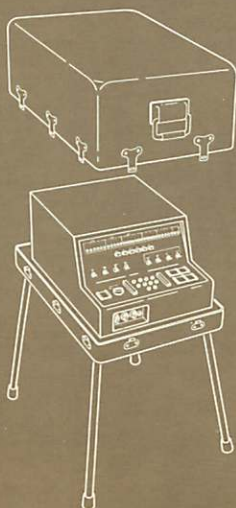
Reliability is further enhanced by encapsulating circuit modules in a carefully selected epoxy resin. This encapsulation assures operation free from the effects of humidity, vibration, and stresses normally transmitted to components through their leads.

Typical L-2010 circuit assembly designed, built, and tested to withstand effects of rugged military environments.

Welded modules assure high-component density and maximum reliability.

INPUT
SELECTION

REGISTER
DISPLAY

SELF-
CONTAINED
KEYBOARD

OPERATION-
CONTROL
SWITCHES

PROGRAM-
CONTROL
SWITCHES
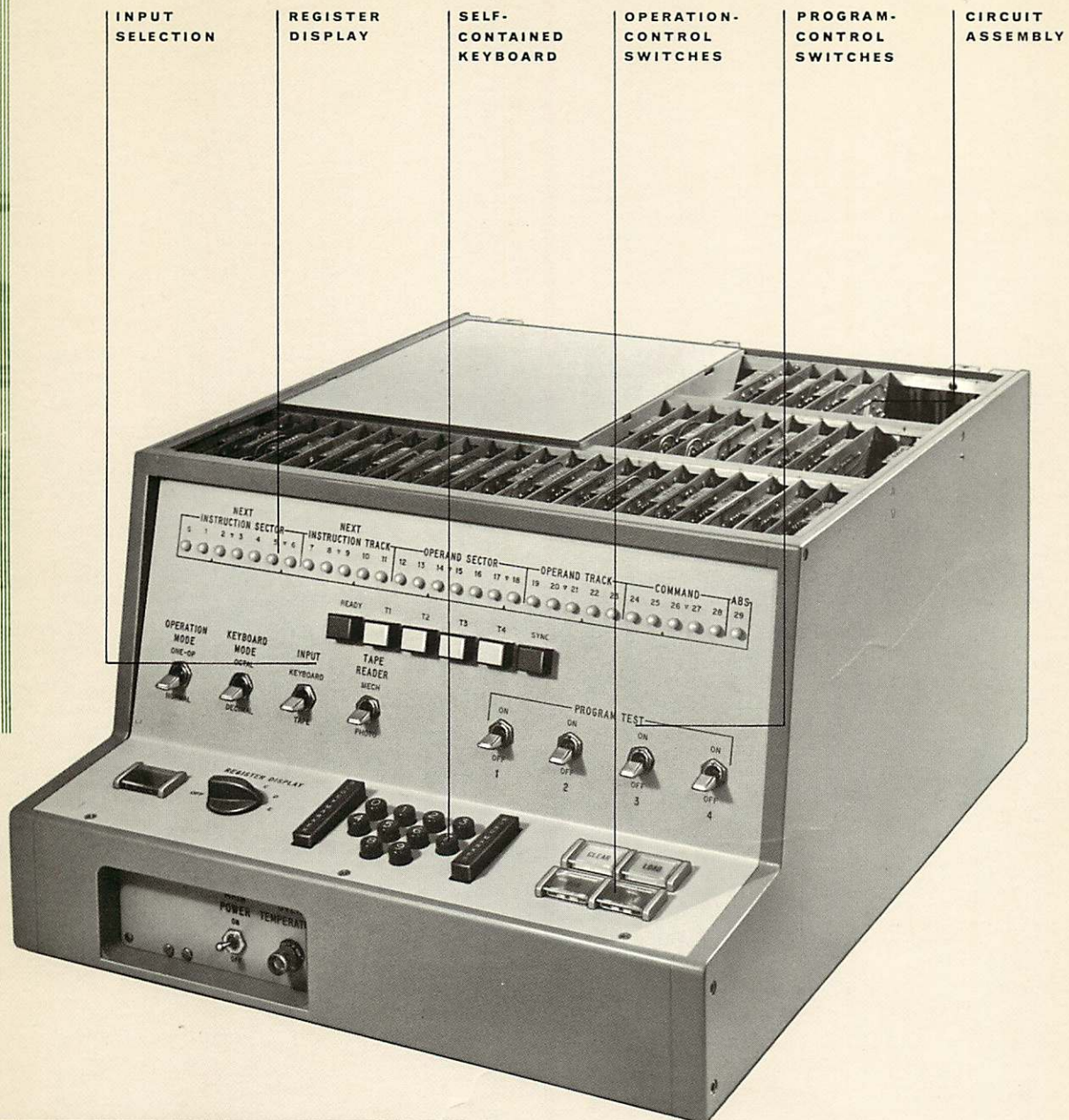
CIRCUIT
ASSEMBLY

*For field operation, optional carrying case makes L-2010
fully portable.*

MINIMUM MAINTENANCE

Repetitive use of three types of basic circuit modules minimizes both maintenance and spare-parts requirements for the L-2010.

Two of the three modules result from Librascope packaging for the basic logical element—a resistor/diode-coupled NOR circuit used in all logic gates and flip-flops. For highly efficient parts utilization, the circuit is packaged in two different forms: a three-input module and a five-input module.

The third basic module is an emitter-follower element, used to provide additional driving power where required.
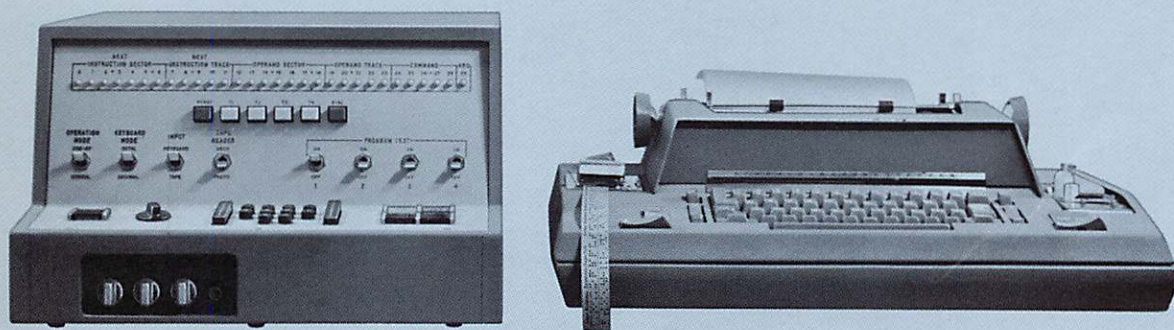
OPERATIONAL CHARACTERISTICS Military environments and applications demand simplicity and flexibility of operation. The L-2010 offers both.

Its features permit manned operation and full or semiautomatic operation.

The unit communicates directly with paper-tape input and output equipment. Its controls permit:

1. Manual selection of inputs from either of two types of paper-tape readers.

2. Automatic transfer of outputs to either a paper-tape punch or typewriter.

The L-2010 also offers buffered operation through a special input/output channel. Use of this channel permits communication with analog-to-digital conversion devices, other L-2010 systems, magnetic-tape systems, etc. without modification to the basic L-2010 unit.

For manned operation, the unit's self-contained keyboard permits manual insertion of input data. Special control switches permit rapid and positive manual selection of alternate program modes of operation.

*A FIELDATA code compatible unit is under development
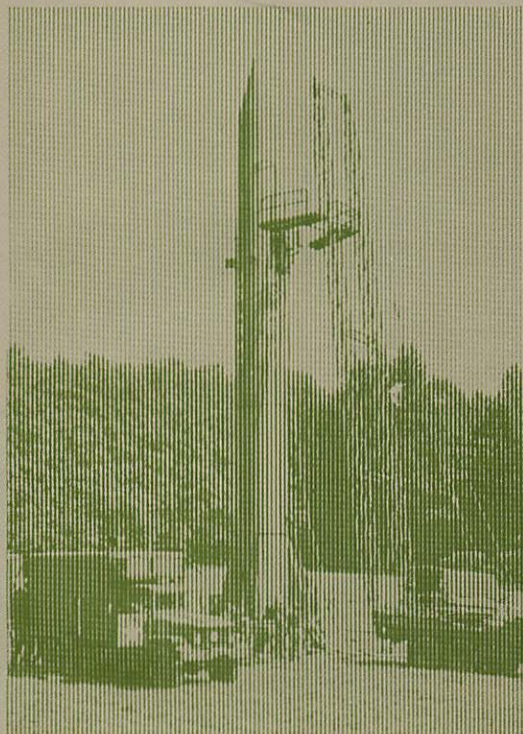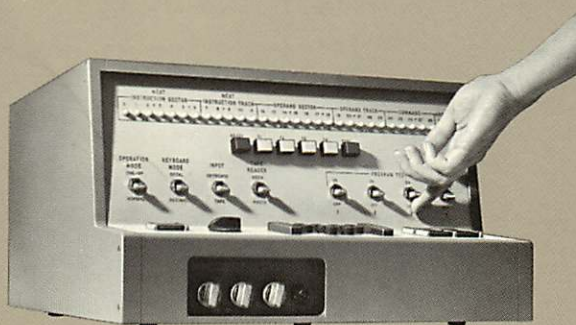
Programming and Numerical System

Internal Number System......binary
Binary Bits/Words............30 (29 + sign)
Instruction/Word.............1
Instructions Decoded........32 + variations
Instruction Type ....one-plus-one
relative address or
absolute address
Arithmetic System ....fixed point, two's
complement
Number Range ....−1 ≦ N < 1

Instruction-Word Format

Memory Instruction Format

Bits	12	12	5	1
	Next Instruction Address	Operand Address	Operation Code	*

Nonmemory Instruction Format

| Bits	12	7	5	5	1
	Next Instruction Address	Instruction Duration Count†	Register Address	Oper-ation Code	*

* Absolute bit: A bit in this position designates absolute rather than relative addresses in the associated instruction word.
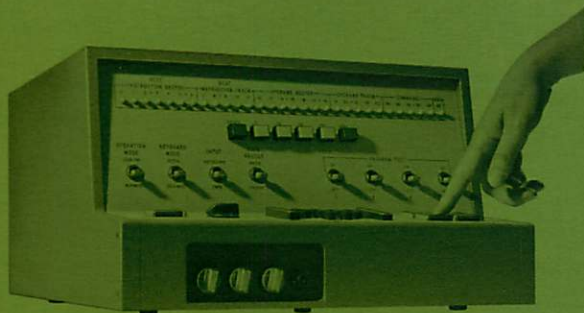
† Instruction duration count: Used to determine length of multiply, divide, and shift commands.

Arithmetic Execution Times

Addition...........78 μsec
Subtraction........78 μsec
Multiplication......156 μsec minimum
2.42 msec maximum
Division ....234 μsec minimum
...........2.5 msec maximum
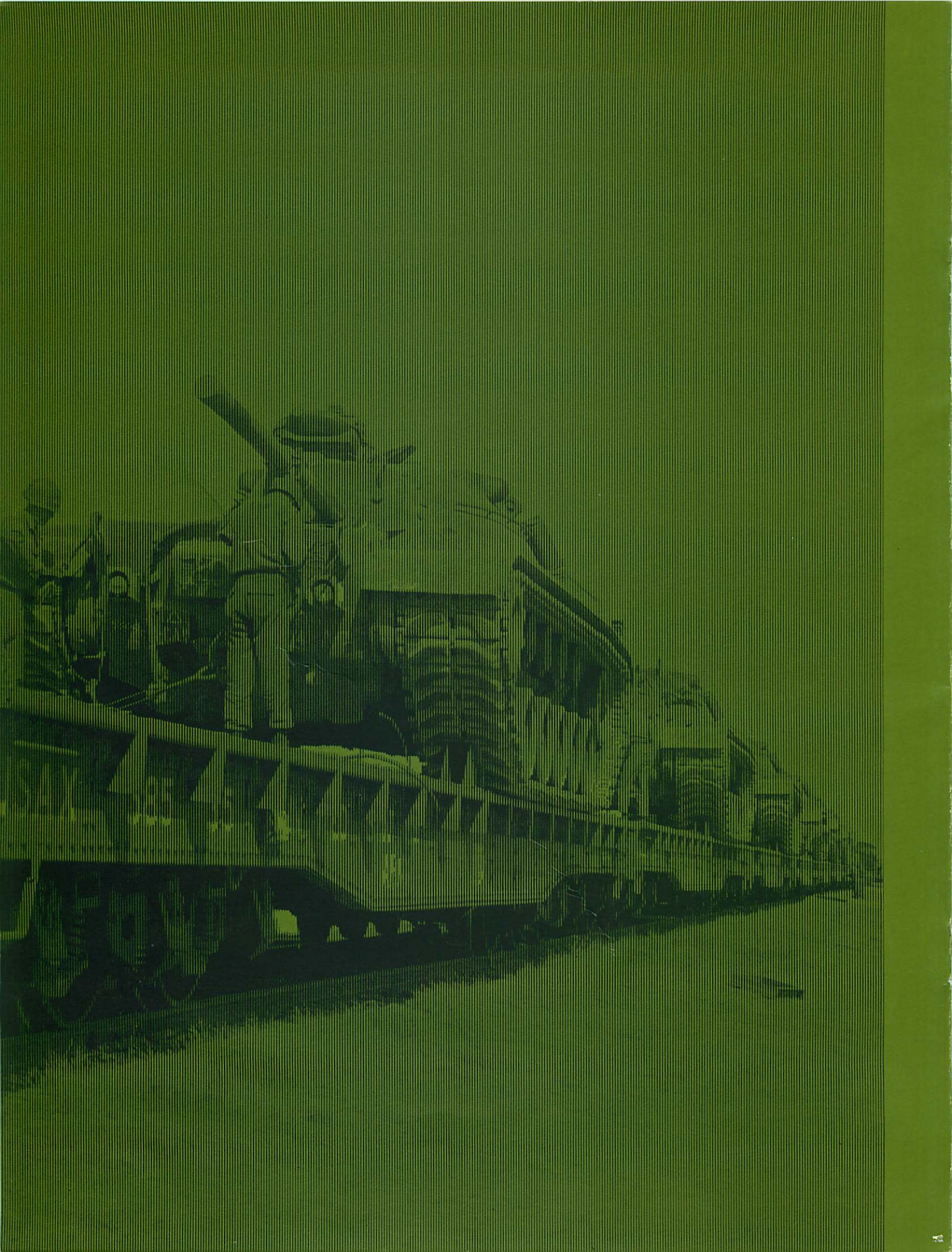
Arithmetic Registers

Four arithmetic registers designated A, B, D, E.

A   High-order accumulator
B   Multiplicand-divisor register
D   Auxiliary register
E   Low-order accumulator

The register address bits in the nonmemory instructions are used in addressing the arithmetic registers.

Input/Output Buffer Channel

One input/output buffer channel, designated F.

Storage

Type . . . . magnetic disk, 6000 rpm
Capacity. . . . . 4096 words general storage
Access Time. . . . . . 5 msec (nonminimal programming)
                       78 μsec minimum (minimal programming)

Direct-Input Capability

Keyboard
Either of two paper-tape readers—up to 300 char/sec

Direct-Output Capability

Binary lamp display
High-speed paper-tape punch—100 char/sec
Typewriter

Typical Buffered-Input Capability

32 shaft encoders
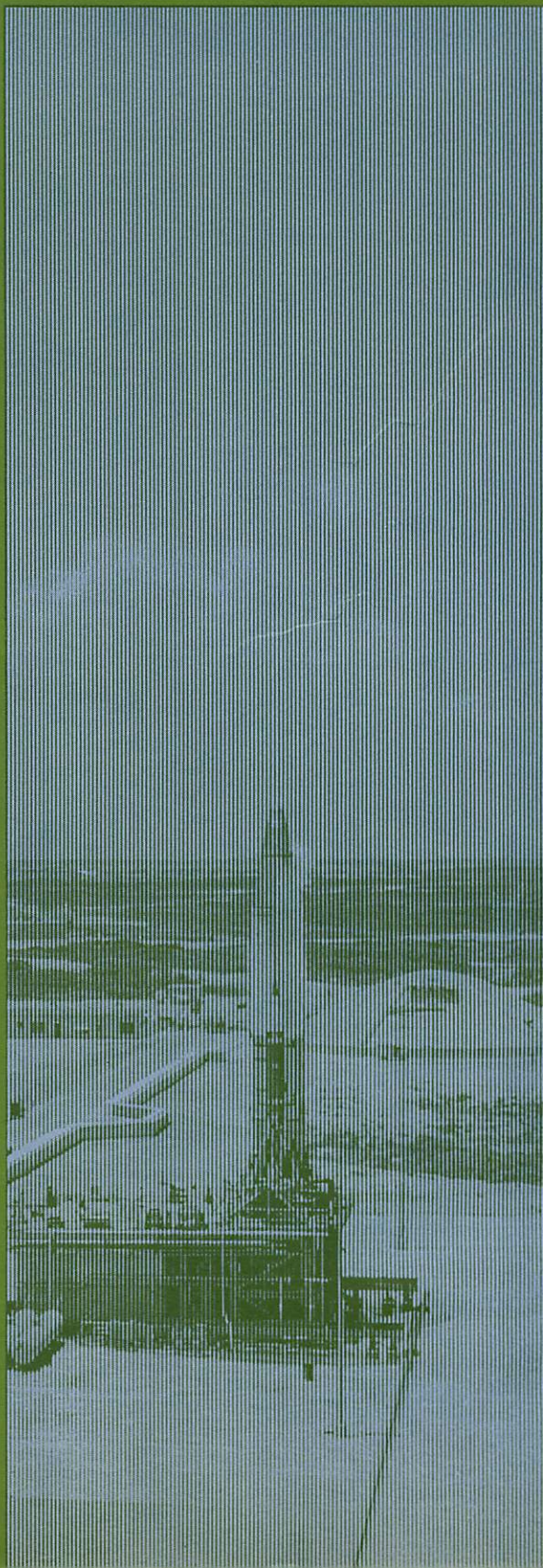16 scaled voltages
16 registers

Typical Buffered-Output Capability

32 digital servo error signals
16 scaled voltages
16 registers

Power, Size, Weight

Power. 500-watt, 400-cycle, 3-phase
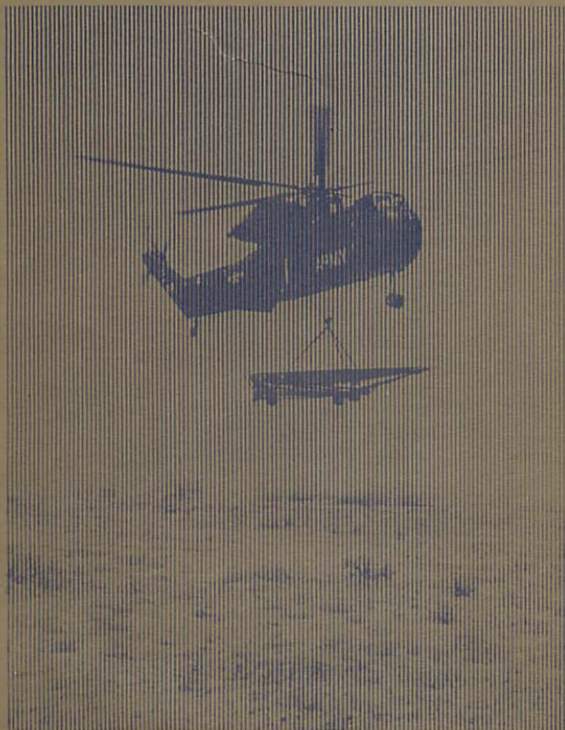Size . . . . 2 cubic feet
Weight. . . . . . 60 pounds

NOTE: The instruction repertoire for the L-2010 is available on request.

L-2010 fits atop standard-sized desk. Compact design facilitates installation where space is critically limited.

TYPICAL L-2010 APPLICATIONS

Its unique design features and operating characteristics fit the L-2010 general-purpose computer to a remarkably broad scope of military data-processing and recording applications.

As a self-contained system, the L-2010 can perform capably in virtually any ground or ship-based military situation or location. Within its capacity, the unit can solve problems that require real-time computing and data display. And since its word length is compatible with that of many larger systems, the L-2010's total applications range up to missile checkout and other complex functions.

Some typical applications of the basic L-2010 unit and functions which it could perform are:

TARGET-MOTION ANALYSIS Real-time sensor data processing, coordinate transformations, and data-smoothing operations to rapidly provide highly accurate target intelligence.

NAVIGATION Precise computations for navigation in conjunction with satellite and high-frequency radio transmissions. Input-output flexibility makes L-2010 useful as computing element in complex inertial guidance systems.

BALLISTIC COMPUTATION Trajectory computations and predictions of weapon-impact points; missile tracking, and calculations of orbits for space vehicles.

SYSTEM SIMULATION Simulation of any system whose operation can be portrayed by mathematical equations. In a war-games application, for example, L-2010 could approximate tactics of an enemy force and evaluate response of defensive units.

AUTOMATIC SYSTEM CHECKOUT Automatic checkout of complex electromechanical analog and electronic digital systems. Rapid isolation and malfunction reporting for maintenance purposes.

Other potential applications include military records keeping, supply depot inventory control, preventive maintenance scheduling, and oceanographic data reduction. The L-2010 can also be used in satellite operations either to perform secondary computations or to act as a buffering unit.
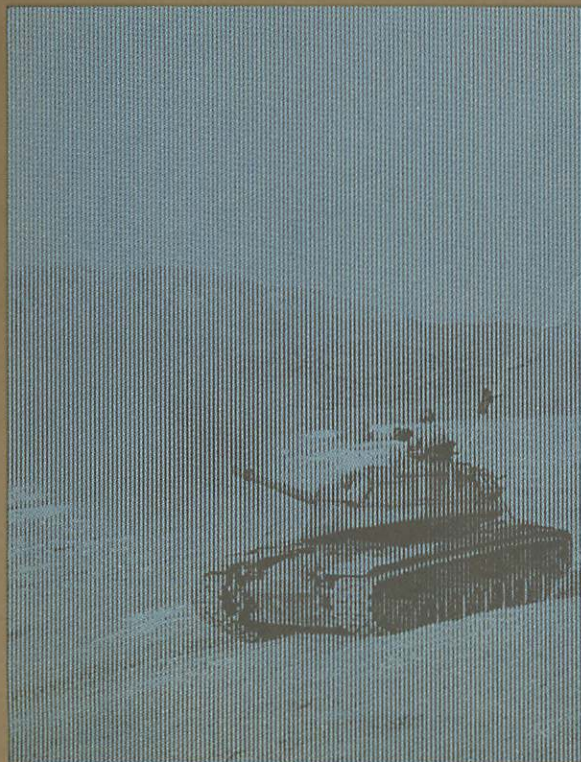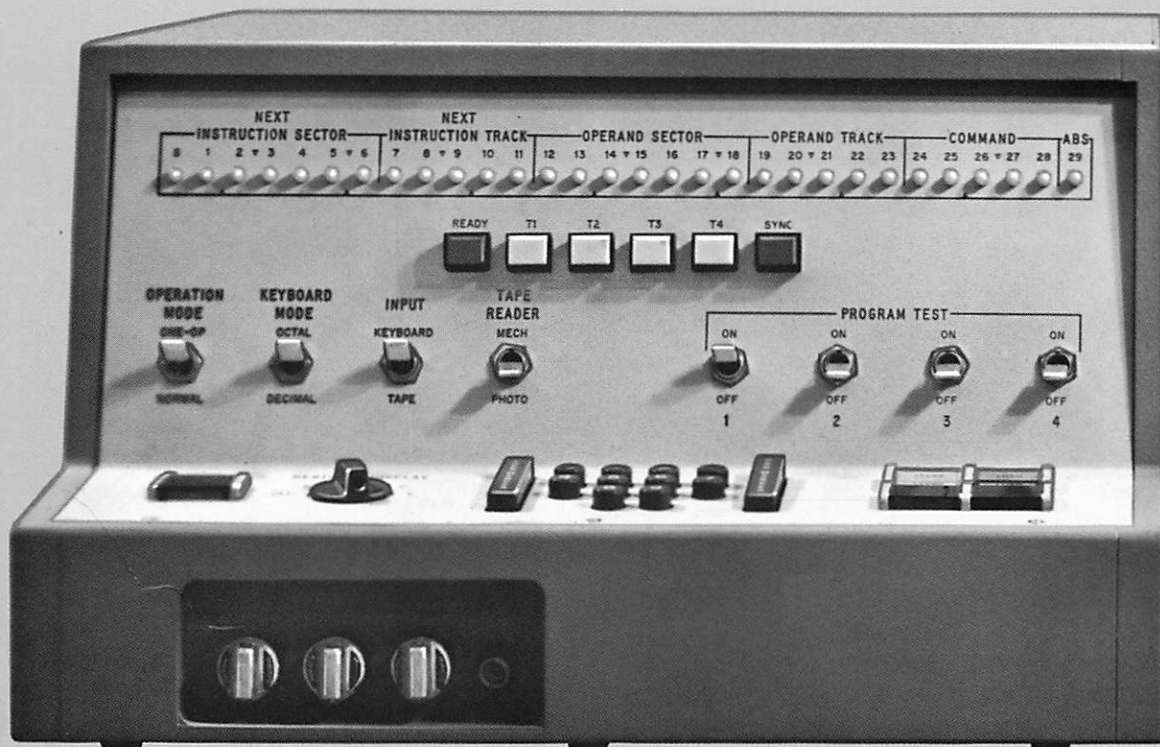
LIBRASCOPE, A LEADER IN COMPUTER TECHNOLOGY

LIBRASCOPE, A LEADER IN COMPUTER TECHNOLOGY The L-2010 is produced by Librascope, one of the nation's leading designers and manufacturers of digital and analog computers, controls, and components.

Founded in 1937, Librascope has established an excellent reputation for the high reliability of systems which serve in a broad range of weapon-control, space-vehicle guidance, and industrial-control applications.

A division of General Precision, Inc., Librascope has developed and/or produced many of the under water fire control systems used in the Navy's antisubmarine surface fleet.

Among its many notable achievements in pacing computer technology, Librascope has designed, developed, and produced:

UNDERWATER FIRE CONTROL GROUP (UFCG) MK 111 for the ASROC Weapon System. UFCG Mk 111 contains the first electronic digital computer developed specifically for shipboard ASW fire control. / **UNDERWATER FIRE CONTROL SYSTEM (UFCS) MK 113**, the Navy's first submarine-installed ASW fire control system using electronic digital computing equipment. **AN/ASN-24 COMPUTER**, first lightweight, compact digital computer developed, under a U.S. Air Force contract, to perform on-board guidance and control functions for aircraft, missiles, and spacecraft. **LIBRASCOPE* 3000 MULTIPLE DATA PROCESSING SYSTEM**, a large-scale, multiple computer system for use in command-and-control operations and management-information systems. **RPC* 4000**, a high-speed, solid-state electronic computing system currently used for scientific and varied management applications. **LGP 30***, first desk-size, general-purpose digital computer for scientific and engineering use.

The company also produces (1) infrared and optical systems for communication and celestial navigation functions, (2) precision photogrammetric instruments, and (3) missile ordnance systems.

Librascope applied research personnel are investigating physical principles in several basic areas of science including solid-state physics. Narrow-band interference filters, infrared detectors, magnetic thin films, electroluminescence, and thermoelectricity are current areas of study.

Advanced research activities at Librascope center around studies in automata and artificial intelligence. Funding for these basic research programs is currently provided by the company and the U.S. Air Force.

*Trademark, General Precision, Inc.

To obtain more information about specific L-2010 applications, price, and delivery schedule, call or write—

Customer Relations
Librascope / Glendale Branch
Glendale 1, California
CHapman 5-8711

or contact one of the following regional sales offices:

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General Precision, Inc.
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