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Space TECHNICAL INFORMATION DIGEST

SPACE SYSTEMS INFORMATION BRANCH, GEORGE C. MARSHALL SPACE FLIGHT CENTER

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UPPER ATMOSPHERE TESTS COMPLETED. In mid-December, 1962, a four-point basic research program aimed at learning more about the ionosphere was concluded. The end of the program came with the completion of a two-month series of 27 rocket-launched chemical releases into the upper atmosphere. The program, designated Project Firefly 3, was conducted by scientists of the Air Force Cambridge Research Laboratories (AFCRL), Bedford, Massachusetts. The information gathered will eventually aid pilots of the X-20 (Dyna-Soar) orbital vehicle.

Some of the rocket-boosted payloads were designed to create "holes" in the ionosphere by removing electrons from the E and F layers of the region. The ionosphere, designated in alphabetical layers by scientists to indicate intensity of negative charge, is a part of the atmosphere that reflects certain radio waves back to the Earth's surface. These layers surround the Earth up to altitudes of 640 km (400 mi).

Other payloads were designed to do the opposite by creating a higher-than-normal electron density useful in propagation studies.

A third series of chemical releases produced nighttime glow that enabled tracking stations to measure upper atmosphere winds, wind shear, and turbulence. The last of the experimental probes involved the use of high altitude grenade explosions to enable AFCRL scientists to observe shock wave disturbances of the ionosphere.

A photograph, taken at midnight, of an aluminum oxide and cesium chemical trail released from a Nike-Apache rocket showed unique wind shear phenomena. The trail left by the chemicals was over 48 km (30 mi) long, reaching from an altitude of 96 to 144 km (60 to 90 mi). Before this experiment, wind motions at this altitude could be photographed only at sunrise or sunset.

Dr. N. W. Rosenberg, AFCRL scientist in charge of the project, said that in the electron depletion experiments a sausage-shaped hole was created in the ionosphere's F-layer. A smaller hole was formed in another experiment in the E-layer.

The multiple grenade explosions, made at altitudes up to 112 km (70 mi), were easily recorded by detectors on the ground. The success appears due to an unusually quiet location of the detectors, increased detector sensitivity, and the use of higher explosive weights than those used in previous experiments. In this technique scientists apply the physical law that sound travels at different speeds at different temperatures. This was the first time that the explosive grenade temperature measurement technique has been extended into the E-layer. (Source: Office of Aerospace Research release (USAF))

TIROS TRANSMITTED OVER 203,300 TV CLOUD PICTURES THROUGH END OF 1962. More than 203,300 television pictures of the Earth's cloud cover had been transmitted by the Tiros meteorological satellite system through the end of 1962, NASA officials recently disclosed.

Tiros 5 and 6, still operating, are providing operational weather data while continuing to serve as a vehicle for research and development. Since April, 1960, six Tiros satellites have been launched and orbited successfully in six tries. They have logged

a total of 1157 days of useful life in that time, averaging more than twice the designed 90-day operational life of each satellite (see Table I). Tiros has reported data concerning ice floes, has given advance warning on hurricanes and other unusual weather phenomena, and has furnished information for intra-governmental and international use.

Three of these spacecraft were instrumented with NASA infrared experiments, and the vast amount of data acquired is currently being studied by NASA and the U. S. Weather Bureau. Cited as a typical use of space for peaceful purposes, Tiros has been used in launch support of deep space probes such as Mariner and Ranger, and for the suborbital and orbital Mercury launches, NASA officials said. (Source: Data supplied by Radio Corporation of America)

VERSATILE SPACE-PROBE BOOSTER ANNOUNCED.

A proposed space research vehicle, called Pegasus, was recently disclosed by the Martin Company. Designed as an economical and versatile space probe for use at altitudes up to 5600 km (3500 mi), the Pegasus (Fig. 1) would be capable of a variety of missions as either a two- or three-stage vehicle. The company has revealed details of the vehicle's capability:

1. Ability to transport a 1-ton payload to an altitude of 295 km (185 mi); 0.5 ton to 590 km (367 mi); 230 kg (500 lb) to 1080 km (690 mi); or 45 kg (100 lb) to 3200 km (2000 mi) in the three-stage configuration.

2. Transportation by the two-stage vehicle of a ton to an altitude of 190 km (120 mi); 0.5 ton to 320 km (200 mi); 230 kg (500 lb) to 445 km (275 mi); or 45 kg (100 lb) to 590 km (365 mi).

The reentry velocities, measured with a flight path of -15 deg at 93,000 m (300,000 ft), vary from 7000 m/sec (21,140 ft/sec) with a 45-kg (100-lb) payload for the 2-stage version to 1700 m/sec (5579 ft/sec) with a 1-ton payload for the three-stage version.

The over-all length of the proposed vehicle is 10.7 m (35 ft) for the three-stage version; the weight is 4530 kg (10,000 lb); and the payload diameter is 76 to 100 cm (30 to 40 in.). Propulsion would be provided by a solid propellant motor; the guidance system could be inertial or a simple "strapdown" reference system.

Table 1. Tiros Highlights

	1	2	3	4	5	6	Total
Launch Date	4/1/60	11/23/60	7/12/61	2/8/62	6/19/62	7/18/62	
Useful Life (a)	89 days	376 days	230 days	161 days	196 days (b)	105 days (b)	1157 days
Total TV Pictures	23,000	37,000	36,000	32,500	42,400 (b)	32,400 (b)	203,300

Performance: Peaceful use of space in advance hurricane and typhoon warnings, charting ice floes, intra-governmental and international use, support of deep space probes and manned space flights.

(a) Designed life of the satellite: 90 days

(b) Still operating as of December 31, 1962

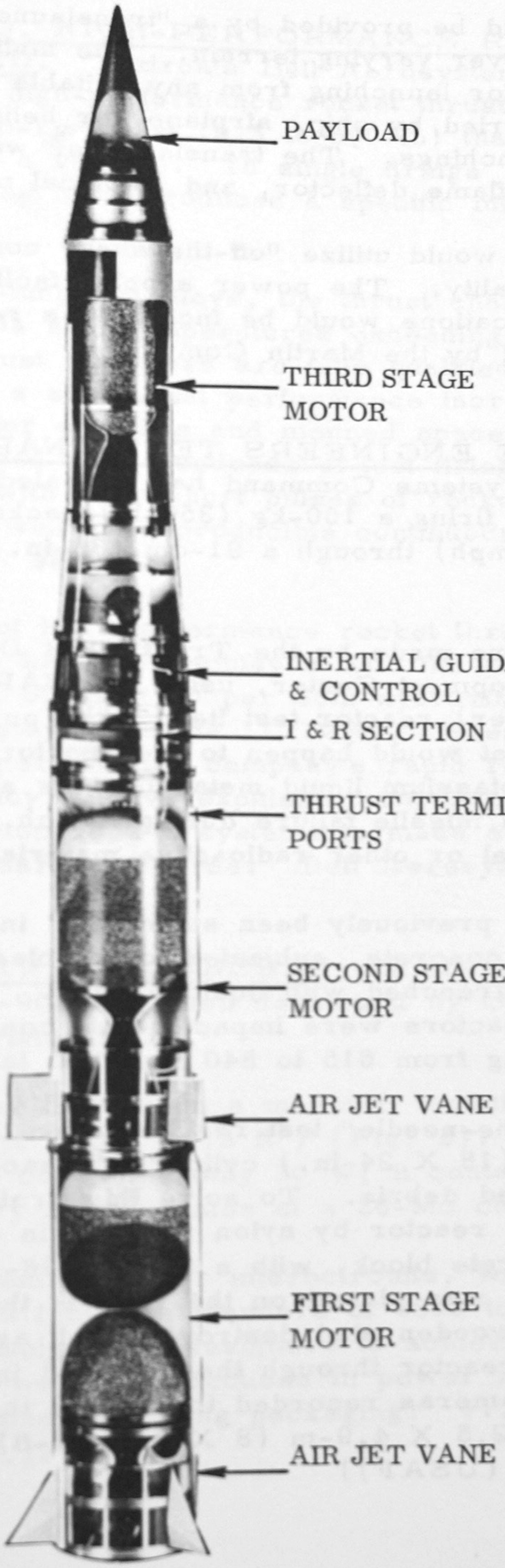
PAYLOAD
THIRD STAGE MOTOR
INERTIAL GUIDANCE & CONTROL
I & R SECTION
THRUST TERMINATION PORTS
SECOND STAGE MOTOR
AIR JET VANE
FIRST STAGE MOTOR
AIR JET VANE

FIG. 1

Mobility would be provided by a "translauncher" that could move the vehicle over varying terrain. The multipurpose space booster is designed for launching from any suitable location on Earth: it could be carried by ship, airplane, or helicopter for equatorial or polar launchings. The translauncher would include an erector, launch pad, flame deflector, and umbilical mast.

The concept would utilize "off-the-shelf" components and subsystems of proven quality. The power supply, facilities for launch control, and communications would be included as required. (Source: Data supplied by the Martin Company)

AIR FORCE ENGINEERS TEST SNAP REACTOR. The Air Force Systems Command has revealed that engineers have succeeded in firing a 160-kg (350-lb) package at speeds up to 840 km/hr (520 mph) through a 91-cm (36-in.) hole in a block of concrete.

The tests were made by the Track Test Division of the Air Force Missile Development Center, using a SNAP (system for nuclear auxiliary power) reactor test item. The purpose of the tests was to determine what would happen to the reactor, and particularly to the sodium potassium liquid metal used as a heat exchanger, in the event of a missile failure during launch. The reactors did not contain fuel or other radioactive material.

Reactors had previously been submerged in water, dropped 30 m (100 ft) onto concrete, subjected to the blast of 115 kg (250 lb) of TNT, and drenched with liquid oxygen. In the final track testing phase, the reactors were impacted onto concrete and water at speeds ranging from 615 to 840 km (380 to 520 mph).

The "thread-the-needle" test resulted from the need to impact the 46 X 61-cm (18 X 24-in.) cylindrical reactor onto water--without any rocket sled debris. To solve this problem, the designers suspended the reactor by nylon webbing in a sled made of maple. A large concrete block, with a 91-cm (36-in.) diameter conduit in the center, was placed on the rails of the track. At peak velocity, the wooden sled destroyed itself against the concrete block, throwing the reactor through the hole and into a tank of water. High speed cameras recorded the impact through the plastic walls of the 2.5 X 2.5 X 4.9-m (8 X 8 X 16-ft) tank. (Source: AFSC news release (USAF))

RADIATION-COOLED, HIGH-PERFORMANCE ROCKET MOTORS DEVELOPED. Textron's Bell Aerosystems Company has developed a line of high-performance rocket thrust chambers in the range of 0.23 to 230-kg thrust (0.5 to 500-lb) that has been operated successfully in a vacuum. In single firings extending for as long as 1 hr, they have produced a specific impulse equal to 320 sec.

Constructed of tantalum-tungsten alloys, the thrust chambers have been operated with stable skin temperatures exceeding 1500° C (2700° F). These thrust chambers are fully qualified for space flight. They represent a substantial performance increase in reaction control systems for satellites and manned space vehicles. This development is based upon hundreds of test firings during which cyclic operation with very short pulses of rocket thrust has been demonstrated, as well as reproducible continuous firings for periods as long as 3600 sec.

Evaluation of this type of high performance rocket thrust chamber for long duration firings has been achieved with the bipropellants nitrogen tetroxide and a blend of 50 per cent hydrazine and 50 per cent unsymmetrical dimethylhydrazine (UDMH). When utilized in complete systems incorporating the company's rapid response valving and high-efficiency positive expulsion propellant tankage, a new generation of reaction control systems is made available to the space vehicle designer. (Source: Bell Aerosystems Company)

COMPACT COMPUTER ANNOUNCED. An all-solid-state digital computer, called the L-90, has been developed by General Precision's Librascope Division.

Physically, the computer is built on a modular "building-block" concept with a volume of 7 dm^3 (0.3 ft^3) (Fig. 2). It weighs only 9 kg (20 lb), and consumes only 30 w; it contains an 8192-word permanent memory and operates at a 20-Mc clock rate.

This instrument uses semiconductor microcircuits, which reduce the electronic part count from the standard of 6800 to less than 1200. This reduction helped the designers to achieve simplicity and high reliability, as well as reductions in power requirements, weight and size (total size, including packaging: 11.4 X 28 X 33 cm (4.5 X 11 X 14 in.).

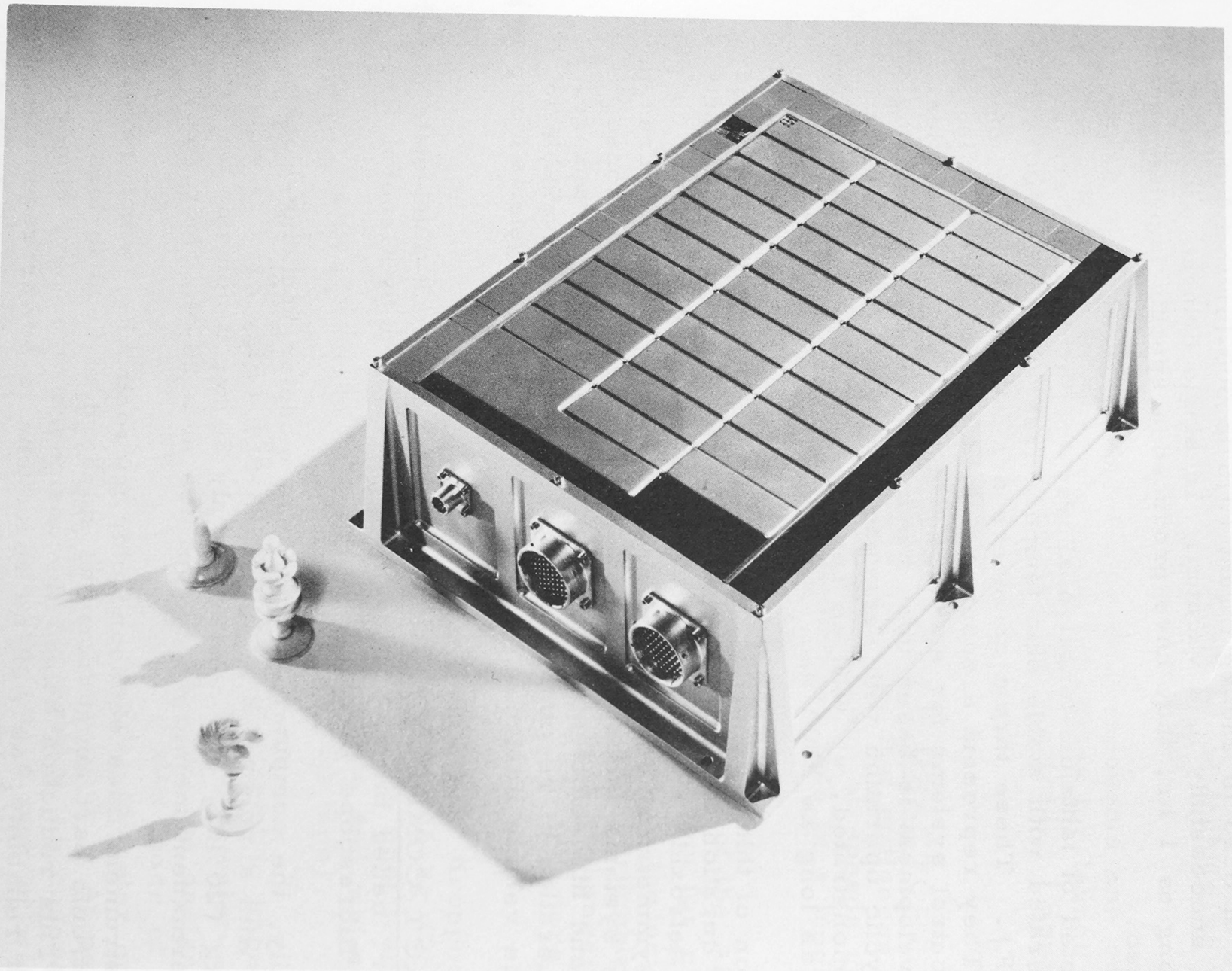

FIG. 2

The company says that the new computer can perform autopilot functions for satellite boosters, ballistic missiles, and manned or unmanned spacecraft. It will also be capable of checking inflight data of future jetliners, of collating sensor data to direct tactical aircraft against submarines, and of gathering and processing telemetry data. The modular "building-block" concept allows the computer flexibility in that arbitrary word lengths can be programmed and synchronous and asynchronous operations can be handled.

A magnetic unit known as the permanent random-access memory is the core of this computer. It is here that the 8192 28-bit words (instructions and constants) are stored. Word length of the nondestructive, nonvolatile memory can be altered electrically to meet a specific requirement and can be programmed. The memory can be built of any number of individual 512-word modules. A block diagram of the computer's basic organization is shown in Fig. 3.

There is an auxiliary computing unit, a sigmator, that accepts asynchronous pulse data and integrates the pulses at 11,000 iterations/sec.

The "thinking time" of the computer involves only 7μsec for addition, 105μsec for multiplication, and 203μsec for division. It performs 71,000 single-word operations/sec, including its instruction-reading.

The computer's packaging is described as being rugged enough to withstand the extreme conditions of a space environment. The circuitry, having been designed and tested for worst case conditions, should perform under temperatures ranging from -55° C to +125° C (-65° F to +255° F). The base of the instrument contains the power supply and a wire interconnection matrix for the permanent memory plug-in modules, both of which are imbedded in a 0.6-cm (0.25-in.) magnesium plate. (Source: Data supplied by General Precision, Inc.)

TECHNICAL REPORTS AVAILABLE. The following listed technical reports can be requested through the NASA library, M-MS-IPL, Bldg. 4481.

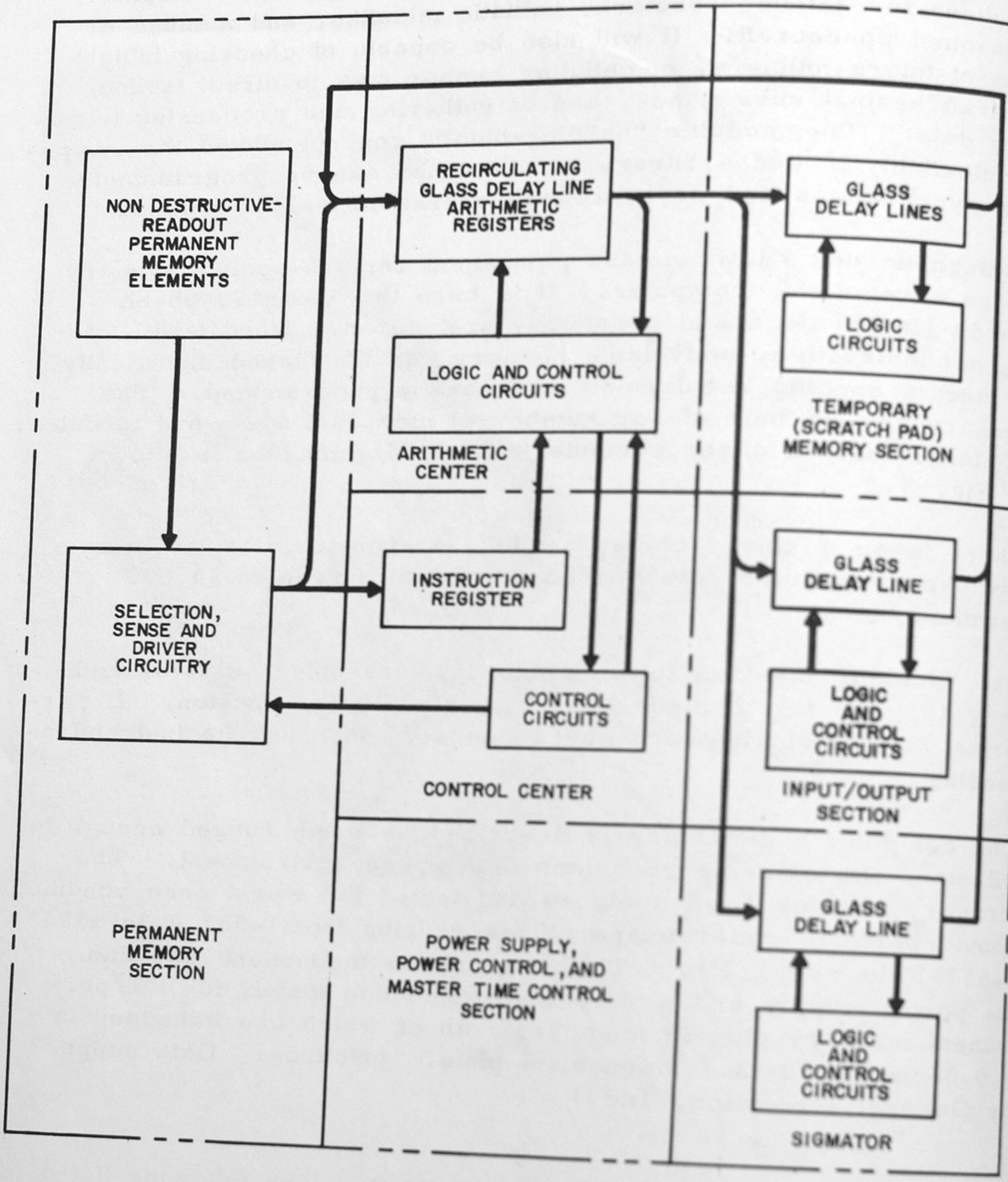
NON DESTRUCTIVE-READOUT PERMANENT MEMORY ELEMENTS
RECIRCULATING GLASS DELAY LINE ARITHMETIC REGISTERS
GLASS DELAY LINES
LOGIC CIRCUITS
TEMPORARY (SCRATCH PAD) MEMORY SECTION
LOGIC AND CONTROL CIRCUITS
ARITHMETIC CENTER
SELECTION, SENSE AND DRIVER CIRCUITRY
INSTRUCTION REGISTER
GLASS DELAY LINE
CONTROL CIRCUITS
LOGIC AND CONTROL CIRCUITS
CONTROL CENTER
INPUT/OUTPUT SECTION
GLASS DELAY LINE
LOGIC AND CONTROL CIRCUITS
SIGMATOR
PERMANENT MEMORY SECTION
POWER SUPPLY, POWER CONTROL, AND MASTER TIME CONTROL SECTION

FIG. 3

NOTE: Those reports with an AD number may be on file in the local ASTIA branch in Bldg. 4484. Readers can save time by calling 876-6088 and inquiring if such reports are available before ordering them through NASA.

1. THE ALLOCATION OF SYSTEM RELIABILITY. Volume I, Development of Procedures for Reliability Allocation and Testing, H. S. Balaban and H. R. Jeffers. AD 282 271
2. DATA FLOW: THE GENERAL PROBLEM AND COGNITIVE MODEL, C. W. Dean and J. V. Lisovich. AD 283 252
3. SUBJECT INDEX, BIBLIOGRAPHY, AND CODE DESCRIPTION OF TECHNICAL CONFERENCE PAPERS ON PLASTICS, 15 February 1961 - 23 February 1962, A. E. Molzon. AD 282 795
4. A DISCUSSION OF SIGNAL AND NOISE ELECTRONIC SIMULATION EQUIPMENTS FOR INFRARED SIGNAL PROCESSING CIRCUITRY DESIGN AND DEVELOPMENT, C. R. Seashore. AD 275 364
5. LITERATURE REVIEW OF NEAR INFRARED ATTENUATING MEDIA, R. A. Coleman and H. C. Donoian. AD 283 443