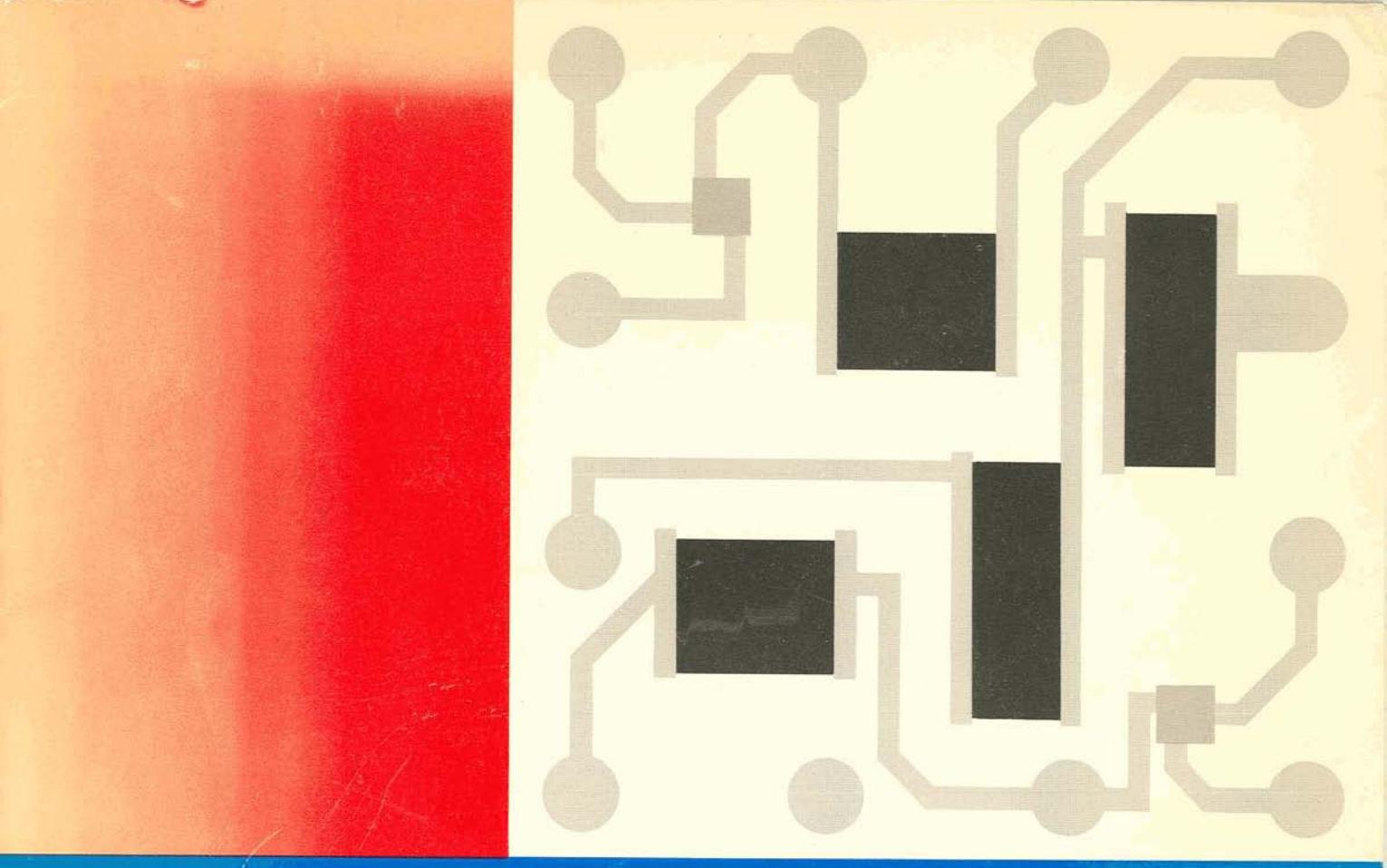


Customer Engineering Announcement

IBM System/360


IBM
SYSTEM/360

IBM System/360

IBM System/360

The IBM System/360, a totally new, all-inclusive concept in data processing, is the result of the combined efforts of IBM's international resources in data processing knowledge. Available in a complete range of sizes, speeds, and configurations, this newest data processing system offers:

Entirely new, more reliable solid logic technology

Processing units in five distinct sizes, each with the same instruction sets

Binary and decimal number handling with equal facility

Character handling

Bit manipulation

Fixed and variable data lengths

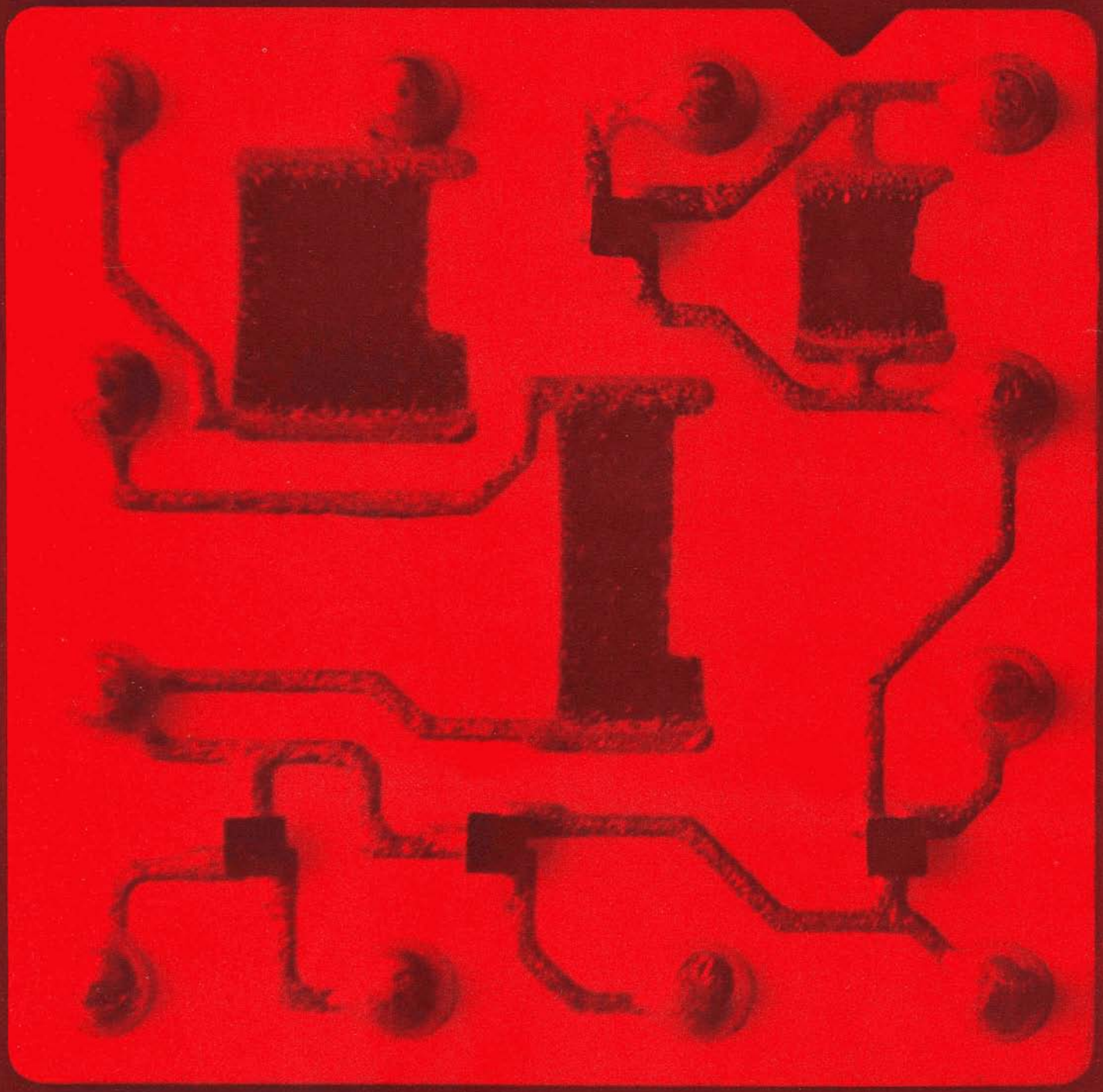
Both add-to-storage and add-to-accumulator operation

Indexing, address modification, and indirect addressing

Large addressing capacity

Easier program relocation

I/O units connecting through one standard I/O interface



Solid Logic Technology

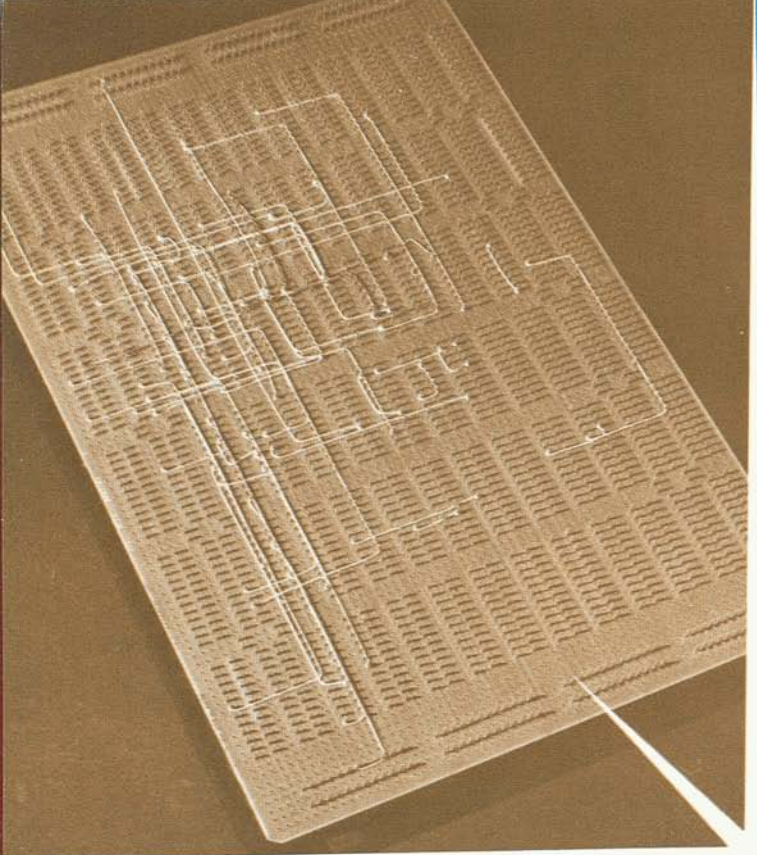
THE MODULE

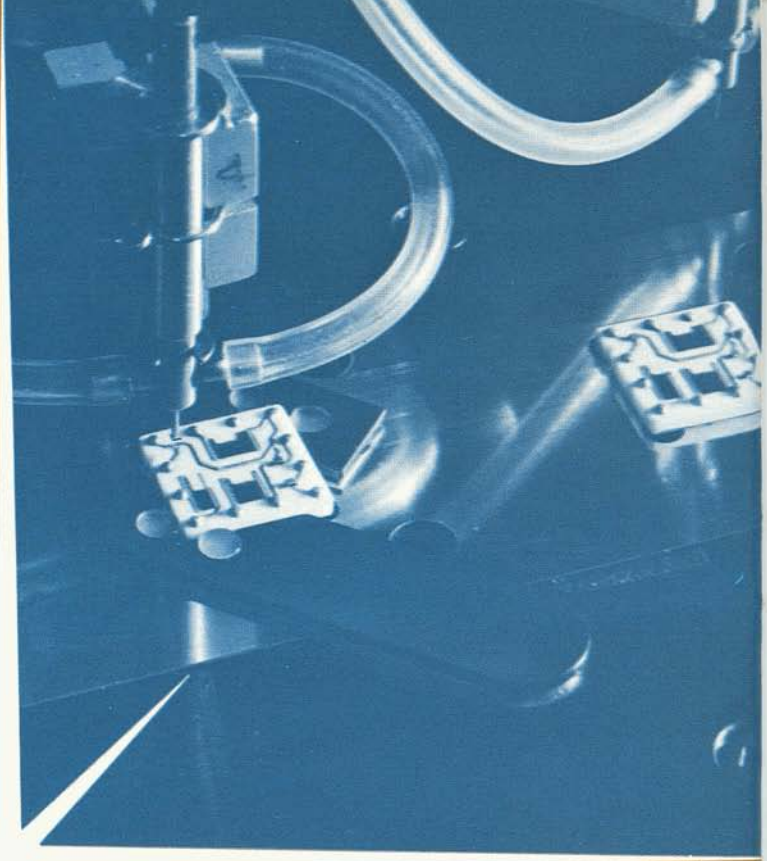
The IBM System/360 uses an entirely new solid logic technology (SLT) that incorporates smaller, more reliable, solid-state components. The basic unit is the module, a ceramic wafer about one-half inch square. Conducting patterns and resistors are silk-screened onto the wafer, and circuit connecting pins are inserted. Printed resistors are tailored to within 1 percent of the desired resistance value by sand-blasting. Diodes and transistors are added by a solder reflow technique. A protective coating and identification marking complete the module.

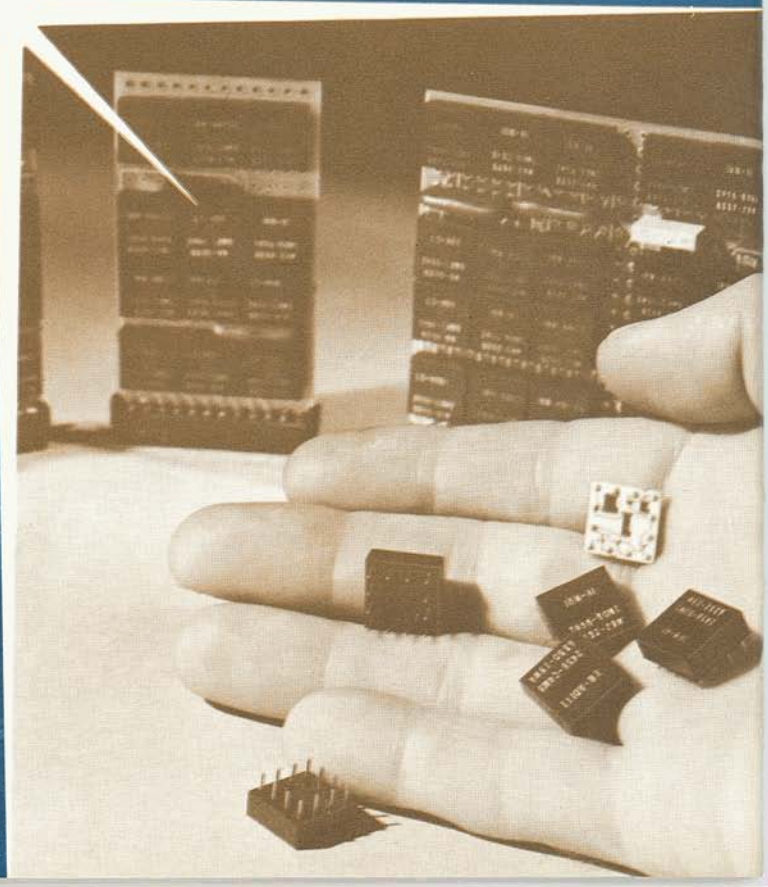
THE LOGIC CARD

The modules are mounted on logic cards similar to SMS cards but, because of the small size of the SLT module, many more complete logic circuits can be built in a given space. For example, all of the logic needed to parity check a nine-bit byte of data requires twelve modules and is mounted on one logic card. This parity checking circuit would require five single SMS cards.

Module capacities of the logic cards vary from the smallest with a maximum of six to the largest with a maximum of 36. Signal and voltage lines enter and







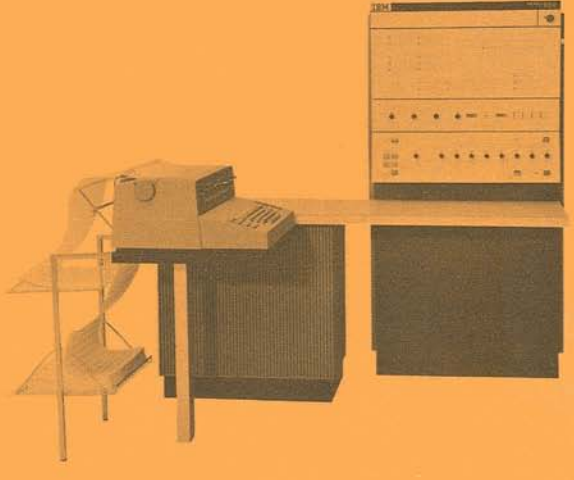
leave a logic card via contacts that connect to pins on a circuit board. Each logic card provides printed conductors for distributing voltages and signals between module circuit points and card pins.

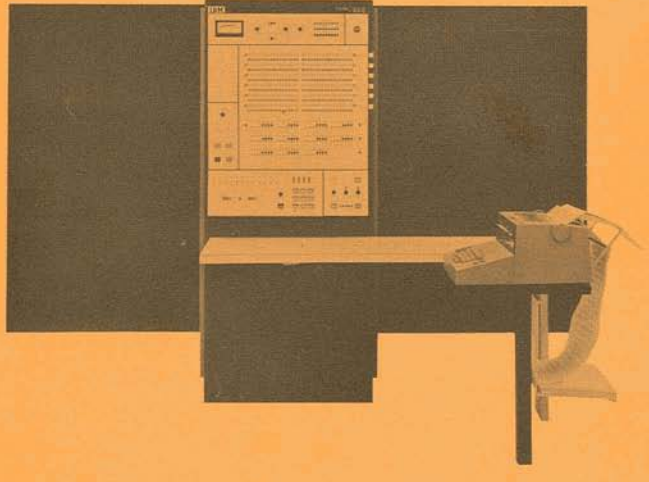
THE CIRCUIT BOARD

Logic cards are plugged into a circuit board measuring about 8.5 by 12.5 inches. Circuit boards are similar to the SMS panel and can accommodate up to 66 six-module cards and 20 cable connectors. Printed conductors on the board supply voltages to the logic cards and connect logic cards to each other.

Connecting pins are placed in holes in the board and protrude from both sides. The pins are designed to accept logic cards on one side and wrapped wire connections on the other. Although printed wiring on the circuit board provides normal logic wiring, wrapped wire connections may be used for meeting special circuit conditions or for making functional changes.

The new solid logic technology components are easier to manufacture than previous circuitry, have greater reliability, and allow circuit speeds as fast as 5 nanoseconds (5×10^{-9} seconds).





Processing Units

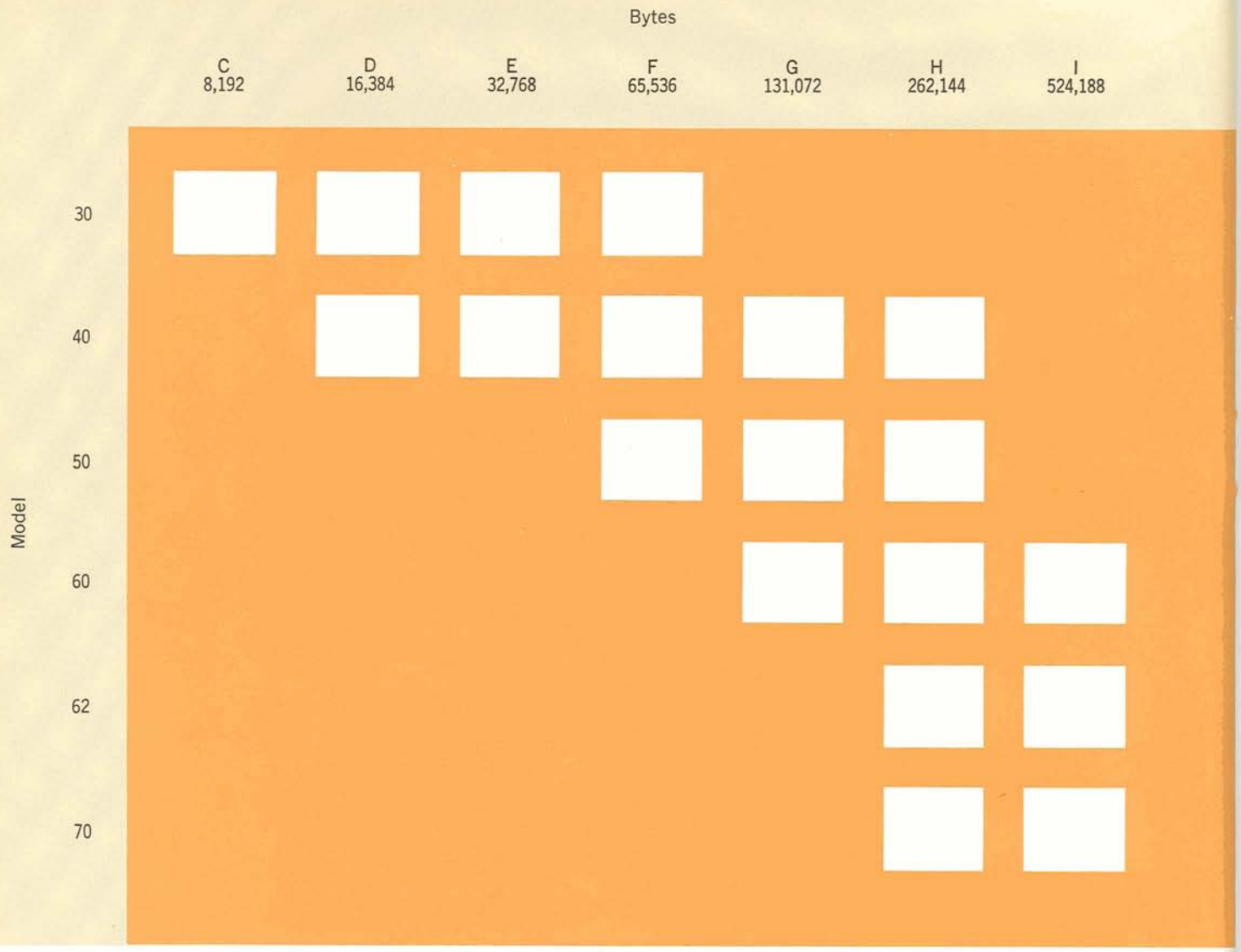
System/360 offers processing units in five distinct sizes, each with the same instruction set. Several processing units can be combined into a single multisystem configuration to provide extremely fast data processing.

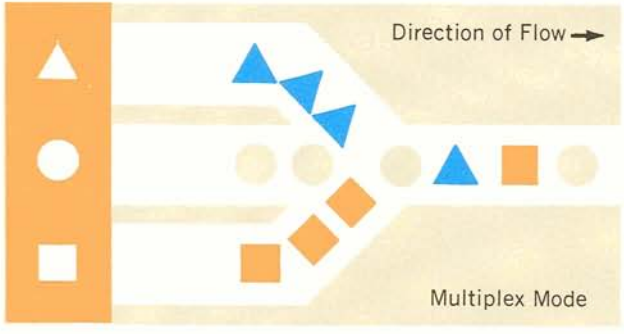
A significant feature of four of the processing units is the read-only storage (ROS) used to control operations. ROS is a fast, permanent storage device used for storing information that will remain fixed during machine operations. The information contained in ROS can be read out when required, but a physical modification is necessary to change the stored information. Used as a control device, the ROS eliminates the need for complex instruction decoders and sequencing networks and introduces a flexibility in machine design never before available. Optional features may be added largely by augmenting or changing control words in the ROS.

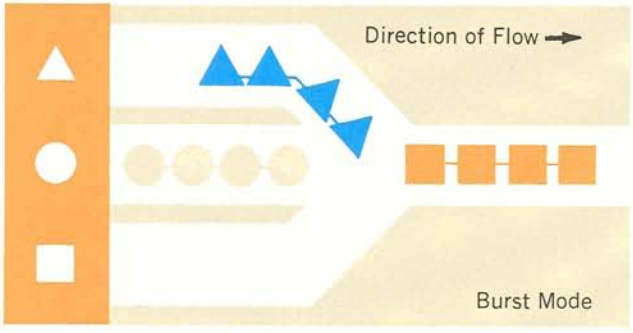
System/360 configurations are available with a feature that permits the running of 1401 programs written to established IBM programming standards.

The instruction set for the System/360 is expandable from a 52-instruction small binary set to a 142-instruction universal set.

Basic data flow for all System/360 processing units reflects the most advanced computer philosophy. For example, special purpose registers such as accumulators are no longer used to handle basic system data. Instead, general purpose registers answer all basic data and address requirements.


Bytes
C
8,192
D
16,384
E
32,768
F
65,536
G
131,072
H
262,144
I
524,188
Model
30
40
50
60
62
70


Direction of Flow
Multiplex Mode


Direction of Flow
Burst Mode

Main Storage

Multiplexor and Selector Channels

Main Storage Units are available in a large variety of capacities and access times, depending on the processing unit, and share the same binary addressing scheme.

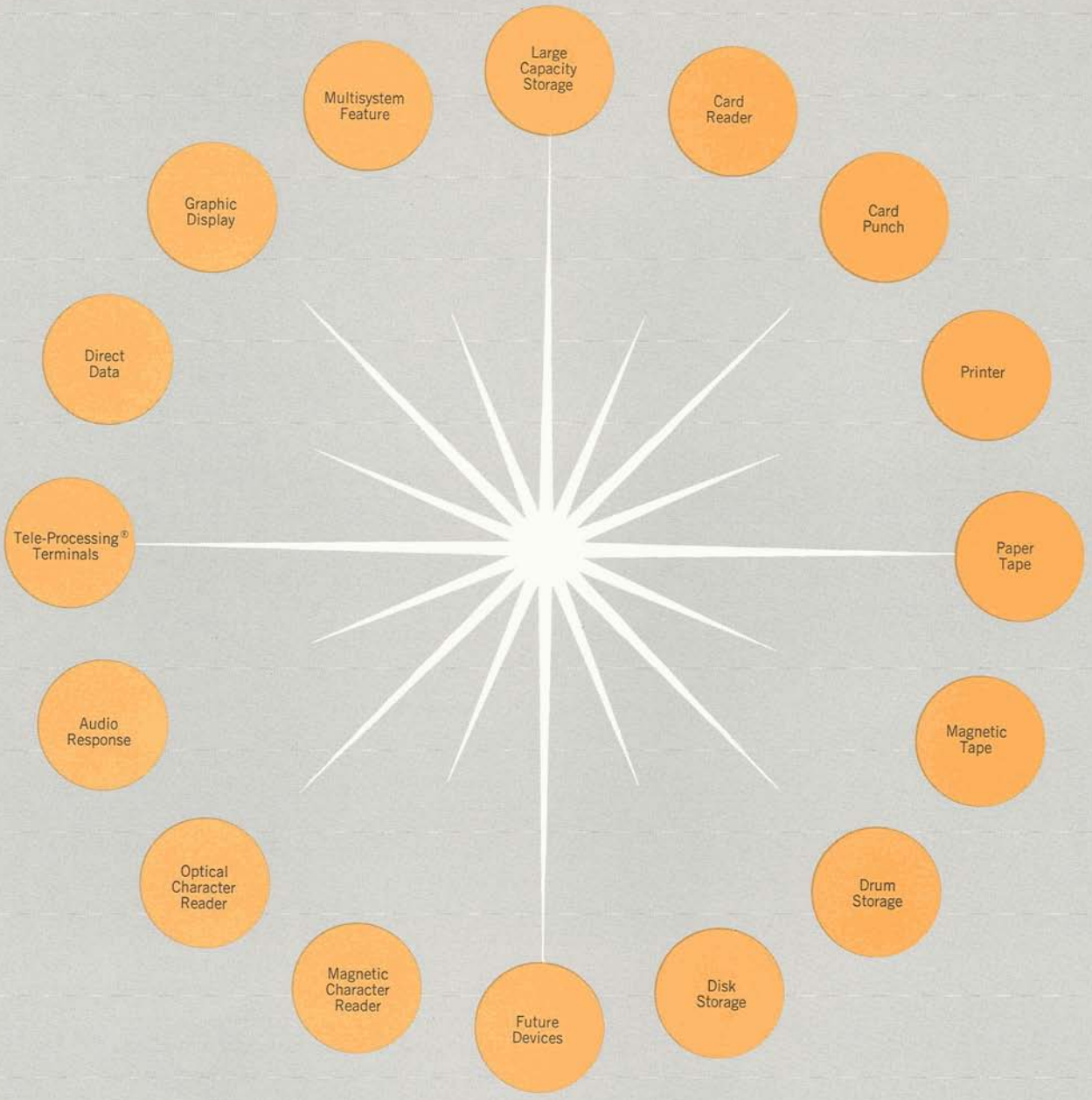
Multiplexor and Selector Channels buffer and control data into and out of the system and present standard signal and data lines to all I/O units via the standard I/O interface.

Storage Sizes Available

The multiplexor channel allows data processing to overlap the simultaneous operation of multiple I/O devices. In "multiplex" mode, multiple I/O devices are serviced while overlapped data processing takes place. Faster data transfer rates for a single I/O device can be achieved by operating the multiplexor channel in "burst" mode; however, overlapped data processing does not take place.

Modes of Operation

Selector channels operate only in "burst" mode, allow extremely fast data rates, and overlapped data processing.


Large Capacity Storage
Card Reader
Card Punch
Printer
Paper Tape
Magnetic Tape
Drum Storage
Disk Storage
Future Devices
Magnetic Character Reader
Optical Character Reader
Audio Response
Tele-Processing® Terminals
Direct Data
Graphic Display
Multisystem Feature

Input/Output

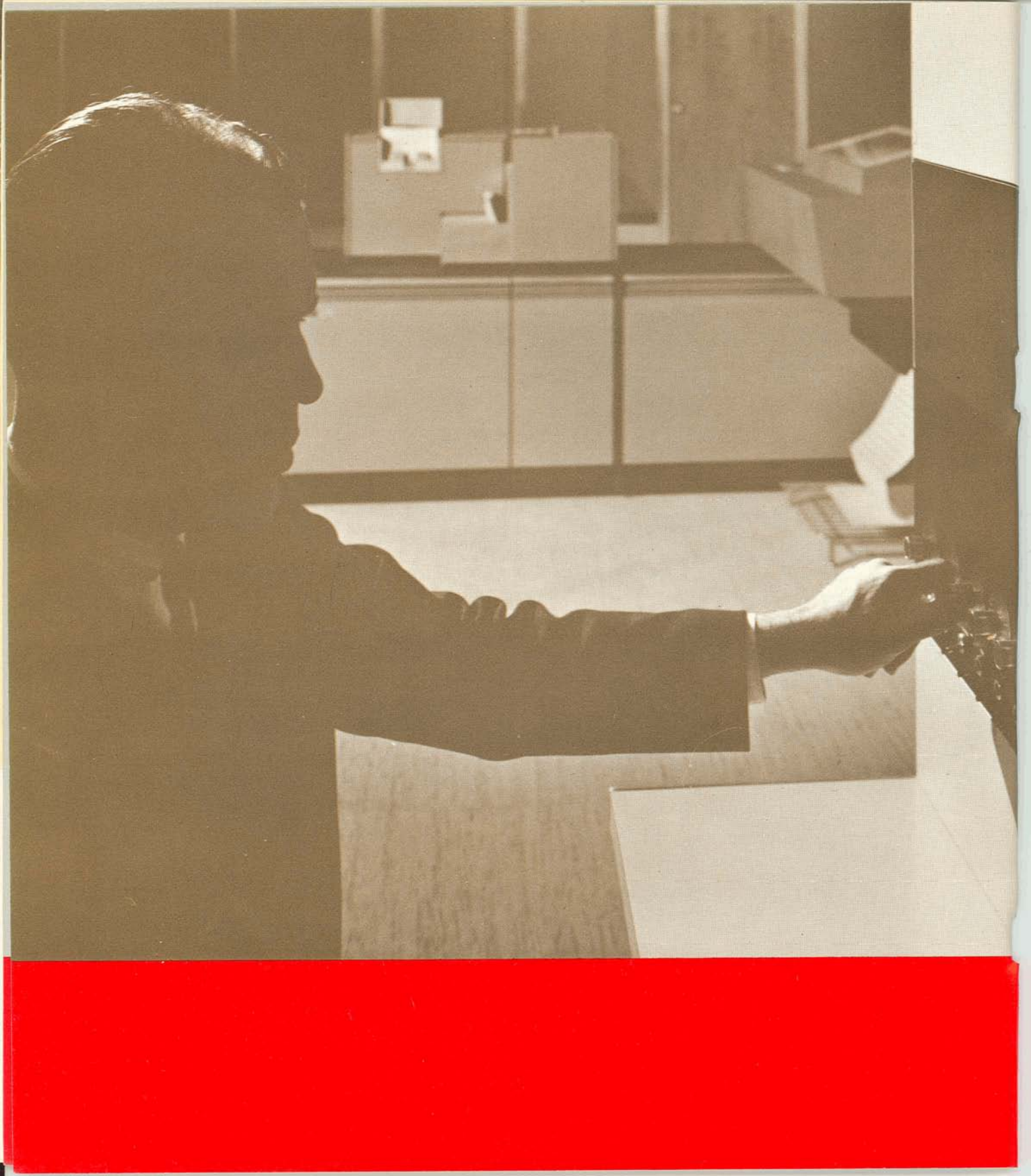
A wide range of new and existing I/O devices can be attached to the System/360. These devices handle data at rates of from a few characters per second to several hundred thousand characters per second. The input/output address format provides for up to 256 I/O devices per channel. I/O units connect to the System/360 through one standard I/O interface.

Among the new I/O devices for the System/360 are:

Random-Access Storage Units store data on 2¼″ by 13″ strips of magnetic tape in data cells. With 200 strips per data cell and ten data cells per unit, unit storage capacity is 400 million bytes.

Display Units permit visual display of tables, graphs, letters, and numbers.

Magnetic Tape Units read and write on nine-track, ½″ tape at a 22.5 KC to 90 KC character rate, 800 bytes-per-inch density. Read backward feature is standard.



Programming and Compatibility

Because models of the IBM System/360 are fully instruction-set compatible, any valid program that operates on one model will operate on any other model providing:

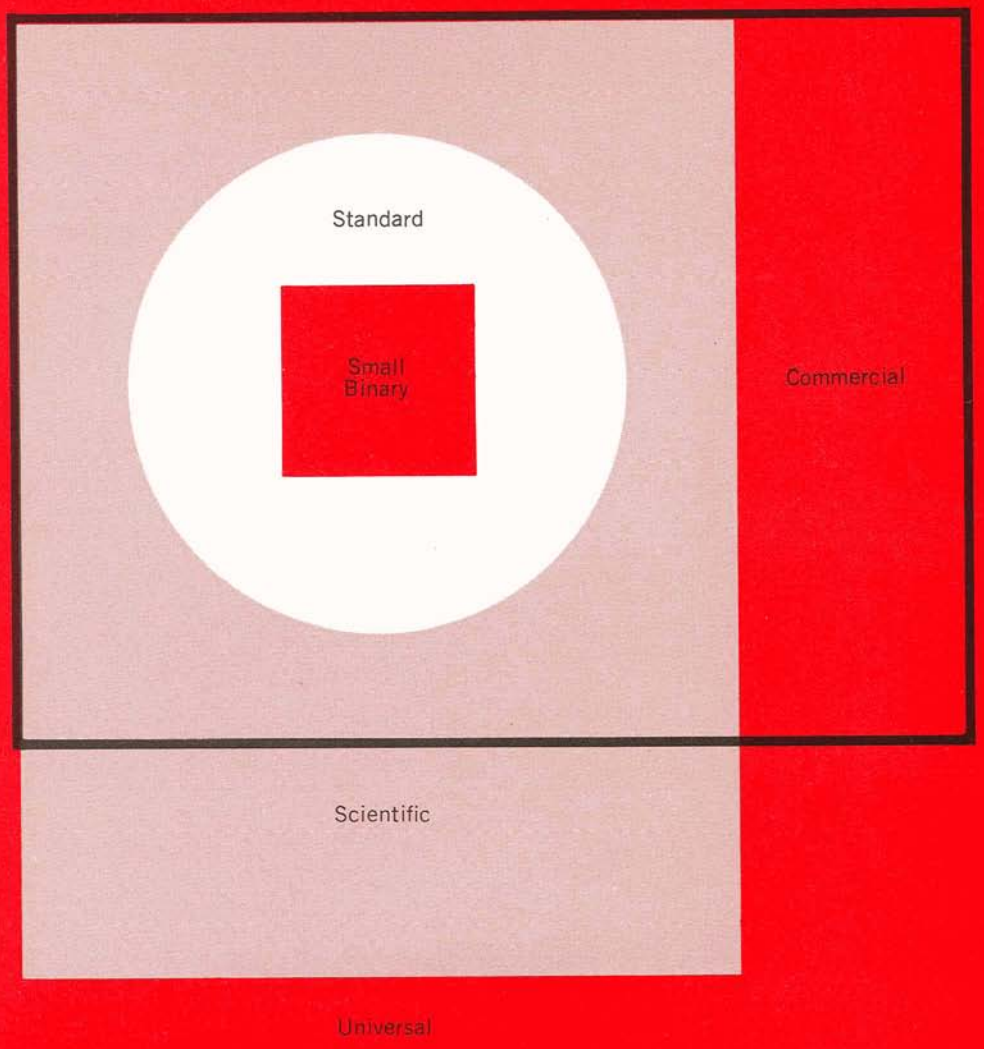
1. Main storage sizes, optional features, and I/O devices are alike.
2. The logic of the program does not depend implicitly on the internal timings of the system or on the relationship between internal timings and input/output speeds.

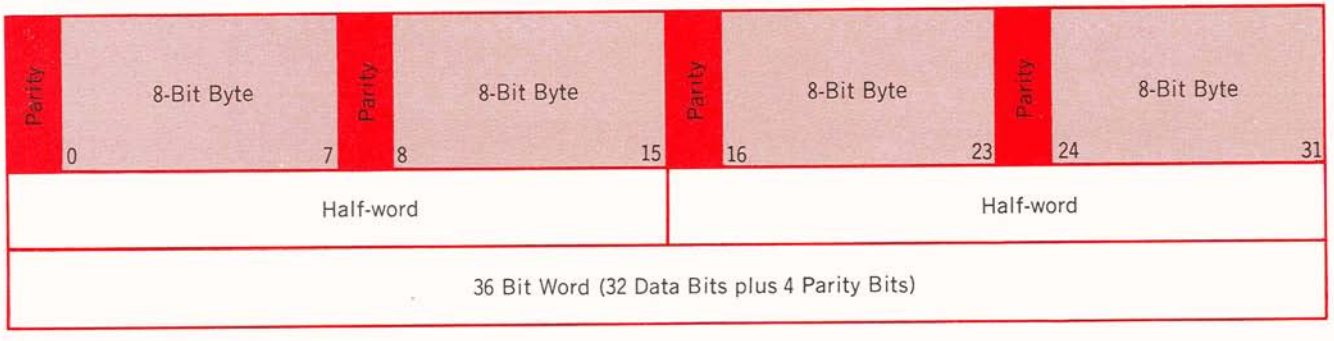
INSTRUCTION FORMAT

The basic unit of length for instructions is the halfword consisting of two bytes of information. A byte contains eight bits plus parity, and a word consists of four bytes or 36 bits. Instructions are from one halfword to three halfwords long and are executed sequentially.

CONTROL AND INDEX WORDS

Control words sequence the execution of instructions, provide status information, and generally control I/O operations. A program status word contains the instruction counter, provides processor status information, and controls processor operations. Channel command words and channel address words control all I/O operations. Index words alter addresses. Both index


Standard
Small
Binary
Commercial
Scientific
Universal


Parity
8-Bit Byte
0
7
Parity
8-Bit Byte
8
15
Parity
8-Bit Byte
16
23
Parity
8-Bit Byte
24
31
Half-word
Half-word
36 Bit Word (32 Data Bits plus 4 Parity Bits)

and control words may be consulted and updated in any desired sequence.

DATA FORMAT

Data format can be numeric, alphabetic, or logical (non-numeric) and fixed or variable in length. Numeric data are distinguished as fixed point, floating point, or decimal. Fixed-point numbers have a binary radix and a fixed length, usually a word or a halfword. Floating-point numbers, represented by a seven-bit characteristic and a signed hexadecimal fraction, occupy either a word or a double-word. Decimal numbers are variable in length, usually packed two digits to a byte, and are represented by true notation with sign. Alphabetic and logical (non-numeric) data may be fixed or variable in length.

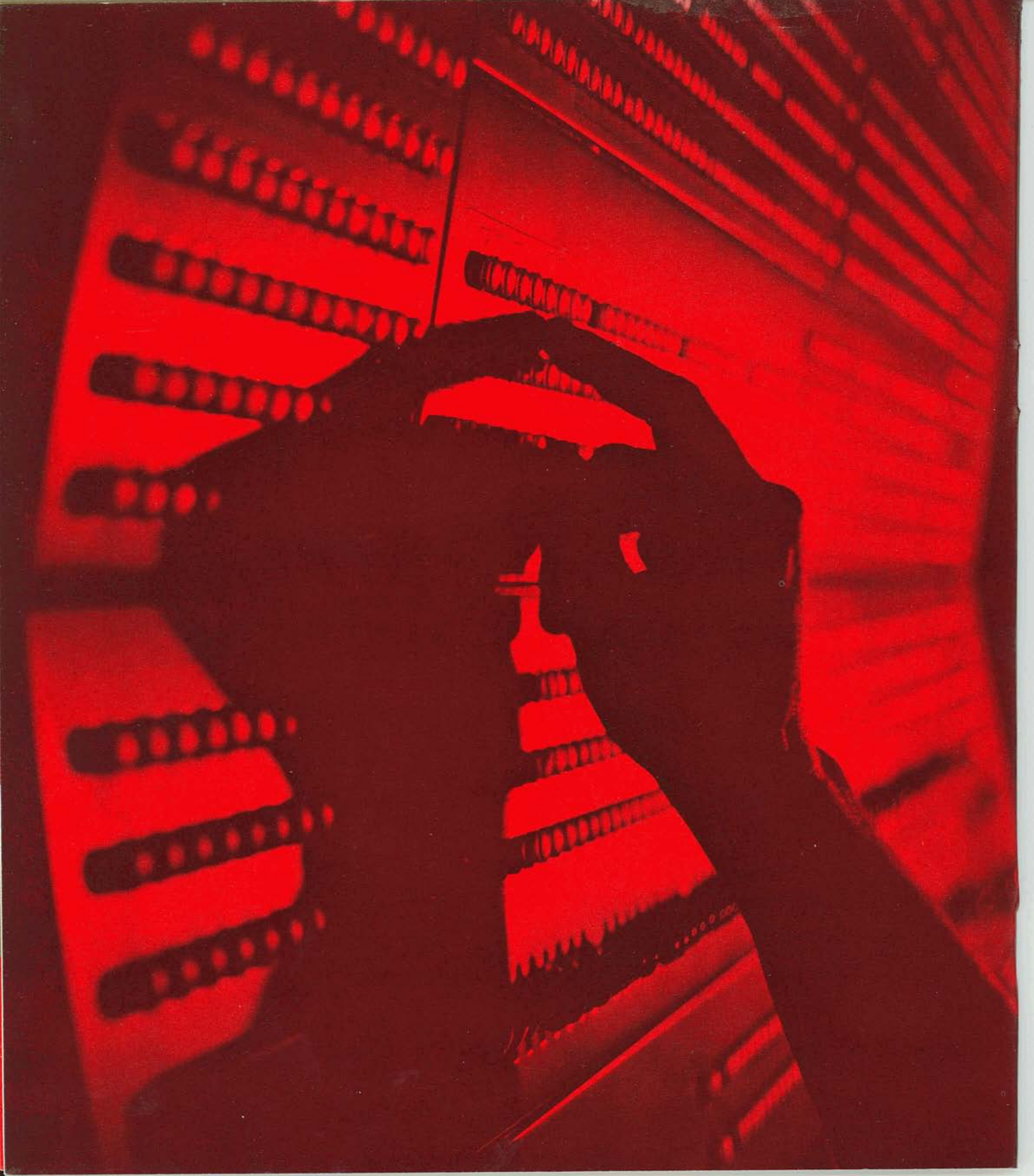
ADDRESSING

Instruction Sets

Word Format

The basic addressable unit of information is the byte. Processing units can accommodate addresses up to 24 bits long to represent a maximum storage capacity of 16,777,216 bytes. Besides main storage, the processing unit can address 16 general and four floating-point registers designated by a four-bit field in the instruction.

The location of data and instructions in storage is specified by an effective address. This effective address is obtained by adding a relative address to an indexable base address. The relative address, or displacement, is contained in the instruction. The address construction provides for easy relocation of programs and data by permitting the program to assign storage areas as information is placed into storage.



CE Features

A maintainability plan, providing the customer engineer with improved and expanded servicing facilities, is incorporated into the basic design of the System/360. These facilities, some model-oriented, include:

The Customer-CE Console on each processing unit allows information in the major registers, machine status indicators, and most storage areas to be displayed. In addition, switches permit information to be entered into the system, determine error handling and recycling procedures, and define modes of operation.

Components are packaged for ease of accessibility and replacement.

Standard Documentation provides uniform manuals, diagrams, and other field support documents.

Failure Detection Circuitry is designed to sense errors and isolate them to a small area of the system.

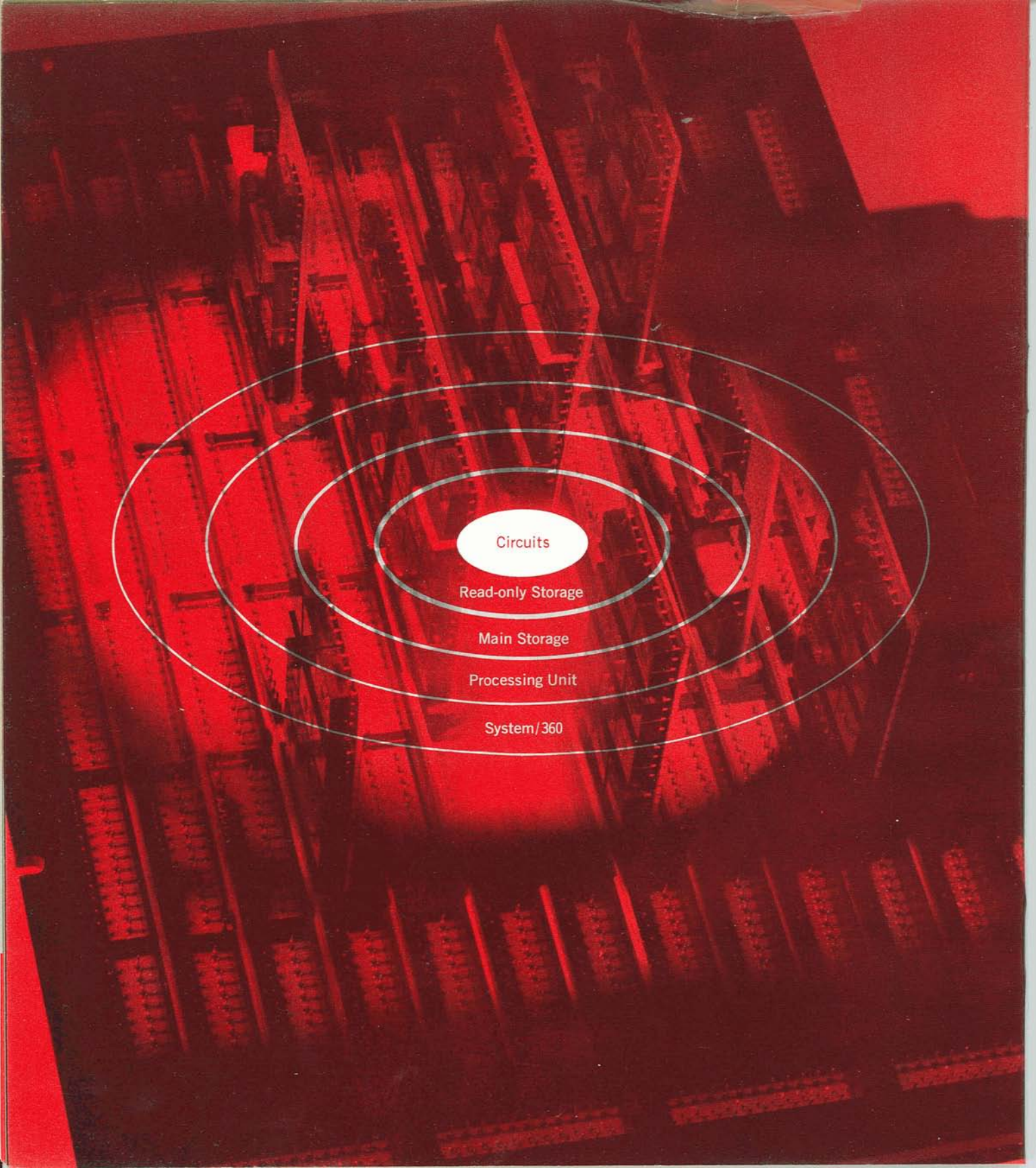
Parity Checking Circuitry checks every major data path.

Functional Packaging simplifies troubleshooting techniques. Examples of functional packaging are:

One complete register byte on a logic card

One complete nine-bit parity checking circuit on a logic card

Two complete adder positions on a logic card


Circuits
Read-only Storage
Main Storage
Processing Unit
System/360

FLT Sequencing Philosophy

Fault Locating Test Patterns (FLT's) prove that each circuit in the logic being tested can be turned both on and off. By turning each circuit on and off, malfunctioning circuits can be *detected* and by sequencing the tests in a decision-tree arrangement the faulty circuit can be *located*. Faults will be resolved to within a few logic cards.

A Diagnostic Index is produced and updated automatically with the FLT's to assure accurate and complete documentation.

A Special Mode of Operation allows FLT's to use a direct data path to main storage so tests can be entered with a minimum of circuitry.

A Diagnose Instruction provides the ability to run diagnostic programs under supervisory program control.

A Log-Out Feature on most configurations allows pertinent processing unit and channel status information to be either automatically or manually stored for later analysis.

Special Programs operating under a supervisory program can automatically:

1. Log out the system status when an error occurs
2. Compare the error against previous errors
3. Control diagnostic procedures
4. Retry the instruction
5. Restart the program from the last checkpoint
6. Report the error

An Error Log Analysis Program is available to perform statistical analyses on collected log-out information.

IBM

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