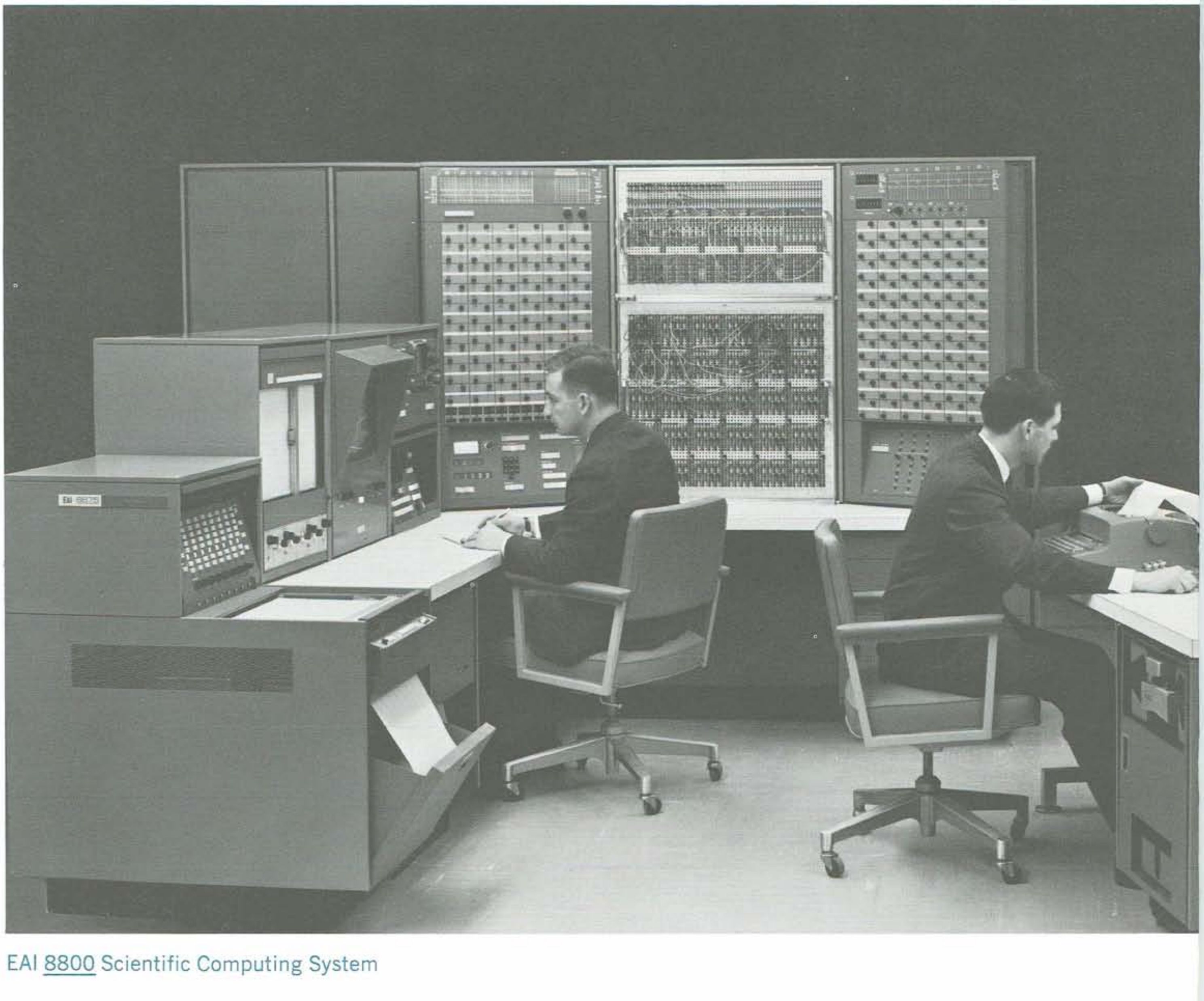
SYSTEM DESCRIPTION

EAI® 8800 SCIENTIFIC COMPUTING SYSTEM

A New-Generation Computing System for Scientific Computation and Simulation

The EAI 8800 Scientific Computing System is a new, extremely-versatile 100-volt computing system that extends the capabilities of analog and hybrid computation in both speed and control flexibility. Based on a completely new solid-state design approach aimed at taking fullest advantage of modern technology, the EAI 8800 System truly is a NEW GENERATION COMPUTING SYSTEM. Completely operator-oriented for maximum convenience and efficiency of operation, the EAI 8800 System offers a greater problem-solving capability with a significantly higher accuracy and speed of computation than any other system available.



EAI 8800 Scientific Computing System

Summary of EAI 8800 Computing System Characteristics

General

- Completely new, 100-volt solid-state analog/hybrid computer
- Operator-oriented, self-contained computing center
- Optimum dynamic performance
- New high level "designed-in" reliability
- Extensive parallel logic for decision-making and control
- Modular expansion capability by plug-in components to the fully-wired console
- Compatible with EAI 8400 Digital Computing System for hybrid computation
- Stored-program input-output system
- All new, fully-integrated display and readout equipment

Computer console

- Human-engineered for optimum accessibility
- Careful shielding throughout, greatly reducing crosstalk for dynamic operation at 1000 CPS operation and higher
- Relay or electronic mode control
- Two megacycle system clock
- Solid-state address register with automatic sequencer and selective scan
- Transistorized digital voltmeter
- Analog and logic patch panels with coordinate address identification
- Logic selector and display panel for full logic readout
- Overload indicator panel with storage option identifies all components
- Solderless connectors used throughout
- 3 amp. reference supply

Computing Components

- Each computing amplifier in compact, removable tray . . . located directly behind program patch panels
- A single type of solid-state amplifier used for all computational circuits
- State-of-the-art amplifier characteristics — typically: 200 KC bandwidth, 20V/μsec velocity limit, .06° phase shift at 1000 CPS, 40 ma output
- Amplifier stable for all values of feedback impedance and output loading
- Summer-integrators available with three or six time scales
- Track-and-store expansion available for all summer amplifiers
- Phase-compensated manual and servo-set coefficient attenuators
- Manual adjustment capability on each servo-set attenuator
- Versatile electronic multiplier/divider can produce square or square root of two independent input variables
- Multiplier design offers increased accuracy for small input values
- Multiplier current output allows combinations of program functions
- Flexible electronic resolver has nine different operational modes . . . includes rate resolution of rectangular-to-polar coordinates
- Ten segment DFG's combinable to yield forty-segment functions
- Simplified DFG set-up has automatic nulling circuit
- Essential communication maintained between analog and logic programs — by digital-to-analog switches, analog comparators, function relays and inter-panel logic trunks
- Electronic comparator has synchronous flip-flop output
- Synchronous logic simplifies programming complexities
- General-purpose logic gates are high-speed, multi-purpose
- Logical complement provided for all logic component outputs
- Four modes of operation possible with versatile quad registers
- Monostables offer variable delay from microseconds to seconds
- Logic differentiators enable pulse generation and event initiation

Input-Output

- Efficient man-machine communication emphasized
- Stored-Program Input-Output System with:
  17 bit word size . . . 4,096 word basic memory
  15 character-per-second typewriter
  300 character-per-second tape reader
  100 character-per-second tape punch
  complete software including operations interpreter
- High-speed (14 lines/sec) line printer for rapid documentation
- Solid-state recorder with up to eight recording and two event channels
- Recorder chart drive, chart speeds and event markers under local or logic program control
- X-Y plotter pen-lift control from master modes or logic program
- Integral display unit with trace coding, parallax adjustment, pushbutton scale expansion and cross-plotting
- Four trace storage oscilloscope for monitoring program wave-forms, switching conditions, etc.

Improved dynamic performance . . . increased bandwidth, augmented by high-speed switching circuitry and extremely fast logic, is made possible by the compactness of solid-state electronics . . . with most components packaged directly behind the patch panels. The system's excellent dynamic performance can be used for broader repetitive operation programs, for high-speed iterative loops within a larger problem . . . especially where partial differential equations are involved . . . and for complex hybrid applications.

Programming versatility . . . this system **gives to the programmer** the potential for handling the ever-growing complexities of modern scientific computation through its improved design concepts . . . a completely operator-oriented input-output capability . . . solid-state mode control and time scale selection on three levels . . . a multi-purpose complement of high-speed logic elements for decision-making and control . . . and a variety of readout, recording and display devices fully-integrated for highly automated operation.

Excellent reliability . . . the EAI 8800 Computing System is a quality-assured system backed up by a thorough program of testing, evaluation, debugging and correction in each step of manufacture — component, sub-assembly and system. This quality assurance is further enhanced by the "designed-in" reliability features of the system . . . complete elimination of vacuum-tubes . . . solid-state mode control and readout selection system . . . new connector concepts which virtually eliminate soldered connections . . . short-proof reference voltage . . . amplifier output protection . . . rigorous life-test standards, etc. . . . all of which contribute to the achievement of new levels of computer reliability.

Input-Output capability . . . this system integrated with the new and powerful EAI Input-Output System is a complete computing center that is uniquely suited for solving increasingly complex problems more rapidly than ever before. The Input-Output System provides complete monitoring and control of the analog/hybrid system with the additional feature of independent stored-program computation.

Expansion . . . the EAI 8800 Computing System offers, in its versatile, modular-design concept, a component-expansion capability that insures its continued capacity to handle tomorrow's more-advanced applications. All components may be added on a plug-in basis to the fully-wired console which is part of the basic EAI 8800 System.

Readout . . . in terms of peripheral equipment too, the EAI 8800 System has capabilities that provide a new dimension in fast, flexible and efficient computer utilization. The computer console, human-engineered for maximum operating convenience and efficiency itself, contains additional design features which insure that all readout and display equipment also offer maximum accessibility to the operator. A modular expansion desk, providing convenient visual display of the computer outputs, contains such units as a multi-channel display, monitor/display scope, a high-speed printer and an 11 x 17 inch X-Y recorder. In addition, a separate, high-precision multi-channel recorder is available to provide simultaneous rectilinear display of up to eight analog input channels and two timing or event channels.

Thus, in keeping with its overall design concept of a "self-contained-computing center", the EAI 8800 System provides complete capabilities for increased programming efficiency and versatility, improved reliability, and extended input-output performance features.

PERFORMANCE, RELIABILITY, VERSATILITY

The EAI 8800 Scientific Computing System is the culmination of the design evolution in analog/hybrid computer development, an evolution which has been characterized by improved human-engineering . . . by solid-state reliability . . . by high-accuracy dynamic performance . . . by high-speed electronic mode control . . . and by parallel synchronous logic.

Highly efficient man-machine communication and the advanced computing techniques realized with the EAI 8800 System make possible more efficient programming and, as a result, more problem solutions per unit of time. By cutting time and costs in programming, in checking, and in operation, this powerful computing system expands the number of problems that can be undertaken in a simulation laboratory, making available the use of its facilities to more engineers and scientists. In addition, the sizeable expansion capability of the system, provided through its modular-design features, offers the necessary versatility to solve problems of widely varying magnitude from routine calculations to the most sophisticated simulations.

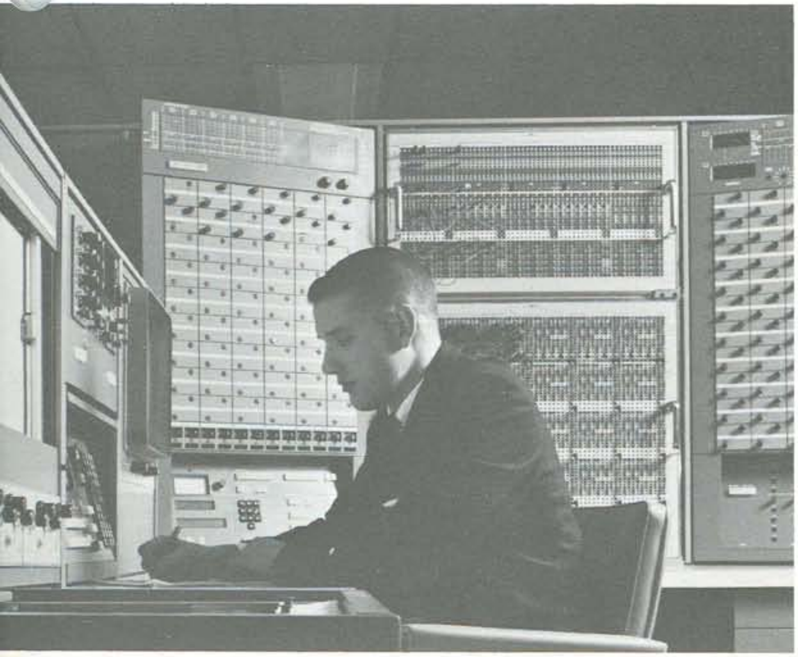
The system yields a computing capability to handle problems of larger scope, of greater speed requirements, and of more complexity than ever before available *plus* sufficient power to handle the more advanced problems which will continue to arise. This is only possible through its embodiment as one, completely new, next-generation machine, achieving its rigorous design goals based on the latest knowledge and experience available in all aspects of analog and hybrid computation.

Computer Console

The Console of the EAI 8800 System is a self-contained computing center with programming, control, and computing components all housed within its three-bay structure. It combines ease and flexibility of programming with multi-level analog and logic control of its large-scale computing capacity. Detailed consideration has been given to human-engineering as an operator-oriented system, with emphasis placed on convenience and efficiency of operation.

Prime consideration also has been given to the elimination of crosstalk effects to enhance overall dynamic performance. This has been done by the employment of shielded leads throughout for critical signal routing, the use of shielded analog patching cords, and the packaging of components in metal trays.

The majority of computing elements are contained in removable trays located directly behind the program patch panels. Additional trays, as well as a pedestal which houses the manual diode function generators and limiters, are located below the full-length console work-shelf. All controls and monitoring devices are located for greatest ease of manipulation and display by the computer operator.



In the center bay is the Program Patching System, composed of two aluminum program patch panels — an analog signal pre-patch panel and a control logic pre-patch panel. This separation of function philosophy in combination with patch-panel coordinate address identification, substantially simplifies the programming task.

The left bay houses the mode and component selector system control panel, including the digital voltmeter and transistorized null-meter displays. It also has provisions for panel-mounting one-half of the system's coefficient attenuators, and includes the analog overload indicator panel. These panels are contained on a swing-out section that can be positioned for optimum access and display. The attenuator panel is, itself, a vertically-hinged swing-out section, which provides access to the central amplifier balance panel and attenuator fuses.

The right bay contains a second control panel which has provisions for function generator set-up, analog and digital function switches, and a digital logic readout panel. It includes the second attenuator panel and a logic indicator panel for monitoring logic element output states. As with the left bay, these panels are mounted on a swing-out section which can be adjusted to a convenient position.

Internally, the innovation of multiple power supply and ground connectors initiated in previous EAI computing systems has been extended in this new system. Strip busbars pass closely to all computing element connectors, while individual voltage-regulators are used on the more critical busbars to eliminate interaction between groups of amplifiers. The system's major heat-and-magnetic-field-producing elements, rectifiers and pre-regulators are mounted externally in a remote pedestal, permitting accurate temperature control and low hum to be readily achieved in the main console.

Computing Components

The many desirable characteristics of the EAI 8800 Scientific Computing System are evidenced in each analog and logic computing component contained in the system. Designed for optimum reliability, these devices, as the natural extensions of proven EAI equipment presently in use, offer excellent static and dynamic performance combined with the maximum possible versatility in operational use.

A solid-state, 100-volt operational amplifier is used for all computational circuits. To insure highly reliable operation of this device, quality components are used throughout. Furthermore, the most recent developments in high-frequency components have been studied, evaluated, and employed wherever possible. As a result, the amplifier offers state-of-the-art operating characteristics . . . a typical small signal bandwidth of 200 KC, $20V/\mu$sec velocity limit, 0.06° phase shift at 1000 CPS, 40 ma output, and unconditional stability for all values of output capacitance and for any feedback impedance. The same degree of design care has been applied to all amplifier-associated linear and nonlinear networks . . . summers, summer-integrators, function generators, resolvers, multipliers, etc.

An extensive number of patchable logic elements are included for the functions of decision making and control. These elements . . . general-purpose logic gates, quad registers, flip-flops, logic differentiators, and monostables . . . make use of 20 megacycle circuit modules, have a typical signal rise time of 5 nanoseconds or less, and employ "worst-case" design techniques to assure reliability compatible with the analog components.

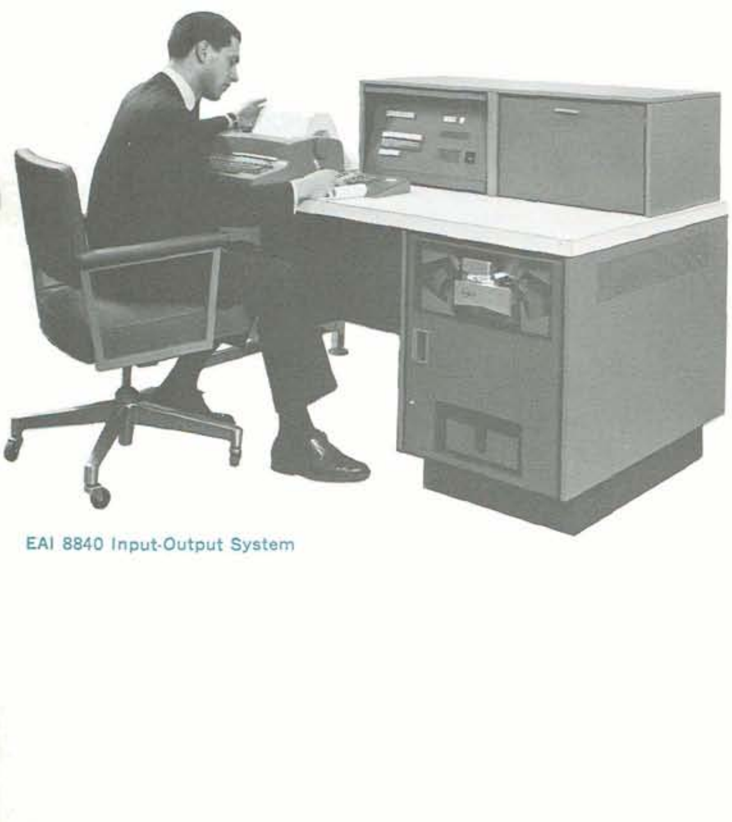
The necessary interface between analog and logic programs is provided by a number of different computing elements which have terminations on both program patch panels. High-speed event detection is supplied by analog voltage comparators which cause a logic level change dependent upon its analog input characteristics. A comparator's true and complementary states appear at the output of a clocked set-reset flip-flop to facilitate program sequencing as well as to permit program enabling or inhibiting of event occurrences. Digital-to-analog switch control is possible from the logic program by solid-state switches for high-speed operation, and by function relays for real-time applications. Digital function switches and voltage-limited analog trunks provide additional communication paths.

Versatility of operation is another of the important design criteria for the computing equipment used in the EAI 8800 System. By providing increased component usefulness and related increased control flexibility, the effective computing power is multiplied. Control of integrator modes and selection of up to six time scales are possible not only for the complete system, but also in each of three separate sectors and even on an individual integrator basis. Logic elements, too, contain not only their own logical inverters but offer multi-purpose application as well. Any one of the quad registers, for example, can be used alternately as four independent set-reset flip-flops, as a binary counter, or as a BCD counter. Each logic gate can perform alternately the logical AND, NAND, OR, and NOR functions.

Extremely flexible operation is provided by the electronic resolvers, each of which has nine different operational modes . . . from standard one and two-vector polar-to-rectangular conversion to rate resolution of rectangular-to-polar coordinates . . . including the maximum of free component utilization, thus offering additional elements for other problem needs. Similarly, each electronic multiplier has several modes: multiply, divide, square (of two independent variables), or square root (of two independent variables); and function generators can be combined to yield up to a forty-segment representation of a critical function in addition to their normal ten or twenty-segment capabilities.

Representative Component Tray

Input/Output



EAI 8840 Input-Output System

Efficient man-machine communication has been stressed in the design of the EAI 8800 Scientific Computing System. Major emphasis has been placed on operator access and entry of information into the system in order to enhance the rapport between the programmer and his problem.

A versatile serial-input keyboard at the operator's fingertips addresses components for monitoring on the digital voltmeter or outputting on the high-speed printer. This same keyboard can alternately load a new setting into the precision voltage divider, and instruct an attenuator to achieve a new setting. Through the use of additional control panel push-buttons, it is possible to scan all component outputs or to restrict the scanning process only to areas of interest. The depression of still another keyboard function pushbutton relinquishes these controls to the versatile EAI Input-Output System.

The Input-Output System functions as a digitally controlled automatic set-up and check-out system. Additionally useful as a small-scale digital computer, it offers the operator a powerful tool through its arithmetic capabilities. The system can be used either for analog computer input-output or, by itself, to perform engineering calculations too tedious and time consuming to be performed manually and yet not complicated enough to justify the use of a large-scale data processor. As an input-output device, it provides all of the functions normally associated with an analog computer input-output system . . . the adjustment of servo-set coefficient attenuators, readout, and mode control. In addition, it has the capability for checking the computer program, storing run programs, resetting attenuators as a function of intermediate results, calculating attenuator settings, processing input-output information, and other operations which require the computational capability of a small-scale digital computer. The Input-Output System is designed to operate both independently of and as an integral unit in the EAI 8800 Scientific Computing System.

The EAI 8840 Input-Output System is a self-contained desk-type console, consisting of a main frame with control panel and 4096 words of memory. It has a word size of seventeen bits (sixteen bits plus sign). The typewriter supplied is an IBM Selectric capable of 15 character-per-second operation. A high-speed 300 character-per-second tape reader and 100 character-per-second punch permit automatic programming and record documentation.

The Input-Output System is supported by a complete set of software programs which include an assembler, an operations interpreter, a library of arithmetic sub-routines, utility programs, and diagnostic routines. Of these, the operations interpreter is of major importance to the analog computer programmer. With this program, the various controls of the Input-Output System can be used to enter addresses and values, and to change modes in essentially the same manner that the analog computer is operated. As a result, the operator can prepare analog operating sequences with familiar techniques, but have the whole system operate under stored-program control.

SYSTEM OPERATIONAL CHARACTERISTICS

Mode Control

The analog control system of the EAI 8800 System offers varying degrees of programming sophistication to match program control level with problem complexity level. Three increasingly higher levels of control . . . Master control for operation of the entire system, Sector control for multi-speed nested computation, and Local control for independent operation of individual integrators and track-store summers . . . are provided for both mode and time-scale programming. The most sophisticated simulations may employ a composite of all three levels.

Under Sector control, in which computing components can be programmed in three individual sectors and under Local control, related mode control timing can be chosen over a broad range of fast and slow intervals . . . from interval timers — from counters — from logic program occurrences — or from remote sources.

Speed and flexibility of operation have been stressed in analog mode control. The fastest switching circuitry is available with pushbutton, logic program, or remote source control. Integrators of the system can be of two types . . . all-electronic mode control (EMC) integrators, or high-speed relay mode control (RMC) integrators. With RMC elements, three time scales are provided: 0.1 second, 1 second, and 10 seconds. EMC integrators offer six time constants ranging from 0.1 milliseconds to 10 sec-

onds in decade steps. Significantly, to meet the changing demands of future requirements at computer laboratories, the RMC integrators can be readily converted to EMC integrators and vice versa, by the simple replacement of plug-in network modules. Either type of integrator can be used individually as a track-store device under independent control.

Summer amplifiers in the EAI 8800 System offer similar flexibility . . . as standard summers, they contain RMC circuitry; when a summer is to be used also as a track-store device, it is supplied as an EMC unit with two storage capacitors. In this manner, optimum performance of the track-store summer is obtained for real-time and high-speed computation as a point storage device, or for complementary operation with any other EMC summer.

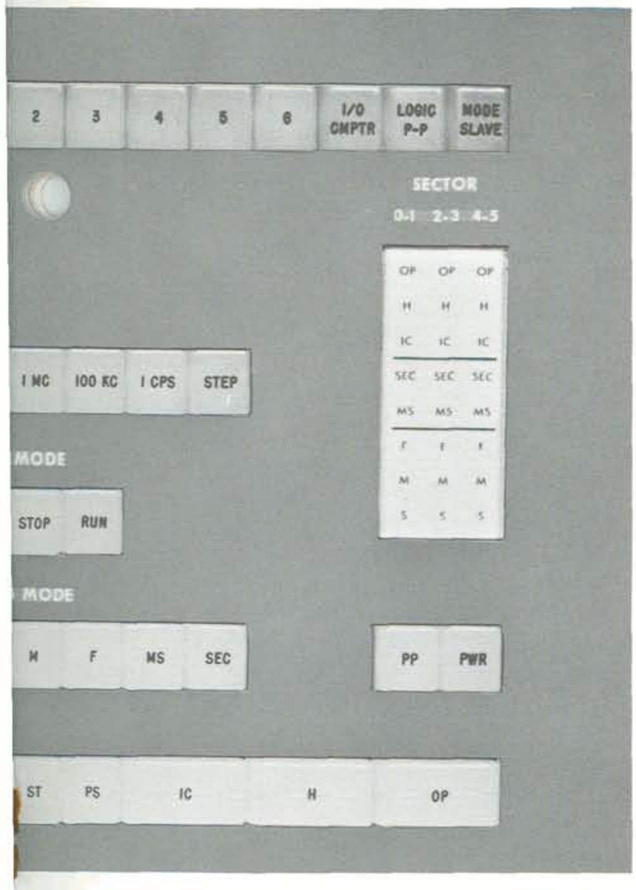
For further convenience and efficiency of operation the Pot Set mode facilitates the accurate setting of attenuators, the Rate Test mode permits the integrating rate of all integrators in the computer to be checked, and the Static Test mode provides static test voltages for problem check out.

A versatile digital mode control system, similar in its functions to the analog modes of Operate, Hold, and Initial Condition, commands the extensive number of logic elements included in the EAI 8800 System. The digital modes . . . Run, Stop, and Clear . . . control the clock pulses to the parallel logic elements. The computer is placed in these modes by depressing momentary pushbuttons on the main mode control panel, or by patching on the Control Logic patch panel. Another digital mode, Step, allows single clock signals to be generated manually, facilitating program trouble-shooting and analysis.

Since the parallel logic elements can be used not only for *decision-making* but also for *sequencing* mode control functions and data conversion cycles, it is particularly important that the system synchronize the various logical operations. For this reason, the logic elements employed are driven with a basic timing reference to prevent changes of state in the logic program or to allow such changes to take place one-at-a-time under operator control. The use of such "clocked" logic further serves to simplify the check out of programs involving a number of elements in a logical step-by-step procedure.

The basic timing reference or clock for the system is a two-megacycle crystal-stabilized oscillator. Counters are included which generate rates of one-megacycle, 100KC and 1 CPS by counting down the clock frequency. Frequencies of 100KC, 10KC, and 1KC are available at the control logic panel to generate repetitive operation frequencies for computer integrating amplifiers and storage summers.

The necessary provisions have been made in the EAI 8800 System for all analog modes, problem check modes, time scales, and digital modes to be controlled remotely from the Input-Output System, from the digital section of a hybrid system, or from other analog computing systems.



Mode Control

Programming

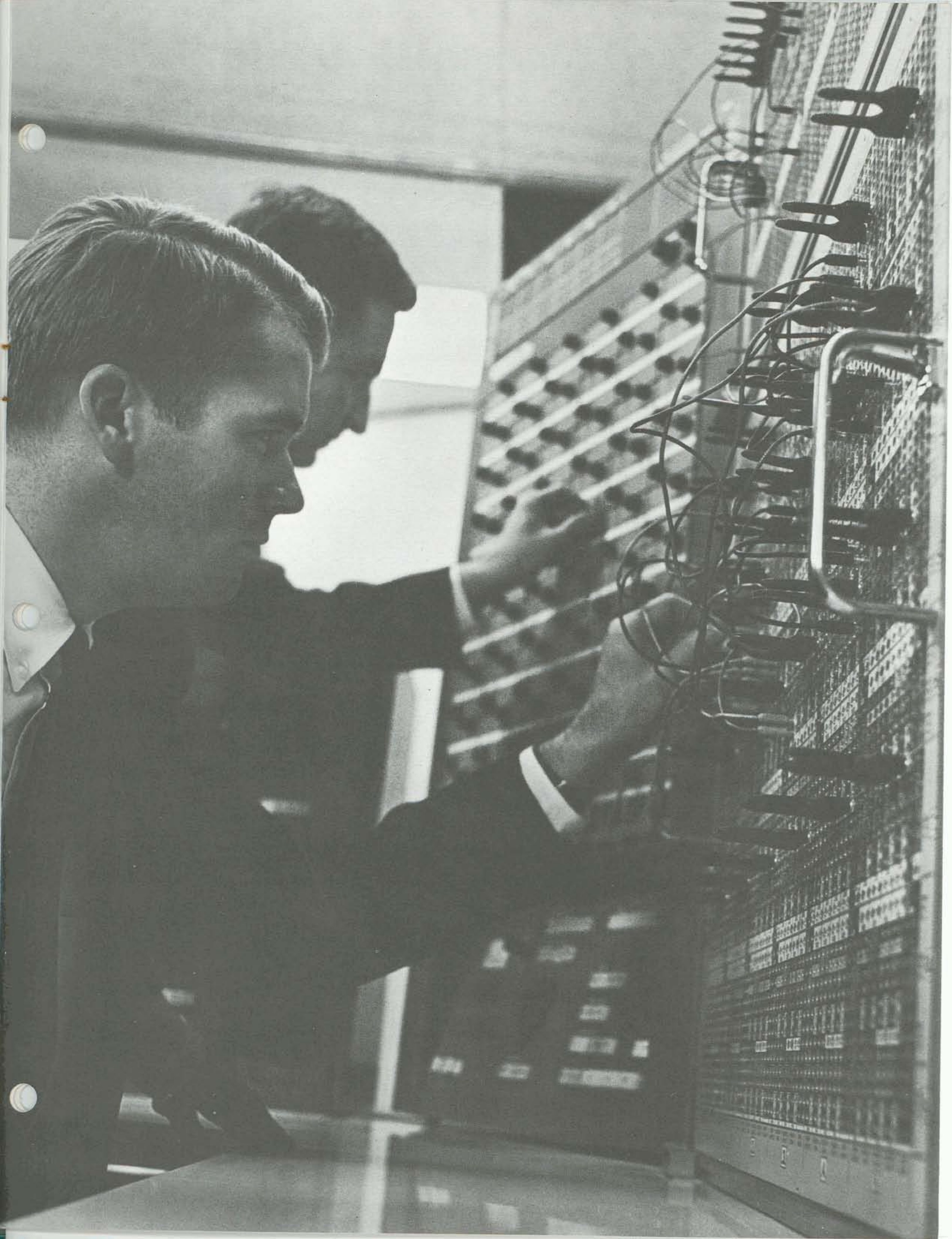
Since a significant portion of the overall problem-solving cycle for a general purpose analog computer is devoted to programming, emphasis has been placed on efficiency in design of the program patching system of the EAI 8800 Computing System. It features a 4,080 terminal analog pre-patch panel and a 2,400 hole control logic pre-patch panel, both of which can be replaced in seconds with full assurance of electrical continuity on all contacts.

Extensive programming and patching flexibility is offered by the multiple input and output terminations, fully-shielded analog patching elements, fan-out logic patch cords, a coordinate address format, and new dual-purpose spring contacts which allow necessary connections to be made with a minimum number of patching operations. Further assistance in programming is provided by a consistent color-coding scheme used in conjunction with bold high-contrast lettering to provide maximum legibility for patching terminal identification.

The layout of the panels is aimed at grouping all types of computing elements and their controls in repeated patterns so that patch cord lengths are minimized. As a result, patch panel clutter is reduced by the many connections which can be made with patching plugs, and by the significant number of connections which can be made with multi-contact patching springs, permitting multiple closures to be actuated by the insertion of a single patch cord. The identification of computing elements is accomplished by a coordinate address system, allowing quick location of any component. This is further aided by the arrangement of overload and logic-state indicators, which are directly related to the patch panel location of components.

A significant portion of analog computer programming time is also related to the set up of problem coefficients, and it is of considerable value to facilitate this phase. This requirement is properly met in the EAI 8800 System with the Digital Attenuator System. Used in conjunction with the console's input-output system, the Digital Attenuator System enables the operator to make automatic selections and adjustments of servo-set coefficient attenuators . . . from punched tape by the EAI Input-Output System or another digital computer. Furthermore, manual setting can be accomplished at the console from the input keyboard, or actually at the attenuator since each unit has its own manual adjustment capability. This flexibility permits operator to make continuous parameter changes during a problem run.

Completely automatic control of many aspects of the computer programming process is possible from punched tape on the EAI Input-Output System. Initiation of mode changes (in both analog and logic mode control systems), time scale selection, attenuator setting, and documentation of interim and final problem results are some of the time-saving operations that can help to simplify programming.



The very necessary man-machine communication involving the display and documentation of problem results has been another area of particular emphasis in the design of the EAI 8800 Computing System. Recognizing the need not only for the 'availability' of results but also for their accurate and reliable presentation, EAI offers a complete selection of equipment to satisfy these requirements. This equipment is fully integrated into the system, thus eliminating the additional programming burden usually associated with peripheral devices.

The readout system of the EAI 8800 System utilizes a high-speed, solid-state digital voltmeter, single reed-relay contacts for each readout point and a set of solid-state shift registers with decoding matrix for high-speed scanning of analog outputs. Both values and addresses of all outputs, including integrator initial derivations, are available in visual and electrical form for local monitoring, remote selection and display at the Input-Output System or a digital computer. A sequential scan mode in conjunction with the EAI 8860 Printer can be used for direct high-speed (14 line-per-second) readout on hard copy. The readout system can be used at even faster rates for entry into digital computer memory. A particularly useful feature of the scanning system is that missing elements are passed by in less than a millisecond without recording.

To provide a complete computational system, a variety of peripheral devices are available:

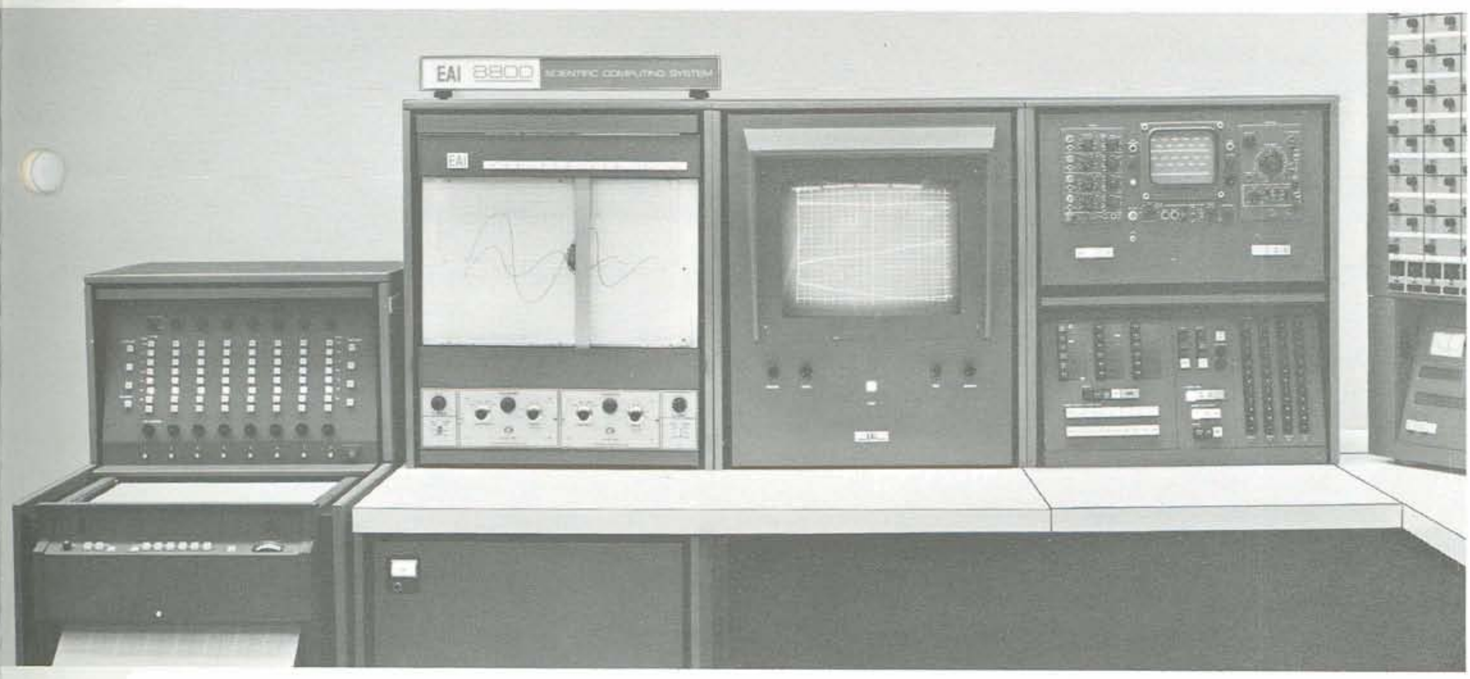
Readout and Display

X-Y Recorders . . . the EAI 8850 transistorized 11″ x 17″ X-Y Recorder plots one or more independent variables as functions of time or any other independent variable — provides accurate graphic recording of computer solutions . . . has continuously variable scale factor control, pen and arm origin can be set anywhere on plotting surface, pen lift can be controlled by computer mode control system, scale extension or suppression permits plotting in any desired quadrant within a 30″ x 45″ area.

Time Base Recorder . . . the EAI 8875 Eight Channel Recorder represents a revolutionary advance in all-solid-state direct-writing oscillographic design, in which recorder control functions are fully integrated with the computing system to provide centralized control of computation and readout . . . offers rectilinear display of up to eight analog channels and two timing or event channels (80 mm channels are available for expanded displays), maximum recording linearity within 0.5%, selection of twelve chart speeds, local or logic panel control of chart drive, chart speeds and event markers — compatible with any analog computing system.

Multi-Channel Display Unit . . . the EAI 8880 Display Unit is a self-contained precision display system featuring high resolution and accuracy, and wide bandwidth. Employing a 14-inch oscilloscope, this unit provides simultaneous display of four individually-coded traces of 18 possible inputs, adjustment of display parallax, selection of sweep time from computer patch panel, a versatile cross-plotting capability, and display mode controls which facilitate interpretation of high-speed solutions.

Monitor Display . . . a four-trace storage oscilloscope, the EAI 8881 Monitor Display forms an integral part of the computing system to monitor program wave-forms switching conditions, voltages, etc. . . . has two megacycle bandpass and variable sweep range, single sweep operation, a variety of trigger facilities, . . . can be slaved to repetitive display unit for photographic recording purposes.



Display and Readout Equipment

Expansion

The modular design concept of the EAI 8800 Scientific Computing System provides a growth potential which allows the customer to establish a modest-sized installation initially and to expand later as the workload and problem complexity dictate.

Each system is fully-wired at EAI for the maximum equipment expansion. All components can be added to the system in the field on a simple plug-in basis with no additions of wiring harnesses, soldering, etc. required. Additional peripheral equipment can be quickly and easily connected in the same manner.

Full slaving capability is another of the ready-expansion features of the EAI 8800 Computing System. With the addition of the standard cables, it is possible to slave the mode control, the time scaling system, and the 100 volt reference supply to any one of six other EAI 8800 Systems.

Further expansion into a large-scale hybrid computing facility is also readily possible for all users of the EAI 8800 Analog Computing System with the addition of the EAI 8400 Digital Computing System . . . a digital computer developed expressly for operation in the real-time simulation environment. Together these systems form an extremely powerful, *completely integrated* hybrid computer with full software support and system responsibility provided by EAI as a total system supplier.

EAI 8800 SCIENTIFIC COMPUTING SYSTEM

EQUIPMENT SUMMARY

COMPUTER CONSOLE

Mode Control and Timing System

Mode and time-scale selector (with rate and static test busses)
Sector indicator panel
Two megacycle system clock
Clock mode and frequency selector
Repetitive operation counter
Slave selector
Quad interval timers (3)

Input-Output System

Input keyboard
Input-output selector
Address register (with automatic sequencer and selective scan)
Transistorized voltmeter
Address and value display
Precision voltage divider
Servo amplifier
I/O System interface buffer
Comparator indicator panel
Logic selector and display
Logic display panel

Program Patching System

Dual patch-bay (with latching mechanism)
Analog pre-patch panel (4,080 terminals)
Control logic pre-patch panel (2,400 terminals)
Analog patching kits
Control logic patching kits

Overload Indicator System

Overload indicator panel (with storage option)
Overload indicator bus (with automatic HOLD option)
Audible overload alarm

Manual DFG System

Set-Up panel
Dual set-up amplifier (with automatic nulling circuit)

Power Distribution System

Bus-bar distribution matrix (with overload indicators)
Monitor voltmeter
±100 volt reference supply (3-ampere)

ANALOG COMPUTING COMPONENTS	QTY.
Summer-Integrators (See Note 1)	60
Integrators (assigned to electronic rate resolvers)	6
Summers (with or without track-and-store networks)	60
Inverters	48
Inverters (with high-gain mode)	20
Inverters (assigned to electronic resolvers)	18
Other Amplifiers (assigned to electronic resolvers)	48
Coefficient Attenuators (See Note 2)	240
Electronic Multipliers (See Note 3)	72
Sine-Cosine Generators (assigned to electronic resolvers)	6
Electronic Resolvers (See Note 4)	6
Ten-Segment Arbitrary Diode Function Generators	30
Limiter Networks	30
Passive Element Resistors (one megohm)	15
Passive Element Capacitors (with three or six time scales)	15
Analog Function Switches (SPTT)	15
Dual-Range Noise Generator	1

LOGIC CONVERSION COMPONENTS	QTY.
Digital-to-Analog Switches	30
Analog (voltage) Comparators	30
Function Relays (DPDT)	24
Inter-Panel Logic Trunks (voltage-limited)	15

PARALLEL LOGIC ELEMENTS (See Note 5)	
General-Purpose Logic Gates	100
Quad Registers (with pre-set switch) (See Note 6)	15
Comparator Flip-Flops	30
Logic Differentiators	8
Monostables (with delay selector)	4
Digital Function Switches	9
General-Purpose Indicators	

EXTERNAL TRUNK LINES	QTY.
Analog Input Trunks (monitored)	96
Analog Output Trunks (non-monitored)	96
Logic Input Trunks	50
Logic Output Trunks	50

PERIPHERAL EQUIPMENT	
Stored-Program Input-Output System	1
X-Y Plotters	4
Line Printer	1
Recorders (See Note 7)	3
Display Unit	1
Oscilloscope	1

NOTE 1. Summer-Integrators can have relay mode control with three time scales or electronic mode control with six time scales.
NOTE 2. Coefficient Attenuators are available as thumbwheel-controlled or servo-set; twenty-four are three-terminal.
NOTE 3. Twenty-four of the Electronic Multipliers are associated with Electronic Resolvers.
NOTE 4. Electronic Resolvers are available in five versions, respectively offering additional modes of operation.
NOTE 5. All Parallel Logic Elements have true and complementary output states.
NOTE 6. A Quad Register can alternately be used as a binary or BCD counter, or separated into four set-reset flip-flops.
NOTE 7. The Recorder is available in three different channel configurations to meet individual requirements: 4-80 mm channels, or 2-80 mm and 4-40 mm, or 8-40 mm channels.

EAI®

ELECTRONIC ASSOCIATES, INC. *West Long Branch, New Jersey*

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