# System 18/30



GENERAL AUTOMATION

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# Automation...The Coming of Age

Fifteen years have passed since the visibility of computer-based automation was achieved. During this time, hundreds of computer-control projects were undertaken and thousands of computers put on-line in automatic control applications. Three generations of computing equipment have passed ... beginning with vacuum tubes and relays, to transistors and solid-state electronics, then integrated and micro circuits. Computer equipment costs through three generations have reduced from millions of dollars each, to tens of thousands and less. **Computer based automation technology is coming of age.**

The GA 18/30 Fourth Generation Control System answers the need for the next level automated systems.

Business demands more and higher quality goods and services at lower costs. The way open to meet these demands is more automation, which produces increased productivity and refinement of communication and control. The maturing automation technology, products, programmable machinery and instruments assure the economic and dependable success of an automation project.

GENERAL AUTOMATION, INC., has that required mature technology, products, and process specialization. The combining of these into the GA 18/30 system program is the new generation of computer-based automatic control systems.

The GA 18/30 system encompasses centralized and distributed automatic control systems. The system consists of five modular sections: the 1804 processor; a family of communicating equipment and dedicated terminals provide remote data collection, processing, control and display capability; a set of minor and major data processing peripherals provide bulk storage, program and data input/output and data display; the process input/output section contains the input/output devices required to connect the 18/30 system to industrial machinery, data collection devices, measuring instruments and sensors; the computer to computer section provides local connection to other computers in automatic Management Information and Control Systems.

The modularity of the entire system permits matching the size of the work to be performed automatically with economics.

The 18/30 system is supported by GENERAL AUTOMATION's Technical Applications Centers (TAC) located in major cities in the United States and Europe. Each TAC center is staffed with industrial process specialist, process programmers, engineers, and service personnel. GA TAC Center personnel provide the technological services required to up-grade a semi-automatic process control to a fully automatic computer based control system.

Software for the 18/30 includes assemblers, utility packages, FORTRAN, subroutine library, and test and verify programs. A family of Real-Time Monitor Executive systems and modular product control programs are available for each GA applied 18/30 system. Contract software is supplied for new and unique applied systems. GA, as one source, supplies the automatic process control hardware, software and engineering required to accomplish your Automation Project.

Design and organization of the 1804 has produced a processor that is **totally** program compatible with the IBM 1800 and the IBM 1130.

Fourth generation materials including Medium Scale (MSI) and Small Scale (SSI) Integrated Circuits enable substantial reductions in costs and size with corresponding increases in performance and reliability. One (MSI) component replaces over sixty solid-state components formerly used to implement the same function. This capability has been applied throughout the 18/30 system to produce factors of two to four times performance at less than one-half the costs, and at the same time, substantially increasing the reliability.

This achievement provides equipment and project mechanization capability to the large community of experienced users of IBM 1800 and IBM 1130 systems. To those users who have IBM 1800 and IBM 1130 centers, their investments in learning and applying computing equipment can be applied to other automation projects within their organization's business activity at substantial cost savings.

This document describes the sections of the GA 18/30 system, typical applications, and GENERAL AUTOMATION's services for accomplishing an Automation Project.

# Features
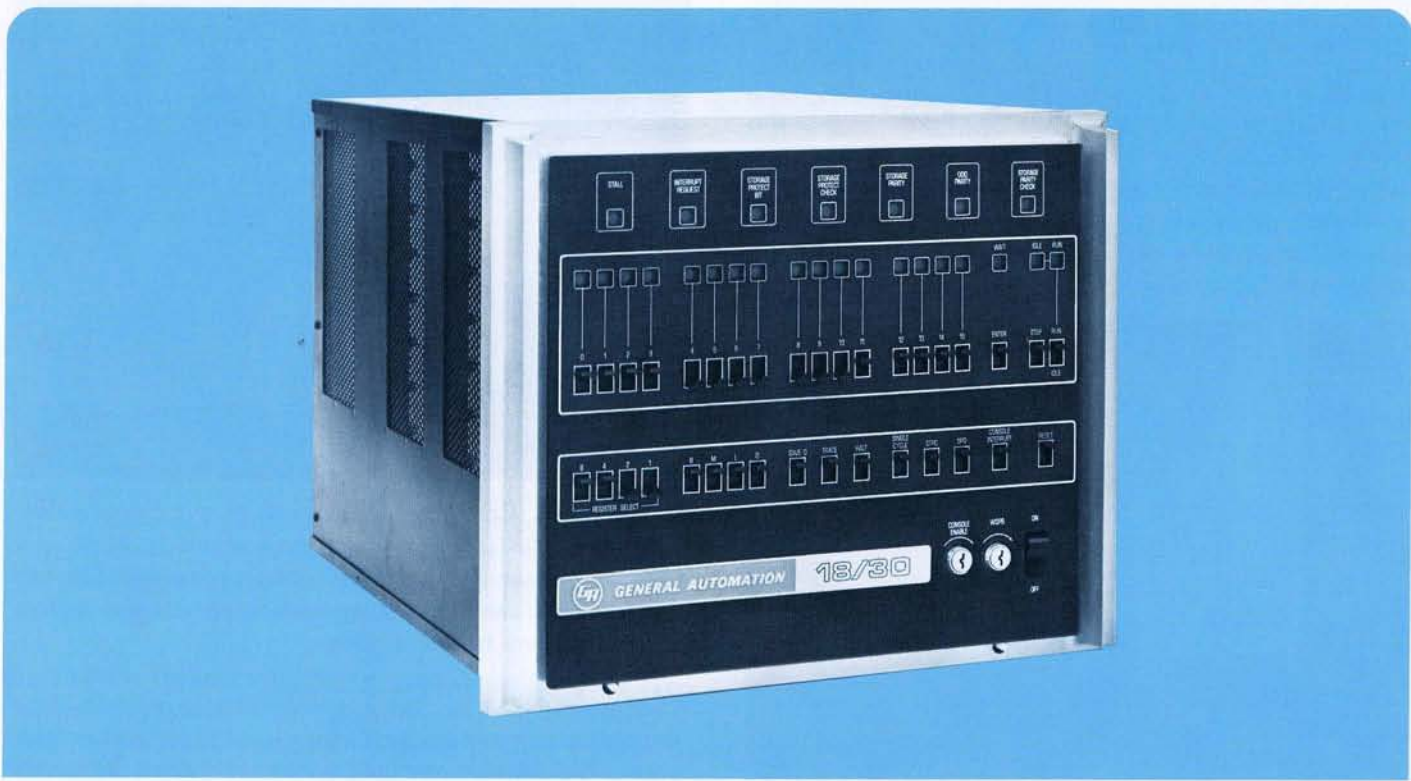
**FAST AND POWERFUL** — The GA 18/30 system has a 16 bit word length, single and double precision arithmetic hardware multiply, divide plus parity and storage protection bits. The processor has a 960 nonsecond memory available in 4K increments to 32K and a 16 word 35 nanosecond scratch pad. Direct addressing to the entire 32K memory is provided. The GA 18/30 will process over 400,000 instructions per second. While the instruction repertoire is fully compatible with both the IBM 1800 and 1130, the GA 18/30 is equipped with an extra class of multi-purpose register-to-scratch-pad commands.

**FULL PRODUCT LINE** — GA 18/30 system is available with a full line of: local and remote terminal processors; analog and digital process input/output subsystems; minor and major data processing peripherals; communications adapters, pre and post processors, concentrators and separators; computer to computer couplers; program generation software; GA Real Time Monitor Executive Systems and prod-

uct software; and the exclusive GA Technical Application Centers.

**SAFETY FEATURES** — The GA 18/30 offers full automation safety features. The fail safe system includes systems monitor, automatic power fail shut down and restart, console lockout, storage protect lock out, memory parity, read only memory, system safe lines, system reset lines, GA exclusive industrial reliability packaging, and interchangeability of parts.

**SOFTWARE READY TO GO** — Full software compatibility with the IBM 1800 and 1130 means you may have your programs written, debugged and running already. They will run faster and at lower costs. In addition to being program compatible with the IBM 1800 and 1130 systems, the GA 18/30 software includes assemblers, compilers, library utility programs, real-time monitor executives product and control programs.

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# GA 18/30 Industrial Applications

The GA 18/30 system offers new profit opportunities for industry through supervisory control, monitoring, production control, process accounting, and other applications too numerous to name. Here are only a few . . .

**STEEL MILLS** Today there are few hot strip mills, basic oxygen furnace and continuous casting machines that are built without process computers. The GA 18/30 system offers higher profits through reduced operating expenses and increased yield of better quality products. GA 18/30 system applications include such areas as electrolytic tinning lines, annealing lines, electric furnaces and utilities dispatching.

**RAILROADS** Connected to a remote data acquisition center, a GA 18/30 system keeps track of rolling stock and allocates its services. Such computer control systems can use automatic car identification systems which transmit data on passing cars to the computer.

**TRAFFIC CONTROL** Large populated municipalities face the problem of smooth traffic flow in and out of downtown areas efficiently. Mass transit systems and electronic traffic control of the very near future will use process computers.

**POWER** The GA 18/30 system will monitor, determine sequence of events, control and perform calculations in both nuclear generating and fossil-fueled generating stations and system operations. The GA 18/30 performs such functions as load frequency control, telemetering and supervisory control and on-line power systems studies.

**MANUFACTURING** The GA 18/30 industrial computer system has the facility for logical decision making and counting required for production monitoring and machine control. A GA 18/30 system can be coupled with large bulk memory and high speed card equipment to give it the capacity required for control of production, inventory and product quality.
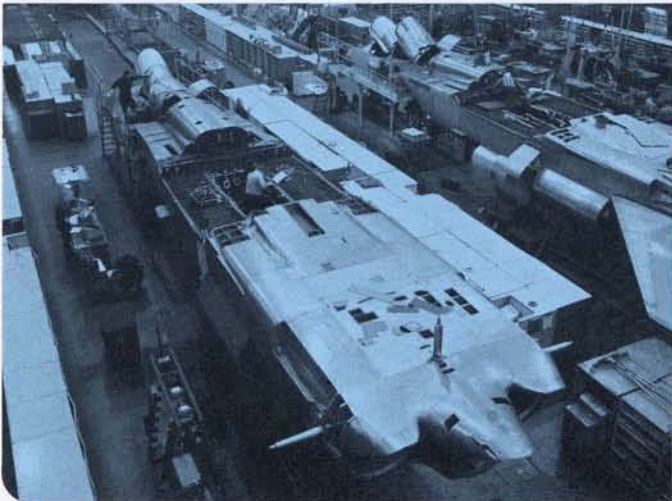




**PETROLEUM** Refinery information and oil movement systems, cracking plants, and crude oil units are all key refinery applications for process computers. Other applications include product blending, reformers, alkylation units, and lubricants of wax plants. Computers have also been successfully applied to on-shore and off-shore production, crude and production pipe lines and truck terminals.

A GA 18/30 system can pace production lines, schedule production and maintenance, supply numerical control data, control the machines which do the metalworking, material handling, wiring assembling, and testing, dispatch men, materials and tools, monitor and analyze machine performance and provide statistical analysis for quality control.

# 1804 Processor

The 1804 processor is a medium scale Industrial Automation Computer designed to function in an automatic computer based control system. The materials, organization, and construction produce the highest level of reliability, system fail-safe operation, and performance versus cost.

The processor control unit has a unique organization, using medium scale integrated (MSI) circuits, which produces on an instruction-by-instruction basis compatibility with the IBM 1800 and the IBM 1130 processor-controllers. The memory operates at less than 960 nanoseconds full cycle time. The arithmetic unit performs single and double precision arithmetic and hardware multiply and divide.

System Fail-Safe operation is assured with console locks, memory parity, storage protect, operations monitor, auto power shutdown and restart, violation interrupts, auto system reset, system-safe signals, wide environmental operating margins for industrial environments, and wire-free construction. The 1804 processor is the most reliable and fail-safe medium scale industrial automation computer ever offered.

The processor is available in a minimum configuration of 4096 words of storage, full instruction set, three hardware index registers, (MSI) 35 nanosecond 16 bit register scratchpad memory, memory parity and storage protect, and 6 internal interrupts, console, hardware multiply and divide, six classes of instructions:

- Load and Store
- Arithmetic
- Shift
- Branch
- I/O
- Processor/Scratchpad

To the minimum configuration, the following can be added as needed on a plug-in basis:

- 4096 word memory modules to a max. of 32,768 words
- Five automatic data channels
- Three internal timers
- Operation monitor
- Automatic power shut-down and restart
- I/O bus line drivers and receivers
- Data Processing Peripheral Group I/O controllers
- External interrupts
- Process I/O Group Controllers
- Alternate memory modules of read-only memory

These additional system elements plug into the basic 1804 processor main-frame. The other system sections are contained in plug-in add-on chassis to the 1804.

For detailed description of the 1804 Processor, request GA 18/30 System Reference Manual, publication #88A00026A.
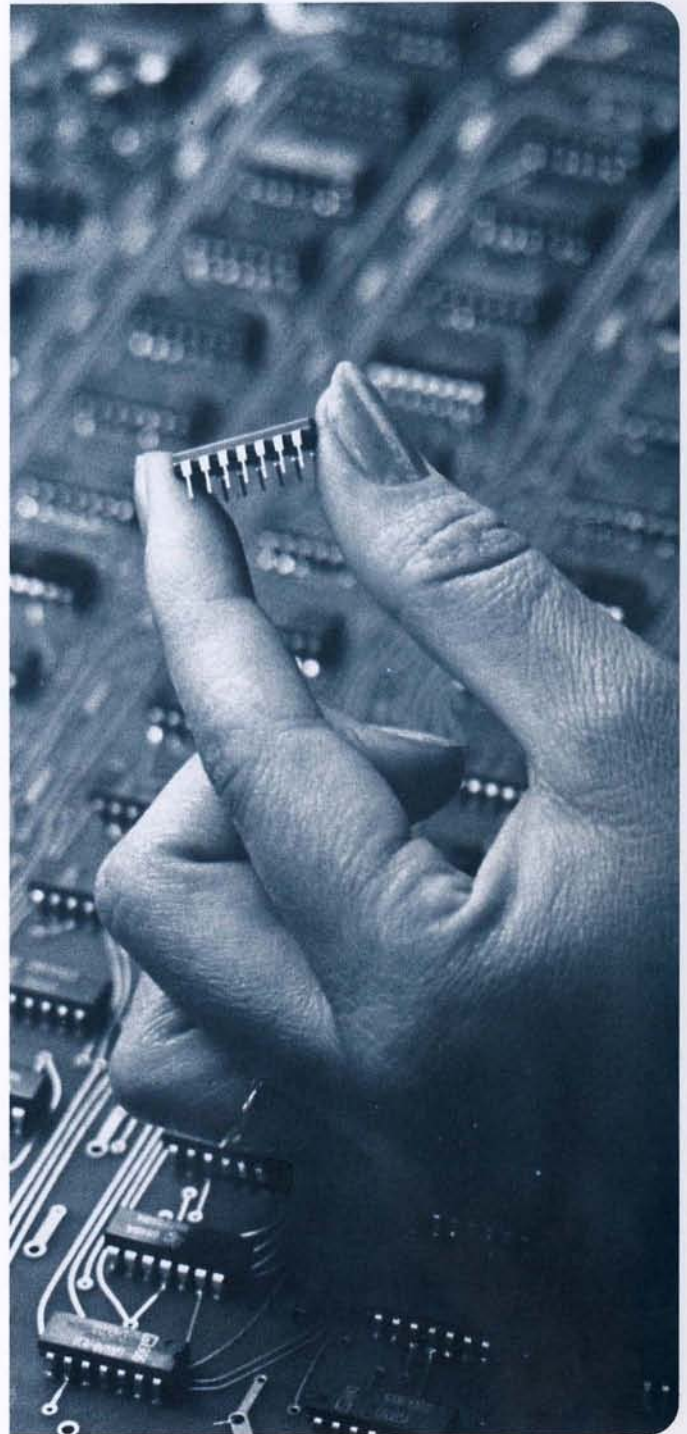
# 1804 Specifications

**TYPE:**

General purpose digital computer
Industrial-automation based industrial control computer
Fixed word length, binary 16-bit plus parity bit, plus
storage protect bit and 32-bit
Parallel arithmetic

**CONSTRUCTION:**

Integrated circuits
Small scale integrated circuits (SSI)
Medium scale integrated circuits (MSI)
Wire-free, double-side printed circuit boards
Printed Circuit Mother Boards
Ruggedized for industrial environment

**MEMORY:**

Random Access
8 memory sizes (4K to 32K in 4K increments)
16 data bit word plus parity bit and storage protection bit
Wide temperature ferrite magnetic cores
Memory cycle time of 960 nanosecond
16 word MSI 35 nanosecond scratchpad memory

**ARITHMETIC:**

Parallel, 16-bit
Binary, two's complement
Fixed point
Single and double precision
Hardware multiply and divide
Overflow and carry indicators may be program tested

**INSTRUCTIONS:**

Six classes (over 400 modifications):
Load and store (single and double word)
Arithmetic and logical (single and double word)
Shift
Processor/scratch pad
Branch and skip
I/O
Instruction repertoire compatible with IBM 1800 and
1130 to binary coding level.

**SPEED:**

| | |
|---|---|
| Add time (single precision) | 2.4 $\mu$s. |
| (double precision) | 3.6 $\mu$s. |
| Load and store (single precision) | 2.4 $\mu$s. |
| (double precision) | 3.6 $\mu$s. |
| Multiply | 12.0 $\mu$s. |
| Divide | 13.2 $\mu$s. |
| Branch | 1.2 $\mu$s. |
| I/O Transfers | 3.6 $\mu$s. |
| Data channel transfers | 1.2 $\mu$s. |
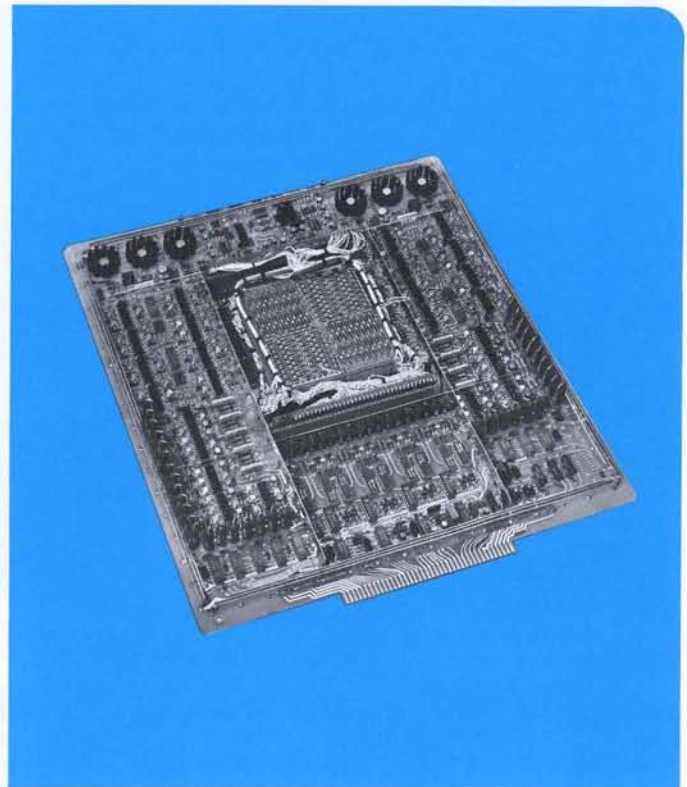
**PANEL:**

Programmer's console
16 data switches and indicators
Register select switches for 20 registers
Console lockout switch-key operated
Storage protect lockout-key operated
Alarm indicators
13 control switches

**FAIL-SAFE:**

Operations monitor (stall alarm)
Automatic power fail shutdown and restart
Memory parity bit and interrupt
Storage write protect bit and interrupt and
console key lock
Console enable/disable key lock
System reset signal
System safe signal
Wide temperature memories
Industrial environment operation
Wire-free construction

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## INPUT/OUTPUT:

16-bit parallel I/O data buss
Programmable parallel I/O data channel
Up to 61 automatic priority interrupt levels
Up to 1024 system automatic priority interrupts
   Programmable interrupts
   Mask control on each interrupt level
Five data channels (cycle stealing)
Console data entry switch input via sense instruction

## DIMENSIONS:

19" x 15¾" x 22½" Rack space with
power supply and cooling

## WEIGHT:

85 to 105 lbs. (options selected)
with power supply and cooling

## TEMPERATURE:

0 degrees Centigrade to 50 degrees
Centigrade operable

## HUMIDITY:

To 90% relative
(no condensation)

## POWER:

115 volts AC ± 10% single phase
47 to 63 HZ

## SOFTWARE:

Program compatible with IBM 1800 and
1130 systems
Assemblers
FORTRAN
Hardware test and verify routines
Basic utility systems
Subroutine library
Real-Time Monitor Executives
Product control programs

## SYSTEM SECTIONS:

Processor and expansions
Data processing peripherals
Process Input/Output devices
Communications Input/Output and terminals
Computer-to-computer couplers
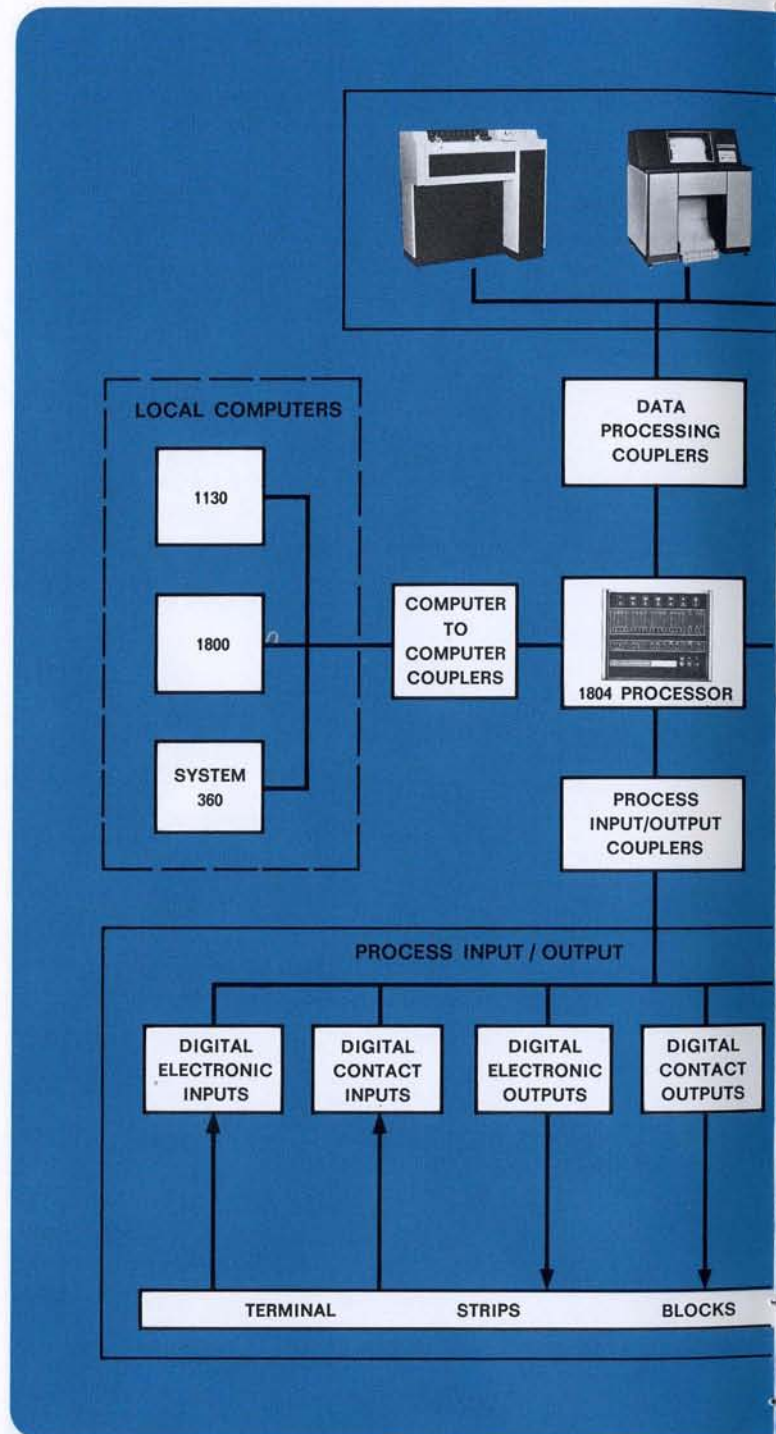
# GA 18/30 Systems

DATA PROCESSING PERIPHERALS

TERMINALS

COMMUNICATIONS COUPLERS

| | |
|---|---|
| CONCENTRATORS SEPARATORS | TIME SHARING SYSTEMS |
| DATA-SET COUPLERS | INFORMATION PROCESSING SYSTEMS |
| PRE-POST COMMUNICATION PROCESSORS | DECENTRALIZED CONTROL SYSTEMS |

DATA-SET COUPLERS

REMOTE TERMINAL COUPLER

BATCH PROCESSING TERMINALS

DATA ACQUISITION TERMINALS

DIRECT DIGITAL CONTROL TERMINALS

NUMERICAL CONTROL TERMINALS

CONCENTRATORS SEPARATORS

DATA LOGGING TERMINALS

PRODUCTION TEST TERMINALS

DATA PROCESSING TERMINALS

COMMUNI-CATION SWITCH TERMINALS

INFORMATION DISPLAY TERMINALS

SOURCE DATA COLLECTOR

SOURCE DATA COLLECTOR

SOURCE DATA COLLECTOR

SOURCE DATA COLLECTOR

SOURCE DATA COLLECTOR

SOURCE DATA COLLECTOR

ANALOG INPUTS

ANALOG INPUTS/ OUTPUTS

ANALOG OUTPUTS

MULTIPLEXERS

SIGNAL CONDITIONING

POWER         CABINETS

# Processing I/O

## ANALOG INPUT

Analog Signals are collected and converted to digital form by the Analog Input Subsystem. The Analog Input Subsystem modules include:

- **Terminations** — the customer/computer interface for wiring from sensors and transducers.
- **Signal Conditioners** — interposing circuit elements for attenuation of noise signals and for converting the input signals to levels acceptable to the ADC.
- **Multiplexer** — a signal switching system which routes a selected analog signal to the analog-to-digital conversion (ADC) module.
- **Amplifier** — provides signal isolation and amplification for introduction to the analog-to-digital converter.
- **Analog-to-digital-converter** — Converts the selected analog input signal to its digital equivalent and presents the result to the computer for processing.

The General Automation Analog input Subsystem offers a variety of functional modules which can be configured to accommodate a wide range of signal types and sampling rates. Generally, the analog signals can be classified as follows:

- **High-level, single-ended** — Full-scale range of ± 5V with signal reference to a common point (no common-mode voltage).
- **High-level, differential** — Full-scale range of ± 5V (or, optionally, ± 200 mv) with both signal and reference lines electrically isolated (moderate common-mode voltage).
- **Low-level, differential** — Signals with a range of program-selectable full-scale voltages in the milli-watt range. This class usually requires a high-degree of signal and reference isolation and is often subjected to high common mode voltage environments. Typical inputs are thermocouples, P/I Transducers, chromatographs, etc.

The General Automation 1451, 1452, and 1453 Multiplexer Units in the following description have been engineered to optimize the acquisition of signals falling in the classification previously cited.

## GA 1451 MULTIPLEXER UNIT

The 1451 high-level, single-ended input unit is used to provide a multiplexing input capability for single-ended analog signals. All analog signal sources connecting to the input circuits of the 1451 must be referenced to a common ground. The multiplexer is suited for applications where ground potential differences are small with respect to signal voltages.

### DESCRIPTION:

The multiplexer is a high-speed unit featuring all silicon solid-state electronics, field effect transistors (FET's), and built-in selection and control logic. It provides contactless switching of up to 16 analog input signals per unit.

### FEATURES:

- **16 Input Channels per Unit** — Sixteen input channels provide economical switching for single-ended input signals.
- **Bipolar 5V Range** — ± 5V range for direct interface with ASIU-01 Analog Input/Output Unit.
- **FET Solid-State Switches** — Field effect transistor switches are used for high-speed, contactless switching of input signals.
- **Built-In Multiplexer Address Logic** — Control logic built into the unit provides fully buffered selection of multiplexer channels without the need for additional controllers.

## GA 1452 MULTIPLEXER UNIT

The 1452 differential input unit is used to provide a multiplexing input capability for differential analog signals. The multiplexer is suited for applications where ground potential differences or common mode voltages would induce significant errors in an analog-to-digital process using single-ended switching.

### DESCRIPTION:

The multiplexer is a high-speed unit featuring all silicon solid-state electronics, field effect transistors (FET's), high impedance input circuits, and built-in selection and control logic. It provides contactless switching of up to eight analog input signals per unit and contains isolation amplifiers for converting differential analog input signals into single-ended analog signals with a common reference to the processor ground.

### FEATURES:

- **8 Input Channels per Unit** — Eight differential input channels per unit provide economical switching for differential input signals.
- **Bipolar 5V or 200 mv Range** — ± 5V or ± 200 mv range for direct interface with ASIU-01 Analog Input/Output Unit.
- **FET Solid-State Switches** — Field effect transistor switches are used for high-speed, contactless switching of input signals.
- **High Input Impedance** — Differential isolation amplifiers with high impedance input provide common mode voltage rejection.

- **Built-In, Buffered Selection Logic** — Control logic built into the unit provides fully buffered selection of input channels without the need for additional controllers.

## GA 1453 MULTIPLEXER / AMPLIFIER UNIT

The 1453 low-level, differential input unit is used to provide a multiplexing input capability for low-level differential analog signals. The multiplexer is suited for applications where large ground potential differences or common mode voltages would induce significant errors in an analog-to-digital process using single-ended switching. Wide dynamic-range inputs are accommodated through the use of program-selected gain changing differential amplifiers.

### DESCRIPTION:

The multiplexer is a moderate-speed unit featuring all silicon solid-state control electronics, high impedance input circuits, and built-in selection and control logic. It provides highly reliable mercury-wetted relay switching of up to eight analog input signals per unit routing low-level analog input signals into the differential amplifier.

### FEATURES:

- **8 Input Channels per Unit** — Eight differential input channels per unit provide economical switching for low-level input signals.
- **Bipolar millivolt ranges** — Millivolt signals are amplified for direct interface with 5V input range of Analog-to-digital converter.
- **Mercury-wetted Relay Switches** — No-bounce signal select with minimum cross-talk and highest noise immunity.
- **High Input Impedance Differential Amplifier** — Differential isolation amplifier with high impedance input provides both amplification and common mode voltage rejection. Program-selectable gain settings enhance system accuracy.
- **Built-In, Buffered Selection Logic** — Control logic built into the unit provides fully buffered selection of input channels without the need of additional controllers.

## GA 1440 ANALOG-TO-DIGITAL CONVERTER (ADC)

The 1440 ADC unit is the control and conversion unit of the analog input subsystem. Used with the Model 1451, 1452 and 1453 multiplexers, the ADC converts the selected analog signal to its digital equivalent by the successive approximation, asynchronous timing method. Total conversion time is 40 microseconds for an 11-bit plus sign, digital value. This value may be read into the computer either through the arithmetic unit adapter or directly into memory via a data channel.

## ANALOG INPUT SIGNAL CONDITIONING

GA 1460-Series signal conditioners are selectively applied to analog input points to obtain one or more of the following conditioning features:

- High-frequency noise rejection
- AC power line and harmonics rejection
- Current-to-voltage mode conversion
- Voltage attenuation
- Thermocouple material to copper conductor interfacing with cold-reference-junction measurement features.
- Special bridge circuit interfaces (for example, RTD's, Strain Gauge, Galvometers, etc.)

## ANALOG INPUT TERMINATION

Analog input signal terminations provide either screw-down terminals or rugged multi-point cable connectors for terminating field wiring from customer sensors and transducers.

The signal termination modules can be mounted in customer housings or in GA 1900-Series racks and enclosures.

## ANALOG OUTPUT

Digital values generated by computer program are converted to analog signals for transmission to system control elements and recording devices by the analog output subsystem.

The analog output subsystem modules include:

- **Digital-to-analog-converter (DAC)** — Converts digital values received from the computer I/O bus to its equivalent analog value.
- **Analog Output Demultiplexer** — Expands the output channel capacity of the DAC by employing analog output holding amplifiers and signal routing logic circuits.
- **Analog Output Signal Conditioners** — Interposing circuit elements for converting output signals to levels acceptable to the external control circuitry.
- **Terminations** — The customer/computer interface for wiring to control elements or recording equipment.

The following summarizes the General Automation Analog Output Subsystem features.

## GA 1470-1 DIGITAL TO ANALOG CONVERTER

The 1470-1 unit is the control and conversion unit of the analog output subsystem. It is used with the 1480 analog output holding amplifiers to provide the processor with a high performance analog output system capable of transmitting analog output signals under program control.

# Processing I/O (continued)

## DESCRIPTION:

This high speed, high performance unit features all silicon solid-state electronics with self-contained logic, timing buffer storage, and comparison circuits for driving analog output holding amplifiers (demultiplexers).

## FEATURES:

- **12 Bits Including Sign** — Twelve-bit converter offers high output resolution.
- **Bipolar 5V Range** — ± 5V range provides 2.5 mv per bit resolution. Other output ranges available with the 1460 Series signal conditioners.
- **High Conversion Speed** — With a 3.3 $\mu$s per bit conversion rate, total conversion time is only 40 $\mu$s.
- **Interrupt and Ready Signals** — Priority interrupt and device ready logic provides signals and control for synchronizing a control program with the analog output unit.
- **Built-In Precision Power Supply** — All precision voltages are internally generated.

## GA 1480 ANALOG OUTPUT DEMULTIPLEXER

The analog output holding amplifier is used with the GA 1470-1 Digital-to-Analog Converter to provide analog output capability for the processor. The unit's high accuracy, high resolution and low decay rate make it ideal for driving remote analog control equipment.

## DESCRIPTION:

The holding amplifier is an eighty-channel unit featuring all silicon solid-state electronics, low output impedance, low decay rate, and self-contained logic for selecting output channels.

## FEATURES:

- **8 Output Channels per Unit** — Eight analog output channels per unit provide economical analog output capability.
- **Low Output Impedance** — Low output impedance (milliohms) makes output voltages virtually independent of load.
- **Low Decay Rate** — Decay rate is a low 0.04% full scale per second at 25 degrees Centigrade.
- **Bipolar 5V Output Range** — ± 5V output range provides 2.5 mv per bit output resolution. (Other ranges available with 1460 Series signal conditioners.)
- **High Slewing Speed** — Fast response from high-gain driving circuits provides extremely fast output slewing speeds. System is critically damped for smooth, no-hunt response.

- **Built-In, Buffered Selection Logic** — Control logic built into the unit provides fully buffered selection of output channels without the need for additional controllers.

## GA 1463 and 1464 ANALOG OUTPUT SIGNAL CONDITIONERS

The analog output signal conditioners are used when the standard output ranges must be modified to meet specific external circuit requirements. Typically, the signal modifications include the following:

- Voltage attenuation
- Zero offset
- Voltage amplification
- Split range outputs

## ANALOG OUTPUT TERMINATION

Analog output signal terminations provide either screw-down terminals or rugged multi-point cable connectors for terminating field wiring to customer equipment.

The signal termination modules can be mounted in customer housing or in GA 1900-Series racks and enclosures.

## DIGITAL INPUT

The General Automation Digital Input Subsystem permits Computer-directed real-time acquisition of digital information in eight-or sixteen-bit parallel groups. The input format is independent of the digital input subsystem; that is, the 16-bit word may comprise fields of binary-coded-decimal, free-binary, discrete bits, or any other pattern. Interpretation of the input format is easily accomplished by the computer program.

The digital input subsystem modules include the following:

- **Termination** — the customer/computer interface for wiring from field contacts, switches, electronic driver, etc.
- **Signal Conditioners** — provide one or more conditioning features such as electrical isolation, decision level threshold setting and contact bounce suppression.
- **Group Select and Control Logic** — timing, control and address recognition logic for implementing computer selection and read-in functions.
- **Adapter Unit** — connects the digital input modules in the computer I/O bus; or optionally, to a data channel for direct memory transfer of data.

The General Automation 1410, 1420 and 1430 Series input units and the 1490-Series signal conditioner units are engi-

neered to accept signals from a variety of sources. Typically, these include:

- Relay contacts
- Switch contacts
- Solenoid drivers
- High-speed Electronic switches
- Cable line drivers
- Pulse generators
- Tachometers

The following descriptions summarize the digital input subsystem features:

## GA 1410-1 DIGITAL INPUT and 1490 SIGNAL CONDITIONING

The 1410-1 differential input unit provides a digital input signal interface to the processor for high speed applications or for applications requiring high-level electrical isolation. It can be used effectively as an input unit for pulse type or dc signals, as an interface with remote equipment having low power logic signal outputs, or as a line receiver.

### DESCRIPTION:

Featuring high-speed, reliable, all silicon circuits, the digital differential input unit converts a change in the level of an external voltage into a digital logic level signal. Input signal conditioning, built-in control logic, and provision for changing the decision threshold provide for maximum flexibility and wide application.

### FEATURES:

- **16 Input Circuits per Unit** — Digital input circuits are arranged in two groups of eight, with independent gating for reading each group if desired.
- **Differential Input Circuit** — Differential input stage increases common mode voltage capabilities and eliminates typical grounding problems.
- **Input Signal Conditioning** — Input signal conditioning rejects high frequency noise and matches circuit response to processor speed.
- **Logic Signal Compatibility** — Decision threshold is compatible with 2.5 ($\pm$ 1.5) V logic levels and has provision for easily changing to other levels.
- **Dual Built-In Control Logic** — Control logic built into the unit allows independent gating of data from each set of eight inputs without the need for additional controllers.
- **Flexible Gating for Remote Applications** — Spare, non-dedicated, control input provides a direct means of enabling each group of outputs when the unit is applied as a line receiver in remote equipment.

## GA 1430-1 DIGITAL INPUT and 1492 SIGNAL CONDITIONING

The 1430-1 digital input relay receiver provides a digital input signal interface to the processor for applications that require electrical isolation. The low power requirements of the input relay coils make the unit suitable in applications having either hard contact or electronics signal sources.

### DESCRIPTION:

The digital input relay receiver provides electrical isolation for processor input signals through the use of relay coil input circuits. This fast-operating unit features all silicon electronics and long-life relays with rhodium-gold contacts and arc suppression diodes. Built-in control logic provides maximum flexibility for wide application.

### FEATURES:

- **16 Input Circuits per Unit** — Digital input circuits are arranged in two groups of eight with independent gating for reading each group separately if desired.
- **Electrical Isolation** — Relay coil input circuits provide complete electrical isolation between input and output.
- **Built-In Suppression** — Built-in arc suppression diodes protect external drivers from inductive voltage transients of relay coils.
- **Dual Built-In Control Logic** — Control logic built into the unit allows independent gating of information from each set of eight inputs without the need for additional controllers.
- **Flexible Gating for Remote Applications** — Spare, non-dedicated, control inputs can be used to enable each group of outputs when the unit is applied as a line receiver in remote equipment.

## GA 1420-1 PULSE INPUT and 1491 SIGNAL CONDITIONING

The pulse input unit provides a digital input signal interface to the processor for high-speed applications. Discrete pulses increment the count accumulators on a one-for-one basis.

### DESCRIPTION:

Featuring high-speed, reliable, all silicon circuits, the digital pulse counter unit accumulates digital pulses in either 8-bit (256 counts) or 16-bit (32,768 counts) register. Counter overflow-generated interrupts and counter register preset features permit a wide variety of application modes. (For example, if the pulse source is a crystal clock circuit, the counter can be preset to generate arbitrarily selected time intervals). Input signal conditioning; built-in control logic, and provision

for changing the decision threshold provide for maximum flexbility and wide application.

**FEATURES:**

- **Two 8-bit or one 16-bit Counter per Unit** — Circuits are arranged in two 8-bit counters with provisions for cascading into a single 16-bit counter.
- **Counter Preset Logic** — Counter registers can be preset to any value under program control.
- **Counter Overflow Logic** — Eight stage overflow logic generates an interrupt signal when the capacity or the counter is exceeded by one pulse. Indefinitely large accumulations are permitted through appropriate programming responses to the overflow interrupts.
- **Input Signal Conditioning** — Input signal conditioning rejects high frequency noise and eliminates spurious count signals.
- **Logic Signal Compatibility** — Decision threshold is compatible with 2.5 ($\pm$ 1.5) V logic levels and has provision for easily changing to other levels.
- **Dual Built-In Control Logic** — Control logic built into unit allows independent gating of data from either 8-bit counter or as a single 16-bit register without the need for additional controllers.

## DIGITAL INPUT TERMINATION

Digital input signal termination modules permit field wiring connections to either screw-down terminals or multi-point cable connectors.

The signal termination modules can be mounted in customer housing or in GA 1900-Series racks and enclosures.

## DIGITAL OUTPUT

The General Automation Digital Output Subsystem permits the direct transmission of digital control signals from the computer to customer equipment under program control. Outputs can range from a discrete or single bit to arbitrarily complex bit patterns or arrays. The Digital Output Subsystem comprises the following modules:

- **Terminations** — the customer/computer interface for wiring to customer actuators, indicators, digital control elements, etc.
- **Date Register and Output Units** — holds digital data received from the computer and converts the output signals to required mode (relay contacts, power drivers, pulses, etc.).
- **Adapter Units** — provides interface to the computer I/O Channel, or optionally, connects to direct memory access data channels.

Typical applications of the GA Digital Output Subsystem include:

- Relay coil and solenoid actuation
- Indicator drive
- Display drive (back projection, matrix, etc.)
- Resistor-ladder analog output drive
- Stepping motor and setpoint positioner drive
- Local device data transmission (parallel, BCD, etc.)
- Crossbar multiplexer switch control

The following summarizes the features of the GA Digital Output Subsystem:

## GA ELECTRONIC DRIVER OUTPUT

The power driver provides the interface between the processor and peripheral or control equipment requiring high-speed (above 1 kHz) driver signals from the processor. It is ideally suited to applications that require electrical isolation with nominal common mode voltage rejection. The unit is also suited for use as a relay driver, lamp driver, or line driver.

**DESCRIPTION:**

The buffered bipolar power driver provides electronic outputs from a logic buffer register set by processor control signals. It features high-speed, reliable, all silicon circuits with versatile electronics and control logic. Easily applied to a variety of applications, the unit offers the flexibility needed to build a tailored system using standard units.

**FEATURES:**

- **18 Output Drivers per Unit** — Output drivers are arranged in two groups of eight plus two drivers with independent gating for sending control or data-exchange signals to external equipment.
- **Fully Buffered** — Each output driver has its own buffer storage for maintained signal output.
- **Dual Built-In Control Logic** — Control logic built into the unit allows independent gating of information into each eight-bit buffer, if desired, without the need for additional controllers.
- **Bipolar Outputs** — Access is provided to both emitter and collector of each output transistor. Either positive or negative polarity signals can be switched using collector or emitter inputs.
- **Output Isolation** — Isolation stages between control circuits and output drivers increase common mode voltage capabilities and eliminate grounding problems found in conventional interface modules.
- **Interrupt and Ready Signals** — Priority interrupt and device ready logic provides signals and control for synchronizing a program with external equipment.

## GA 1431-1 CONTACT CLOSURE OUTPUT

The 1431-1 buffered contact output unit provides the interface between the processor and peripheral or control equipment requiring electrically isolated drive signals from the processor. It is ideally suited to applications requiring high common mode voltage capabilities with moderate (2ms) operation time. The unit is also suited for use in controlling electromechanical equipment, lamps, annunciators, or in driving long lines.

### DESCRIPTION:

The buffered contact output unit provides isolated relay contact outputs from a logic buffer set by the processor. This fast-operating unit features all silicon electronics and long-life rhodium-gold contacts. Versatile electronics and control logic provide the flexibility needed to build a tailored system using standard components.

### FEATURES:

- **18 Contact Outputs per Unit** — Outputs are arranged in two groups of eight plus two outputs with independent gating for sending control or data-exchange signals to external equipment.
- **Fully Buffered** — Each contact output has its own buffer storage for maintained signal output.
- **Dual Built-In Control Logic** — Control logic built into the unit allows independent gating of information into each eight-bit buffer, if desired, without the need for additional controllers.
- **Fast-Operating Rhodium-Gold Contacts** — Long-life contact normally provide over 100 million error-free operations when used at 100 ma, 12V dc. Contact operation is complete within 2 ms.
- **Interrupt and Ready Signals** — Priority interrupt and device ready logic provides signals and control for synchronizing a control program with external equipment.
- **Flexible Gating for Remote Applications** — Spare, non-dedicated, control input can be used to prevent gating of new data into the output buffers under external control.

## GA 1420-1 DIGITAL PULSE OUTPUT UNIT

The pulse output unit provides the interface between the processor and control equipment requiring pulse signals from the processor. The unit is suited for use with setpoint positioners, stepping motors and sequencing devices.

### DESCRIPTION:

The buffered pulse output unit provides electronic pulse outputs from a logic buffer set by processor control signals. It features high-speed, reliable, all silicon circuits with versatile electronics and control logic. Easily applied to a variety of application, the unit offers the flexibility needed to build a tailored system using standard units.

### FEATURES:

- **16 Output Drivers per Unit** — Output drivers are arranged in two groups of eight.
- **Fully Buffered** — Pulse drivers are buffered, permitting minimum computer connect time. Pulse duration is hardware adjustable to meet external equipment requirements.
- **Dual Built-In Control Logic** — Control logic built into the unit allows independent gating of information into each eight-bit buffer, if desired, without the need for additional controllers.
- **Multiple Parallel Outputs** — Any arrangements of 1-16 outputs may be pulsed by one computer command.
- **Output Isolation** — Isolation stages between control circuits and output drivers increase common mode voltage capabilities and eliminate grounding problems found in conventional interface modules.
- **Interrupt and Ready Signals** — Priority interrupt and device ready logic provides signals and control for synchronizing a control program with external equipment.

## DIGITAL OUTPUT TERMINATION

Digital output signal terminations provide either screw-down terminals or rugged multi-point cable connectors for terminating field wiring to customer equipment.

The signal termination modules can be mounted in customer housing or in GA 1900-Series racks and enclosures.

# Communications I/O

## TELEPROCESSING I/O UNITS

The General Automation teleprocessing input/output units provide for interfacing the GA 18/30 to communications facilities for operation in either asynchronous or synchronous modes of transmission.

## GA 1551 DATA SET ADAPTER

The 1551 Data Set Adapter provides for the connection to a WECO 103A E or F Data Set or equivalent.

The exchange of data between the adapter and the processor is byte serial and between the adapter and the Data Set is bit serial. The method of serial transmission is asynchronous with one leading start bit and one or two trailing stop bits surrounding the 8 bits of the character.

The electrical and control interface characteristics conform to EIA RS-23B standards and may operate with a 2 wire-HDX, 4 wire-HDX, or 4 wire-FDX communication system.

The transfer rate is 110 bits/second, standard, 150 bps or 300 bps, optional.

## GA 1552 DATA SET ADAPTER

The 1552 Data Set Adapter provides for the connection to a WECO 202C or D Data Set or equivalent.

The exchange of data between the adapter and the processor is byte serial and between the adapter and the Data Set is bit serial. The method of serial transmission is asynchronous with one leading start bit and one or two trailing stop bits surrounding the 8 bits of the character.

The electrical and control interface characteristics conform to EIA RS-323B standards and may interface with 2 wire-HDX, or 4 wire-HDX, or 4 wire-FDX communication systems. Operation with the supervisory (reverse) channel feature of the Data Set is provided.

The data transfer rate is 1200 bps standard (1050 bps or 1800 bps, optional).

## GA 1553 DATA SET ADAPTER

The 1553 Data Set Adapter provides for connection to a WECO 201A1 or B1 Data Set or equivalent.

The exchange of data between the adapter and processor is byte serial and between the adapter and the Data Set is bit serial. The method of serial transmission is synchronous with the data clock being provided from the Data Set.

The electrical and control interface characteristics conform to EIA RS-232B standards and may interface with 2 wire-HDX, 4 wire-HDX, or 4 wire-FDX communication systems.

The data transfer rate (determined by the Data Set) is 2000 bps when utilizing a 201A1 or 2400 bps when utilizing a 201B1.

## GA 1554 DATA SET ADAPTER

The 1554 Data Set Adapter provided for the connection to Data Sets with synchronous transmitting capabilities of up to 4800 bps (e.g. Milgo 4400/48).

The exchange of data between the adapter and processor is byte serial and between the adapter and the Data Set is bit serial. The method of serial transmission is synchronous with the data clock being provided from the Data Set.

The electrical and control interface characteristics conform to EIA RS-323B or to MIL-STD-188B (AUTODIN) and may interface with 2 wire-HDX, 4 wire-HDX, or 4 wire-FDX communication systems.

The data transfer rate is determined by the clock of the Data Set.

## GA 1555 AUTOMATIC CALLING UNIT ADAPTER

The 1555 Automatic Calling Unit Adapter provides for connection to a WECO 801A or 801C ACU or equivalent.

The exchange of data between the adapter and the processor is BCD character serial and between the adapter and the ACU is BCD character serial.

This adapter unit is designed to complement and work with the 1551, 1552, and 1553 Data Set Adapter Units. The electrical and control interface characteristics conform to EIA RS-232B standards.

The data transfer rate is determined by the Automatic Calling Unit.

# Peripherals

## GA 18/30 DATA PROCESSING I/O UNITS

The following General Automation units are available for incorporating into a GA 18/30 system.

### GA 1361 PRINTER/KEYBOARD

The 1361 provides for printed output at a rate of 15 characters per second and provides for data entry into the processor via a keyboard.

### GA 1362 PRINTER/KEYBOARD

The 1362 provides for printed output and punched paper tape output at a rate of 10 cps and provides for data entry into the processor via a keyboard or a paper tape reader at 10 cps.

### GA 1363 PRINTER/KEYBOARD

The 1363 is a high reliability version of the 1362 and provides identical operating characteristics and functions.

### GA 1364 PRINTER/KEYBOARD

The 1364 is a high reliability unit providing for printed output at a rate of 15 cps and provides for data entry into the processor via a keyboard.

### GA 1361 PRINTER

The 1361 printer provides for printed output at a rate of 25 cps and a line length of up to 132 columns. All 64 characters of the EBCDIC code are available.

### GA 1362 PRINTER

The 1362 printer provides for printed output at a rate of 300 lines per minute and up to 120 columns per line (132 columns per line optional). All 64 characters of the EBCDIC code are available.

### GA 1311 CARD READER

The 1311 provides for the serial reading of standard 80-column punched cards at a rate of 300 cards per minute.

### GA 1312 CARD READER/PUNCHER

The GA 1312 Card Reader/Puncher provides for the serial reading and punching of standard 80 column punched cards. The card read function provides a read rate of 500 cards per minute. The card punch function provides for punching cards at 300 cards per minute.

### GA 1321 PAPER TAPE READER

The 1321 Paper tape reader reads one inch, 8-channel paper tape at a rate of 300 cps. Data is read into the processor as a direct image of the holes in the tape and the encoding/decoding of the information is a function of the operating program.

### GA 1322 PAPER TAPE PUNCH

The 1322 Paper Tape Punch provides for the punching of

one inch, 8-channel paper tape at a rate of 60 cps. Data characters are punched as a direct image of the data output from the processor and the encoding/decoding of the information is a function of the operating program.

### GA 1331 MAGNETIC TAPE UNIT
The 1331 provides magnetic tape input and output capability at a rate of 19.2 kilo-bytes per second. Data is recorded and retrieved in an 800 bpi, 9-track, odd parity format. The 1331 provides for the handling of reels with up to 2400 feet of tape storage.

### GA 1332 MAGNETIC TAPE UNIT
The 1332 provides magnetic tape input and output capability at a rate of 28.8 kilo-bytes per second. Data is recorded and retrieved in an 800 bpi, 9-track odd parity format. The 1332 provides for the handling of reels with up to 2400 feet of tape storage.

### GA 1333 MAGNETIC TAPE UNIT
The 1333 provides magnetic tape input and output capability at a rate of 60 kilo-bytes per second. Data is recorded and retrieved in an 800 bpi, 9-track, odd parity format. The 1333 provides for the handling of reels with up to 2400 feet of tape storage.

### GA 1371 PLOTTER
The 1371 is an incremental plotter used to record digital information into graphic form. The plotter operates at 300 steps per sec. and at 0.01 inches per step.

### GA 1341 DISC STORAGE
The 1341 Disc Storage is a random access memory and is completely program compatible with the IBM 2311 disc drive. The storage of the 1341 is in excess of 5 million bytes. The storage media for data is an interchangeable disc pack consisting of 6 discs (IBM 1361 or equivalent). The transfer rate of the 1341 is 156 kilo-bytes per second.

### GA 1342 ROTATING MEMORY STORAGE
The 1342 is a fixed-head rotating memory storage unit with a storage capacity of 32 kilo-bytes minimum and expandable in 32 kilo-bytes increments to a maximum capacity of 256 kilo-bytes. The average access time is 8.7 milliseconds to any byte in the memory.

### GA 1343 ROTATING MEMORY STORAGE
The 1343 is a fixed-head rotating memory storage unit with a storage capacity of 512 kilo-bytes minimum and expandable in 32 kilo-bytes increments to a maximum capacity of 1.2 million bytes. The average access time is 8.7 milliseconds to any byte in the memory.
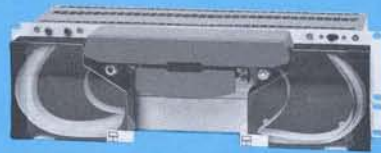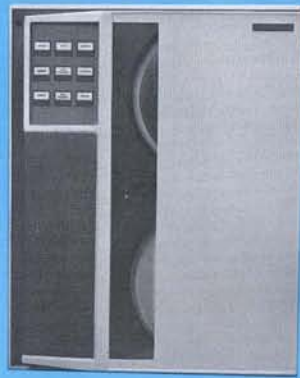
# GA 18/30 Software

The GENERAL AUTOMATION 18/30 user has at his disposal a wide variety of software support packages and systems. The standard GA software packages permit the user to write, debug, edit and execute his program with minimal effort.

Standard GENERAL AUTOMATION software support packages available include:

- Assembler
- Basic ASA FORTRAN Compiler
- Basic Utility System
- Mathematics and function subroutine library
- Peripheral device drivers
- Program loaders and link modules
- Real Time Monitor Executive

In addition, GENERAL AUTOMATION supports a continuing software development program aimed at expanding the standard software support packages as well as increasing the scope and variety of application programs.

## ASSEMBLER (18/30)

The GA 18/30 Assembly System is a symbolic assembly program that minimizes the time required for assembling program. The assembler system allows the programmer to code his program using mnemonic operation codes, special characters and other necessary symbols. Program locations are designated through the use of symbolic labels, making the program writing independent of actual machine locations. A set of macro-instructions facilitate memory allocation, program linkages, definition of labels and constants, etc.

## FORTRAN

The GENERAL AUTOMATION Basic ASA FORTRAN compiler produces GA 18/30 object programs from source statements written in the FORTRAN language. This feature permits the user to write and execute original application programs or to take advantage of software which has been previously written for other computers such as the IBM 1800 or 1130 systems. The high degree of compatibility offered by the GA FORTRAN system permits the GA user to avail himself of the vast number of source programs available through software sharing organizations or through the public domain libraries.

## BASIC UTILITY SYSTEM

The GA 18/30 Basic Utility System provides utility functions which enable the programmer to test, debug and modify his programs. Some of the features available to the BUS user are:

- Display/Change Memory
- Display/Change Registers
- Enter and begin program execution
- Trap and halt execution
- Print contents of memory **(Dump)**
- Output Source/Object programs
- Input Source/Object programs
- Protect/Unprotect Memory

## MATHEMATICS AND FUNCTIONAL SUBROUTINES

Standard subroutines, available both to FORTRAN and assembly language programs, include extended precision add, subtract, multiply and divide; transcendental functions (trigonometric, exponential, etc.); and logical functions (AND, OR, EXCLUSIVE OR, etc.).

## PERIPERAL EQUIPMENT DRIVERS

Peripheral device drivers for all GA Standard Input/Output equipment are available for integration into the programming system.

## LOADERS AND LINK MODULES

Programs generated by the assembler or compiler can be loaded and linked in computer memory under the control of standard loader routines. Format control and input validity checking are standard features of the GA loaders.

## REAL TIME MONITOR EXECUTIVE

The GENERAL AUTOMATION RTMX System and other powerful ECP Systems, described in separate publications, enable the 18/30 user to construct a complete operating system tailored to his specific real time requirements. An integrated system, utilizing RTMX, standard subroutines and drivers and user-written application programs offers the best solution to the customer's complex control problem and is often the key to profitable plant operation.

# General Automation...Your Automation Partner

GENERAL AUTOMATION'S business is to apply computer technology to help industry reach Information and Control System objectives through automation. The Company is dedicated to the philosophy that an increasing segment of industry needs to apply computer intelligence to a larger and more varied list of automation tasks. Thus, GENERAL AUTOMATION provides an array of products and services which help industrial users apply computer technology to the simplest possible levels of machine or processed-oriented tasks.

It is important to recognize that GENERAL AUTOMATION is not only in the business of supplying a diverse line of computer products, but GA also provides a complete spectrum of automation services designed to assist the user. These services cover such activities as: process analysis, systems engineering, application programming and consultation.

The business of GENERAL AUTOMATION is computer technology. This product is highly technical. To maintain the highest possible level of strength to serve customers in the automation business, the Company has established a set of cohesive business objectives, and has paced its growth consistent with meeting those objectives.

GENERAL AUTOMATION is a company with total capability to perform the tasks required to automate a process. Combined, our services and products give to you an AUTOMATION PARTNER with a problem understanding capability and an automation solution ability.

By automation of your industrial and mechanized processes GENERAL AUTOMATION can replace time consuming laborious methods with automated techniques that require only intelligent decision to control and operate. The result is increased efficiency, increased accuracy, and increased production . . . all at reduced operating costs.

GENERAL AUTOMATION is a total solution oriented company. Automation to us means providing solutions for the complete spectrum of tasks required to automate a process. This includes:

- Consulting
- System Design and Engineering
- Application Programming
- Adapting dedicated standard computer products to automation systems
- Installation services and product support
- Quality and product assurance

Our product is results . . . not just hardware, software, or systems elements.

Since we provide both automation services and automation products, our company is structured to satisfy the needs of both. GENERAL AUTOMATION is divided into two major operating divisions: Automation Products Division (APD) and Automation Sciences Division (ASD).

## AUTOMATION PRODUCTS DIVISION

The Automation Products Division designs, develops, and manufactures all standard computer products used in our automation systems. By providing a complete product line of standard computer subsystems, we provide to our customers the advantages of product optimization and overall reduction of recurring production costs. This coupled with complete software for all standard products supports our AUTOMATION PARTNER.

## AUTOMATION SCIENCES DIVISION

As stated earlier, both automation services and automation products are required to provide total capability to the automation customer. APD provides standard automation computer products. The purpose of the Automation Sciences Division is to provide automation services. These services can be simply stated as:

- Systems Development
- Systems Engineering
- Software
- Consulting

The Systems Development group is responsible for the design of automation solutions for various automation processes. This group combines GENERAL AUTOMATION's computer products and automation solution capabilities into total solutions to automation problems.

The Systems Engineering group is responsible for the design of special hardware used in association with the basic GENERAL AUTOMATION mini-controllers. Usually, this special design involves the interfacing between processor equipment and the customers' application.

The Software group is responsible for providing real-time programming systems for automation systems and applications. This group forms the backbone of GENERAL AUTOMATION's capability in structuring simple, yet powerful, software solutions to customer problems.

The Consulting group within ASD provides the link between products and total automation capability and solutions. This group is capable of analyzing automation requirements, performing feasibility studies and system analysis, constructing system configurations and mathematical modeling of both the system and application software requirements, and providing the automation solution.

## PRODUCTS

GENERAL AUTOMATION offers a complete line of standard industrial mini-computer products and mini-controllers (system interface units). These products, supported by complete standard product software, provide the nucleus of hardware used in our automation systems.

The SPC-12 industrial mini-computer provides a new concept in hardware design and software capability. The result is a mini-computer that meets the most stringent requirements of real-time data collection, processing and on-line control.

All functional facilities required for control applications are standard in the SPC-12. The basic computer includes a 4,096 8-bit word memory (expandable to 16,384 words), with a full cycle time of 2 micro-seconds. It provides a parallel adder; six addressing modes; eight 12-bit hardware registers

including an accumulator, index, and two index/accumulator registers; 50 basic commands; priority interrupt system; relative time clock; operators console; console lock; and Teletype interface.

The SPC-12 is the **only** industrial mini-computer that offers full automation safety features. The fail-safe system includes stall alarm, console lock, power fail protection and automatic restart, system safe lines, 24-volt battery back-up and wide temperature (lithium) memories.

Interfacing of the SPC-12 with other systems equipment is made exceptionally easy with our full line of compatible plug-in mini-controllers.

Pre-engineered mini-controllers provide a complete modular functional control system. More than 40 such mini-controllers are available including analog multiplexers, analog-to-digital and digital-to-analog converters, output analog storage units,
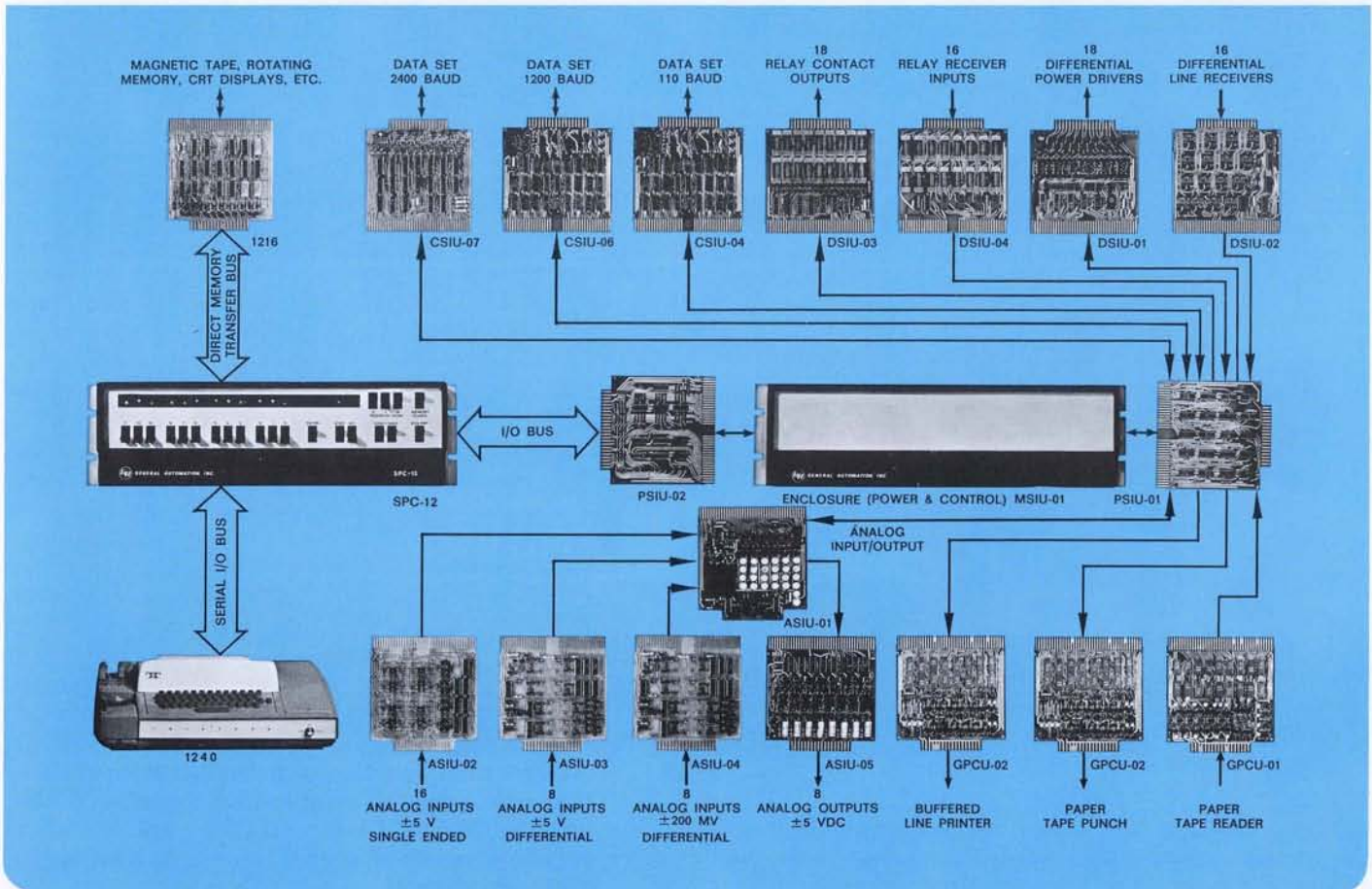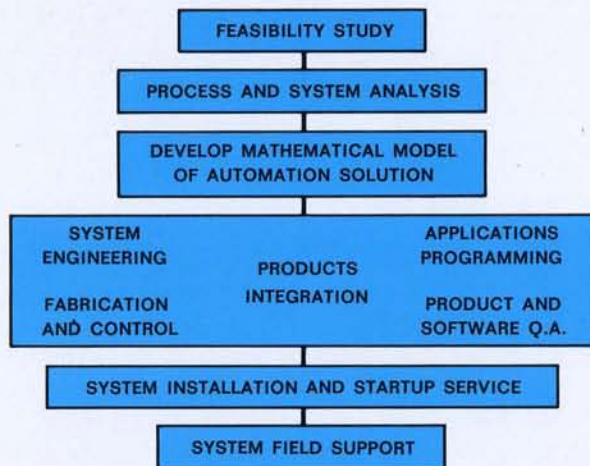
relay inputs, electronic inputs, relay outputs, electronic out-puts, controllers for Teletype terminals, data sets, line print-ers, card readers, paper tape punches and readers, magnetic tape units, disc memories, and other computer peripheral equipment.

In addition to our standard processors and mini-controllers GENERAL AUTOMATION has a series of standard functional data acquisition systems. These systems feature the same design standards used in all GENERAL AUTOMATION prod-ucts and are optimized to reduce recurring production costs. Standard application programming operating systems are available with each of the standard function data acquisition systems.

## SERVICES

GENERAL AUTOMATION's computer and system products are the tools for automating a process. GENERAL AUTOMATION's services provide the requirements neces-sary to achieve total automation solutions and total customer support. This means that GENERAL AUTOMATION has a total automation capability. As your AUTOMATION PART-NER, we can do the entire job—from analysis and planning to an operating system.

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┌─────────────────────────────────┐
│        FEASIBILITY STUDY        │
└─────────────────────────────────┘
┌─────────────────────────────────┐
│   PROCESS AND SYSTEM ANALYSIS   │
└─────────────────────────────────┘
┌─────────────────────────────────┐
│   DEVELOP MATHEMATICAL MODEL    │
│      OF AUTOMATION SOLUTION     │
└─────────────────────────────────┘
┌──────────────────────────────────────────┐
│ SYSTEM                    APPLICATIONS    │
│ ENGINEERING     PRODUCTS  PROGRAMMING     │
│              INTEGRATION                  │
│ FABRICATION               PRODUCT AND     │
│ AND CONTROL               SOFTWARE Q.A.   │
└──────────────────────────────────────────┘
┌─────────────────────────────────┐
│ SYSTEM INSTALLATION AND STARTUP SERVICE │
└─────────────────────────────────┘
┌─────────────────────────────────┐
│       SYSTEM FIELD SUPPORT      │
└─────────────────────────────────┘
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Each service offered by GENERAL AUTOMATION has a unique purpose in the AUTOMATION PARTNER concept. These services, in addition to being an intricate part of GENERAL AUTOMATION's total automation support capa-bility, are available in module form.

## TECHNICAL APPLICATION CENTERS

GENERAL AUTOMATION is establishing a nationwide struc-ture of technical application centers, providing a high level of technical support and services to its customers. In line with its philosophy of strong technical support, GENERAL AUTOMATION is locating TAC Centers in areas central to regional users.

Staffed by highly qualified technical personnel, the TAC Centers offer a wide variety of technical assistance and services specifically designed to meet the needs of GENERAL AUTOMATION clients in that area. Some of the services included are:

- **Applications Engineering:** The GA Applications Engi-neer works closely with customer engineers in formu-lating system requirements, recommending customer supporting equipment modifications or purchases, if they are required, and configuring a system which satisfies the customer's technical requirements and economical objectives.

- **Systems Engineering:** The systems engineering func-tion includes the detailed design and integration of system hardware and software components. Project management, implementation, and coordination with customer engineers are key responsibilities of the GA System Engineer. Making recommendations in areas of site preparation, field transducer selection, and sys-tem interconnections, etc., the GA Systems Engineer "gets the job done" on time, on budget and, most important, to the customer's satisfaction.

- **Programming and Systems Analysis:** GA programming and analysis services are available to the customer to help him design, flow chart and code the solutions to his automation problems. Programming and analysis services range from job and problem consultation to complete systems responsibility, as desired by the customer.

- **Maintenance and Service:** TAC Centers are the home base of maintenance engineers and service technicians whose services range from installation supervision to performance of complete system maintenance con-tracts. Completely factory trained, qualified customer engineers are located in the TAC Center in order to afford the customer the quickest possible response to his service requirements.

- **Customer Training:** Standard hardware and program-ming training courses are available through the TAC Centers. Qualified instructors conduct courses rang-ing from short introductory or familiarization sessions to complete detailed programming discipline. In addi-tion, the GA TAC Center instructors are qualified to present a variety of special courses to meet special client requirements.

# System 18/30

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