

GE/PAC 4000

GENERAL ELECTRIC PROCESS AUTOMATION COMPUTER

SMALL PROCESS COMPUTER expandable with functional modules

- small initial investment
- simplified system and application engineering
- easy to install
- economical field expansion



**GENERAL
ELECTRIC**



GE/PAC 4000

New efficiency, economy in a process computer

BETTER MANAGEMENT REPORTS

The GE/PAC 4000 presents accurate, up-to-date process operation data in real-time, that is, as the operation takes place. You save money because decisions are based on current information that enables you to operate your process more efficiently. For instance, productivity is accurately measured and operator efficiency can be rewarded or corrected.

Process sensor signals, scanned automatically by GE/PAC, provide raw data that is converted into useful information by GE/PAC. It can be printed out under computer control to provide complete, factual records of plant operation. This information can be prepared by GE/PAC for direct use by accounting, and for the plant manager in terms of raw material yield, fuel efficiencies, or other calculated results.

BETTER OPERATOR INFORMATION

GE/PAC compares deviations in actual process operation with ideal operation under various conditions and prints out "operator guides." This information saves you money because it results in more consistent operation of your plant.

GE/PAC continually "looks at" many process variables. If any variables go "off normal," it immediately warns the operator by means of a display panel or typewriter print-out, so corrections can be made before they become serious. Continual process checking by GE/PAC frees the operator to concentrate on other aspects of running the process.

BETTER PROCESS CONTROL

GE/PAC can automatically control your process with the addition of computer-control elements. The control can provide set-point references to process controllers or directly actuate process valves and motors. Computer control saves you money by optimizing process operation, smoothing process fluctuations, and reducing operator personnel.

TYPICAL FUNCTIONS

The GE/PAC modular concept lets you start with only core memory, arithmetic and control unit, typewriter, and tape reader and punch. This system can perform off-line functions such as data processing, optimizing calculations, and engineering analysis.

By adding a scanner and input-output unit, you can put the computer on-line. On-line functions can include automatic logging, alarming, performance analysis, monitoring, controlling, continuous testing, checkout, evaluation, as well as providing computer calculated guides for the operator.

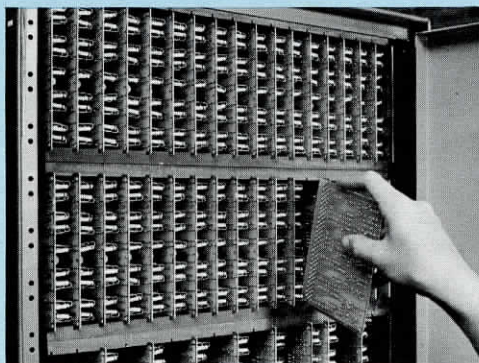
HOW GE/PAC MEANS NEW ECONOMY

Small Initial Investment—You buy only the modules to do the functions initially required. GE/PAC operates on standard 115/230-volt ac power. It requires no special enclosure nor air conditioning under normal conditions, operating in a temperature range of 32 to 131 F and humidity range of 5 to 100 percent. Its compact size reduces floor space requirements.

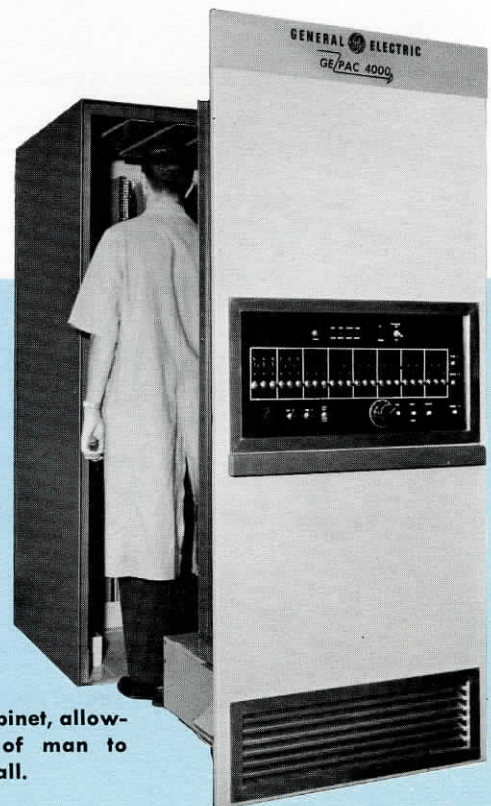
Simplified Systems Engineering—GE/PAC 4000 is completely compatible with General Electric Directo-Matic II control and GE/MAC instruments. This compatibility of components and circuitry eliminates expensive interfacing equipment often necessary with conventional computer-control systems and greatly facilitates system design and engineering.

Easy to Install—GE/PAC requires no special site preparation prior to installation. The compact cabinet can even be recessed in a closet. Since all components draw out on the roll-out truck, all are accessible from the front. Power, signal, and peripheral leads normally enter through the bottom, but can be brought in through the top, left side, or rear of the cabinet.

Economical Field Expansion—The modularity of GE/PAC components permits easy, economical expansion of your system in the field. As your automation needs grow with your process, GE/PAC permits you to add to your system and still preserve your initial investment.



Standard modules make GE/PAC extremely versatile. Printed wiring boards slide into rack, have plug-in connections.



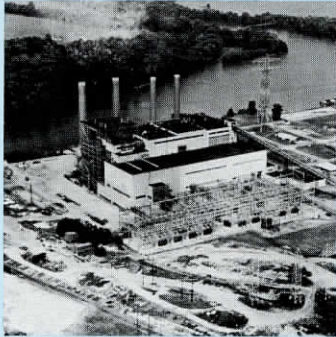
Computer rolls out of cabinet, allowing convenient entry of man to terminations on back wall.

All industries benefit from GE/PAC 4000

Automatic reporting, monitoring and control mean dollar savings through: smoother operation, improved product quality, increased production, lower costs, better management reports, and increased process knowledge. The benefits are found in every industry such as plastics, rubber,

glass, textiles, mining, and the examples shown here.

The GE/PAC 4000 system you need could rent for less than \$2000 a month and save you many times that each month in improved production. You owe it to yourself to review your control needs and see what GE/PAC can offer you.

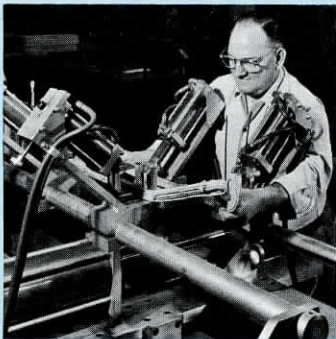


UTILITY

- Steam plant logging and control
- Sub-station logging
- Economic dispatch

FOOD PROCESSING

- Mixing
- Blending
- Cooking
- Inventory

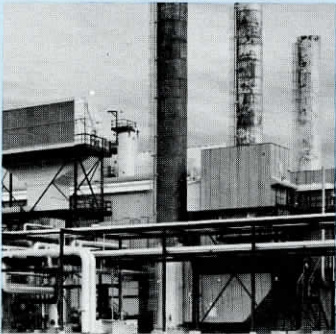
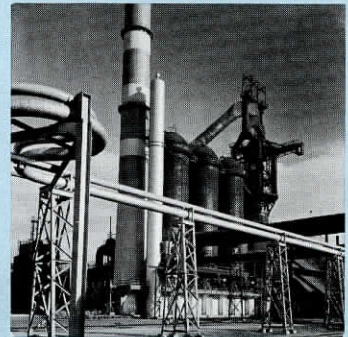


MANUFACTURING

- Quality control
- Conveyor control
- Machine programming
- Testing
- Check out

METALS

- Blast furnace
- Oxygen converter
- Reversing hot mills
- Tandem cold mills
- Hot strip mills
- Aluminum

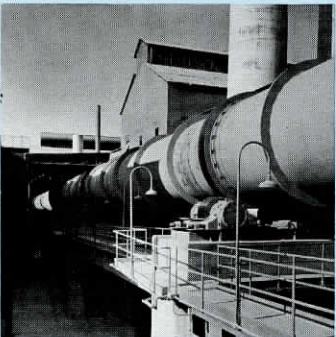
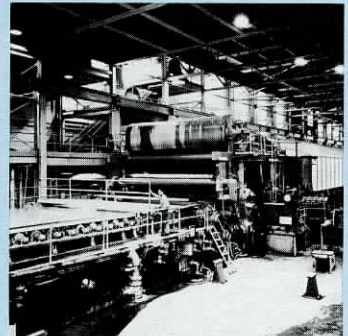


CHEMICAL

- Reaction
- Blending and mixing
- Distillation
- Purification
- Steam and power
- Pilot plant

PAPER

- Paper machine
- Digesters
- Chemical recovery
- Steam and power

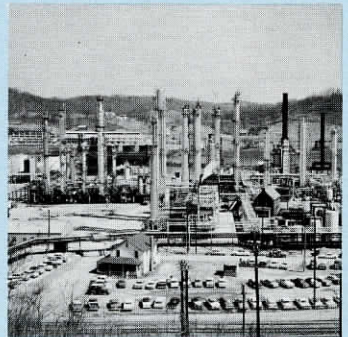


CEMENT

- Raw materials blending
- Kiln control

PETROLEUM

- Crude distillation
- Cracking
- Reforming
- Alkylation
- Blending
- Steam and power
- Tank truck loading



Circuitry, construction speed installation, save space and simplify trouble shooting

FIELD TERMINATIONS—are located at the inside rear of the cabinet. With the truck rolled out, a man can walk into the cabinet. Back panel terminations are connected to functional modules on the truck by an expandable wiring ribbon.

ROLL-OUT TRUCK—draws out of cabinet easily by lifting the front-mounted handle and pulling. A track at the bottom of the cabinet guides the truck and locks it when fully open.

INDUSTRIAL CONSTRUCTION—sturdy, yet lightweight unit is built to withstand a wide range of environments. Small systems in a single cabinet (32" wide x 36" deep x 76" high) save space. The cabinet meets NEMA I standards for industrial use.

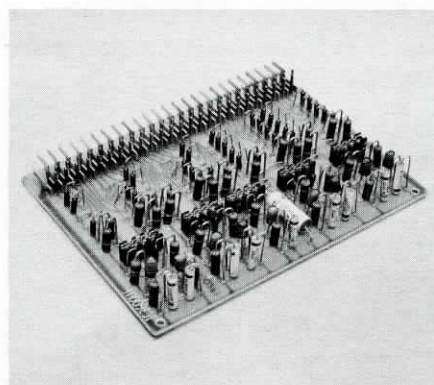
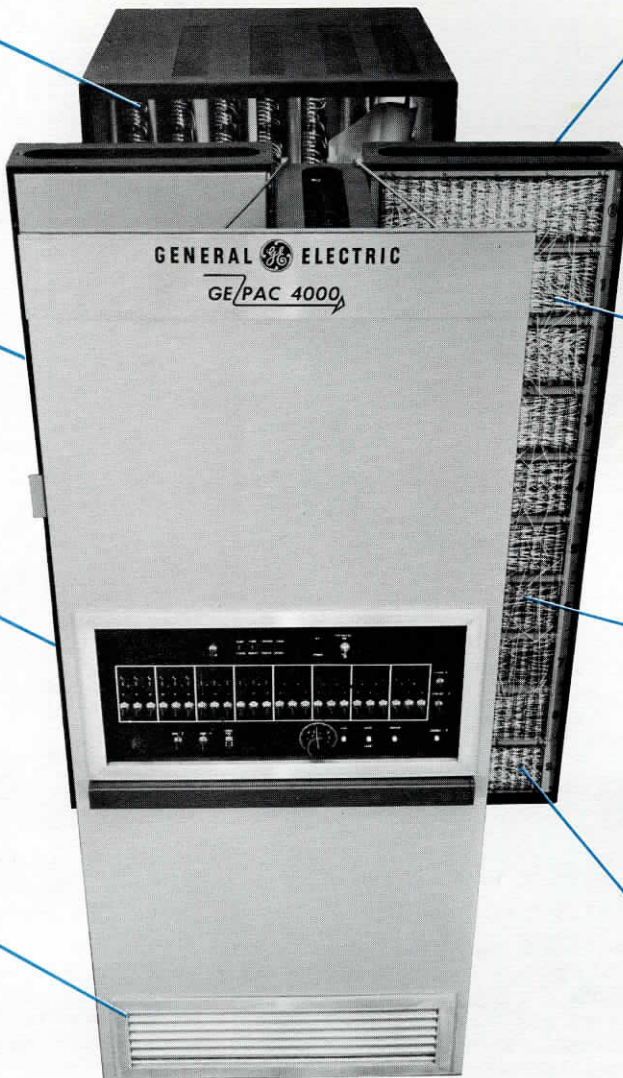
BLOWER AND VENTILATION SYSTEM—Internal air flow through vent in front, in and around pages of components, and out the top eliminates need for special cooling in applications up to 131 F.

HINGED PAGES—All components are mounted on three pages, two hinged on either side of a stationary center one. This provides easy access to all components. Test points on back of each page facilitate check-out and trouble shooting.

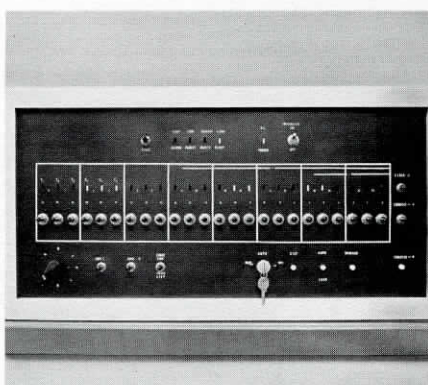
MODULAR FUNCTIONS—Each function to be performed is supplied in a standard functional module. This permits selection of only those functions you initially need, yet incorporates ease of expanding as your automation requirements grow.

PRINTED WIRING BOARDS—Boards are mounted in 10 rows of 17 cards per row in frames on each page. Each board slides in and is connected by stab-on connectors. Interconnection between boards is on the back of each page.

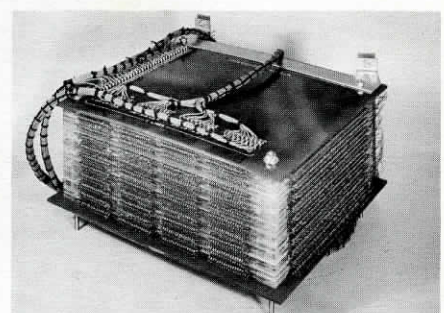
SILICON DIODES AND TRANSISTORS—Power consumption is cut, temperature operating range is increased by the use of silicon semiconductors throughout. GE/PAC operates reliably at ambient temperatures from 32 to 131 F.



Printed wiring board provides higher packing density of components, cuts space.



All necessary input and display devices are located on console in front of unit.



High-speed magnetic memory core with 24-bit word is available in 1000- to 16,000-word size. Core is sealed and temperature regulated to permit operation from 32 to 131 F without adjustment.

Comprehensive library of software helps you quickly tailor a program to your needs

To use any computer effectively, it is essential to communicate with it in order to express the functions to be performed. GE/PAC software, consisting of process oriented programs, permits this communication. Without such a comprehensive software library, programming costs can be expensive.

Program debugging aids assist in checking the programs. Standard subroutines save programming time by allowing the programmer to pick standard routines like building blocks to put a program together. Here is a review of GE/PAC software.

GE/PAC Assembler translates easy-to-use symbolic instructions into machine language, even while GE/PAC is on-line handling process data. Symbolic instructions represent storage address, operation codes, constants and explanations. Each symbolic instruction produces one actual computer instruction for GE/PAC. This symbolic assembly language provides programmers a convenient way to specify functions to be performed by GE/PAC. Without an assembler, programming must be done in absolute binary or octal form, which is cumbersome and prone to human error.

Extended function commands supplement the wired-in commands. They are subroutines entered by hardware means and treated by the assembler in the same manner as wired-in commands.

GE/PAC FORTRAN II compiler translates standard FORTRAN II algebraic statements into GE/PAC 4000 programs. FORTRAN II is well known, easy to learn, easy to write, and produces final programs that are virtually error free. Using FORTRAN II, programs are easily adapted from one computer to another with little or no manual changes. FORTRAN II requires an 8,192 word core, and compiling may be done on-line if sufficient memory is available.

Programming debugging aids such as loader, tracer, and dump programs provide you with complete off-line testing and check-out subroutines.

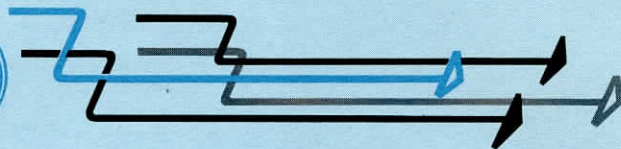
GE/PAC MONITOR is an outstanding program for dispatching computer work efficiently. It permits programs to be handled in separate packages and gives building-block flexibility to programming, complementing the modular GE/PAC equipment. MONITOR provides:

- (a) real-time scheduling;
- (b) priority assignment of computer functions;
- (c) scanning on analog inputs;
- (d) limit checking;
- (e) alarming;
- (f) converting raw signals to engineering units;
- (g) averaging;
- (h) input-output of information in digital form;
- (i) diagnostic checking of proper operation of peripheral equipment.

Special extra functions required by a specific application are easily added by MONITOR. Changes in priority of assignment and frequency of all computer functions are made without rewriting programs.

MONITOR gives you a complete scan/log/alarm program in a few man-months, permitting a system to be installed and providing benefits much faster than ever before possible. You specify the characteristics of your analog sensors using standard input/output summary forms. The basic process monitoring functions are implemented quickly, and additions, including eventual control of the process, can be added rapidly in the field.

The GE/PAC program library contains a complete **diagnostics program**. This program is used to quickly pinpoint trouble spots, permitting quick repair and restoration of service.



Operating Specifications

CENTRAL PROCESSOR

Computer Type: Digital, binary, fixed point

Circuitry: Solid state, silicon semi-conductors throughout

Storage, Working:

Temperature-regulated magnetic core available in two sizes:
1,024, 2,048, or 4,096 words
4,096, 8,192, or 16,384 words

Storage, Backup:

Magnetic drum: 16,384 to 224,000 words

Transfer Time Between Drum and Core:

1 to 512 words in 16.7 milliseconds. Transfer begins immediately upon command. Effective transfer rate: 123,000 char/sec

Parity Checking: Provided both core and drum

Word Size: 24 bits

Instructions (including extended function commands)

Arithmetic	18	Instructions
Loop control	6	
Program control	11	
I/O control	8	
General	14	
Word logical	10	
Bit logical	7	
Testing	26	
Total	100	Instructions

Operating Times (in microseconds)

Memory access	1.5
Memory read-write cycle	5
Add	16
Subtract	16
Full-word shift	16
Logical commands	16
Data transfer commands	24

Operational Requirements:

Power: 115/230 volts $\pm 10\%$, three-wire, single phase, 50 or 60 cps ± 1 cycle

Power Usage: Central processor 1500 W, typical system 3000 W.

Environment:

Temperature range: 32 F to 131 F
Relative humidity: 5% to 100%

Physical Characteristics:

Cabinet dimensions (small systems will require only one cabinet): 32" wide, 36" deep, 76" high

Weight: approximately 1,000 pounds

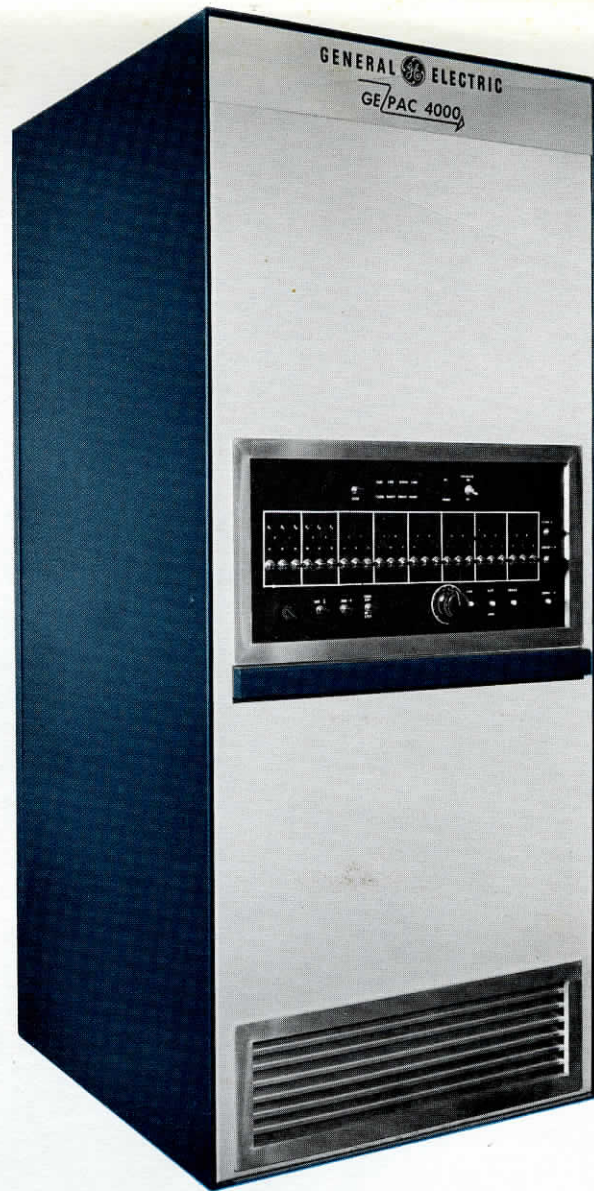
Packaging: Rugged industrial construction meets NEMA Type I standards. Full access from the front; circuitry mounted on roll-out truck. Input terminations and relay matrix at rear and side of cabinet. Can be installed against wall, in corner, or recessed area. Programmer's console on front of cabinet.

Operator Communication:

Typewriter—fixed carriage, 15 char/sec

Typewriter—movable carriage, 10 char/sec

Paper-tape reader—100 char/sec (lower speed model available)



Paper-tape punch—110 char/sec (lower speed model available)

Photoelectric card reader—30 cards/min

Operator's console—many standard models available

Digital clock—memory clock in hours, minutes, seconds

Display devices—trend recorders, annunciators

Process Communication:

Analog inputs: 16 to 1024 at 40 to 110 pt/sec

Analog accuracy: 0.1% of full scale

Analog ranges: low level: 10, 20, 40, 80 millivolts

high level: 0.25, 0.5, 1.0, 2, 4, 8 volts

Contact inputs: groups of 18 at computer execution rates

Pulse inputs: any number at computer execution rates

For more information about GE/PAC 4000 process computers, or Integrated Process Control, contact your nearest General Electric Sales Office.

GENERAL ELECTRIC

PROCESS COMPUTER SECTION, INDUSTRY CONTROL DEPARTMENT

PHOENIX, ARIZONA