Summary Brochure

Series 16 Direct Digital Control System

Honeywell

INTRODUCING THE HONEYWELL SERIES 16 DDC SYSTEM

The Honeywell Series 16 Direct Digital Control (DDC) System is a modular hardware/software functional package for the process control industry. Supervisory control, optimization, and report generation can be implemented on line, while performing direct digital control. The package allows the user to configure his particular system in an efficient manner. Significant economic advantages may be realized at each stage of his project — from initial system analysis, through startup, use, and future expansion. These advantages are achieved through:

- System integrity
- Ease of system implementation
- System modularity

System Integrity

Reliability — The integrated-circuit central processor combines high speed with field-proven performance and reliability.

Input Isolation and Protection — Input lines are isolated from noise sources and protected from accidental connection to high voltages.

Input Accuracy and Sensitivity — The analog converter utilizes successive approximation, 13 bits plus sign. Accuracy is ±.05 percent of full scale for low-level analog inputs.

Software Error Checks — Analog inputs are checked against standards and compared with process variable limits.

Analog Output Validity — A unique output validity subsystem provides hardware monitoring to insure correctness of station addressing and data update.

System-Integrated Backup Stations — Automatic and manual analog backup stations were designed as integral parts of the overall system. They operate with the output validity system to insure compatibility and control system integrity.

System Implementation

Simplified Data Entry — The Series 16 DDC System utilizes simplified loop data entry with table-filling techniques. This reduces the time normally required to implement software for a DDC system.

OLERT Operating System Support — The DDC system software, Controlware I, is supported by OLERT, an advanced real-time operating system which provides convenient and powerful multiprogramming facilities.

FORTRAN Compatibility — The user may utilize Honeywell Real-Time FORTRAN IV in writing his special real-time I/O as well as supervisory programs for operation under the OLERT executive.

Standard Control Analysis — The Controlware program utilizes a full value positional algorithm, non-interacting in the frequency domain.

Compatible PID Settings — Digital mode control settings are the same as analog backup station settings. Tuning the loop will result in a single set of constants for both the algorithm and the backup controller.

Operator Interface — The operator's console provides for complete overview and control of the process, insuring high reliability through features such as key-lock control and area concepts.

System Modularity

Modular Structure — The Series 16 DDC System is uniquely modular in design. The software has been structured to handle hardware expansion and software additions.

Foreground/Background Programming — On-line program development may be performed in a background mode using real-time language.

Special Control Routine Additions — Controlware is modular, and provision is made for convenient links to special control routines.

General Algorithm Data Entry — The algorithm is structured for convenient on-line or off-line entry of data and loop parameters into its table segments.

Input Scan Structure — The input software routine is modularized by functions and provides for signal conditioning. There are standard routines for linearization and conversion; linkages are provided for special routines.

Operator's Console Modular Software — Operator's console software is easy to use in implementing special functions and variations of displays.

System Configuration — The modularity and ease of expansion of the Series 16 DDC System offers to the user a functional package which he can utilize to configure his system uniquely for maximum benefits.

STANDARD SERIES 16 DDC FUNCTIONS

Accepts analog and digital information from a wide variety of process sensors.

Provides variable scan frequencies in multiples of ¼ second cycles.

Prints accurate reports of plant status in clear, readable formats with all values in logical or engineering units.

Records process variable alarm conditions as they occur; calls for operator attention and types alarm summaries for future reference.

Provides area-concept for multiple operator's consoles.

Provides for remote operation of operator's consoles and backup stations.

Provides foreground/background processing capability.

Provides three-mode proportional, integral derivative (PID) computer control with full-value positional algorithm.

All mode switches between computer and stations are bumpless transfers.

Hardware error detection can trigger bumpless transfer from computer to stations.

Provides computer manual mode operation from operator's consoles.

Provides nonlinear compensation for valve saturation, reset windup and batch startup.

Limits rate-of-change of valve output to protect against unstable process conditions.

Utilizes unique validity checks to insure system integrity.

Utilizes table-filling loop data entry.

SYSTEM DESCRIPTION

Central Processor Unit (CPU)

The DDP-516 CPU is an integrated-circuit, general-purpose computer featuring extremely high computational and input-output speeds. The basic 16-bit word format is used with a 32K-word core memory and a cycle time of 960 nanoseconds to provide unique capabilities for direct digital control. Standard hardware capabilities supported by the DDC package includes:

- Memory Lockout
- High-Speed Arithmetic
- Real-Time Clock

Process Interface Controller (PIC)

- Provides terminal connections for field input and output lines.
- Provides means for the central processor to communicate efficiently and at machine speed with process signals by effectively buffering input-output-device response times.
- Conditions and converts input signals to a proper computer format.
- Converts computer output data to a form and level acceptable to the process actuators and peripherals.
- Provides isolation from electrical noise introduced at remote devices and/or in lines between field-mounted devices and the computer.
- Provides protection from accidentally applied voltages on field input/output signal lines.

Analog Input Subsystem

The analog input hardware — signal conditioning boards and A/D converter — is contained in the PIC. Associated with the hardware is the Analog Input Subsystem performing functions such as:

- Point selection
- Reading of analog inputs
- Drift and offset correction
- Limit checking of analog inputs
- Linearization and conversion
- Special functions specified by the user

Message Center

The message center consists of logging and alarm typewriters with associated software which arranges and outputs data from the typewriters. The message software accepts requests from the typewriters, formats a message and initiates its typeout. This software is used for all standard alarm and error messages, validation of console entries and standard process-variable summaries.

Operator's Console

The standard operator's console, available in rack or table-mounted configurations, is divided into two devices: a display device with its associated power supply and a keyboard device. As many as four consoles can be supplied per system. The display device can contain as many as four registers of rear projection units.

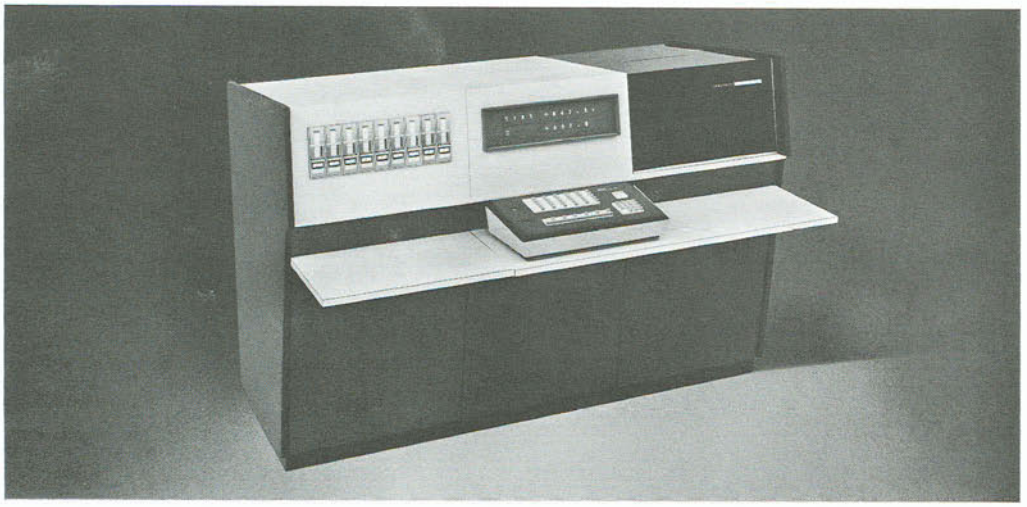
Associated with the operator's console is a package of related software providing additional protection against invalid entries in two ways:

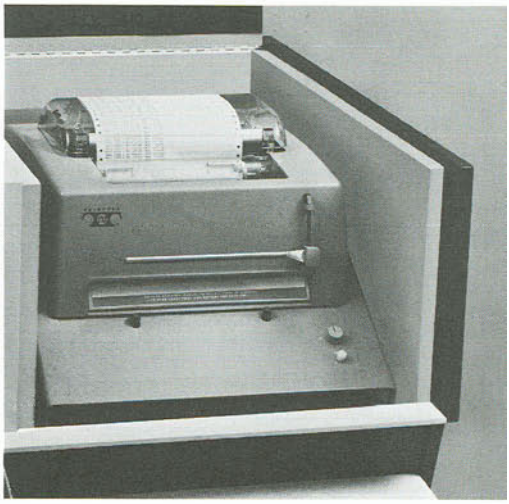
- Each time a button is depressed, a visual action occurs on the display. This "character echo" function insures that the information was received accurately by the computer.
- Reasonability tests are made for most entries. Examples are:
  1. Nonexistent point or loop I.D.
  2. Entry value beyond allowable range
  3. Key lock violation

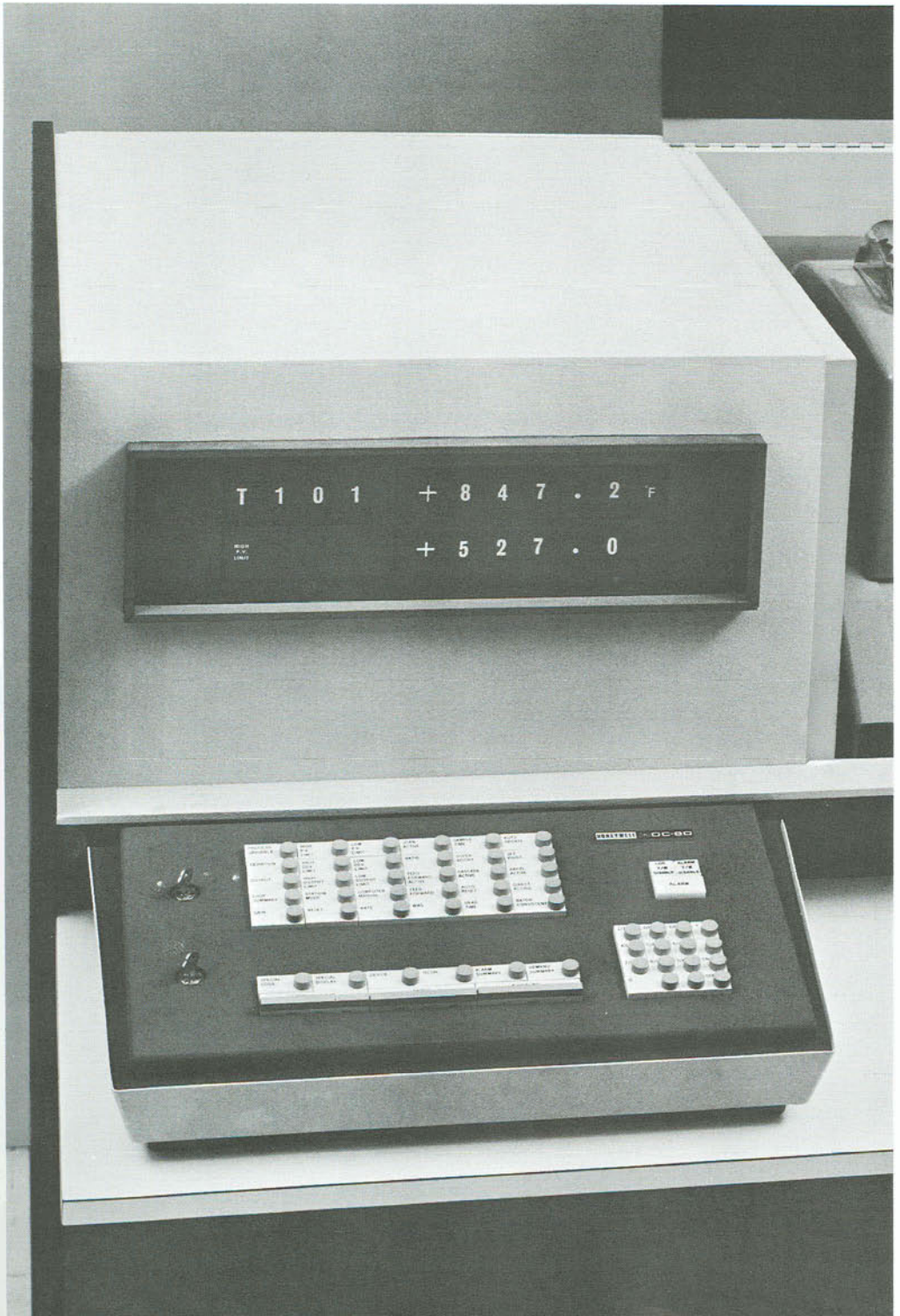
Whenever a violation is found, an "error" message is displayed in the console function window, and the entry is rejected.

DDC Analog Output Subsystem

This subsystem interfaces the PIC with the process value outputs required for control. Each subsystem has the capacity for up to seven groups of DDC backup control stations with a maximum capacity of 72 stations per group. One station logic interface (SLI) unit is used for each station group. The SLI provides the stations with address decoding, D/A signal buffering, validity checking and analog feedback signal buffering.







DDC Backup Stations

Design Features

- System-integrated stations
- Bumpless transfer to and from all modes
- Valve-position feedback
- Automatic computer-to-station switching
- Operator readout
- Modular station design
- Preset manual option
- Battery-power backup option

These stations are supplied in the manual and three-mode configuration. Three types of stations are available:

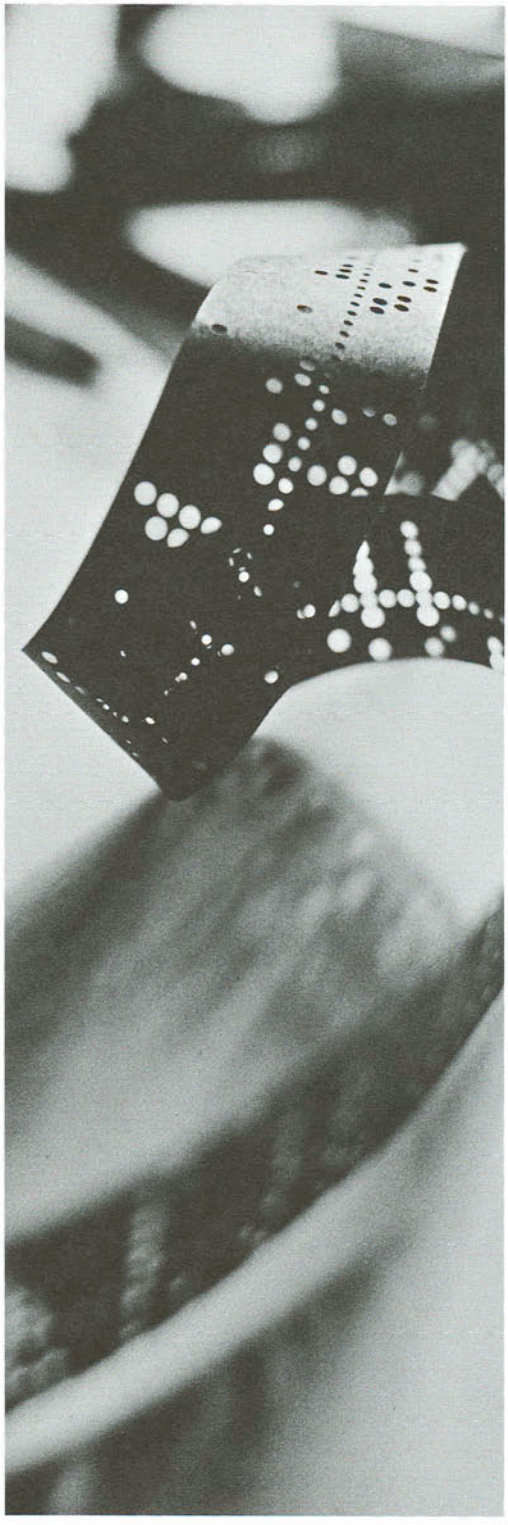
Manual Station — Provides manual adjustment of 4-20 ma signals in a backup mode.

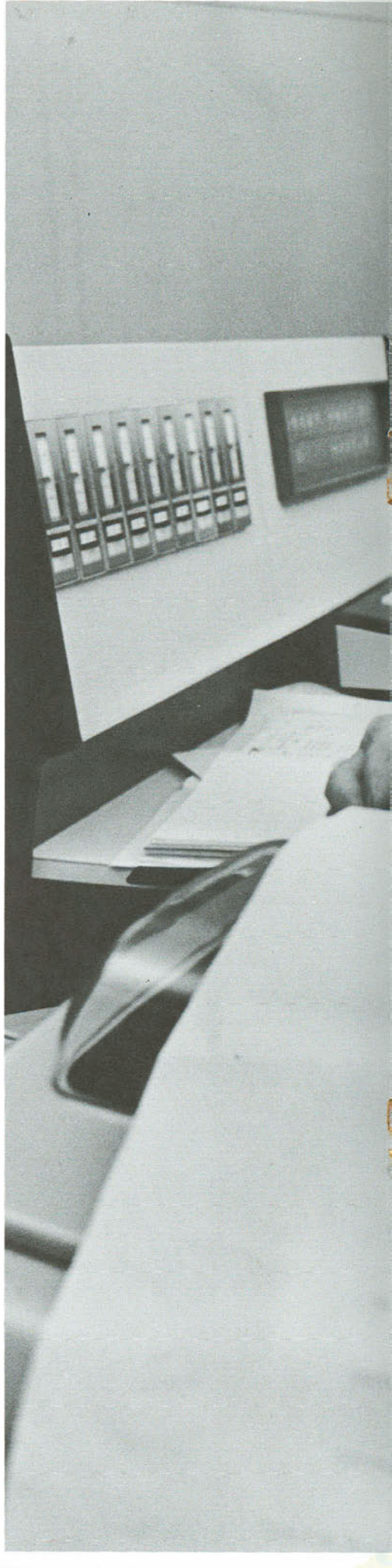
Standard Three-Mode Station — Provides for either manual adjustment of the 4-20 ma signal or three-mode automatic control in backup operation. The station set point is manually adjusted by the operator.

Tracking Three-Mode Station — Provides for either manual adjustment of the 4-20 ma signal or three-mode automatic control in backup operation. The station set point automatically tracks the process variable when the station is under computer control.

System Validity Checks

System validity checks insure that hardware failure will not create a system upset which could cause product loss, equipment destruction or a safety hazard. To accomplish this integrity, the Series 16 DDC System detects symptoms of hardware failures before the failures have caused the process to be drastically upset. It will abort DDC control with all valves at a safe operating level when it is determined that the time-shared portion of the system is no longer effective in control.





EXTENSIVE SOFTWARE

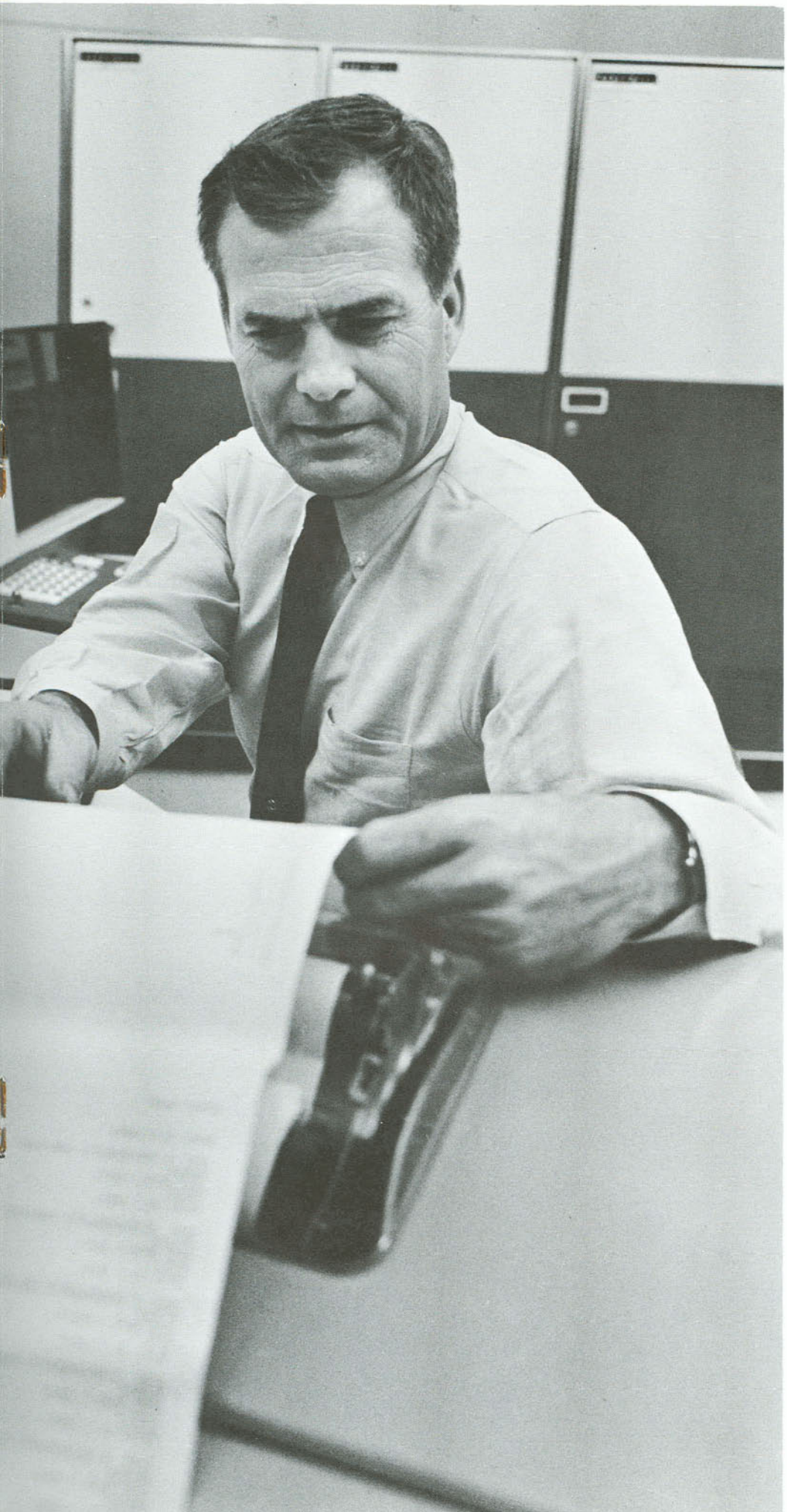
OLERT

OLERT (On-Line Executive for Real Time) is the operating system which provides the multiprogramming capability that supports the DDC software (Controlware) and custom user programs in the Series 16 DDC System. OLERT coordinates the operation of the central processor unit and associated peripheral equipment, allocating resources to meet the demands of the process. OLERT schedules applications programs and peripheral interface programs based on time, priority interrupts and operator requests. The program allocates memory, handles interrupt responses, maintains an internal clock and timers, provides job-oriented memory protection and permits communication among programs and between the software and the operator.

Controlware I

Operating directly under OLERT is Controlware I, structured into three basic software subsystems: Analog Processing Subsystem, Operator's Console Subsystem and Message Center Subsystem.

DDC Analog Processing Subsystem Software — The DDC System Software services the Analog Input Subsystem and individual DDC stations. The software scans and processes analog inputs (points) either at a predetermined interval or upon request. Processing includes inputting points, correcting points for drift and offset, performing linearization, normalizing and limit checking as required. Utilizing a double buffering technique, the software insures high-speed processing of input/output information to individual DDC stations.



Operator's Console Software — This package is designed for high-speed, reliable operation in conjunction with the entire Controlware I package. Its adaptability allows a user to specify his own programs or loop record parameters. The software also allows more than one console to be used in an application.

Message Center Software — The message subsystem accepts requests from the other programs, formats a message and initiates a typeout. Working in conjunction with the input/output editor contained in OLERT, the message subsystem accepts user messages and routes them to a typewriter.

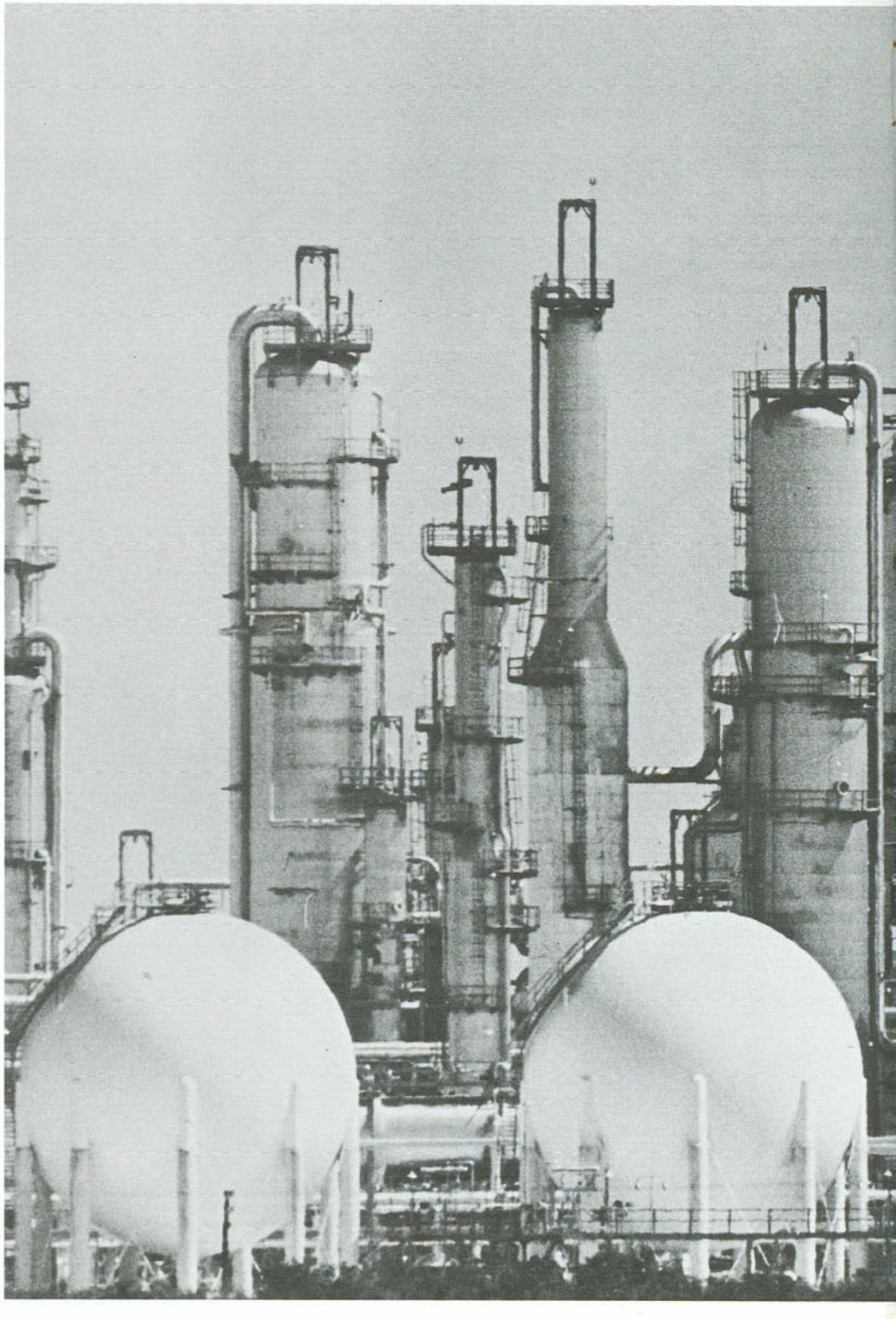
One of the subsystem's primary features is its incorporation of the Area Concept for delineation of system priorities and responsibilities. Although of paramount importance in a DDC system, its utility is also very beneficial in a data acquisition system, in that any typewriter, regardless of area assignment, can be backup for any other typewriter. This provides the flexibility needed in the event consoles or typewriters at one location are out of service at any time.

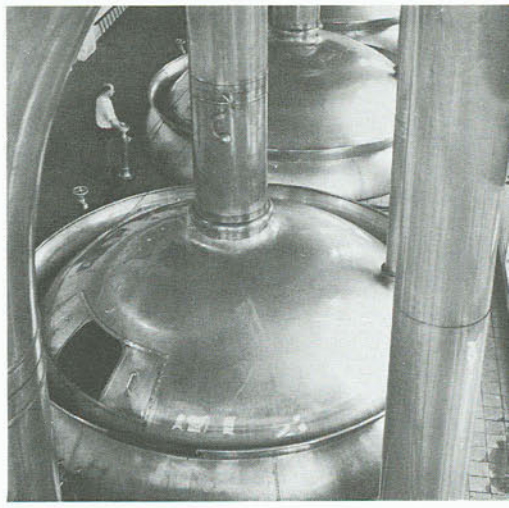
WIDE VARIETY OF APPLICATIONS

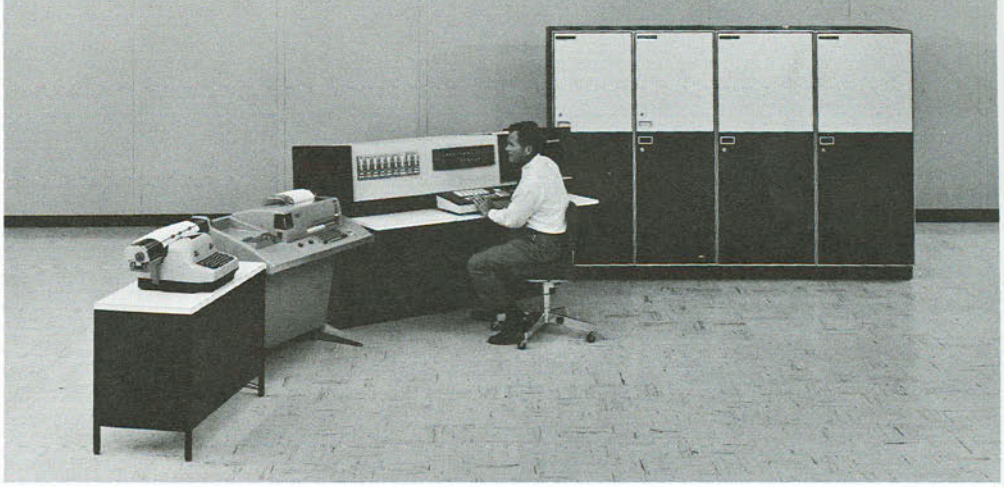
The Series 16 Direct Digital Control System, designed to handle most current applications effectively and accurately, has the state-of-the-art sophistication needed to handle future applications as well.

Because of its flexible and versatile modular design approach, the Series 16 DDC System is suitable for a wide range of applications. Modularity of design also permits easy expansion to include supervision and optimization. Computer-directed data acquisition and control systems manufactured by Honeywell have already proved their worth in a number of areas, such as:

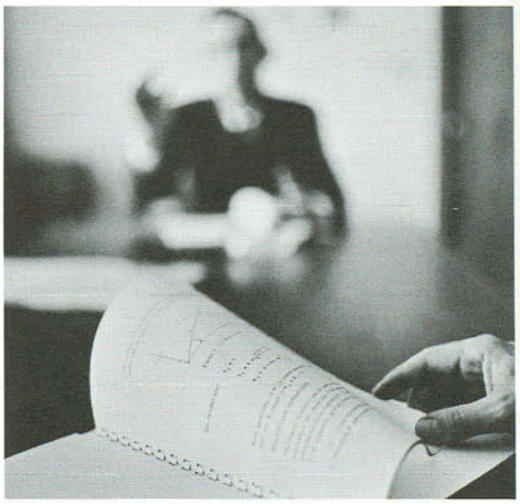
- Nuclear and conventional power plants
- Blast furnaces
- Continuous casting
- Textile dyeing
- Paper mill monitoring
- Food making
- Cigarette production
- Metals producing
- Petrochemical processing
- Pipeline control
- Mining







EASY IMPLEMENTATION



User programming time and costs are substantially reduced by table-filling techniques which provide standard Controlware programs with loop and control parameters.

Analog Input Subsystem tables are user-tabulated for loop parameters. Additional tables in this subsystem are used to group analog points and provide temporary storage, define engineering units and give ranges of values, and handle input buffer tables. The Operator's Console Subsystem tables identify console display parameters and console keyboard parameters. Message Center Subsystem tables give a directory of messages and abbreviations and output-device identification. General System tables provide a directory of tables in the system, area designation and translation and conversion parameters.

The ease and flexibility of implementing the Honeywell Series 16 DDC System allows users to quickly reach a level of proficiency that lets them put the capabilities of the system to good use.

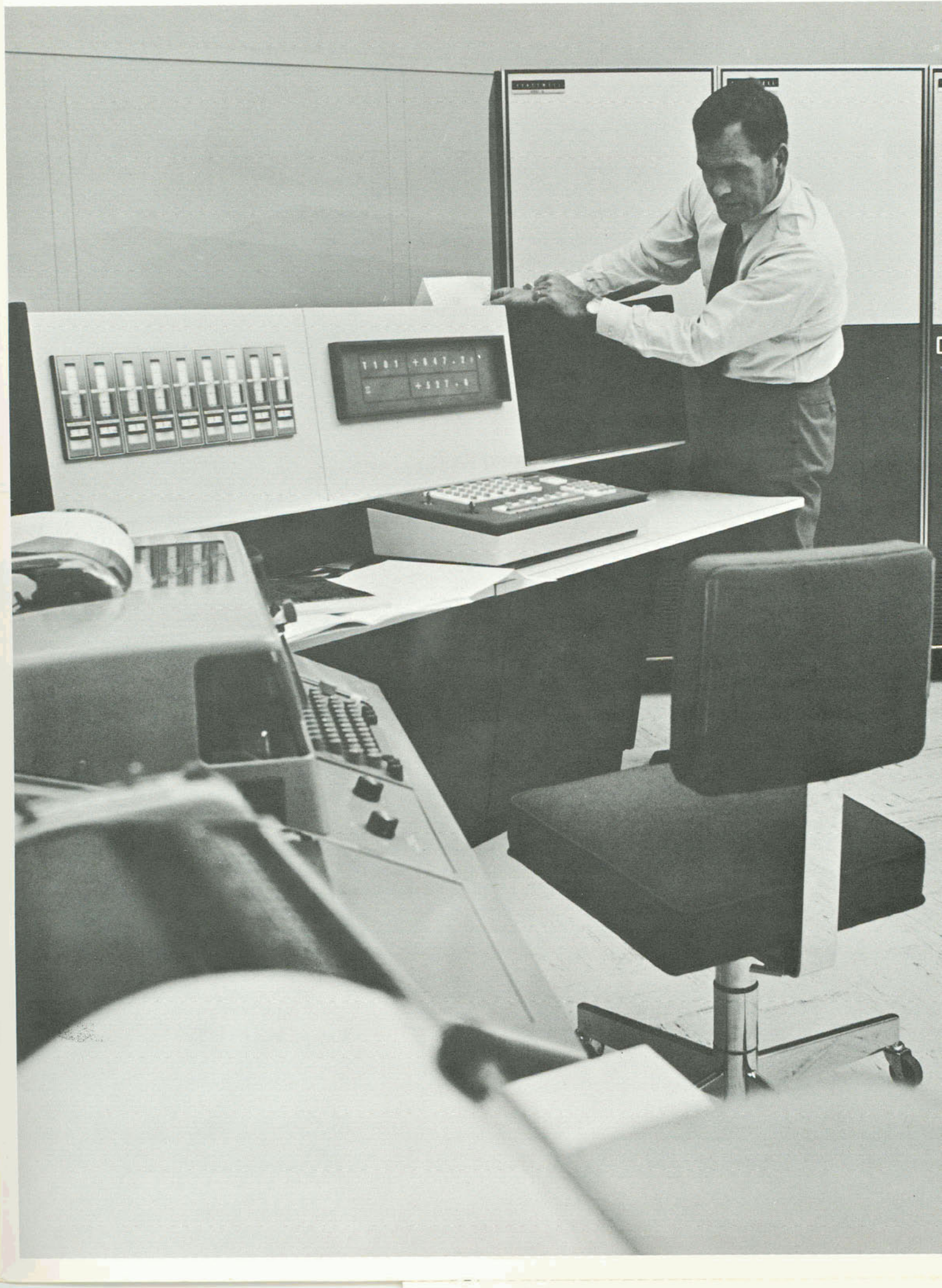
EXTENSIVE SUPPORT SERVICES

Honeywell provides all the assistance necessary to implement its direct digital control system. Training programs include:

- Programming/Software
- Logic/Maintenance

Extensive documentation and easy implementation allow a user to absorb details about the system quickly. As a result, little time is necessary to attain the level of proficiency necessary for complete utilization of the system's capabilities.

Further support is provided in the form of systems engineering personnel, programming people and applications analysts, both in the field and at Honeywell's Computer Control Division for initial installation and future support.



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