SECTION I
INTRODUCTION

GENERAL

A Programmable Controller (P.C.) is a solid-state device designed to perform logical decision making for control applications in the industrial environment. In other words, the P.C. is the modern way to perform industrial control functions that formerly required relays, solid-state electronics, or a mini-computer. The Programmable Controller is a unique device in that its capabilities were not available until the last few years.

Features that are unique with programmable controllers, and in particular, the MODICON Models 184/384 are as follows:

- Solid-state device throughout.

- Designed specifically to operate in the industrial environment *without* special protection such as fans, air conditioning, and electrical filtering.

- Programmed with a light-weight, rugged programming panel connected directly to the Controller.

- Simple to program. The programming language is a relay ladder concept very similar to magnetic relay circuitry. Thus engineers, technicians, and electricians can readily learn to program the Controller without extensive training or experience.

A block diagram of a typical industrial control system is shown in Figure 1. Before the advent of the P.C., the sequencing logic or logic decision-making for nearly all automated industrial systems was accomplished with relays, solid-state electronics, or mini-computers; Figure 2 shows typical installations for industrial control using antiquated techniques. The MODICON 184/384 Programmable Controllers (Figure 3) are universal logic decision-making devices that replace relays, solid-state electronics, and in some cases mini-computers.

The benefits compared to previous devices afforded by the MODICON 184/384 Programmable Controller are as follows:

Compared to Relays:

- Changes accomplished quickly and, in most cases, without hardware modifications to Controller.

- Solid-state reliability provided by Controller.

- Controller is reusable.

- Indicator lights provided on Controller at major diagnostic points to assist in troubleshooting.

Compared to Solid-State Electronics:

- Changes accomplished quickly and, in most cases, without hardware modifications to Controller.

- Controller is reusable.

- Maintenance is very easy on Controller.

- Controller is designed for industrial environment.

Compared to Mini-Computer:

- Controller is simple to program and install in industrial environment.

- Maintenance is very easy on Controllers.

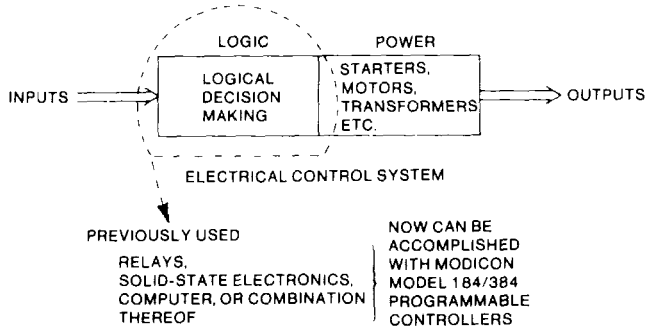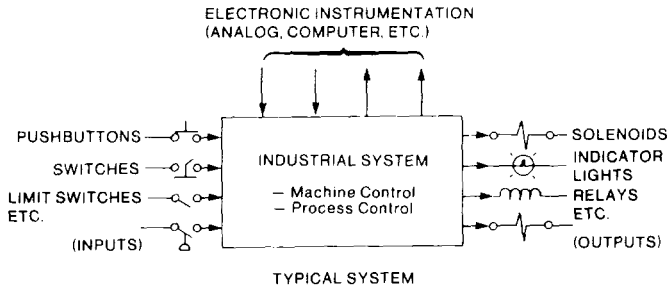- Controller is designed for industrial environment.

ELECTRONIC INSTRUMENTATION
(ANALOG, COMPUTER, ETC.)

PUSHBUTTONS
SWITCHES
LIMIT SWITCHES
ETC.
(INPUTS)

INDUSTRIAL SYSTEM

— Machine Control
— Process Control

SOLENOIDS
INDICATOR
LIGHTS
RELAYS
ETC.
(OUTPUTS)

TYPICAL SYSTEM

LOGIC   POWER

INPUTS

LOGICAL
DECISION
MAKING

STARTERS,
MOTORS,
TRANSFORMERS
ETC.

OUTPUTS

ELECTRICAL CONTROL SYSTEM

PREVIOUSLY USED

RELAYS,
SOLID-STATE ELECTRONICS,
COMPUTER, OR COMBINATION
THEREOF

NOW CAN BE
ACCOMPLISHED
WITH MODICON
MODEL 184/384
PROGRAMMABLE
CONTROLLERS

*Figure 1.   Typical Industrial Control System,
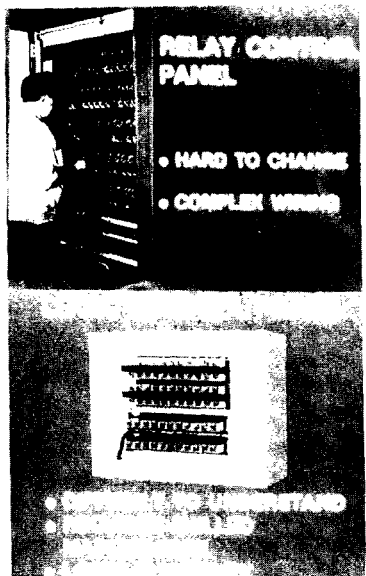Block Diagram*

*Figure 2.   Typical Relay and Solid State Electronics
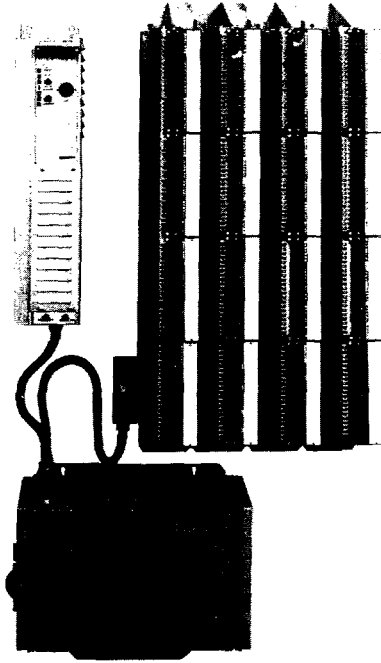Installations for Industrial Control*

Figure 3. MODICON 184/384 Programmable Controller

A typical Programmable Controller can be divided into three components as shown in Figure 4. These components are a Processor, Power Supply, and an Input/Output (I/O) Section.

PROCESSOR

The Processor (the "brain" of the system) is a completely solid-state device designed to perform a wide variety of production, machine tool, and process-control functions. In the past, these functions could only be performed by conventional electromechanical devices, relays, and their associated wiring. However, the sophisticated and compact circuitry contained in the Processor can not only provide these functions, but also a much wider scope and variety of control functions than conventional relay circuitry, with minimal effort.

The Processor operates on DC power ($\pm 5V$) which is supplied by the Power Supply. Internal DC power is also routed through the Processor to operate a portion of the I/O and devices connected to the service port. Once the ladder-diagram program is entered into the Processor, it remains resident until deliberately changed by the user with one of the programming devices. The program is unaltered through power failure or power off conditions.

The Processor, in addition to the cables that connect it to the Power Supply and the I/O Section, has an access port on the left side which is used for entering instructions and data. The most common method of entering data or programs into the Processor through this port is with the Programming Panel (Figure 5).

Other devices that could also connect to the port are a Tape Loader, a Computer Interface, CRT, or for diagnostics or troubleshooting, a Telephone Interface providing communications to MODICON's Service Center.
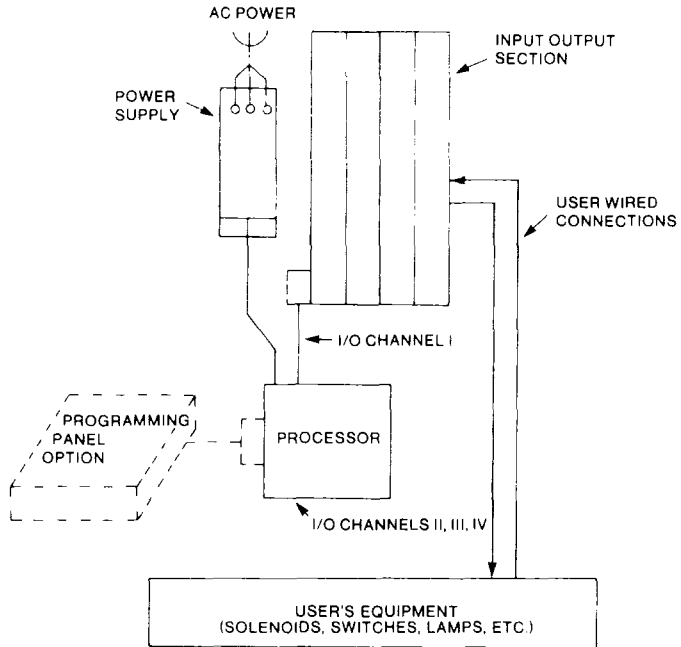
5

Figure 4. Basic System Configuration

POWER SUPPLY

The MODICON 184/384 Controller system operates on standard 115 Vac power, either 50 Hz or 60 Hz or 230 Vac 50 Hz (not interchangeable). The Main Power Supply is connected to the Processor through a single cable with keyed plug-in connector, and is contained within a heavy-duty finned case. No adjustments or maintenance are required. Lamps are provided to indicate operational power-ready status. No external cooling is required; however, free-air circulation should be provided. Auxiliary power supplies are also required on some expanded I/O systems.

INPUT/OUTPUT SECTION

A major characteristic of the 184/384 Controller is that the input and output control devices are directly connected to the Controller. User wiring to and from the Controller is accomplished through heavy-duty housings. Each housing is designed to contain four I/O modules, and each module contains 16 circuits — either input or output. Each housing is provided with a wiring conduit enabling easy access to bare-wiring clamp terminals. In addition, the cover of the wire conduit has flexible fasteners permitting the user to remove it for easier installation and routing of wires. Each terminal is capable of accepting either one AWG No. 12 or two AWG No. 14 wires.

NOTE

An optional I/O housing (Model B241) is also available that accommodates two I/O modules and is approximately half as tall as the standard housing (Model B240).
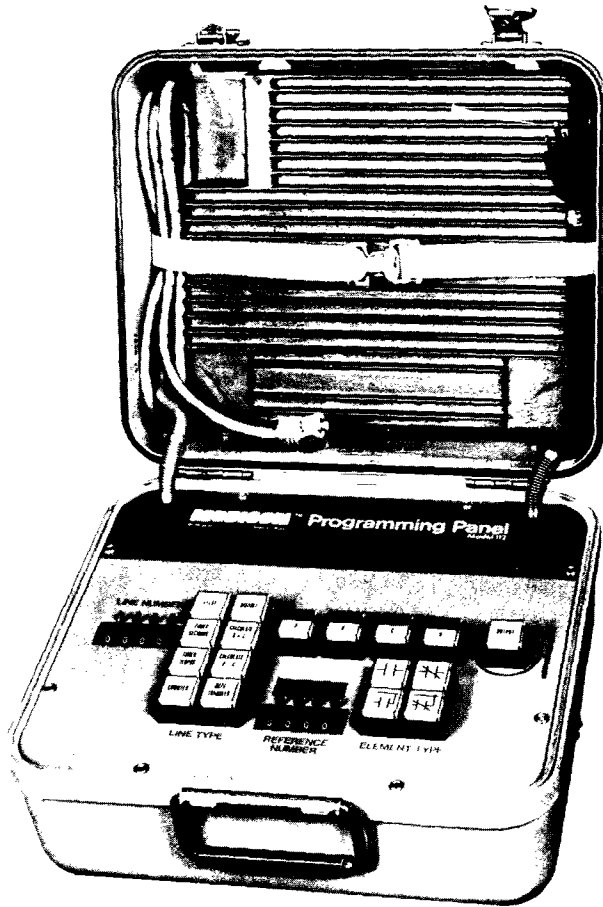
Figure 5. Programming Panel

MODICON offers a variety of I/O modules, designed either to be output-driving or input-handling circuits. Appendix B contains specifications for available I/O modules and their circuitry. The input and output modules are solidly constructed units easily removed or plugged into their housings. Once inserted, electrical contact is automatically made through plated spring connectors. I/O modules can be removed and replaced without removing power either on the field or internal logic; there is no requirement to shut down the system to replace I/O modules.

NOTE

When an input or output module is removed, all 16 circuits on the modules will be disconnected.

All input and output circuits are individually isolated with either transformer coupling or photo diodes to prevent transients on the field wiring from affecting the internal logic. No periodic maintenance is required. Indicator lamps are provided on each module to indicate the field power status, ac output fuse condition, and operational status of the module.

A summary of 184/384 Controller specifications is provided in Table 1.

Table 1. Basic Modicon 184/384
Controller Specifications

Power Requirements:

Standard	115 Vac ± 15%, 50/60 Hz,
	300 Volt amps (Max)
	7 amp peak start-up transient
Optional	230 Vac ± 15% 50Hz
	300 Volt Amps (Max)
	3 amp peak start-up transient

Environmental Requirements:

Ambient temperature	0°C to 60°C
Humidity	0% to 95% (non-condensing)

Dimensions: (WxHxD)

Processor (184)	22 in. x 12 in. x 13 in.
Processor (384)	22 in. x 15 1/2 in. x 13 in.
Power Supply (115V)	7 in. x 25 1/2 in. x 13 in.
Power Supply (230V)	7 in. x 29 1/2 in. x 13 in.
Single I/O Housing	5 in. x 41 in. x 13 1/2 in.
Four Housings (One Channel)	20 in. x 41 in. x 13 1/2 in.

Weight:

Processor (184)	40 lbs.
Processor (384)	45 lbs.
Power Supply (115 Vac)	40 lbs.
Power Supply (230 Vac)	45 lbs.
I/O Module	5 lbs.
Single I/O Housing	13 lbs.
Four Housings (One Channel)	52 lbs.

PROGRAMMING PANEL (Models 102 and 112)

The MODICON 184/384 system Programming Panels (Figure 5) are small, suitcase-size units which plug into the Processor and enable the user to easily "program" the Processor with all desired logic and control information. The two available options differ only in that Model 102 is limited to relay, timer, and counter capabilities; the Model 112 permits arithmetic computation and data transfers in addition to the Model 102 capabilities.

With only 17 illuminated pushbuttons and 2 sets of thumbwheels (4 digits each), the Programming Panel represents a simple control panel enabling the electrician to program the Processor from his ladder diagram. The "language" used to program the Controller is familiar relay symbology; there are no requirements to learn a new programming language.

The Programming Panel is a rugged, easily transportable unit, ideally suited for use in an industrial environment. It is designed to operate in locations where electromagnetic noise, high temperature, humidity, mechanical shock, etc., are prevalent.

Additional 115 Vac power is required for the Programming Panel lamps. This power is normally supplied by the convenience outlet on the main power supply.

For additional details on the Programming Panel, see Appendix A.

8

CRT PROGRAMMING PANEL (Models 140 and 145)

The CRT Programming Panels utilize the same format and references as the "hard-hat" programming panels (Models 102 and 112). These units allow programming in either the standard four element logic lines as well as a multi-node (10X7) format. In the four element display mode, up to fourteen lines can be displayed simultaneously, in any numerical order; or with these logic lines, any mix of registers, inputs, or latches (up to 40) can be displayed. In multi-node, up to seven coils can be programmed on the screen.

All programs are entered in real time and any line can display its real time power flow/register content. Ladder diagrams can be printed out locally from the CRT as an option. Up to sixteen controllers can be simultaneously connected to the CRT Programmer at a total accumulated distance of up to 3 miles. Special features such as Search, Trace, Cross-References, etc. are also available as standard on all models. Model 140 is a portable CRT with a 9" screen; Model 145 has the same feature except that it is packaged in a desk top version with a 12" screen. For additional details see Appendix A.