Topic 5

Introduction to PLC technology in Mechatronics

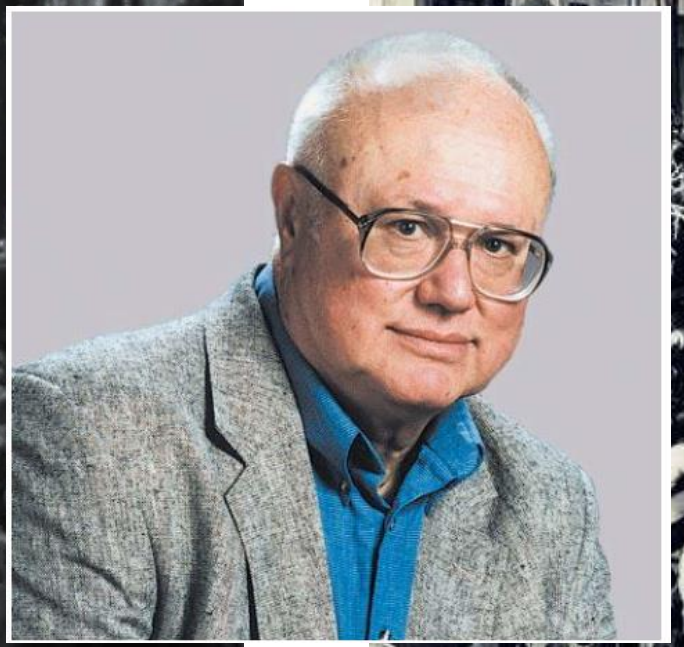
Question

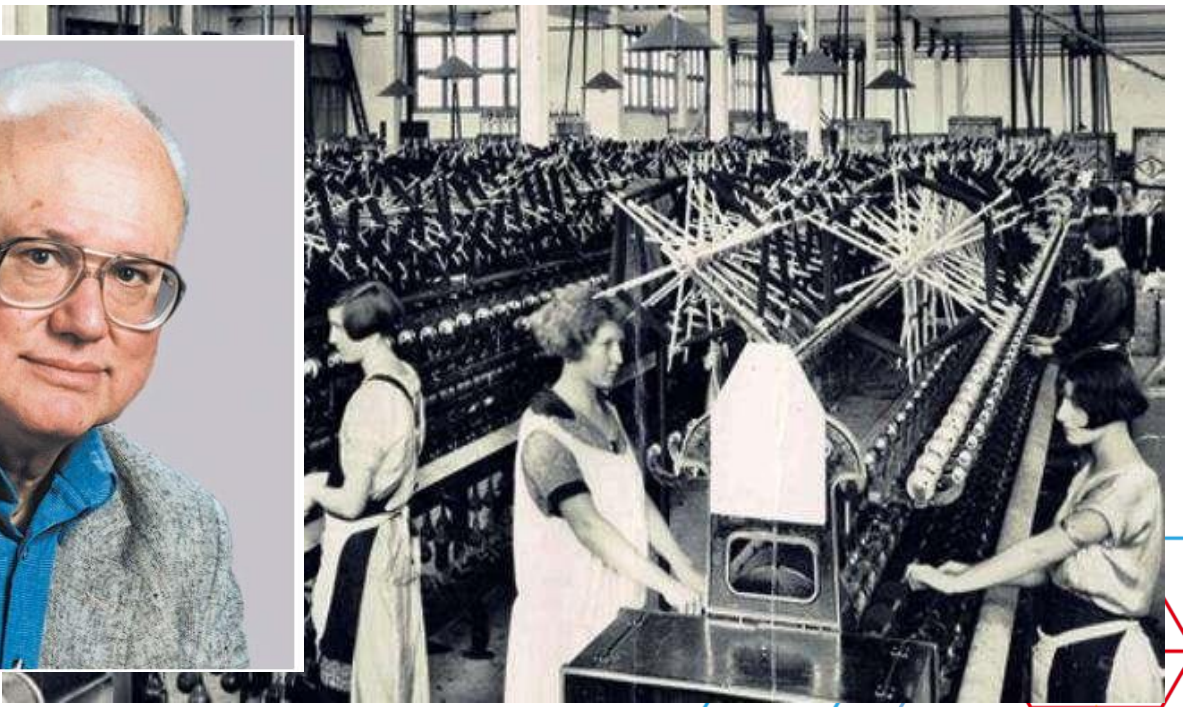
?

What is PLC

1. History of PLC

The demand for human social development drives the continuous progress of industrial production





1. History of PLC

PLC—— the brain of automated production line

P ——Programmable

L —— Logic

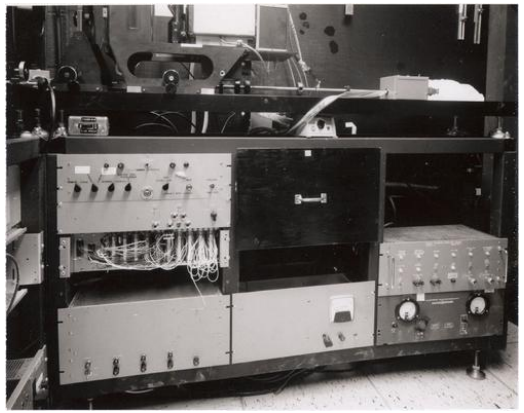
C —— Controller

Automated production lines - the result of continuous pursuit of production efficiency

2. Development of PLC

Origin

In the early 1970s



PDP-14 （American DEC）

Practicality

1970s~

In the early 1980s

SC series (Japan Fuji Electric)

rapid growth1980s~

In the mid-1990s

S5 series (Germany Siemens)

Progress and

Improvement

Late 20th century ~ So far

S7 series (Germany Siemens)

3. Brand of PLC

Common PLC brands/manufacturers

SIEMENS Ingenuity for life

ABB

Rockwell Automation

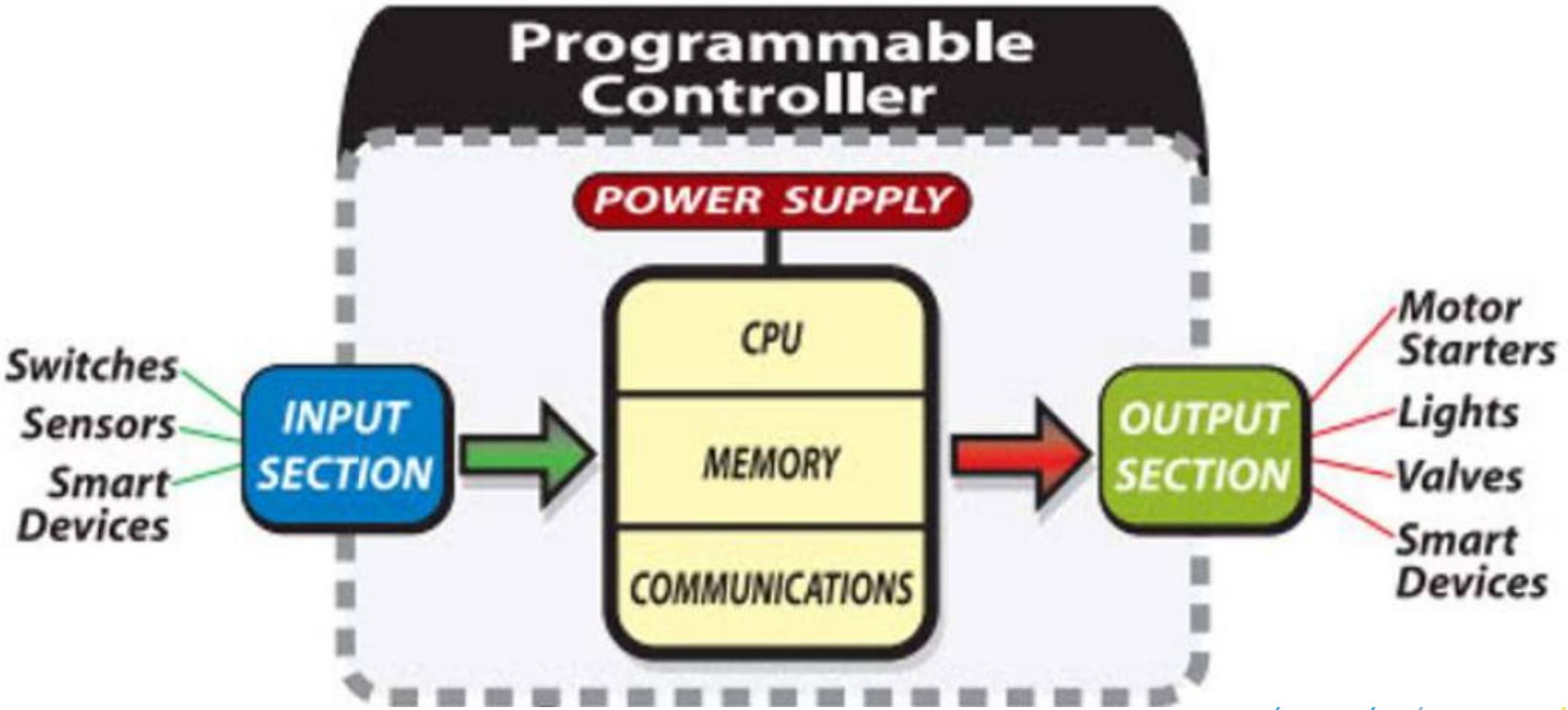
OMRON

MITSUBISHI

XINJE 信捷

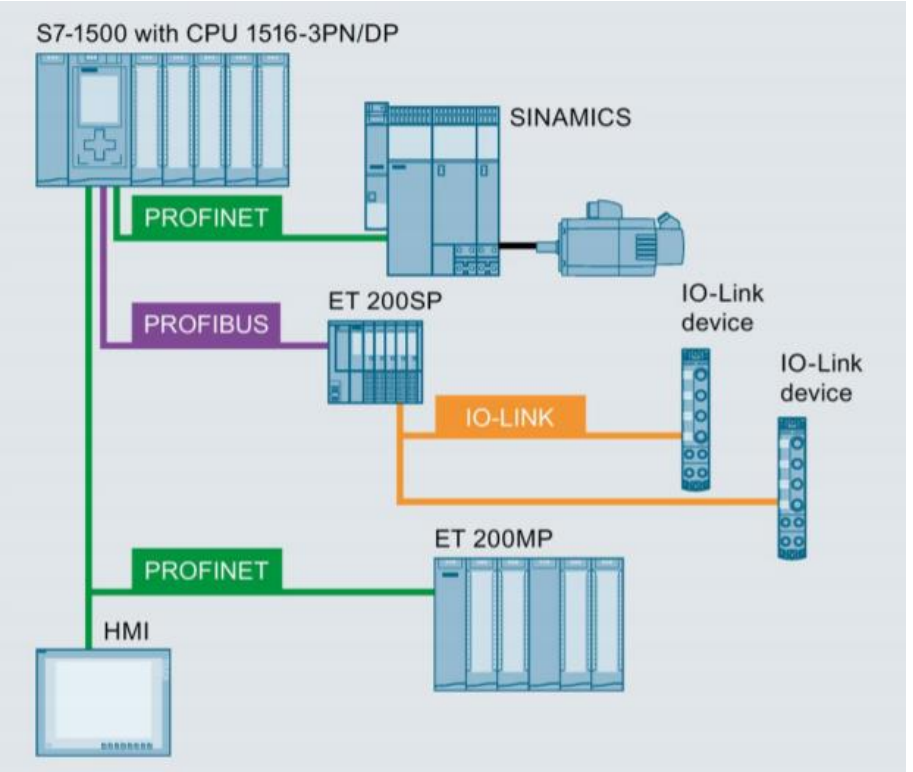
INOVANCE 汇川技术

4. Main components of a PLC



Composition of common PLC systems

Composition of common PLC systems



Composition of common PLC systems

1. PLC master station

Power module
PM/PS

S7-1500
CPU

Signal module
DI/DO/AI/AO

Composition of common PLC systems

2. Distributed IO salve station

Distributed IO salve station

Interface module
IM

Signal module
DI/DO/AI/AO

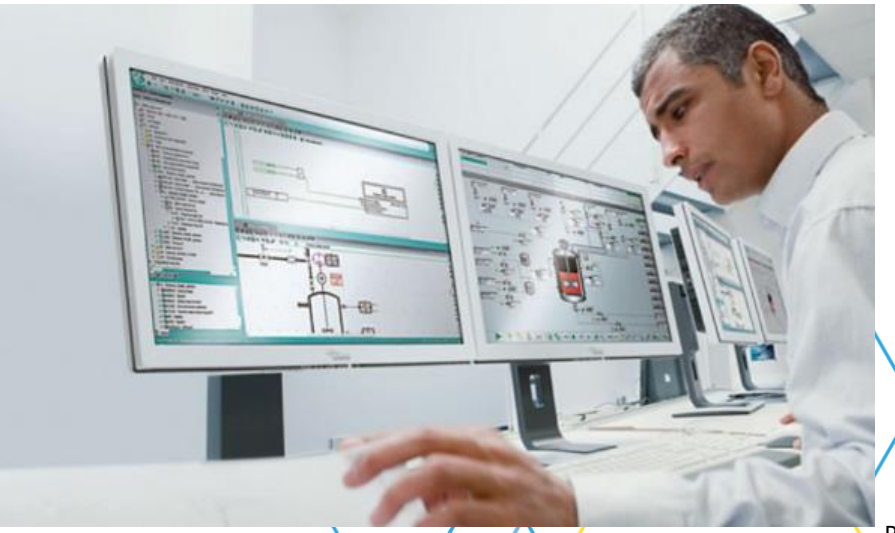
Composition of common PLC systems

3. HMI

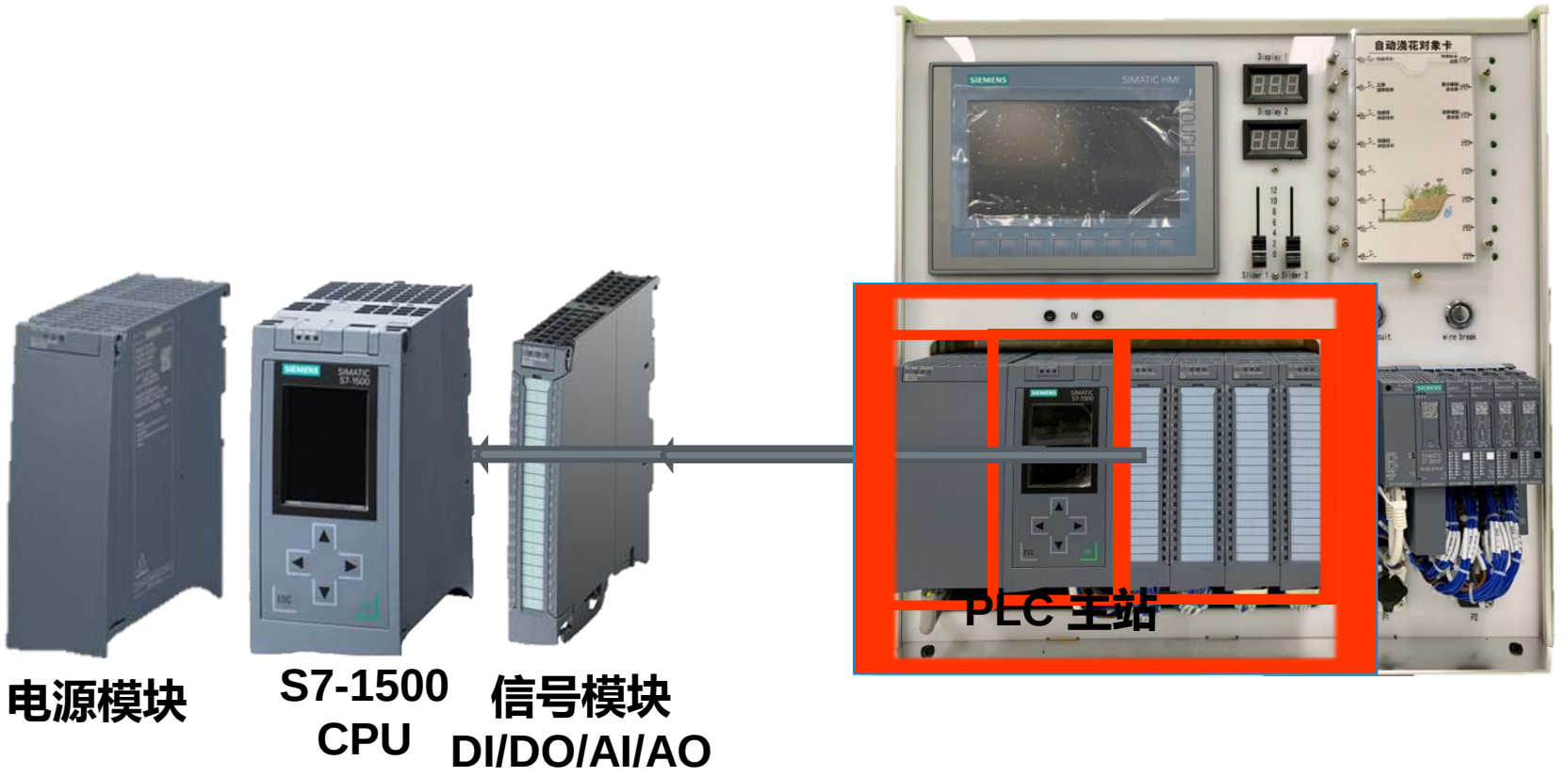
Composition of common PLC systems

4. Industrial control software

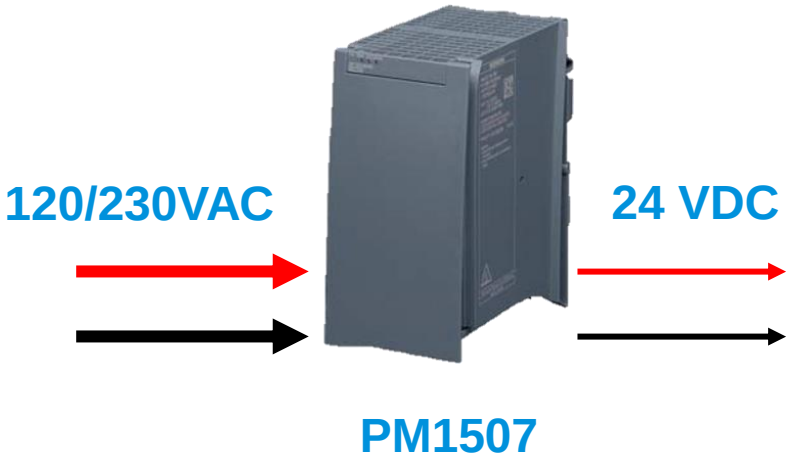
Industrial control software (TIA/WINCC)



1. PLC master station



1. 1 Power module



1. 2 CPU Module

Siemens' fastest automation controller

The SIMATIC S7-1500 has high-speed backplane bus, PROFINET performance, and extremely short response time. The CPU command processing time can reach 1 ns, achieving extremely high productivity and product quality in the production process.

1. 2 CPU Module

S7-1500 CPU family member

Common series CPU

CPU1511、CPU1512、CPU1513、CPU1515、CPU1516、CPU1517、CPU1518

Compact style(C) CPU

CPU1511C、CPU1512C、……

Safety(F) CPU

CPU1513F、CPU1517F、……

1. 2 CPU Module

S7-1500 CPU family member

Motion control (T) CPU

CPU1515T、
CPU1517T、
……

Redundance(R/H) CPU

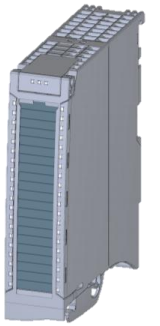
CPU1515R、
CPU1517H、
……

1. 3 Signal Moule

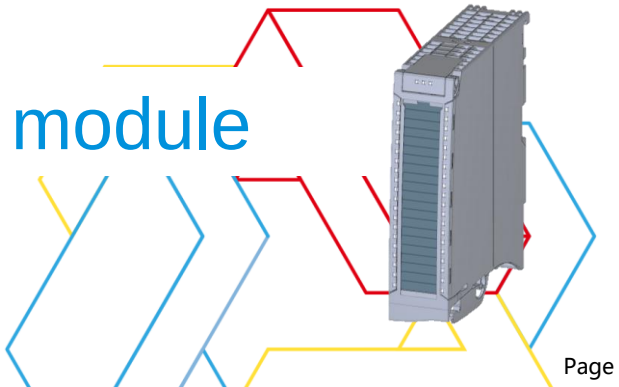
The vast majority of electrical signals used in industrial PLC control systems

Electrical signal

- Digital signal → Digital module

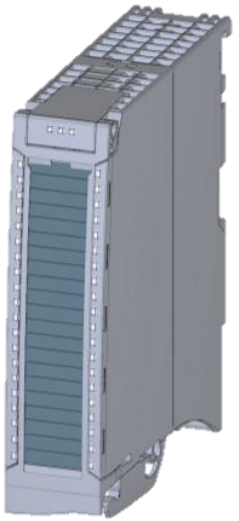


- Analog signal → Analog module



1. 3 Signal Moule

Digital Module



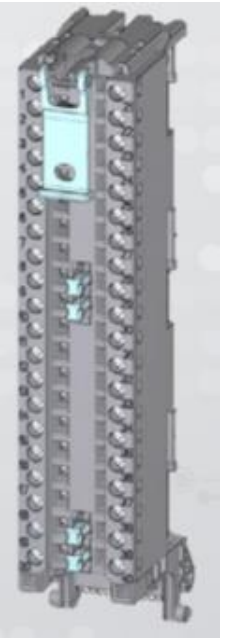
DI（Digital Input）module：
Responsible for collecting of on-site input signals
(proximity switches、light switches)

DO（Digital Output）module：
Responsible for output signals to executing devices
(solenoid valves, indicator lights, etc.)

1. 3 Signal Moule

wiring

Front connector



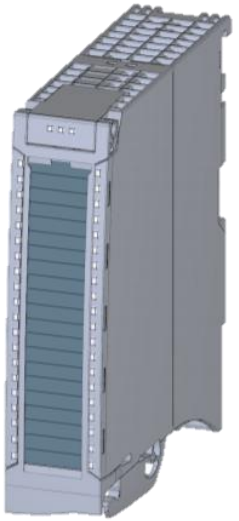
Terminal with screw x 35 mm

Terminal with clamp x 25 mm

Terminal with clamp x 35 mm

1. 3 Signal Moule

Analog Module



AI （Analog Input）Module：
Responsible for collecting of on-site input signal
(temperature ,flow)

AO （Analog Output）Module：
Responsible for outputting signals to executing devices
(motors, electromagnetic control valves, etc.)

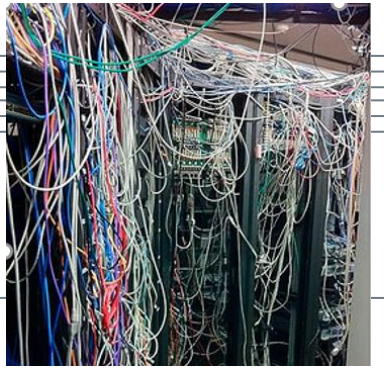
2. Distributed IO salve station

Interface module
IM

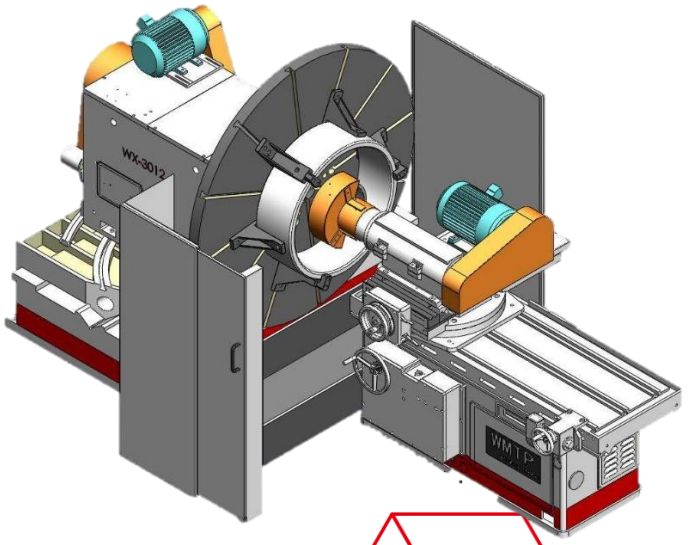
Signal module
DI/DO/AI/AO

2. Distributed IO salve station

Why do we need ?



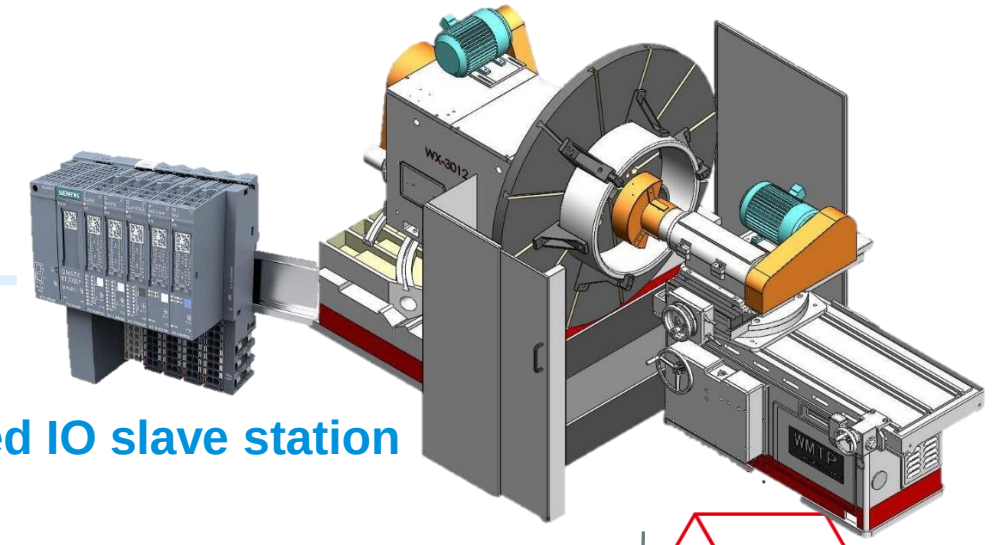
Signal cables



200m

2. Distributed IO salve station

Why do we need ?



Distributed IO slave station

200m

3. Human machine interface

The medium for interaction and information exchange between systems and users


ML130L

4. Industrial control software

Siemens

TIA V15

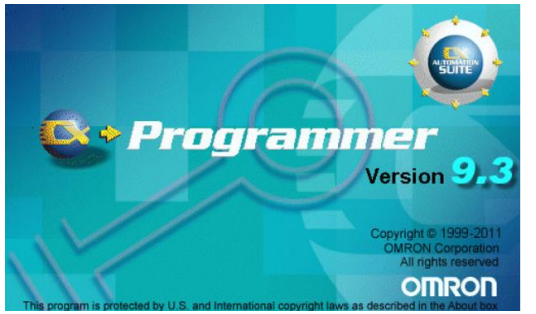
Totally Integrated Automation Portal

Mitsubishi

GX Works

GX Developer

Omron



CX-Programmer

XINJE 信捷

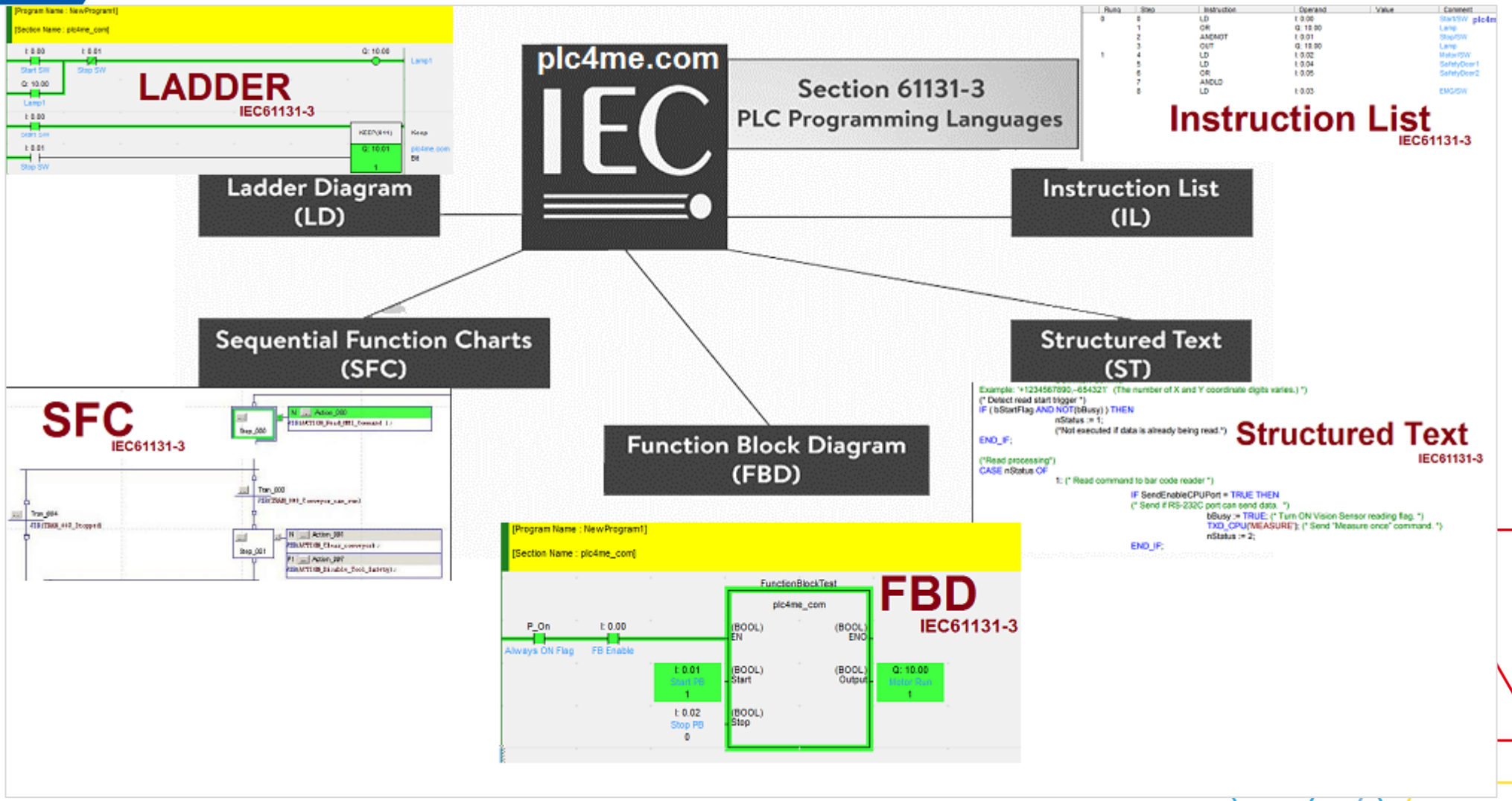
INOVANCE 汇川技术

DELTA 台达

Allen-Bradley

Schneider Electric

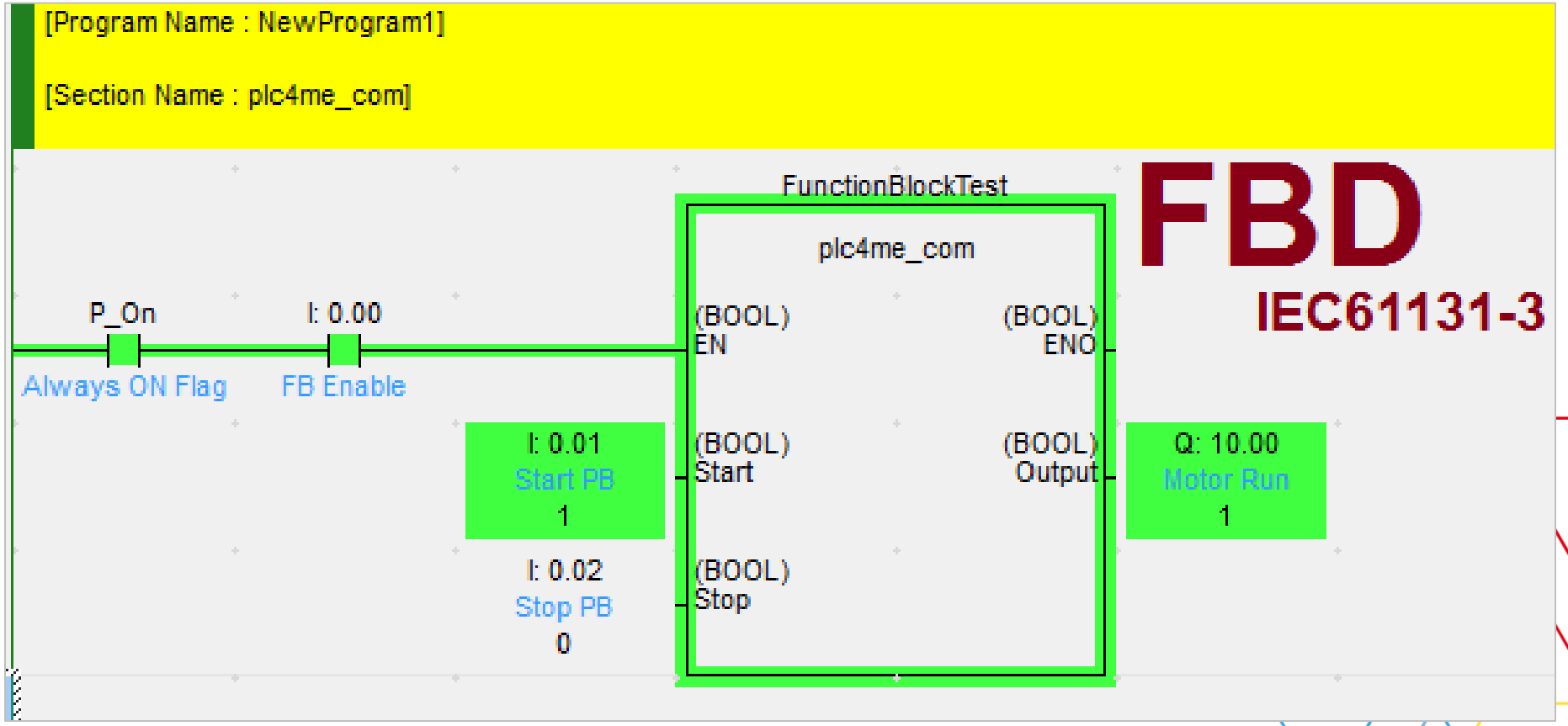
4.1 Programming Languages



4.1 Programming Languages

- **Function Block Diagram (The abbreviation is FBD)**

Describe the connection of functions, function blocks, and programs as a set of connected graphic blocks. It looks like the electronic circuit diagram we often use.



How to Choose a Controller

How to Choose a Controller

Security projects require security level certification

Safety(F) CPU

High reliability, reducing production downtime

redundance(R/H) CPU

Complex motion control requirements

Motion control(T) CPU

Simple project with limited cost

Compact(C) CPU

How to Choose a Controller

Step 1:

Consideration	Information to Record	
1. Proposed System	___ New system	___ Existing system

Determine whether your system is new or existing:

- Will your system be installed from scratch or are there existing products already installed?
- The rest of your system will need to be compatible with new components.

How to Choose a Controller

Step 2:

Consideration	Information to Record	
2. Environmental Issues	____ Codes/environmental issues to consider	____ No codes or environmental issues to consider

Consider any environmental issues that will affect your application (temperature, dust, vibration, codes specific to your facility, etc.).

How to Choose a Controller

Step 3:

Consideration	Information to Record	
3. Discrete Devices	_____ Total inputs: _____ AC _____ DC	_____ Total outputs: _____ AC _____ DC

Determine

- how many discrete devices your system will have.
- Which types (AC, DC, etc.) are needed?

How to Choose a Controller

Step 4:

Consideration	Information to Record	
4. Analog Devices	____ Total inputs: ____ Voltage ____ Current ____ Thermo ____ RTD	____ Total outputs: ____ Voltage ____ Current

Determine

- how many analog devices your system will have.
- Which types (voltage, current,
- temperature, etc.) are needed?

How to Choose a Controller

Step 5:

Consideration	Information to Record
5. Specialty Modules or Features (application-specific)	_____ High speed counter _____ Positioning _____ Servo/stepper _____ BASIC programming _____ Real-time clock _____ Others (list)

Determine whether your system will require any specialty features:

- Will your application require high-speed counting or positioning?
- What about a real-time clock or other specialty feature?

Step 6:

Consideration	Information to Record
6. CPU Required	**Hardware requirements:** _____ K program memory required (estimated) _____ K data memory required (estimated) _____ Fast scan time required? _____ Battery backup required? **Software/special function requirements:** ____ PID ____ Floating Point Math Others (see Programming section below)

Determine the type of CPU you will need:

- How much memory will your system require?
- How many devices will your system have (determines data memory)?
- How large is your program, and what types of instructions will your program
- include (determines program memory)?
- How fast a scan time do you need?

How to Choose a Controller

Step 7:

Consideration	Information to Record	
7. I/O Locations	_____ Local . . . only	_____ Remote Locations Specific remote I/O protocol required? Which one? _____

Determine where your I/O will be located:
Will your system require only local I/O, or both local and remote I/O locations?

How to Choose a Controller

Step 8:

Consideration	Information to Record
8. Commuications	_____ Ethernet _____ PLC to PLC _____ Modbus RTU _____ ASCII (interface to serial devices) _____ Other

Enter number of physical locations needed, and if/what specific protocol may be required.
Determine your communication requirements:
Will your system be communicating to other networks, systems or field devices?

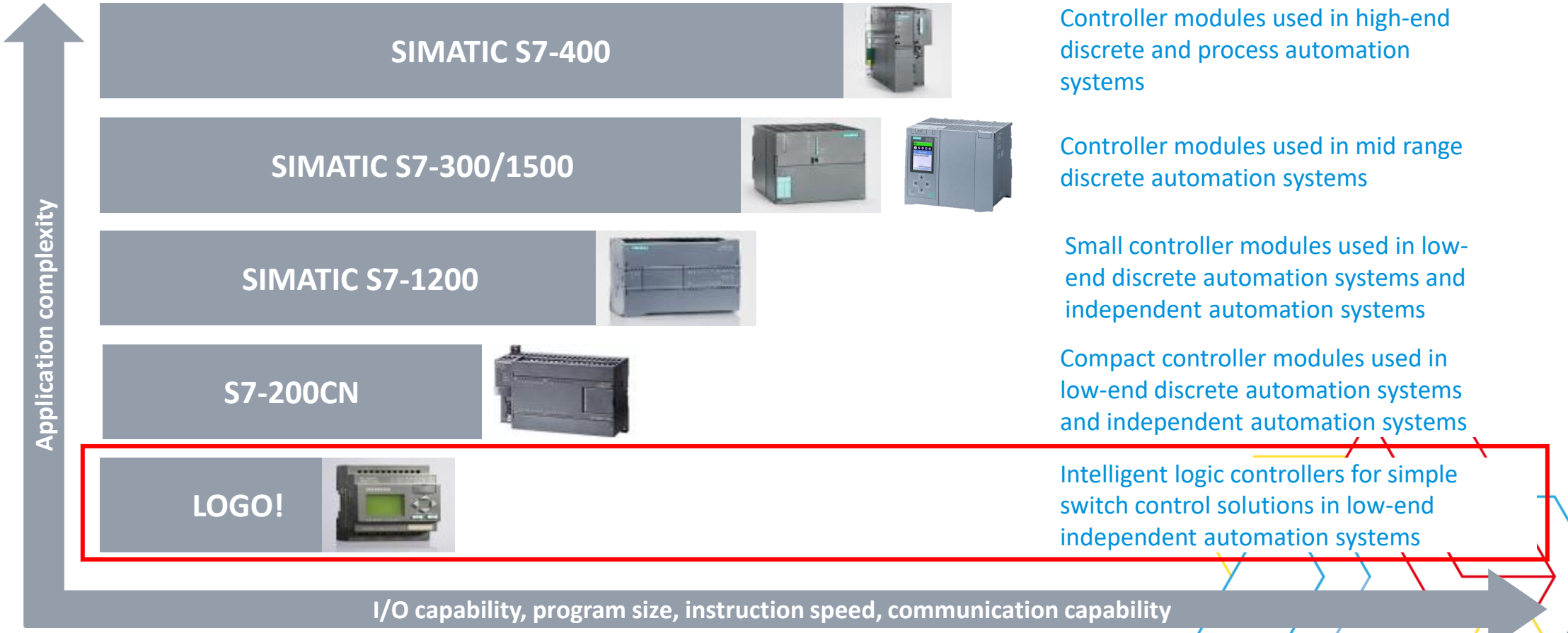
How to Choose a Controller

Step 9:

Consideration	Information to Record	
9. Programming	____ Floating point math	____ PID loops
		____ number of loops needed
		____ Subroutines
	____ Drum sequencer	____ Direct interrupts
		____ Others (list)

Determine your programming requirements:
Does your application require only traditional programming instructions, or are special instructions necessary?

Siemens controller product positioning



Controller modules used in high-end discrete and process automation systems

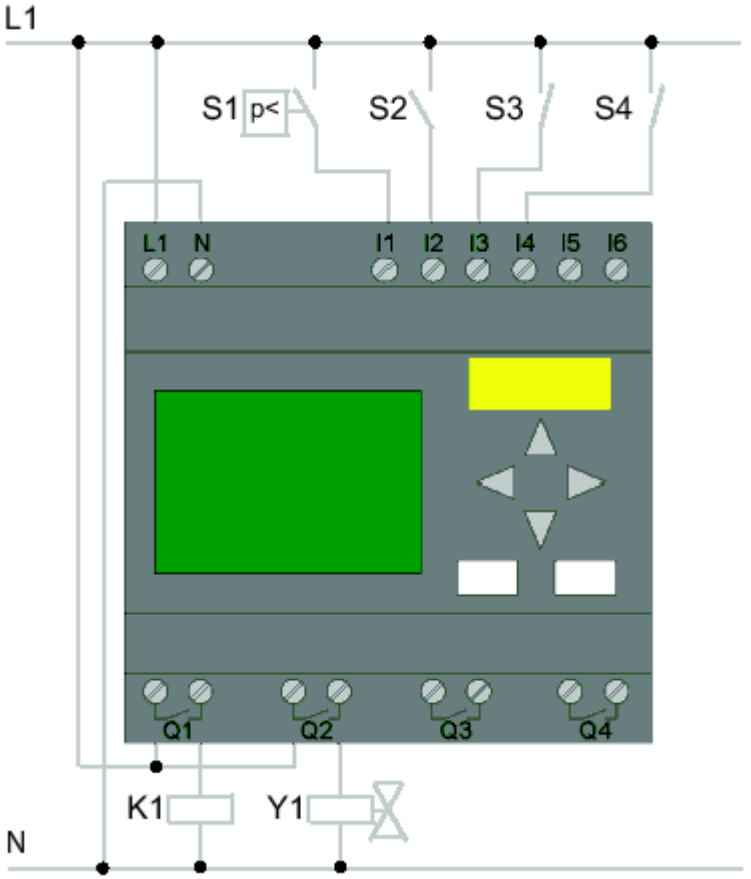
Controller modules used in mid range discrete automation systems

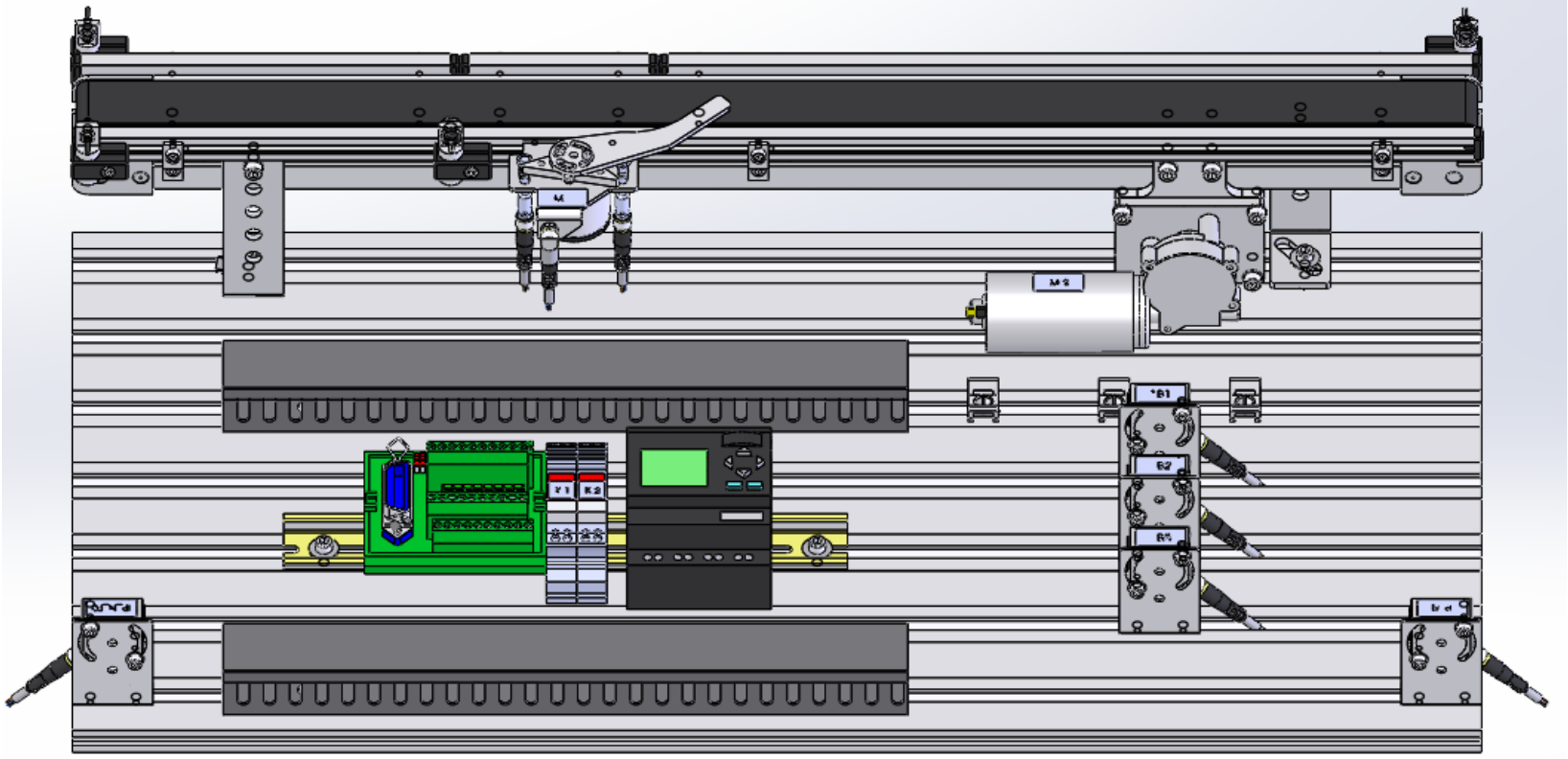
Small controller modules used in low-end discrete automation systems and independent automation systems

Compact controller modules used in low-end discrete automation systems and independent automation systems

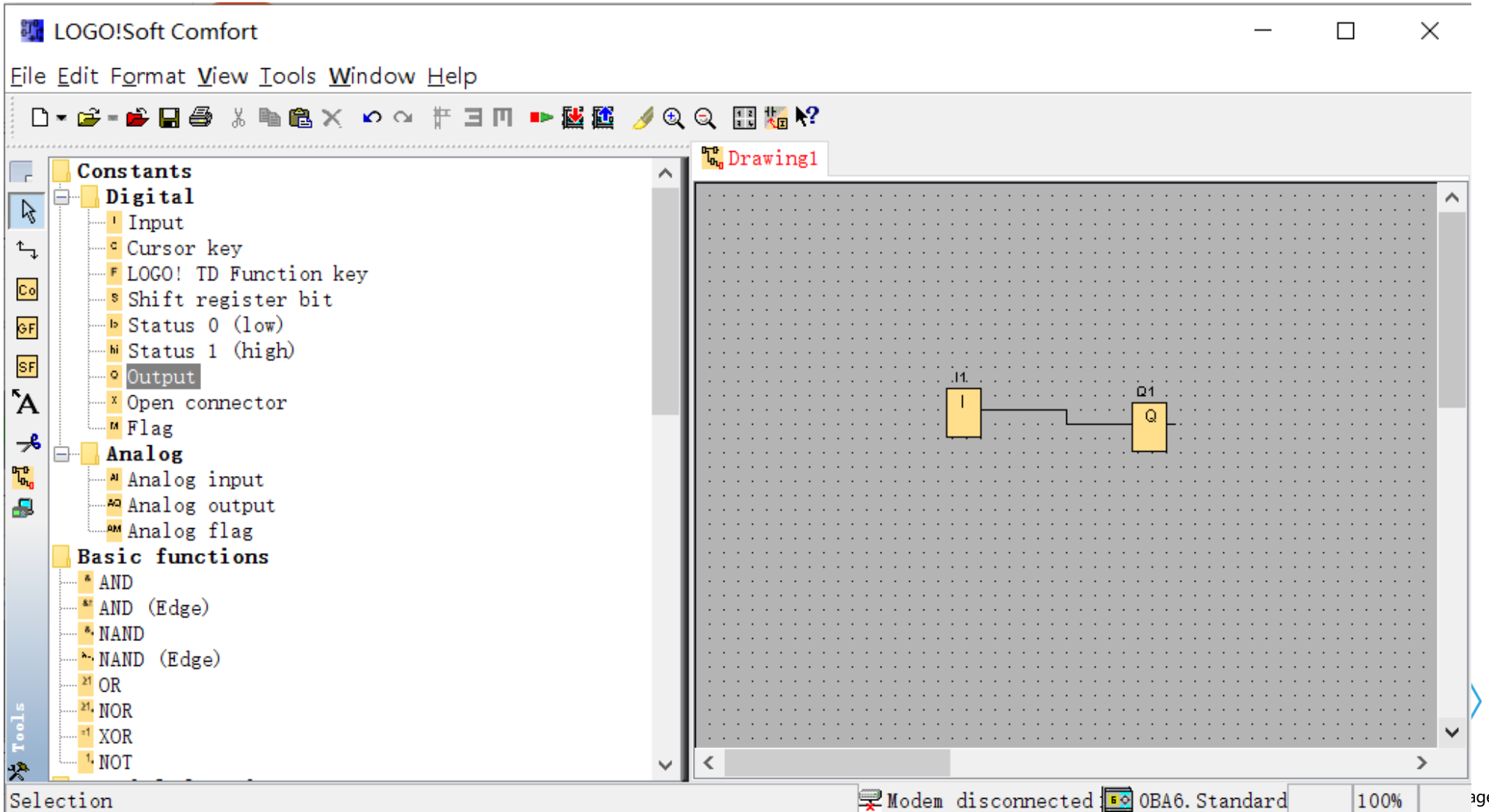
Intelligent logic controllers for simple switch control solutions in low-end independent automation systems

LOGO Application





LOGO!Soft Comfort



Thank You !