Programmable control systems

The first ones was introduced in the late 1960’s

Before that we had relay logic circuits which were hard wired

Programmable control systems

- As technology quickly progressed, many complex operational tasks have been solved by connecting programmable logic controllers (PLC) and a central computer. Beside connections with devices, possibilities for communication among instruments are so great that they allow a high level of exploitation and process coordination.
- With the execution of a program stored in program memory, PLC continuously monitors status of the system through signals from input devices. Based on the logic implemented in the program, PLC determines which actions need to be executed with output instruments. To run more complex processes it is possible to connect more PLC controllers to a central computer

Advantages of control panel that is based on a PLC controller:

- 1. number of wires needed for connections is reduced by 80%
- 2. Consumption is greatly reduced
- 3. allow for fast and easy error detection.
- 4. Change in operating sequence or application of a PLC controller to a different operating process can easily be accomplished
- 5. Needs fewer spare parts
- 6. It is much cheaper compared to a conventional system
- 7. Reliability of a PLC is greater than that of an electro-mechanical relay or a timer

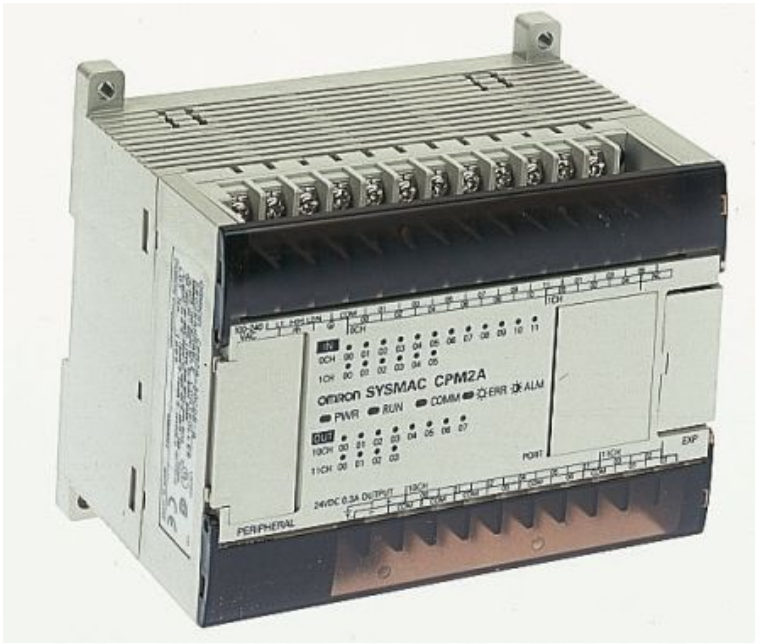
Where is PLC used and why?

- First used by automotive
  - Hard wired relays were complicated, expensive, unreliable
- Lots of I/O
  - Many components are controlled
- Stability/ Reliability
  - Designed for the industry
  - Compared to PC, this can not crash
- Home automation
  - Very easy to program
  - Visual programming

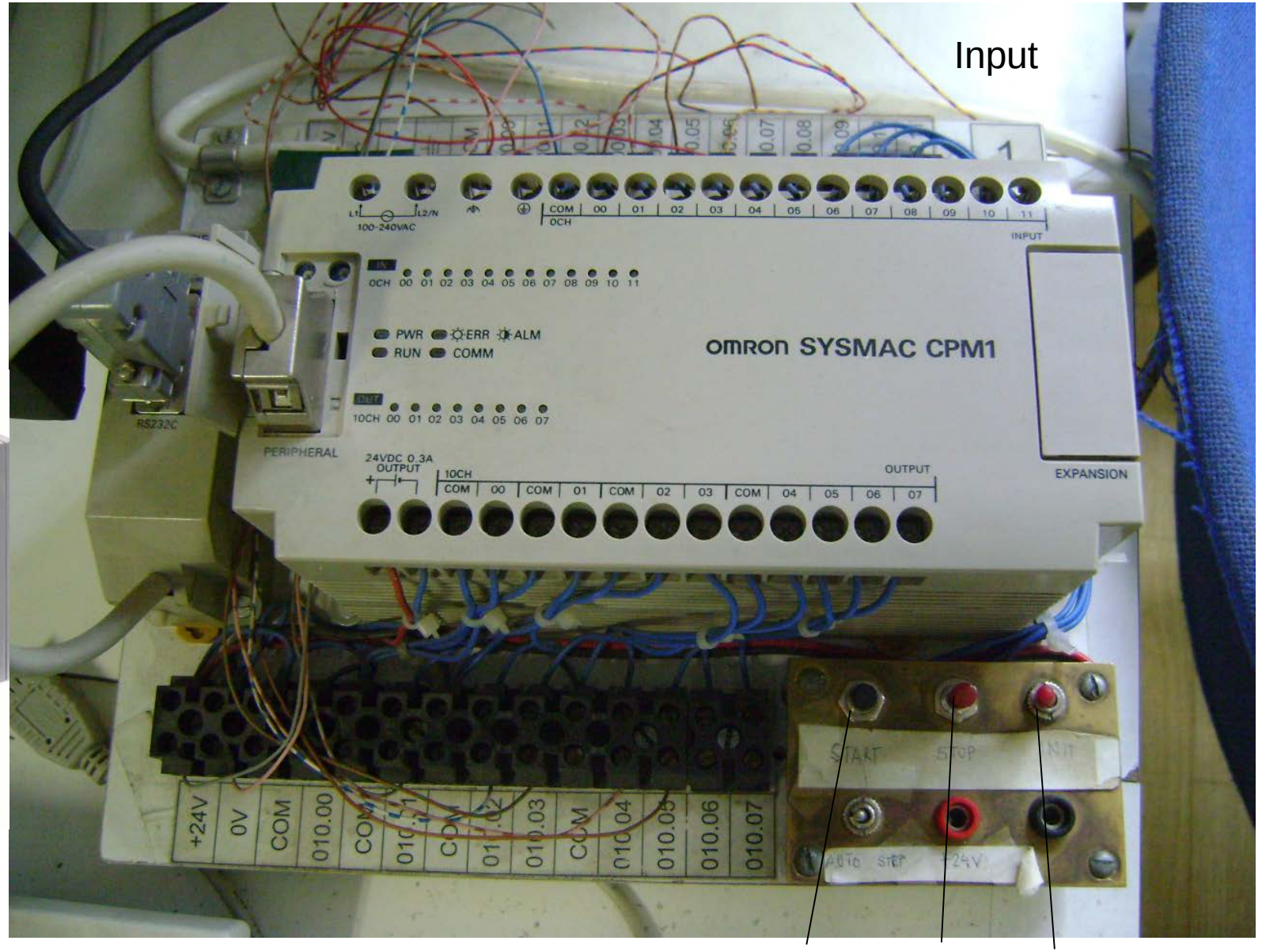
Types of PLCs

- Small system – less than 500 I/Os.
- Medium system has I/Os ranging from 500 to 5,000.
- Large system with over 5,000 I/Os

Types of PLCs



Port selection, modules

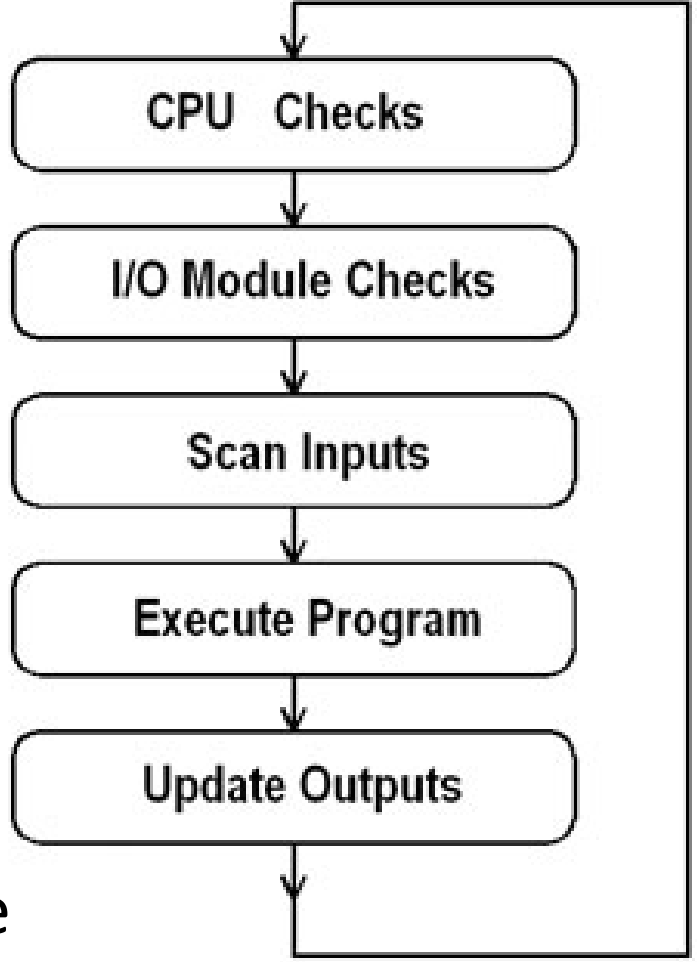


PLC programming languages

- Ladder diagram (LD)
- Sequential Function Charts (SFC)
- Function Block Diagram (FBD)
- Structured Text (ST)
- Instruction List (IL)

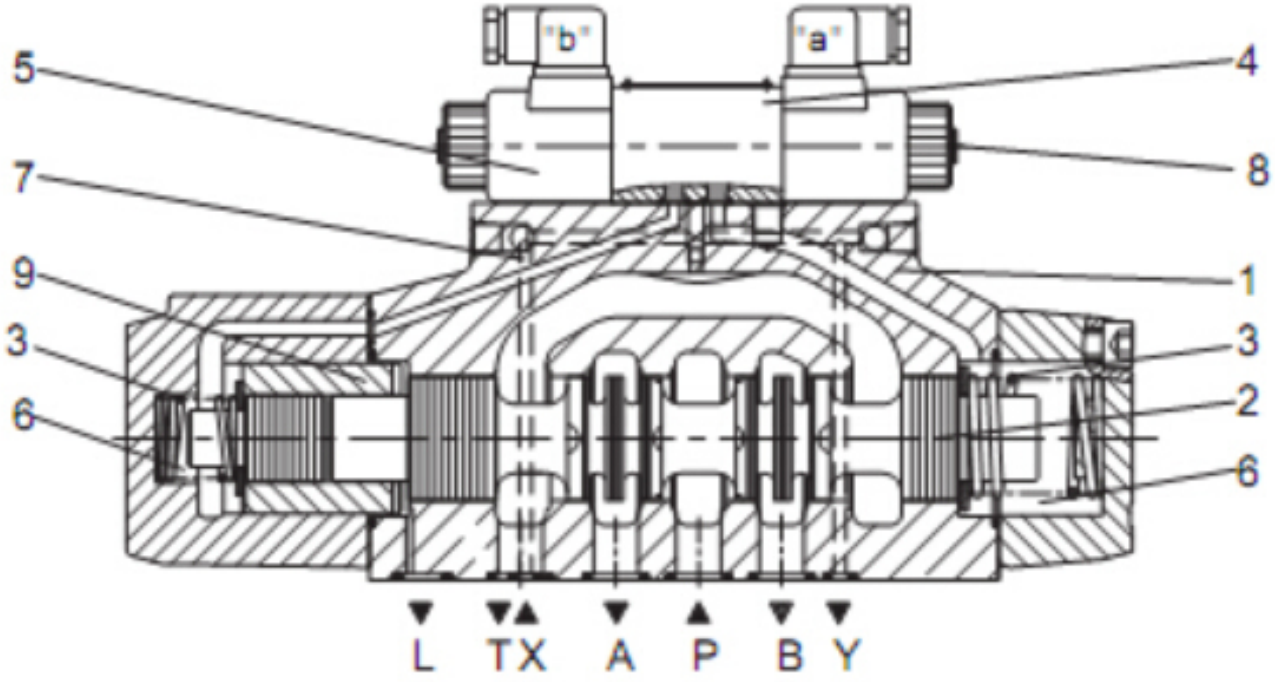
Process of a scan cycle

- Input Scan:
  - A simple way of looking at this is the PLC takes a snapshot of the inputs and solves the logic
- Execute Program (or Logic Execution):
  - The PLC executes a program one instruction at a time using only the memory copy of the inputs the ladder logic program
- Output Scan:
  - When the ladder scan completes, the outputs are updated using the temporary values in memory



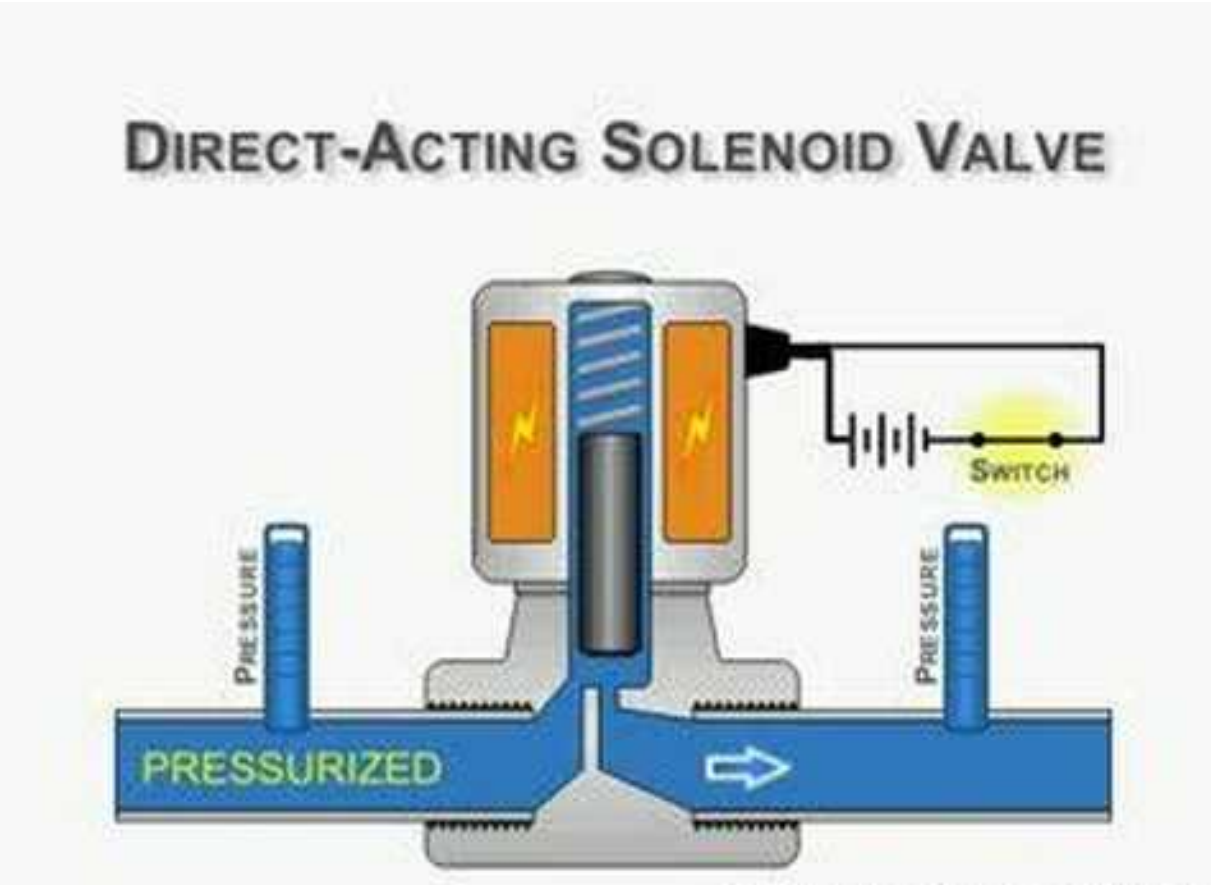
Solenoid valves

- A solenoid valve is an electromechanically operated valve.

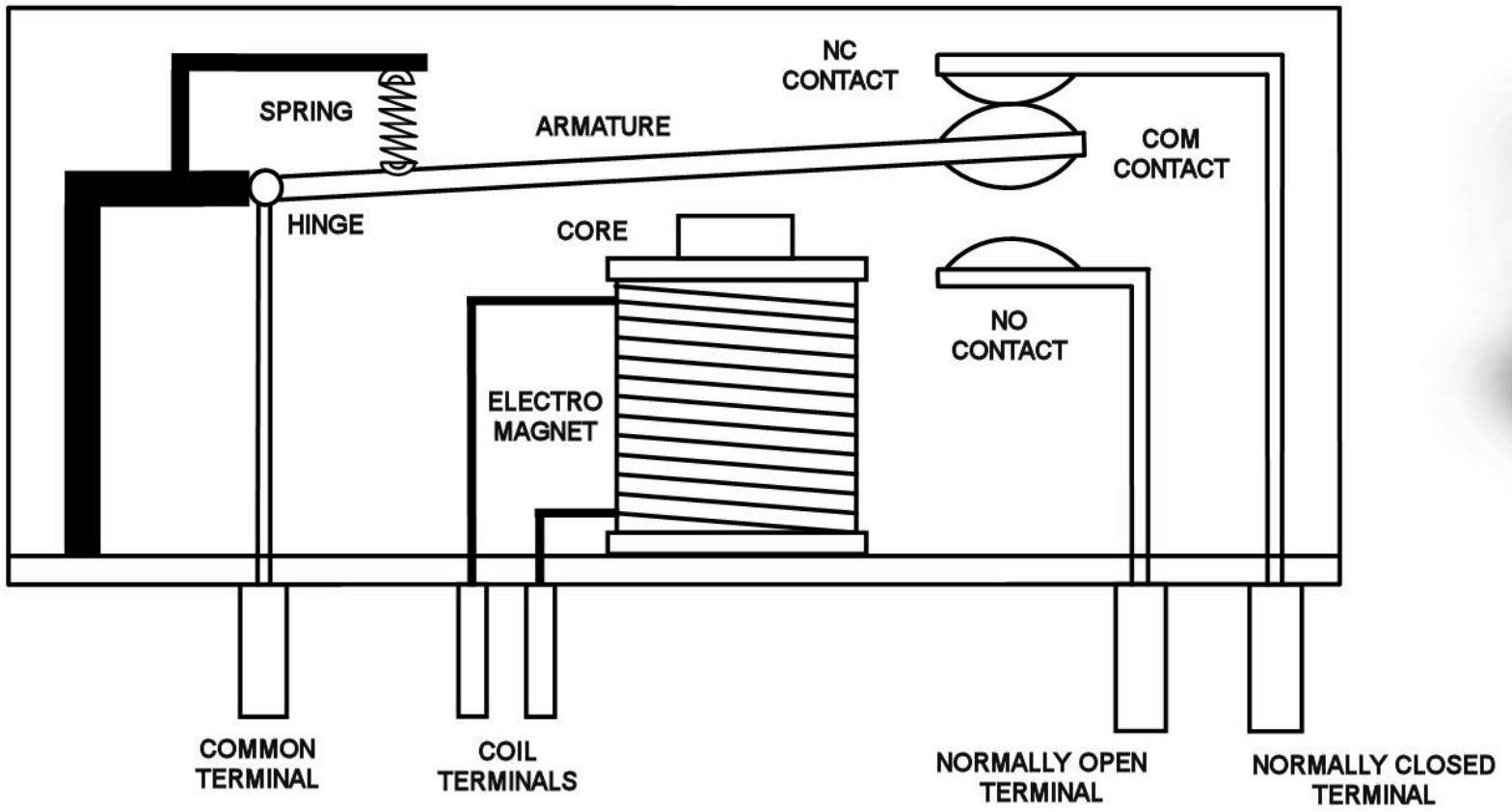


Structure configuration of directional valves type WEH32 with hydraulic centre

1 Housing
2 Main control spool
3 Spring
4 Pilot valve
5 Solenoid
6 Spring chamber
7 Pilot line
8 Hand override



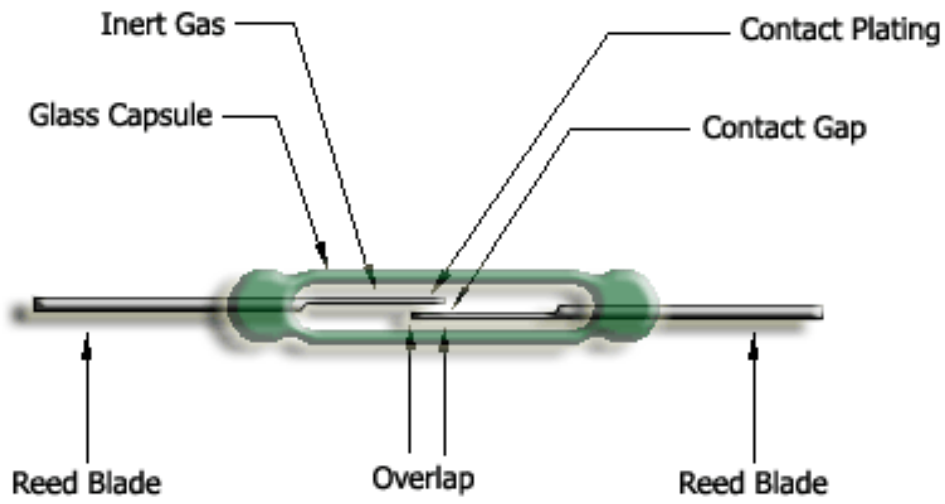
Relay

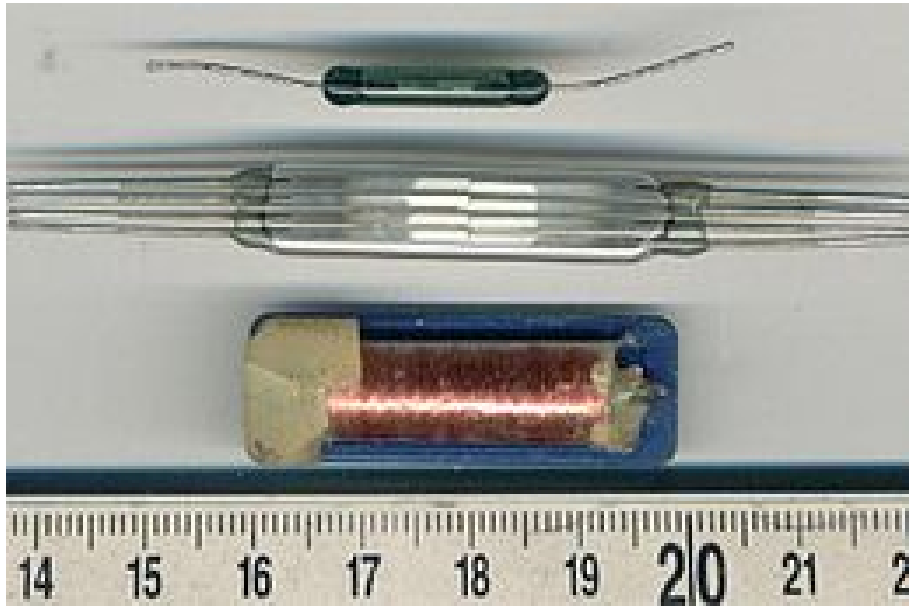

NC
CONTACT
SPRING
ARMATURE
COM
CONTACT
HINGE
CORE
NO
CONTACT
ELECTRO
MAGNET
COMMON
TERMINAL
COIL
TERMINALS
NORMALLY OPEN
TERMINAL
NORMALLY CLOSED
TERMINAL


TWISTED
THROTTLE

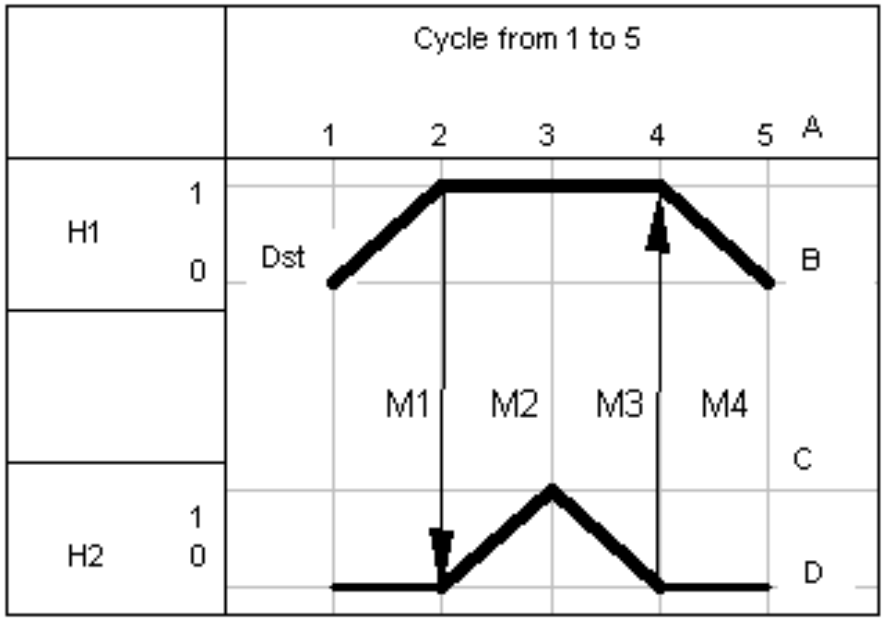
Reed Relay

- It is a type of relay that uses an electromagnet to control one or more reed switches.
- The contacts are of magnetic material and the electromagnet acts directly on them without requiring an armature to move them





Shift Register



M1 = B*Dst*(M4[M1]+Dst)

H1 + = M1[M2]

M2 = A*M1[M2]

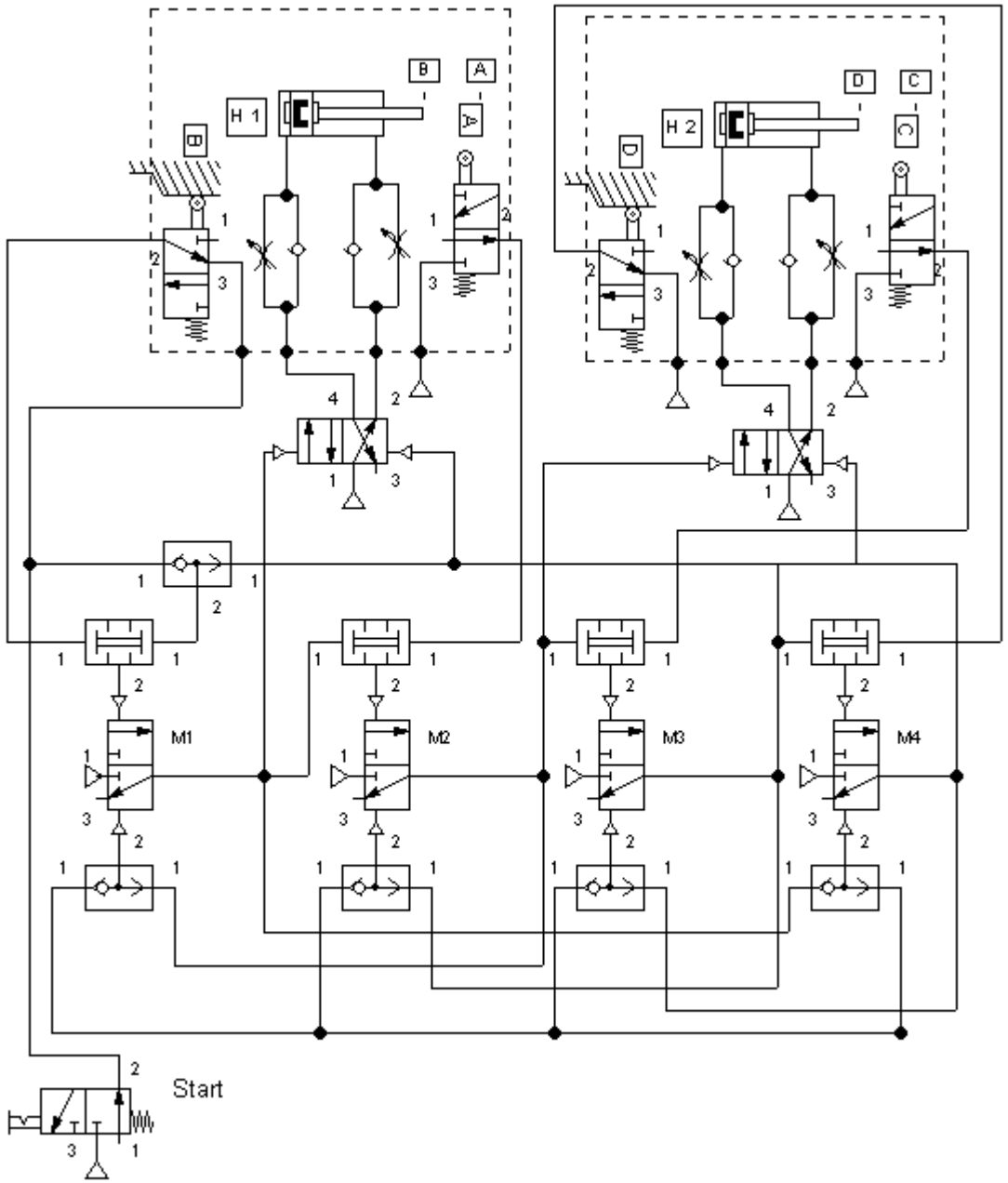
H2 + = M2[M3]

M3 =C*M2[M3]

H2 - = M3[M4]

M4 =D*M3[M4]

H1 - = M4[M1]



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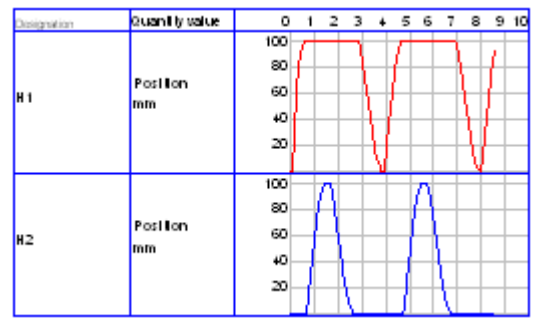
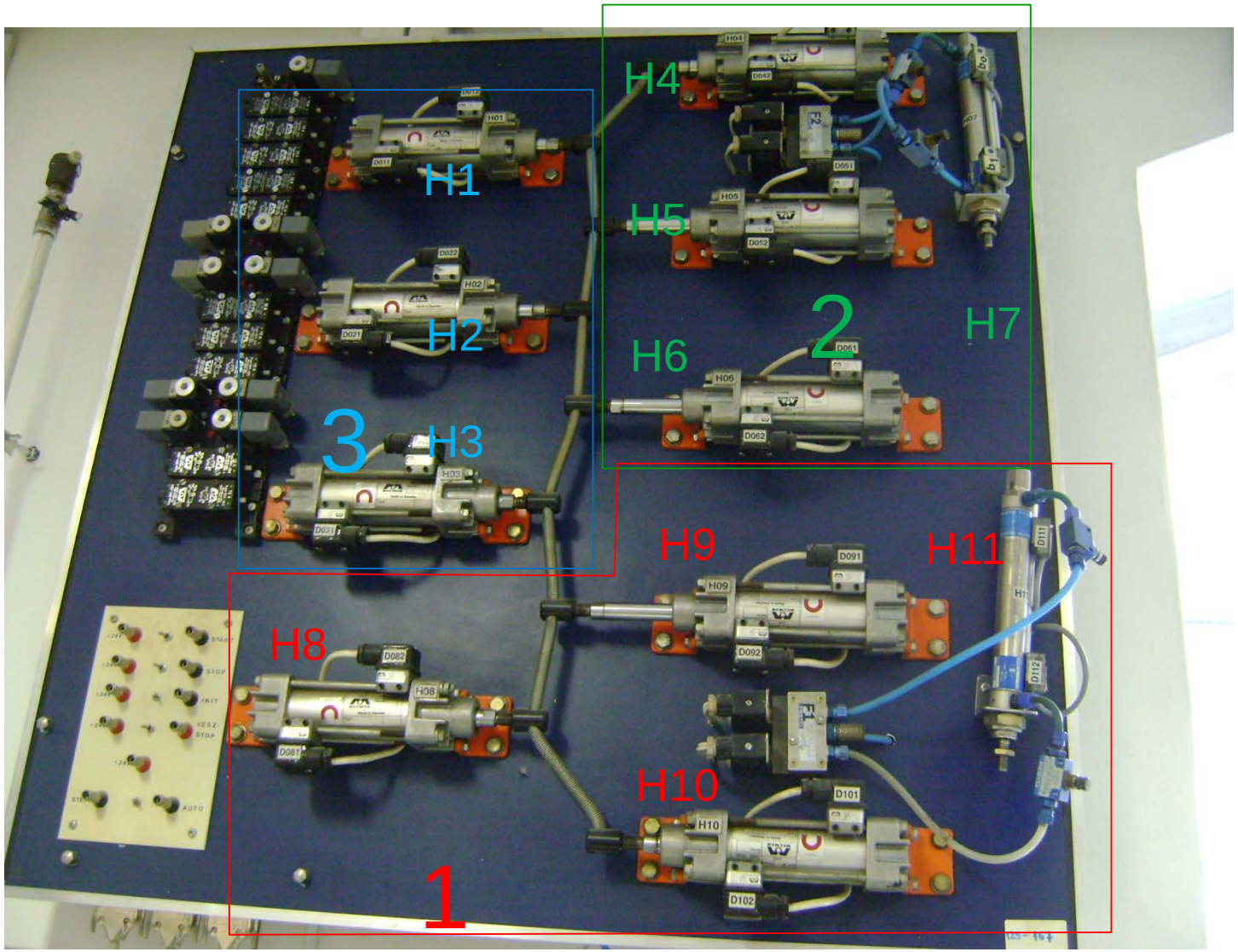
M4 =D*M3[M4]

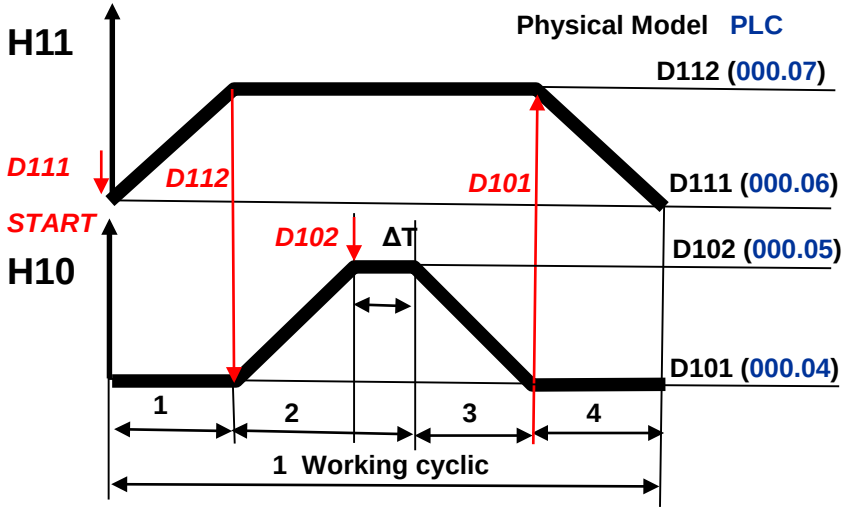
H1 - = M4[M1]

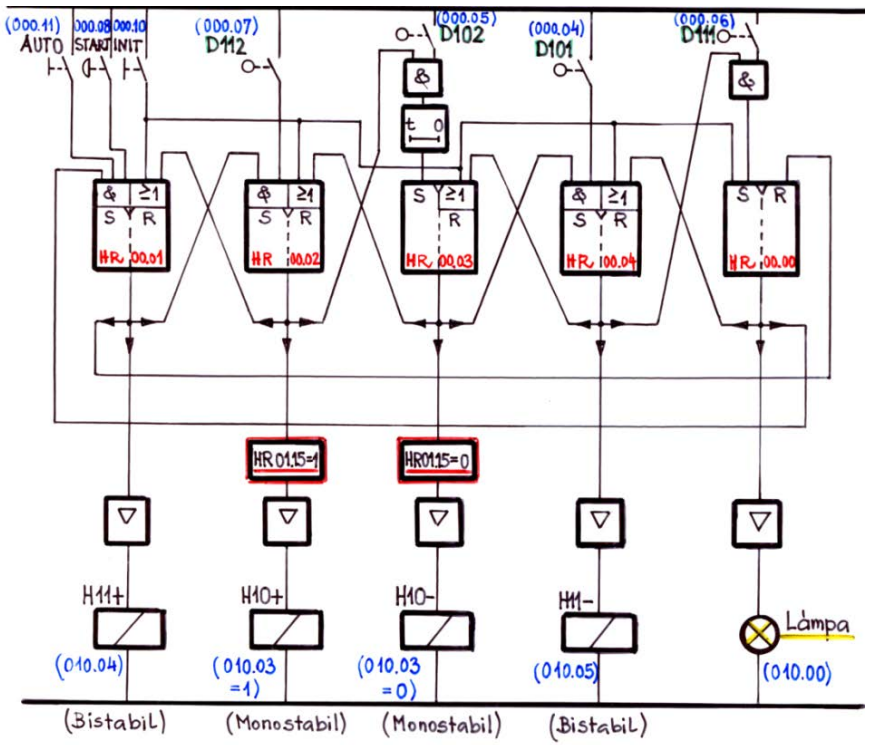


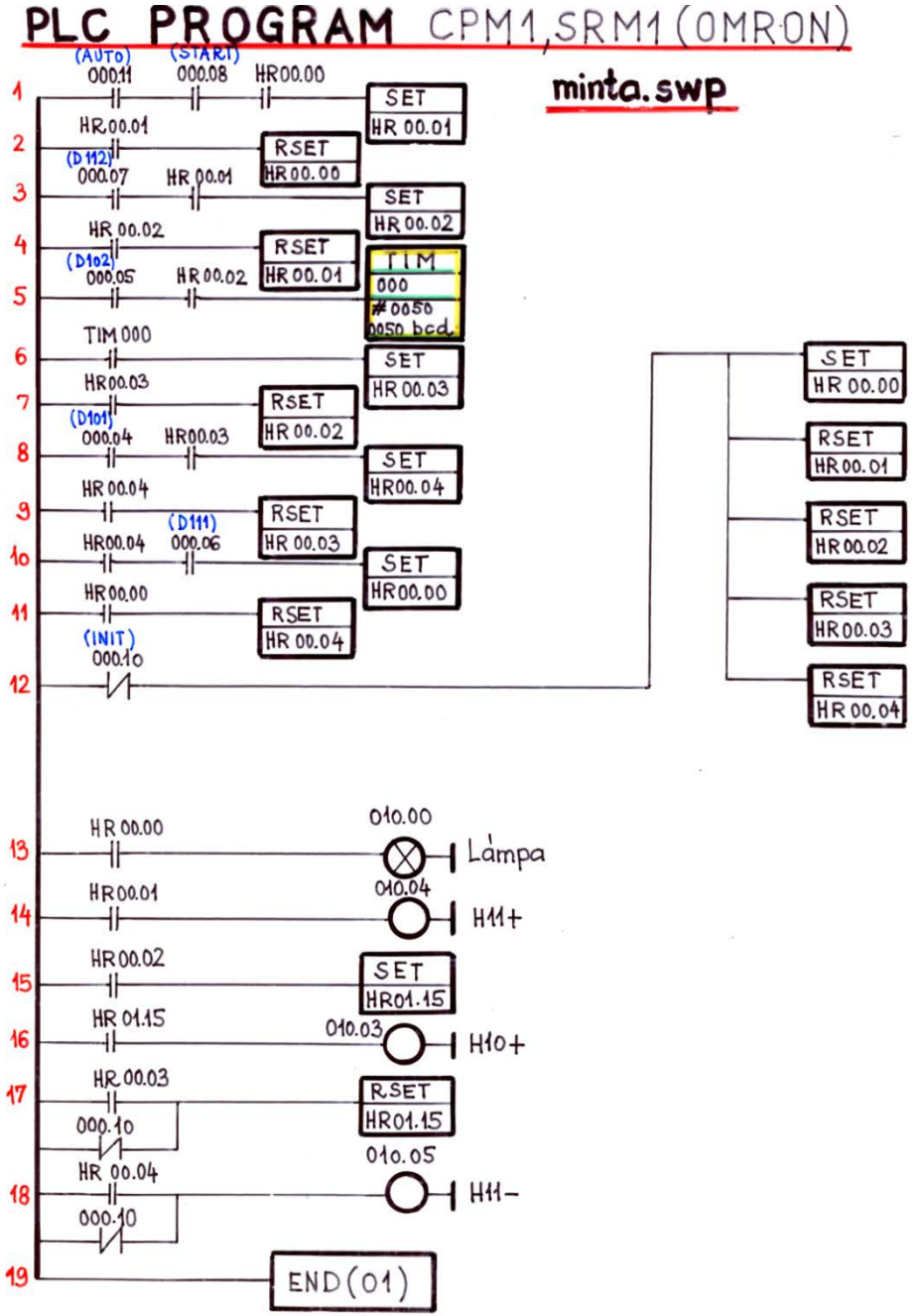
In Lab



H10 single acting (monostable); H11 double acting cylinder (bistable)


H11
Physical Model PLC
D112 (000.07)
D111
D112
D101
D111 (000.06)
START
D102
ΔT
H10
D102 (000.05)
D101 (000.04)
1
2
3
4
1 Working cyclic


AUTO
START
INIT
D112
D102
D101
D111
HR 00.01
HR 00.02
HR 00.03
HR 00.04
HR 00.00
HR 01.15=1
HR 01.15=0
H11+
H10+
H10-
H11-
Lámpa
(010.04)
(010.03 =1)
(010.03 =0)
(010.05)
(010.00)
(Bistabil)
(Monostabil)
(Monostabil)
(Bistabil)


PLC PROGRAM CPM1,SRM1 (OMRON)
minta.swp
(AUTO) 000.11
(START) 000.08
HR 00.00
SET HR 00.01
HR 00.01
RSET HR 00.00
(D112) 000.07
HR 00.01
SET HR 00.02
HR 00.02
RSET HR 00.01
(D102) 000.05
HR 00.02
TIM 000 #0050 0050 bcd
TIM 000
SET HR 00.03
HR 00.03
RSET HR 00.02
(D101) 000.04
HR 00.03
SET HR 00.04
HR 00.04
RSET HR 00.03
(D111) 000.06
HR 00.04
SET HR 00.00
HR 00.00
RSET HR 00.04
(INIT) 000.10
SET HR 00.00
RSET HR 00.01
RSET HR 00.02
RSET HR 00.03
RSET HR 00.04
HR 00.00
010.00
Lámpa
HR 00.01
010.04
H11+
HR 00.02
SET HR01.15
HR 01.15
010.03
H10+
HR 00.03
RSET HR01.15
000.10
010.05
HR 00.04
H11-
000.10
END (01)