BERL2125

Flexible Manufacturing System 2

Assignment: PLC Design of an Automated Manufacturing Station

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1.0 Introduction to MAP system

In a Flexible Manufacturing System (FMS), the Material Allocation Planning (MAP) system serves as a critical component in optimizing the handling and movement of materials within the manufacturing process.

MAP systems are designed to streamline operations by ensuring that materials, components, and resources are efficiently managed and allocated. They achieve this by minimizing downtime, reducing bottlenecks, and ensuring the correct placement of materials at the appropriate stages of production. This process enhances the overall efficiency, responsiveness, and adaptability of FMS to dynamic production demands.

The function of the **MAP 201** is to use a gravity feeder to position parts inside a column. Each part features an asymmetrical internal housing, and a pneumatic cylinder is employed to eject it. A cylinder with a plunger confirms the correct orientation of the part. Once verified, a pneumatic cylinder in the oval section moves the workpiece to its final position. If the orientation is incorrect, a single-acting cylinder ejects the part via a transfer ramp.

The **MAP 202** operates as a Cartesian handling device with two shafts. Its role is to transport parts from one position to another by holding them securely with three vacuum pads. This precise and efficient mechanism ensures smooth and reliable handling of materials within the system.

2.0 SEQUENCE OPERATION SYSTEM MAP-201(b)

1. Only 4 solenoid valves cylinder used in this MAP-201 (b) circuit.
2. When press PB1, First solenoid valve (A+) will push square block forward then retract.
3. Second solenoid (C+) used to push an insertion inside the block then retracts.
4. Third solenoid(B+) which is a body transfer forward cyllinder will push the block forward, moving it onto the long lane then retract.
5. Fourth solenoid (D+) which is rejection cyllinder forward pushing the block moving onto the ramp downwards.
6. The process will repeat 5 times then green lamp will turn on if all block were put correctly.
7. If the the process repeat 5 times but some block were not inccorectly place such as upside down block. The red lamp is turned on.

STEP	**ACTION**	
	Block Correct	**Block Upside Down**
Step 1	A+	A+
Step 2	C+	C+
Step 3	C-	C-
Step 4	A-	A-
Step 5	B+	B+
Step 6	B-	B-
Step 7	D+	D+
Step 8	D- , CNT 1	D-, CNT 1
Step 9	CNT 2	CNT 2
Step 10	GREEN LIGHT	-
Step 11	-	RED LIGHT

2.1 SEQUENCE OPERATION SYSTEM MAP-202 (b)

1. There are (4) four solenoid valves, manufactured in MAP-202(b).
2. Solenoid valve (A+) is to Cover insertion manipulator Forward.
3. Solenoid valve (A-) is to Cover insertion manipulator.
4. Solenoid valve (B+) is to Cover insertion manipulator.
5. Solenoid valve (V) is to Vacuum in cups.
6. The sequence process is to move cover to another side and backit to main site.
7. If the vacum not detect the cover, the buzzer and red light will blink (ON) 5 times.

STEP	ACTION	
	TRUE	DETECT NO OBJECT
Step 1	B+	-
Step 2	V+	-
Step 3	B-	-
Step 4	A+	-
Step 5	B+	-
Step 6	V-	-
Step 7	B-	-
Step 8	B+	-
Step 9	V+	-
Step 10	B-	-
Step 11	A-	-
Step 12	B+	-
Step 13	V-	-
Step 14	B-	-
Step 15	-	B-
Step 16	-	V-
Step 17	-	Red light & Buzzer ON 5x

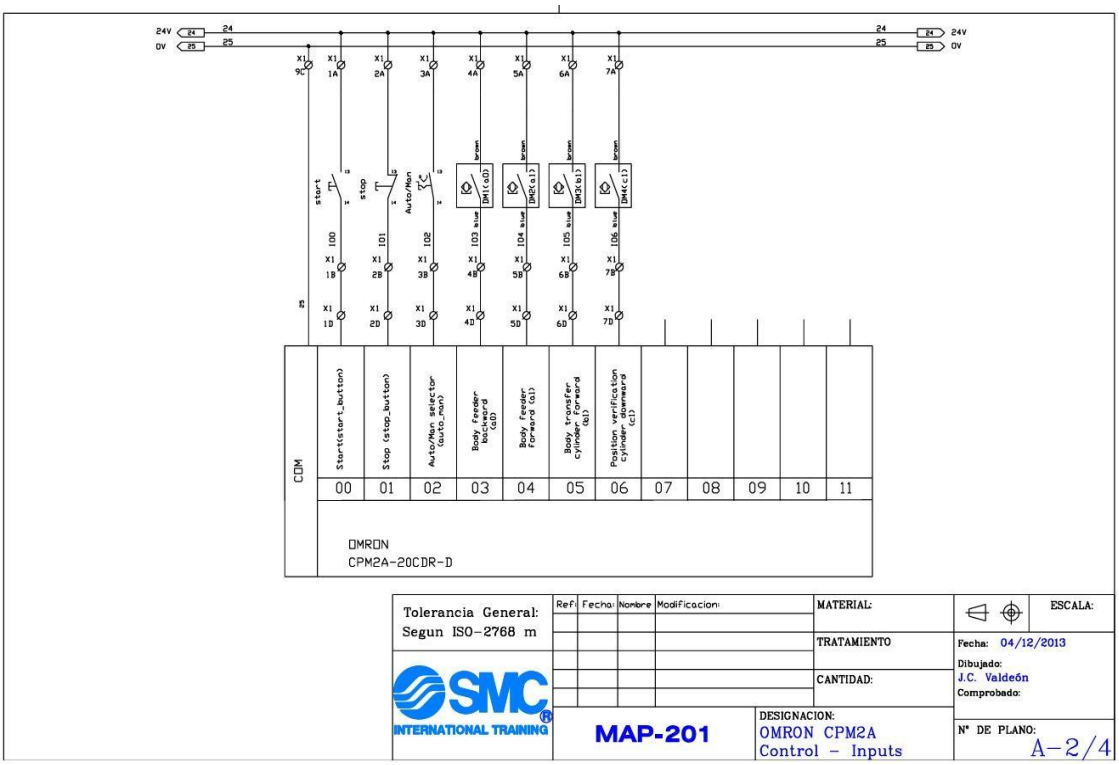
3.0 MAP 201 (Base supply module) I/O Addressing Table

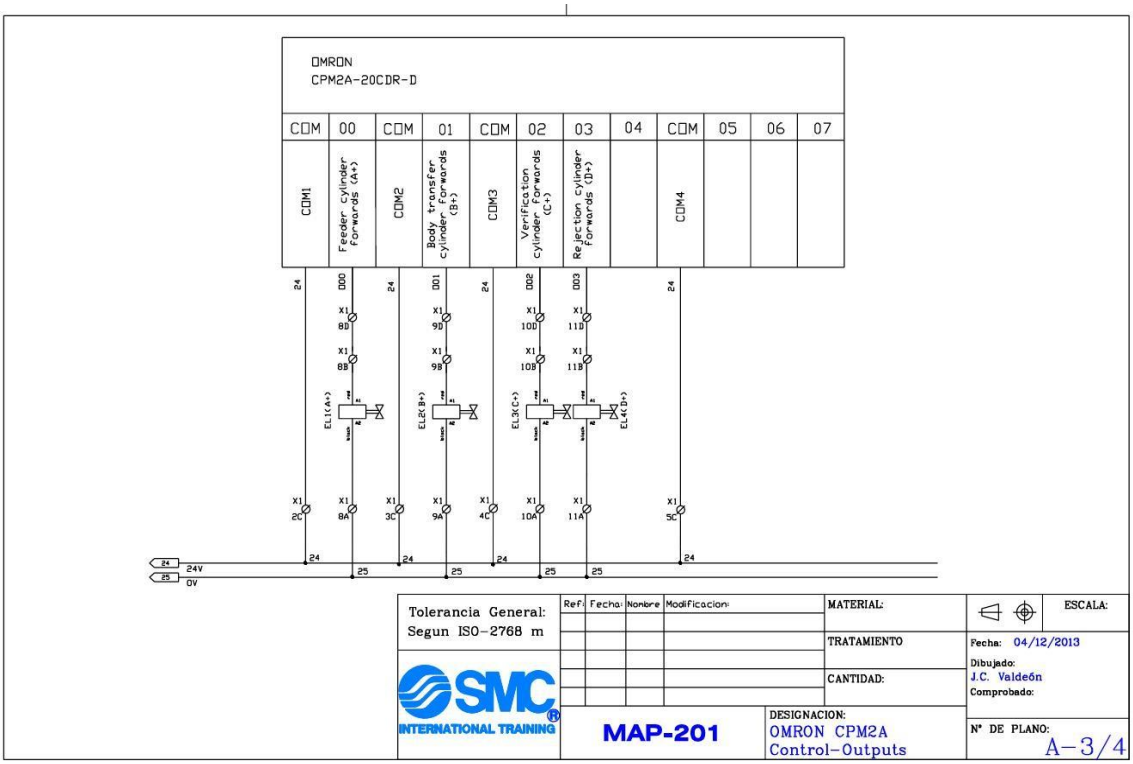
Variable Name	Devices Name	Address	Comment
Input			
StartButton	PushButton (NO)	0.00	PB (NO) To start a process
StopButton	PushButton (NC)	0.01	PB(NC) to stop a process
Auto/Manual Switch	Selector Switch	0.02	Used for switching between Auto and Manual mode.
a0	ReedSwitch	0.03	position or proximity sensor, likely for detecting the state of Cylinder A.
a1	ReedSwitch	0.04	Position or proximity sensor, likely for detecting the state of Cylinder A.
b1	ReedSwitch	0.05	Position or proximity sensor, likely for detecting the state of Cylinder B.
c1	ReedSwitch	0.06	Position or proximity sensor, likely for detecting the state of Cylinder C.
Sensor	Inductive Sensor	0.10	Detects metallic objects or machine components for automation processes.
Output			
Cylinder A+	Solenoid Valve	10.00	Activates Cylinder A to extend
Cylinder B+	Solenoid Valve	10.01	Activates Cylinder B to extend
Cylinder C+	Solenoid Valve	10.02	Activates Cylinder C to extend
Cylinder D+	Solenoid Valve	10.03	Activates Cylinder D to extend
Red	TowerLight	10.04	Indicate red light
Yellow	TowerLight	10.05	Indicate yellow light
Green	TowerLight	10.06	Indicate green light
Buzzer	Buzzer	10.07	Emits sound as an alert

3.1 MAP 202 (Cover positioning module) I/O Addressing Table

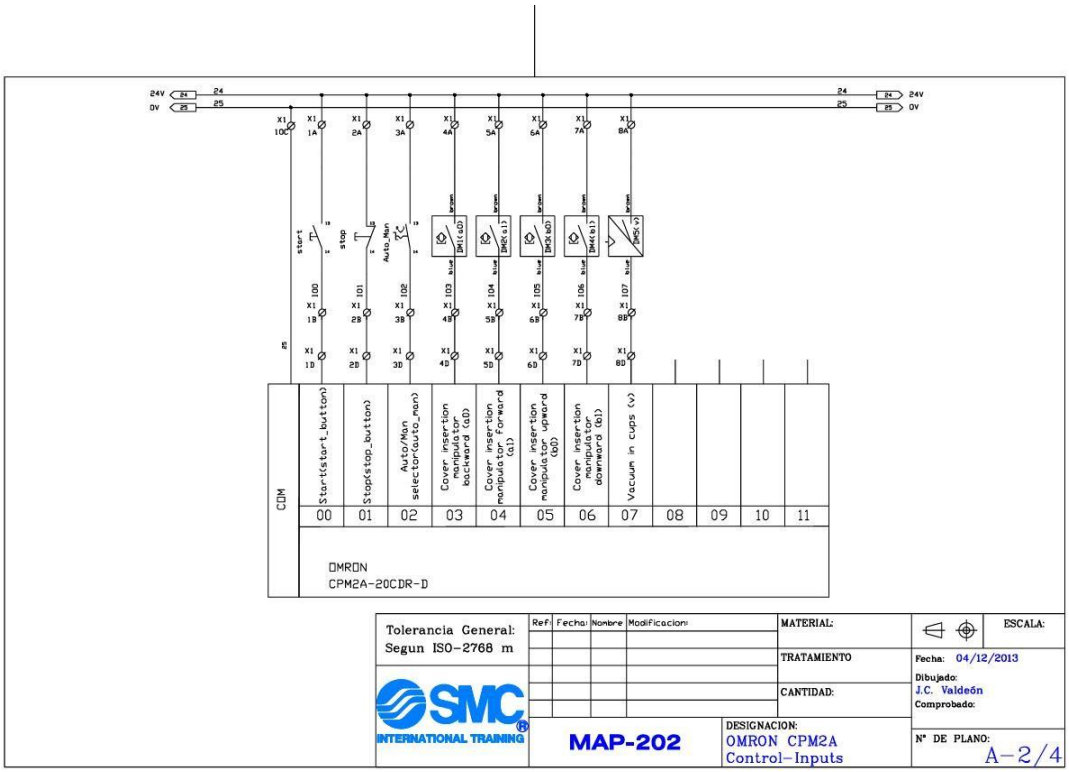
Variable Name	Devices Name	Address	Comment
Input			
Start Button	PushButton (NO)	0.00	PB (NO) To start a process
Stop Button	PushButton (NC)	0.01	PB(NC) to stop a process
Auto/ Manual Switch	Selector Switch	0.02	Used for switching between Auto and Manual mode.
a0	ReedSwitch	0.03	Position or proximity sensor, likely for Cylinder A's initial state.
a1	ReedSwitch	0.04	Position or proximity sensor, likely for Cylinder A's final state.
b0	ReedSwitch	0.05	Position or proximity sensor, likely for Cylinder B's initial state.
b1	ReedSwitch	0.06	Position or proximity sensor, likely for Cylinder B's final state.
v	Pressure Sensor	0.07	Detects pressure changes, possibly for vacuum or pneumatic systems.
Output			
A+	Solenoid Valve	10.00	Activates Cylinder A to extend
A-	Solenoid Valve	10.01	Activates Cylinder A to retract
B+	Solenoid Valve	10.02	Activates Cylinder B to extend
V+	Vaccum	10.03	Controls vacuum operation
Yellow	TowerLight	10.04	Indicate yellow light
Green	TowerLight	10.05	Indicate green light
Buzzer	Buzzer	10.06	Emits sound as an alert
Red	TowerLight	10.07	Indicate red light

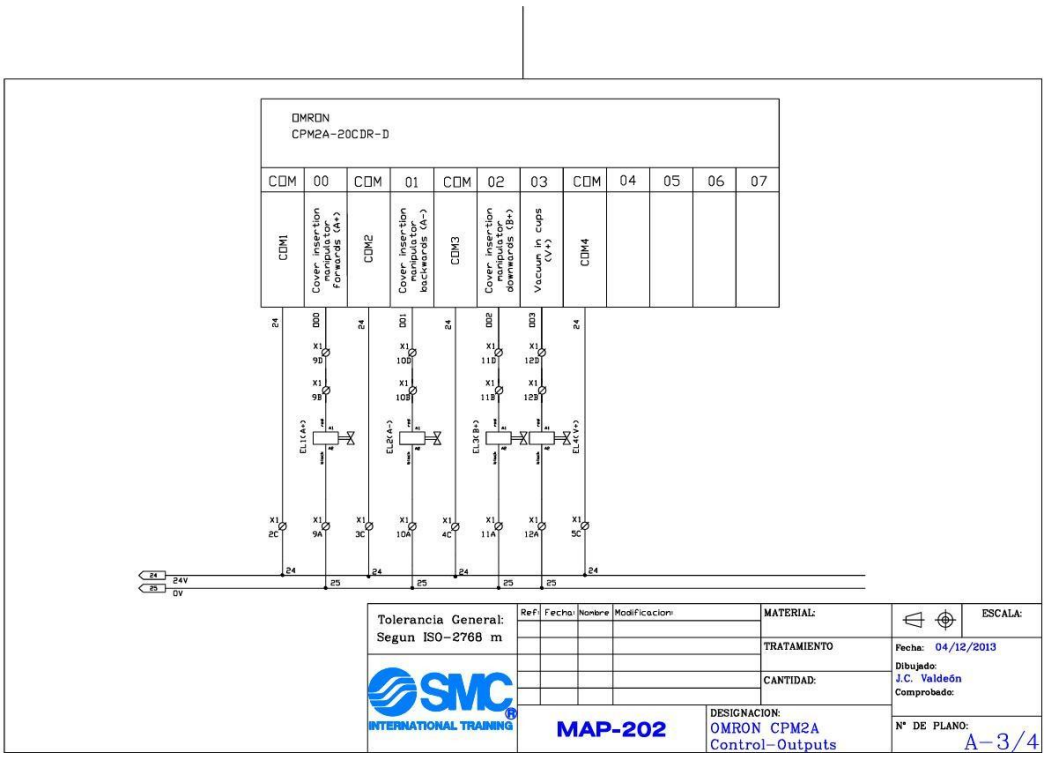
4.0 Electrical diagram for MAP201 system



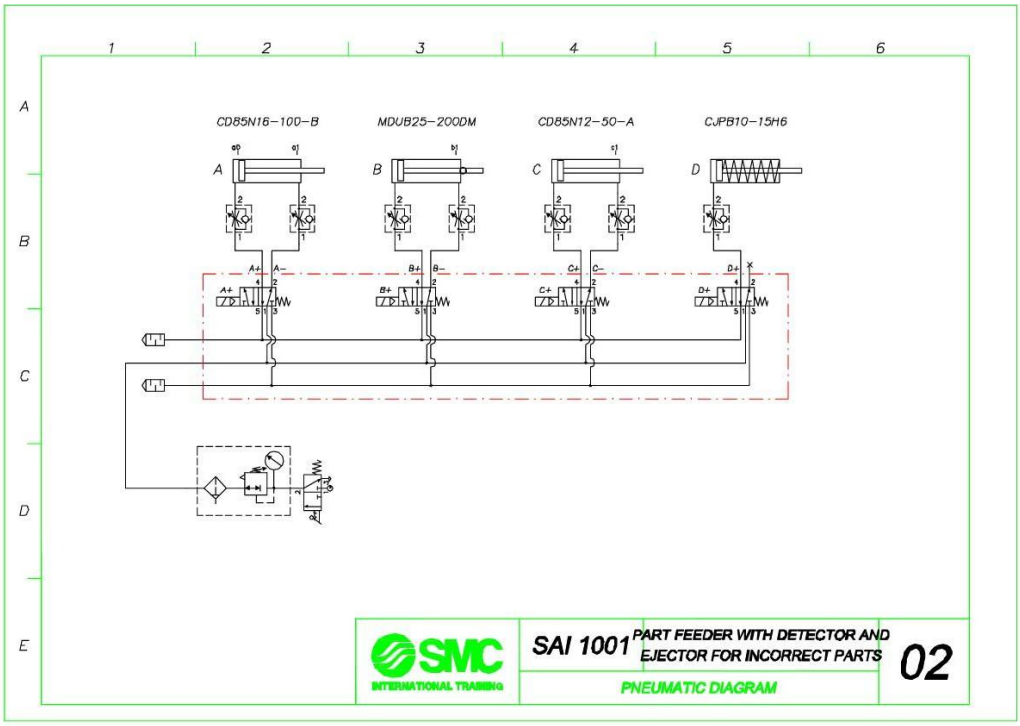


4.1 Electrical diagram for MAP202 system

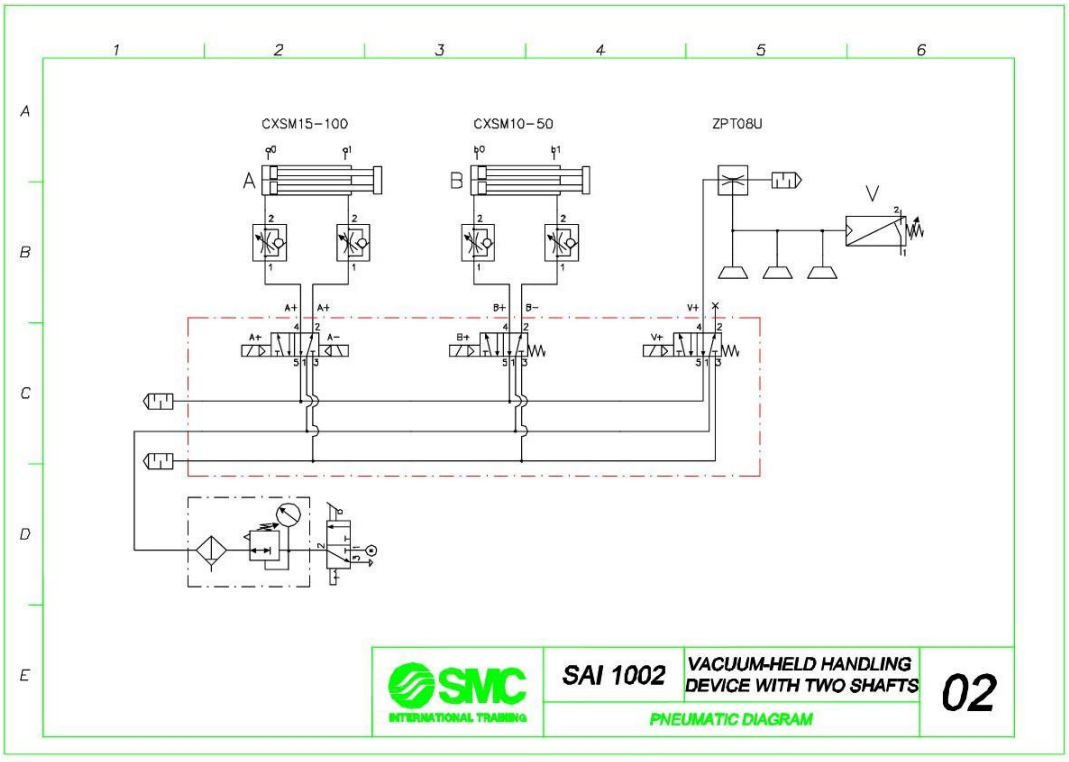




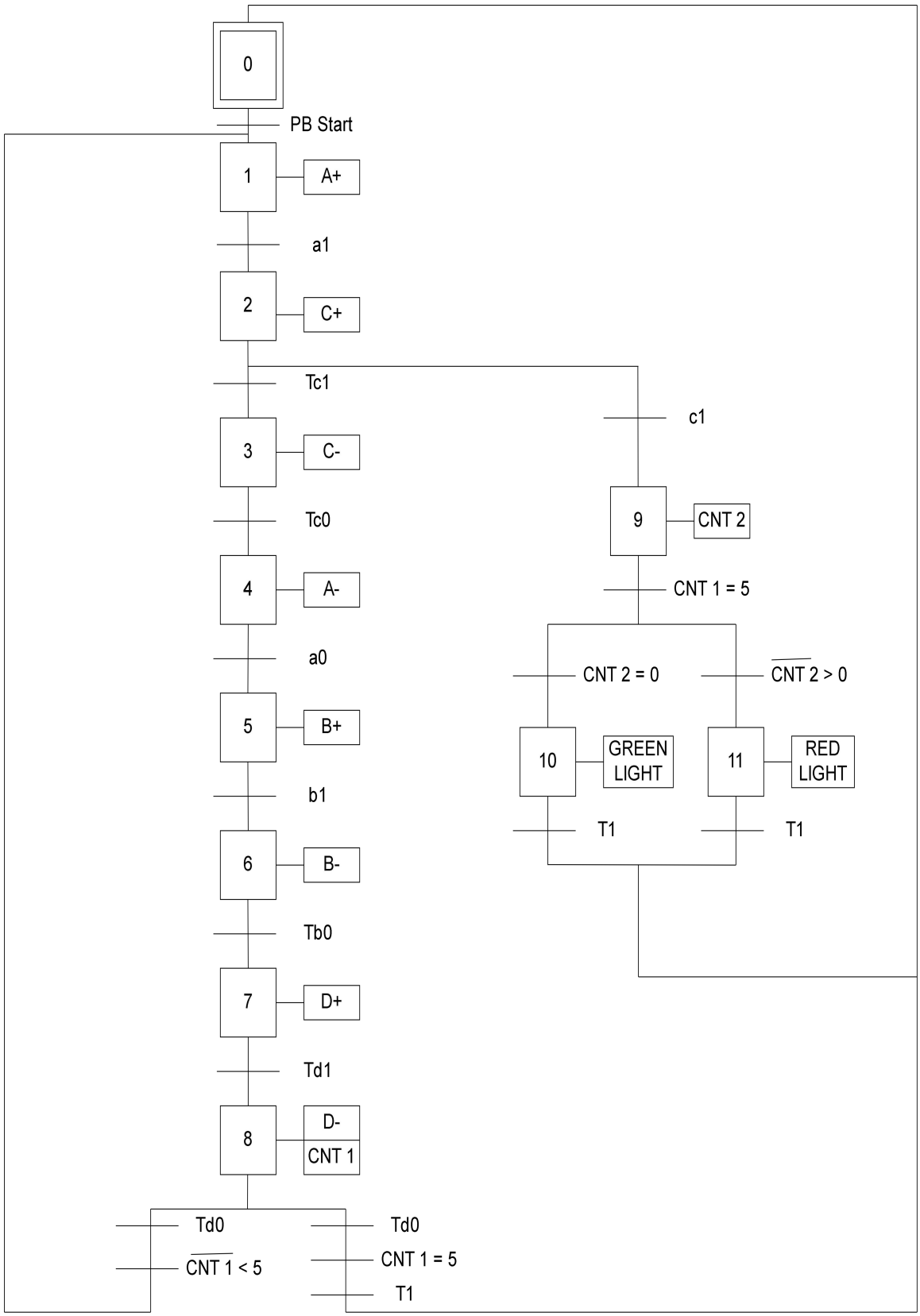
5.0 Electro-pneumatic diagram for MAP201 system



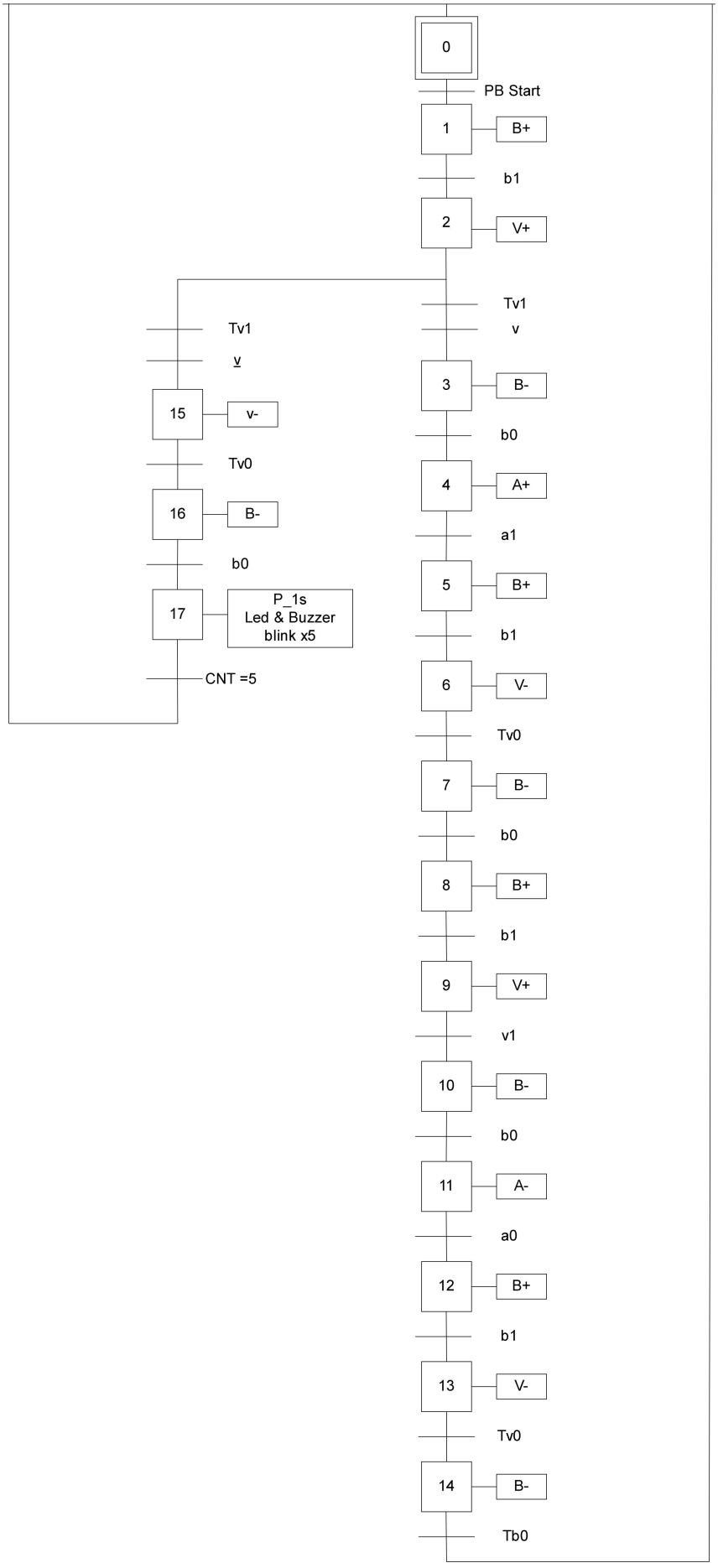
5.1 Electro-pneumatic diagram for MAP202 system



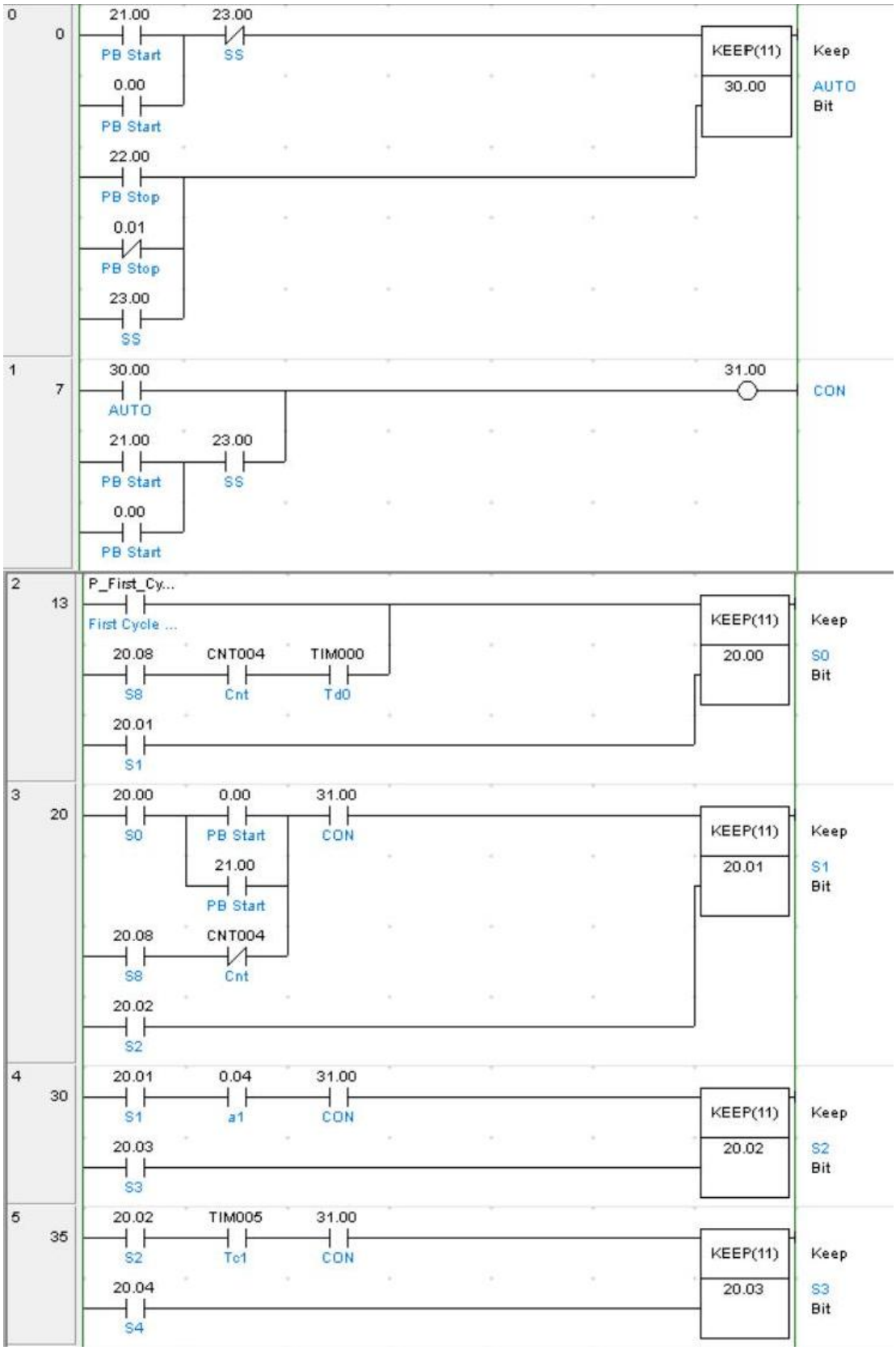
6.0 Grafcet MAP-201

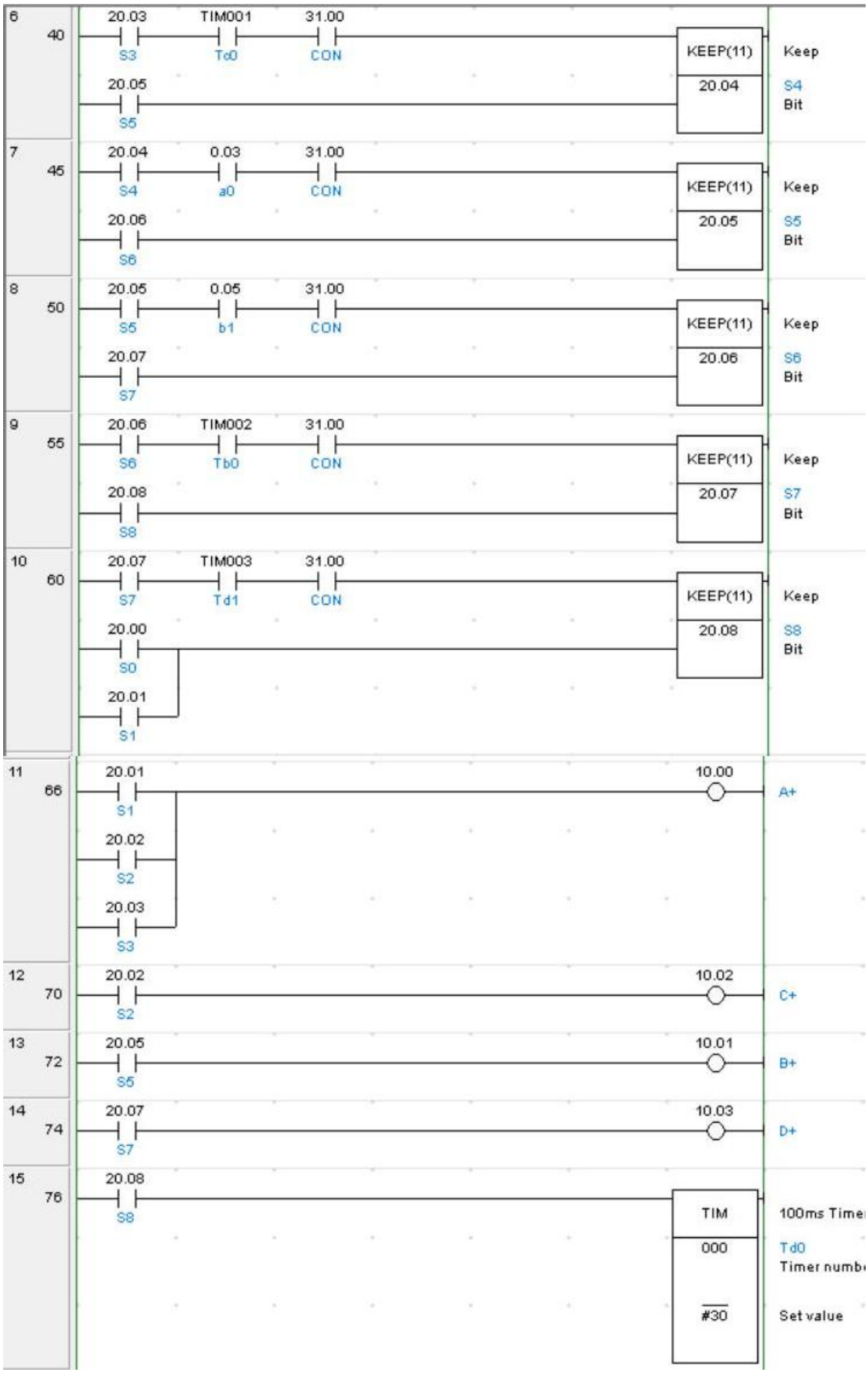


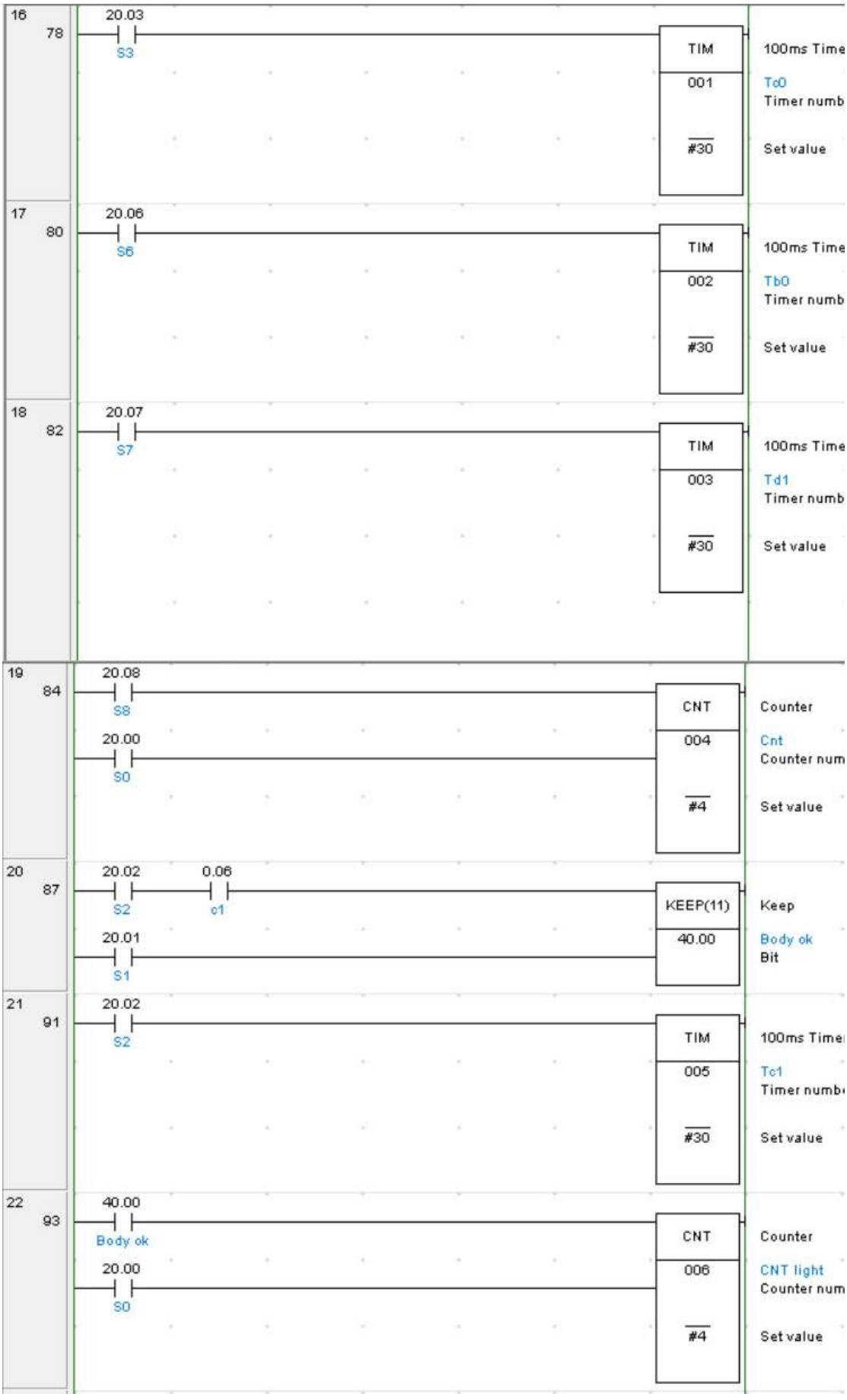
6.1 Grafcet MAP-202

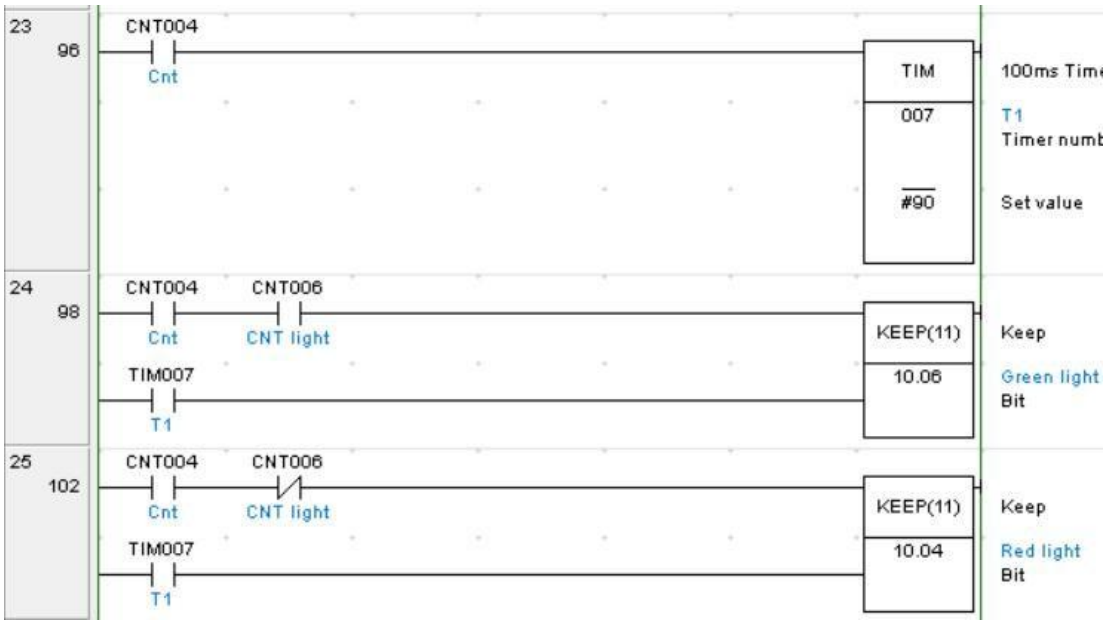


7.0 PLC programming language (LD/FBD or SFC) for MAP201 system

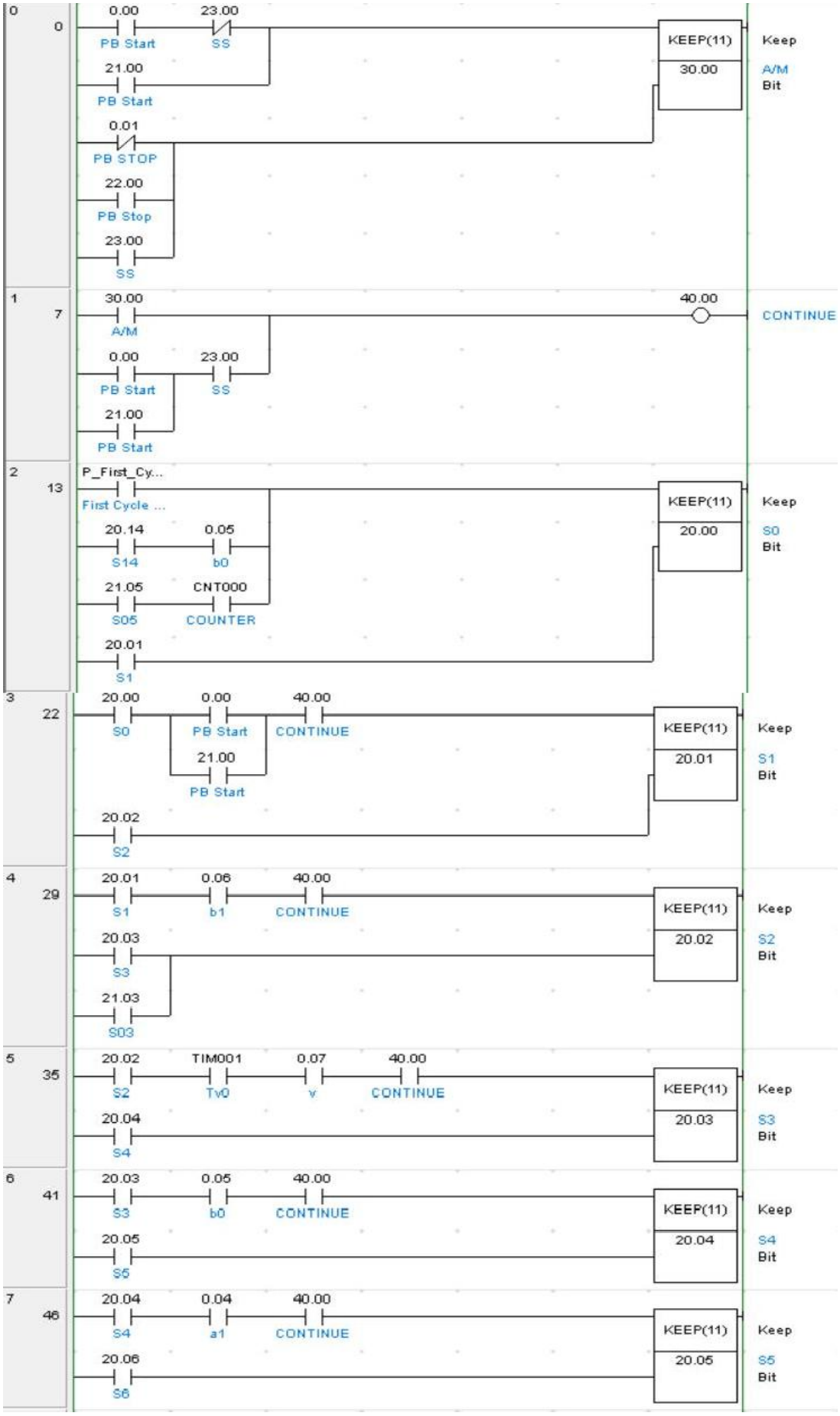


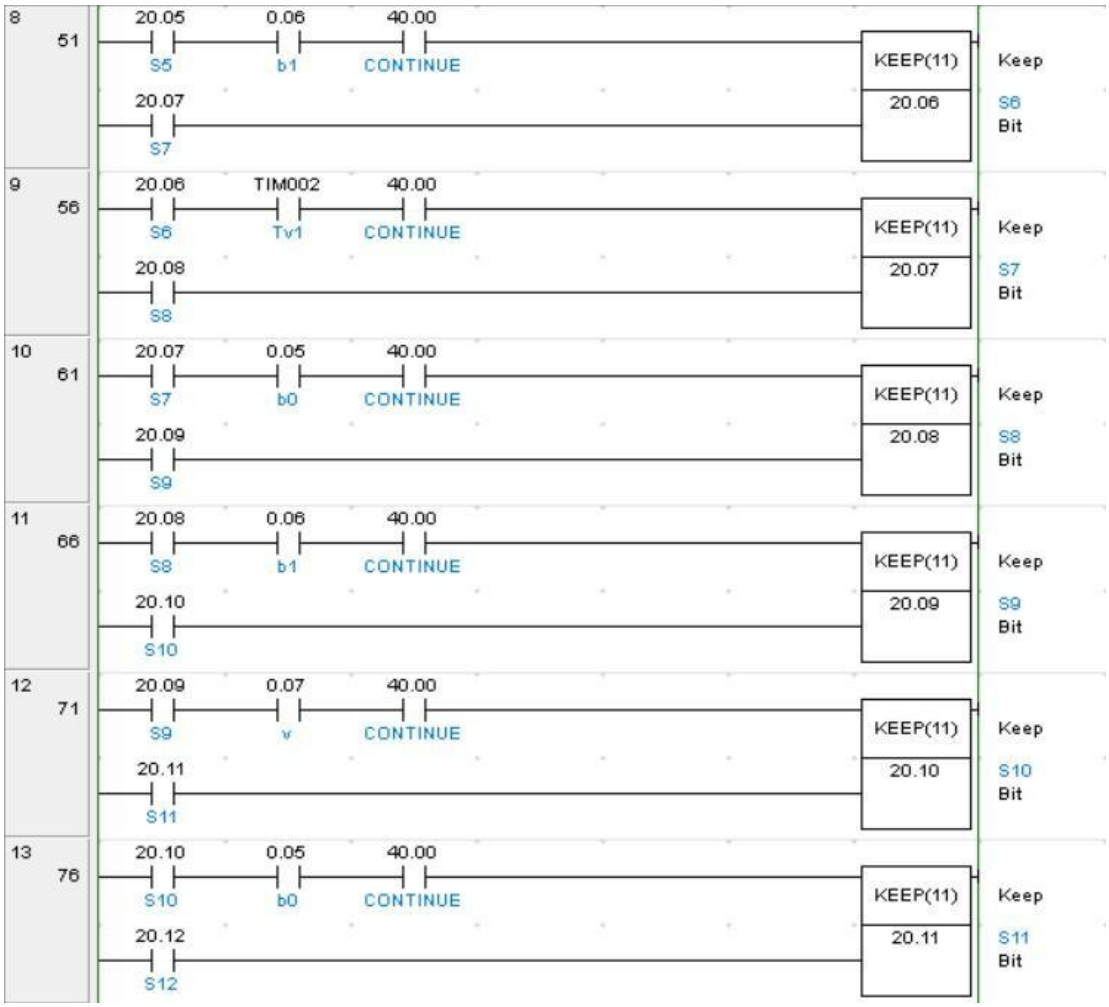

6
40
20.03
S3
TIM001
Td0
31.00
CON
KEEP(11)
20.04
Keep
S4
Bit
20.05
S5
7
45
20.04
S4
0.03
a0
31.00
CON
KEEP(11)
20.05
Keep
S5
Bit
20.06
S6
8
50
20.05
S5
0.05
b1
31.00
CON
KEEP(11)
20.06
Keep
S6
Bit
20.07
S7
9
55
20.06
S6
TIM002
Tb0
31.00
CON
KEEP(11)
20.07
Keep
S7
Bit
20.08
S8
10
60
20.07
S7
TIM003
Td1
31.00
CON
KEEP(11)
20.08
Keep
S8
Bit
20.00
S0
20.01
S1
11
66
20.01
S1
10.00
A+
20.02
S2
20.03
S3
12
70
20.02
S2
10.02
C+
13
72
20.05
S5
10.01
B+
14
74
20.07
S7
10.03
D+
15
76
20.08
S8
TIM
000
Td0
#30
Set value

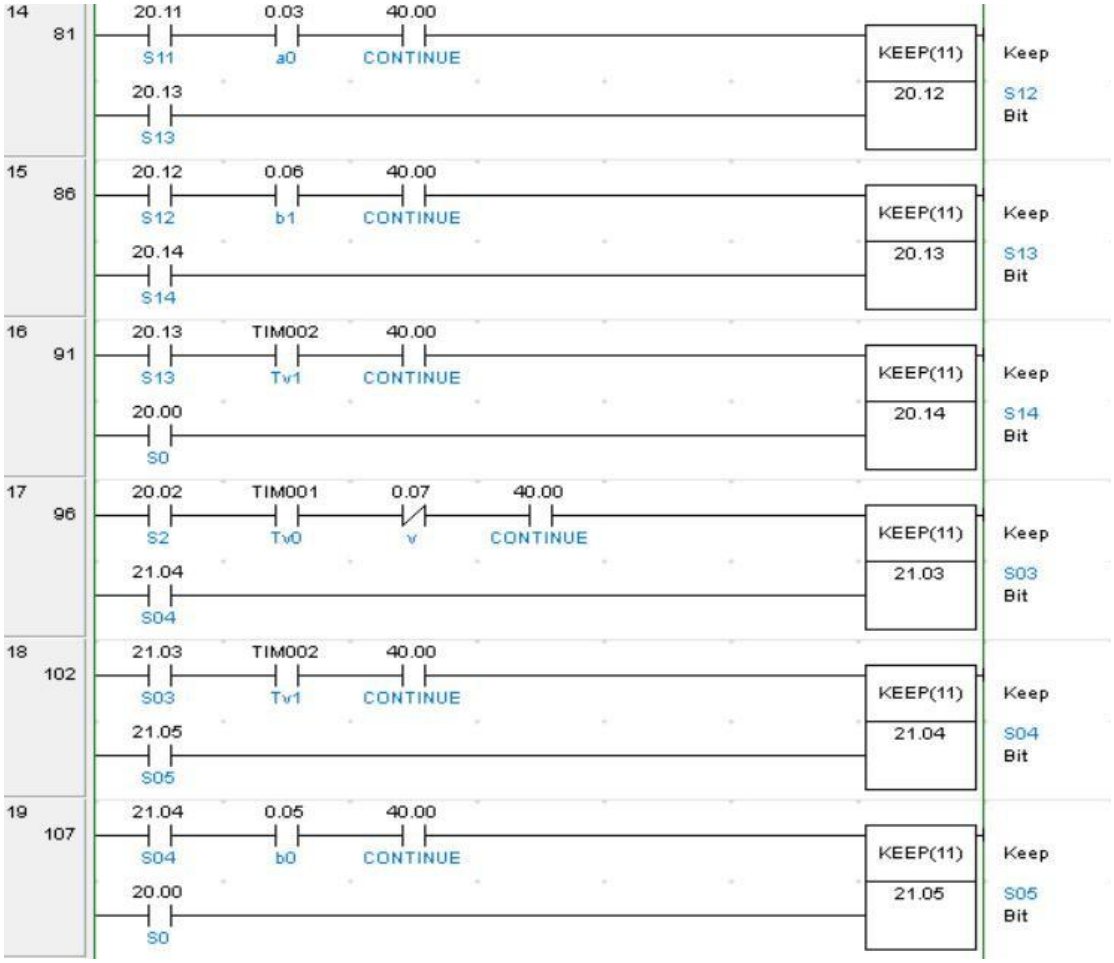

16
78
20.03
S3
TIM
001
#30
100ms Time
Tc0
Timer numb
Set value
17
80
20.06
S6
TIM
002
#30
100ms Time
Tb0
Timer numb
Set value
18
82
20.07
S7
TIM
003
#30
100ms Time
Td1
Timer numb
Set value
19
84
20.08
S8
20.00
S0
CNT
004
#4
Counter
Cnt
Counter num
Set value
20
87
20.02
S2
0.06
c1
20.01
S1
KEEP(11)
40.00
Keep
Body ok
Bit
21
91
20.02
S2
TIM
005
#30
100ms Time
Tc1
Timer numb
Set value
22
93
40.00
Body ok
20.00
S0
CNT
006
#4
Counter
CNT light
Counter num
Set value

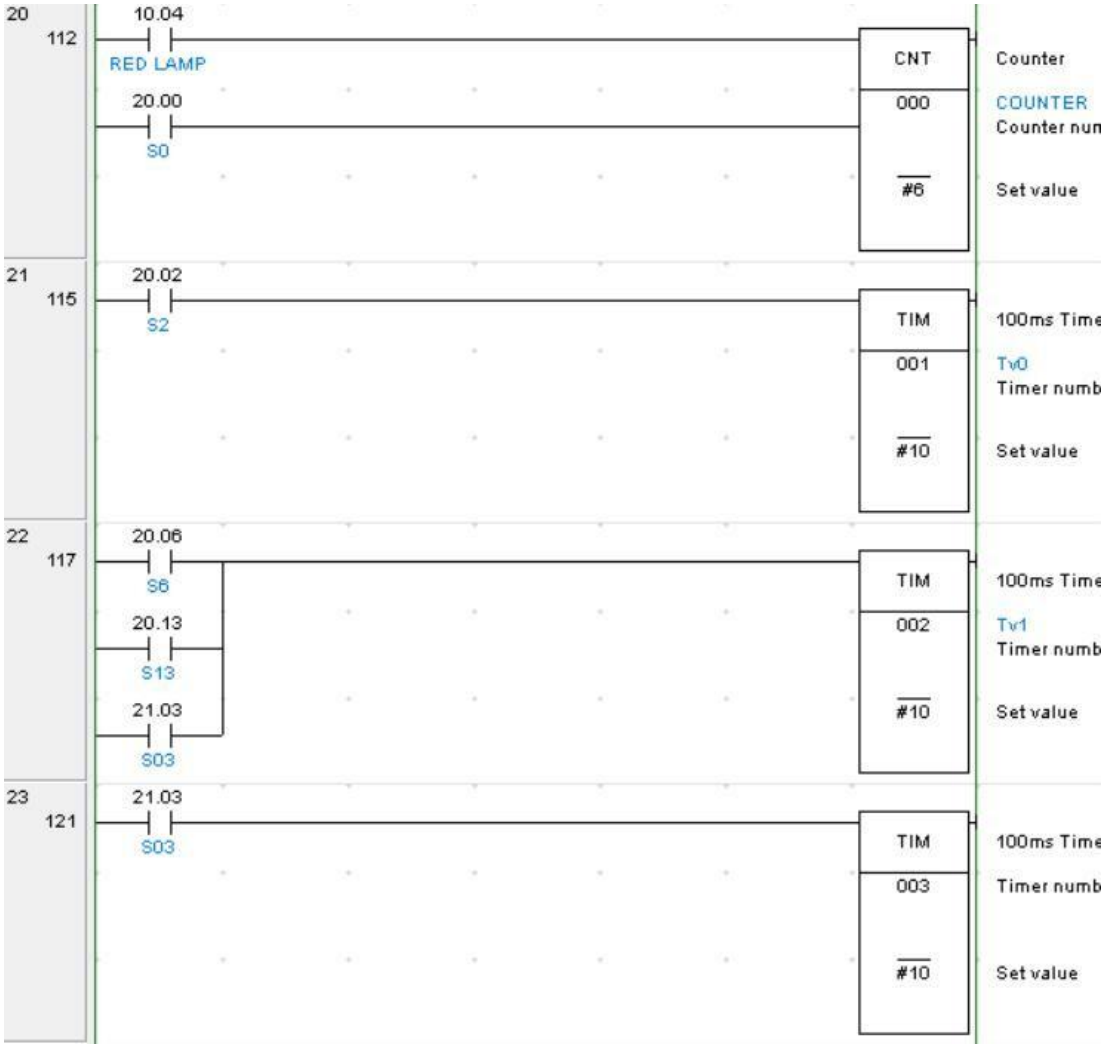

23
96
CNT004
Cnt
TIM
007
#90
100ms Tim
T1
Timer numb
Set value
24
98
CNT004
Cnt
CNT006
CNT light
TIM007
T1
KEEP(11)
10.06
Keep
Green light
Bit
25
102
CNT004
Cnt
CNT006
CNT light
TIM007
T1
KEEP(11)
10.04
Keep
Red light
Bit

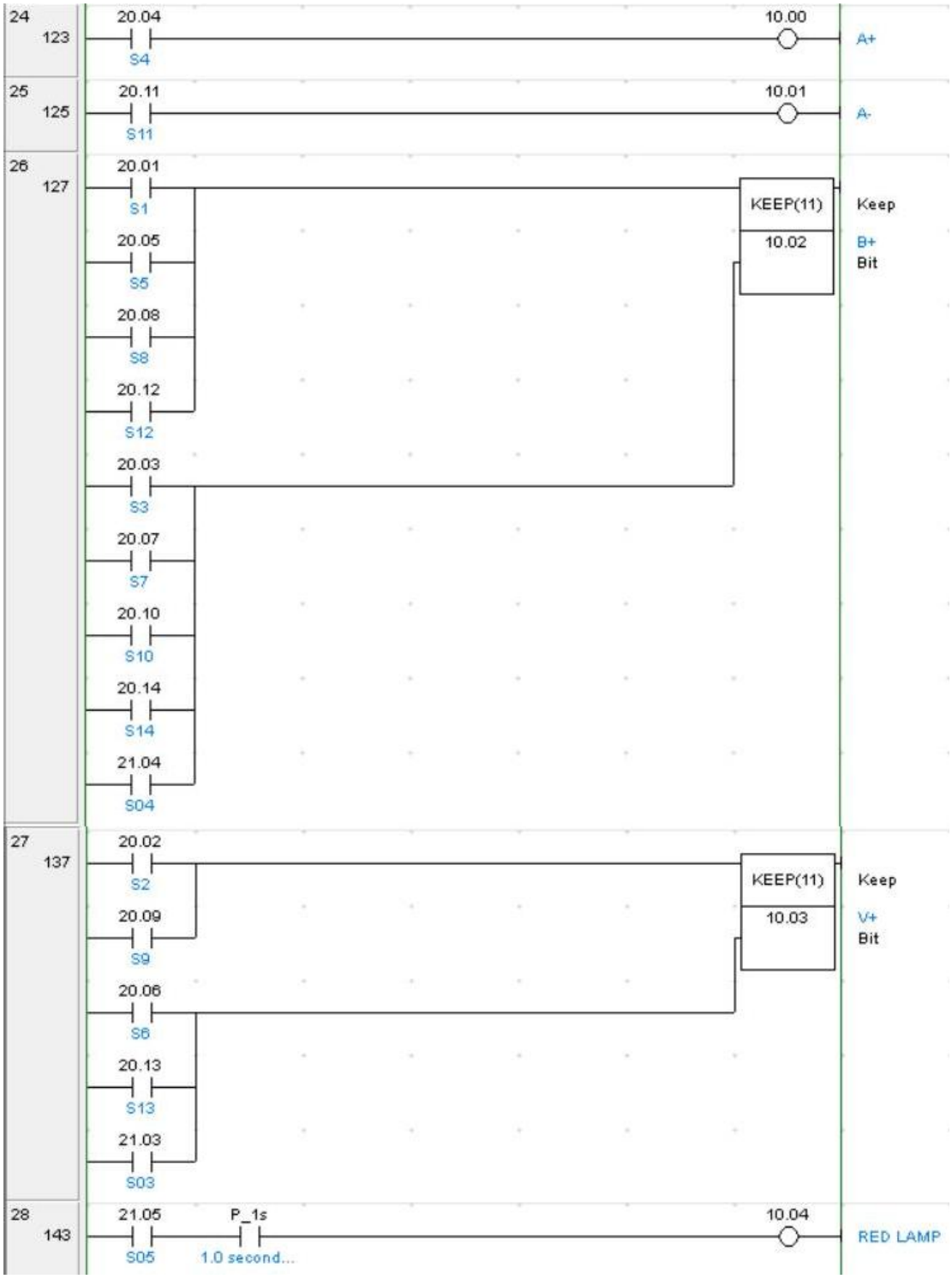
7.1 PLC programming language (LD/FBD or SFC) for MAP202 system




8
51
20.05
S5
0.06
b1
40.00
CONTINUE
20.07
S7
KEEP(11)
20.06
Keep
S6
Bit
9
56
20.06
S6
TIM002
Tv1
40.00
CONTINUE
20.08
S8
KEEP(11)
20.07
Keep
S7
Bit
10
61
20.07
S7
0.05
b0
40.00
CONTINUE
20.09
S9
KEEP(11)
20.08
Keep
S8
Bit
11
66
20.08
S8
0.06
b1
40.00
CONTINUE
20.10
S10
KEEP(11)
20.09
Keep
S9
Bit
12
71
20.09
S9
0.07
v
40.00
CONTINUE
20.11
S11
KEEP(11)
20.10
Keep
S10
Bit
13
76
20.10
S10
0.05
b0
40.00
CONTINUE
20.12
S12
KEEP(11)
20.11
Keep
S11
Bit


14
81
20.11
S11
0.03
a0
40.00
CONTINUE
KEEP(11)
20.12
Keep
S12
Bit
20.13
S13
15
86
20.12
S12
0.06
b1
40.00
CONTINUE
KEEP(11)
20.13
Keep
S13
Bit
20.14
S14
16
91
20.13
S13
TIM002
Tv1
40.00
CONTINUE
KEEP(11)
20.14
Keep
S14
Bit
20.00
S0
17
96
20.02
S2
TIM001
Tv0
0.07
v
40.00
CONTINUE
KEEP(11)
21.03
Keep
S03
Bit
21.04
S04
18
102
21.03
S03
TIM002
Tv1
40.00
CONTINUE
KEEP(11)
21.04
Keep
S04
Bit
21.05
S05
19
107
21.04
S04
0.05
b0
40.00
CONTINUE
KEEP(11)
21.05
Keep
S05
Bit
20.00
S0


20
112
10.04
RED LAMP
CNT
Counter
000
COUNTER
Counter nun
20.00
S0
#6
Set value
21
115
20.02
S2
TIM
100ms Time
001
Tv0
Timer numb
#10
Set value
22
117
20.06
S6
TIM
100ms Time
20.13
S13
002
Tv1
Timer numb
21.03
S03
#10
Set value
23
121
21.03
S03
TIM
100ms Time
003
Timer numb
#10
Set value

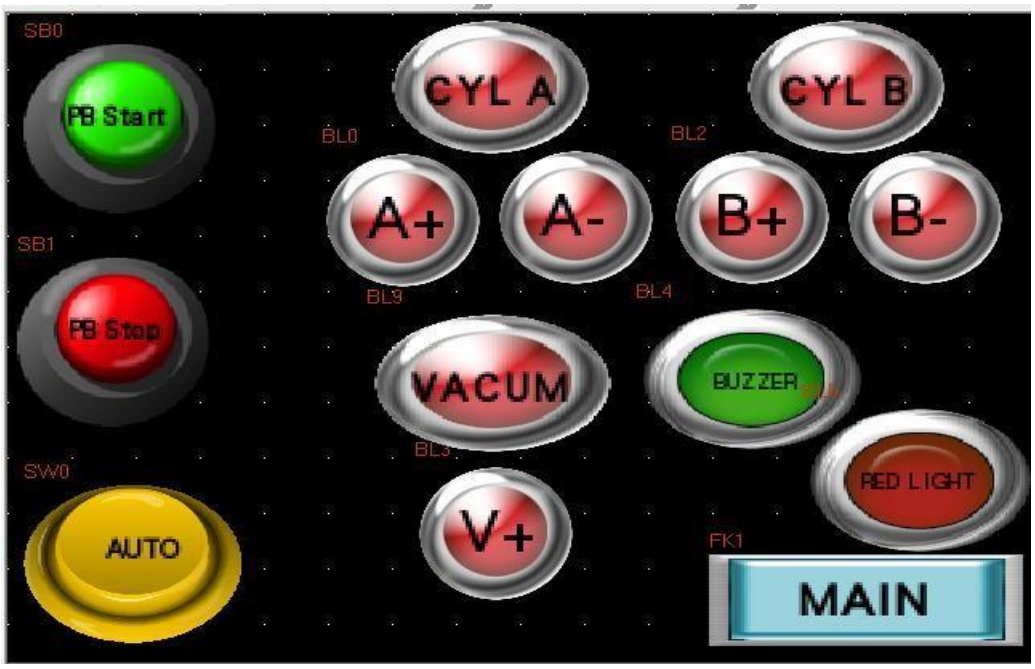

24
123
20.04
S4
10.00
A+
25
125
20.11
S11
10.01
A-
26
127
20.01
S1
20.05
S5
20.08
S8
20.12
S12
20.03
S3
20.07
S7
20.10
S10
20.14
S14
21.04
S04
KEEP(11)
10.02
Keep
B+
Bit
27
137
20.02
S2
20.09
S9
20.06
S6
20.13
S13
21.03
S03
KEEP(11)
10.03
Keep
V+
Bit
28
143
21.05
S05
P_1s
1.0 second...
10.04
RED LAMP

8.0 HMI CONTROL DESIGN

MAIN channel

MAP - 201

MAP - 202



9.0 Discussion

The implementation of the MAP 201 and MAP 202 systems in a Flexible Manufacturing System demonstrates the effectiveness of automation in optimizing material handling and allocation processes.

The MAP 201 system focuses on precision in material positioning and verification using gravity feeding and pneumatic cylinders. Its sequence operations ensure that materials are oriented correctly and moved efficiently to their intended positions. This reduces errors during production and enhances reliability.

The MAP 202 system incorporates a Cartesian handling mechanism that uses vacuum pads for secure material movement. This approach minimizes material damage while improving handling accuracy. The inclusion of dual shafts in the design adds flexibility, enabling the system to adapt to various production requirements.

10.0 Conclusion

The design and implementation of the MAP 201 and MAP 202 systems highlight the importance of automation in modern manufacturing. By leveraging PLCs, pneumatic systems, and advanced handling mechanisms, these systems optimize material allocation and movement within a Flexible Manufacturing System.