

TEST PROJECT – DAY 2
PROJET D'ÉPREUVE – JOUR 2

AUTOMATION AND CONTROL CONTRÔLE ET AUTOMATISATION

POST-SECONDARY
NIVEAU POSTSECONDAIRE

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1.0 Process description

1.1 – General description

The first part of the manufacturing process of particle board is the receiving of raw materials. Trucks loaded with wood chips and shavings deliver the product and unload via a truck dump where the material is separated by product type.

A main conveyor runs inside a large storage building to a diverter valve. The diverter valve diverts the material to either one conveyor for Zones A and B, or the other conveyor for Zones C and D.

1 of 4 zones must be selected to send the material to their respective pile. For example, hardwood chips would go to Zone A, spruce shavings would go to Zone B, cedar shavings would go to Zone C and pine chips would go to Zone D.

Once selected, the conveyor that corresponds to the zone selected would start, the diverter would need to be in the proper direction, and then the main conveyor would start. Material would run up the main conveyor, drop into the diverter valve onto the next conveyor, then dropping onto the floor in the storage building.

This process would continue to run until no more material is on the conveyor.

2.0 – Manual Mode

2.1 –Manual Sequence Description

When selecting between the Manual and Automatic modes, none of the last state/selection/values will be maintained.

When the Automatic/Manual selector switch is set to Manual Mode (SS1_1):

- L3 will be flashing to indicate a Manual Mode selection.
- Manual step (MAN_STEP) will be initially set to 0

A Jog Cycle Select pushbutton (PB4) is to be programmed to advance through the steps each time the button is pushed. (Example: press PB4 once for Step 1, push it again for Step 2, etc.)

This cycle repeats for all six selectable items in the process.

If PB4 is pressed when in cycle step 6, the cycle resets to step 0.

A different lamp will flash for each step in the Manual cycle. Each step will enable the operator to jog a different part of the process using the Start/Jog button (PB3). (See table below)

For example:

The first time manual is selected

- L3 will flash to indicate Manual Mode and the Manual Step (MAN_STEP) will be 0.

Press the Jog Cycle Select button PB4,

- Manual Step advances to Step 1, L4 will flash at 0.5 Hz (on 1 second, off 1 second).

Press PB4 again,

- Manual Step advances to Step 2, L4 will flash at 1 Hz (on 0.5 seconds, off 0.5 seconds)

Step	Lamp/Flash Freq	Action when Start/Jog pushed
Step 0	N/A	N/A
Step 1	L4 Flashes 0.5 Hz	Conveyor A-B runs FWD
Step 2	L4 Flashes 1 Hz	Conveyor A-B runs REV
Step 3	L5 Flashes 0.5 Hz	Conveyor C-D runs FWD
Step 4	L5 Flashes 1 Hz	Conveyor C-D runs REV
Step 5	L6 Flashes 0.5 Hz	Main Conveyor runs 30 Hz
Step 6	L6 Flashes 1 Hz	Diverter Switches

Table 1- Manual Step (MAN_STEP) Cycle Sequence

3.0 – Automatic Mode

3.1 – Automatic Mode Description

When the Auto/Manual switch is set to Automatic Mode (SS1_2):

- Amber tower light (L3) will be on steady
- Green tower light (L2) will be on indicating that the process is ready to start

When the Ready light is on, the zone is selected prior to pressing the Start/Jog button (PB3)

SS2_1 (In6)	SS3_1 (In7)	Zone
0	0	A
1	0	B
0	1	C
1	1	D

Table 2 - Zone Selection

Zone A Selected

When the Start/Jog (PB3) button is pushed:

- L2 will shut off (Process Is Ready)
- Conveyor A-B will run in the FWD direction. There must be feedback to the PLC from the Aux. contacts within 1 second or the process goes into a fault condition.

Diverter Solenoid (L7) must be on to divert material to Conveyor A-B.

- LS1 is made (diverter is toward Conveyor A-B)

Once the diverter is in position, the main conveyor starts and runs at 60 Hz.

- L6 will be on indicating the process is running

The proximity switch (PS1) looks for chips on the conveyor belt

- If proximity switch detects chips within 10 seconds, the process continues to run

Zone B Selected

When the Start/Jog (PB3) button is pushed:

- L2 will shut off
- Conveyor A-B will run in the REV direction. There must be feedback to the PLC from the Aux. contacts within 1 second or the process goes into a fault condition.

Diverter Solenoid (L7) must be on to divert material to Conveyor A-B.

- LS1 is made (diverter is toward Conveyor A-B)

Once the diverter is in position, the main conveyor starts and runs at 60 Hz.

- L6 will be on indicating the process is running

The proximity switch (PS1) looks for chips on the conveyor belt

- If proximity switch detects chips within 10 seconds, the process continues to run

Stop Sequence Zones A&B

If proximity switch does not detect chips for 10 seconds

- Conveyors stop, process returns to Ready state

If stop button is pushed

- Conveyors stop, process returns to Ready state

Zone C Selected

When the Start/Jog (PB3) button is pushed:

- L2 will shut off
- Conveyor C-D will run in the FWD direction. There must be feedback to the PLC from the Aux. contacts within 1 second or the process goes into a fault condition.

Diverter Solenoid (L8) must be on to divert material to Conveyor C-D.

- LS2 is made (diverter is toward Conveyor C-D)

Once the diverter is in position, the main conveyor starts and runs at 60 Hz.

- L6 will be on indicating the process is running

The proximity switch (PS1) looks for chips on the conveyor belt

- If proximity switch detects chips within 10 seconds, the process continues to run

Zone D Selected

When the Start/Jog (PB3) button is pushed:

- L2 will shut off
- Conveyor C-D will run in the REV direction. There must be feedback to the PLC from the Aux. contacts within 1 second or the process goes into a fault condition.

Diverter Solenoid (L8) must be on to divert material to Conveyor C-D.

- LS2 is made (diverter is toward Conveyor C-D)

Once the diverter is in position, the main conveyor starts and runs at 60 Hz.

- L6 will be on indicating the process is running

The proximity switch (PS1) looks for chips on the conveyor belt

If proximity switch detects chips within 10 seconds, the process continues to run

Stop Sequence Zones C&D

If proximity switch does not detect chips for 10 seconds

- Conveyors stop, process returns to Ready state

If stop button is pushed

- Conveyors stop, process returns to Ready state

4.0 – Inputs and Outputs

4.1 – Input Table

Input Detail	Symbol	Contact Type	PLC inputs Assignment	Information supplied at state (1)
Emergency Stop	PB1	NC	In0	E-stop not pressed
Stop	PB2	NC	In1	Stop button not pressed
Start/Jog (Manual)	PB3	NO	In2	Button pressed, start process
Jog Cycle Select	PB4	NO	In3	Button pressed, cycle jog control
Manual Mode	SS1_1	NO	In4	Manual mode selected
Automatic Mode	SS1_2	NO	In5	Auto mode selected
Zone selection switch 1 (LSB)	SS2_1	NO	In6	Zone B or D selected
Zone selection switch 2 (MSB)	SS3_1	NO	In7	Zone C or D selected
Limit A (Diverter Position)	LS1	NO	In8	Diverter toward Conveyor A-B
Limit B (Diverter Position)	LS2	NO	In9	Diverter toward Conveyor C-D
Proximity Sensor (Material Present)	PS1	NO	In10	Chips present
K1 Overload	MC1	NO	In11	Conveyor A-B running
K2 Overload	MC2	NO	In12	Conveyor C-D running

4.2 – Output Table

Output Detail	Symbol	PLC outputs Assignments	Action at state (1)	
			Auto	Manual
Tower Lamp Red	L1	Q0	Flashing = fault condition	Off
Tower Lamp Green	L2	Q1	Solid = process is ready	Off
Tower Lamp Amber	L3	Q2	Solid = Auto Mode Selected	Flashing = Manual Mode Selected
Indicating Lamp White	L4	Q3	Conveyor A-B or Conveyor C-D running (Auto)	See Table 1
Indicating Lamp Blue	L5	Q4	Main Conveyor running (Auto)	See Table 1
Indicating Lamp Green	L6	Q5	Chips present (Auto)	See Table 1
Indicating Lamp Amber	L7	Q6	Send Diverter toward Conveyor A-B	
Indicating Lamp Amber	L8	Q7	Send Diverter toward Conveyor C-D	
Motor Contactor M1 Fwd (Conveyor AB)	K1_F	Q8	Conveyor A-B is running toward Zone A	
Motor Contactor M1 Rev (Conveyor AB)	K1_R	Q9	Conveyor A-B is running toward Zone B	
Motor Contactor M2 Fwd (Conveyor CD)	K2_F	Q10	Conveyor C-D is running toward Zone C	
Motor Contactor M2 Rev (Conveyor CD)	K2_R	Q11	Conveyor C-D is running toward Zone D	
VFD Digital Input 02	VFD In 02		VFD Run Command	
VFD Digital Input 05	VFD In 05	Q13	VFD Preset Speed 60 Hz	Off
VFD Digital Input 06	VFD In 06	Q14	Off	VFD Preset Speed 30 Hz