Design a Machine for Olive-Wood Residual Comprising for Heat Purposes

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Abstract

In order to reduce the dependency on traditional heating methods having electricity or diesel power as primary source, the idea of building a project based on the reprocessing of olive and wood waste in the production of the thermal energy that will be used in home heating and water heating has emerged.

This project aims to design a firewood machine to produce firewood As a source of thermal energy from the olive peat (Jeft), which available and costless in Palestine. In addition, sawdust and peat will be used in specific proportions to speed up the ignition process, and reduce the amount of fumes generated at the beginning of the combustion process. . The proposed design consists of mechanical, electrical system, and HMI control. Furthermore, it can be scaled up for large production purposes.

الملخص

يعتمد بشكل رئيسي على الكهرباء والديزل في فلسطين في مختلف مجالات الحياة، بما في ذلك جانب التدفئة مع العديد من المشاكل التي تواجه الكهرباء وقطاع النفط، مما أدى إلى عدم الوصول إلى الطاقة المطلوبة .ومع وجود العديد من بقايا العمليات الصناعية والإنتاجية التي يمكن استخدامها للتعويض عن نقص الطاقة أو لتكون مصدرا بديلا، فأصبح هناك ميل لتوفير مصادر الطاقة من هذه المخلفات .يهدف هذا المشروع إلى تصميم ماكينة حطب لإنتاج الحطب ليكون مصدرًا للطاقة الحرارية من جفت الزيتون الذي يحتوي . بالإضافة إلى نشارة الخشب الناتجة من العمليات الصناعية الخشبية والزيوت المتبقية من العمليات الصناعية؛ لإنتاج الحطب مع طاقة أعلى، والمزيد من وقت الاشتعال وسعر أقل.

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Chapter One
Introduction

1.1 Introduction

As well known, Palestine depends on electricity in various areas of life, including heating, but the amount of electricity consumed by the citizen is much lower than the amount consumed by the Israeli, where the electricity available to the Palestinian citizen does not exceed 15% of what is available to the Israeli [1]، which prompted the Palestinian community to resort to nature and its sources.

Wood is the second most important source of heating in Palestine according to the Palestinian Central Bureau of Statistics [2]. Where statistics indicate that the proportion of dependence on wood in heating amounted to 29%, which came second after electricity, which amounted to39% and the proportion is still increasing.

Because of the cost of wood in heating, where the price of tons of wood from 800-1500 NIS, there has been a trend to produce alternative firewood produced from olive peat (olive cake) instead of disposing of it without exploitation

1.2 Problem definition

The Palestinian citizen faces difficulties in getting proper heating in the winter due to the problems faced by electricity in Palestine and the lack of natural resources for wood and the increasing demand for it.

1.3 Motivation

Due to the problems faced by the individual in heating it was necessary to find an alternative source of natural wood, which has more thermal energy, more ignition time and less price. By exploiting residues of some materials, which the community facing problem in disposal from it.

1.4 Project Objectives

This project will achieve the following objectives:

1) Design a fully controlled machine that mix wood-olive waste together and convert it to pieces that useful for heat and warming applications.
2) Introducing new state of the art technologies to realize Human machine interface such HMI
3) Applying our knowledge and years of studying industrial automation.

1.5 Method

This project is based on the design a machine that produces firewood consisting of a mixture of materials with low cost and good heating capabilities, and these materials are:

1) Peat (JEFT)

Peat is the solid waste produced by the olive sorting process as shown in Figure 1.1

Figure 1. 1 "peat "

According to statistics, the results of the olive sorting process are oil by 16%, peat by 40% and liquid waste as in the following figure 1.2

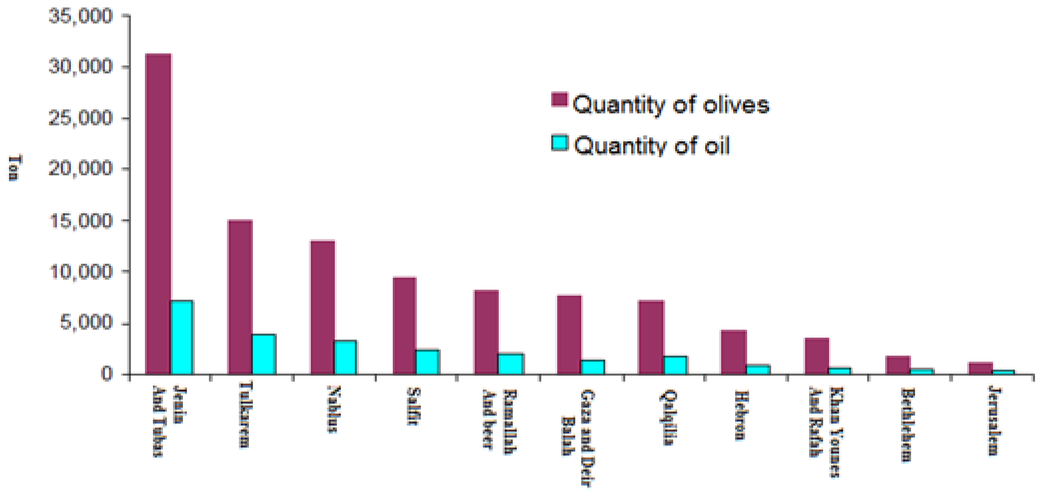


Figure 1. 2 Percentage of oil and peat produced in Palestine

Figure 1.3 shown the percentage of peat as a source of energy besides other sources like Diesel, electricity and solar energy.

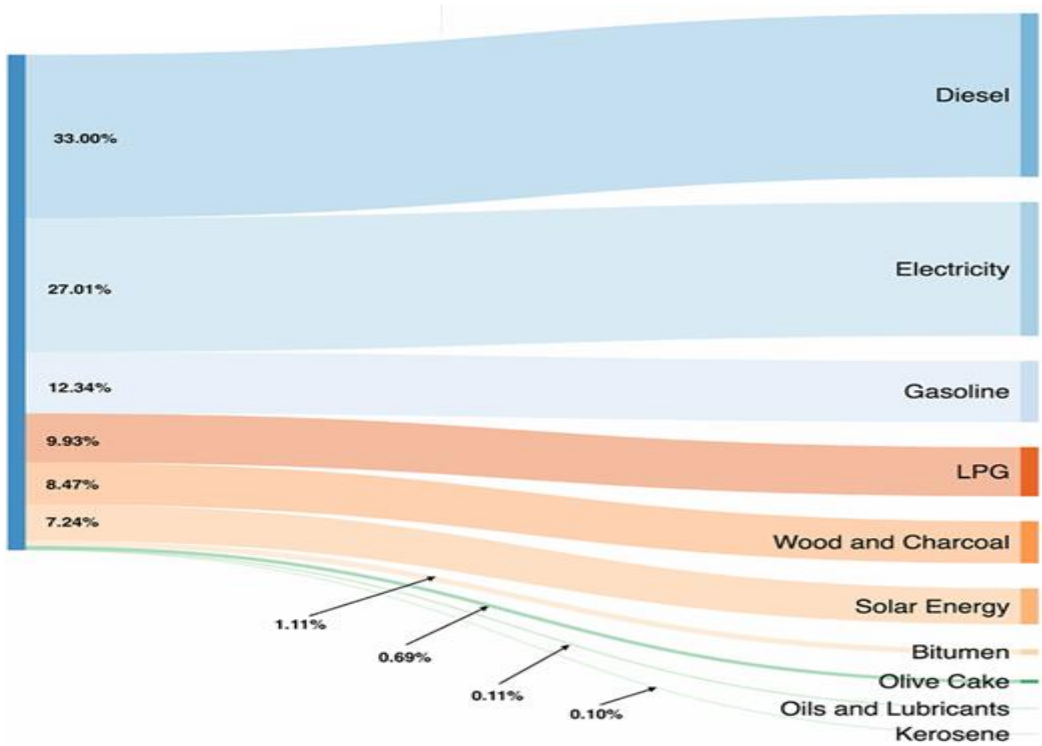


Figure 1. 3 Energy balance in Palestine

Peat will be the main ingredient in the mixture and the highest ratio; to give the produced product high thermal energy and more ignition time.

2) Wood dust (Sawdust) :

Sawdust or wood dust is a waste product of woodworking operations such

as sawing, milling, planning, routing, drilling and sanding. It is composed of fine particles of wood as shown in Figure 1.4.

Figure 1. 4 Sawdust

The average rate of sawdust burning is 0.00252kg / min . The efficiency of the sawdust stove is 34.6%and the efficiency of the kerosene stove is 32.1%. In addition sawdust cheaper and readily available [3].

Sawdust will be added to the mixture in order to reduce the humidity in the mixture and accelerate the ignition process.

1.6 Expected results

It is expected to produce a machine for the production of firewood made from the residues of Peat and Sawdust for production heating unit with lower cost, good heating capability and fast ignition.

1.7 Literature review

There are many industrial and production processes that result in a lot of residues, which have been studies and experiments to use them in a useful way.

El-Bashiti, Mansour in 2017 improving the methods of production of bioethanol from the peat, where 10 grams of peat was added to a solution of acids. The result is that: one liter of the solution produces 9.3 grams of bioethanol, which is used as a source of alternative energy sources, especially in automotive fuel [4].

Regel, Waelkens in 2011discusses the possibility of producing biogas from olive residues. Where they made several attempts through specialized fermentation processes. The result was that they produced 720 liters of biogas per kg of dry organic matter from the peat (solid olive residues), which is more than the amount of gas that can be produced from corn fermentation. In addition to producing 3600 kWhper ton [5].

Abu Hamed, Alsharein 2015, a study entitled "The potential of using olive cake in Palestinian territories "[6], is made to examine the possibility of producing energy from the olive cake in the West Bank and the Gaza Strip. The study concluded that peat contains a high amount of energy that can reach up to 18 MJ / kg. This means that approximately 28,000 tons of peat is capable of producing about 1.3% of the total energy consumed in 2009 in the West Bank and the Gaza Strip. This means that the peat can produce enough electricity to cover the needs of about 60,000 Palestinians, or need a city like Jericho.

Akgun, Doymaz in 2005,, a study entitled "Modelling of olive cake thin-layer drying process"[7] focused on drying and modelling of olive cake over a wide temperature range by using mathematical models. In addition, the activation energy were calculated, where the energy accounts indicated that the amount of energy produced is 17.97 kJ/mol.

And away from theoretical research, in the city of Gian in Andalusia, south of Spain, there is an energy plant mainly operated by olive peat, where 100,000 tons of peat are processed annually, producing 126,144,000 kWh [8].

There has been a trend towards the production of firewood from the olive peat, where simple machines used to compress the peat in the form of a cylinder, each piece length of 20 centimeters and the weight of 600 grams ignites for half an hour more than natural firewood [9].

1.8 Functional Block Diagram

Figure 1.5 illustrates proposed functional block diagram describing the design procedure of the proposed machine.

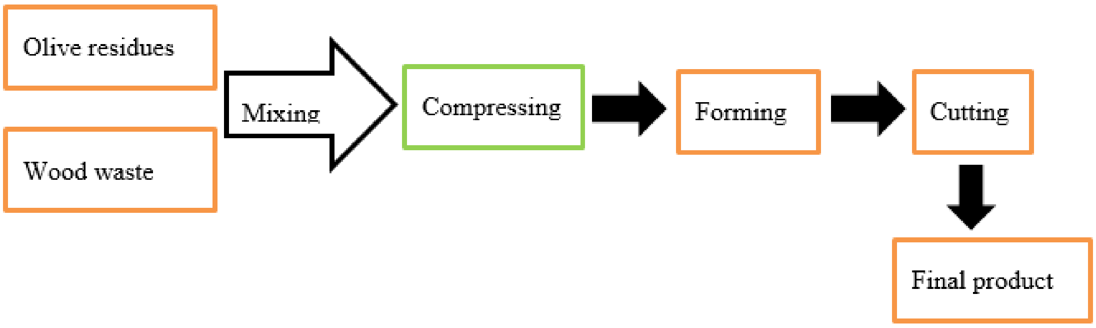


Figure 1. 5 Functiona Block Diagram

1.9 Estimated Cost:

The estimated cost of the proposed design is about 6000 NIS as stated in table 1.1

Table 1. 1 cost estimation

Component	Price (NIS)
3 three phase induction motor	1800
VFD	500
PLC	1000
HMI	500
Mechanical elements	1600
Overhead & manufacturing	1000
TOTAL COST	6600

1.10 Time Schedule

This section shows the project work time that is needed to achieve our goals. This Schedule is divided into fifteen weeks of the first semester as following in Table 1.2

Table 1. 2 First semester time plan

Week / Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Finding Project Idea	■	■													
Proposal		■	■	■	■										
Collecting data			■	■	■	■	■	■	■						
Documentation			■	■	■	■	■	■	■	■	■	■	■	■	
Preparing for presentation													■	■	■
Print documentation															■

2

Chapter two
Conceptual and Mechanical Design

2.1 Conceptual design.

2.2 Mechanical design.

2.3 Calculation of quantities.

2.4 Sawdust and Jeft feed screw design.

This chapter present the conceptual design, mechanical components and operating procedures of system.

2.1 Conceptual design

The operation of the machine is either through the HMI Screen or through

The control panel according to the following steps:

1. When pressed on the start switch on the control panel or the HMI Screen, the mix screw start running.
2. The user select the percentage of Jeft to sawdust from the HMI Screen.
3. The sawdust and Jeft conveyors move the material to the mixing tank with the selected percentage.
4. The compression screw compress the material to get the final compressed product.
5. The machine is stopped when the stop switch is pressed through the control panel or the HMI Screen
6. When the emergency switch is pressed, the system stops directly from working.

The conceptual design shown in Fig 2.1 below.

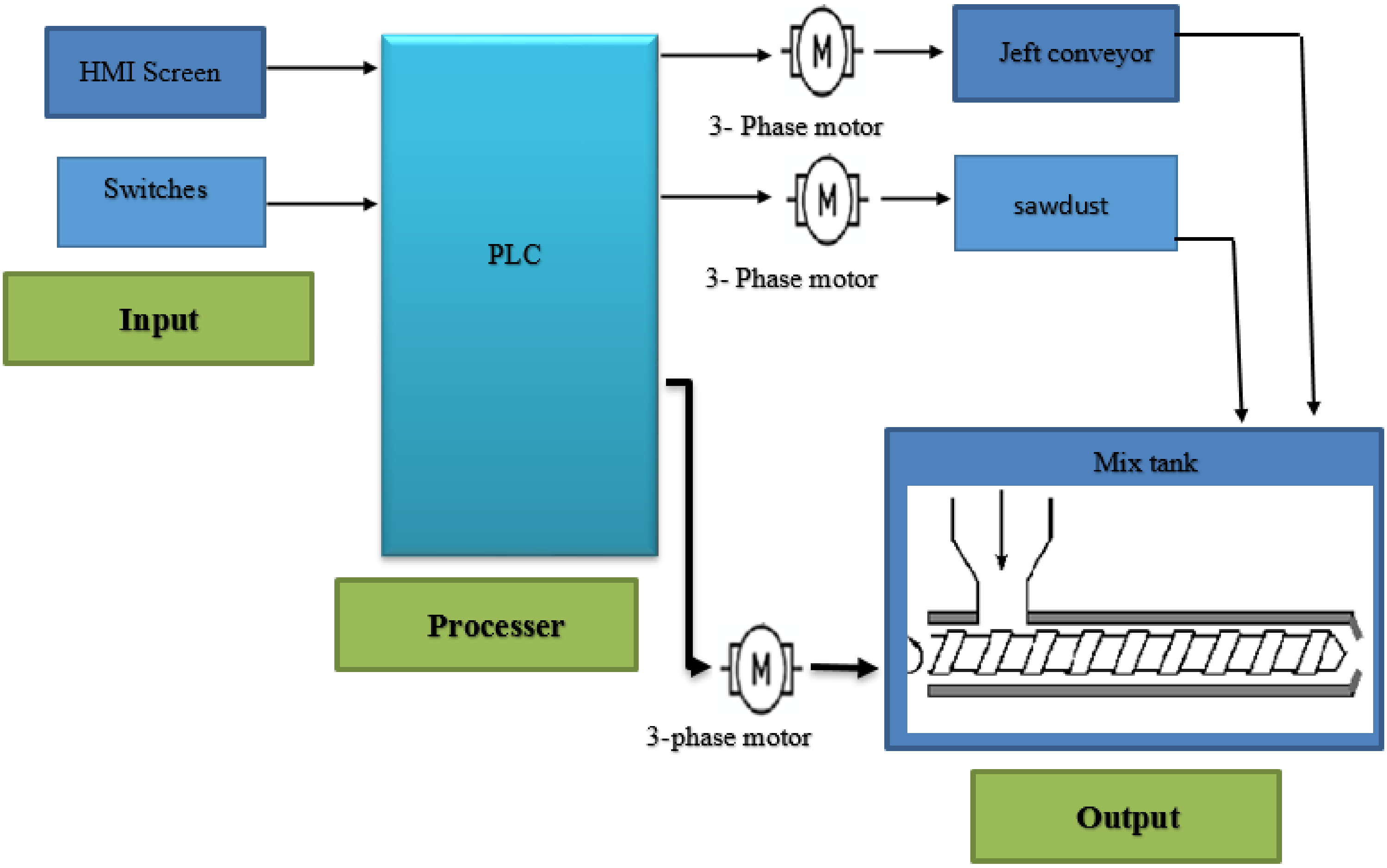


Figure 2. 1 : conceptual design

The conceptual design contain the following components:

1) Jeft and sawdust feed system
2) Motors and drivers
3) Screw to compress the mix
4) HMI Screen
5) PLC Controller
6) Accessories & switch
7) Protection devices

2.2 Mechanical design

The proposed mechanical design has the following modules:

2.2.1 Mixing and compression screw design.

Figure 2.2illustrates the Mixing and compression screw machine it is a single extrusion die screw press as shown in

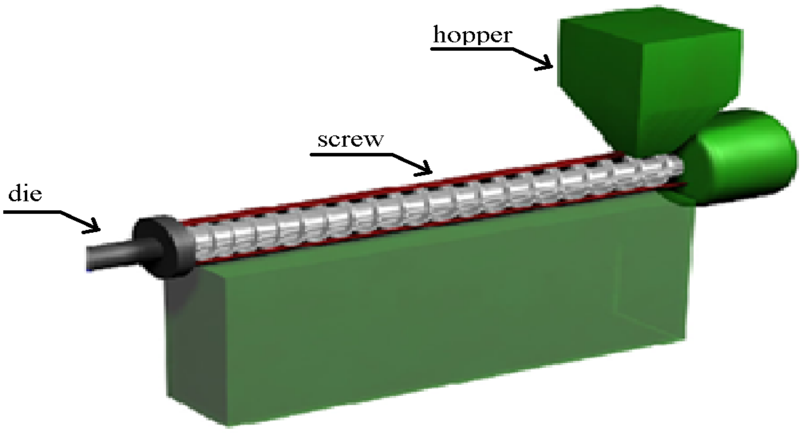


Figure 2. 2 general construction

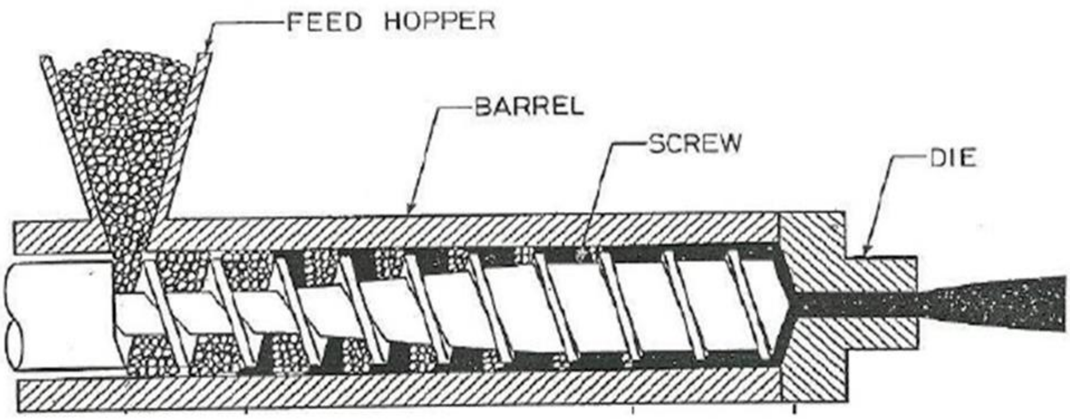


Figure 2. 3 A single extrusion die screw press

The main parts of the module the machine are:

The hopper: this is where the raw material (sawdust) is feed into the machine.

The screw: takes the material from the hopper through the barrel and compresses it.

The die: this is where the raw material extruded through it.

The Module Description: a machine is a single extrusion die screw press. It consists mainly of driving motor, screw, die and the housing with a hopper. When the motor is started, raw materials are fed into the machine through the hopper; the raw materials are compressed in the barrel, and extruded through the die. During operation, the rotating screw takes the material from the hopper through the barrel and compresses it against the die, which forms a buildup of pressure gradient along the screw. The screw continuously forces the materials into the die.

Pressure is built up along the screw rather than in a single zone as in the piston type

Machines.

2.2.2 The hopper designs

The hopper: this is a container where the raw material feed into the machine. It is made of mild steel, having conical shape. It fixed to the barrel housing.

The hopper designed as a frustum of a square pyramid as shown in Fig (2.4)

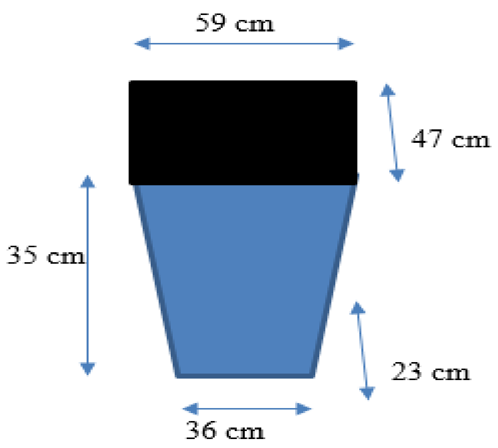


Figure 2. 4 Hopper

The volume of the hopper can be calculated by the equation:

$V= (H/3) [(X^2Y-x^2y)/X-x]$ (2.1)

Where:

V: Volume of hopper

H: Hight of the hopper

X: inlet length

x: outlet length

Y: inlet width

y: outlet width.

$V=(35/3)[(59^2*47-36^2*23)/59-36]= 67869\ cm^3 = 0.067869\ m^3$.

2.2.3 Die Design

This is where the raw material extruded through it, which forms a buildup pressure gradient along the screw as shown in Fig (2.5)

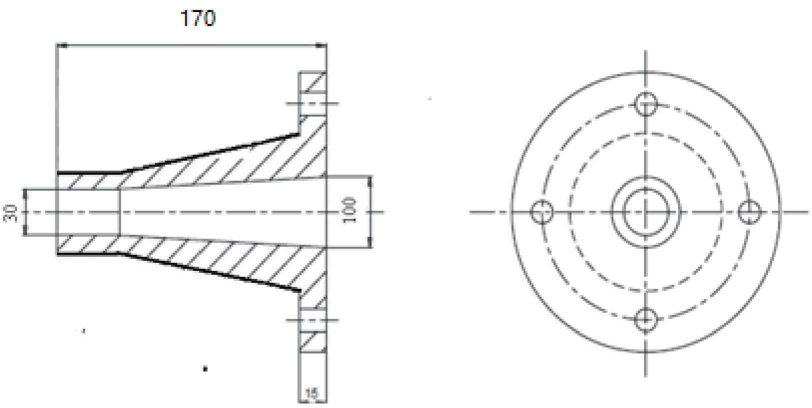


Figure 2. 5 Die section

Entry diameter = 100 mm

Exit diameter = 30 mm

Taper angle = 35.5˚

2.3 Calculation of quantities:

The final product will be a mixture of Jeft and Sawdust with specified percentage of mixture suitable for realizing good heat performances taking into account the directive values according to table 2.1

table 2. 1 materials density

Density	Kg/m^3
JEFT (Immediately after sorting)	1200
Sawdust	350

In order to complete the design, the following assumption are stated:

Quantity required to be produced= 10 m^3 / hour.

So, the all capacity in Kg / h can be calculated as:

10 m^3 / h * 1200 kg/m^3 = 12000 Kg/h.

The output capacity of the screw in kg/h can be calculated using the following equation:

$$\boldsymbol{Q = 60 \cdot \frac{\pi}{4} \cdot D^2 \cdot S \cdot N \cdot \alpha \cdot P \cdot C} \quad \text{.. (2.2)}$$

Since:

Q: Screw capacity in(kg/h).

D: diameter of screw(m).

S: screw pitch in (m).

N: screw speed in rpm.

α: loading ratio.

P: material loos density in kg/m^3.

C: inclination correction factor.

table 2. 2 Diameter Factor

Screw Diameter (Inches)	Factor Fd
4	12
6	18
9	31
10	37

The loading ratio α can be selected according the following table:

table 2. 3 loading ratio α

Material	Min loading ratio	Max loading ratio
Not free flowing	0.12	0.15
Average flowability	0.25	0.30
Free flowing	0.4	0.45

The inclination correction factor can be determined from data table below:

table 2. 4 correction factor

Inclination in °	Correction factor C
0	1
5	0.9
10	0.8
15	0.7
20	0.65

Discharge capacity of Jeft and sawdust conveyers:

Q for 1 rpm:

$$Q= 60 * \frac{\pi}{4} *0.21^2 * 0.24 * 1 * 0.21 *1200 *1$$

Q= 125.6 kg/h.

To determine the final speed of the screw:

$$N_{Final} = \frac{\text{capacity for N rpm Qall}}{\text{capacity for 1 rpm}} = \frac{12000}{125.6} = 95.5 \text{ Rpm.} \Rightarrow \omega = 10 \text{ rad/s.}$$

2.4 Sawdust and Jeft feed screw design.

The general construction of the screw conveyer as shown Fig 2.6

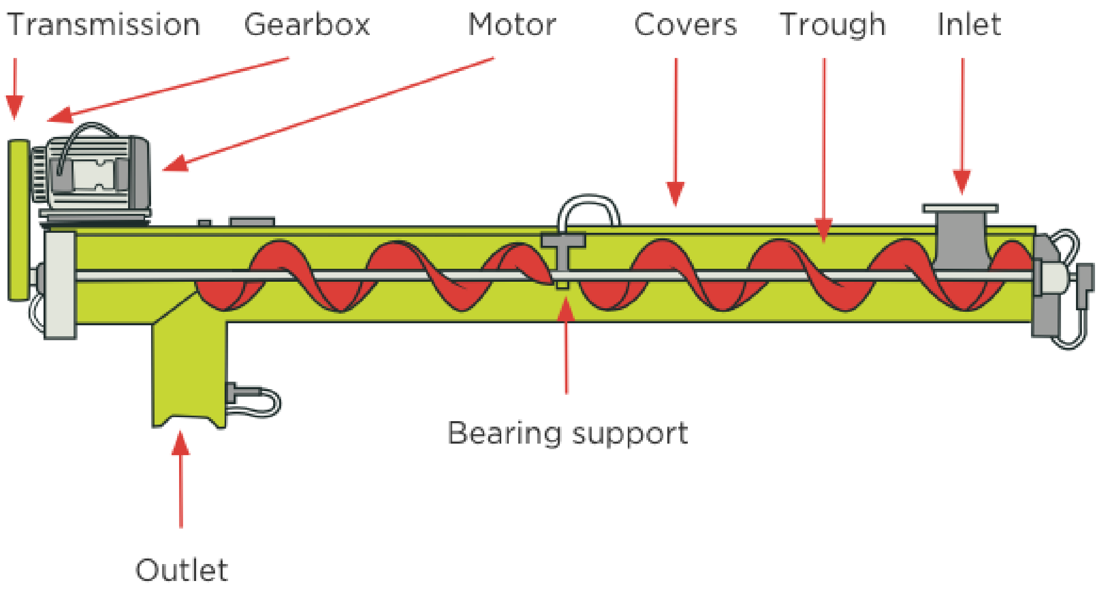


Figure 2. 6 general construction of screw conveyer

Screw conveyer is a mechanical system that mainly consist of three-phase induction motor and screw, which drive material from inlet region to outlet region according to the percentage that selected from the HMI screen.

The percentage of the material determined by the dimensions of the screw and motor parameter the dimensions of the screw as shown in Figure 2.7.

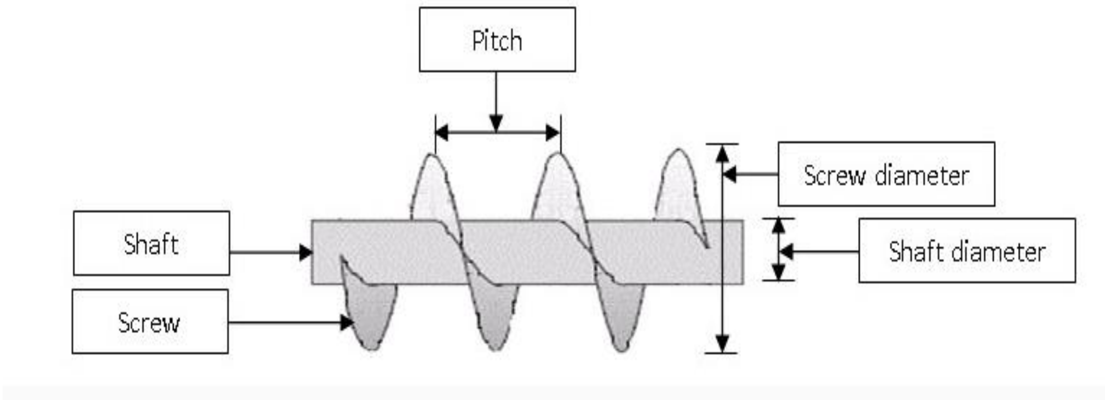


Figure 2. 7 the dimensions of the screw

2.4.1 Sawdust feed screw design.

According to the equation (2.1) and the requirement discharge value (Qs) for sawdust screw the suitable dimension for the screw will be:-

Screw diameter = 0.27 m

Shaft diameter = 0.12 m

Pitch of screw = 0.20 m

The construction of sawdust screw shown in fig 2.8.

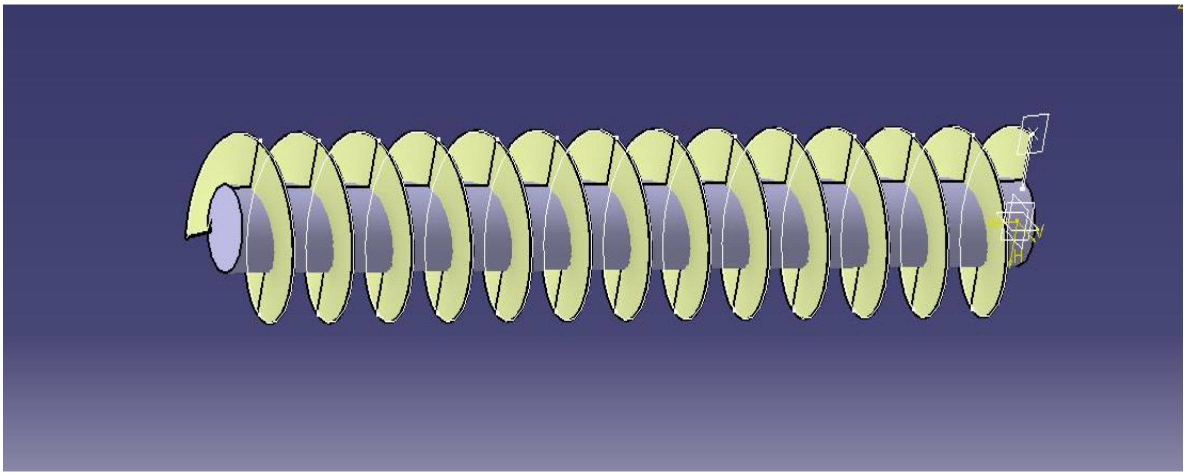


Figure 2. 8 the construction of sawdust screw

2.4.2 Jeft feed screw design.

According to the equation (2.1) and the requirement discharge value (Qs) for JEFT screw the suitable dimension for the screw will be:-

Screw diameter = 0.33 m

Shaft diameter = 0.16 m

Pitch of screw = 0.24 m

The construction of Jeft screw shown in fig2.9.

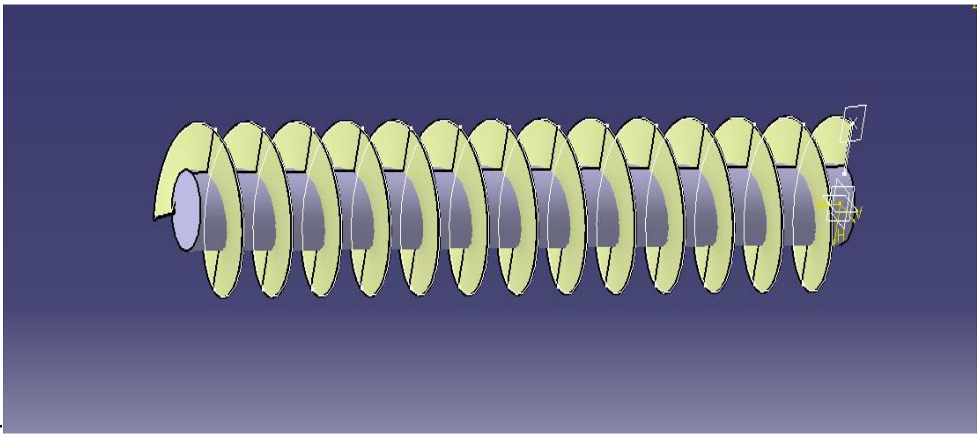


Figure 2. 9 the construction of Jeft screw

3

Chapter three

Electrical Design

3.1 Introduction

3.2 Electrical Component

3.3 Motors sizing

3.4 Protection circuit sizing

3.5 Power circuit

3.6 PLC control circuit

3.1 Introduction

Electrical design of the machine means:

- Electrical component.
- Motors sizing.
- Power circuit design.
- Control circuit design.
- Contactor sizing.
- Protection circuit sizing.

3.2 Electrical Component

3.2.1 Motors

The machine needs three three-phase induction motor, one for Sawdust fed screw; one for Jeft fed screw and one for die screw press.nThey will move the screw, sawdust screw, jeft screw and press screw Via connected to the shaft of the motors. (See fig 3.1)

Figure 3. 1 three phase induction motor

3.2.2 Variable Frequency Drive (VFD)

VFD as illustrated in fig 3.2 is a type of adjustable-speed drive used in Electro-mechanical drive systems to control AC motor speed and torque by Varying motor input frequency and voltage.

The machine has one VFD used to Control fed screw speed.

Figure 3. 2 VFD

3.2.3 Protection & Switching Devices

Every motor and pump need an overload, three-phase circuit breaker that is Used to protect the motors and their installations also, an earth leakage circuit Breaker. In addition, they need a 24V contactor to control the motor ON/OFF Operations. Emergency switch is also needed for emergency cases as illustrated on Fig 3.3.

Figure 3. 3 Protection & Switching Devices

3.2.4 PLC (Programmable Logic Controller)

A programmable logic controller (PLC) as illustrated on fig 3.4 is a Microprocessor-based piece of hardware that is specifically designed to operate in
The industrial environment.

Generally, PLCs (as the name suggests) implement logic, determining Outputs based on some logical combination of inputs. PLCs are programmable Devices that are capable of taking inputs from sensors and activating actuators in Order to control industrial equipment.

The PLC type that will be used is DELTA-DVP32ES2 that has 16 inputs and 16 outputs. We chose delta PLC because of its good quality, it is easy to be Programmed, has accepted price and meet the required purpose.

The PLC DELTA-DVP32ES Datasheet is attached in the Appendix A.

Figure 3. 4 PLC DELTA-DVP32ES

3.2.5 HMI (Human Machine Interface)

A Human Machine Interface (HMI) as illustrated in fig 3.5 is the user Interface that connects an operator to the controller for an industrial system.

HMIs are usually deployed on Windows based machines, communicating with programmable logic controllers (PLC) and other industrial controllers.

The HMI Datasheet is attached in the Appendix B.

Figure 3. 5 HMI Screen.

3.3 Motors sizing

3.3.1 Mixing and Comprising Motor

Now, the screw Horse Power should be assigned which is divided in to Friction HP and Material HP:

$$FHP = \frac{3.28*DF*HBF*L(m)*S}{1000000} \quad \text{.....................................} \quad (3.1)$$

Since:

FHP: friction horse power(hp).

DF: Diameter Factor.

HBF: Hanger Bearing Factor

L: length of conveyor (m)

S: speed of conveyor (rpm)

Table 3. 1 Hanger Bearing Factor

B earing type		Hanger Bearing Factor Fb
B	Ball	1
L	Martin Bronze	2
S	Graphite Bronze Melamine	3.4
H	Hard Surfaced	4.4

The Friction Horse Power can be calculated as:

$$FHP = \frac{3.28*31*4.4*1*95.5}{1000000} = 0.04\ HP$$

The Material Horse Power can be calculated by using this Equation:

$$MHP = \frac{7.231088*cp*MF*L(m)}{1000000} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.2)$$

Cp: capacity in kg/h

MF: material factor

$$MHP = \frac{7.231088*12000*1.25*1}{1000000} = 0.5\ HP$$

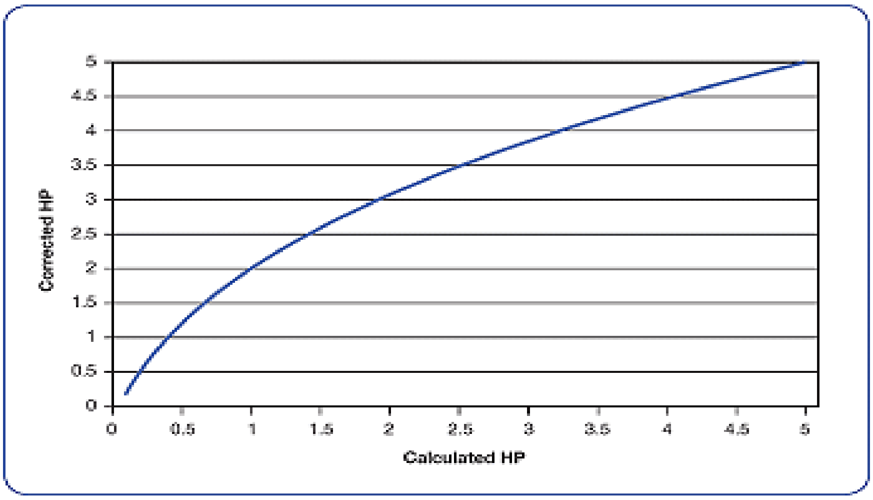


Figure 3. 6 corrected HP Factor

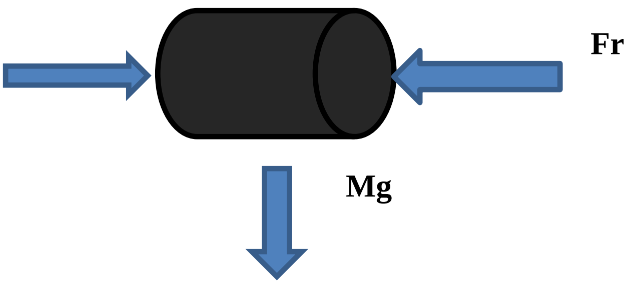
The figure 2.5 shows corrected MHP factor that previous calculated, so the Final MHP is 1.25 HP.

The Total Screw Horse Power:

$$TSHP = \frac{FHP+MHP}{e} = \frac{0.04+1.25}{0.65} = 1.98\ HP$$

This HP for the screw without pressing operation. The design has to be considered the pressed Jeft in calculations of Horse Power of motor.

The free body diagram of pressing section is shown below:



Fact: acting force.

Mg: weight of the Jeft.

Fr: friction force.

M = D*V =1200*$(0.11)^2$ *π *1 = 45.6 kg.

Fr= μ_s* mg = 0.9 *45.6 *9.81 = 402.6 N.

When equilibrium:

Fact = Fr=402.6 N

The work applied on the material to move it from outlet of screw conveyor to outlet of pressing section can be calculated as:

W = Fact * d

Since the d is the all distance that the motor stay moves the material (1.2 m):

W=402.6 *1.2=483.12 N.

The velocity of discharging the material is:

V = r * w

The radius of the pipe is 0.11 m and the angular velocity of the screw is 10 rad/s:

V=0.11 * 10 =1.1m/s.

The time of the material needs to move through the pressing operation is given by:

t= d/v =1.2/1.1 =1.09 sec.

if the material needs work 483.2 joules and the time of movement is 1.09, then, the power dissipated is equal:

P=w/t =483.2/1.09 = 443.3 watt.

P=0.6 HP.

The total HP must the motor delivered to the screw and the pressing section is:

THP = 1.98 + 0.6 = 2.58 HP

Standard HP motors sizes is 3 HP selected

The torque can be calculated as:

P = T * w → T= P/w =2238/10 = 223.8 N.M

3.3.2 Sawdust fed screw motor

The sawdust is 30% of the overall material in the mixing and compressed screw conveyor, so, the sawdust capacity is 30% of the total capacity that has been calculated previously.

$$Q = \frac{30}{100} \times Qtotal = 0.3 \times 12000 = 3600\ kg/h$$

From eq (2.2)

$$\mathrm{Q} = 60 \cdot \frac{\pi}{4} \cdot \mathrm{D}^2 \cdot \mathrm{S} \cdot \mathrm{N} \cdot \alpha \cdot \mathrm{P} \cdot \mathrm{C}$$

we can determine the capacity for 1 rpm notice that the density of sawdust is 350kg/m^3:

Q (1 rpm) = 60 * π/4 *(0.21)^2 * 0.17 * 1 *0.25 * 350 * 0.7

Q = 21.6 kg/h for 1 rpm.

The speed of the conveyor to discharge the required capacity is:

$$S = \frac{3600\frac{kg}{h}\ for\ N\ rpm}{21.6\frac{kg}{h} for\ 1\ rpm} = 167\ rpm$$

The FHP and MHP of sawdust screw can determine by eq (3.1) and eq (3.2):

$$\mathrm{FHP} = \frac{3.28*31*4.4*1.5*167}{1000000} = 0.11\ \mathrm{HP}$$

$$MHP = \frac{7.231088*3600*5*1.5}{1000000} = 0.19$$ corrected to 0.4 HP.

TSHP = $\frac{0.11+0.4}{0.6} = 0.85\ HP$ → 1 HP motor selected.

P = T * w → T= P/w =746/18 = 41.4 N.M

The selected sawdust motor specification is illustrated in table 3.2

Table 3. 2 Specification of selected sawdust motor

Name	Rated value
Voltage	380V/50Hz
Power	0.5 hp
Current	1.4 A
Rotating speed	1420

3.3.3 Jeft fed screw motor

The sawdust is 30% of the overall material in the mixing and compressed screw conveyor, so, the sawdust capacity is 30% of the total capacity that has been calculated previously.

$$Q = \frac{70}{100} \times Qtotal = 0.7 \times 12000 = 8400\ kg/h$$

From eq (2.2)

$$\mathrm{Q} = 60 \cdot \frac{\pi}{4} \cdot \mathrm{D}^2 \cdot \mathrm{S} \cdot \mathrm{N} \cdot \alpha \cdot \mathrm{P} \cdot \mathrm{C}$$

we can determine the capacity for 1 rpm notice that the density of sawdust is 350kg/m^3:

Q (1 rpm) = 60 * π/4 *$(0.21)^2$ * 0.17 * 1 *0.25 * 1200 * 0.7

Q = 74.2 kg/h for 1 rpm.

The speed of the conveyor to discharge the required capacity is:

$$S = \frac{8400 \frac{kg}{h}\ for\ N\ rpm}{74.2 \frac{kg}{h} for\ 1\ rpm} = 113rpm$$

The FHP and MHP of sawdust screw can determine by eq (3.1) and eq (3.2):

$$\text{FHP} = \frac{3.28*31*4.4*1.5*113}{1000000} = 0.10 \text{ HP}$$

$$MHP = \frac{7.231088*8400*5*1.5}{1000000} = 0.45 \text{ corrected to 0.55 HP.}$$

$$\text{TSHP} = \frac{0.1+0.55}{0.6} = 0.93\ HP \quad \Rightarrow \quad \text{1 HP motor selected.}$$

$$P = T * w \quad \Rightarrow \quad T = P/w = 746/18 = 41.4 \text{ N.M}$$

Table 3. 3 Specification of selected JEFT motor

Name	Rated value
Voltage	380V/50Hz
Power	0.5 hp
Current	1.4 A
Rotating speed	1420

3.4 Protection Circuit Sizing

The following table describes selected motors specifications. (See table 3.7)

Table 3. 4 Motors nameplate

Name	phase	P / kW	V	A	f/Hz
Comprising motor	3Φ	2.238	380	4.2	50
Jeft motor	3Φ	0.373	380	1.4	50
Sawdust motor	3Φ	0.373	380	1.4	50

3.4.1 Comprising motor protection circuit

- Overload

OL = In = 4.2A ……………………..……..…………..... (3.6)
Where

In: nominal current.

- MCB (Miniature Circuit Breaker)

MCB = 1.25In = 5.25 A ……………………………….…...... (3.7)

- Contactor

Contactor = 1.1*Pin = 2.4618 Kw …………………………….. (3.8)

Where

Pin: power input to motor.

The following table shows the selected components ratings. (See table 3.5)

Table 3. 5 Selected Protection Components Ratings

Name	Overload size	MCB size	Contactor size
Comprising Motor	6 A	6A	4KW – AC3
Sawdust Motor	6 A	6A	4KW – AC3
Jeft motor	6 A	6A	4KW – AC3

`

3.5 Power circuit

The power circuit is shown on fig 3.7.

`

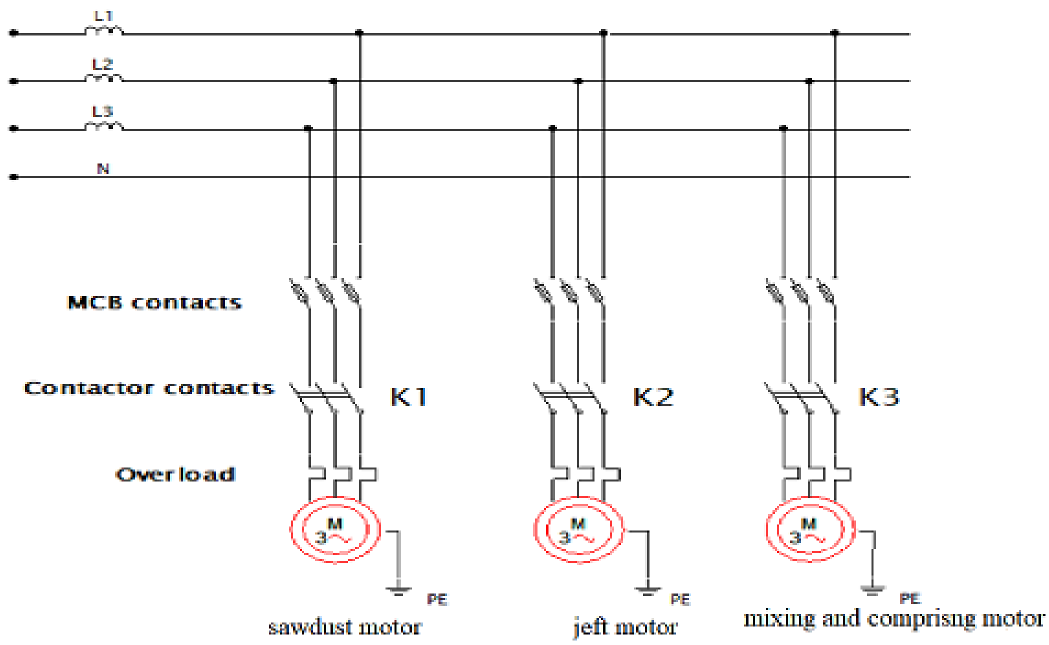


Figure 3. 7 Power Circuit

3.5 PLC control circuit

3.5.1 PLC I/O Table.

- PLC Inputs Information shown in table 3.6

Table 3. 6 PLC Inputs Information

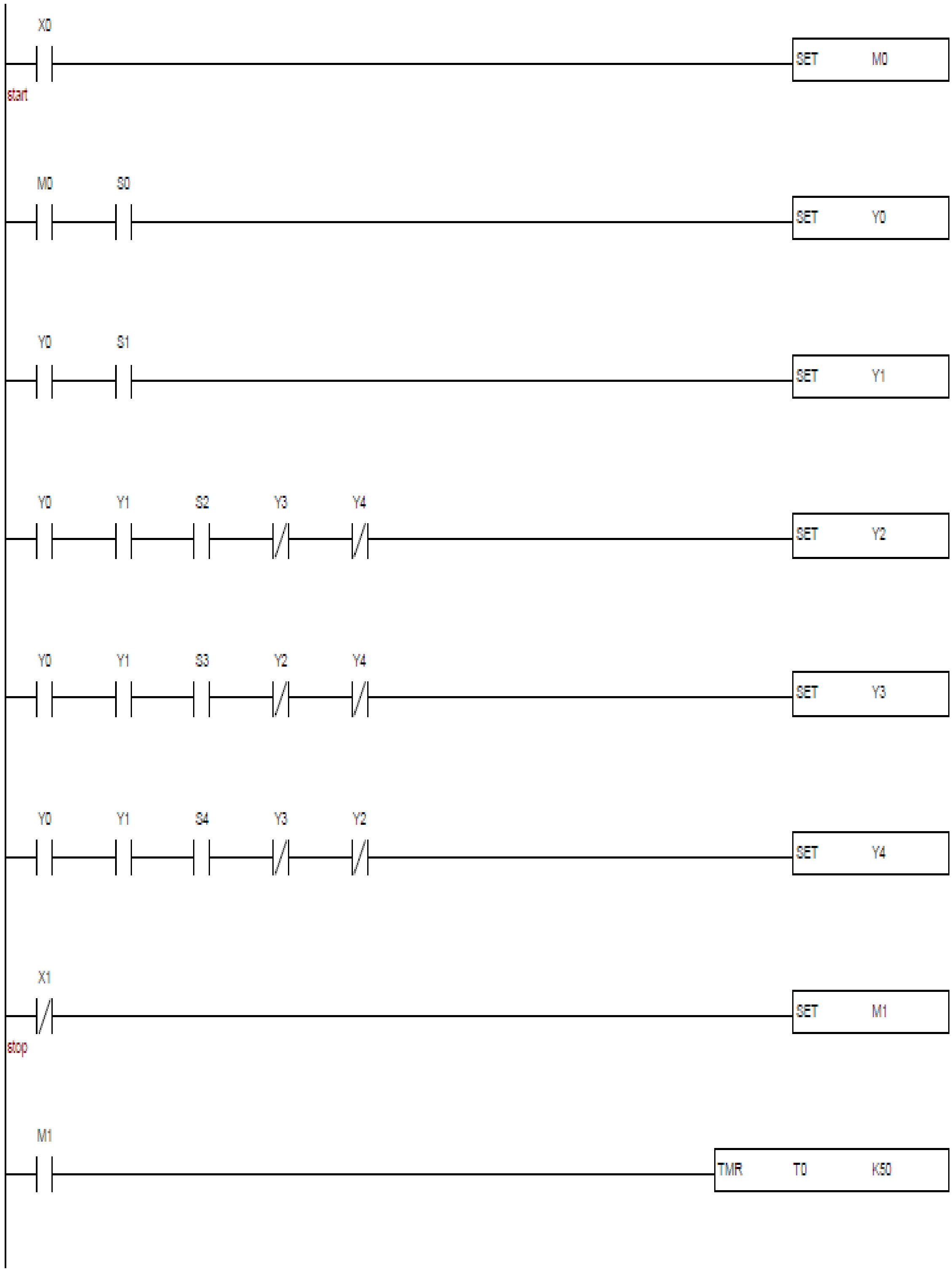
Input No.	
x0	Start
X1	stop
X2	Ls1
X3	Ls2
X4	EM
X5	OL
X6	Empty
X7	Empty
X8	Empty
X9	Empty
X10	Empty
X11	Empty
X12	Empty
X13	Empty
X14	Empty
X15	Empty

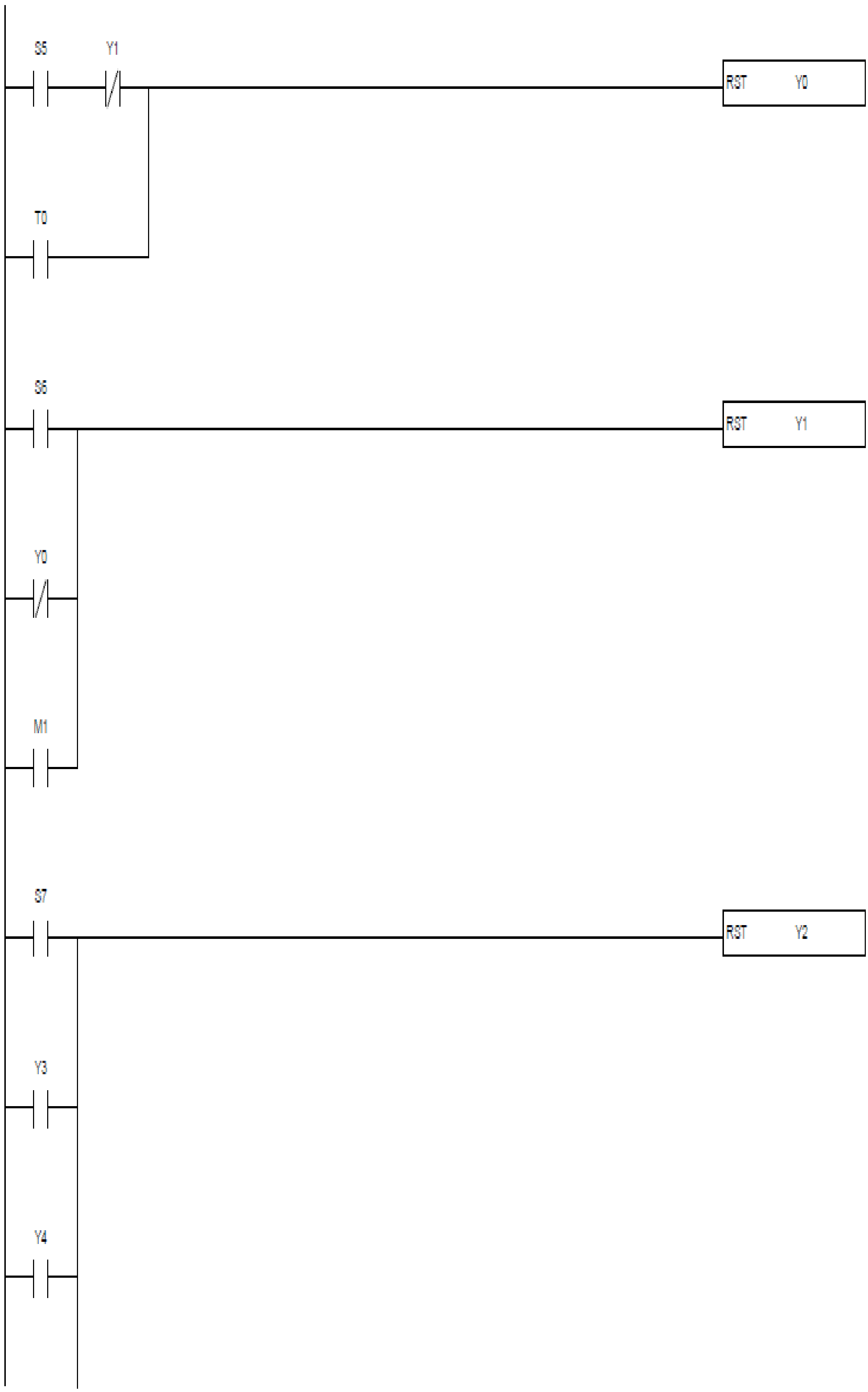
- PLC output Information shown in table 3.7
-

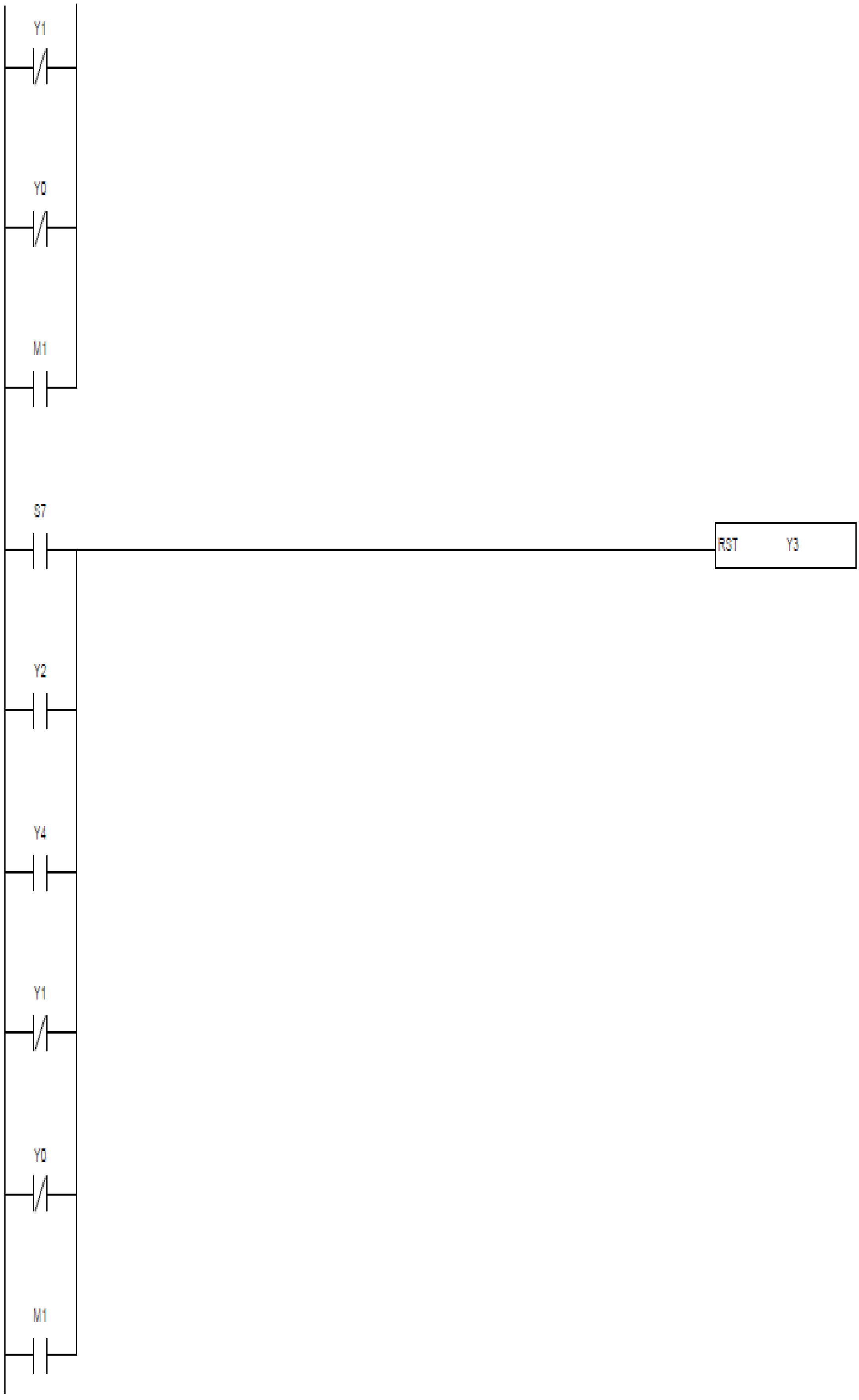
Table 3. 7 PLC output Information

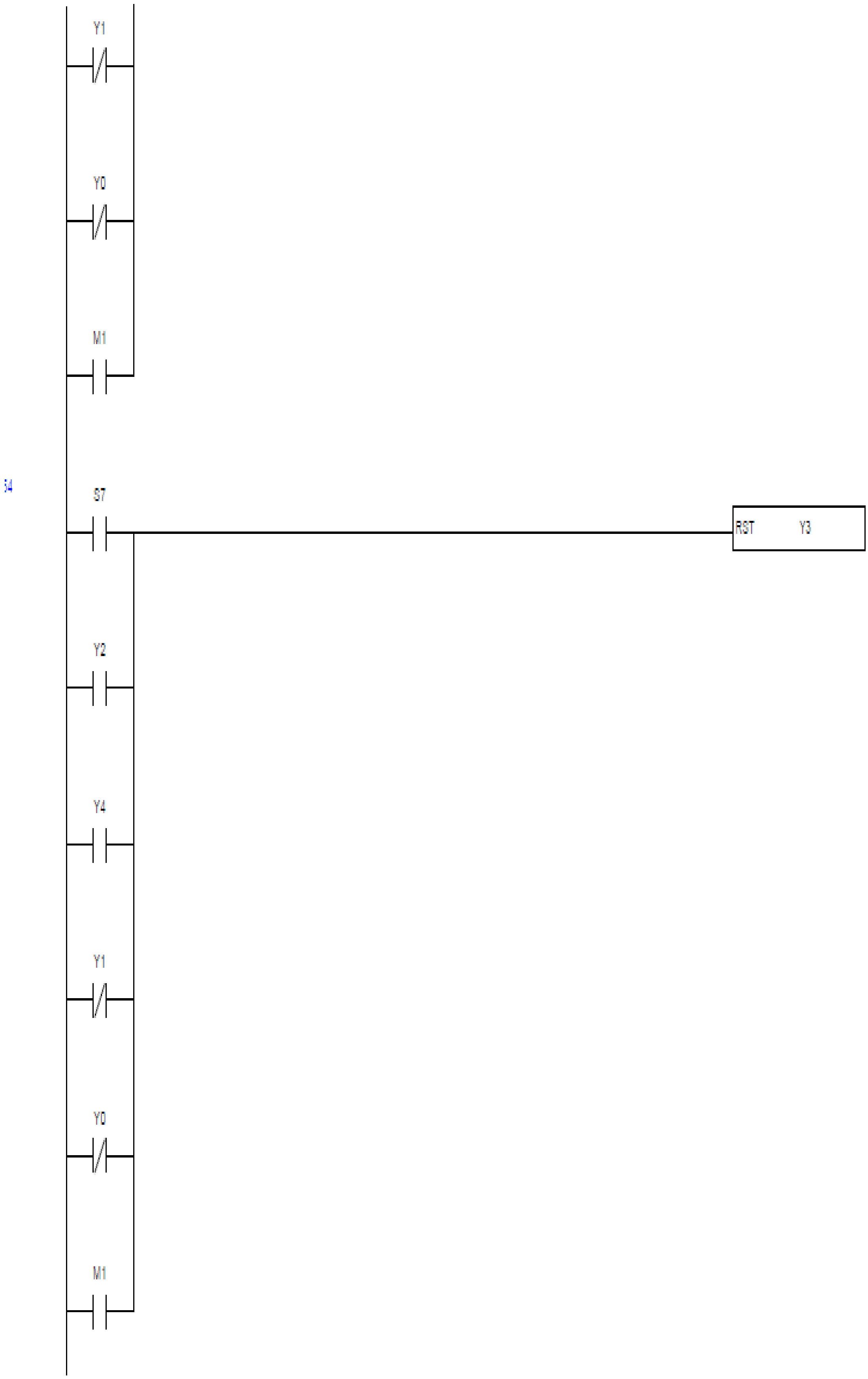
output No.	Description
Y0	Comprising motor
Y1	Jeft motor
Y2	Sawdust motor speed1
Y3	Sawdust motor speed 2
Y4	Sawdust motor speed3
Y5	Alarm lamp
Y6	Empty
Y7	Empty
Y8	Empty
Y9	Empty
Y10	Empty
Y11	Empty
Y12	Empty
Y13	Empty
Y14	Empty
Y15	Empty

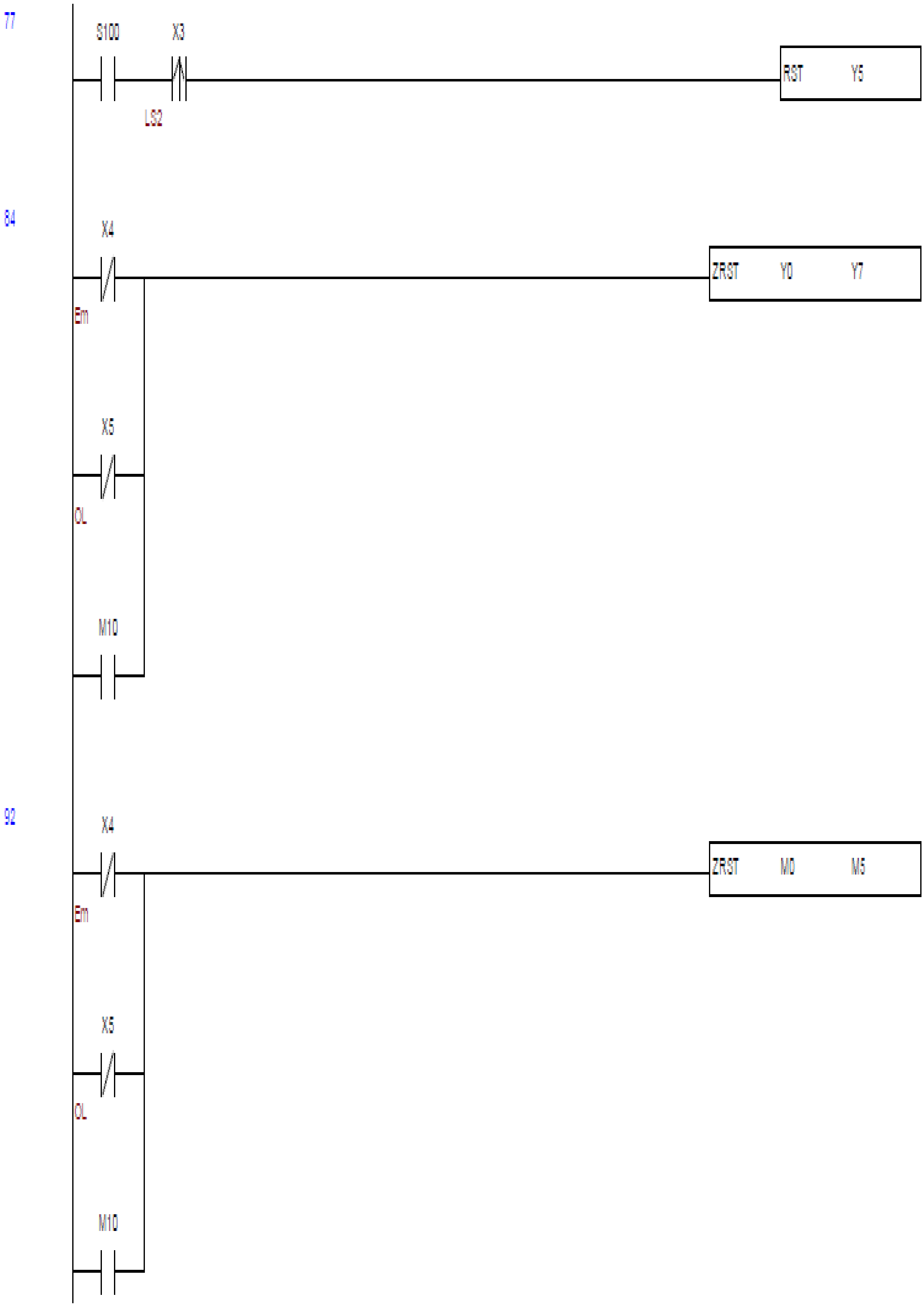
3.5.2 PLC Code

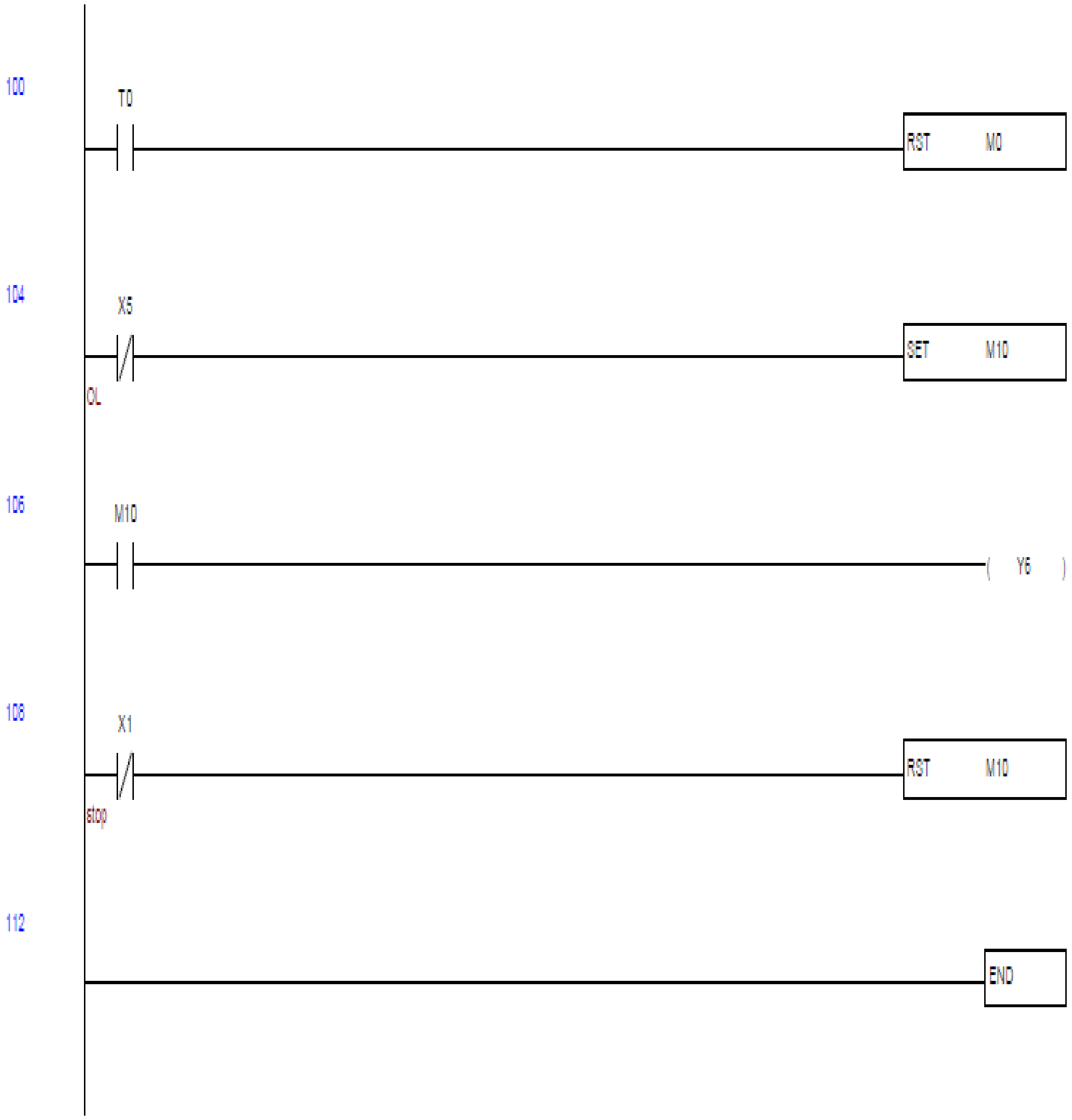

X0
start
SET M0
M0
S0
SET Y0
Y0
S1
SET Y1
Y0
Y1
S2
Y3
Y4
SET Y2
Y0
Y1
S3
Y2
Y4
SET Y3
Y0
Y1
S4
Y3
Y2
SET Y4
X1
stop
SET M1
M1
TMR T0 K50


S5
Y1
RST Y0
T0
S6
RST Y1
Y0
M1
S7
RST Y2
Y3
Y4


Y1
Y0
M1
S7
RST Y3
Y2
Y4
Y1
Y0
M1


Y1
Y0
M1
54
S7
RST Y3
Y2
Y4
Y1
Y0
M1


77
S100
X3
LS2
RST
Y5
84
X4
Em
X5
OL
M10
ZRST
Y0
Y7
92
X4
Em
X5
OL
M10
ZRST
M0
M5


100
T0
RST M0
104
X5
OL
SET M10
106
M10
(Y6)
108
X1
stop
RST M10
112
END

References:

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[2] Palestinian Central Bureau of Statistics www.pcbs.gov.ps,2014.

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[6] Tareq Abu Hamed, Lina Ismail & Aiman Alshare, *The potential of using olive cake in power generation in the Palestinian territories.*2015,pp.368-378.

[7] Nalan A. Akgun, Ibrahim Doymaz, *Modelling of olive cake thin-layer drying process,* Journal of Food Engineering, 2005, pp.455-461.

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[10]Sabri, M. (2012, May 22). Thomas screw conveyor design. Retrieved from

https://www.slideshare.net/MusaSabri/thomas-screw-conveyor-design

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Appendix A
“PLC Delta User Manual”

Model Explanation

DVP□□□□□□□⁝2⁝

- Product Series: DVP Series
- Inputs+Outputs points / unit: 08~60points
- Models
  - E : Main Processing Unit (Base Unit)
  - X : Extension Unit
  - S : S-TYPE Main Processing Unit
- Model Types
  - S : Standard
  - X : A/D, D/A Functions
  - C : Inextensible
  - M : Digital Input (X input extend)
  - N : Digital Output (Y output extend)
  - P : Digital Input/Output (X/Y extend)
- 00 : AC Input H TYPE
- 01 : DC Input L TYPE
- 11 : DC Input H TYPE
- R : Relay
- T : Transistor
- N : No Output Module
- 2 : Upgrade Model

00 : AC Input **H TYPE**

01 : DC Input **L TYPE**

11 : DC Input **H TYPE**

Peripheral Equipment

◎ DVPHPP: Handheld Programming Panel

◎ WPLSoft: Windows Ladder Logic Programming Software

◎ DPLSoft: DOS Ladder Logic Programming Software

◎ DVPACAB115: 1.5M Cable (HPP ⇔ PLC, DVPHPP has this cable attached)

◎ DVPACAB215: 1.5M Cable (PC (9 PIN & 25 PIN D-SUB) ⇔ PLC)

◎ DVPACAB230: 3M Cable (PC (9 PIN & 25 PIN D-SUB) ⇔ PLC)

◎ DVPACAB2A30: 3M Cable (PC (9 PIN D-SUB) ⇔ PLC)

◎ DVPACAB230: 3M Cable (PC ⇔ PLC)

◎ DVPACAB315: 1.5M Cable (HPP ⇔ PC)

◎ DVPACAB403: 30cm Cable (MPU-main processing unit⇔Extension Unit or Extension Unit⇔Extension Unit I/O signal extension cable)

◎ DVPAADP01: HPP Power Supply (DVPACAB315 is attached)

1.2. Product Profile and Outline

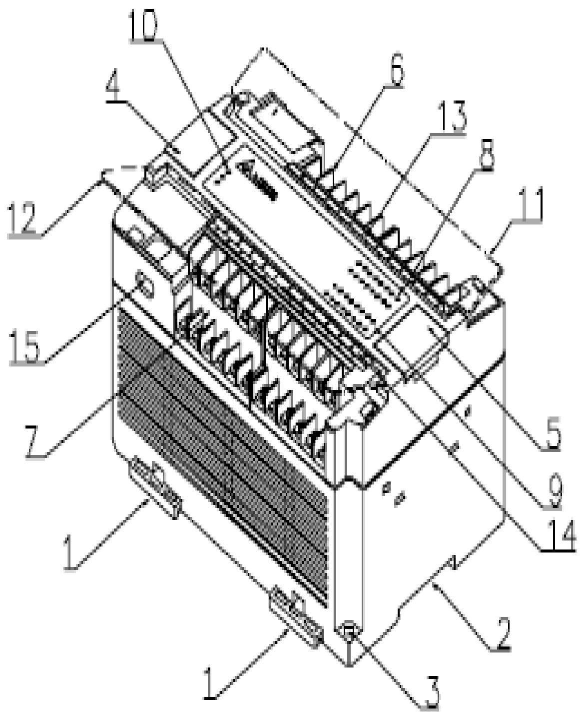
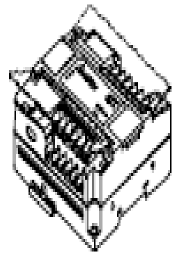
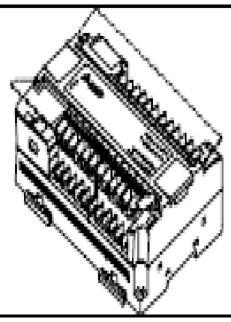


Fig. 1-1: Features of the DVP PLC

1	DIN rail clip	9	Output indicators
2	DIN rail (35mm)	10	Status indicators, POWER, RUN ERROR
3	Direct mounting holes	11	I/O terminal cover
4	Programming port cover (RS-232)	12	I/O terminal cover
5	Extension port	13	I/O terminal nameplate panel
6	I/O terminals	14	I/O terminal nameplate panel
7	I/O terminals	15	RS-485 Communication port
8	Input indicators		

◎ Digital I/O Extension-01 (L-Type)

Model	Power	Input Unit		Output Unit		Profile reference	
		Point	Type	Point	Type		
DVP16XM01N	24VDC	16	DC Sink or Source	0	None	❶	 ❶
DVP16XN01R		0		16	Relay	❷	
DVP24XN01R		0		24			
DVP24XP01R		16		8			
DVP32XP01R		16		16			
DVP16XN01T		0		16	Transistor		 ❷
DVP24XN01T		0		24			
DVP24XP01T		16		8			
DVP32XP01T		16		16			

1. Sink or Source connections. Please refer to Chapter 4 Installation and Wiring.

2. Please refer to Chapter 2 Standard Specifications for detailed electrical specifications.

■ Wiring Notes

The following guidelines provide general information on how to wire the I/O connections to DVP PLCs.

☑ Environment

1. **DO NOT** store the PLC in a dusty, smoky, or corrosive atmosphere.
2. **DO NOT** store the PLC in an environment with high temperature or high humidity.
3. **DO NOT** install PLC on a shelf or on an unstable surface.

☑ Construction

1. Some machine fabrication environments may accidentally cause conductive debris to fall through the DVP cooling vents and into the unit. ALL DVP units come with a protective sheet wrapped round the unit, covering the cooling vents. However, it must be removed before electrical operation.
2. There should be a 50mm or more distance between the PLC and other control components. Also, keep the PLC away from high voltage lines & power equipment.

☑ Avoid creating sharp bends in the wires.

☑ Avoid running DC wiring in close proximity to AC wiring.

☑ To minimize voltage drops on long wire runs, consider using multiple wires for the return line.

☑ Avoid running input wiring close to output wiring where possible.

☑ Avoid running wires near high power lines.

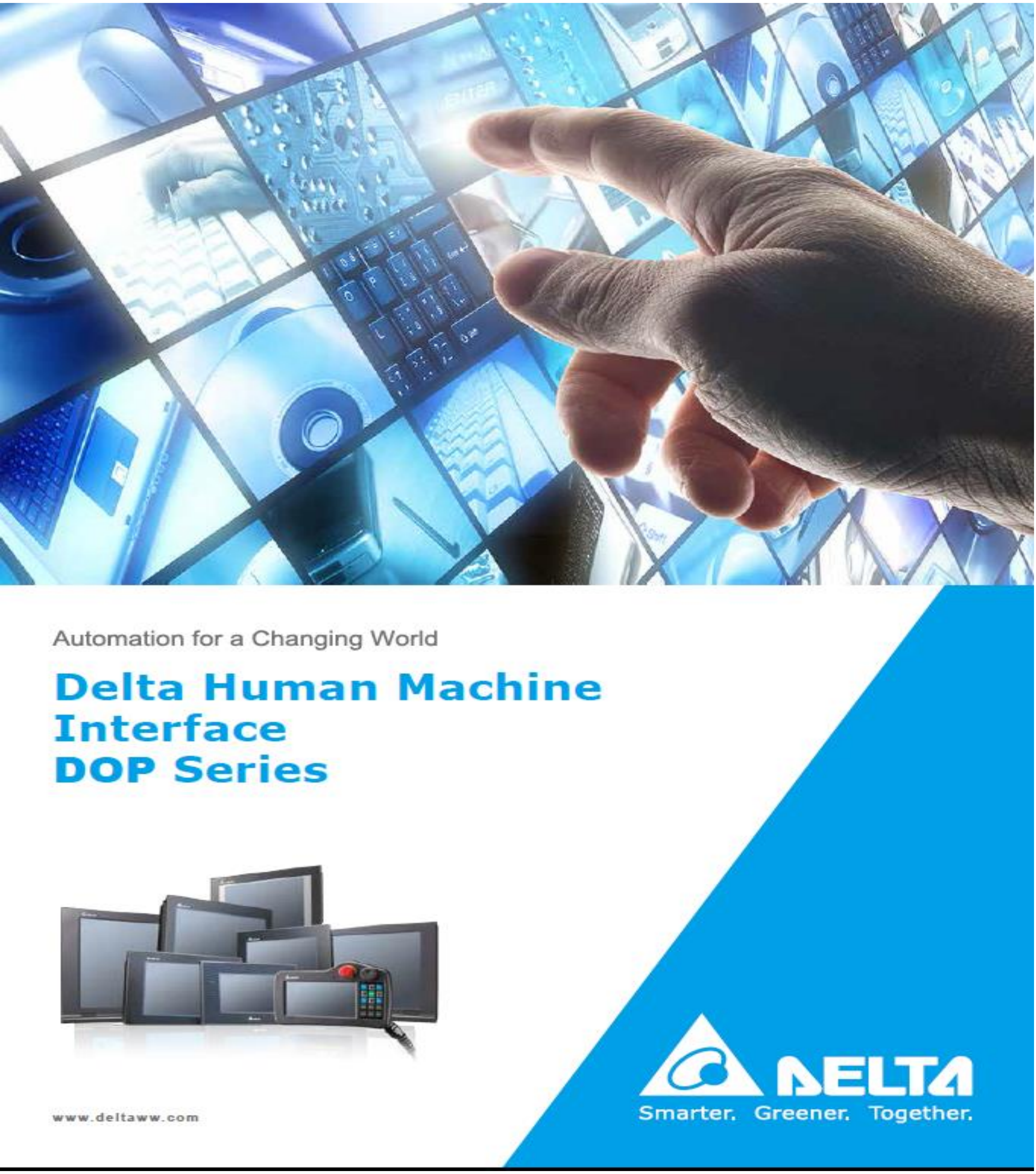
☑ Use wire trays for routing where possible.

☑ Use the shortest possible wire length.

☑ Always use a continuous length of wire. Do not splice wires to attain a needed length.

☑ Recommended wire terminations.

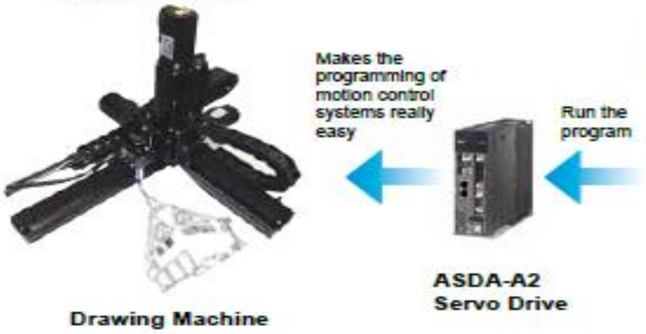
Appendix B
“HMI User Manual”

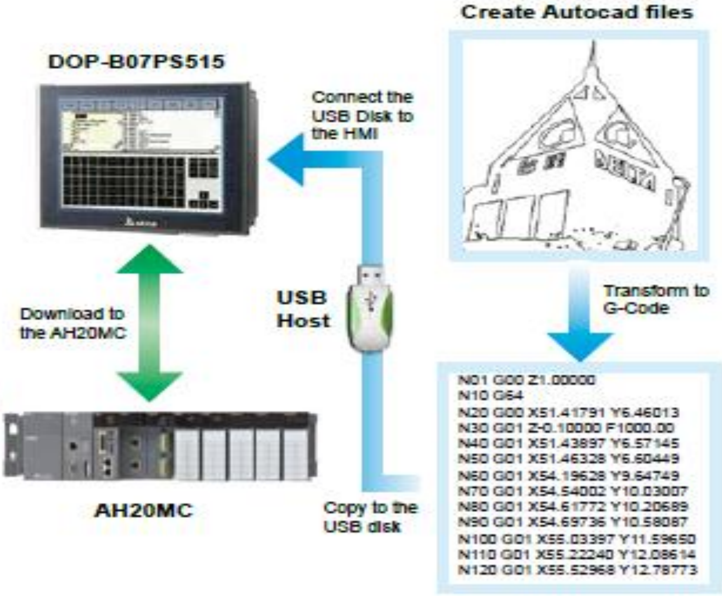

Automation for a Changing World
Delta Human Machine Interface DOP Series
www.deltaww.com
DELTA
Smarter. Greener. Together.

Integrates Delta Professional Functions (PS Models Only):

G-Code

- Supports Delta's motion controllers: DVP-10MC / DVP-20PM / AH20MC
- Capable of viewing and changing the G-code files with the HMI
- Supports serial and Ethernet communications



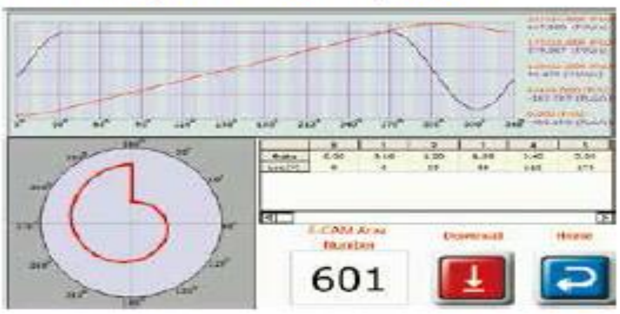


Electronic Cam (E-Cam) Curve Table

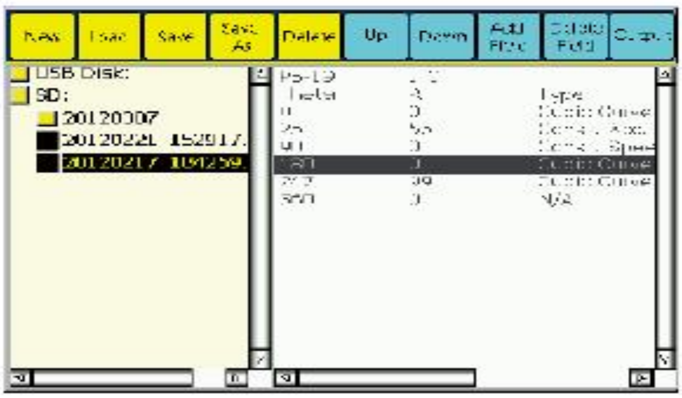
- Supports ASDA-A2 series servo drives
- A personal computer is not required. Electronic cam curves can be generated on HMI and downloaded to the ASDA-A2 series servo drive directly

Supports E-Cam table macro for making E-Cam curve on HMI

- Auto rotary shear with sealing zone
- Indirect printing
- Auto rotary shear – cos compensation

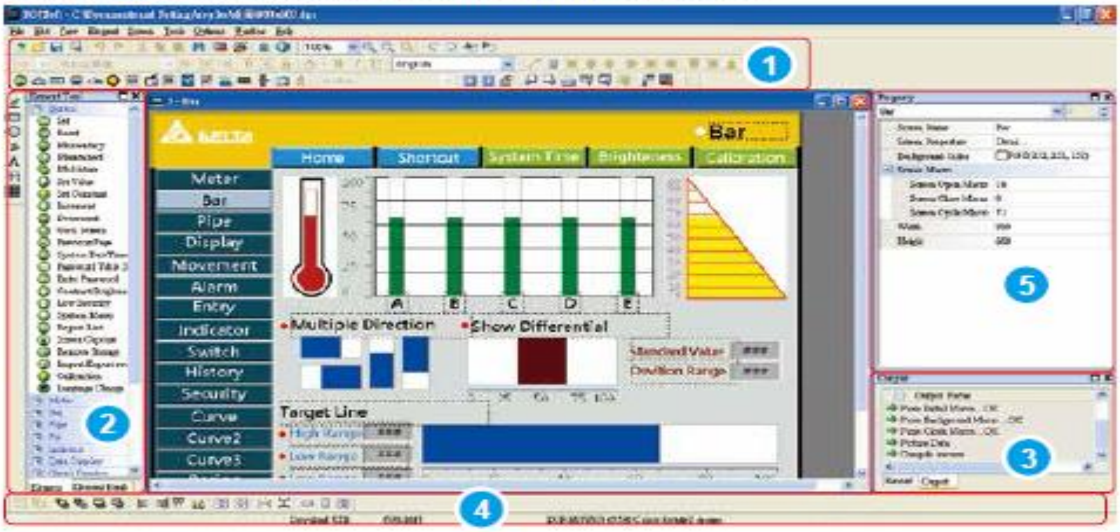


Supports cubic curve manual creation



DOPSoft

The all new and upgraded configuration software provides complete functions and a user-friendly operator interface. Make editing easier than ever with a whole new level of design.



1 Toolbar

Actions such as edit, save, upload and compile can be executed easily just by clicking the attractive and easy-to-see icons on the toolbar.

2 Element Tool Window

The Element Tool Window provides a wide variety of element icons for selection. Use the mouse to select the desired element icon and drag it onto the work place to create a new element.

3 Output Window

The Output Window displays all the editing actions and output messages when the compile function is enabled. Once an error occurs, the error messages are displayed in Output Window as well.

4 Layout Toolbar

The Layout Toolbar offers Bring to Front, Send to Bottom, Align, Across / Down Space Evenly, Make Same Size and other functions for the benefit of creating intricate and beautiful elements.

5 Property Table

The Property Table displays the element property settings for each element.

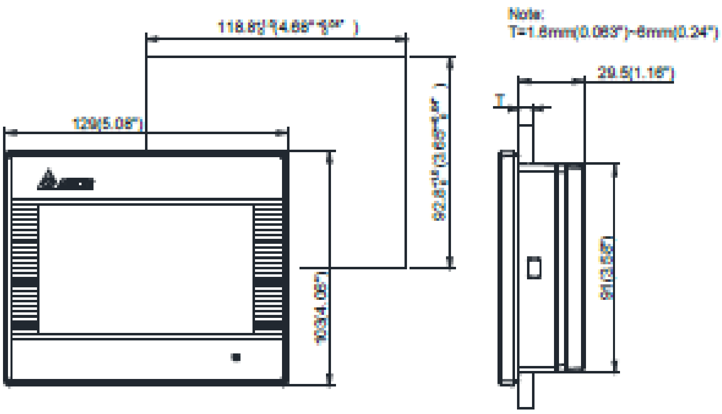
Picture Bank

Newly designed picture bank offers more colorful and attractive elements.

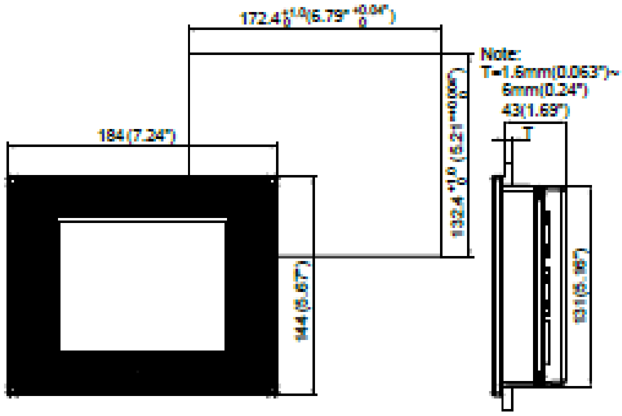
Dimensions Unit: mm (inches)

DOP-B Series

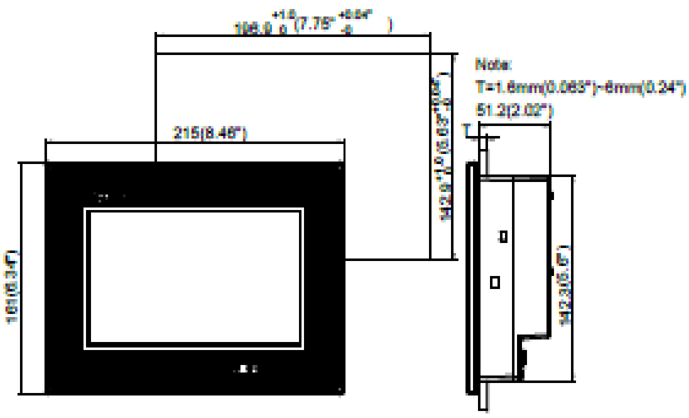
• DOP-B03S(E)211



• DOP-B05S111



• DOP-B07S(E)415 / DOP-B07PS415



• DOP-B07S(E)515 / DOP-B07PS515