Palestine Polytechnic University

College of Engineering and Technology

Electrical and Computer Engineering Department

Graduation Project:

Packaging Machine of Sugar Bags: Design and Operation

Project Team:

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Hebron – Palestine

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According to the orientations of the supervisor on the project and the examined committee is by the agreement of a staffers all, sending in this project to the Electrical and computer engineering department are in the college of the engineering and the technology by the requirements of the department for the step of the bachelor's degree.

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Committee signature

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Department head signature

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Abstract

قمنا بتصميم ماكينة لتغليف باكيتات السكر الورقية بوزن واحد كيلوغرام والتي تحتوي على موتور ثلاث فاز بقدرة 120وات وظيفة هذا الموتور تحريك السير الناقل بطول 2م والذي يقوم بنقل كيس السكر المعبأ لإجراء عملية التغليف اللازمة ليخرج مغلقا وجاهزا.

في اثناء سير الكيس على السير الناقل يمر على سيلندرين هوائيين وظيفتهما ثني الكيس الثنية الاولى ليتم وضع الصمغ عليها وبعد ذلك يصل الكيس الى وعاء التصميغ المثبت على الجنب من السير الناقل حيث يتم التصميغ عبر عجل دوار يلف مع مرور الكيس حاملا معه الصمغ. وبعدها ينتقل الكيس الى الخطوه الاخيرة ليدخل في مسار يثنيه بشكله النهائي ويصل نهاية السير وقد اصبح مغلقا. حيث يتم ضبط جميع العمليات المنطقية باستخدام "PLC"

We have designed packaging machine of sugar bags with one kilogram, which contains 3 phase motor with 120 watt to drive the conveyor (2 meters) which moves the filled bag to package.

The bag on the conveyor reaches 2 double acting cylinders to make the first close and put the glue on. After that bag will reach to glue bottle that is beside the conveyor, here the glue will be put in the bag by some mechanism. Finally the bag moves with some technique to be packaged. And this will happen by using "PLC" controller.

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List of table

Project cost:

Equipments	Cost ($)
3 ph induction motor	90
laagers	50
Chain & gear & screw	110
Rah' conveyor	110
Switches , Protection system	100
Solenoid valves & cylinders& pneumatic component	157
Lathe , welding and machine body	210
money to lather	850
Total cost	1677

Schedule time:

Table 1.2 Schedule time

week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Choosing project																
Collection data																
Data analysis																
Practical experiment on colors																
Machine design																
Writing project text																

Week	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Mechanical parts design																
Interfacing program																
Electrical circuit																
PLC program																
Calibration& Timing																

Chapter one

Introduction

1.1 Introduction

1.2 Reasons for choosing the project

1.3 Project Description

1.1 Introduction:

Long time ago people used to be simple and live in a simple way, but they began to develop slowly till this era which everything is goes quickly in every parts of life like agricultural, industrial field ... etc

Manual old classical machine needs to development in order to work with this period. As we know the manual classical method of control face a lot of problems which reduces the amount of production, waste a lot of time without achieving higher accuracy, and efficient performance. And because it depends on human factor who gets tired that reduces working time. Here we need a lot of workers in order to make the producing process.

Filling and packaging machines at past designs were manually controlled but now most of them automatically controlled.

Automatic control method using Industrial Automation, modern technology in order to increase the production amount in a short time and higher accuracy without the need of too many labors and works more hours than traditional.

And so the feed back to the factory will be better and it lower costs by reducing the number of labors

1.2 Reasons for choosing the project:-

The new and developed technology has now been part of the Palestinian local industrial society and to walk with development era through converting the manual machine into automatic machine by using comfortable technique.

Walking with the needs of this time and solving the problems which are faced by factories in order to get larger amount of products with good quality.

This project has been chosen to serve production in the local Palestinian community. Another group tried to design a project like it but unfortunately it failed.

Because of the market need of such a machine we have chosen this project to wide local production of sugar bags.

To get rapid production, low time and cost for this machine it should be translated from manual machine to full automatic machine using PLC. And so getting enhancement machine by high performance and efficiency

1.3 Project Description:-

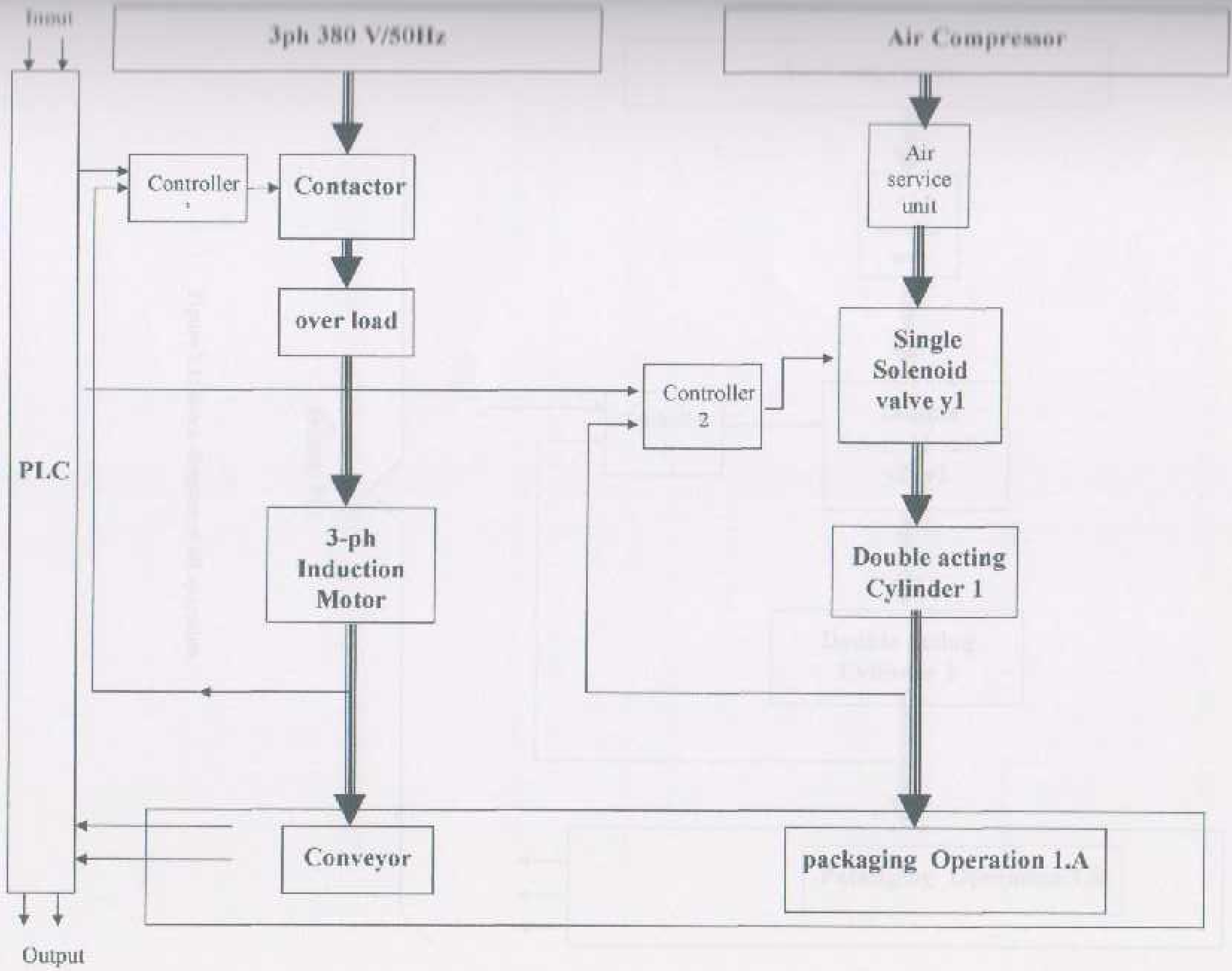
The project consists of:

- Conveyor which carries the empty bag to the filling part.
- Filling part; when the empty bag reaches the sensor built on the valve it gives an order to stop the conveyor and at the same time the bag is filled on with a specific amount of sugar, when it is filled the same conveyor takes it to the packaging side.
- Packaging part; the filled bag enters into a mechanism which makes the packaging process.

This process will be controlled by PLC (Programmable Logic Controller)

Chapter two

General block diagram


Input
3ph 380 V/50Hz
Air Compressor
Controller
Contactor
Air service unit
over load
Single Solenoid valve y1
Controller 2
PLC
3-ph Induction Motor
Double acting Cylinder 1
Conveyor
packaging Operation 1.A
Output

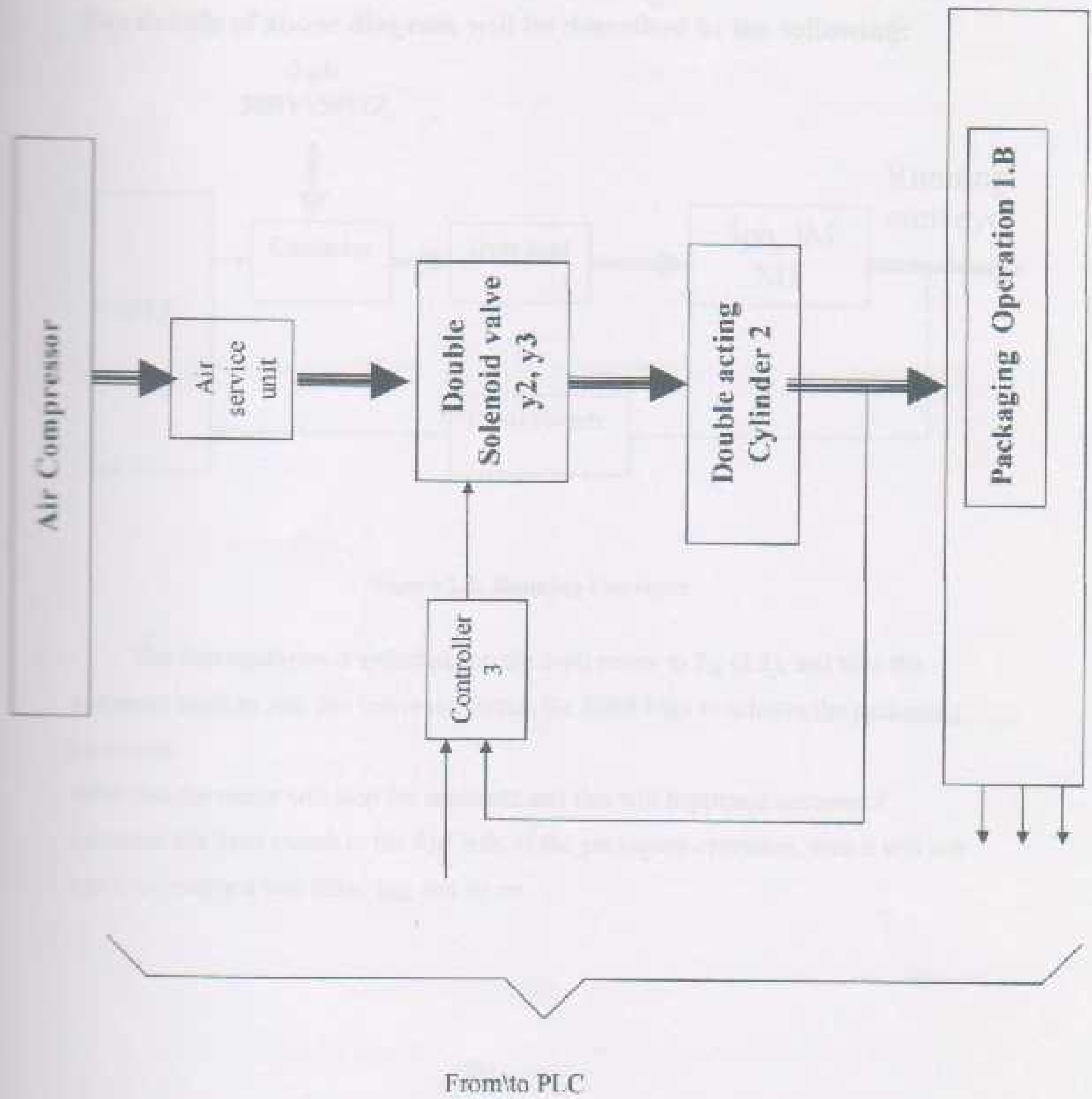


Figure 2.1: Block diagram of all operation.

The details of above diagram will be described in the following:

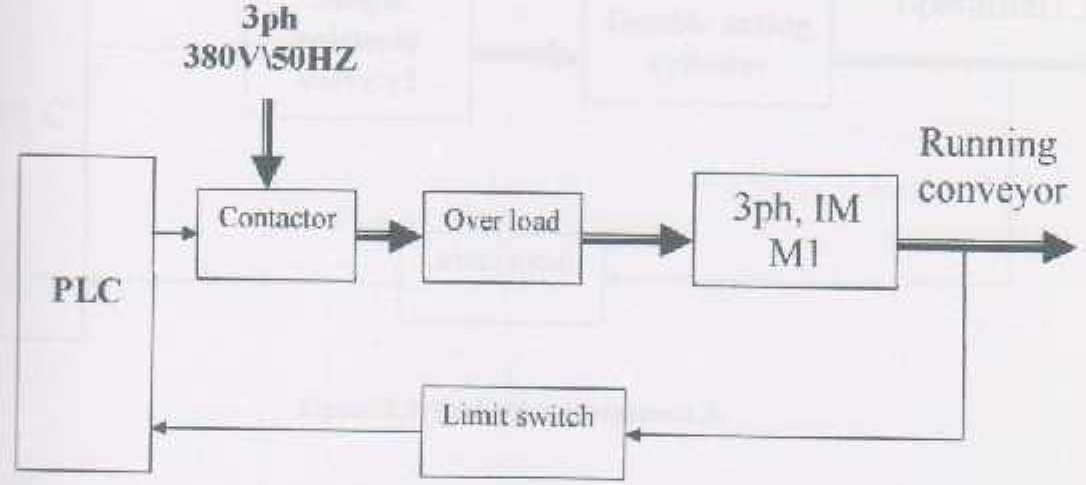


Figure 2.2: Running Conveyor

The first operation is switching on the 3-ph motor in fig (2.2), and then the conveyor starts to run, this conveyor carries the filled bags to achieve the packaging operation.

After that the motor will stop for moments and this will happened because of existence the limit switch in the first side of the packaging operation, then it will run again to receive a new filled bag and so on.

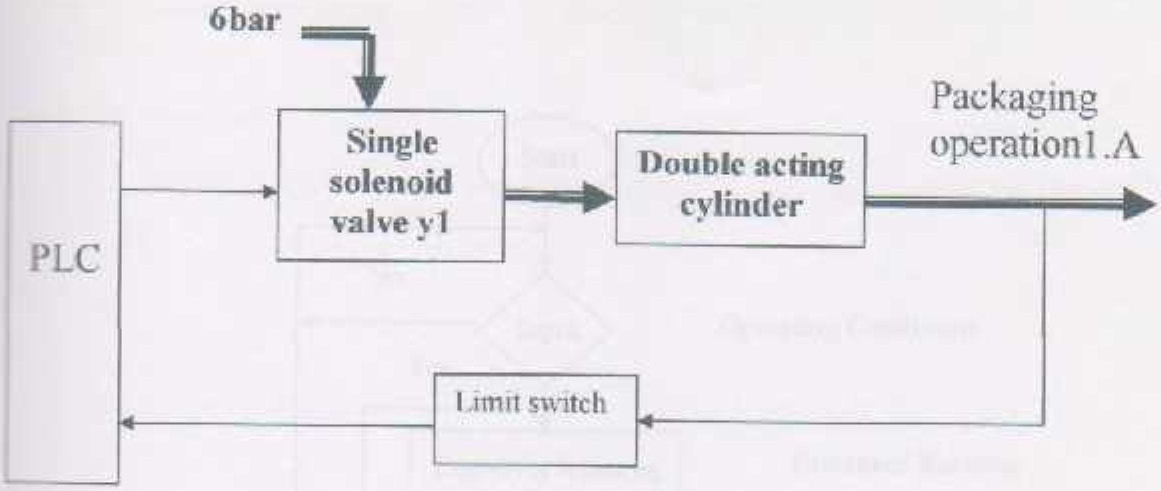


Figure 2.3: Packaging Operation1.A

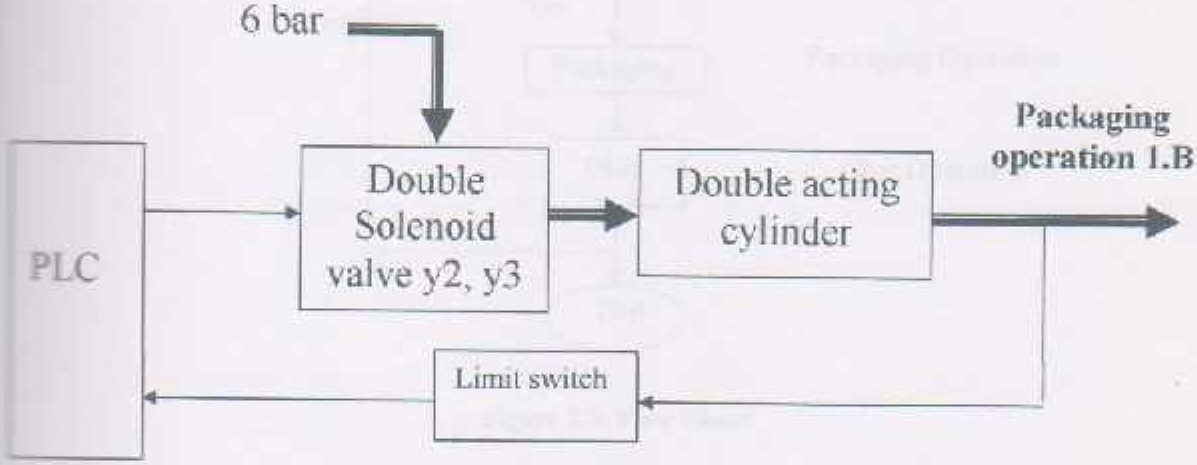


Figure 2.4: packaging operation1.B

In fig (2.3, 2.4) the second operation is packaging operation; which includes two double acting cylinders (cylinder controls cylinder) when the bag reaches the limit switch it gives the PLC an order to stop the motor for a moment; where the first cylinder moves the second cylinder (to achieve the initial discourage of the bag) until reaches the maximum flow out and this will happened by using limit switch, then the second cylinder activated (to get the discourage the bag as desired form) until reaches the maximum flow out and this will activate limit switch to make the motor runs again, after few moments the second cylinder in fig. (2.4) will flow in and then the first cylinder in fig. (2.3) will flow in.

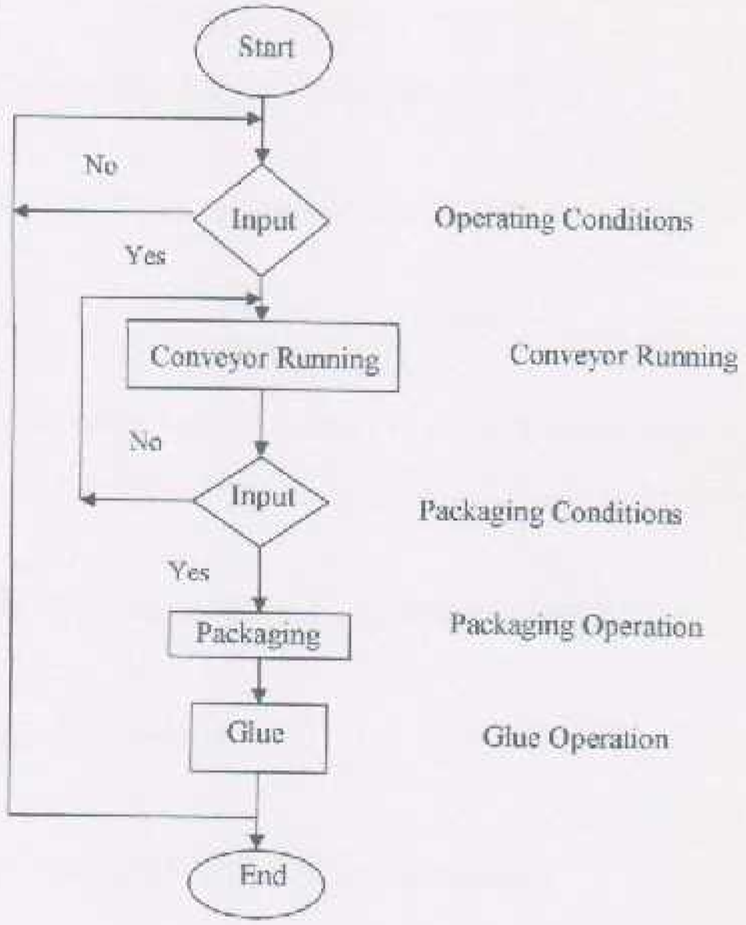


Figure 2.5: Flow Chart

Figure. (2.5) presents complete packaging operation from the beginning to the end, and show the operations that the bag will pass through it.

Start: here don't have any actions.

Input (operating conditions): here the emergency free, stop push button also free, and the start push button activated.

Conveyor Running: after all input operating conditions.
Input (packaging condition): here reaches the limit switch that will stop the motor and achieve the packaging operation.

Packaging operation: after all input packaging conditions.

Glue operation: this will happened after the packaging operation without any input conditions.

End: the bag is ready.

Chapter Three

Programmable Logic Controller "PLC"

3.1 Introduction:

3.2 Typical Programmable Logic Controller-base Control System

3.3 The Role of the Programmable Controllers (PLC)

3.4 Programmable Controller

3.5 Conventional Control Panel and Its Difficulties

3.6 A Systematic Approach of Control System Design using a Programming Logic Controller

3.7 PLC program

3.1 Introduction:

In general, a Control System is a collection of electronic devices and equipment which are in place to ensure the stability, accuracy and smooth transition of a process or a manufacturing activity. It takes any form and varies in scale of implementation, from a power plant to a semi- conductor machine. As a result of rapid advancement of technology, complicated control tasks accomplished with a highly automated control system, which may be in the form of Programmable Controller (PLC) & possibly a host computer, etc. Besides signal interfacing to the field devices (such as operator panel, motors, sensors, switches, solenoid valves and etc.), capabilities in network communication enable a big scale implementation and process co-ordination besides providing greater flexibility in realizing distributed control system. Every single component in a control system plays an important role regardless of size. For instance, as shown in Fig (3.1) the PLC would not know the happenings around it without any sensing devices. And if necessary, an area host computer has to be in place to co-ordinate the activities in a specific area at the shop floor.

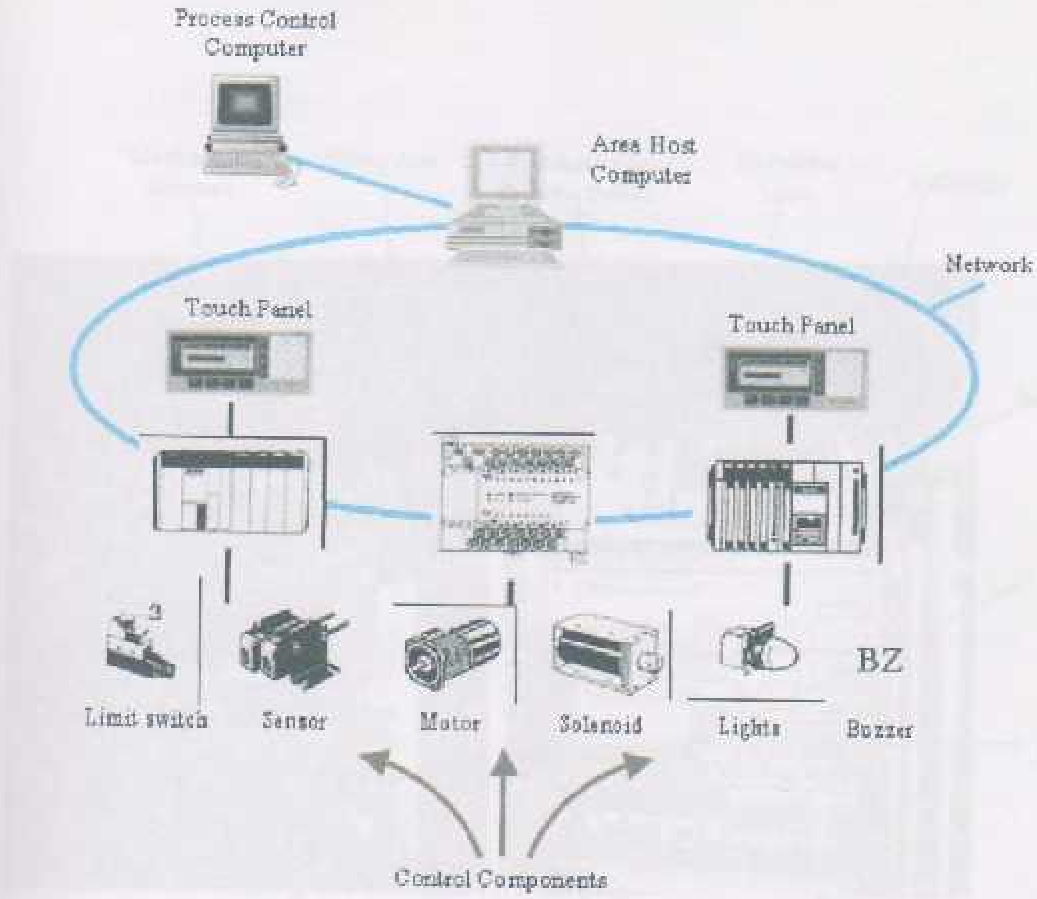


Figure 3.1: control components

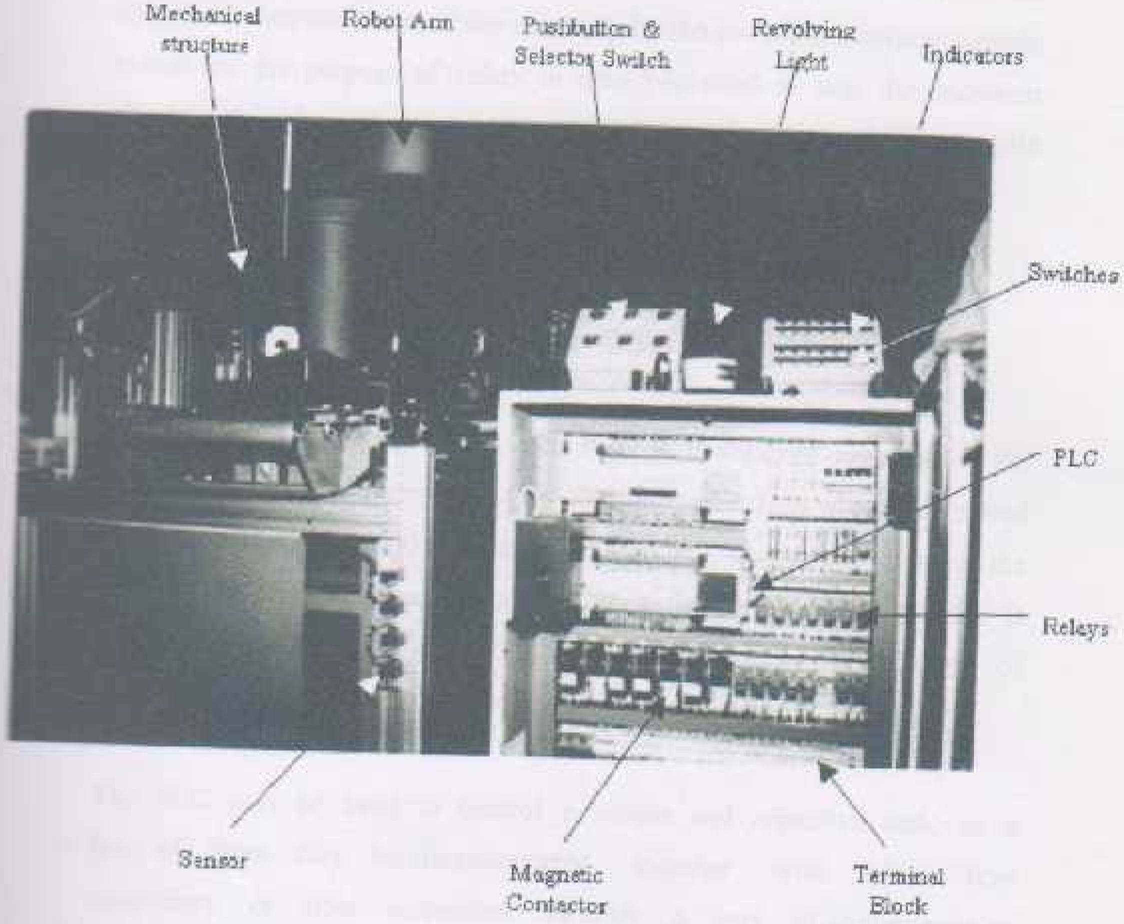


Figure 3.2: typical application of a Gantry Robot Control Machine

3.2 Typical Programmable Logic Controller-base Control System:

Fig (3.2) is a typical application of a Gantry Robot Control Machine. It is used in a pick and place operation. The whole process sequence is controlled by a PLC. The various input devices such as selector switches, push buttons, toggle switches, sensors are connected to the input of the PLC via the input terminal block. The output devices such as the revolving light, indicators, relays, contactors and solenoid valves are connected to the output terminals of the PLC. The whole process is controlled by a ladder program loaded into the PLC CPU memory. The program will execute a sequence automatically according to the pre-defined sequence of operations. Manual operations are also provided to allow operator to activate the machine manually by the switches, emergency push-button for the purpose of safety in case you need to stop the operation abruptly. In this application, the control system operates as a stand-alone operation.

3.3 The Role of the Programmable Controllers (PLC):

In an automated system, the PLC is commonly regarded as the heart of the control system. With a control application program (stored within the PLC memory) in execution, the PLC constantly monitors the state of the system through the field input devices' feedback signal. It will then based on the program logic to determine the course of action to be carried out at the field output devices.

The PLC may be used to control a simple and repetitive task, or a few of them may be interconnected together with other host controllers or host computers through a sort of communication network, in order to integrate the control of a complex process.

3.3.1 Input Devices:-

Intelligence of an automated system is greatly depending on the ability of a PLC to read in the signal from various.

Push-buttons, keypad and toggle switches, which form the basic manmachine interface, are types of manual input device as shown in fig (3.3). On the other hand, for detection of work piece, monitoring of moving mechanism, checking on pressure and or liquid level and many others, the PLC will have to tap the signal from the specific automatic sensing devices like proximity switch, limit switch, photoelectric sensor, level sensor and so on. Types of input signal to the PLC would be of ON/OFF logic or analogue. These input signals are interfaced to PLC through various types of PLC input module.

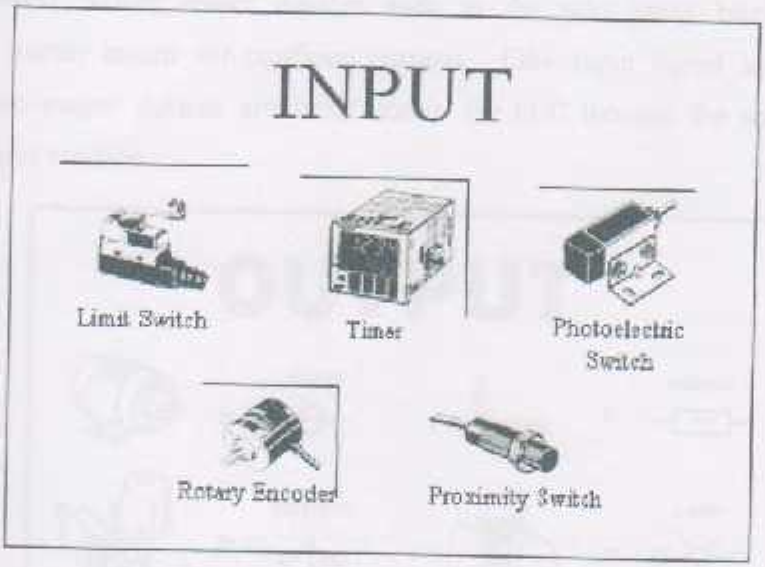


Figure 3.3: input devices

3.3.2Output devices:

An automatic system is incomplete and the PLC system is virtually paralyzed without means of interface to the field output devices. Some of the most commonly controlled devices are motors, solenoids, relays indicators, buzzers and etc. Through activation of motors and solenoids the PLC can control from a simple pick and place system to a much complex servo positioning system. These type of output devices are the mechanism of an automated system and so its direct effect on the system performance.

However, other output devices such as the pilot lamp, buzzers and alarms are merely meant for notifying purpose. Like input signal interfacing, signal from output devices are interfaced to the PLC through the wide range of PLC output module

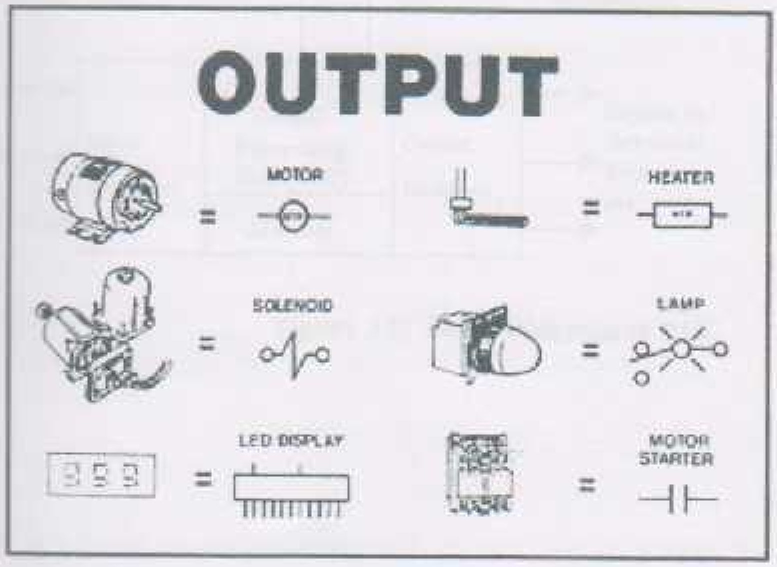


Figure 3.4: output devices

3.4 Programmable Controller:

A PLC consists of a Central Processing Unit (CPU) containing an application program and Input and Output Interface modules, which is directly connected to the field I/O devices. The program controls the PLC so that when an input signal from an input device turns ON, the appropriate response is made. The response normally involves turning ON an output signal to some sort of output devices.

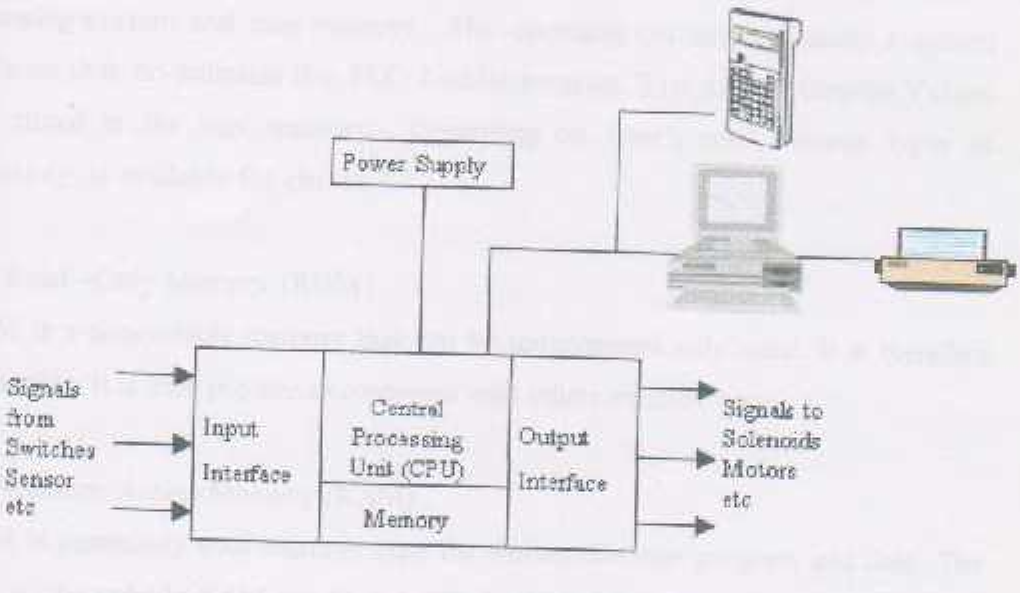


Figure 3.5: Block Diagram of PLC

Central Processing Unit:

The Central Processing Unit (CPU) is a microprocessor that co-ordinates the activities of the PLC. System. It executes the program, processes I/O signals & communicates with external devices.

Memory:

There are various types of memory unit. It is the area that holds the operating system and user memory. The operating system is actually a system software that co-ordinates the PLC Ladder program, Timer and Counter Values are stored in the user memory. Depending on User's need, various types of memory is available for choice:

(a) Read -Only Memory (ROM)

ROM is a non-volatile memory that can be programmed only once. It is therefore unsuitable. It is least popular as compared with others memory type.

(b) Random Access Memory (RAM)

RAM is commonly used memory type for storing the user program and data. The data in the volatile RAM would normally be lost if the power source is removed. However, this problem is solved by backing up the RAM with a battery.

(c) Erasable Programmable Read Only Memory (EPROM)

EPROM holds data permanently just like ROM. It dose not require battery backup. However, its content can be erased by exposing it to ultraviolet light. A prom writer is required to reprogram the memory.

(d) Electrically Erasable Programmable read Only Memory (EEPROM)

EEPROM combines the access flexibility of RAM and the non-volatility of EPROM in one. Its contents can be erased and reprogrammed electrically, however, to a limit number of time

3.5 Conventional Control Panel and Its Difficulties:

3.5.1 Control panel:

In the beginning of the Industrial revolution, especially in the 1960 & 1970, automated machines were controlled by electromechanical relays. These relays were all hardwired together inside the control panel. In some cases, the control panel was so huge that it could cover the entire wall. Every connection in the relay logic must be connected. Wiring is not always perfect; it takes time to troubleshoot the system. This is a very time consuming affair. On top of that, the relays have limited contacts. If modification is required, the machine has to be stopped, space may not available and wiring has to be traced to accommodate changes. The control panel can only be used for that particular process. It cannot be changed immediately to a new system. It has to be redone. In terms of maintenance, an electrician must be well trained and skillful in troubleshooting the control system. In short, conventional relay control panel are very inflexible.

A typical example of the conventional control panel is shown in Figure (3.6)

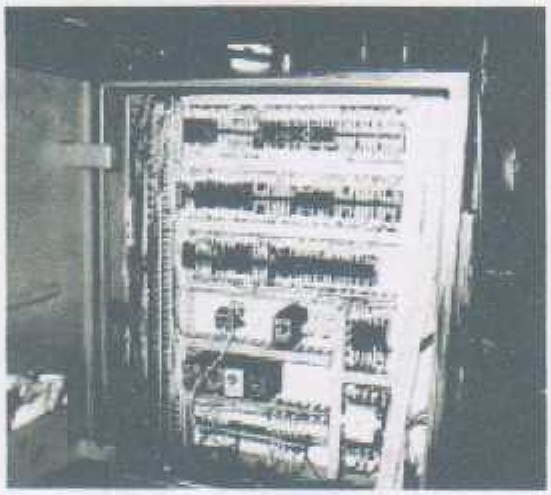


Figure 3.6: Typical Conventional Control Panel

3.5.2 Disadvantage of Conventional Control Panel:

In this panel we can observe the following points

- there are too many wiring work in the panel.
- Modification can be quite difficult.
- Troubleshooting can be quite troublesome as you may require a skillful person.
- Power consumption can be quite high as the coil consumes power.
- Machine downtime is usually long when problems occur, as it takes a longer time to troubleshoot the control panel.
- Drawings are not updated over the years due to changes. It causes longer downtime in maintenance and modification.

3.5.3 Programmable Controller Control Panel and Their Advantages:

With the arrival of programmable controllers, the control design and concept improve tremendously. There are many advantages in using the programmable controllers.

A typical example of the PLC control panel is shown in Fig (3.7)

Figure 3.7: Typical PLC Control Panel

3.5.4 Advantages of PLC Control Panel:

Here are the major advantages that can be distinguishably realized:-

- The wiring of the system usually reduces by 80% compared to conventional relay control system.
- The power consumption is greatly reduced as PLC consumes much less power.
- The PLC self diagnostic functions enable easy and fast troubleshooting of the system.
- Modification of control sequence or application can easily be done by programming through the console or computer software without changing of I/O wiring, if no additional Input or Output devices are required.
- In PLC System spare parts for relays and hardware timers are greatly reduced as compared to conventional control panel.

- The machine cycle time is improved tremendously due to the speed of PLC operation is a matter of milliseconds. Thus, productivity increases.
- It cost much less compared to conventional system in situation when the number of I/Os is very large and control functions are complex.
- The reliability of the PLC is higher than the mechanical relays and timers.
- An immediate printout of the PLC program can be done in minutes. Therefore, hardcopy of documentation can be easily maintained.

Here are some comparisons between some types of controller as see below in the table (3.1).

Table 3.1: comparison between different types of controllers

Comparison	Relay System	Computers	PLC Systems
Price per unit	Fairly low	High	Low
Physical size	Bulky	Fairly compact	Very compact
Operating speed	Slow	Fairly fast	Fast
Noise immunity	Excellent	Fairly good	Good
Installation	Time consuming in all phases	Time consuming in programming	Easy in all phases
Complex operation	None	Yes	Yes
Ease of change	Very difficult	Quite simple	Very simple
Easy of maintenance	Poor-large No. of contacts	Poor-several custom boards	Good-few standard cards

3.6 A Systematic Approach of Control System Design using a Programming Logic Controller:

The concepts of controlling a control system are a very simple and easy task. It involves a systematic approach by following the operation procedure.

1. Determine the Machine Sequence of Operation

'Firstly, you have to decide what equipment or system you want to control. The Ultimate purpose of the programmable controller is to control an external system. This system to be controlled can be machine equipment, or process and is often generically called the controlled system. The movement of the controlled system is constantly monitored by the input devices that give a specified condition and send a signal to the programmable controller. In response, the programmable controller outputs a signal to the external output devices which actually controls the movement of the controlled system as specified and thus achieves the extended control action. In simplicity, you need to determine the sequence operation by drawing out the flowchart.

2. Assignment of Inputs and Outputs:

Secondly, all external input and output devices to be connected to the programmable controllers must be determined. The input devices are the various switches, senses, etc. The output devices are the solenoids, electromagnetic valves, motor, inductors etc.

After identifying all the various INPUT and OUTPUT devices, assigned the numbers corresponding to the INPUT and OUTPUT number of the particular programmable controller you will be using. The actual wiring will follow the numbers of the programmable controller. The assignment of INPUT and

OUTPUT numbers must be carried out before writing the ladder diagram because the number dictate what is the precise meaning of the contacts in the ladder diagram.

3. Writing of the Program:

Next, write the ladder diagram program by following the control system sequence of operation as determined by step one.

4. Programming into Memory

Now, you can apply power to the programmable controller. Depending on the type of programmable controller, you may have to do a I/O generation to prepare the system configuration. After that, you can enter your program in the memory either by programming console or by computer aided ladder software tool. After completion of the programming, you should check for any coding errors by means of diagnostic function, and if possible simulate the whole operation to see that it is alright.

5. Running the System

Before the start push-button is pressed, thoroughly ensure that the input and Output wiring are correctly connected according to the I/O Assignment. Once confirmed, the actual operation of the PLC can now be started. You may need to debug along the way and fine tune the control system if necessary. Test run thoroughly until it is safe to operate by anyone.

3.7 PLC Program:

PLC controller takes the trouble of controlling many operations within the machine such as filling, packaging preparation, and packaging operation.

The plc connection of all operation is shown below in Fig. (3.8)

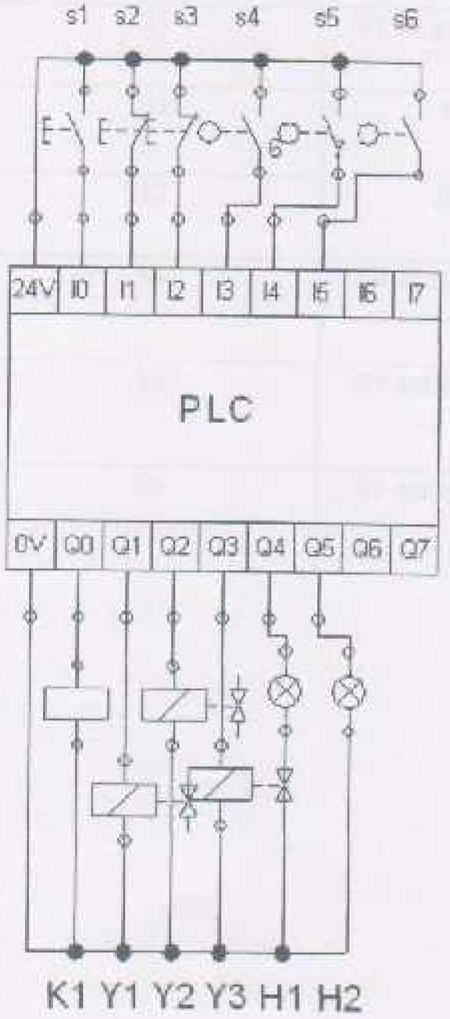


Figure3.8: PLC connection of all operation

Allocation table of the PLC program that has been used for operations control:

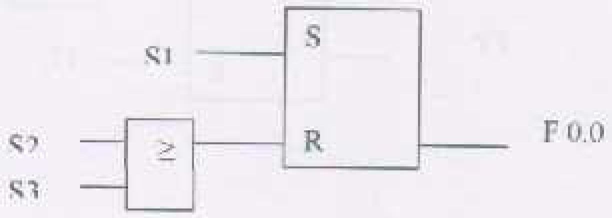
Table 3.2: Allocation Table for Inputs

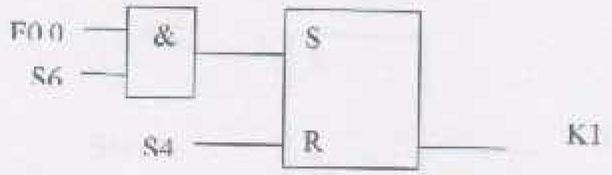
Input	Symbol	Logic allocation
Emergency	S3	S3: is activated all operation are OFF (EM=0)
Start	S1	S1 is pressed motor ON (S1=1)
Stop	S2	S2 is pressed motor OFF (S0=0)
Limit switch	S4	S4 activated → solenoid valve (Y1) activates (S4=1)
Limit switch	S5	S5 activated → solenoid valve (Y2) activates (S5=1)
Limit switch	S6	S6 activated → solenoid valve (Y3) activates (S6=1)

Table 3.3: Allocation Table for Outputs

Output	Symbol	Logic Allocation
Motor's contactor	K1	K1=1 → motor running.
Solenoid valve1	Y1	Y1=1 → Cylinder1 activates (flow out).
Solenoid valve2	Y2	Y2=1 → cylinder2 activates (flow out).
Solenoid valve3	Y3	Y3=1→cylider2 return to state normal (flow in)
Green lamp	H1	H1=1 → start packaging operation & motor is running.
Red lamp	H2	H2=1 → end packaging operation & the motor is stop.

3.8 Block diagram of plc program :





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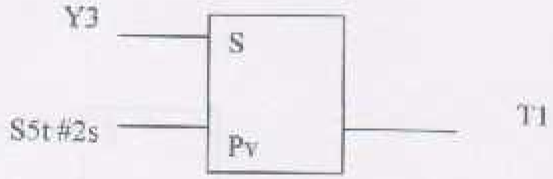

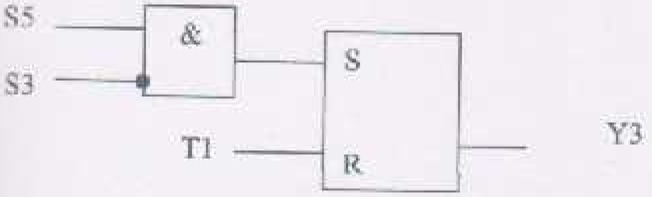

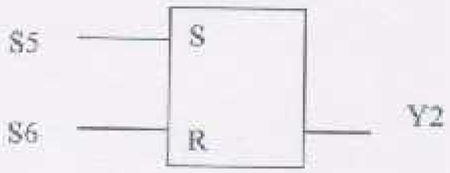

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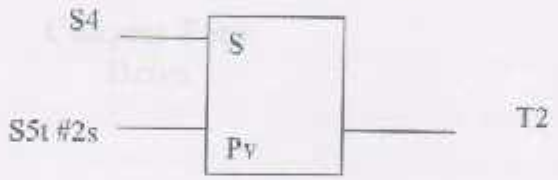
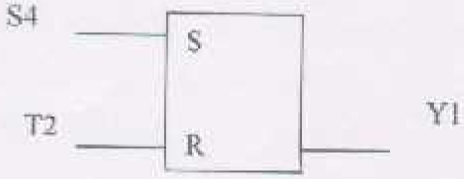




Chapter Four
Drive

4.1 Introduction.

4.2 Relationship of Motor Speed and Torque

4.3 Mechanical Calculations

4.1 Introduction:

AC motor drives are widely used to control the speed of conveyor systems, blower speeds, pump speeds, machine tool speeds, and other applications that require variable speed with variable torque. The complete system consists of an ac voltage input that is put through a diode bridge rectifier to produce a dc output which across a shunt capacitor, this will, in turn, feed the PWM inverter. The PWM inverter is controlled to produce a desired sinusoidal voltage at a particular frequency, which is filtered by the use of an inductor in series and capacitor in parallel and then through to the squirrel cage induction motor.

A modern adjustable speed AC machine system is equipped with an adjustable frequency drive that is a power electronic device for speed control of an electric machine. It controls the speed of the electric machine by converting the fixed voltage and frequency of the grid to adjustable values on the machine side. There are many types of inverters, and they are classified according to number of phases, use of power semiconductor devices, commutation principles, and output waveforms.

This research interest in three-phase inverter circuit that changes DC input voltage to a three-phase variable-frequency variable-voltage output. Three-phase inverters are also used in applications in which AC with a controllable frequency is required. In this application, three-phase AC is rectified into DC and then filtered to minimize the ripple content. The DC link is generally used for this purpose. This is a variable DC obtained by employing three-phase full controlled power Transistors Bridge. This controlled DC is converted into controlled pulses by means of as voltage to frequency converter. These controlled pulses are fed to the inverter bridge for producing the variable voltage variable frequency output. This output is fed to the three-phase induction motor for controlling its speed.

4.2 Relation ship of motor speed and torque:

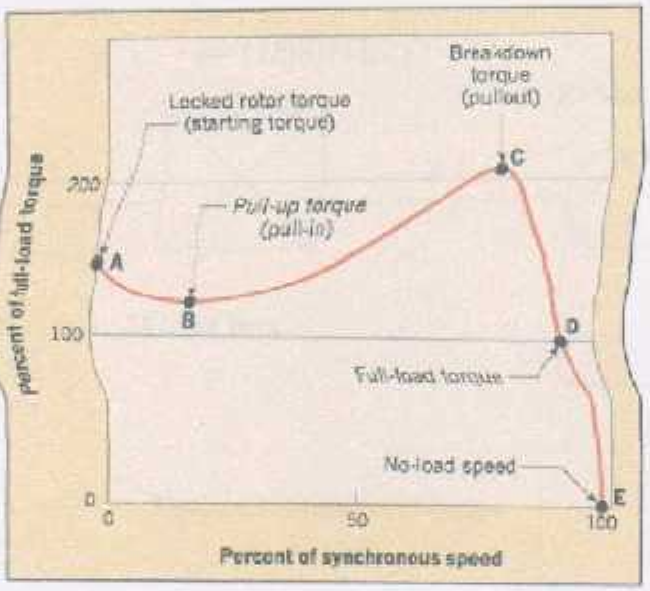


figure 4.1 : The Delicate Relationship of Motor Speed and Torque (This is a typical torque-speed curve for a standard AC induction motor)

It's important to understand some details of motor performance as shown by a typical Torque-Speed curve in the Figure (7.1) to the right. The plot shows what happens in terms of output torque and motor speed when a motor is started with full voltage applied.

The motor is initially at zero speed and develops locked-rotor torque (Point A). As the motor accelerates, some motor designs produce a slight dip in torque. If they do, the lowest point on this curve is called the pull-in or pull-up torque (Point B). As the speed increases further, the torque generally increases to the highest point on the curve (Point C), which is called the pullout or breakdown torque. Finally, when the motor is loaded to its full-load torque, the motor speed stabilizes (Point D).

4.3 Mechanical calculations:

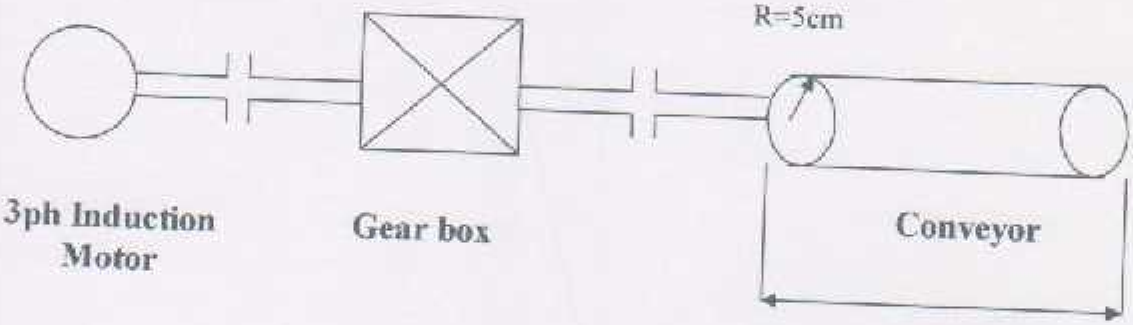


Figure 4.2: Mechanical design

4.4.1 Total moment of inertia:

The inertia can be calculated if the dimensions and weights of the load and motor are known. for the figure6.2 the mass M rotate about axis Z with an angular acceleration (α). All particles of the body move in parallel planes that are normally to rotation axis Z. The particle dm accelerate with tangent acceleration ($r.\alpha$) and from the second Newton low of motion the resultant tangent force affected to dm equal ($r.\alpha.d_m$) the moment of this force about axis Z equal ($r^2\alpha dm$), finally we express the total moment of the mass M around axis Z by $\int r^2 \alpha dm$ for the rigid body α is the same for all radial lines and May we take out of the integral sign, then the moment of inertia define as:

$$J = \int r^2 dm = \rho \int r^2 dV \qquad \text{.......................... (4.3)}$$

Where:

J: moment of inertia ($kg.m^2$).

r: distance between part of the mass and axis's of rotation at angular(m) acceleration(α)($rev/\sec^2$) .

m: mass of the rigid body(kg).

ρ: density of the rigid body (kg/m^3).

dV: part of the volume.

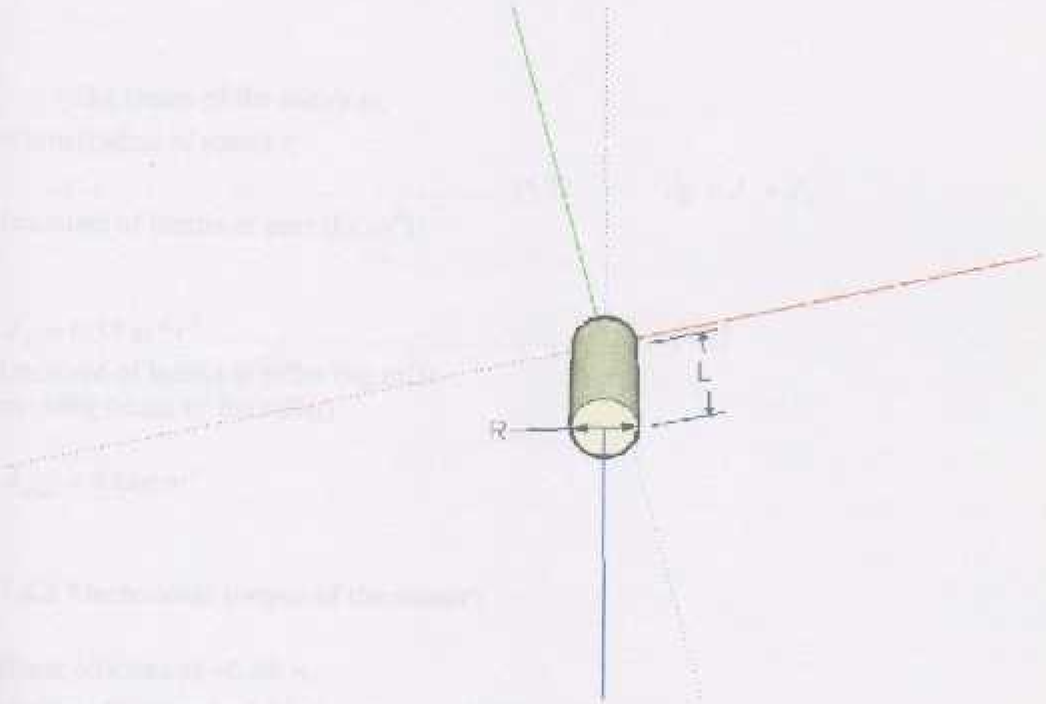


Figure4.3: Roller (or any uniform cylinder)

The inertia of the uniform cylinder can be derivative from equation (4.3) Around Z axis, and given by:

$$J_z = \frac{1}{2} mr^2 \qquad (4.4)$$

Where:

J_Z: moment of inertia at the center of the roller (uniform cylinder) (kg.m^2).

r: radius of base roller (m).

m: mass of roller (kg).

………………………(4.5) $J_{total} = J_m + J_g + J_z * a^2 + m * R * a^2$

$J_m = 0.5 * m_r * r_r (kg.m^2)$ ……………………………………(4.6)
(moment of inertia at rotor the motor).

= 0.5*5*0.03 J_m
J_m $kg.m^2 = 0.075$

=5kg (mass of the rotor) m_r
=3cm (radius of rotor) r_r
……………………………………………… (4.7) $Jg = J_1 + J_2$
(moment of inertia at gear (kg.m^2)).

$J_2 = 0.5 * m * r^2$ ……………………………………………(4.8)
(moment of inertia at roller (kg.m^2)).
m=10kg (mass of the roller)

$J_{total} = 0.6 kg.m^2$

7.4.2 Mechanical torque of the motor:

(Gear efficiency) =0.65 η_1
(Roller efficiency) =0.65 η_2
V =0.0299m/s (conveyor speed)
=V/R ……………………………………………………………(4.9) w_2
R=2cm (roller radius)
$w_m = \frac{w_2}{a}$
=0.5 (gear ratio) a
=1/50 a
…………………………………………………… (4.10) $F_n = m.g$
m=5 kg (mass to be moved()
=50N F_n
=0.2 N.m T_m
tension on the roller T_n
…………………………………………………… (4.11) $T_n = F_n * R$
=0.2N.m (friction torque o roller) T_r

$$T_1 = T_m + \frac{Tn * \alpha}{\eta_1} + \frac{T_f * \alpha}{\eta_1 \eta_2} + T_{acc} \quad \text{.......................................(4.12)}$$

$$T_{acc} = J_{tot} * \alpha = J_{tot} * \frac{w_m}{t_s} \quad \text{..(4.13)}$$

α : angular acceleration (rad/sec^2).

: acceleration torque (Nm)T_{acc}

:acceleration time. t_s

=1st_s

$rad/\sec^2$ =1/1=1α

Table 4.1: Results of calculations

v	w_2	w_m	J_{tot}	T_{load}	Power of motor
m/s	1/s	1/s	$kg.m^2$	N.m	watt
0.0229	1.44	149.67	0.6	0.82	123

.... (4.14)$T_{Load} * w_m$ Power of motor =

Name plate of the motor:

Type 156B4 Nr2103598100					
S1 serv.		cosφ 0.65		prot IP 55	
V Δ/Y	Hz	hp	Kw	rpm	A Δ/Y
220/380	50	0.12	0.9	1360	0.8/0.45
240/415	50	0.12	0.09	1360	0.9/0.5
260/440	60	0.12	0.11	1640	0.8/0.45
IFQ Asynchronous motors					

Chapter Five

Pneumatic

5.1 Introduction

5.2 Components of Pneumatic System

5.3 Valves

5.4 Pneumatic System Design

5.5 Pneumatic Design for the Project

5.1 Introduction:-

Pneumatics has long since played an important role as a technology in the performance of mechanical work. It is also used in the development of automation solutions.

The pneumatic cylinder has a significant role as a linear drive unit, due to it

Relatively low cost, ease of installation, simple and robust construction and ready availability in various sizes and stroke lengths.

Some industrial applications employing pneumatics are listed below:

General methods of material handling:

- Clamping
- Shifting
- Positioning
- Orienting
- Branching of material flow

General applications:

- Packaging
- Filling
- Metering
- Locking
- Driving of axes
- Door or chute control
- Transfer of materials
- Turning and inverting of parts
- Sorting of parts
- Stacking of components
- Stamping and embossing of components

Pneumatic systems consist of an interconnection of different groups of elements:-

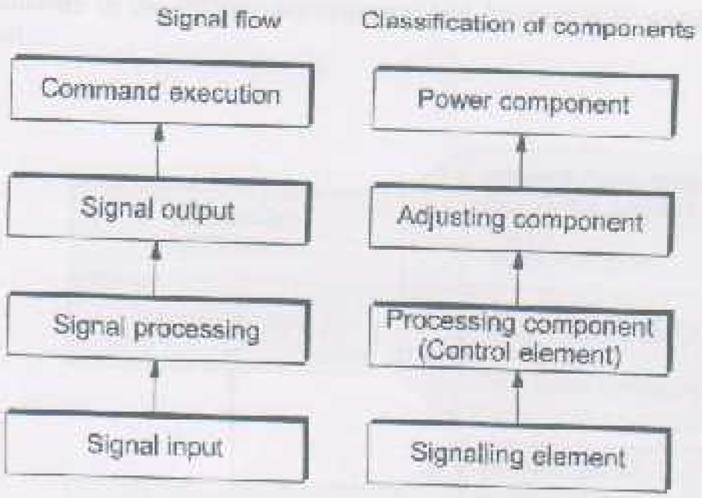


Figure 5.1: signal flow

This group of elements forms a control path for signal flow, starting from the signal section (input) in figure (5.1) through to the actuating section (output).

Control elements control the actuating elements in accordance with the signals received from the processing elements.

The primary levels in a pneumatic system are:

- Energy supply
- Input elements (sensors)
- Processing elements (processors)
- Control elements
- Power components (actuators)

The elements in the system are represented by symbols which indicate the function of the element.

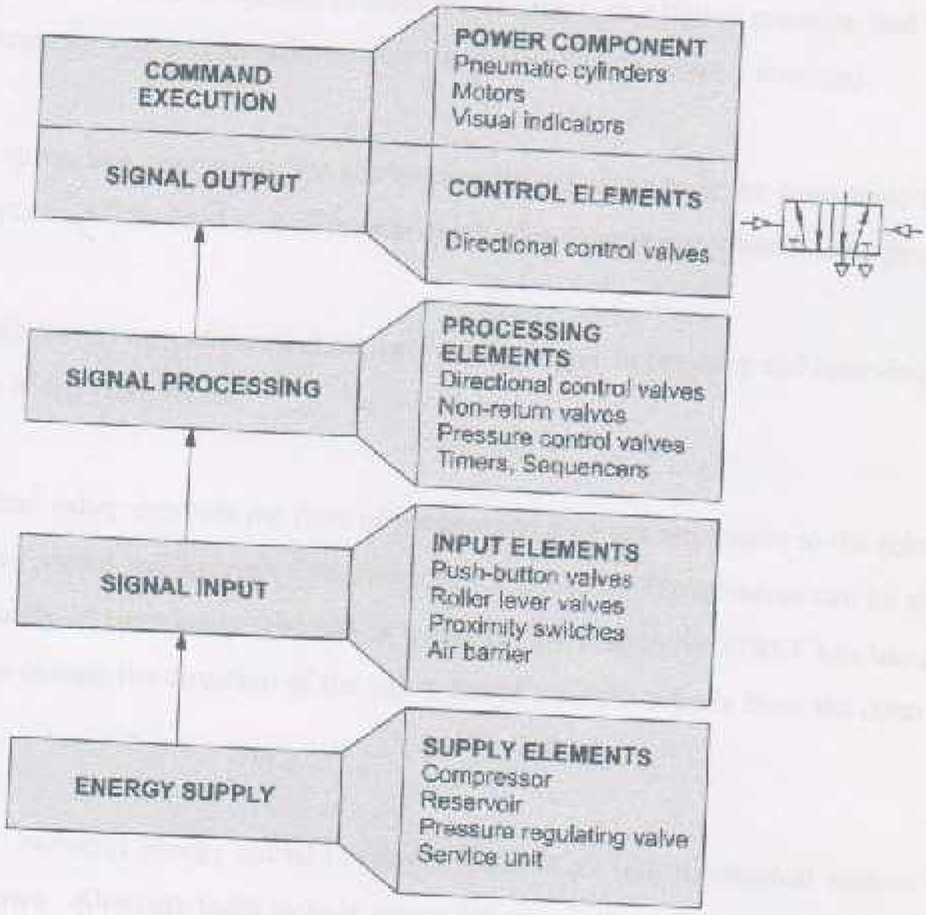


Figure 5.2: Pneumatic control system

5.2 Components of a pneumatic system:-

Elements of a basic pneumatic system:

1. Compressor: a pump which compresses air, raising it to a higher pressure, and delivers it to the pneumatic system (sometimes, can also be used to generate a vacuum).

2. Check valve: one-way valve that allows pressurized air to enter the pneumatic system, but prevents backflow (and loss of pressure) into the compressor when it is stopped.

3. Accumulator: stores compressed air, preventing surges in pressure and relieving the duty cycle of the compressor.

4. Directional valve: controls the flow of pressurized air from the source to the selected port. Some valves permit free exhaust from the port not selected. These valves can be actuated either manually or electrically (the valves typically provided in the FIRST kits use dual solenoids to change the direction of the valve, based on input signals from the control system).

5. Actuator: converts energy stored in the compressed air into mechanical motion. A linear piston is shown. Alternate tools include rotary actuators, air tools, expanding bladders, etc

5.3 Valves:

The function of valves is to control the pressure or flow rate of pressure media. Depending on design, these can be divided into the following categories:

- Directional control valves
  - Input/signaling elements
  - Processing elements
  - Control elements
- Non-return valves
- Flow control valves
- Pressure control valves
- Shut-off valves

5.4 solenoid valve:

There are many different types of solenoid valves available, and many companies that make them.

A solenoid is a coil of wire that becomes magnetized when electricity is run through it. Solenoids often have a hole in the middle and a protruding metal rod that is pushed or pulled by magnetism when power is applied.

A solenoid valve uses a solenoid to actuate a valve. This lets you control the flow of water, air, or other things with electricity.

When selecting a solenoid valve, you must pay attention to:

Coil voltage, current, AC or DC, and intermittent versus continuous duty.

valve type

aperture size

pressure rating, such as "50 PSI"

materials (medium) that it can control, such as "air/water"

type of connection to each port, such as "1/4" NPT"

5.5 Pneumatic System Design:-

As we design a pneumatic system of the type used in the FIRST competitions, we want to know three things:

- How much force can an actuator apply.
- is that force sufficient to move the desired load.
- How fast can the load be moved.

To determine how much force an actuator can apply, we need to calculate the **Theoretical Force**. For a pneumatic piston actuator (shown in figure (5.3)), that is determined by multiplying the surface area of the moving piston by the pressure applied. In other words, for a round piston:

$$F_t = p * D^2/4 * P \text{............ (5.1)}$$

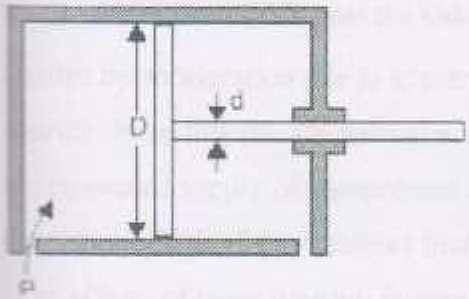


Figure 5.3: pneumatic piston actuator

Where D is the diameter of the piston and P is the working pressure of the injected air. Note that on The reverse stroke of the piston, the available surface Area of the piston is decreased by the area of the piston rod. In that case:

$$F_t = p * (D^2 - d^2)/4 * P \text{..... (5.2)}$$

Note this does not account for inefficiencies in the actuator due to friction between the piston and the cylinder wall, the piston rod and the packing gland, stiction forces, etc. For our purposes, these factors contribute to an approximate 5% loss in efficiency (i.e. the practical force available from the piston is about 95% of the calculated force).

Metal parts or about 0.005 for iron rolling on iron as in a ball bearing, etc.).

The Load Ratio is the relationship between the force required to move the load and the available force from the actuator. The load ratio is determined by:

Load ratio = (Required Forced / Theoretical Force) * 100 %.................(5.3)

In theory, the load ratio must be 100% or lower to be able to perform the task. In practical applications, the load ratio should be 85% or lower. Also note that if the actuator is able to deliver more force than the minimum needed to move the load, then the excess force delivered by the actuator is used to accelerate the load. In other words:

Acceleration Force (F_a) = Theoretical Force (F_t) – Required Force (F_r)... (5.4)

Knowing the acceleration of the object and the distance to be traveled (the stroke of the piston), we can calculate the time required for the object to move from rest to the end of the piston stroke (remember that the value of G is determined by the weight of the object divided by acceleration due to gravity; 32 ft/sec^2 for English units, or 9.8 m/sec^2 for metric). Note that this theoretical acceleration is based on the assumption that there is an instantaneous supply of compressed air, and there is no back pressure on the back side of the piston. Each of these factors limits the practical acceleration of the load.

The effects of these limiting factors can be reduced by applying a number of strategies when designing the pneumatic system. A very complex set of calculations can be used to evaluate the different design parameters, or we can use a set of "Rules of Thumb" which result in approaches that are close enough for our purposes. These are captured below.

5.5 Pneumatic design for the project:

The project includes pneumatically operations for performing filling, preparation, packaging, and glue operation.

5.5.1 Pneumatic design fro Packaging operation:

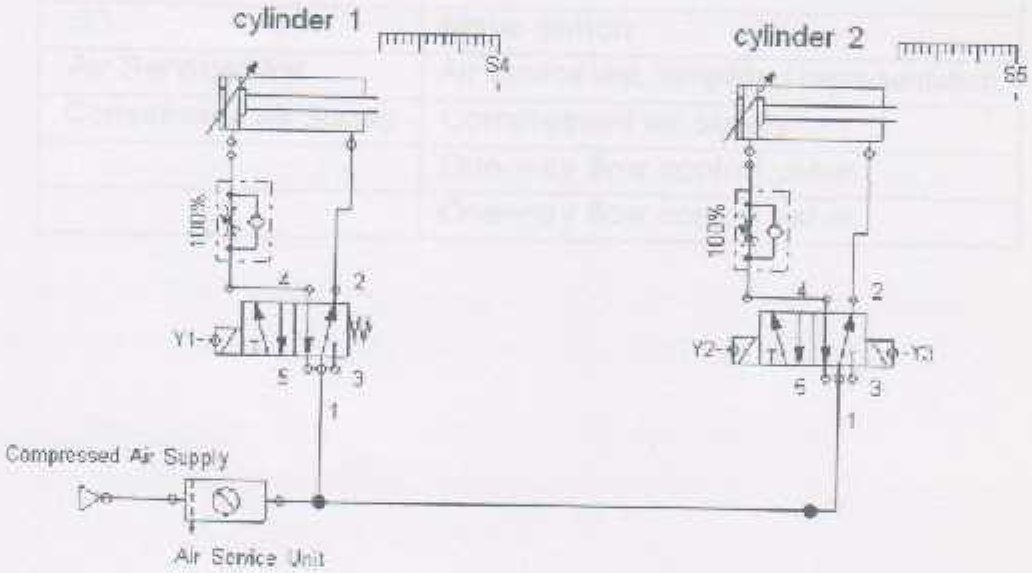


Figure 5.4: Pneumatic design for Packaging operation

Table 5.1: elements of Pneumatic design for packaging operation

Designation	Component Description
	5/n Way Valve
	Double acting cylinder
	Double acting cylinder
	5/n Way Valve
Y2	Valve solenoid
Y3	Valve solenoid
Y1	Valve solenoid
S4	Make switch
S5	Make switch
	Electrical connection 0V
	Electrical connection 24V
S3	Make switch
Air Service Unit	Air service unit. simplified representation
Compressed Air Supply	Compressed air supply
	One-way flow control valve
	One-way flow control valve

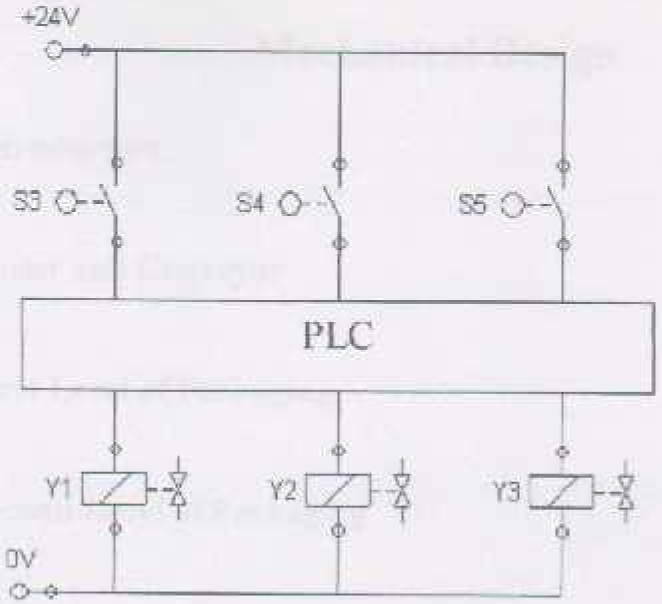


Figure 5.5: Control circuit of pneumatic design for packaging operation

The filled bag enters the packaging operation. When the filled bag reaches to cylinder1 the limit switch detects the bag and gives an order to activate cylinder1 (flow out) to ensure discouraging operation as shown in Fig (5.4).

The elements used in this pneumatic circuit are shown in table (5.5).
When using the solenoid valve then it should be controlled by electrical signal taken from PLC controller as shown in figure (5.6).

Chapter Six

Mechanical Design

6.1 Introduction

6.2 Motor and Conveyor

6.3 First Level of Packaging

6.4 Second Level of Packaging

6.5 Third Level of Packaging

6.6 Last Level of Packaging

6.7 Final Form of the Machine

6.8 design explanation

6.1 Introduction

This section talks about mechanical machine parts and elements used, then how the implementation method is to be constructed. Also there are detailed dimensions of the whole elements used with directed positions.

The mechanical system in this project has main parts, this parts are combined together to form mechanical units, and those units are combined also together for forming the machine. Following is a brief discussion about each one of the components.

6.2 Motor and Conveyor

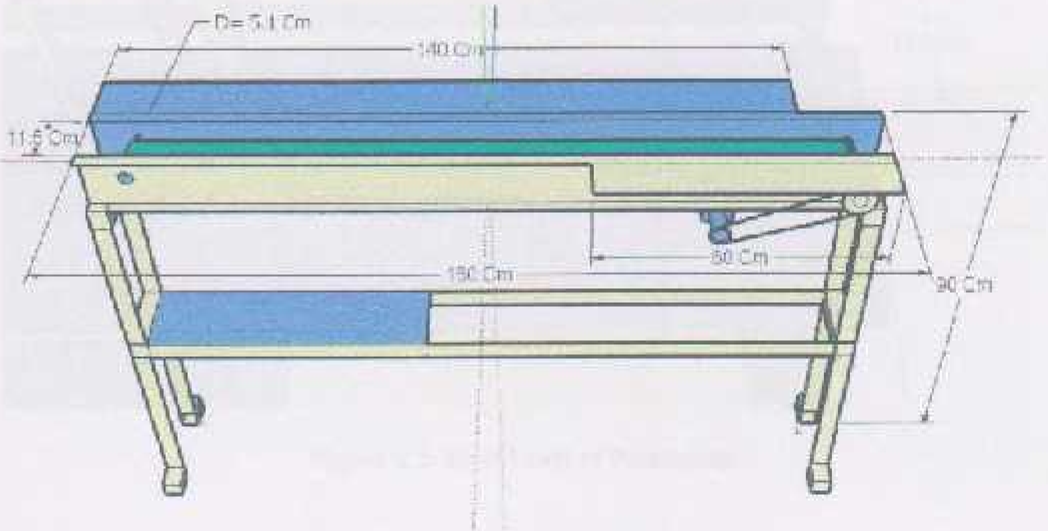


Figure 6.1: Motor and Conveyor

Fig (6.1) explains the connection of the motor with the conveyor through the reduction gear.

6.3 First Level of Packaging

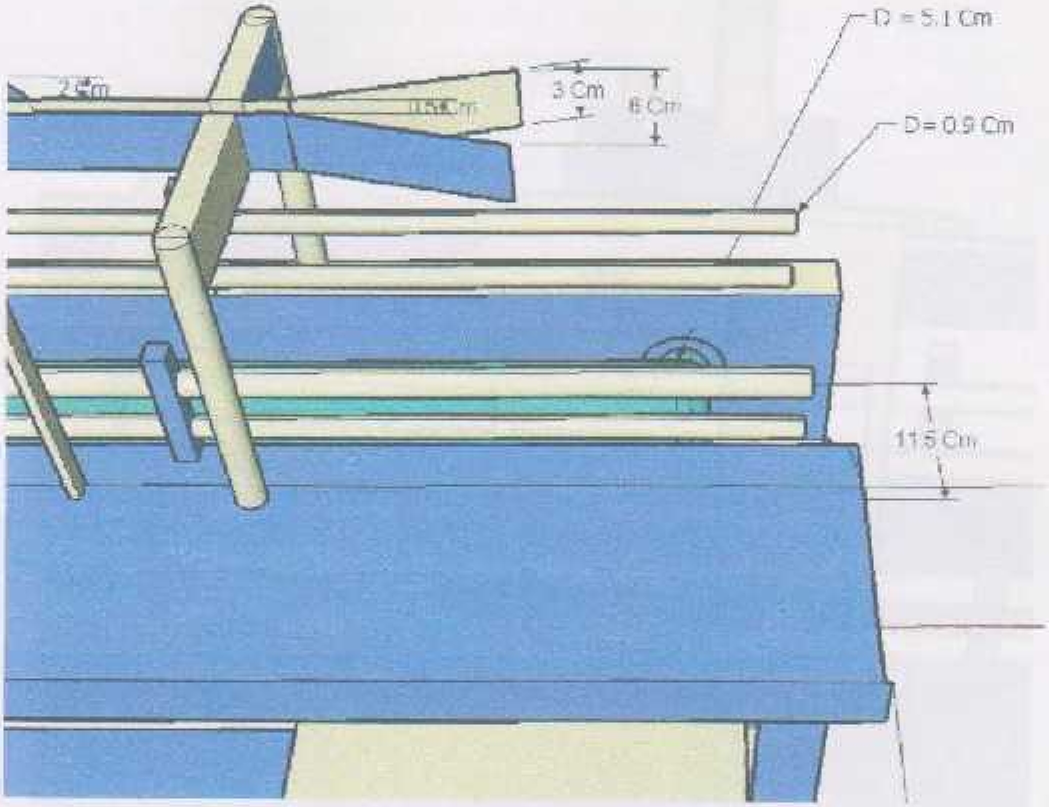


Figure 6.2: First Level of Packaging

Fig (6.2) here bag will prepare for the second level by nearing the up parties to each other and passing through the path.

6.4 Second Level of Packaging

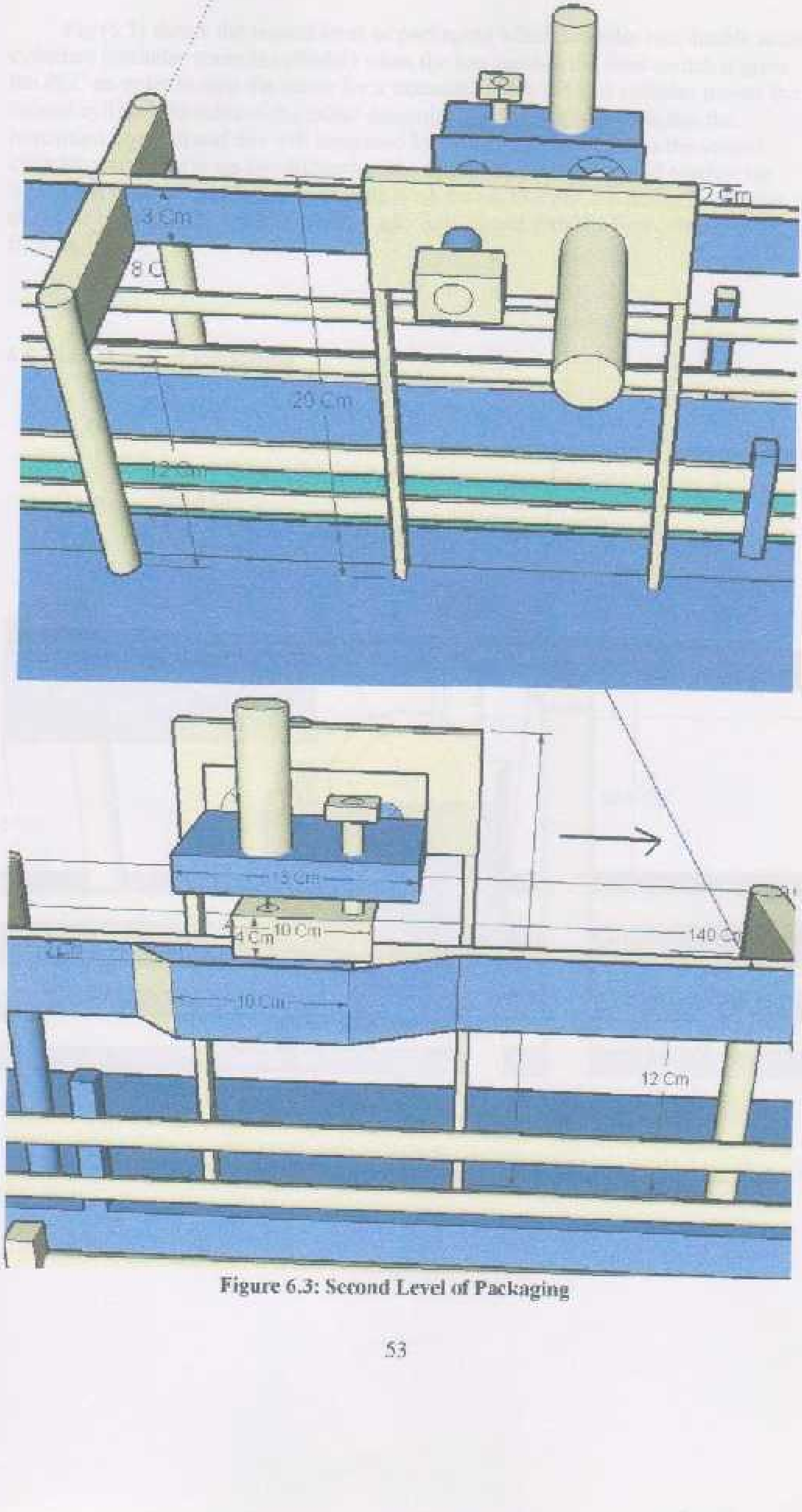


Figure 6.3: Second Level of Packaging

Fig (6.3) shows the second level of packaging which includes two double acting cylinders (cylinder controls cylinder) when the bag reaches the limit switch it gives the PLC an order to stop the motor for a moment; where the first cylinder moves the second cylinder (to achieve the initial discourage of the bag) until reaches the maximum flow out and this will happened by using limit switch, then the second cylinder activated (to get the discourage the bag as desired form) until reaches the maximum flow out and this will activate limit switch to make the motor runs again, after few moments the second cylinder will flow in and then the first cylinder will flow in.

6.5 Third Level of Packaging

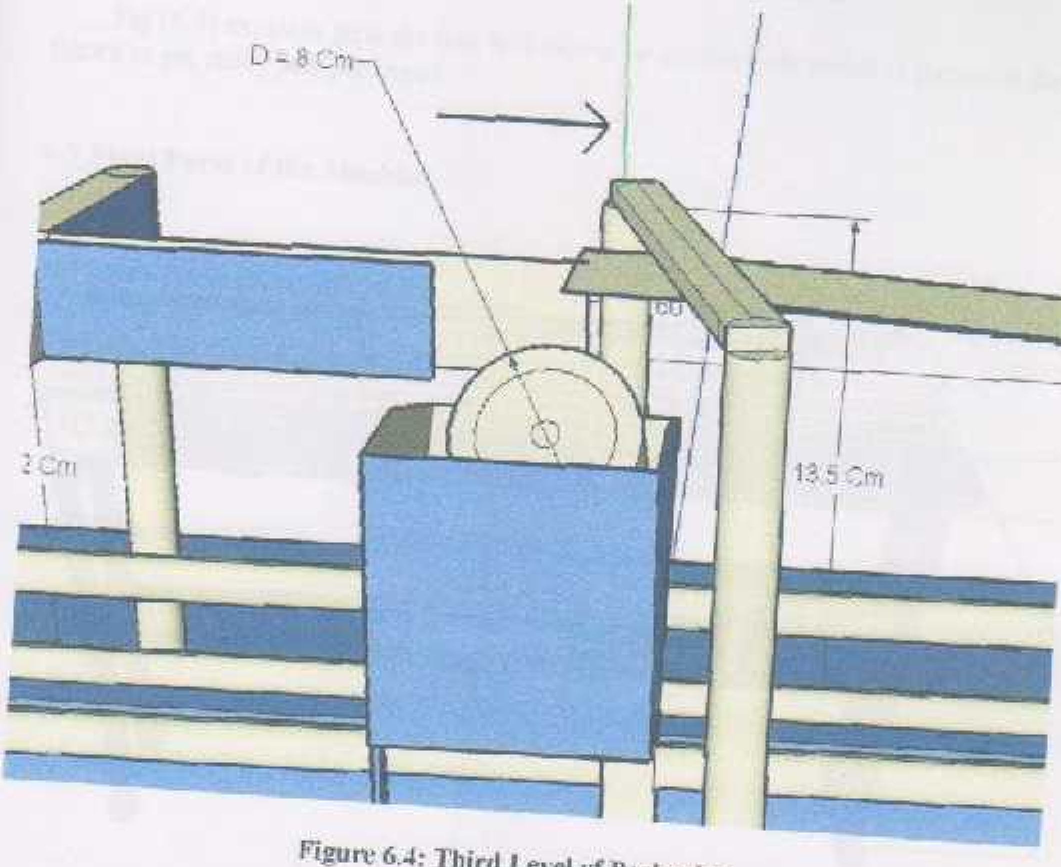


Figure 6.4: Third Level of Packaging

Fig (6.4) shows the third level and here the closed end bag parties will have the glue on it.

6.6 Last Level of Packaging

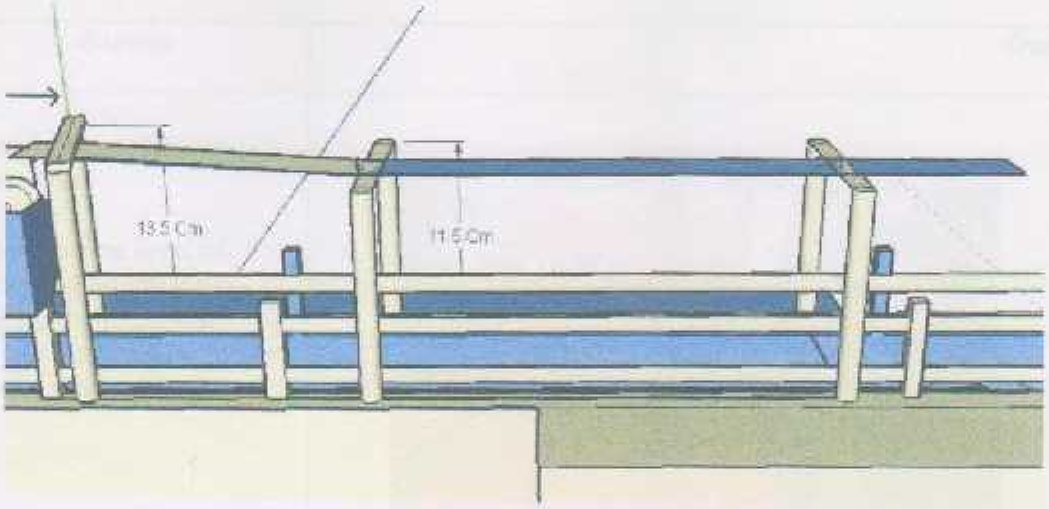


Figure 6.5: Last Level of Packaging Operation

Fig (6.5) explains how the bag will moves under the path which is shown in the figure to get ready and packaged.

6.7 Final Form of the Machine

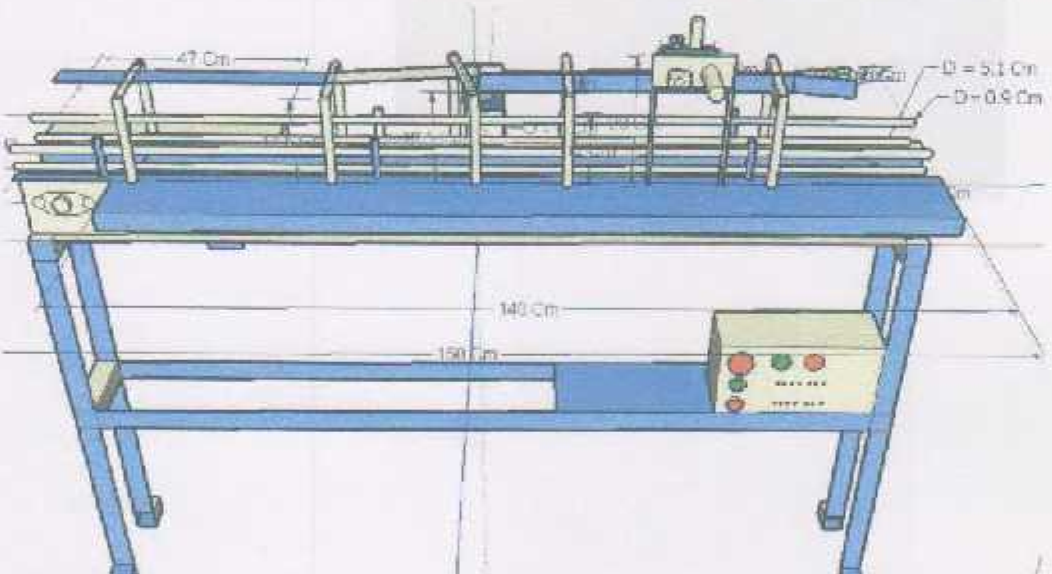


Figure 6.6: Final form of the machine.

Figure (6.6) shows the whole machine with all pats and final form.

6.8 Design Explanation

Explain	Design
First level packaging operation: Show the first level of packaging operation to prepare the upper parts of the bag then moves to the second level operation	

Second level of packaging operation :

here the bag reach to the second level of packaging to make the first close by using two double acting cylinders as shown beside.

When the bag reaches to the limit switch shown, the motor will stop and the cylinders will activate by some arrangement.

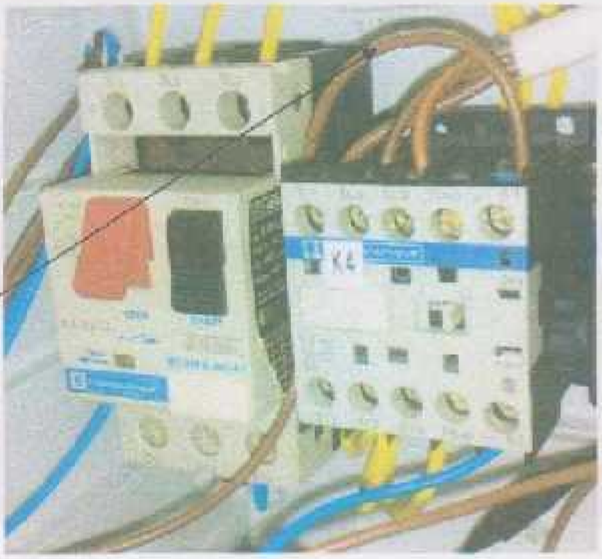
Cylinder 1

Cylinder 2

Limit switch it gives the PLC an order to stop the motor and to activate the cylinders

Shows the bag after get out from second packaging operation to become ready to put the glue on the first close.	

Given	Form
Glue operation : here the bag reaches to the glue bottle, and it will be glued due to presence the tire on the glue Tire carries glue to the upper part of the bag	
The last packaging operation : After ending the glue operation the bag will enter the last level, here the bag will forced to move under the condition that is shown beside.	

Shows the motor connection with contactor (K4) and overload protection (O.L). Contactor responsible on running the motor after it takes an order from PLC. Overload is adjusting on rated current exactly which is taken from the name plate From PLC	
Here two solenoid valve it takes signal from PLC and operates the two double acting cylinders Takes signal from PLC	

PLC Inputs

PLC Outputs

control panel include start, stop, and emergency push buttons, signal lamp and input /output PLC

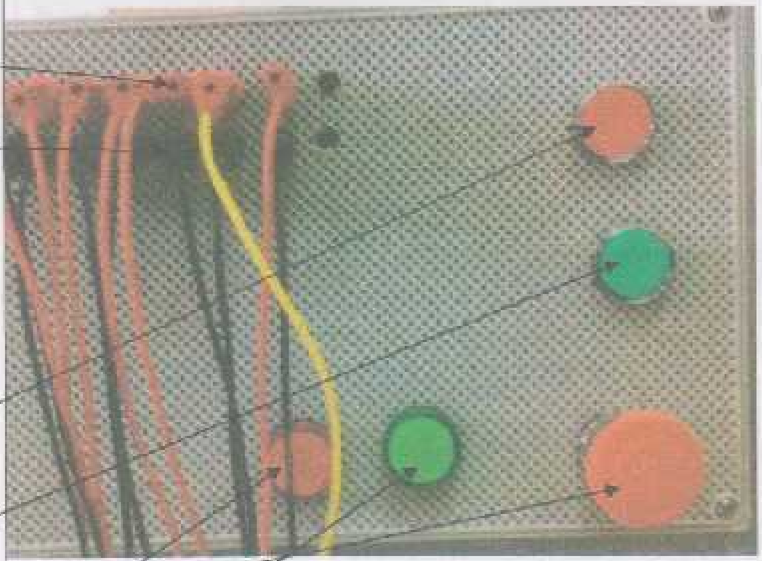
Stop Push Button

Start Push Button

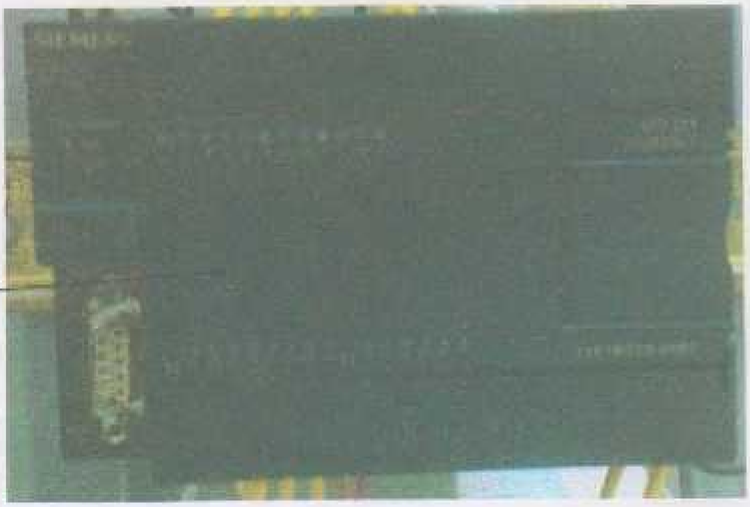
Emergency Push Button

ON when the system off

ON when the system on



Here is the PLC which responsible about controlling the whole operations



PLC Type

Siemens, S200,

S7

6/6 input, output

Fig. beside explain how to connect the motor with reduction gear.
Gear with conveyor through chain

Screw necessary to the belt calibration of the conveyor

The Final Form of the Machine	 

Chapter seven

Protection and Switches

7.1 Introduction to protection

7.1.2 Contactor

7.1.3 Overload

7.2 Introduction to Switches

7.2.1 Limit Switches

7.2.2 Pushbutton

7.2.3 Emergency Switches

7.3 Conclusion

7.4 Recommendation

7.1 Introduction to protection:

The power circuit of an automatic control system must perform the function of isolation, safety control, function control and electrical protection, which detected overloads and short circuit.

Protection device must be used in electrical control circuit detect any electrical and mechanical problems, which can occur in the load.

Any protection device must allow the motor to start but also protect the motor by preventing its operation when an over current occurs for too long a time period.

7.1.2 Contactor

Figure 7.1: Contactor.

A contactor is an electrically controlled switch (relay) used for switching a power circuit. A contactor is activated by a control input which is a lower voltage /

current than that which the contactor is switching. Contactors come in many forms with varying capacities and features. Unlike a circuit breaker a contactor is not intended to interrupt a short circuit current

Contactors range from having a breaking current of several amps and 110 volts to thousands of amps and many kilovolts. The physical size of contactors ranges from a few inches to the size of a small car.

Contactors are used to control electric motors, lighting, heating, capacitor banks, and other electrical loads.

Contactors used for starting electric motors are commonly fitted with overload protection to prevent damage to their loads. When an overload is detected the contactor is tripped, removing power downstream from the contactor.

Contactors are designed to be directly connected to high-current load devices, not other control devices, when current passes through the electromagnet, a magnetic field is produced which attracts ferrous objects, in this case the moving core of the contactor is attracted to the stationary core. Since there is an air gap initially, the electromagnet coil draws more current initially until the cores meet and reduce the gap, increasing the inductive impedance of the circuit.

7.1.2 Overload

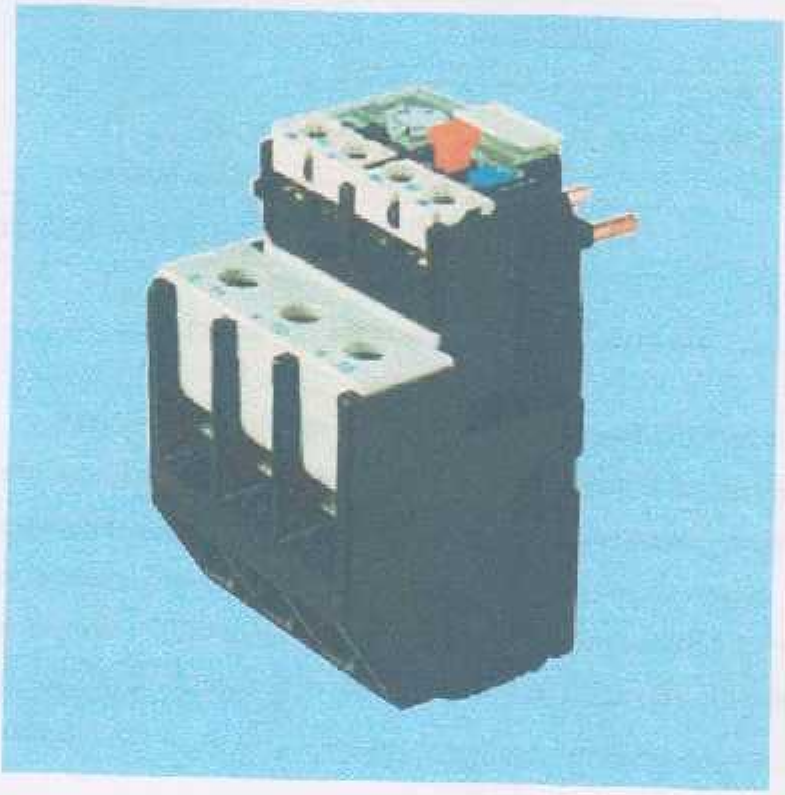


Figure 7.2: Overload.

Unlike other consumers such as filament bulbs, fluorescent tubes and heating resistors, motors may be subject to overloads. These kinds of overloads arise for several reasons, for example,

• Because the friction conditions of the driven machines change,

• Because pumps have to work against different pressure heads,

• When the tool engages more powerfully and the transport carriage has a greater load,

• Because startups or braking operations are too long.

• Due to blocked rotors

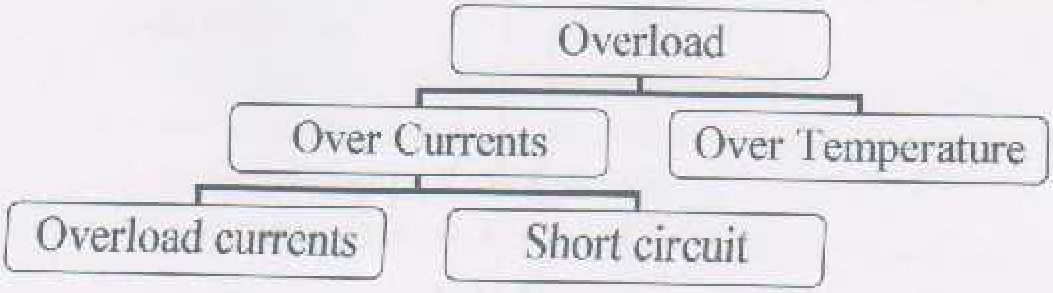


Figure 7.3: Different categories of overload

Motors that are designed for a specific relationship between the loads, startup time and switch off time can also be overloaded if the startup time is lengthened or the switch off time is reduced whilst the current consumption is kept constant. These kinds of time changes can also change torque characteristics. If the torque increases, the current consumption increases as well, leading to an increase in motor temperature with every increase in current.

A long period of increased current consumption may damage or destroy the insulation of the motor windings.
The life span of motors depends very much on the observance of temperature limits. Examinations have shown that the lifespan of motors is considerably reduced with even the Slightest continuous over temperature above the permissible continuous temperature limit. As a rough guide it can be assumed that the lifespan of a winding insulation is reduced by 50 % with every over temperature of 10 °C.

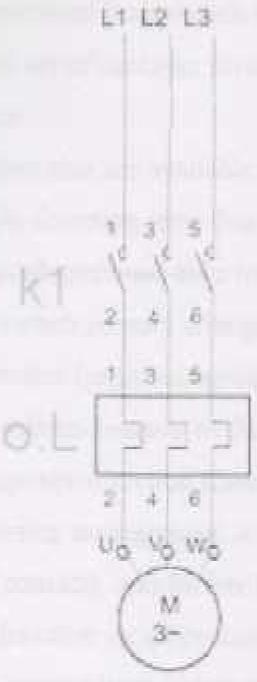


Figure 7.4: Motor Connection.

In figure (4.2) shows the motor connection with contactor (K1) and overload protection (O.L). Contactor responsible on running the motor after it takes an order from PLC. Overload is adjusting on rated current exactly which is taken from the name plate.

7.2 Introduction in switches

Switches are commonly employed as input devices to indicate the presence or absence of a particular condition in a system or process that is being monitored and/or controlled. In motorized electromechanical systems.

7.2.1 Limit switch

Limit Switches & Limit Switch Information: A mechanical limit switch interlocks a mechanical motion or position with an electrical circuit. A good starting point for limit-switch selection is contact arrangement.

The most common limit switch is the single-pole contact block with one NO and one NC set of contacts; however, limit switches are available with up to four poles.

Limit switches also are available with time-delayed contact transfer. This type is useful in detecting jams that cause the limit switch to remain actuated beyond a predetermined time interval.

Other limit switch contact arrangements include neutral-position and two-step. Limit switches feature a neutral-position or center-off type transfers one set of contacts with movement of the lever in one direction. Lever movement in the opposite direction transfers the other set of contacts. Limit switches with a two-step arrangement, a small movement of the lever transfers one set of contacts, and further lever movement in the same direction transfers the other set of contacts.

Maintained-contact limit switches require a second definite reset motion. These limit switches are primarily used with reciprocating actuators, or where position memory or manual reset is required. Spring-return limit switches automatically reset when actuating force is removed.

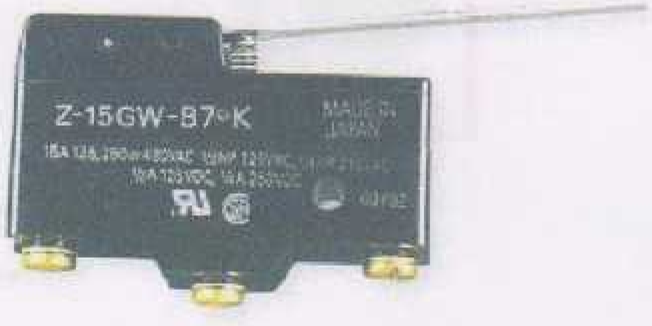


Figure 7.5: Limit Switch.

7.2.2 Push button switch

A push button switch is used to either close or open an electrical circuit depending on the application. Push button switches are used in various applications such as industrial equipment control handles, outdoor controls, mobile communication terminals, and medical equipment, and etc. Push button switches generally include a push button disposed within housing. The push button may be depressed to cause movement of the push button relative to the housing for directly or indirectly changing the state of an electrical contact to open or close the contact. Also included in a pushbutton switch may be an actuator, driver, or plunger of some type that is situated within a switch housing having at least two contacts in communication with an electrical circuit within which the switch is incorporated. Typical actuators used for contact switches include spring loaded force cap actuators that reciprocate within a sleeve disposed within the canister. The actuator is typically coupled to the movement of the cap assembly, such that the actuator translates in a direction that is parallel with the cap.

Figure 7.6: Pushbutton.

7.2.3 Emergency switch

In factories and the like where industrial machinery is installed, in order to ensure the safety of an operator in cases such as where a fault occurs during operation of machinery, an emergency stop switch for emergency stop of the machinery is necessarily provided. A machine is typically powered by an electrical power source and typically has an on/off switch for use during normal operating conditions. For safety reasons, a machine will usually also include an emergency stop switch for terminating electrical power to the machine in an emergency situation. The emergency switch is activated under circumstances demanding an immediate cessation of operation of the machine. Most of the conventional exercise apparatus driven by electric motor include an emergency stop switch in the circuit controller for an immediate cutoff of the power supply to stop the motor, thereby ensuring the safety of the operator. An emergency stop safety switch as commonly used in machinery or exercise equipment utilizes either a push-button or pull configuration.

Figure 7.7: Motor Connection.

Conclusion

This project operated as we designed, the bag moves in the conveyor as well as we designed during to existence the iron supporters that are based beside it. The two double acting cylinders with the suitable connection as we did performed good bag preparing to put the glue on it. We controlled the machine as we want by using "PLC" controller.

Recommendation

This project need to some developments and enhancements in some areas:

1. Adding the filling part to this project.
2. Adding the packaging preparation part.
3. It has capability to replace our glue mechanism by pneumatic spray of glue.
4. This machine can be used in other food materials such as salt, coffee, tea... etc by control the highest of the packaging operations due to type of the material.

References:

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6- George Mcpherson, Report D. Laramore, Introduction to Electrical Machines and Transformer, wiely, New York.

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9- Ahmed Hawamde, Mohammed Abedraboh, Yasser Hasheesh, Filling and Packaging Machine of solid Materials: Design and Operation, Palestine Polytechnic University, Hebron, Palestine,2007-2008.

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12- http://en.wikipedia.org/wiki/Main_Page

13- http://www.ferret.com.au/t/Electrical-Protection

14- http://www.sensorsportal.com/HTML/Sensor.htm

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16- http://web5.automationdirect.com/adc/Home/Home

Appendix A

Programmable Logic Controller "PLC"

2006-07-04

5011634301-YIE1

DVP-ES/EX

Programmable Logic Controller Instruction Sheet

1 WARNING

This Installation Sheet only provides descriptions for electrical specifications, function specifications, installation & wiring, troubleshooting and peripherals. Other detail information about programming and instructions, please see PLC Application Manual. For more information about the optional peripherals, please refer to their individual instruction sheet or user manuals.

This is an OPEN TYPE PLC. The PLC should be kept in an enclosure away from airborne dust, high humidity, electric shock risk and vibration. Also, it should be equipped with protective methods such as some special tools or keys to open the enclosure, so as to avoid the hazard to users and the damage to the PLC. The power must be OFF before any maintenance.

Never connect the AC main circuit power supply to any of the input/output terminals, as it will damage the PLC. Check all the wiring prior to power up. To avoid any electromagnetic noise, make sure the PLC is properly grounded. Do NOT touch terminals when power on.

2 INTRODUCTION

2.1 Model Name Explanation and Peripherals

Thank you very much for purchasing Delta's DVP-ES/EX Series PLC. DVP-ES/EX Series provide the main processing units and extension units. The processing units offer 14~60 points and the extension units offer 8~32 points. The maximum input and output can be extended up to 128 points respectively. Also, it can be used on various applications according to input and output points, power supply, digital input and output modules.

■ Nameplate Explanation

[illegible]

■ Model/Serial Number Explanation

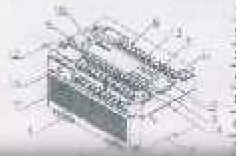
DVP □□□□□□□S

Product Series; Points (Input + Output); Models: E: Main Processing Unit (MPU), X: Extension Unit; Model Type: S: Standard, X: A/D, D/A Functions, C: [illegible]; M: Digital Input, N: Digital Output, P: Digital Input/Output; R: Relay, T: Transistor, N: No Output Module; S: Advanced Type; 00: AC Input, M TYPE; 01: DC Input, L TYPE; 11: DC Input, H TYPE

■ Peripherals

1. DVP-HPP Series: Handheld Programmable Panel
2. WPLSoft: DVP-PLC Programming Software Tool (Windows based software)
3. DVPACAB115: 1.5M Cable (HPP ⇔ PLC, provided in DVP-HPP Series)
4. DVPACAB215: 1.5M Cable (PC ⇔ PLC)
5. DVPACAB230: 3.0M Cable (PC ⇔ PLC)
6. DVPACAB315: 1.5M Cable (HPP ⇔ PC)
7. DVPACAB405: 50cm Cable (Main processing unit ⇔ Extension unit, or Extension unit ⇔ Extension I/O signal extension cable)

2.2 Product Profile and Outline

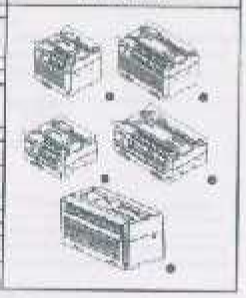


1. DIN rail clip	9. Input / Output
2. DIN rail (35mm)	10. Status indicator: POWER, RUN, and ERROR
3. Direct mounting holes	11. Input / Output terminal cover
4. Communication Ports Cover (RS-232C)	12. Input / Output terminal nameplate
5. Extension Port/indicators	13. Input / Output terminal nameplate
6. Input / Output terminals	14. Input / Output terminal nameplate
7. [illegible]	15. [illegible]

2.3 DVP-ES/EX Series Models

1. ES Standard Main Processing Units (MPU-00)

Model Name	Power	Input Unit Point	Input Unit Type	Output Unit Point	Output Unit Type	Profile
DVP14ES00R2	100~240 VAC	8	DC Sink or Source	6	Relay	[illegible]
DVP24ES00R2		16		8		[illegible]
DVP32ES00R2		16		16		[illegible]
DVP40ES00R2		24		16		[illegible]
DVP60ES00R2		36		24		[illegible]
DVP14ES00T2		8		6	Transistor	[illegible]
DVP24ES00T2		16		8		[illegible]
DVP32ES00T2		16		16		[illegible]
DVP40ES00T2		24		16		[illegible]
DVP60ES00T2		36		24		[illegible]



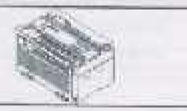
2. ES Standard Main Processing Units (MPU-01, 11)

Model Name	Power	Input Unit Point	Input Unit Type	Output Unit Point	Output Unit Type	Profile
[illegible]	24 VDC	[illegible]	DC Sink or Source	[illegible]	Relay	[illegible]
[illegible]		[illegible]		[illegible]		[illegible]
[illegible]		[illegible]		[illegible]		[illegible]
[illegible]		[illegible]		[illegible]		[illegible]
[illegible]		[illegible]		[illegible]	Transistor	[illegible]
[illegible]		[illegible]		[illegible]		[illegible]
[illegible]		[illegible]		[illegible]		[illegible]

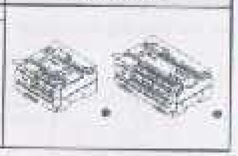
3. EX Special Function Main Processing Units (MPU-00, MPU-11)

Model Name	Power	Input Point DI	Input Point AI	Input Type DI	Input Type AI	Output Point DO	Output Point AO	Output Type DO	Output Type AO	Profile Reference
DVP20EX00R2	100~240 VAC	8	4	DC Sink or Source	-20mA~20mA or -10V~+10V	6	2	Relay	0~20mA or 0~10V	
DVP20EX00T2		8	4			6	2	Transistor		
DVP20EX11R2	24 VDC	8	4			6	2	Relay		

4. Digital I/O Extension Unit for DVP-ES/EX Series-00

Model Name	Power	Input Unit Point	Input Unit Type	Output Unit Point	Output Unit Type	Profile Reference
[illegible]	100~240 VAC	8	DC Sink or Source	24	Relay	
[illegible]		16		8		
[illegible]		16		16		
[illegible]		[illegible]		[illegible]		
[illegible]		[illegible]		[illegible]	Transistor	
[illegible]		[illegible]		[illegible]		
[illegible]		[illegible]		[illegible]		

5. Digital I/O Extension Unit for DVP-ES/EX Series-01 (L TYPE)

Model Name	Power	Input Unit Point	Input Unit Type	Output Unit Point	Output Unit Type	Profile	Profile Reference
[illegible]	24 VDC	[illegible]	DC Sink or Source	[illegible]	None	[illegible]	
[illegible]		[illegible]		[illegible]	Relay	[illegible]	
[illegible]		[illegible]		[illegible]		[illegible]	
[illegible]		[illegible]		[illegible]		[illegible]	
[illegible]		[illegible]		[illegible]		[illegible]	
[illegible]		[illegible]		[illegible]	Transistor	[illegible]	
[illegible]		[illegible]		[illegible]		[illegible]	
[illegible]		[illegible]		[illegible]		[illegible]	
[illegible]		[illegible]		[illegible]		[illegible]	
[illegible]		[illegible]		[illegible]		[illegible]	

6. Digital I/O Extension Unit for DVP-ES/EX Series-11 (H TYPE)

Model Name	Power	Input Unit Point	Input Unit Type	Output Unit Point	Output Unit Type	Profile	Profile Reference
[illegible]	24 VDC	[illegible]	DC Sink or Source	[illegible]	None	[illegible]	
[illegible]		[illegible]		[illegible]	Relay	[illegible]	
[illegible]		[illegible]		[illegible]	Transistor	[illegible]	

3 SPECIFICATIONS

3.1 Function Specifications

Item		Specifications	Remarks
Control Method		Stored program, cyclic scan system	
I/O Processing Method		Batch processing method (when END instruction is executed)	I/O refresh instruction is available
[illegible]		[illegible]	[illegible]
Program Capacity		3792 Steps	Built-in EEPROM
Instructions		32 basic sequential instructions (including STL, RET)	107 application instructions
Step Relays (Latched)	Initial Step Point	10 points	S0~S9
	Zero Return Point	10 points	S10~S19
	General Step Point	108 points	S20~S127
Auxiliary Relays	General	512+232 points	M0~M511, M768~M999
	Latched	256 points	M512~M767
	Special	280 points	M1000~M1279
Timers	Digital	64 points	T0~T63 (100 ms time base)
		63 points	T64~T126 (10 ms time base, when M1028 is ON)
		1 points	T127 (1 ms time base)
Counters	General	112 points	C0~C111
	Latched	16 points	C112~C127
	High Speed	13 points, 1 phase 20KHz, 2 phase 5KHz	C235~C254 (all latched type)
Data Registers	General	408 points	D0~D407
	Latched	192 points	D408~D599
	Special	288 points	D1000~D1143, D1280~D1311
Pointers	P	64 points	P0~P63
Index Registers	E / F	2 points	E (=D1028), F (=D1029)
Constants	Decimal K	16 bit: -32768~32767	32 bit: -2147483648~+2147483647
	Hexadecimal H	16 bit: 0000~FFFF	32 bit: 00000000~FFFFFFFF
Serial Communication		2 Ports is provided. RS-232C: Program read/write communication port. RS-485: General function communication port (controlled by RS instruction). Special drive instructions for Delta AC drive are also supported.	
Protection Features		Password, I/O specification, Execution time, illegitimate instruction or operand	
Monitor / Debug		Program execution time display, Stability, Device setting	

* Note: For more information about special relays and data registers, please refer to the Delta PLC Application Manual.

3.2 Electrical Specifications

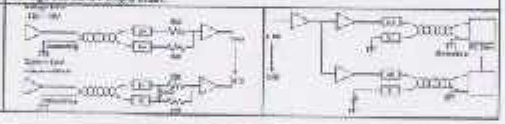
Item \ Model	DVP-14ES00	DVP-24ES00	DVP-32ES00	DVP-40ES00	DVP-60ES00	DVP-20EX00	DVP-14ES01	DVP-24ES01	DVP-24ES11	DVP-20EX11
Power Supply Voltage	100~240VAC (-15% ~ +10%)						24VDC (-15% ~ +20%)			
Operation Specification	The PLC start to execute if power supply is 85~130VAC. If the voltage of power supply drops to 70VAC, the PLC will stop. Maximum power loss time is 10ms or less.						Maximum power loss time is 5ms or less			
Fuse	2A / 250VAC						2A / 250VAC			
Power Consumption	20VA	25VA	30VA	30VA	35VA	30VA	6.5W	6.5W	5W	8W
DC24V Supply Current	400mA	400mA	400mA	400mA	400mA	400mA	—	—	—	—
Power Protection	DC24V output short circuit						DC24V input polarity			
Voltage Withstand	1500VAC (Primary-secondary), 1500VAC (Primary-PE), 500VAC (Secondary-PE)									
Insulation Resistance	> 5 MΩ at 500VDC (between all inputs/outputs and earth)									
Noise Immunity	ESD: 8KV Air Discharge; EFT: Power Line: 2KV, Digital I/O: 1KV, Analog & Communication I/O: 250V; RS: 26MHz~1GHz, 10V/m									
Grounding	The diameter of grounding wire cannot be smaller than the wire diameter of terminals 24V and 0V (All DVP units should be grounded directly to the ground pole)									
Environment	Operation: 0°C~55°C (Temperature), 50~95% (Humidity), Pollution degree 2; Storage: -25°C~70°C (Temperature), 5~95% (Humidity)									
Vibration / Shock Resistance	Standard: IEC1131-2, IEC 68-2-6 (TEST Fc) / IEC1131-2 & IEC 68-2-27 (TEST Ea)									
Weight (g)	430	350	500	585	735	538	260	414	400	306

Input Point Type	Input Point Electrical Specifications: Digital Input	Analog Input (A/I)
Input Type	DC (SINK or SOURCE)	Voltage input: -10V~+10V, Input impedance: 112KΩ; Current input: -20mA~+20mA, Input impedance: 250Ω
Input Current	24VDC 5mA	
Active Level (Analog input resolution)	Off→On, above 16VDC; On→Off, below 14.4VDC	Voltage input: 10bit; Current input: 10bit
Reaction Time (Conversion Sampling Time)	About 10ms (An adjustment range of 0~15ms could be selected through D1020 and D1021)	3ms (Time could be adjusted through D1118)

Output Point Type	Output Point Electrical Specifications: Relay-R	Transistor-T
Current Specification	2A/1 point (5A/COM)	55°C 0.1A/point, 50°C 0.15A/point, 45°C 0.2A/point, 40°C 0.3A/point (5A/COM)
Voltage Specification	Below 250VAC, 30VDC	30VDC
Maximum Load	75VA (Inductive); 90W (Resistive)	9W/1 point
Reaction Time	About 10 ms	Off→On 20us, On→Off 30us

3.3 AD/DA Specifications

Items	Analog Input (A/D) Voltage Input	Analog Input (A/D) Current Input	Analog Output (D/A) Voltage Output	Analog Output (D/A) Current Output
Analog I/O Range	±10V	±20 mA	0~10V	0~20 mA
Digital Conversion Range	[illegible]	[illegible]	[illegible]	[illegible]

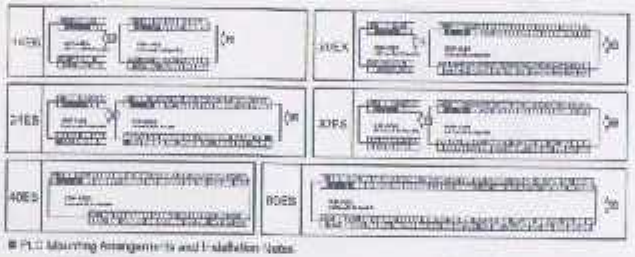
Items	Analog Input (A/D)		Analog Output (D/A)	
	Voltage Input	Current Input	Voltage Output	Current Output
Output Impedance	–		[illegible]	
Tolerance Carried Impedance	–		1KΩ~2MΩ	0~500Ω
Overall Accuracy	Non-linear accuracy: ±0.5% of full scale within the range of PLC operation temperature. Maximum deviation: ±1% of full scale at [illegible]			
Reaction Time	[illegible] × channels			
Absolute Input Range	±15 V	±32 mA	–	
Digital Data Format	2's complement of 16-bit, 12 significant bits		2's complement of 16-bit, 8 significant bits	
Average Function	Provided			
Isolation Method	Isolation between digital area and analog area. No isolation among channels.			
Protection	Voltage output has short circuit protection but a long period of short circuit may cause internal wire damage and current output break.			
External Wiring Diagram				

4 INSTALLATION & WIRING

■ Dimensions

Model name (mm)	L	H1	W	W1	W2 (E Type)	W3 (S Type)
[illegible]	105	25	86	114	80	90
[illegible]	105	25	80	108	80	90
[illegible]	105	25	90	115	80	90
[illegible]	105	35	103	125	82	–
[illegible]	90	45.5	[illegible]	145	[illegible]	–
[illegible]	90	45	150	155	63	–

■ Terminal Wiring



■ PLC Mounting Arrangements and Installation Notes

■ DIN Rail Installation

The DVP-PLC can be secured to a cabinet by using the DIN rail that is 35mm high with a depth of 7.5mm. When mounting the PLC on the DIN rail, be sure to use the end bracket to stop any side-to-side motion of the PLC, thus to reduce the chance of the wires being pulled loose. On the bottom of the PLC is a small retaining clip. To secure the PLC to the DIN rail, place it onto the rail and gently push up on the clip. To remove it, use a slotted screwdriver, place it on the groove of the retaining clip and press gently, then pull down on the retaining clip and gently pull the PLC away from the DIN rail.

For heat dissipation ensure to provide a minimum clearance of 50mm between the unit and all sides of the cabinet. (as the figure shown below)

■ Direct mounting: Use the specified dimensions and install with M4 screws.

■ Wiring

1. Please use O-type or Y-type terminals for I/O wiring terminals. The specification for the terminals is shown as the figure on the left. PLC terminal screws should be tightened to between 5~8 kg-cm (4.3~6.9 in-lbs). Only use 60/75°C copper conducting wire.
2. DO NOT wire to the No Function terminals [illegible]. I/O signal wires or power supply should not run through the same multi-wire cable or conduit.
3. When tightening the screws and performing the wiring, please avoid that metallic particles fall into PLC. After completing wiring, please remove the label which is used to obstruct the metallic particles on the ventilation hole for well heat dissipation.

■ Installation Notes

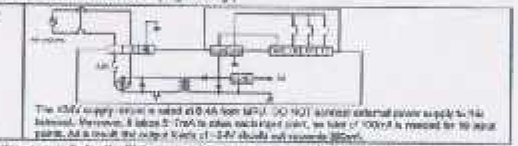
Incorrect installation may result in a PLC malfunction or premature failure of the PLC. Ensure to observe the following items when selecting a mounting location.

1. Do not mount the PLC in a location subjected to corrosive or flammable gases, liquids, or airborne dust or metallic particles.
2. Do not mount the PLC in a location where temperatures and humidity will exceed specifications.
3. [illegible]

There are two power inputs provided in DVP series PLC, AC input and DC input. Please pay particular attention to the following notes:

1. Connect the AC input (100VAC~240VAC) to terminals L and N. Any AC110V or AC220V connected to the +24V terminal or input points will permanently damage the PLC.
2. The AC power inputs for the MPU and the I/O Expansion Unit should be ON or OFF at the same time.
3. Please use wires of 1.6mm or above for the grounding of the MPU.
4. If the power-cut time is less than 10ms, the PLC still operates unaffectedly. If the power-cut time is too long or the power voltage drops, the PLC will stop operating and all the outputs will be OFF. Once the power is restored, the PLC will return to operate automatically. (There are latched auxiliary relays and registers inside of the PLC, please be aware when programming.)

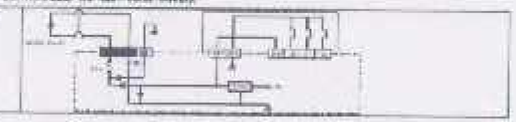
AC Input Type



The +24V supply output is rated at 0.4A from MPU. DO NOT connect external power supply to this terminal. Moreover, it takes 5~7mA to drive each input point, so [illegible] 100mA is needed for 16 input points. As a result the output loads of +24V should not exceed 300mA.

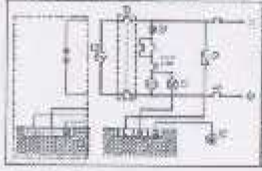
5. When DC voltage is supplied to the PLC, ensure the power is at terminals 24VDC and 0V (power range is 20.4VDC~26.4VDC). When the voltage is lower than 17.5VDC, PLC will stop operating, all outputs will turn OFF and the ERROR LED will flash continuously.

DC Input Type



■ Safety Wiring

Since the PLC is in control of numerous devices, operation of either one device would affect the operation of other devices, therefore the breakdown of either one device would subsequently be detrimental to the whole auto control system, and danger will thus be resulted. Please use the recommended wiring below for the power input:

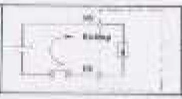


①	Power supply for AC loads
②	Fuse for circuit protection (3A Line)
③	Power On pilot indicator
④	Emergency stop: PLC must provide a quick manual method to disconnect all system power.
⑤	Circuit isolation device (System Power Disconnect): Utilize the electromagnetic contactor and the relay 1 for the isolation unit of the power circuit to prevent the possible instability of the system when the power is supplied on and off.
⑥	DVP PLC MPU (main processing unit)
⑦	Grounding resistance: 100Ω or less
⑧	Power supply: AC: 100~240VAC, 50/60Hz; DC: 24VDC

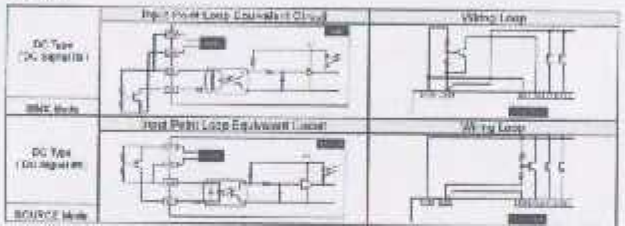
■ Input Point Wiring

The input signal of the input point is the DC power DC input. There are two types of DC type wiring: SINK and SOURCE, defined as follows:

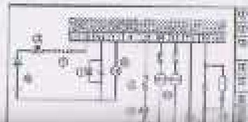
① Definition

Sink = Current flows into the common terminal S/S		Source = Current flows out of the common terminal of S/S	

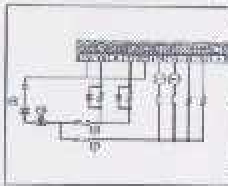
② Wiring



③ Practical Relay Output Wiring



④ Practical Transistor Output Wiring



5 TRIAL RUN

■ Power Indication

1. The "POWER" LED at the front of the MPU or the Extension Unit will be lit (in green) if the power is on. If the indicator is not on when the MPU is powered up, it means that there is abnormal condition on the DC power supply of the PLC. It is thus necessary to check the wiring on terminals +24V and 0V. If the ERROR LED is blinking swiftly, it indicates that the +24V power supply of the PLC is insufficient.
2. The "LOW V." LED on the Expansion Unit is an indication that the input power voltage is insufficient, thus all outputs of the expansion unit should be turned off.

■ Operation and Test

1. If the ERROR LED of the MPU is not blinking, use the peripheral device to give the RUN command, and the RUN indicator will then be on.
2. HPP could be utilized to monitor the timer (T), the counter (C) and the data register (D) during operation, and moreover, to force the output contacts to conduct the On/Off action. If the ERROR LED is on (but not blinking), it indicates that the setting of the user's program has exceeded the preset overtime limit, thus users have to double check the program and perform the On/Off function again. (The PLC is at this moment back to STOP status automatically.)

■ PLC Input/Output Reaction Time

The total reaction time from the input signal to the output operation is calculated as follows:
Reaction time = input delay time + program scan time + output delay time

Input delay time	Default 10ms. Please refer to the usage of special registers D1020~D1021
Program scan time	Please refer to the usage of special register D1010
Output delay time	Relay module: 10ms. Transistor module: 20~30us

6 TROUBLESHOOTING

Judge the errors by the indicators on the front panel. When errors occurred on DVP series PLC, please check:

① "POWER" LED

There is a "POWER" LED at the front of the MPU. The "POWER" LED will be lit (in green) when the power is connected to MPU. If the indicator is not on when the MPU is powered up and with the input power being normal, it indicates that the PLC is out of order. Please have this unit to be replaced or repaired at a distributor near you.

② "RUN" LED

Identify the status of the PLC. When the PLC is in operation, the light will be on, and the user could thus use HPP or the editing program of the ladder diagram to give commands to make the PLC "RUN" or "STOP".

③ "ERROR" LED

If an incorrect program is input to the MPU, or the instruction and the device exceed the allowable range, the indicator will blink. At this moment, the user should check the error code saved in the MPU data register D1004 to correct the program. Find out the cause of the error and modify the program. Then, re-send the correct program to the MPU.

If the ERROR LED is blinking swiftly, it suggests that the +24VDC power supply of the PLC is insufficient. Please check whether the power supply of 24VDC is normal or not.

When the ERROR LED is on (not blinking), it indicates that the execution time of the program loop has exceeded the time-out setting (set by D1000). Please check the program loop or use "WDT" instruction to solve the problem. When the ERROR LED is on, please power down the MPU and start up it one time, and then check if the RUN LED is off. If the RUN LED is not off, please check if there is any noise and interference and check if any conductive material falling into the PLC.

④ "Input" LED

The On/Off signals of the input point could be displayed through the "Input" LED. Also, the status signal of the input point could be monitored through the device monitoring function of HPP. As long as the input point is actuated, the LED is on. Therefore, if an error is detected, please check HPP, the LED indicator and the input signal circuits. Please pay particular attention to check if an electrical switch with significant leakage current is used as it often results in the unexpected operation of input point.

⑤ "Output" LED

Output LED indicates if the output signals are on or off. Please check the following items when the LED On/Off indications does not correspond to the commands.

[illegible]

Appendix B

Pneumatic

Symbol	Description
	DIRECTLY OPERATED SOLENOID VALVES - MONOSTABLE
	3/2 N.C., mechanical spring return
	3/2 N.C., mechanical spring return with manual override
	3/2 N.O., mechanical spring return
	3/2 N.O., mechanical spring return with manual override
	2/2 N.C., mechanical spring return
	2/2 N.C., mechanical spring return with manual override
	2/2 N.O., mechanical spring return
	2/2 N.C., mechanical spring return with manual override
	3/2 N.C., mechanical spring return quick exhaust
	ELECTROPNEUMATICALLY OPERATED VALVES - MONOSTABLE
	3/2 N.C. mechanical spring return with manual override
	mechanical spring return 2/2 N.C., with manual override
	3/2 N.O., mechanical spring return with manual override
	2/2 N.C., mechanical spring return with manual override
	3/2 N.C., pneumatic spring return with manual override
	2/2 N.C., pneumatic spring return with manual override
	3/2 N.O., pneumatic spring return with manual override
	2/2 N.C., pneumatic spring return with manual override
	5/2 mechanical spring return with manual override
	5/2, pneumatic spring return with manual override
	5/3 centre closed, electropneumatic return with manual override
	5/3 centre open, electropneumatic return with manual override
	5/3 pressure centre, electropneumatic return with manual override
	ELECTROPNEUMATICALLY OPERATED VALVES - STABLE
	3/2 with manual override
	2/2 with manual override

Symbol	Description
	electropneumatic return, 5/2 bistable, with manual override
	PNEUMATICALLY OPERATED VALVES - MONOSTABLE
	3/2 N.C. mechanical spring return
	3/2 N.O. mechanical spring return
	2/2 N.C. mechanical spring return
	2/2 N.C. mechanical spring return
	3/2 N.C. pneumatic spring return
	mechanical spring return, 5/2 monostable
	5/2 pneumatic spring return,
	5/3 centre closed mechanical spring return
	5/3 centre open mechanical spring return
	5/3 pressure centre mechanical spring return
	PNEUMATICALLY OPERATED VALVES - BISTABLE
	3/2 pneumatic return
	2/2 pneumatic return
	3/2 differential pneumatic return
	2/2 differential pneumatic return
	2/2 differential pneumatic return
	5/2 pneumatic return
	5/2 differential pneumatic return
	MANUALLY OPERATED VALVES - MONOSTABLE
	3/2 N.C. button operated mechanical spring return
	3/2 N.O. button operated mechanical spring return
	2/2 N.C. button operated mechanical spring return
	2/2 N.O. button operated mechanical spring return
	5/2 button operated mechanical spring return
	3/2 N.C. lever operated mechanical spring return
	3/2 N.O. lever operated mechanical spring return

Symbol	Description
	2/2 N.C. lever operated mechanical spring return
	2/2 N.O. lever operated, mechanical spring return
	5/2 lever operated, mechanical spring return
	5/3 centre closed, lever operated mechanical spring return
	5/3 centre open, lever operated mechanical spring return
	5/3 pressure centre, lever operated mechanical spring return
	3/2 N.C. pedal operated mechanical spring return
	5/2 pedal operated mechanical spring return
	MANUALLY OPERATED VALVES - BISTABLE
	3/2N.C. push pull button operated
	2/2 N.C. push-pull button operated
	5/2 push-pull button operated
	3/2 N.C. lever operated lever return
	2/2 N.C. lever operated lever return
	5/2 lever operated lever return
	5/3 centre closed, lever operated lever return
	5/3 centre open, lever operated lever return
	5/3 pressure centre, lever operated lever return
	5/2, pedal operated pedal return
	5/2
	3/2
	MECHANICALLY OPERATED VALVES - MONOSTABLE
	3/2 N.C. plunger operated mechanical spring return
	3/2 N.O. plunger operated mechanical spring return
	5/2 plunger operated mechanical spring return
	3/2 N.C. roller operated mechanical spring return
	3/2 N.O. roller operated mechanical spring return
	5/2 roller operated mechanical spring return

Appendix C

Motor

STANDARD 3-PHASE INDUCTION MOTORS

T-Series

D3 Brook Crompton, 3 Phase Motors

PRODUCT LIST
May 2007

ELECTRIC MOTORS

D3 Brook Crompton, 3 Phase Motors

Note:
Motors listed in this catalogue are indicative of product commercially available in New Zealand.

The 'T' range is a high quality range of electric motors with a specification suitable for most industrial applications. It is manufactured in ISO 9001 approved factories.

Please refer to Hamer Limited for motors to suit your particular application.

STANDARD MOTOR RANGE

KW	SPEED	FRAME	CODE
0.37	1400	D71	TNA370D4FA
	1000	D80	TNA370D6FA
0.55	1500	D80	TNA550D4FA
	1000	D80	TNA550D6FA
0.75	3000	D80	TNA750D2FA
	1500	D80	TNA750D4FA
	1000	D90S	TNA750D6FA
1.1	3000	D80	TNB110D2FF
	1500	D90S	TNB110D4FF,HF
	1000	D90L	TNB110D6FA
1.5	3000	D90S	TNB150D2FA,HA
	1500	D90L	TNB150D4FF,HF
	1000	D100L	TNB150D6FA
2.2	3000	D90L	TNB220D2FA,HA
	1500	D100L	TNB220D4FF,HF
	1000	D112M	TNB220D6FA
3	3000	D100L	TNB300D2FF,HF,FA,HA
	1500	D100L	TNB300D4FF,HF
	1000	D132M	TNB300D6FA
4	3000	D112M	TNB400D2FF,HF,FA,HA
	1500	D112M	TNB400D4FF,HF
5.5	3000	D132S	TNB550D2FF,HF,FA,HA
	1500	D132S	TNB550D4FF,HF
	1000	D132M	TNB550D6FF,HF
7.5	3000	D132S	TNB750D2FF,HF,FA,HA
	1500	D132M	TNB750D4FF,HF
11	3000	D160M	TNC110D2FF,HF
	1500	D160M	TNC110D4FF,HF
15	3000	D160M	TNC150D2FF,HF
	1500	D160L	TNC150D4FF,HF
18.5	3000	D160L	TNC185D2FF,HF
	1500	D180M	TNC185D4FF,HF
22	3000	D180M	TNC220D2FF,HF
	1500	D180M	TNC220D4FF,HF

FF Cast Iron Foot Mount
FA Aluminium Foot Mount

HF Cast Iron Foot & Flange Mount *
HA Aluminium Foot & Flange Mount *

* B5/B35 Standard Flange
B14/B34 Please consult for availability

Prices Available on Application

Also Available – Thermistors & Anti-Cond Heater

DIRECTIVES / STANDARDS / SPECIFICATIONS

Directives

The 'T' range complies with European Directives in the following manner:

Compliance with European Directives

Directive	Low Voltage (LV)	Machinery (MD)	Electromagnetic Compatibility (EMC)
Reference Numbers	73/23/EEC 93/68/EEC	89/392/EEC 91/368/EEC 93/44/EEC	89/336/EEC 92/31/EEC 93/68/EEC
Motor CE Marked	Yes	No	No
Standards	EN 40034	Not applicable	EN 55081 Parts 1 and 2 Emissions EN 50082 Parts 1 and 2 Immunity
Documentation for customers' technical file	Declaration of conformity	Certificate of incorporation	Statement *
Safety instructions with every motor	Yes	Yes	Yes
Comment	Relevant electrical Equipment operating between 50 to 1000 volts AC	Component	Component

** Motors operating from a correctly applied, sinusoidal (AC) supply meet the requirements of the EMC directive and are within the limits specified in standards EN 50081 and EN 50082 for industrial (Part 2) and residential, commercial and light industrial environments (Part 1)*

Standards

The 'T' range is based on IEC standards thus:

Performance	IEC 60034-1
Dimensions	IEC 60072-1 *
Mounting	IEC 60034-7
Enclosure Protection	IEC 60034-5
Vibration	IEC 60034-14 (grade N)

Outputs and shaft diameters are also in accordance with BS 5000 Part 10, Appendix A

** Flange mounting hole*
Position in accordance with BS 5000 Part 10

Other Options

Thermistor protection
Anti-condensation heaters

For other options, please enquire

Specification

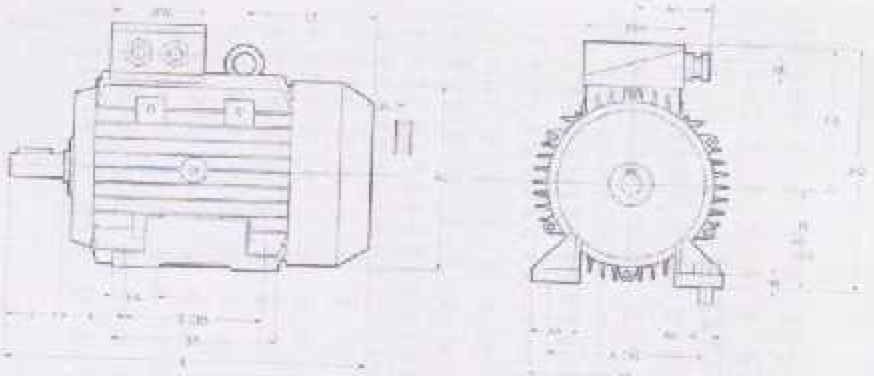
	Standard Product	Option
Frame Metal	63-80 aluminium 90-132 aluminium 160-250 cast iron	- Cast iron -
Fan Cover	Steel with 8mm grid	-
Enclosure	IP55	-
Voltage	3 kW and below 220-240/380-415 4 kW and above 380-415/660-720	- Spot voltage in the range 110 to 500 V
Frequency	50 Hz	60 Hz
Lubrication	63-180 double-shielded bearings 200-250 through greasing	- -
Insulation	Class F	-
Temperature Rise	Class B	Class F
Drain Holes	63-180 – none 200-250 – provided	Available -
Bearing Location	Drive end	-

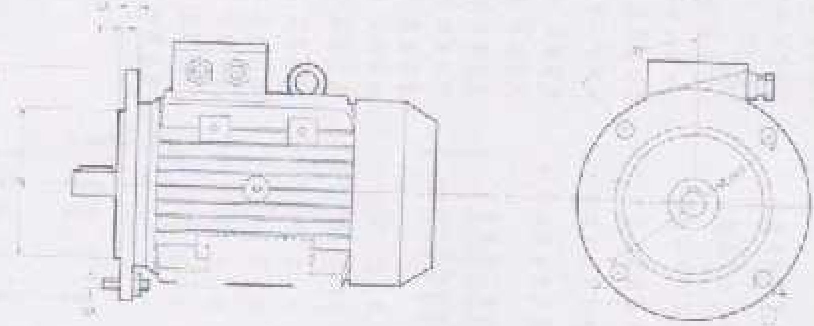
DIMENSIONS

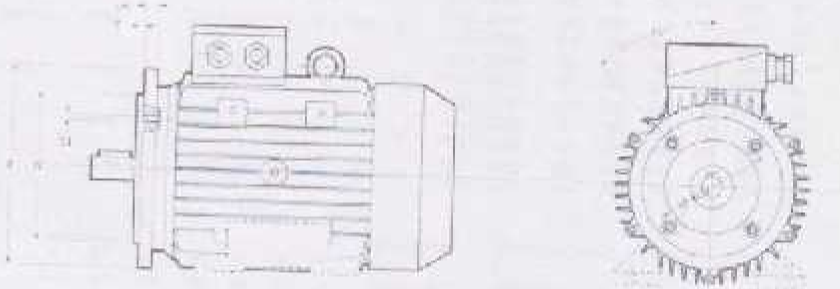
Foot, flange and face mounting

Frame sizes 63 to 180

Mounting options







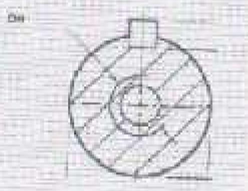
B3, B5/B35, B14/B34
IM 1001, IM 3001/IM 2001, IM 3601/IM 2901

Type Cast iron	Aluminium	Cast iron	A	B	BA	C	H	K	AA	L	AA	AB	AC	AD	BB	HD	AA	HB	HD	LA	HBW	HH
	T-DA63		100	50	12	40	53	M6	20	212	38	124	128	85								
	T-DA71		112	50	12	45	71	M6	20	241	28	150	143	87	30	36	7	80	155	–	80	74
	T-DA80		125	100	15	53	80	M6	20	273	30	155	163	75	28	108	11	119	180	–	83	82
T-DF90S	T-DA90S		140	100	15	56	90	M8	20	304	45	176			27	128	9	135	190	–	88	93
											57	192	180	82	38	126	12	142	232			
T-DF90L	T-DA90L														41.5	131	15	145	235	–	105	125
			140	125	15	56	90	M8	25	333	45	178	180	88	43	131	15	142	232			
T-DF100L	T-DA100L										57	192			48	136	15	140	235	–	109	125
			160	140	15	63	100	M10	20	374	35	190	206	98	40	170	4					
T-DF112M	T-DA112M										50	214			60	169	15	155	255	131	109	125
			190	140	30	98	112	M10	25	384	54	220	233	95	48	170	18	168	280	115		
T-DF132S	T-DA132S										66	246			56	172	16	169	281	116	109	128
			216	140	30	89	132	M10	25	443	35	244	262	95	71	216	5			128		
T-DF132S2	T-DA132S-2B										71	274			63	180	18	181	313	152	104	122
			216	140	35	89	132	M10	25	480	35	248	263	95	71	213	5			178		
T-DF132M	T-DA132M										71	274			63	180	18	181	313	192	109	125
			216	178	38	89	132	M10	23	480	35	284	283	95	71	290	5			178		
T-DF160MA											71	224			79	216	18	181	315	192	109	125
T-DF160L			254	210	40	108	160	M14	32	605	50	300	326	105	87	256	20	234	374	258	130	130
T-DF180M			254	254	40	108	160	M14	32	605	50	300	326	105	87	300	20	234	374	238	130	130
T-DF180L			279	241	40	121	180	M14	32	645	70	340	324	105	72	300	24	235	400	267	130	130
			279	279	40	121	180	M14	33	664	70	340	324	105	70	320	24	234	410	267	136	130

Type Cast iron	Aluminium	FF mounting	M	N	P	LA	S	T
	T-DA63	FF115	115	95	140	10	M8	3
	T-DA71	FF130	130	110	160	10	M8	3.5
	T-DA80	FF165	165	130	200	11	M10	3.5
T-DF90	T-DA90	FF165	165	130	200	10	M10	3.5
T-DF100L	T-DA100L	FF215	215	180	250	11	M12	4.0
T-DF112M	T-DA112M	FF215	215	180	250	11	M12	4.0
T-DF132	T-DA132	FF265	265	230	300	15	M12	4.0
T-DF160		FF300	300	250	350	18	M16	5.0
T-DF180		FF300	300	250	350	15	M16	5.0

B14 mounting		M	N	P			
FT75	(C90)	75	60	90	11	M5	2.5
FT85	(C105)	85	70	105	12	M6	2.5
FT115	(C140)	115	95	140	14	M8	3.0
FT100	(C120)	100	80	120	12	M6	3.0
FT130	(C160)	130	110	160	14	M8	3.5
FT115	(C140)	115	95	140	10	M8	3.0
FT130	(C160)	130	110	160	10	M8	3.5
FT130	(C160)	130	110	160	10	M8	3.5
FT165	(C200)	165	130	200	12	M10	3.5
FT130	(C160)	130	110	160	13	M8	3.5
FT165	(C200)	165	130	200	14	M10	3.5
FT165	(C200)	165	130	200	16	M10	3.5
FT215	(C250)	215	180	250	16	M12	4.0
FT165	(C200)	165	130	200	16	M10	3.5
FT215	(C250)	215	180	250	17	M12	4.0
FT265	(C300)	265	230	300	17	M12	4.0
FT215	(C250)	215	180	250	17	M12	4.0
FT265	(C300)	265	230	300	17	M12	4.0

Type	Shaft Drive end D	DH	F	E	G	GA	ED	Bearing drive end	Bearing non-drive end
T-DA63	11 j6	M4	4 h9	23	8.5	12.5	10	6202 ZZ C0	6202 ZZ C3
T-DA71	14 j6	M5	5 h9	30	11	16	20	6203 ZZ C0	6203 ZZ C3
T-DA80	19 j6	M6	6 h9	40	15.5	21.5	32	6204 ZZ C0	6204 ZZ C3
T-DF90/DA90	24 j6	M8	8 h9	50	20	27	40	6205 ZZ C0	6205 ZZ C0
T-DF100/DA100	28 j6	M10	8 h9	60	24	31	50	6206 ZZ C0	6206 ZZ C3
T-DF112M/DA112M	28 j6	M10	8 h9	60	24	31	50	6306 ZZ C0	6306 ZZ C3
T-DF132/DA132	38 k6	M12	10 h9	80	33	41	63	6308 ZZ C0	6306 ZZ C3
T-DF160M	42 k6	M16	12 h9	110	37	45	94	6309 ZZ C0	6308 ZZ C3
T-DF160L	42 k6	M16	14 h9	110	37	45	94	6309 ZZ C0	6309 ZZ C3
T-DF180M	48 k6	M16	14 h9	110	42.5	51.5	94	6311 ZZ C0	6309 ZZ C3



Appendix D

Limit switch

Electric Limit Switch

for hazardous areas

Type 4744

SAMSON

Application

Limit switches in type of protection ⟨Ex⟩ II 2 G EEx ed IIC T6 for attachment to pneumatic control valves according to IEC 60534-6-1

For valve travels from 7.5 to 150 mm

CE ⟨Ex⟩

The limit switch supplies a limit signal when an adjusted limit is exceeded in either direction, especially when a control valve has reached a final position. This signal is suitable for reversing control signals, initiating visual or audible alarms and for connection to central control or alarm systems.

- One or two electric limit switches which can be overridden
- High load capacity, for example, alternating current up to 500 V/10 A

Attachment to control valves with cast yokes or rod-type yokes according to IEC 60534-6-1 and NAMUR recommendation.

Versions

- **Type 4744** (Figs. 1 and 2) Limit switch with one or two momentary-contact limit switches designed as a position switch conforming to EN 50041.
  Each contact is equipped with one NC contact and one NO contact, acting as snap-action switch, or also switchable as a single-pole double throw switch (SPDT).

Type of protection "Flameproof Enclosure" ⟨Ex⟩ II 2 G EEx ed IIC T6 according to test certificates PTB 01 ATEX 1053 and II 2 D IP 65 T 80 °C according to LCIE ATEX 6308.

- **Type 4744-2** (Fig. 3) - Limit switch with one momentary-contact switch for mounting to a rod-type yoke of V2001 Series Valves

Type of protection "Flameproof Enclosure" ⟨Ex⟩ II 2 G EEx d IIC T6 according to PTB 00 ATEX 1093 X.

Principle of operation of Type 4744 (Fig. 2)

When the limit switch is attached to the control valve, the valve travel is transmitted to the switch lever via the lever. The switch lever actuates the snap-action contact of one of the momentary-contact limit switches when the adjusted limit value is reached. This switch can be overridden and is equipped with an overrange protection. For coarse adjustment (switching point), the momentary-contact limit switch is shifted on the base plate. The adjustment screw is used for fine adjustment. The terminal connections determine whether the limit switch is used either as an NO contact, an NC contact or a changeover contact (Fig. 4).

Refer to Information Sheet T 8350 EN for selection and application of positioners and limit switches.

Fig. 1 · Type 4744 Electric Limit Switch with protection cover

Fig. 2 · Type 4744 Electric Limit Switch with two momentary-contact switches and protective cover removed

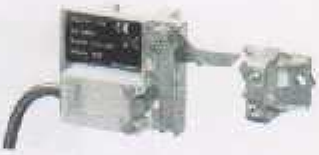


Fig. 3 · Type 4744-2 Electric Limit Switch preferably for Series V2001 Valves

Fig. 4 · Electrical connection

Table 1 · Technical data

Limit switch Type	4744	4744-2
Momentary-contact switch	1 or 2	1
Type of protection	Flameproof enclosure, terminal space in increased safety ⟨Ex⟩ II 2 G EEx ed IIC T6 - PTB 02 ATEX 1053 II 2 D IP 65 T 80 °C - LCIE 03 ATEX 6308	Flameproof enclosure ⟨Ex⟩ II 2 G EEx d IIC T6 PTB 00 ATEX 1093 X
Permissible load (load capacity)	AC voltage	
	500 V / 10 A Utilization category AC-15	250 V / 5 A
	DC voltage	
	125 V / 10 A 250 V / 0.2 A Utilization category DC-12	250 V / 0.4 A
Travel range	7.5 ... 100 mm with extended lever up to max. 150 mm	15 mm
Permissible ambient temperature *	-55 ... 70 °C	-20 ... 75 °C
Degree of protection	IP 65	IP 66
Weight (approx.)	1.75 kg	0.4 kg
Housing material	Glass fiber reinforced polyester	Duroplast

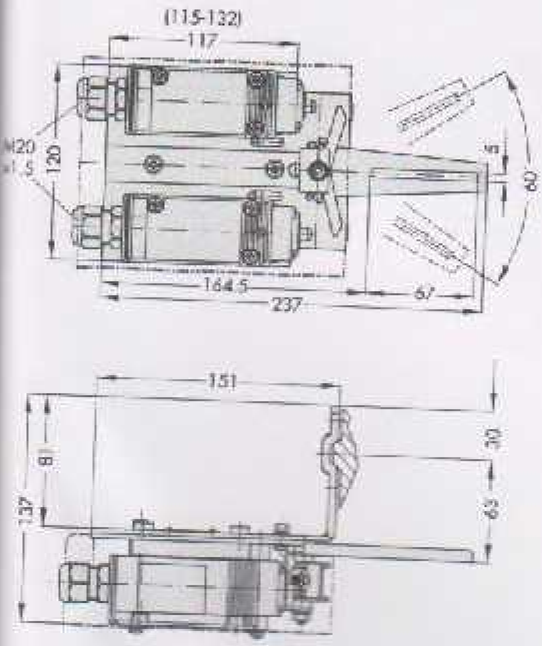
* The limits specified in the relevant approval certificate additionally apply for use in hazardous areas.

Summary of approvals

Type of approval	Certificate number	Date	Type of protection/Comments
EC Type Examination Certificate	PTB 01 ATEX 1053	2001-08-09	⟨Ex⟩ II 2 G EEx ed IIC T6; Type 4744
	LCIE 03 ATEX 6308	2003-10-10	II 2 D IP 65 T 80 °C; Type 4744
	DMT 01 ATEX E 178	2001-12-28	⟨Ex⟩ II 2 G EEx de IIC T6 II 2 D IP 65 T 80 °C; Type 4744
	PTB 00 ATEX 1093 X	2000-12-07	⟨Ex⟩ II 2 G EEx d IIC T6/T5; Type 4744-2
GOST approval	2002.C312	2003-01-10	1 Ex d IIC T6 X, valid until 2008-01-01

Dimensions in mm

Type 4744



Type 4744-2