Palestine Polytechnic University

College of Engineering

Electrical Engineering Department

Graduation Project

Design, Build and Operation Of Automatic Sticking Carton Boxes Machine

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الخليل – فلسطين

كلية الهندسة

دائرة الهندسة الكهربائية

إسم المشروع

Design, Build and Operation Machine Of Automatic Sticking Carton Boxes Machine

أسماء الطلبة

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بلال عيد

معاذ هاشم مراعبة

بناء على نظام كلية الهندسة وإشراف ومتابعة المشرف المباشر على المشروع وموافقة أعضاء اللجنة الممتحنة تم تقديم هذا المشروع إلى دائرة الهندسة الكهربائية وذلك للوفاء بمطلبات درجة البكالوريوس في الهندسة تخصص أتمتة صناعية .

توقيع المشرف

_____

توقيع اللجنة الممتحنة

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توقيع رئيس الدائرة

_____

Dedication

We dedicate this project:

To our parents

To our brothers

To our friends

To our teachers

To our nation

Acknowledgement

First and for most we should offer our thanks, obedience and gratitude and gratitude to Allah

Our appreciation to:

Palestine Polytechnic University

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Our supervisor Prof. Abdel-karim Daud for his helps and support

To Prof. Sameer Khader

To Dr. Fouad Zaro

To Eng.Hareth Shalalda

To Eng. Mohammed Alqaisi

To any one whom helped us

Abstract:

Industrial machine to close carton boxes automatically, as most factories in Hebron and Bethlehem are closing the boxes manually, so we designed this machine.

This machine closes from 10 to 15 cartons per minute, and the width of carton box which the machine can closed it from 20 - 50 cm and height of 15 - 50 cm.

The carton box passes through three stages in order to close it, the first stage the stage of the conveyor transporting the box to the adhesive stage, the second stage is the calibration stage where the machine takes the dimensions of the carton box to be closed, the third stage is the stage where the carton box is closed through the pulling belts, that pass the carton box between upper and lower adhesives.

This machine is controlled by a "PLC" and human machine interface "HMI" Where the "PLC" that takes signals from "HMI", switches and sensors to control the operation of the machine and also monitor the machine through the "HMI".

The main objective of this machine is to facilitate the outputs of the production process in the factories where they save time, effort, cost and high efficiency and reduce prices to the consumer.

ملخص:

ماكنة صناعية لاغلاق صناديق الكرتون بشكل اتوماتيكي حيث ان معظم المصانع في الخليل وبيت لحم تقوم باغلاق الصناديق بشكل يدوي فلذلك قمنا بتصميم هذه الماكنة.

هذه الماكنة تقوم بإغلاق من 10 إلى 15 صندوق كرتون بالدقيقة الواحدة و عرض صناديق الكرتون التي تستطيع الماكنة اغلاقها من 20 – 50 سم وإرتفاعها 15 – 50 سم.

حيث أن صندوق الكرتون يمر بثلاث مراحل من اجل اغلاقه المرحلة الاولى مرحلة السير الناقل الذي يقوم بنقل الصندوق لمرحلة اللصق المرحلة الثانية مرحلة المعايرة حيث تقوم الألة بأخذ ابعاد صندوق الكرتون المراد لصقه المرحلة الثالثة وهي المرحلة التي يتم فيها لصق صندوق الكرتون حيث تقوم أقشطة السحب بتمرير الصندوق من بين ادوات اللصق العلوية والسفلية.

يتم التحكم في عمل هذه الألة من خلال "PLC" وشاشة تحكم "HMI" حيث ان ال "PLC" يأخذ إشارات من شاشة التحكم و المفاتيح والمجسات للتحكم في عمل الألة وايضا مراقبة الالة من خلال ال "HMI".

الهدف الأساسي من هذه الألة هو تسهيل مخرجات العملية الإنتاجية في المصانع حيث تقوم بتوفير الوقت والجهد والتكلفة وكفاءة عالية وتقليل الأسعار على المستهلك.

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1.1 General Background

Industry is a cornerstone of society, thus contributing to national income support. In the recent era industry trends towards advanced automation, the process of industry has become easy and precise.

Time is one of the most important success factors for the industry therefore, it is necessary to strive towards finding technical solutions that contribute to reducing the time and effort of the workers.

The last steps of many industries are the process of packaging the product, and a lot of products are placed inside of carton boxes, and these boxes need to close tightly and this process takes a lot of time from the whole industrial process.

From here it was necessary to design an automatic system that saves time, and effort to contribute to the success of the industrial process.

Sticking Carton Boxes machine the best solution to the close products carton boxes in the all factory used carton boxes.

Industrial machine to close carton boxes automatically, as most factories in Hebron and Bethlehem are closing the boxes manually is shown in the figure 1.1, so we designed this machine.

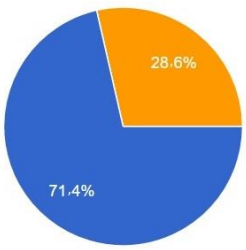


Figure 1.1: Factories Closing The Boxes Manually

1.2 Project Aims

The idea of "sticking carton boxes machine project" Comes from the problems facing local factories in closing carton boxes, for that the project to achieve the following objective:

1- To save a lot of time in the industrial process.
2- To minimize human effort.
3- To reduce cost and achieve a successful industrial process.
4- To ensure best closing for carton boxes.
5- To high efficiency and the adhesive form on the product is the same style and uniform compared to manual sticking.
6- To reduce the price of the product to the consumer.

1.3 Literature Review

After reviewing the previous studies about sticking carton boxes machine, we found some of company design for similar machine, as the following :

1- IPG-Intertape polymer group
   This company design sealing machine in different style but the cost of this machine is too match and non-automatic adjust. [12]
2- ITW-Signode Packing Solution/ India
   This company design FTM550 Semi-Automatic carton sealing machine with flexible taping head , and manual adjust of the conveyer. [13]
3- ROBOPAC [14]
   This company is the major products of sticking film in global.

1.4 Project Description

Sticking carton boxes machine as a solution for sealing top and bottom of product carton using the tap film by automatic system saving time and cost and effort and easy to operate from any non-specialist person.

The system control from PLC system and two motor for automatic adjust of upper Tap Head and right-lift lifting conveyor, the carton inter from packing machine and deliver into lifting conveyer, after this the upper and lower tap head is sealing the carton in two side.

1.5 Project Part

1- Mechanical overall structure
2- Electrical Control System

1.6 Project cost

Table 1.1: Project Cost

No.	Description	Amount "NIS"
1.	System Body and Gears	3000
2.	PLC delta and HMI	1700
3.	Contactors, overloads, circuit breaker and fuses	1000
4.	Motors and Encoders	2000
5.	Sensors and switches	200
6.	electrical control panel and wire and cable	900
	Total Amount	8200 NIS

1.7 Time Structure

Table 1.2: Time Structure

Week / Tasks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Task 1																
Task 2																
Task 3																
Task 4																
Week / Tasks	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Task 5																
Task 6																
Task 7																
Task 8																

Task 1- Selection project title

Task 2- Collection data and information on the subject of the project

Task 3- Identify function and task

Task 4- Design and analysis

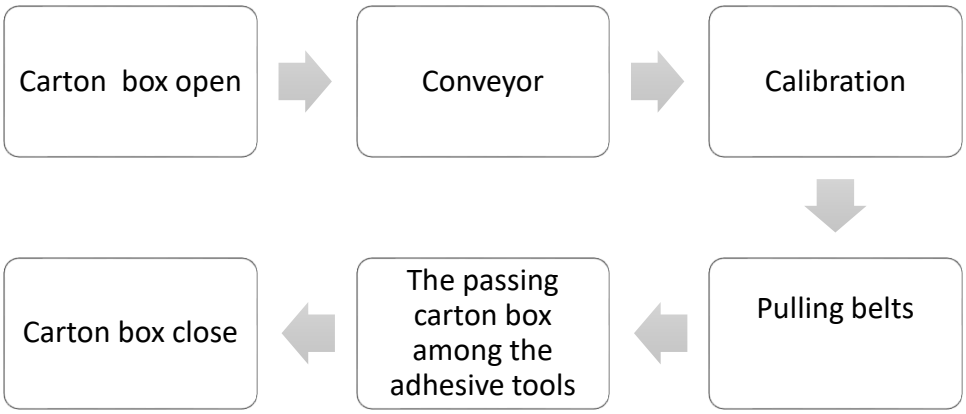
Task 5- Determine Mistakes

Task 6- Generate Solutions

Task 7- Generate Alternative Designs

Task 8- Results and Conclusion

1.8 Block Diagram



2

Chapter Tow The Sticking System

2.1 Introduction

2.2 Conveyor

2.3 Calibration

2.4 Pulling

2.1 Introduction

In this chapter, we will show the general stages of the sticking system. In our project we will show the new technology in sticking cartoon in a full automated system programmed with a PLC, which will allow the user to control the operation of the system, The proposed machine is shown in the figure 2.1.

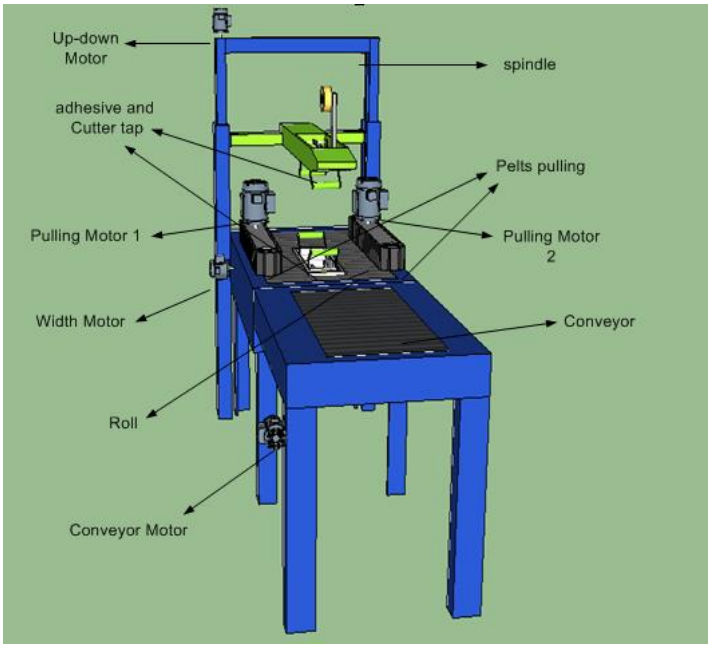


Figure 2.1: The Proposed Machine

In order to draw an image in our minds about how the machine works and how the manufacturing stages pass through it to get the final product, we divided the stages of production into three general stages, these stages are:

1) Conveyor
2) Calibration
3) Pulling

2.2 conveyor

The first stage of the project it uses a conveyor to transport cartoon boxes from the person or filling machine to the calibration using a motor to move the conveyer, the conveyer as shown in the figure 2.2

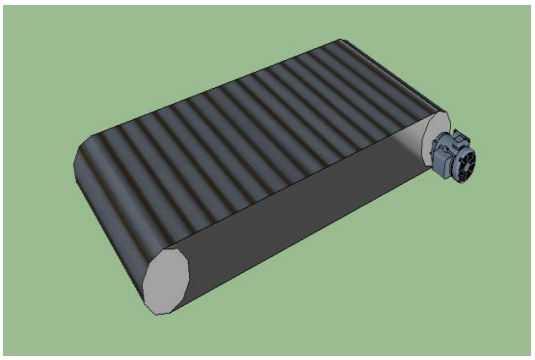


Figure 2.2: The conveyor

2.3 Calibration

Calibrate the width of the carton box, where the control of the place of the pulling belts horizontally, through motor works in both directions, as shown in the figure 2.3.

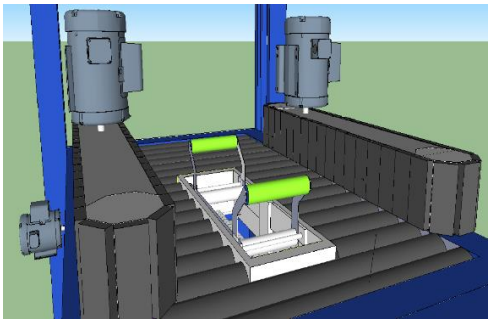


Figure 2.3: The calibrate pulling belts

Calibrate the height of the carton box, where the control of the place of the spindle for the adhesive vertically, through motor run in both directions as shown in the figure 2.4.

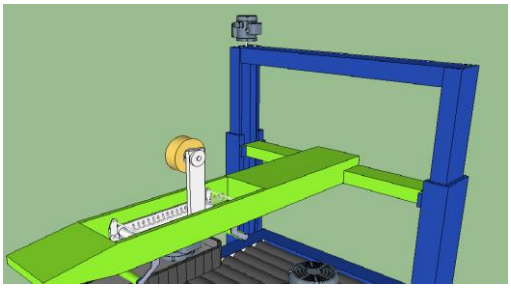


Figure 2.4: The calibrate spindle

2.4 Pulling

Pull the carton box, through the horizontal pulling belts, and pass it between the upper and lower adhesive tools, where the control of the pulling belts through two motor running at the same time and direction as shown in the figure 2.5.

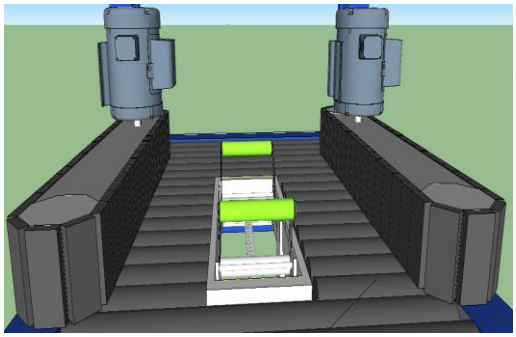


Figure 2.5: The pulling belts

3

Chapter Three Mechanical Parts

3.1 Introduction

3.2 Proposal System Description and Specifications

3.3 Mechanical Design

3.1 Introduction

As explained before, sticking cartoon pass through several stages, After put the carton box on the conveyor belt, conveyor to transfer of the carton box to the calibration, when the calibration according to the width and height of the box, the pull of the carton box through passing between the upper and lower adhesive, the process is done.

Since the machine used for facilitating the outputs of the production process and in order to maintain the product, most of the machine parts are made of steel. and in order to obtain a good and simple design a set of parameters must be considered, these parameters are related to the machine itself such as: safety, portability, cost, design simplicity, availability, work space, on the other hand, the design must be able to produce efficient suitable for user related into the international standard.

3.2 Proposal System Description and Specifications

The first step in mechanical design is to know the whole operation of the system and to know how the machine is bind as shown in figure (2.1).

3.3 Mechanical Design

In this section each block will be explained in details, the used material for most parts in this machine is stainless steel (1020) because it resistant the high weights.

3.3.1 Conveyer belt Machine

In this part will explain how to design of the belt conveyor machine. The design process begins by calculating dimension, power required and torque. The power will be a reference in choosing the electric motor. The following design as shown in figure (3.1).

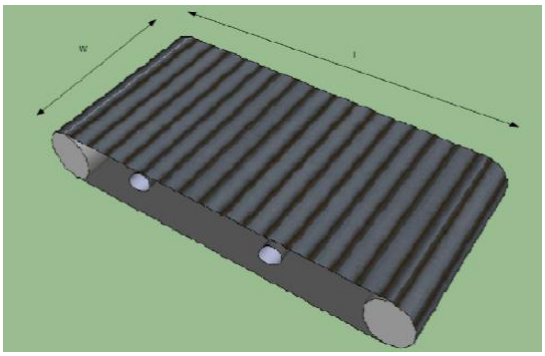


Figure 3.1: The main parameters of the belt conveyor

The dimension:

w = 40 cm, l = 60 cm.

The belt speed for slip belt should not exceed 0.35 m/s with nonabrasive materials so

S = 0.35 m/s

Feeder belt tension and power. The effective height of load in the hopper supported by the belt can be assumed as twice the loaded belt width for most lumped bulk material. Thus the mass of the load supported by and to be the belt is approximately.

$$Mass = 2{W_f}^2 * L_f * \mu \qquad (3.1)$$

Where:

W_f = hopper opening width (m) (40 cm)

L_f = hopper opening length (m) (60 cm)

μ = martial density (kg/m^3) (470 kg/m^3)

$$Mass = 2 * 0.4^2 * 0.6 * 470 = 90.24\ Kg$$

Effective belt tension can be described by formula:

$$T_e = \mu_0 * 2{W_f}^2 * L_f * \mu * 9.81 * 10^{-3} \quad (3.2)$$

Where

T_e Belt tension (KN)

μ_0 For slider belt operation equal 0.6

W_f = hopper opening width (m) (40 cm)

L_f = hopper opening length (m) (60 cm)

μ = martial density (kg/m^3) (470 kg/m^3)

$$T_e = 0.6 * 2 * 0.4^2 * 0.6 * 470 * 9.81 * 10^{-3} = 0.513\ KN$$

The belt power can be described by formula:

$$P = T_e * S \quad (3.3)$$

Where:

P = Belt power (KW)

T_e = Belt tension (KN)

S = Belt speed (m/s)

$$P = 0.513 * 0.35 = 0.178\ KW$$

So we needed electric motor is 0.25 hp

3.3.2 Table

In this part we will talk about the table, and its size, and what are the parts installed on the table. The following design as shown in figure (3.2).

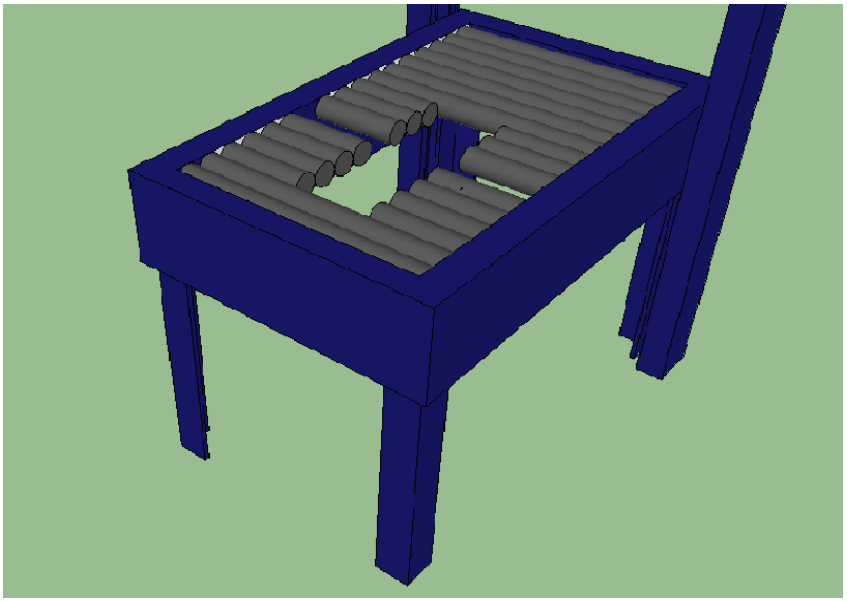


Figure 3.2: The main parameters of table

Table size: 60 cm width and length 70 cm.

Where the table contains the pelts pulling, screw tightening and expansion (width), screw ups and downs, adhesive and cutting tool, spindle, and rolls.

3.3.3 Calibration Machine

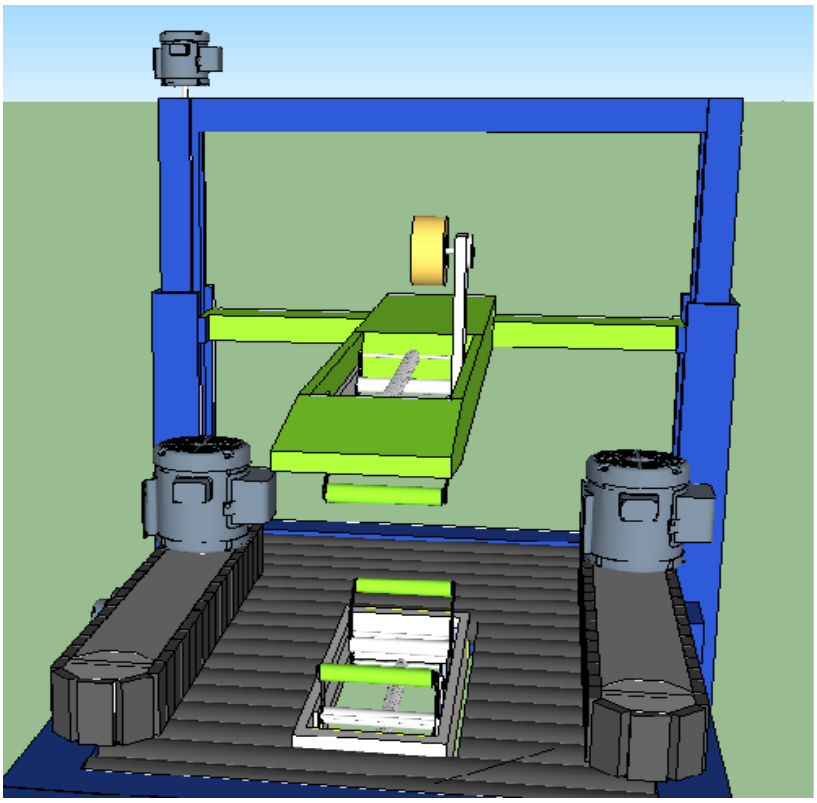


Figure 3.3: The calibration machine

3.3.3.1 Screw close and expansion (width)

In this part is controlled in place of pelts pulling horizontally, by connecting them with two nut attached to two screws connected to each other by gear, one of the screws is connected with the motor working in both directions as shown in figure (3.4).

Figure 3.4: The screw tied nut and gear connect with motor for width

3.3.3.2 Screw ups and downs

In this part is controlled in place of the cutter adhesive by connecting them with nut attached to screw, the screw is connected with the motor working in both directions as shown in figure (3.5).

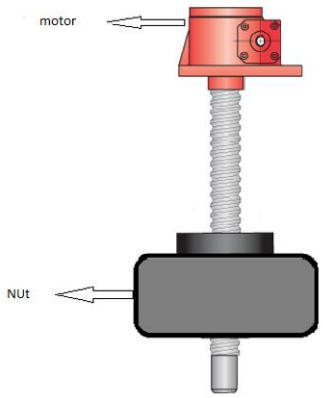


Figure 3.5: The screw tied nut connect with motor for up and down

3.3.3.3 Calculation torque and power for ball screw

Calculation torque:

For width:

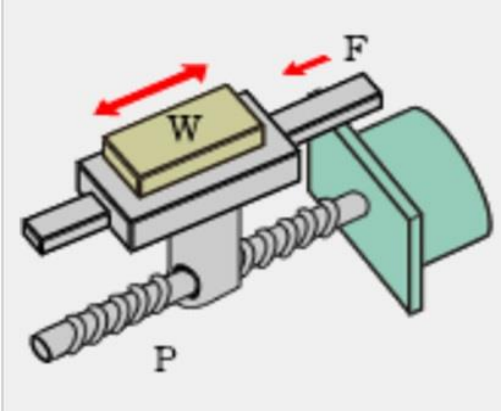


Figure 3.6: The screw tied nut connect with motor

$T = \frac{1}{2\pi} * P(F + \mu wg)$ (3.4)

F: External force " N".

W: Mass of load "Kg".

μ: Friction coefficient on sliding surface.

g: Gravity acceleration "m/s^2" .

P: Ball screw lead "m".

T: Torque "N.m".

Caiculation torque:

For width:

w=15kg, μ=0.15, g = $9.8m/s^2$, p = 0.15m, and let f = 50N.

$T = \frac{1}{2\pi} * P(F + \mu wg)$

T total = 2*17.2N.m = 34.4 N.m.

For ups and downs:

w=15kg, μ=0.15, g = $9.8m/s^2$, p = 0.15m, and let f = 600N.

T = 17.2N.m.

Calculation power:

For width:

1N.m = 0.00000037 hp h (3.5)

34.4 N.m. = $1.27*10^{-5}$ *3600s = 34.2watt = 0.045 hp.

For ups and downs:

17.2 N.m = 17watt = 0.023 hp.

3.3.3.4 Spur Gear Design

Gear transmission classified according to the location of shaft, the direction of rotation, and the teeth formed lines. Spur Gear is a gear of the parallel shaft with teeth aligned in two zones of the cylinder is called "pitch field". Both surfaces of the cylinder are crossing each other with a fixed parallel axis. The spur gear is shown in the in figure (3.7).

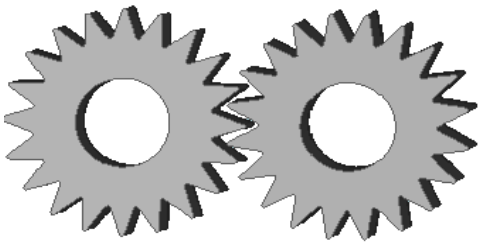


Figure 3.7: The Spur Gear

The main parameters of the spur gear is the pitch circle or module, pitch diameter, outside diameter, whole depth, Spur Gear form as shown in the following figure (3.8).

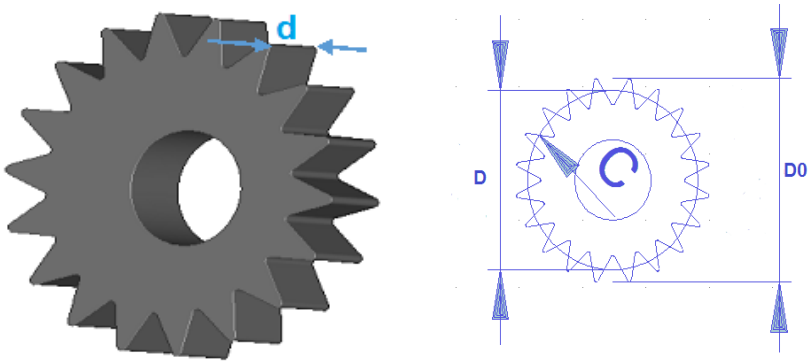


Figure 3.8: The main parameters of the spur gear

C = Pitch circle (cm)

D = Pitch Diameter (cm)

D0 = outside Diameter

d = whole depth (4 cm)

Standard dimension of spur gear; main dimensions of spur gear is expressed with a pitch diameter is an imaginary circle that rolls without slipping as a point of meeting two tooth profile pairs. The tooth size is expressed by the pitch circle is the distance along the circle of the distance between two profiles of adjacent teeth. Pitch circle is a circle which has the radius of half the pitch diameter with its center at the axis of the gear. The relationship between pitch diameter and pitch circle can be seen by the following equation:

$$C = \frac{\pi * D/2}{T} \qquad (3.6)$$

Note:

D = 4.5 cm

T = 27 Teeth

$$C = \frac{3.14 * 4.5/2}{27} = 0.26 \text{ cm}$$

The tooth size may be determined from the amount of pitch circle, because the pitch circulars the circumference of a pitch divided by the number of tooth. However, because the pitch circle always contains π factor used as a dimension of the tooth is less convenient. To remedy this, take a measure called 'module' with the M symbol, where:

$$M = \frac{D}{T} \qquad (3.7)$$

Where:

M = Module

D = Pitch Diameter (mm)

T = Number of Teeth

$$M = \frac{4.5}{27} = 0.1666 \text{ cm/teeth}$$

Outside diameter, it is the overall diameter of the gear which is the pitch circle plus two addendums. Its relationship with module can be described by formula:

$$D_0 = 2M + D \tag{3.8}$$

Where:

D_o = Outside diameter (mm)

M = Module

D = Pitch diameter (mm)

$$D_0 = 2 * 0.1666 + 4.5 = 4.833 \text{ cm}$$

Gear ratio is comparing the speed ratio or the pitch diameter ratio or the number of teeth ratio.

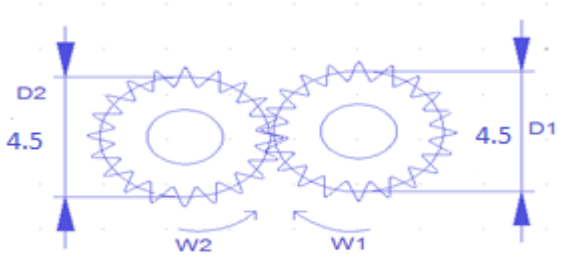


Figure 3.9: The gear ratio

Gear ratio may be expressed by the formula:

$$i = \frac{n1}{n2} = \frac{D_2}{D_1} = \frac{T_2}{T_1} \quad (3.9)$$

Where:

i = Gear ratio

n1 = Speed of pinion (rpm)

n2 = Speed of gear (rpm)

T2 = Number of teeth of gear

D1= Pitch diameter of pinion (mm)

D2 = Pitch diameter of gear (mm)

We want value of ratio (i) to equal 1.

3.3.4 Pulling belts machine

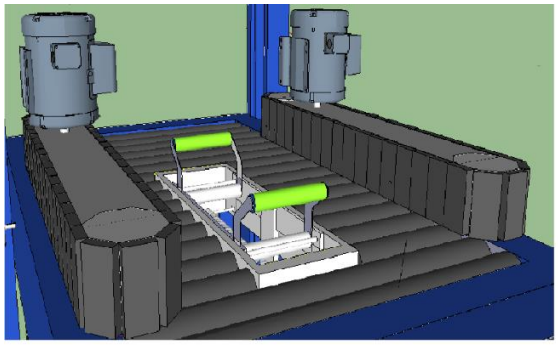


Figure 3.10: the pulling belt

Belt pulling specifications:

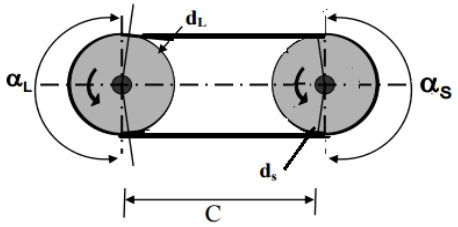


Figure 3.11: Open belt drive

dl: Diameter of the first pulley.

ds: Diameter of the second pulley.

αl: Angle of wrap of the first pulley.

αs: Angle of wrap of the second pulley.

c: Centar distance between the two pulley.

dS = 100 mm, dL = 100 mm, μS = 0.20, μL = 0.20, c=800mm.

Rotational speed of the motor=1400 rpm, , density of belt material (ρ)= 1000 kg/m3 ; allowable stress for the belt material (σ) = 2 MPa; thickness of the belt = 5mm, breadth = 50mm

Determination of angle of wrap:

$\beta = \sin^{-1}\left(\frac{dl-ds}{2c}\right)$ (3.10)

β = zero.

αl = 180° = 3.14 rad.

αs = 180° = 3.14 rad.

Length of open belt:

$L0 = \frac{\pi}{2}(dl + ds) + 2C + \frac{1}{4C}(dl - ds)^2$ (3.11)

$L0 = \frac{\pi}{2}(100 + 100) + 1600 = 1914\text{mm}.$

$v = \frac{\pi * 100 * 1440}{60 * 1000} = 7.53$ m/s (3.12)

$m = bt\rho = \frac{b}{1000} * \frac{5}{1000} * 10^3 = 0.005$ kg/m (3.13)

$mv^2 = 0.283*b$ N.

$\mu S\ \alpha s = \mu l\ \alpha l = 0.20 * 3.14 = 0.628.$

$\frac{T1 - 0.283*b}{T2 - 0.283*b} = e^{0.688} = 1.99$ (3.14)

(T1 – T2) = 26.56 N.m

power equation:

p = (T1 – T2) * v (3.15)

P=0.2Kw

Power transmission

P = 0.2kW = 0.25hp.

3.3.5 Adhesive and cutting tool

Components of adhesive tool:

Spring, Cutting Tool, Adhesive tape, and arm.

Size of adhesive tool:

Width = 15cm, length = 30cm.

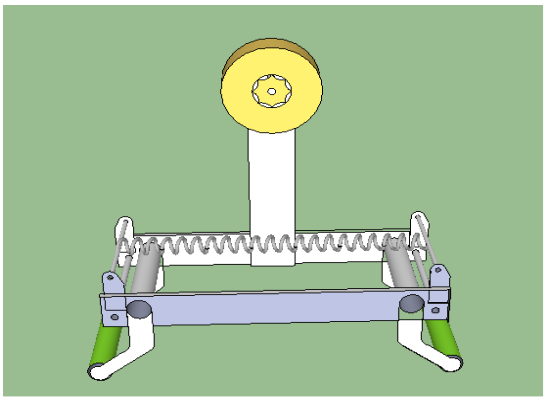


Figure 3.12: Adhesive and cutting tool

Working principle:

Where the carton box passes, the arm of the adhesive device shakes inside for both ends, because they are tied to the same spring, at the first end of the arm after his rush, the beginning of the tape is installed on the carton box, and when the carton box passes, the arm returns to its normal position and during its return, the end of the tape is installed on the other end of the carton box and cut tape.

4

Chapter Four Electrical Parts

4.1 Introduction

This chapter contains the electrical component specifications (motor, sensor, overload, etc), power and control circuit, and protection, PLC and human machine interface program (HMI) that used in our project.

4.2 Motor calculations

1. There are five motors
2. Tow pulling motor "AC motors"
3. Conveyor motor "DC motors"
4. Tow calibration motor "DC motors"

1. Tow pulling motor calculation

   Tow pulling motor power that obtain by the equation, (3.10) , (3.11) , (3.12) , (3.13) , (3.14) , (3.15) equal 200 w

2. Conveyor motor calculation

   The conveyor motor that obtain by the equation (3.1),(3.2),(3.3) equal 178 W

3. Tow calibration calculation

   Width motor calibration that obtain by the equation (3.4),(3.5) equal 34.2 W

   Up-down motor calibration that obtain by the equation (3.4), (3.5) equal 17 W

Table 4.1: Data sheet of motors

type	Power HP	Voltage (v)	n (rpm)	Current (A)	Frequency (Hz)	phase
AC Motor						
Pulling motor 1	0.25	380	1400	1.15	50	3
Pulling motor 1	0.25	380	1400	1.15	50	3
DC Motor						
Conveyor motor	0.25	24	1200	2		
Width motor	34	24	1260	1.4		
Up-down motor	17	24	3300	2.7		

4.3 Circuit Breaker

A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by excess current, typically resulting from an overload or short circuit. Its basic function is to interrupt current flow after a fault is detected. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. Circuit breakers are made in varying sizes, from small devices that protect low-current circuits or individual household appliance, up to large switchgear designed to protect high voltage circuits feeding an entire city. The generic function of a circuit breaker, RCD or a fuse, as

an automatic means of removing power from a faulty system is often abbreviated as ADS (Automatic Disconnection of Supply).

In this project we used two circuit breaker , first circuit breaker three phase for a two pulling motor,transformer,dc motors,PLC, and Second three circuit breaker for dc motors, is connect before the dc motors.

Figure 4.1: Circuit breaker

4.4 Overload

To protection the motor we used overload switches and it defined as overload relays are intended to protect motors against excessive heating due to long time motor over currents up to and including locked motor currents. Protection of the motor due to short circuits or grounds is a function of circuit breakers, or motor short-circuit protectors.

In this project we used two overload, first overload for a two pulling motor, and Second overload for dc motors, is connect before the transformer.

Figure 4.2: over load

4.5 Switches

The emergence switch are used to stop the machine immediately when something wrong happened with the machine as shown in the figure 4.3.a. The start pushbutton switch are used to turn on the project as shown in the figure 4.3.b .The stop pushbutton switch used to turn off the project as shown in the figure 4.3.c . The limit switch is a switch operated by the motion of a machine part or presence of an object. They are used for controlling machinery as part of a control system 4.3.d.

a- Emergence switch b- Start pushbutton switch c- Stop pushbutton switch

d: limit switch

Figure 4.3: switches

4.6 Contactors

A contactor is an eclectically controlled switch used for switching a power circuit, similar to a relay except with higher current ratings.

A contactor is controlled by a circuit which has a much lower power level than the switched circuit.

Contactors come in many forms with varying capacities and features. Unlike a circuit breaker, a contractor is not intended to interrupt a short circuit current.

Contactors range from those having a breaking current of several amperes to thousands of amperes and 24 V DC to many kilovolts. The physical size of contactors ranges from a device small enough to pick up with one hand to large devices approximately a meter (yard) on a side. Contactors are used to control electric motors, lighting, heating, capacitor banks, thermal evaporators, and other electrical loads.

In this project we used six contactors, first contactor for a Tow pulling motor and second contactor for conveyor motor and third and fourth contactors for width calibration motor for two directions and fifth and sixth contactors for the adhesive tool holder arm calibration motor for two directions. As shown in figure 4.4.

Figure 4.4: Contactor

4.7 Transformer

A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction.

In our project, we used a 1phase transformer to transform 220v to 24v AC, before rectifier.

4.8 Fuse

A fuse is an electrical safety device that operates to provide overcurrent protection of an electrical circuit including the source of power and the load. Its essential component is a metal wire or strip that melts when too much current flows through it, thereby interrupting the current. It is a sacrificial device and once a fuse has operated it is an open circuit, and it must be replaced or rewired, depending on type.

In our project, we used a fuses before rectifier.

4.9 Rectifier

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification.

In our project, we used a full-wave rectifier for DC motors.

Figure 4.5: Rectifier

4.10 Encoder

A rotary encoder, also called a shaft encoder, is an electro-mechanical device that converts the angular position or motion of a shaft or axle to an analog or digital signal.

There are two main types: absolute and incremental (relative). The output of absolute encoders indicates the current position of the shaft, making them angle

transducers. The output of incremental encoders provides information about the motion of the shaft, which is typically further processed elsewhere into information such as speed, distance and position.

In our project, we used a two encoder, the first encoder stabilized with the motor that moves the pulling belts (width of carton box), and the second encoder stabilized with the motor that moves the spindle “up-down motor” (height of carton box), to processed the distance and compare it with width and height of input carton box.

Figure 4.6: Encoder

4.11 Flow chart

4.12 power circuit

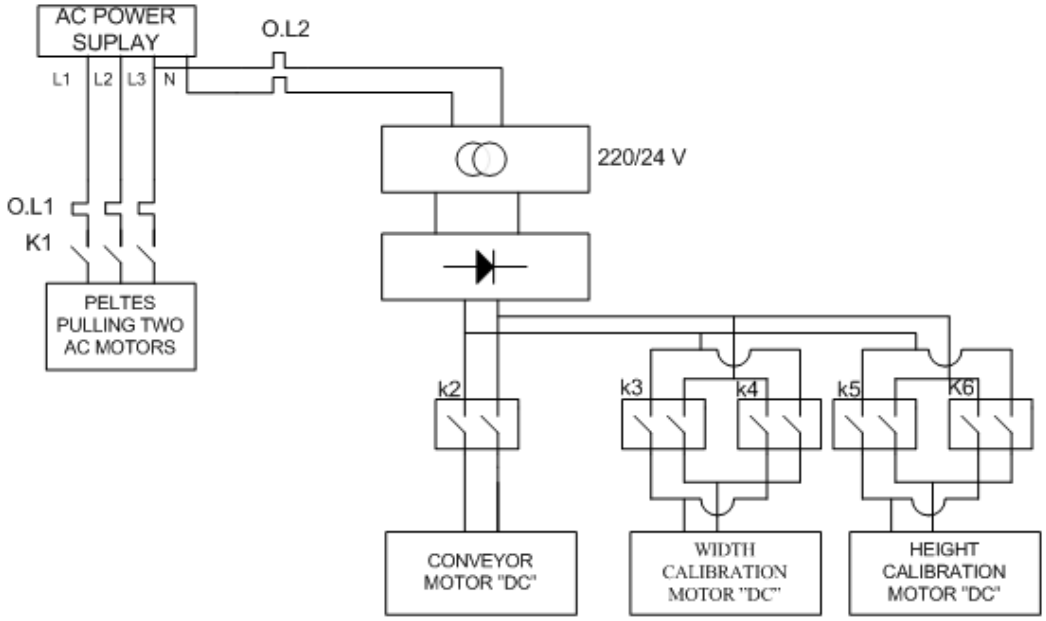


Figure 4.7: Power Bloke Diagram

4.13 PLC.

Programmable Logic Controller (PLC) is a digital computer used for automation of electromechanical process, such as control of machinery on factory assembly lines, PLCs are used in many industries and machine. Unlike general-purpose computers, the PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery backed-up or non- volatile memory.

The PLC used in this machine is PLC- DVP24ES2. And its software is the program WPLsoft, as shown in the figure 4.8.

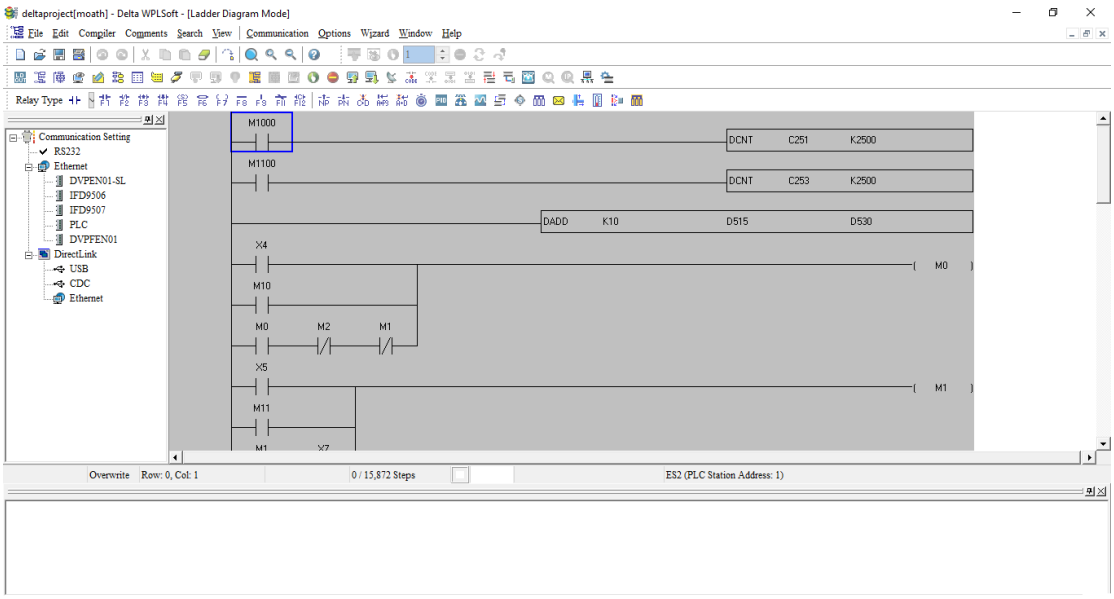


Figure 4.8: WPLsoft Software.

4.14 Control Circuit

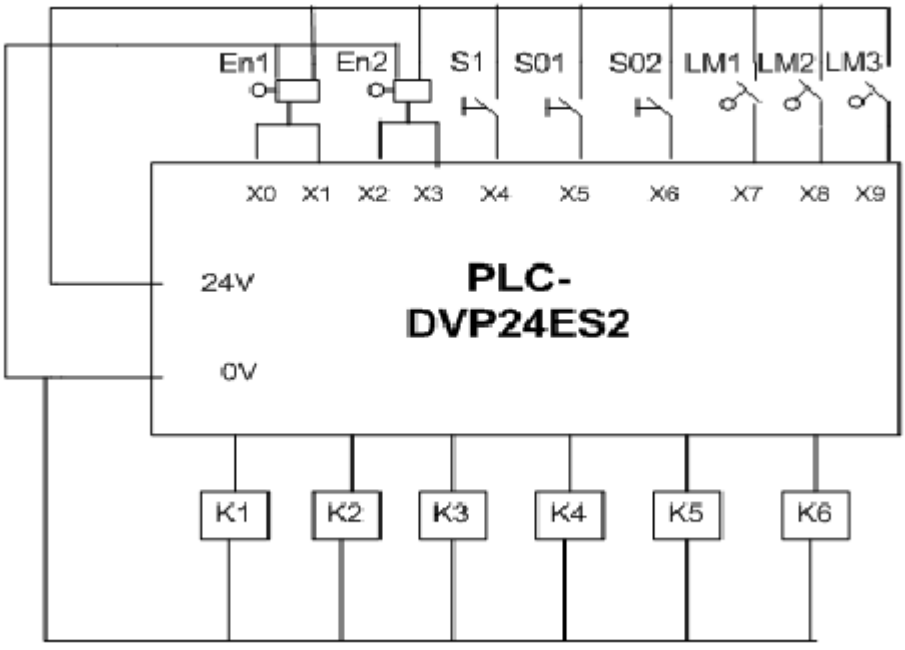


Figure 4.9: PLC Connection

In this machine we need 10 inputs, described in table 4.2, and 6 outputs, described in table 4.3

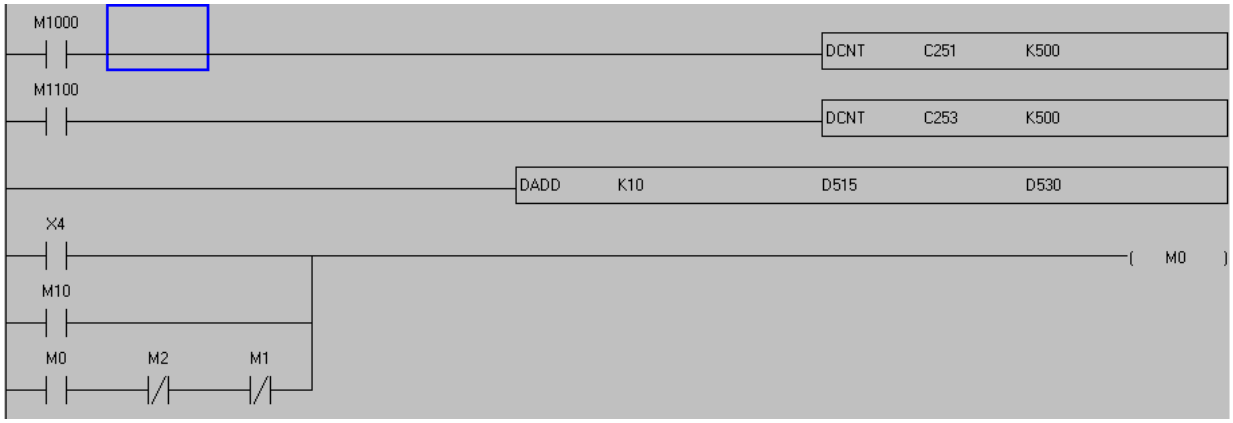
Table 4.2: Input parameter

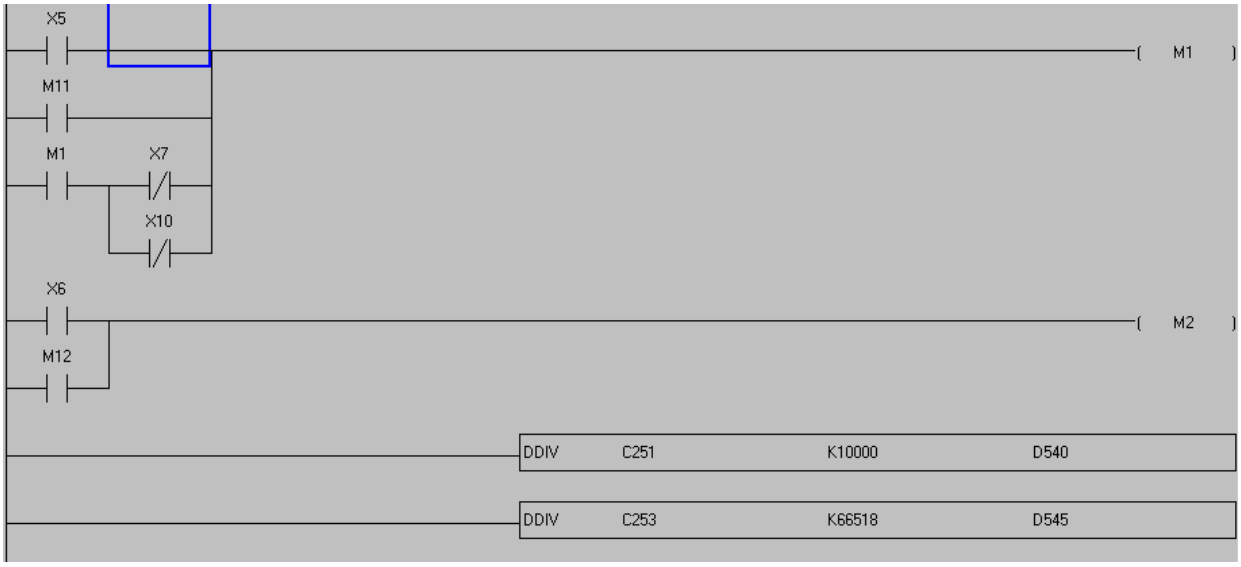
Input	Symbol	Logic allocation
Encoder1 (width) A X0	A	Pulse (+) right
Encoder1 (width) B X1	B	Pulse (-) left
Encoder2 (height) A X2	A	Pulse (+) right
Encoder2 (height) B X3	B	Pulse (-) left
Start (NO) X4	S1	Start =1, operation is run
stop (NC) X5	S01	Reset machine and Turn off all motor
pause (NC) X6	S02	process Stop =0, operation is stop
Limit switch 1 (NO) X7	LS1	LS1 =1, Limit switch counter
Limit switch 2 (NO) X10	LS2	LS4 =1, Limit switch spindle place to normal
Limit switch 3 (NO) X11	LS3	LS5 =1, Limit switch belts pulling place to normal

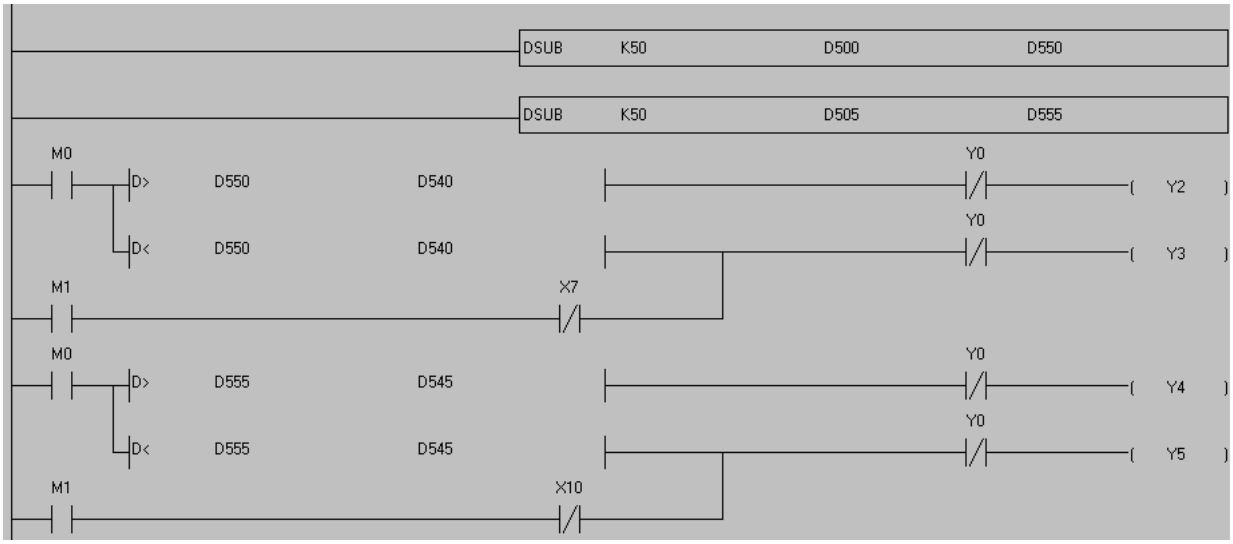
Table 4.3: Output parameter

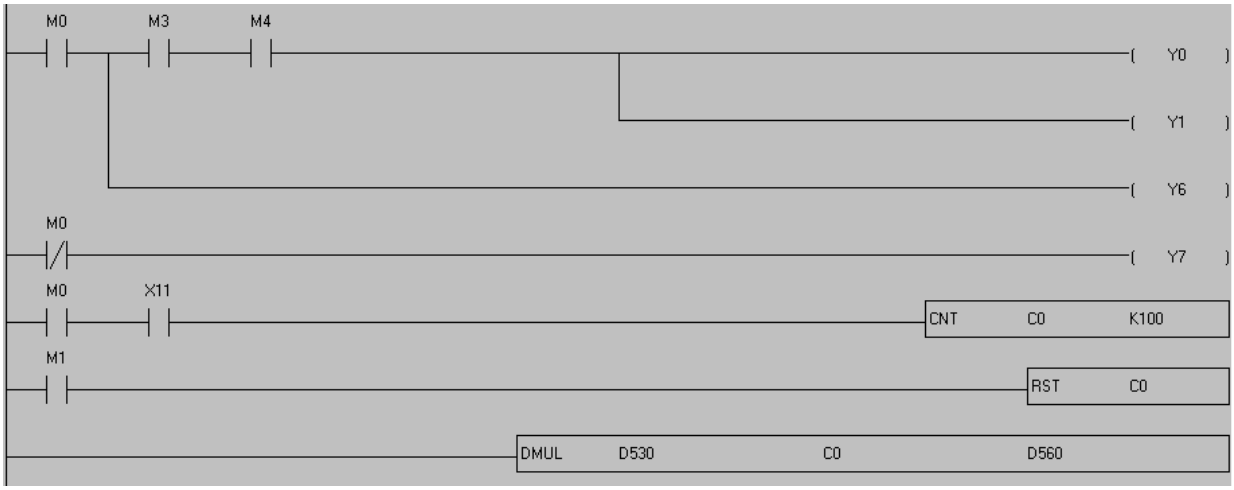
Output	Symbol	Logic allocation
Contactor 1 Y0	K1	K1 =1, Tow pulling motor is on
Contactor 2 Y1	K2	K2 =1, conveyor motor is on
Contactor 3 Y2	K3	K3 =1, width calibration motor is on "RIGHT"
Contactor 4 Y3	K4	K4 =1, width calibration motor is on "LIFT"
Contactor 5 Y4	K5	K5 =1 Height calibration motor is on "UP"
Contactor 6 Y5	K6	K6 =1,Height calibration motor is on "DOWN"

4.15 PLC Ladder Program.




X5
M1
M11
M1
X7
X10
X6
M2
M12
DDIV C251 K10000 D540
DDIV C253 K66518 D545


DSUB K50 D500 D550
DSUB K50 D505 D555
M0
D> D550 D540
Y0
Y2
D< D550 D540
Y0
Y3
M1
X7
M0
D> D555 D545
Y0
Y4
D< D555 D545
Y0
Y5
M1
X10


M0
M3
M4
Y0
Y1
Y6
M0
Y7
M0
X11
CNT C0 K100
M1
RST C0
DMUL D530 C0 D560

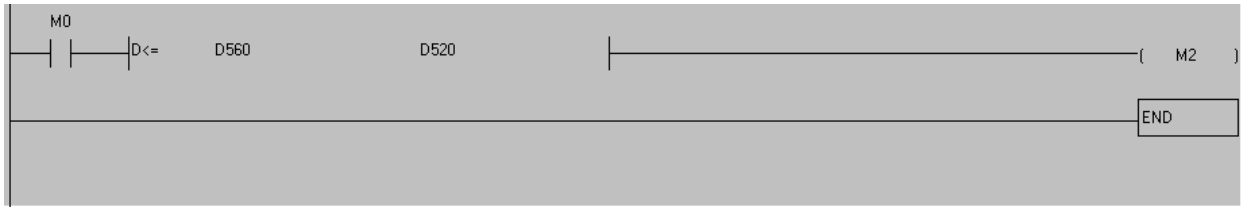


Figure 4.10: Ladder program

4.16 Human machine interface (HMI).

4.16.1 Introduction.

The Human Machine Interface (HMI) includes the electronics required to signal and control the state of industrial automation equipment. These interface products can range from a basic LED status indicator to a 20-inch TFT panel with touchscreen interface. HMI applications require mechanical robustness and resistance to water, dust, moisture, a wide range of temperatures, and, in some environments, secure communication. They should provide Ingress Protection (IP) ratings up to IP65, IP67, and IP68, it must first be working with a programmable logic controller (PLC). It is the PLC that takes the information from the sensors, and transforms it to Boolean algebra, so the HMI can decipher and make decisions.

The HMI that used in this project is delta HMI DOP-B03S211, as shown in figure 4.11.

Figure 4.11: HMI

The software for DOP- DOP-B03S211 is the program Screen editor, as shown in the figure 4.12.

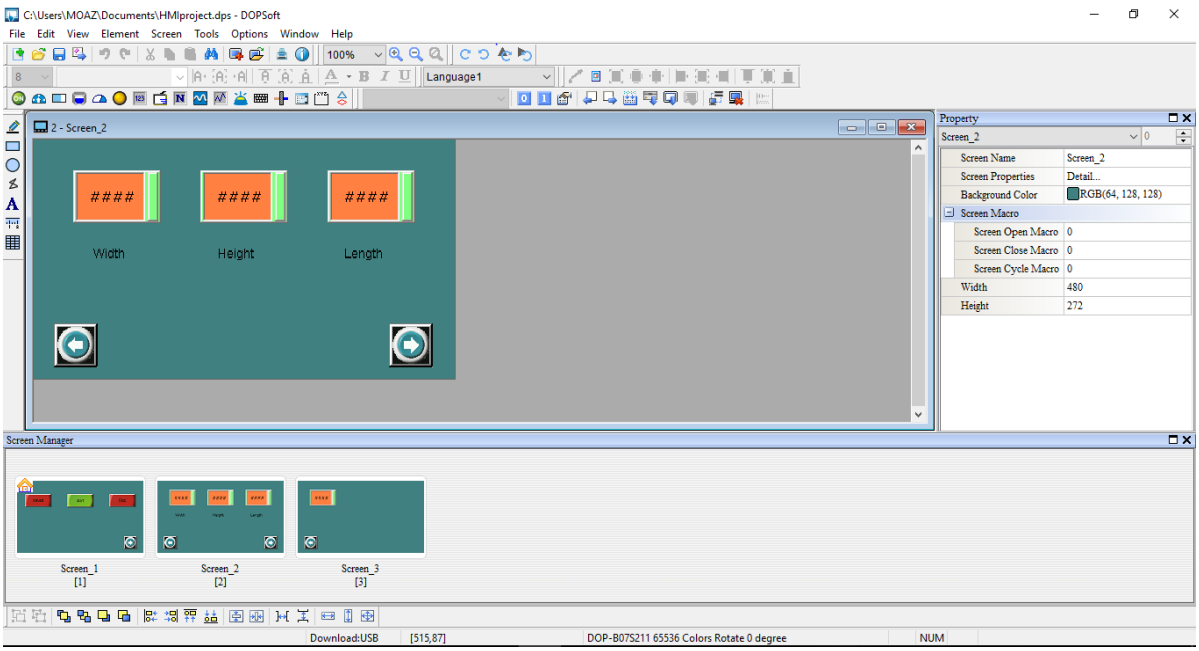


Figure 4.12: Screen Editor Software.

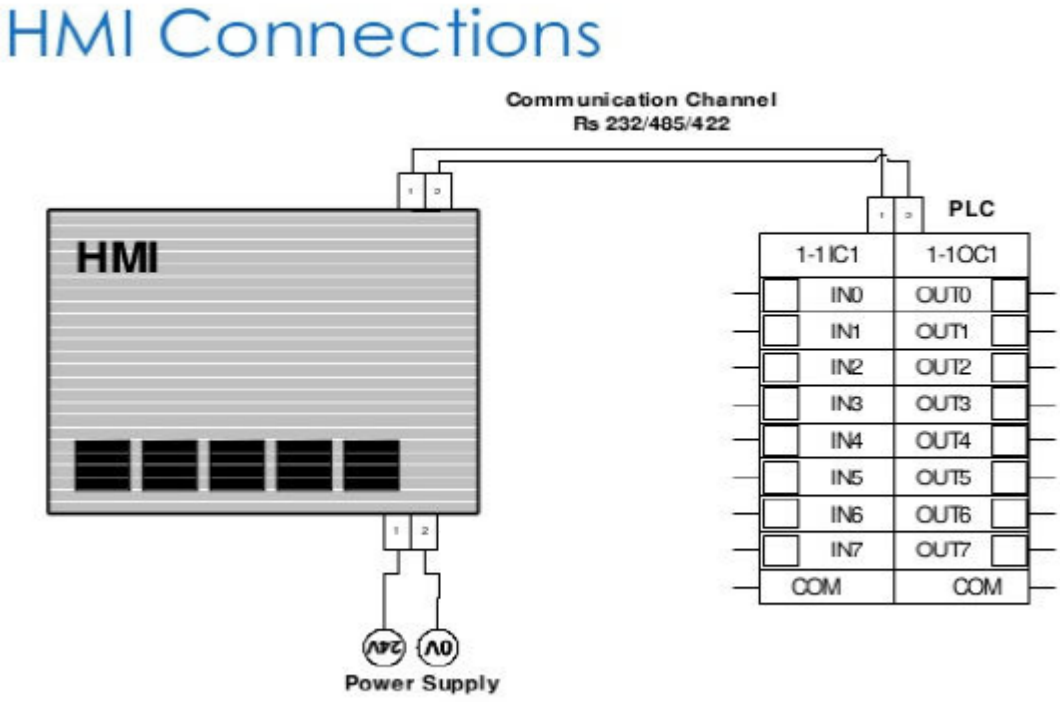


Figure 4.13: HMI to PLC Communication.

4.16.2 HMI design.

Screen_1:

The (start) pushbutton to start the work of the machine, put the machine does not work if we don't enter the width, height, and length of carton box, and the (stop) pushbutton to stop and reset the work of machine and rest the counter, the (pause) pushbutton to stop the work of the machine temporarily.

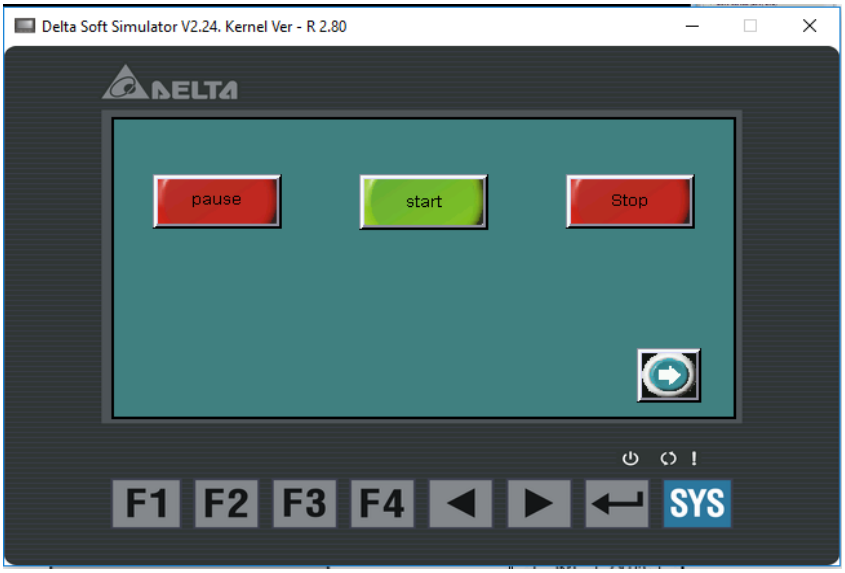


Figure 4.14: Screen 1.

Screen_2:

Numeric entery1 to enter the (width) of carton box, numeric entery2 to enter the (height) of carton box, numeric entery3 to enter the (length) of carton box.

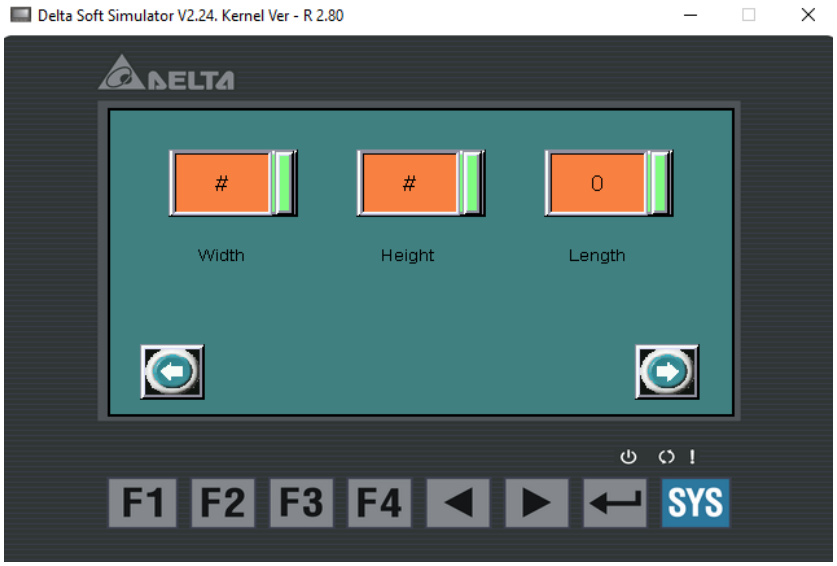


Figure 4.15: Screen 2.

Screen_3:

Numeric entry to enter length of tap, and numeric display to display the length of tap, and the counter to count number of closed carton box.

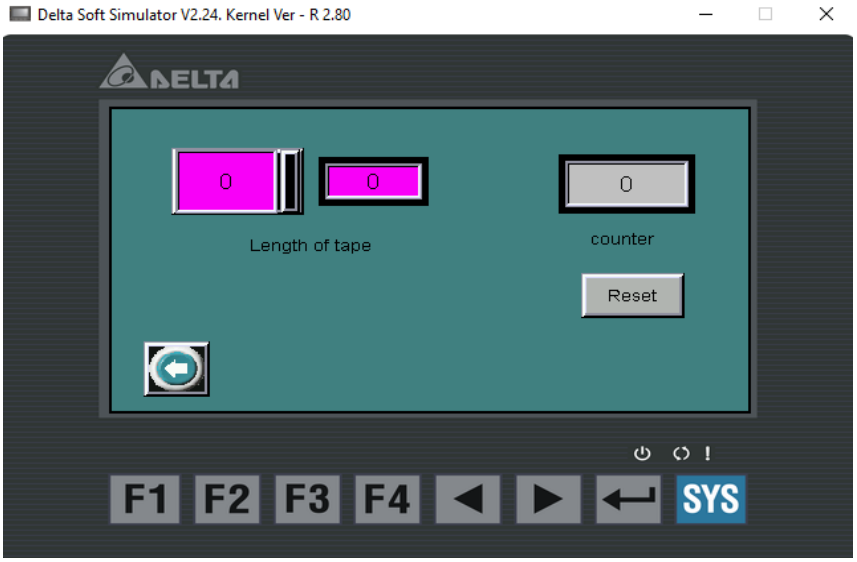


Figure 4.16: Screen 3.

5

Chapter five Experimental Result & Recommendations

5.1 Introduction

5.2 Test Result

5.3 Recommendation

5.4 Future Work

5.5 Conclusion

5.1 Introduction

This chapter provides experimental result and some future work for this project. In this chapter we are listing some goals hope to be accomplished or at least under attention.

5.2 Test Result

1. The machine operator enters the carton box measurements "height, width, height" from HMI screen and presses the play button.
2. The calibration motors in the machine start working to place the machine equipment in its proper place
3. The machine can stick boxes from 20 cm to 50 cm and height from 20 cm to 50 cm.
4. Carton drives start working to pass the boxes through the gluing equipment to affix the box with the best quality.
5. The machine affixes up to 10-15 cartons per minute "depends on the length of the box".

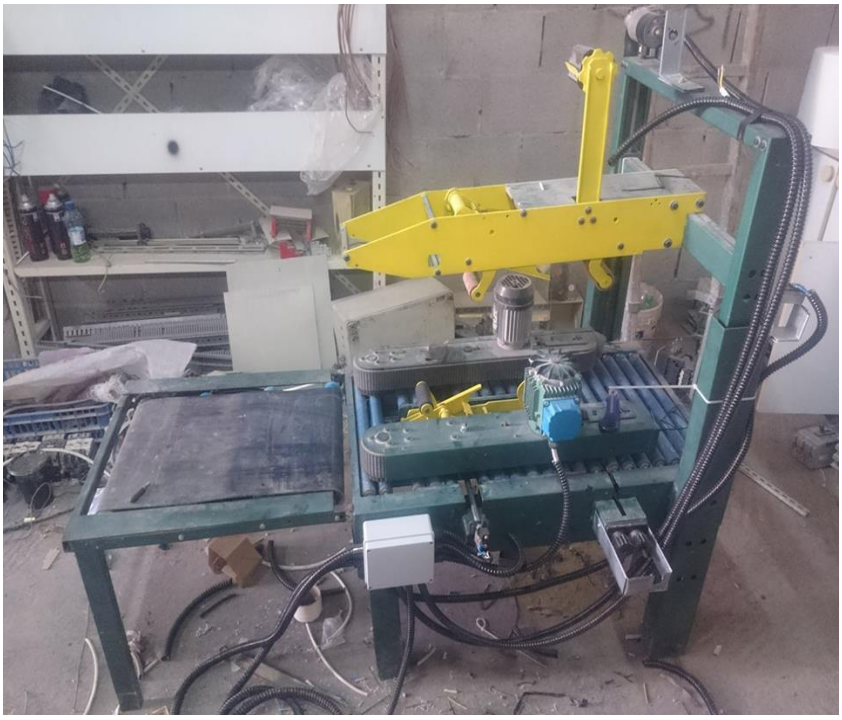


Figure 5.1.a: the final machine

Figure 5.1.b: the final machine

Figure 5.2: final control panel

5.3 Recommendation

These recommendations are recorded to people who can create opportunities for student to make something new and useful, in order to make difference:

1. Such projects should be handled among different departments according to the project nature (we had lots of mechanical problems that might solve without having enough previous knowledge).
2. Once the university administration financially supported graduation projects, this support must be provided at the beginning of the project work, to enable students to do their projects according to the time plan, and to test them at the proper time.
3. The university should provide the proper toolsets, which enable the student to assemble his project and to test it the university campus, so he could get benefit of experiences in the university.

5.4 Future Work

The following tasks are suggested as future works:

1. Increase the number of boxes that can be pasted per minute.
2. Put carton box packing arm.
3. Connect the machine to the SCADA system or NI-LABVIEW to control it.
4. Put seal to seal boxes.

5.5 Conclusion

1. Increase the number of box that are stuck during a specific work period.
2. Improving the quality of the box final form.

References

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[5] INPUT STATION FOR BELT CONVEYO Assignee: Arch Environmental Equipment, Inc., 2510407 9/1976 Germany. Paducah, Ky

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APPENDIX A

APPENDIX B

APPENDIX C

APPENDIX D

APPENDIX A

LS
totally enclosed three-phase asynchronous motors

General information

Efficiency class IE1

Totally enclosed three-phase asynchronous motors, LS series, according IEC 60034, 60038, 60072 powers of 0.09 to 200 kW, frame sizes 56 to 315 mm.
• Single speed: 2, 4, 6 and 8 poles; 230/400V or 400V Δ, 50Hz.
• Two speed: 2/4, 4/6, 4/8, 6/8, 6/12 poles; centrifugal or general use; PAM, Dahlander or separate coils; 400V Y or Δ, 50Hz.

The selection tables for motors in this catalogue allow for:
• Direct on line starting on the mains supplies 230V or 400V operating in:
- delta connection (Δ) at 230V,
- star connection (Y) at 400V.
• The star/delta start (Y/Δ) on mains supply 400V with:
- star connection (Y) during initial starting,
- delta connection (Δ) on 400V duty.

Finition
Assembled with protected screws.
RAL 6000 finishing paint (green).

Protection of the flange and shaft end against atmospheric corrosion.
Individual anti-shock packaging.
Conception multipositions en version B5/V1-B14/V18 version.

Mains supply
• Standard according to the IEC 60038:
- 230/400 V +10% -10% at 50Hz.
Standard construction suitable for the following power supplies:
- 220/380V +5% -5% at 50Hz,
- 230/400V +10% -10% at 50Hz,
- 240/415V +5% -5% at 50Hz,
- 265/460V +5% -5% at 60Hz.
Voltages for the powers equal or greater than 3kW:
- 380V Δ +5% -5% at 50Hz,
- 400V Δ +10% -10% at 50Hz,
- 415V Δ +5% -5% at 50Hz,
- 460V Δ +5% -5% at 60Hz.
Construction suitable for Y/Δ starting.

Description of the LS aluminium three-phase motors

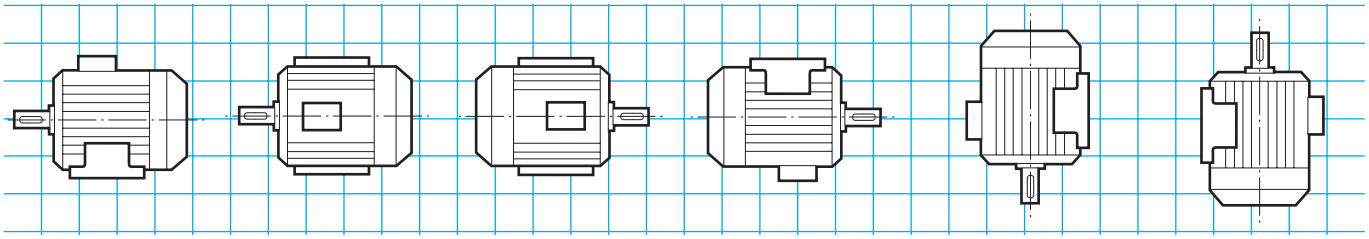
Component	Materials	Remarks
Finned housing	Aluminium alloy	- with bolt-on or cast foot, or without foot - 4 or 6 mounting holes for the foot housings - lifting rings for frame size 132 M, option in 132 S and 112 - optional earth terminal
Stator	Insulated low carbon magnetic steel laminations Electrolytic copper	- the low carbon content guarantees long term stability of the characteristics - assembled laminated pack - semi-enclosed slots - insulation system class F
Rotor	Insulated low carbon magnetic steel laminations Aluminium (A5L)	- inclined slots - squirrel cage pressure die cast in aluminium (or alloy for special applications) - mounted on the shaft by heat shrinking - dynamically balanced rotor, 1/2 key
Shaft	Steel	- for frame size 132: • shaft end fitted with screw and washer • closed keyway - for frame size 132: • tapped centre hole • open keyway
End shields	Aluminium alloy	- LS 56 - 63 - 71 front and rear - LS 80 - 90 rear
	Cast iron	- LS 80 - 90 front (optional for LS 80 and 90 rear) - LS 100 to 315 front and rear
Bearing and lubrication		- ball bearings - 2RS type lubricated for life from LS 56 to LS 71 included - ZZ types lubricated for life from LS 80 to LS 180 included - semi-protected or open types for frame size 200 - regreasable open types from 225 upwards - rear preloaded bearings
Labyrinth seals Lipseals	Technopolymer or steel Synthetic rubber	- lipseal or front jet deflector for all flange motors - lipseal, jet deflector or labyrinth seals for foot motor
Fan	Composite material or aluminium alloy	- 2 directions of rotation: straight blades
Fan cover	Composite material or steel sheet metal	- on request, fitted with a drip cover for operation in vertical position, shaft facing down
Terminal box	Composite material or aluminium alloy	- IP 55 - rotatable, mounted opposite position to the feet - fitted with a 6 steel stud standard terminal board (brass as an optional extra) - terminal box delivered fitted with cable glands (optionally without cable glands) - 1 earth terminal in all terminal boxes

LS
totally enclosed three-phase asynchronous motors

Mounting positions

A

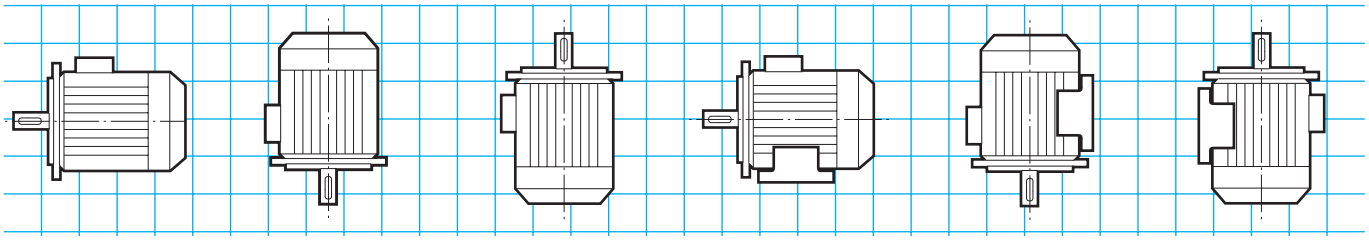
Foot mounted motors



IM 1001 (IM B3) **IM 1051** (IM B6) **IM 1061** (IM B7) **IM 1071** (IM B8) **IM 1011** (IM V5) **IM 1031** (IM V6)

(FF) flange with plain holes mounted motors

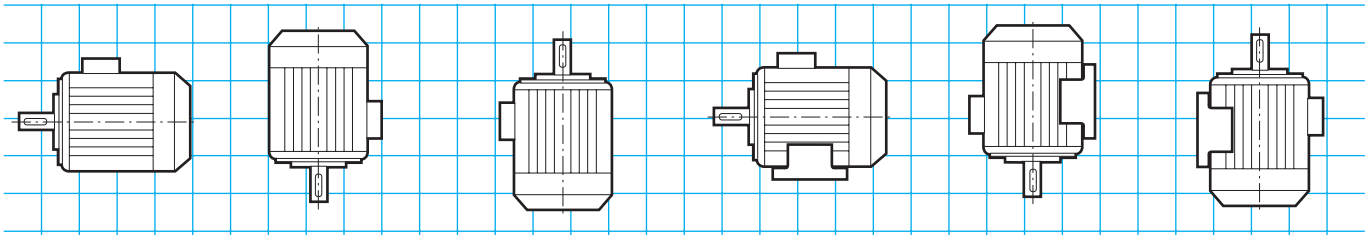
• Possible position IM 3001 (IM B5) up to 225 frame size inclusive



IM 3001 (IM B5) **IM 3011** (IM V1) **IM 3031** (IM V3) **IM 2001** (IM B35) **IM 2011** (IM V15) **IM 2031** (IM V36)

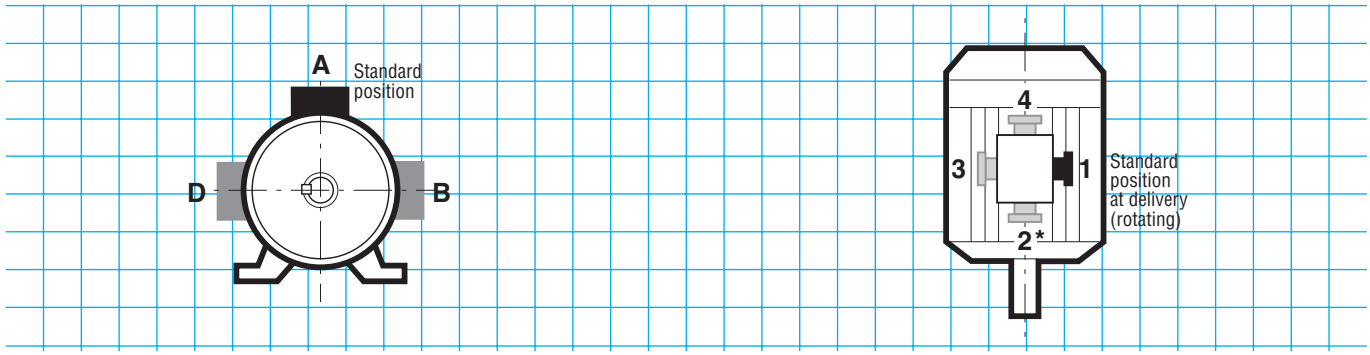
(FT) flange with tapped holes mounted motors

• Possible positions up to 132 frame size inclusive



IM 3601 (IM B14) **IM 3611** (IM V18) **IM 3631** (IM V19) **IM 2101** (IM B34) **IM 2111** (IM V58) **IM 2131** (IM V69)

Terminal box positions in relation to the motor shaft end



A : standard

Cable gland positions in relation to the motor shaft end

1 : standard

* Position 2 not recommended and not feasible on standard motor fitted with plain hole flange (FF)

LS
totally enclosed three-phase asynchronous motors

Adaptation possibilities

Leroy-Somer offers, for use with the LS totally enclosed three-phase asynchronous motors, many options which meet the needs of highly diverse applications. They are described below and in the chapters relating to gearboxes and to speed variation.
For other variants or any specific adaptation, consult the technical specialists at Leroy-Somer.

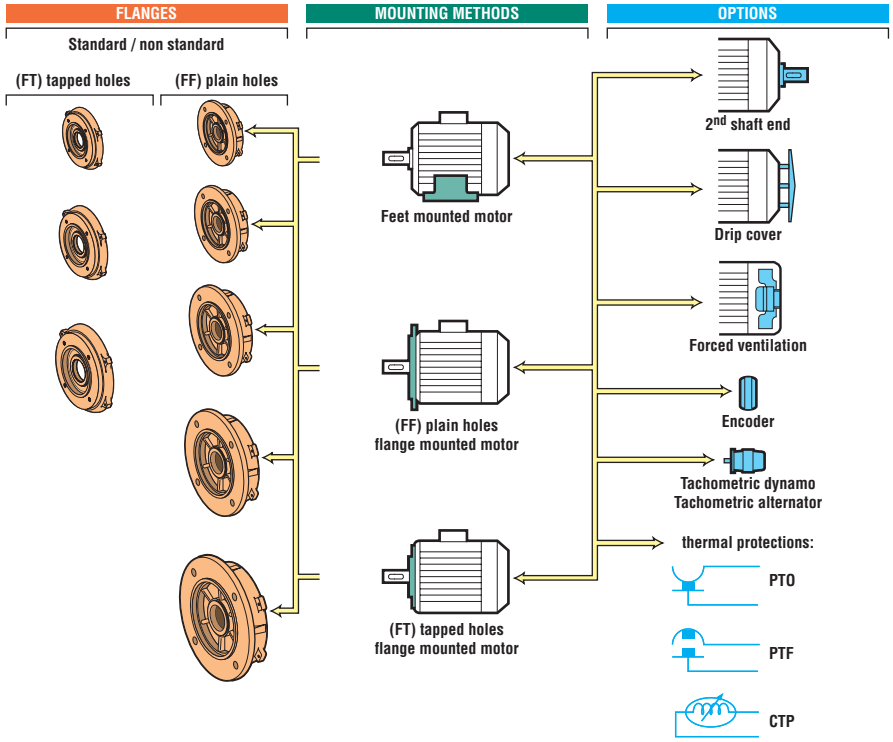
The LS three-motors may be associated to:

- gearboxes
- electronic variable speed drive[1]

The options:

- drip cover
- anti-blocking cover
- forced ventilation
- thermal protection
- aluminium terminal box
- brass cable glands
- cable glands of different dimensions
- switch
- cables output
- stainless steel plate
- second shaft end
- non standard flanges
- renforced sealing
- plug-in connector

1. Conforming to regulations for use as indicated by the standard IEC 34-17.



Designation / Codification

4P 1500 min^{-1}	LS	180	MT	18.5 kW	IM 1001 (IM B3)	400 VΔ	50 Hz	IP 55
Speed polarity	Motor type	IEC 60072-1 frame size	Housing designation and builder index	Rated power	IEC 60034-7 mounting position	Power supply voltage	Power supply frequency	IEC 60034-5 protection

Codification example:
LS three-phase asynchronous motor, 1500 min-1, 18.5 kW IM 1001 (IM B3), 400 V Δ

Designation	Code
4P LS 180 MT 18.5 kW IM 1001 (IM B3) 400 V Δ	EA4 18 302

Codification example:
Addition of a drip cover

Designation	Code
• drip cover	MATP 1024

The table above is an example.
It enables the creation of the designation for the required product.
The designation corresponds to a product code.
The product codes that are present in the selection grids can be used directly. They simplify the ordering process.
The codification table is incorporated in the price list with the designations list.

LS
totally enclosed three-phase asynchronous motors

Selection

A

IP 55 - 50 Hz - Class F - ΔT 80 K - 230 V Δ / 400 V Y - S1

2 poles 3000 min-1

IE1

Type	Rated power P_N kW	Rated speed N_N min-1	Rated torque M_N Nm	Rated current $I_{N\ (400V)}$ A	Power factor Cos Phi 4/4	Power factor Cos Phi 3/4	Power factor Cos Phi 2/4	Efficiency* IEC 60034-2-1; 2007 η 4/4	Efficiency* IEC 60034-2-1; 2007 η 3/4	Efficiency* IEC 60034-2-1; 2007 η 2/4	Starting current/ Rated current Id / In	Starting torque/ Rated torque Md/Mn	Maximum torque/ Rated torque M_M/Mn	Moment of inertia J kg.m2	Weight IM B3 kg	Noise LP db(A)
LS 56 M	0.09	2860	0.3	0.44	0.55	0.45	0.4	54	45.2	37.1	5.0	5.3	5.4	0.00015	3.8	54
LS 56 M	0.12	2820	0.4	0.5	0.6	0.55	0.45	58.7	54	45.2	4.6	4.0	4.1	0.00015	3.8	54
LS 63 M	0.18	2790	0.6	0.52	0.75	0.65	0.55	67.4	66.9	59.3	5.0	3.3	2.9	0.00019	4.8	57
LS 63 M	0.25	2800	0.9	0.71	0.75	0.65	0.55	67.8	67.3	59.2	5.4	3.2	2.9	0.00025	6	57
LS 71 L	0.37	2800	1.3	0.98	0.8	0.7	0.6	68.4	67.6	63.9	5.2	3.3	3.9	0.00035	6.4	62
LS 71 L	0.55	2800	1.9	1.32	0.8	0.7	0.55	75.7	75.2	71.1	6.0	3.2	3.1	0.00045	7.3	62
LS 71 L	0.75	2780	2.6	1.7	0.85	0.75	0.65	74.6	75.8	73.1	6.0	3.3	2.9	0.0006	8.3	62
LS 80 L	0.75	2840	2.5	1.64	0.87	0.8	0.68	**75.7**	76.1	73.3	5.9	2.4	2.2	0.0007	8.2	61
LS 80 L	1.1	2837	3.7	2.4	0.84	0.77	0.65	**77.3**	78.3	76.4	5.8	2.7	2.4	0.0009	9.7	61
LS 80 L	1.5	2859	5.0	3.2	0.83	0.76	0.62	**79.3**	80	78.1	7.0	3.2	2.8	0.0011	11.3	61
LS 90 S	1.5	2870	5.0	3.4	0.81	0.72	0.58	**80**	79.5	75.9	8.0	3.9	4.0	0.0014	12	64
LS 90 L	1.8	2865	6.0	3.6	0.86	0.8	0.69	**81.9**	82.5	81.4	8.0	3.6	3.6	0.0017	14	64
LS 90 L	2.2	2862	7.3	4.3	0.88	0.83	0.73	**82**	83	82	7.7	3.7	3.3	0.0021	16	64
LS 100 L	3	2868	10.0	6.3	0.81	0.73	0.59	**82.5**	82.6	80.1	7.5	3.8	3.9	0.0022	20	66
LS 100 L	3.7	2850	12.5	8	0.85	0.76	0.62	**82.7**	82.2	77.2	8.6	0.0	0.0	0.0022	21	66
LS 112 M	4	2877	13.3	7.8	0.85	0.78	0.65	**85**	85.3	83.7	7.8	2.9	2.9	0.0029	24.4	66
LS 112 MG	5.5	2916	18.0	10.5	0.88	0.81	0.71	**86.1**	86.4	84.7	9.0	3.1	3.5	0.0076	33	66
LS 132 S	5.5	2916	18.0	10.5	0.88	0.81	0.71	**86.1**	86.4	84.7	9.0	0.0	0.0	0.0076	34.4	72
LS 132 S	7.5	2905	24.5	14.7	0.85	0.78	0.63	**86**	85.8	83.2	8.7	0.0	0.0	0.0088	39	72
LS 132 M	9	2910	29.5	17.3	0.85	0.8	0.71	**87.9**	88.5	87.5	8.6	2.5	3.5	0.016	49	72
LS 132 M	11	2944	35.7	20.7	0.86	0.81	0.69	**88.2**	88.3	86.7	7.5	2.7	3.4	0.018	54	72
LS 160 MP	11	2944	35.7	20.7	0.86	0.81	0.69	**88.2**	88.3	86.7	7.5	2.7	3.4	0.019	62	72
LS 160 MP	15	2935	48.8	28.4	0.85	0.79	0.71	**89.3**	89.7	88.6	8.1	3.0	3.5	0.023	72	72
LS 160 L	18.5	2934	60.2	33.7	0.87	0.83	0.75	**90.09**	90.6	90.0	8.0	3.0	3.3	0.044	88	72
LS 180 MT	22	2938	71.5	39.9	0.87	0.84	0.76	**90.6**	91.2	90.8	8.1	3.1	3.1	0.052	99	72
LS 200 LT	30	2946	97.2	52.1	0.9	0.87	0.82	**91.5**	92.1	91.7	8.6	2.7	3.4	0.089	154	73
LS 200 L	37	2950	120	65	0.89	0.87	0.82	**92.1**	92.6	92.3	7.4	2.6	3.0	0.12	180	73
LS 225 MT	45	2950	146	78	0.9	0.87	0.82	**92.5**	92.7	92.7	7.5	2.8	3.1	0.14	200	73
LS 250 MZ	55	2956	178	96	0.89	0.86	0.8	**92.9**	93.6	92.5	8.3	3.1	3.4	0.173	235	78
LS 280 SC	75	2968	241	129	0.9	0.87	0.82	**93.5**	93.6	93.1	8.5	2.6	3.4	0.39	330	79
LS 280 MC	90	2968	290	154	0.9	0.88	0.83	**93.8**	94.0	93.6	8.4	2.6	3.3	0.47	375	79
LS 315 SN	110	2964	354	184	0.92	0.9	0.86	**94**	94.2	93.9	8.6	2.7	3.4	0.55	445	80
LS 315 MP	132	2976	424	227	0.89	0.87	0.82	**94.4**	94.2	93.1	7.6	2.8	2.9	1.67	715	83
LS 315 MR	160	2976	513	271	0.9	0.88	0.84	**94.6**	94.6	93.7	7.6	2.9	3.1	1.97	820	83
LS 315 MR•	200	2982	640	350	0.87	0.86	0.82	**94.8**	94.3	92.9	9.3	3.8	3.9	1.97	845	83

● Temperature rise class F

* This standard replaces the IEC 60034-2; 1996.

LS
totally enclosed three-phase asynchronous motors

Selection

IP 55 - 50 Hz - Class F - T 80 K - 230 V / 400 V - S1

2 poles 3000 min^{-1}

A

Type	Rated power at 50 Hz P_N kW	IM 1001 (IM B3) Code	Qty	IM 3001 (IM B5) Code	Qty	IM 2001 (IM B35) Code	Qty	IM 3601 (IM B14) Code	Qty	IM 2101 (IM B34) Code	Qty
LS 56 M	*0.09*	*MA2 09 107*	*10*	*MA2 09 109*	*10*	*MA2 09 1C9*	*5*	*MA2 09 111*	*10*	*MA2 09 1D1*	*5*
LS 56 M	*0.12*	*MA2 12 107*	*10*	*MA2 12 109*	*5*	*MA2 12 1C9*	*5*	*MA2 12 111*	*5*	*MA2 21 1D1*	*5*
LS 63 M	*0.18*	*MA2 18 113*	*10*	*MA2 18 115*	*10*	*MA2 18 1C5*	*5*	*MA2 18 117*	*5*	*MA2 18 1D7*	*5*
LS 63 M[1]	*0.18*	*MA2 18 BA1*	*10*	*MA2 18 BA2*	*5*	*MA2 18 BA4*	*5*	*MA2 18 BA3*	*5*	*MA2 18 BA5*	*5*
LS 63 M	*0.25*	*MA2 25 125*	*10*	*MA2 25 127*	*10*	*MA2 25 1C7*	*5*	*MA2 25 129*	*10*	*MA2 25 1D9*	*5*
LS 63 M[1]	*0.25*	*MA2 25 BA1*	*10*	*MA2 25 BA2*	*5*	*MA2 25 BA4*	*5*	*MA2 25 BA3*	*10*	*MA2 25 BA5*	*5*
LS 71 L	*0.37*	*MA2 37 119*	*10*	*MA2 37 121*	*10*	*MA2 37 1C1*	*5*	*MA2 37 123*	*10*	*MA2 37 1D3*	*5*
LS 71 L	*0.55*	*MA2 55 119*	*10*	*MA2 55 121*	*10*	*MA2 55 1C1*	*5*	*MA2 55 123*	*10*	*MA2 55 1D3*	*5*
LS 71 L	*0.75*	*MA2 75 138*	*10*	*MA2 75 139*	*5*	*MA2 75 1C9*	*5*	*MA2 75 140*	*10*	*MA2 75 1D0*	*5*
LS 80 L	0.75	MA2 75 133	10	MA2 75 135[3]	5	MA2 75 1C5	5	MA2 75 137[4]	2	MA2 75 1D7	2
LS 80 L	1.1	EA2 11 233	10	EA2 11 235[3]	5	EA2 11 2C5	5	EA2 11 237[4]	2	EA2 11 2D7	2
LS 80 L	1.5	EA0 00 001	10	EA0 00 002	2	EA0 00 003	1	EA0 00 004	2	EA0 00 005	1
LS 90 S	1.5	EA2 15 233	10	EA2 15 235[3]	5	EA2 15 2C5	3	EA2 15 237[4]	5	EA2 15 2D7	2
LS 90 L	1.8	EA2 18 213	5	EA2 18 215[3]	1		-	EA2 18 217[4]	5		-
LS 90 L	2.2	EA2 22 219	10	EA2 22 221[3]	10	EA2 22 2C1	3	EA2 22 223[4]	5	EA2 22 2D3	2
LS 100 L	3	EA2 30 201	10	EA2 30 203[3]	5	EA2 30 2C3	3	EA2 30 205[4]	5	EA2 30 2D5	2
LS 100 L	3.7	MA2 37 201	5		-		-	MA2 37 205	1		-
LS 112 M	4	EA2 40 201	10	EA2 40 203[3]	5	EA2 40 2C3	2	EA2 40 205	2	EA2 40 2D5	5
LS 112 MG	5.5	EA2 55 201	5	EA2 55 203[3]	3	EA2 55 2C3	2	EA2 55 205	2	EA2 55 2D5	2
LS 132 S	5.5	EA2 55 207	10	EA2 55 209[3]	5	EA2 55 2C9	2	EA2 55 211	2		-
LS 132 S	7.5	EA2 75 201	5	EA2 75 203[3]	10	EA2 75 2C3	2	EA2 75 205	2	EA2 75 2D5	1
LS 132 M	9	EA2 90 201	5	EA2 90 203[3]	1	EA2 90 2C3	2		-		-
LS 132 M	11	EA2 11 340	3	EA2 11 342[3]	2	EA2 11 3C2	1		-		-
LS 160 MP	11	EA2 11 301	3	EA2 11 303[3]	1		-				
LS 160 MP	15	EA2 15 301	2	EA2 15 303 [3]	1	EA2 15 3C3	1				
LS 160 L	18.5	EA2 18 301	1	EA2 18 303	1	EA2 18 3C3	1				
LS 180 MT	22	EA2 22 301	1	EA2 22 303	1	EA2 22 3C3	1				
LS 200 LT	30	EA2 30 301	1	EA2 30 303	1	EA2 30 3C3	1				
LS 200 L	37	EA2 37 301	1	EA2 37 303	1	EA2 37 3C3	1				
LS 225 MT	45	EA2 45 301	1	EA2 45 303	1	EA2 45 3C3	1				
LS 250 MZ	55	EA2 55 301	1			EA2 55 3C3	1				
LS 280 SC	75	EA2 75 301	1			EA2 75 3C3	1				
LS 280 MC	90		-				-				
LS 315 SN	110		-				-				
LS 315 MP	132		-				-				
LS 315 MR	160		-				-				
LS 315 MR[2]	200		-				-				

1. Flange or foot motor (or foot and flange) with shaft end different from the standard (D: 14 j6 - E: 30 mm).
2. Temperature rise class F.
3. Motors IM B5 / IM V1.
4. Motors IM B14 / IM V18.

Selection example:

Speed:	3000 min^{-1} - 2 poles
Power:	2.2 kW
Mounting and position:	IM 1001 (IM B3)
Mains supply voltage:	230/400 V

Designation:
2P LS 90 L 2.2 kW IM 1001 (IM B3)
230/400 V

Code: EA2 22 219

LS
totally enclosed three-phase asynchronous motors

Selection

A

IP 55 - 50 Hz - Class F - ΔT 80 K - 230 V Δ / 400 V Y - S1

4 poles 1500 min-1

IE1

Type	Rated power P_N kW	Rated speed N_N min-1	Rated torque M_N Nm	Rated current $I_{N\ (400V)}$ A	Power factor Cos Phi 4/4	Power factor Cos Phi 3/4	Power factor Cos Phi 2/4	Efficiency* IEC 60034-2-1; 2007 η 4/4	Efficiency* IEC 60034-2-1; 2007 η 3/4	Efficiency* IEC 60034-2-1; 2007 η 2/4	Starting current/ Rated current Id / In	Starting torque/ Rated torque Md/Mn	Maximum torque/ Rated torque M_M/Mn	Moment of inertia J kg.m2	Weight IM B3 kg	Noise LP db(A)
LS 56 M	0.06	1380	0.4	0.29	0.76	0.69	0.62	41.8	37.1	29.7	2.8	2.4	2.5	0.00025	4	47
LS 56 M	0.09	1400	0.6	0.39	0.6	0.52	0.42	55.2	49.6	42.8	3.2	2.8	2.8	0.00025	4	47
LS 63 M	0.12	1380	0.8	0.44	0.7	0.58	0.47	56.1	53.9	46.8	3.2	2.4	2.3	0.00035	4.8	49
LS 63 M	0.18	1390	1.2	0.64	0.65	0.55	0.44	61.6	58	51.3	3.7	2.6	2.6	0.00048	5	49
LS 71 M	0.25	1425	1.7	0.8	0.65	0.55	0.44	69.4	66.8	59.8	4.6	2.7	2.9	0.00068	6.4	49
LS 71 M	0.37	1420	2.5	1.06	0.7	0.59	0.47	72.1	71.7	66.4	4.9	2.4	2.8	0.00085	7.3	49
LS 71 L	0.55	1400	3.8	1.62	0.7	0.62	0.49	70.4	70	65.1	4.8	2.3	2.5	0.0011	8.3	49
LS 80 L	0.55	1410	3.7	1.42	0.76	0.68	0.55	73.2	69.1	62.1	4.5	2.0	2.3	0.0013	8.2	47
LS 80 L	0.75	1400	5.1	2.01	0.77	0.71	0.59	**72.1**	72.8	70.1	4.5	2.0	2.2	0.0018	9.3	47
LS 80 L	0.9	1425	6.0	2.44	0.73	0.67	0.54	**73.2**	72.9	70.3	5.8	3.0	3.0	0.0024	10.9	47
LS 90 S	1.1	1429	7.4	2.5	0.84	0.77	0.64	**76.7**	78.2	76.6	4.8	1.6	2.0	0.0026	11.5	48
LS 90 L	1.5	1428	10.0	3.4	0.82	0.74	0.6	**79.3**	79.9	77.5	5.3	1.8	2.3	0.0032	13.5	48
LS 90 L	1.8	1438	12.0	4	0.82	0.75	0.61	**79.4**	80	77.6	6	2.1	3.2	0.0037	15.2	48
LS 100 L	2.2	1436	14.6	4.8	0.81	0.73	0.59	**80.3**	81.2	79.3	5.9	2.1	2.5	0.0043	20	48
LS 100 L	3	1437	19.9	6.5	0.81	0.72	0.59	**82.8**	83.4	81.8	6	2.5	2.8	0.0055	22.5	48
LS 112 M**	4	1438	26.6	8.3	0.83	0.76	0.57	**81.7**	81.6	80.6	7.1	2.5	3.0	0.0067	24.9	49
LS 132 S	5.5	1447	36.7	11.1	0.83	0.79	0.67	**84.7**	85.6	84.6	6.3	2.4	2.8	0.014	36.5	49
LS 132 M	7.5	1451	49.4	15.2	0.82	0.74	0.61	**86.0**	86.2	84.4	7	2.4	2.9	0.019	54.7	62
LS 132 M	9	1455	59.1	18.1	0.82	0.74	0.62	**86.8**	87.2	86.4	6.9	2.2	3.1	0.023	59.9	62
LS 160 MP	11	1454	72.2	21	0.86	0.79	0.67	**87.7**	88.4	87.5	7.7	2.3	3.2	0.03	70	62
LS 160 LR	15	1453	98.6	28.8	0.84	0.78	0.69	**88.7**	89.3	88.3	7.5	2.9	3.6	0.036	86	62
LS 180 MT	18.5	1456	121	35.2	0.84	0.79	0.67	**89.9**	90.6	90.5	7.6	2.7	3.2	0.085	100	64
LS 180 LR	22	1456	144	41.7	0.84	0.79	0.68	**90.2**	91.0	90.8	7.9	3.0	3.3	0.096	112	64
LS 200 LT	30	1460	196	56.3	0.84	0.8	0.69	**90.8**	91.5	91.2	6.6	2.9	2.9	0.151	165	64
LS 225 ST	37	1468	241	69	0.84	0.8	0.7	**92.0**	92.7	92.7	6.3	2.7	2.6	0.24	205	64
LS 225 MR	45	1468	293	84	0.84	0.8	0.7	**92.5**	93.1	93.0	6.3	2.7	2.6	0.29	235	64
LS 250 ME	55	1478	355	102	0.84	0.8	0.71	**93.1**	93.3	92.7	7	2.7	2.8	0.63	320	66
LS 280 SC	75	1478	485	138	0.84	0.8	0.71	**93.5**	93.9	93.5	7.2	2.8	2.9	0.83	380	69
LS 280 MD	90	1478	581	165	0.84	0.8	0.71	**93.5**	93.8	93.5	7.6	3.0	3.0	1.03	450	69
LS 315 SN	110	1477	711	201	0.84	0.79	0.7	**94.1**	94.5	94.2	7.6	3.0	3.2	1.04	470	76
LS 315 MP	132	1484	849	238	0.85	0.82	0.74	**94.2**	94.4	93.8	7.6	2.9	3.0	2.79	750	70
LS 315 MR	160	1484	1030	287	0.85	0.82	0.74	**94.7**	94.7	93.9	7.7	2.9	3.0	3.27	845	70
LS 315 MR•	200	1486	1285	362	0.84	0.79	0.69	**94.9**	94.9	94.2	8.1	3.1	3.4	3.27	845	70

• Temperature rise class F
* This standard replaces the IEC 60034-2; 1996.
** These motors do not reach the level of efficiency IE1.

LS
totally enclosed three-phase asynchronous motors

Selection

IP 55 - 50 Hz - Class F - ΔT 80 K - 230 V Δ / 400 V Y - S1

A

4 poles 1500 min⁻¹

Type	Rated power at 50 Hz P_N kW	IM 1001 (IM B3) Code	Qty	IM 3001 (IM B5) Code	Qty	IM 2001 (IM B35) Code	Qty	IM 3601 (IM B14) Code	Qty	IM 2101 (IM B34) Code	Qty
LS 56 M	0.06		-		-		-		-		-
LS 56 M	0.09	MA4 09 113	10	MA4 09 115	10	MA4 09 1A5	5	MA4 09 117	10	MA4 09 1B7	
LS 63 M	0.12	MA4 12 119	10	MA4 12 121	10	MA4 12 1B1	5	MA4 12 123	5	MA4 12 1B3	5
LS 63 M[1]	0.12	MA4 12 BA1	10	MA4 12 BA2	5	MA4 12 BA4	5	MA4 12 BA3	5	MA4 12 BA5	5
LS 63 M	0.18	MA4 18 107	15	MA4 18 109	10	MA4 18 1A9	5	MA4 18 111	10	MA4 18 1B1	5
LS 63 M[1]	0.18	MA4 18 BA1	15	MA4 18 BA2	5	MA4 18 BA4	5	MA4 18 BA3	5	MA4 18 BA5	5
LS 71 M	0.18										
LS 71 M	0.25	MA4 25 119	15	MA4 25 121	10		-	MA4 25 123	10		-
LS 71 M	0.37	MA4 37 119	20	MA4 37 121	10	MA4 37 1A1	5	MA4 37 123	10	MA4 37 1B3	5
LS 71 L	0.55	MA4 55 132	10	MA4 55 133	10		-	MA4 55 134	10		-
LS 80 L	0.55	MA4 55 113	15	MA4 55 115[3]	5	MA4 55 1A5	3	MA4 55 117[4]	5	MA4 55 1B7	2
LS 80 L	0.75	MA4 75 119	15	MA4 75 121[3]	10	MA4 75 1A1	3	MA4 75 123[4]	5	MA4 75 1B3	2
LS 80 L	0.9	MA4 90 107	5	MA4 90 109[3]	2	MA4 90 1A9	2	MA4 90 111[4]	5	MA4 90 1B1	2
LS 90 S	1.1	EA4 11 219	15	EA4 11 221[3]	10	EA4 11 2A1	2	EA4 11 223[4]	5	EA4 11 2B3	5
LS 90 L	1.5	EA4 15 207	15	EA4 15 209[3]	15	EA4 15 2A9	2	EA4 15 211[4]	5	EA4 152B1	2
LS 90 L	1.8	EA4 18 207	10	EA4 18 209[3]	5	EA4 18 2A9	2	EA4 18 211[4]	5	EA4 18 2B1	2
LS 100 L	2.2	EA4 22 207	15	EA4 22 209[3]	15	EA4 22 2A9	2	EA4 22 211[4]	5	EA4 22 0B1	2
LS 100 L	3	EA4 30 207	15	EA4 30 209[3]	10	EA4 30 2A9	5	EA4 30 211[4]	5	EA4 30 2B1	2
LS 112 M	4	MA4 40 201	25	MA4 40 203[3]	10	MA4 40 2A3	5	MA4 40 205[4]	5	MA4 40 2B5	2
LS 112 MG	5.5	1637943	2	1792130	5	2344485	2	3901994	3	2502702	2
LS 132 S	5.5	EA4 55 207	10	EA4 55 209[3]	10	EA4 55 2A9	5	EA4 55 211[4]	2	EA4 55 2B1	2
LS 132 M	7.5	EA4 75 207	10	EA4 75 209[3]	5	EA4 75 2A9	5	EA4 75 211[4]	1	EA4 75 2B1	1
LS 132 M	9	EA4 90 201	5	EA4 90 203[3]	2	EA4 90 2A3	2	EA4 90 205[4]	1	EA4 90 2B6	1
LS 160 MP	11	EA4 11 301	5	EA4 11 303[3]	1	EA4 11 3A3	2				
LS 160 LR	15	EA4 15 301	5	EA4 15 303[3]	1	EA4 15 3A3	2				
LS 180 MT	18.5	EA4 18 301	2	EA4 18 303[3]	1	EA4 18 3A3	1				
LS 180 LR	22	EA4 22 301	2	EA4 22 303[3]	1	EA4 22 3A3	1				
LS 200 LT	30	EA4 30 301	2	EA4 30 303	1	EA4 30 3A3	1				
LS 225 ST	37	EA4 37 301	2	EA4 37 303	1	EA4 37 3A3	1				
LS 225 MR	45	EA4 45 301	2	EA4 45 303	1	EA4 45 3A3	1				
LS 250 ME	55	EA4 55 301	1			EA4 55 3A3	1				
LS 280 SC	75	EA4 75 301	1			EA4 75 3A3	1				
LS 280 MD	90		-				-				
LS 315 SN	110		-				-				
LS 315 MP	132		-				-				
LS 315 MR	160		-				-				
LS 315 MR[2]	200		-				-				

1. Flange or foot motor (or foot and flange) with shaft end different from the standard (D: 14 j6 - E: 30 mm).
2. Temperature rise class F.
3. Motors IM B5 / IM V1.
4. Motors IM B14 / IM V18.

Selection example:

Speed:	1500 min⁻¹ - 4 poles
Power:	55 kW
Mounting and position:	IM 1001 (IM B3)
Mains supply voltage:	230/400 V

Designation:
4P LS 250 ME 55 kW IM 1001 (IM B3) 230/400 V

Code: EA4 55 301

LS
totally enclosed three-phase asynchronous motors

Selection

A

IP 55 - 50 Hz - Class F - ΔT 80 K - 230 V Δ / 400 V Y - S1

6 poles 1000 min^{-1}

IE1

Type	Rated power P_N kW	Rated speed N_N min-1	Rated torque M_N Nm	Rated current $I_{N\,(400V)}$ A	Power factor Cos Phi 4/4	Power factor Cos Phi 3/4	Power factor Cos Phi 2/4	Efficiency* IEC 60034-2-1; 2007 η 4/4	Efficiency* IEC 60034-2-1; 2007 η 3/4	Efficiency* IEC 60034-2-1; 2007 η 2/4	Starting current/ Rated current Id / In	Starting torque/ Rated torque Md/Mn	Maximum torque/ Rated torque M_M/Mn	Moment of inertia J kg.m2	Weight IM B3 kg	Noise LP db(A)
LS 56 M	0.045	860	0.5	0.29	0.66	0.59	0.52	34	31.5	25.3	2	1.7	1.7	0.00025	4	54
LS 56 M	0.06	850	0.7	0.39	0.67	0.6	0.53	33.4	30.9	25	2	1.7	1.7	0.00025	4	54
LS 63 M	0.09	860	1.0	0.46	0.8	0.7	0.63	35	32	26	2.1	1.6	1.6	0.0006	5.5	48
LS 71 M	0.12	950	1.2	0.75	0.51	0.44	0.38	45.6	40.5	32	3	2.4	3.0	0.0007	6.5	52
LS 71 M	0.18	945	1.8	0.95	0.52	0.46	0.38	52.8	48.8	40.7	3.3	2.3	2.9	0.0011	7.6	52
LS 71 L	0.25	915	2.6	1.15	0.6	0.52	0.43	51.9	49.6	42.2	3.1	2.0	2.2	0.0013	7.9	52
LS 80 L	0.25	955	2.5	0.85	0.67	0.64	0.48	62.8	62.7	56	3.9	1.6	1.8	0.0024	8.4	41
LS 80 L	0.37	950	3.7	1.1	0.72	0.67	0.57	65.8	59.7	59	4.3	1.7	2.2	0.0032	9.7	41
LS 80 L	0.55	950	5.5	1.8	0.64	0.6	0.47	68	63	55	4.9	2.1	2.6	0.0042	11	41
LS 90 S	0.75	930	7.7	2.1	0.77	0.66	0.54	**70.5**	69.3	63.5	4.7	2.4	2.6	0.0039	13.5	51
LS 90 L**	1.1	915	11.5	3	0.76	0.67	0.55	**70.7**	70.0	66.2	4.5	2.4	2.5	0.0048	15.2	51
LS 100 L**	1.5	905	15.8	4.2	0.74	0.62	0.52	**70.8**	70.8	65.0	5.6	2.5	2.7	0.0058	20	50
LS 112 M**	2.2	905	23.2	5.8	0.76	0.66	0.53	**73.2**	73.3	68.1	6	2.8	2.7	0.0087	24.2	51
LS 132 M**	3	957	30.3	6.8	0.78	0.71	0.59	**78.2**	79.3	77.2	6	2.0	2.6	0.018	38.3	55
LS 132 M	4	961	39.7	9.3	0.75	0.66	0.56	**81.4**	82.3	80.9	5.9	2.5	2.9	0.034	53.3	55
LS 132 M**	5.5	960	54.7	13.3	0.71	0.65	0.52	**81.8**	82.7	80.8	5.5	2.5	2.8	0.039	59.4	55
LS 160 M	7.5	969	73.9	16.3	0.79	0.74	0.63	**86.1**	86.4	84.9	4.7	1.7	2.5	0.089	77	56
LS 160 L	11	968	109	23.4	0.78	0.71	0.64	**86.77**	87.2	85.9	4.6	1.8	2.6	0.105	85	56
LS 180 LR	15	968	148	31.9	0.78	0.71	0.61	**87.7**	88.0	87.0	5.4	1.8	2.6	0.139	110	60
LS 200 LT	18.5	970	182	37	0.81	0.76	0.65	**88.8**	89.2	88.3	6.4	2.4	2.8	0.236	160	62
LS 200 L	22	972	216	43.6	0.81	0.76	0.65	**89.4**	89.7	88.8	6	2.0	2.7	0.295	190	62
LS 225 MR	30	968	296	59.5	0.81	0.79	0.72	**90.4**	91.2	91.0	6	2.2	2.5	0.39	235	63
LS 250 ME	37	978	361	71.1	0.81	0.79	0.69	**91.5**	92.1	92.0	6.2	2.3	2.5	0.85	305	65
LS 280 SC	45	978	439	86.5	0.81	0.79	0.69	**91.6**	92.2	91.9	6.2	2.3	2.5	0.99	340	65
LS 280 MC	55	978	537	106	0.81	0.79	0.72	**92**	93.1	93.4	6	2.4	2.5	1.19	385	65
LS 315 SN	75	983	729	142	0.82	0.78	0.67	**92.8**	92.9	92.3	6.5	2.5	2.7	1.3	438	65
LS 315 MP	90	980	877	164	0.85	0.83	0.76	**92.9**	93.1	92.4	7.2	2.4	2.9	3.74	760	74
LS 315 MR	110	980	1072	200	0.85	0.83	0.76	**93.3**	93.6	93.0	7.2	2.4	2.9	4.36	850	74
LS 315 MR	132	986	1278	242	0.83	0.8	0.72	**94.2**	94.3	93.7	6.6	2.40	2.50	4.36	830	74

* This standard replaces the IEC 60034-2; 1996.
** These motors do not reach the level of efficiency IE1.

LS
totally enclosed three-phase asynchronous motors

Selection

IP 55 - 50 Hz - Class F - ΔT 80 K - 230 V Δ / 400 V Y - S1

A

6 poles 1000 min^{-1}

	Rated power at 50 Hz	IM 1001 (IM B3)		IM 3001 (IM B5)		IM 2001 (IM B35)		IM 3601 (IM B14)		IM 2101 (IM B34)	
Type	P_N kW	Code	Qty	Code	Qty	Code	Qty	Code	Qty	Code	Qty
LS 63 M	0,09	MA6 09 113	5		-		-	MA6 09 117	5		-
LS 63 M[1]	0,09	MA0 00 176	5		-		-	MA0 00 182	5		-
LS 71 M	0,12	MA6 12 113	5	MA6 12 115	5		-	MA6 12 117	5		-
LS 71 M	0,18	MA6 18 107	5	MA6 18 109	5		-	MA6 18 111	5		-
LS 71 L	0,25	MA6 25 119	5	MA6 25 121	5		-	MA6 25 123	5		-
LS 80 L	0,25	MA00010	5	MA000011	1	3582084	2	MA000012	2	3778279	1
LS 80 L	0,37	MA6 37 119	5	MA6 37 121	2	MA0 00 050	2	MA6 37 123	2	MA6 37 124	1
LS 80 L	0,55	MA6 55 113	5	MA6 55 115	5	MA0 00 053	2	MA6 55 117	2	MA6 55 114	1
LS 90 S	0,75	MA6 75 101	5	MA6 75 103[2]	5	MA6 75 108	2	MA6 75 105	2	MA0 00 103	1
LS 90 L	1,1	MA6 11 201	5	MA6 11 203[2]	5	MA6 11 208	2	MA6 11 205	2	MA0 00 132	1
LS 100 L	1,5	MA6 15 201	5	MA6 15 203[2]	3	MA0 00 057	2	MA6 15 205	2	MA0 00 133	1
LS 100 L	1,8	MA6 18 201	2	MA6 18 203	1	MA0 00 058	2	MA6 18 205	2	MA0 00 134	1
LS 112 M	2,2	MA6 22 201	5	MA6 22 203[2]	5	MA0 00 099	2	MA6 22 205	2	MA0 00 138	1
LS 132 S	3	MA6 30 201	5	MA6 30 203[2]	2	MA0 00 101	2		-		-
LS 132 M	4	MA6 40 201	2	MA6 40 203[2]	2		-		-		-
LS 132 M	5,5	MA6 55 201	2	MA6 55 203[2]	2		-		-		-
LS 160 M	7,5	MA6 75 201	1		-	MA0 00 186	1				
LS 160 L	11	MA6 11 301	1		-	MA0 00 187	1				
LS 180 LR	15	MA6 15 301	1		-	MA0 00 188	1				
LS 200 LT	18,5		-		-		-				
LS 200 L	22		-		-		-				
LS 225 MR	30		-		-		-				
LS 250 MP	37		-				-				
LS 280 SP	45		-				-				
LS 280 MP	55		-				-				
LS 315 SN	75		-				-				
LS 315 MP	90		-				-				
LS 315 MR	110		-				-				
LS 315 MR	132		-				-				

1. Flange or foot motor (or foot and flange) with shaft end different from the standard (D: 14 j6 - E: 30 mm).

2. Motors IM B5 / IM V1.

Selection example:

Speed:	1000 min^{-1} - 6 poles
Power:	7.5 kW
Mounting and position:	IM 1001 (IM B3)
Mains supply voltage:	230/400 V

Designation:
6P LS 160 M 7.5 kW IM 1001 (IM B3) 230/400 V

Code: MA6 75 201

LS
totally enclosed three-phase asynchronous motors

Selection

A

8 poles 750 min^{-1}

IP 55 - 50 Hz - Class F - ΔT 80 K - 230 V Δ / 400 V Y - S1

Type	Rated power P_N kW	Rated speed N_N min-1	Rated torque M_N Nm	Rated current $I_{N\ (400V)}$ A	Power factor Cos Phi 4/4	3/4	2/4	Efficiency IEC 60034-2; 1996 η 4/4	3/4	2/4	Starting current/ Rated current Id / In	Starting torque/ Rated torque Md/Mn	Maximum torque/ Rated torque M_M/Mn	Moment of inertia J kg.m2	Weight IM B3 kg	Noise LP db(A)
LS 71 L	0.09	690	1.3	0.5	0.55	0.45	0.4	44	42	36	2.8	1.3	1.5	0.001	8	40
LS 71 L	0.12	650	1.8	0.9	0.55	0.45	0.4	44	42	36	2.1	1.3	1.4	0.001	8	40
LS 80 L	0.18	705	2.4	0.79	0.63	0.54	0.45	52	48	43	2.9	1.5	1.9	0.003	9.7	41
LS 80 L	0.25	700	3.4	0.98	0.68	0.6	0.51	54	52	45	2.8	1.7	1.9	0.004	11.3	41
LS 90 L	0.37	685	5.2	1.2	0.72	0.63	0.52	62	62	56	3.8	1.7	1.8	0.004	13.5	43
LS 90 S	0.37	685	5.2	1.2	0.72	0.63	0.52	62	62	56	3.8	1.7	1.8	0.004	13.5	43
LS 90 L	0.55	670	7.8	1.7	0.72	0.61	0.52	63.5	62	59	3.5	1.7	1.7	0.005	15.2	43
LS 100 L	0.75	670	10.7	2.4	0.71	0.58	0.47	63.5	61.5	55	3.5	1.8	2.2	0.005	18	43
LS 100 L	1.1	670	15.7	3.7	0.68	0.6	0.49	63	62.5	58	3.7	2.0	2.2	0.007	21.8	43
LS 112 MG	1.5	710	20.2	4.7	0.64	0.55	0.43	72	69	62.5	3.8	2.0	2.1	0.015	24	49
LS 132 SM	2.2	713	29.5	6.1	0.68	0.56	0.45	77.1	77.5	71	4	1.7	2.0	0.025	45.6	54
LS 132 M	3	712	40.2	8	0.65	0.56	0.45	79.8	82.9	79	4.3	1.9	2.2	0.033	53.9	54
LS 160 M	4	718	53.2	11	0.63	0.55	0.43	83.3	83.4	81.3	3.9	1.7	2.3	0.068	84	66
LS 160 M	5.5	716	73.4	15.1	0.63	0.55	0.43	83.3	83.5	81.8	3.9	1.7	2.3	0.071	89	66
LS 160 L	7.5	714	100	20.6	0.63	0.55	0.43	83.4	84	82.6	3.9	1.9	2.3	0.09	101	66
LS 180 L	11	720	146	25.6	0.72	0.68	0.57	86	86.3	84.2	3.8	1.4	1.9	0.205	140	68
LS 200 L	15	725	198	32.9	0.75	0.7	0.57	87.7	87.9	86.3	4.4	1.6	2.1	0.27	185	65
LS 225 ST	18.5	725	244	42.4	0.72	0.66	0.54	87.5	87.7	86.2	4.2	1.6	2.1	0.33	210	65
LS 225 MR	22	725	290	51.9	0.7	0.63	0.51	87.4	87.2	85.1	4.4	1.9	2.3	0.4	240	65
LS 250 ME	30	732	391	60.7	0.78	0.74		91.5	92.2		5.8	1.6	2.4	0.86	312	65
LS 280 SC	37	731	483	73.8	0.79			91.6			5.6	1.6	2.4	0.92	334	65
LS 280 MC	45	730	589	88.5	0.8	0.76		91.7	92.6		5.4	1.6	2.3	1.13	378	65
LS 315 SP	55	738	712	105	0.81	0.78	0.71	93.2	93.2	92.2	5.4	1.8	2.4	3.1	660	74
LS 315 MR	75	738	971	143	0.81	0.78	0.71	93.6	93.8	93.1	5.4	1.8	2.4	4.38	815	74

LS
totally enclosed three-phase asynchronous motors

Selection

IP 55 - 50 Hz - Class F - ΔT 80 K - 230 V Δ / 400 V Y - S1

A

8 poles 750 min^{-1}

Type	Rated power at 50 Hz P_N kW	IM 1001 (IM B3) Code	Qty	IM 3001 (IM B5) Code	Qty
LS 71 L	*0.09*		-		-
LS 71 M	*0.12*	*MA0 00 189*	*5*	*MA0 00 190*	*5*
LS 80 L	0.18	MA8 18 101	1	MA8 18 102[1]	1
LS 80 L	0.25	MA8 25 101	2	MA8 25 102[1]	2
LS 90 S	0.37	MA8 37 101	5	MA8 37 102[1]	1
LS 90 L	0.55	MA8 55 101	5	MA8 55 102[1]	2
LS 100 L	0.75	MA8 75 101	5	MA8 75 102[1]	1
LS 100 L	1.1	MA8 11 201	2	MA8 11 202[1]	1
LS 112 MG	1.5	MA8 15 201	2	MA8 15 202[1]	1
LS 132 SM	2.2	MA8 22 201	2	MA8 22 203	1
LS 132 M	3	MA8 30 201	2	MA8 30 203	1
LS 160 M	4		-		-
LS 160 M	5.5		-		-
LS 160 L	7.5		-		-
LS 180 L	11		-		-
LS 200 L	15		-		-
LS 225 ST	18.5		-		-
LS 225 MR	22		-		-
LS 250 ME	30		-		
LS 280 SC	37		-		
LS 280 MD	45		-		
LS 315 SP	55		-		
LS 315 MP	75		-		

1. Motors IM B5 / IM V1.

Selection example:

Speed:	750 min^{-1} - 8 poles
Power:	0.75 kW
Mounting and position:	IM 1001 (IM B3)
Mains supply voltage:	230/400 V

Designation:
8P LS 100 L 0.75 kW IM 1001 (IM B3) 230/400 V

Code: MA8 75 101

LS
totally enclosed three-phase asynchronous motors

Selection

A

IP 55 - 50 Hz - Class F - ΔT 80 K - 400 V Δ - S1

2 poles 3000 min-1

IE1

Type	Rated power P_N kW	Rated speed N_N min-1	Rated torque M_N Nm	Rated current $I_{N\ (400V)}$ A	Power factor Cos Phi 4/4	3/4	2/4	Efficiency* IEC 60034-2-1; 2007 η 4/4	3/4	2/4	Starting current/ Rated current Id / In	Starting torque/ Rated torque Md/Mn	Maximum torque/ Rated torque M_M/Mn	Moment of inertia J kg.m2	Weight IM B3 kg	Noise LP db(A)
LS 56 M	0.09	2860	0.3	0.44	0.55	0.45	0.4	54	45.2	37.1	5.0	5.3	5.4	0.00015	3.8	54
LS 56 M	0.12	2820	0.4	0.5	0.6	0.55	0.45	58.7	54	45.2	4.6	4.0	4.1	0.00015	3.8	54
LS 63 M	0.18	2790	0.6	0.52	0.75	0.65	0.55	67.4	66.9	59.3	5.0	3.3	2.9	0.00019	4.8	57
LS 63 M	0.25	2800	0.9	0.71	0.75	0.65	0.55	67.8	67.3	59.2	5.4	3.2	2.9	0.00025	6	57
LS 71 L	0.37	2800	1.3	0.98	0.8	0.7	0.6	68.4	67.6	63.9	5.2	3.3	3.9	0.00035	6.4	62
LS 71 L	0.55	2800	1.9	1.32	0.8	0.7	0.55	75.7	75.2	71.1	6.0	3.2	3.1	0.00045	7.3	62
LS 71 L	0.75	2780	2.6	1.7	0.85	0.75	0.65	74.6	75.8	73.1	6.0	3.3	2.9	0.0006	8.3	62
LS 80 L	0.75	2840	2.5	1.64	0.87	0.8	0.68	**75.7**	76.1	73.3	5.9	2.4	2.2	0.0007	8.2	61
LS 80 L	1.1	2837	3.7	2.4	0.84	0.77	0.65	**77.3**	78.3	76.4	5.8	2.7	2.4	0.0009	9.7	61
LS 80 L	1.5	2859	5.0	3.2	0.83	0.76	0.62	**79.3**	80	78.1	7.0	3.2	2.8	0.0011	11.3	61
LS 90 S	1.5	2870	5.0	3.4	0.81	0.72	0.58	**80**	79.5	75.9	8.0	3.9	4.0	0.0014	12	64
LS 90 L	1.8	2865	6.0	3.6	0.86	0.8	0.69	**81.9**	82.5	81.4	8.0	3.6	3.6	0.0017	14	64
LS 90 L	2.2	2862	7.3	4.3	0.88	0.83	0.73	**82**	83	82	7.7	3.7	3.3	0.0021	16	64
LS 100 L	3	2868	10.0	6.3	0.81	0.73	0.59	**82.5**	82.6	80.1	7.5	3.8	3.9	0.0022	20	66
LS 100 L	3.7	2850	12.5	8	0.85	0.76	0.62	**82.7**	82.2	77.2	8.6	0.0	0.0	0.0022	21	66
LS 112 M	4	2877	13.3	7.8	0.85	0.78	0.65	**85**	85.3	83.7	7.8	2.9	2.9	0.0029	24.4	66
LS 112 MG	5.5	2916	18.0	10.5	0.88	0.81	0.71	**86.1**	86.4	84.7	9.0	3.1	3.5	0.0076	33	66
LS 132 S	5.5	2916	18.0	10.5	0.88	0.81	0.71	**86.1**	86.4	84.7	9.0	0.0	0.0	0.0076	34.4	72
LS 132 S	7.5	2905	24.5	14.7	0.85	0.78	0.63	**86**	85.8	83.2	8.7	0.0	0.0	0.0088	39	72
LS 132 M	9	2910	29.5	17.3	0.85	0.8	0.71	**87.9**	88.5	87.5	8.6	2.5	3.5	0.016	49	72
LS 132 M	11	2944	35.7	20.7	0.86	0.81	0.69	**88.2**	88.3	86.7	7.5	2.7	3.4	0.018	54	72
LS 160 MP	11	2944	35.7	20.7	0.86	0.81	0.69	**88.2**	88.3	86.7	7.5	2.7	3.4	0.019	62	72
LS 160 MP	15	2935	48.8	28.4	0.85	0.79	0.71	**89.3**	89.7	88.6	8.1	3.0	3.5	0.023	72	72
LS 160 L	18.5	2934	60.2	33.7	0.87	0.83	0.75	**90.09**	90.6	90.0	8.0	3.0	3.3	0.044	88	72
LS 180 MT	22	2938	71.5	39.9	0.87	0.84	0.76	**90.6**	91.2	90.8	8.1	3.1	3.1	0.052	99	72
LS 200 LT	30	2946	97.2	52.1	0.9	0.87	0.82	**91.5**	92.1	91.7	8.6	2.7	3.4	0.089	154	73
LS 200 L	37	2950	120	65	0.89	0.87	0.82	**92.1**	92.6	92.3	7.4	2.6	3.0	0.12	180	73
LS 225 MT	45	2950	146	78	0.9	0.87	0.82	**92.5**	92.7	92.7	7.5	2.8	3.1	0.14	200	73
LS 250 MZ	55	2956	178	96	0.89	0.86	0.8	**92.9**	93.6	92.5	8.3	3.1	3.4	0.173	235	78
LS 280 SC	75	2968	241	129	0.9	0.87	0.82	**93.5**	93.6	93.1	8.5	2.6	3.4	0.39	330	79
LS 280 MC	90	2968	290	154	0.9	0.88	0.83	**93.8**	94.0	93.6	8.4	2.6	3.3	0.47	375	79
LS 315 SN	110	2964	354	184	0.92	0.9	0.86	**94**	94.2	93.9	8.6	2.7	3.4	0.55	445	80
LS 315 MP	132	2976	424	227	0.89	0.87	0.82	**94.4**	94.2	93.1	7.6	2.8	2.9	1.67	715	83
LS 315 MR	160	2976	513	271	0.9	0.88	0.84	**94.6**	94.6	93.7	7.6	2.9	3.1	1.97	820	83
LS 315 MR•	200	2982	640	350	0.87	0.86	0.82	**94.8**	94.3	92.9	9.3	3.8	3.9	1.97	845	83

• Temperature rise class F

* This standard replaces the IEC 60034-2; 1996.

LS
totally enclosed three-phase asynchronous motors

Selection

IP 55 - 50 Hz - Class F - ΔT 80 K - 400 V Δ - S1

2 poles 3000 min⁻¹

A

Type	Rated power at 50 Hz P_N kW	IM 1001 (IM B3) Code	Qty	IM 3001 (IM B5) Code	Qty	IM 2001 (IM B35) Code	Qty	IM 3601 (IM B14) Code	Qty	IM 2101 (IM B34) Code	Qty
LS 100 L	3	EA2 30 202	2	EA2 30 204[2]	1	EA2 30 2E4	2	EA2 30 206	2	EA2 30 2F6	2
LS 112 M	4	EA2 40 202	5	EA2 40 204[2]	5	EA2 40 2A4	1	EA2 40 206	2	EA2 40 2A6	2
LS 112 MG	5.5	EA2 55 202	5	EA2 55 204[2]	2	EA2 55 2E4	1	EA2 55 206	2	EA2 55 2F6	2
LS 132 S	5.5	EA2 55 208	5	EA2 55 210[2]	2	EA2 55 2B0	1	EA2 55 212	2	EA2 55 3B2	2
LS 132 S	7.5	EA2 75 202	5	EA2 75 204[2]	2	EA2 75 2E4	2	EA2 75 206	2	EA2 75 2F6	2
LS 132 M	9	EA2 90 202	5	EA2 90 204[2]	2	EA2 90 2E4	2	EA2 90 206	2	EA2 90 2F6	2
LS 132 M	11	EA2 11 344	5	EA2 11 345[2]	2	EA2 11 3E5	1	EA2 11 346	2	EA2 11 3E6	2
LS 160 MP	11	EA2 11 302	2	EA2 11 304[2]	1	EA2 11 3E4	2				
LS 160 MP	15	EA2 15 302	2	EA2 15 304[2]	2	EA2 15 3E4	1				
LS 160 L	18.5	EA2 18 302	2	EA2 18 304[2]	1	EA2 18 3E4	2				
LS 180 MT	22	EA2 22 302	2	EA2 22 304[2]	1	EA2 22 3E4	3				
LS 200 LT	30	EA2 30 302	1	EA2 30 304	2	EA2 30 3E4	3				
LS 200 L	37	EA2 37 302	1	EA2 37 304	2	EA2 37 3E4	3				
LS 225 MT	45	EA2 45 302	1	EA2 45 304	2	EA2 45 3E4	2				
LS 250 MZ	55	EA2 55 302	1	EA2 55 304	2	EA2 55 3E4	2				
LS 280 SC	75	EA2 75 302	1			EA2 75 3E4	1				
LS 280 MC	90	EA2 90 302	1			EA0 00 194	1				
LS 315 SN	110	MA2 11 402	1			MA0 00 195	1				
LS 315 MP	132	MA2 13 402	1			MA0 00 196	1				
LS 315 MR	160		-				-				
LS 315 MR[1]	200		-				-				

1. Temperature rise class F.

2. Motors IM B5 / IM V1.

Selection example:

Vitesse :	3000 min⁻¹ - 2 poles
Power:	30 kW
Mounting and position:	IM 2001 (IM B35)
Mains supply voltage:	400 V

Designation:
2P LS 200 LT 30 kW IM 2001 (IM B35) 400 V

Code: EA2 30 3E4

LS
totally enclosed three-phase asynchronous motors

Selection

A

4 poles 1500 min^{-1}

IP 55 - 50 Hz - Class F - ΔT 80 K - 400 V Δ - S1

IE1

Type	Rated power P_N kW	Rated speed N_N min-1	Rated torque M_N Nm	Rated current $I_{N\ (400V)}$ A	Power factor Cos Phi 4/4	Power factor Cos Phi 3/4	Power factor Cos Phi 2/4	Efficiency* IEC 60034-2-1; 2007 η 4/4	Efficiency* IEC 60034-2-1; 2007 η 3/4	Efficiency* IEC 60034-2-1; 2007 η 2/4	Starting current/ Rated current Id / In	Starting torque/ Rated torque Md/Mn	Maximum torque/ Rated torque M_M/Mn	Moment of inertia J kg.m2	Weight IM B3 kg	Noise LP db(A)
LS 56 M	0.06	1380	0.4	0.29	0.76	0.69	0.62	41.8	37.1	29.7	2.8	2.4	2.5	0.00025	4	47
LS 56 M	0.09	1400	0.6	0.39	0.6	0.52	0.42	55.2	49.6	42.8	3.2	2.8	2.8	0.00025	4	47
LS 63 M	0.12	1380	0.8	0.44	0.7	0.58	0.47	56.1	53.9	46.8	3.2	2.4	2.3	0.00035	4.8	49
LS 63 M	0.18	1390	1.2	0.64	0.65	0.55	0.44	61.6	58	51.3	3.7	2.6	2.6	0.00048	5	49
LS 71 M	0.25	1425	1.7	0.8	0.65	0.55	0.44	69.4	66.8	59.8	4.6	2.7	2.9	0.00068	6.4	49
LS 71 M	0.37	1420	2.5	1.06	0.7	0.59	0.47	72.1	71.7	66.4	4.9	2.4	2.8	0.00085	7.3	49
LS 71 L	0.55	1400	3.8	1.62	0.7	0.62	0.49	70.4	70	65.1	4.8	2.3	2.5	0.0011	8.3	49
LS 80 L	0.55	1410	3.7	1.42	0.76	0.68	0.55	73.2	69.1	62.1	4.5	2.0	2.3	0.0013	8.2	47
LS 80 L	0.75	1400	5.1	2.01	0.77	0.71	0.59	**72.1**	72.8	70.1	4.5	2.0	2.2	0.0018	9.3	47
LS 80 L	0.9	1425	6.0	2.44	0.73	0.67	0.54	**73.2**	72.9	70.3	5.8	3.0	3.0	0.0024	10.9	47
LS 90 S	1.1	1429	7.4	2.5	0.84	0.77	0.64	**76.7**	78.2	76.6	4.8	1.6	2.0	0.0026	11.5	48
LS 90 L	1.5	1428	10.0	3.4	0.82	0.74	0.6	**79.3**	79.9	77.5	5.3	1.8	2.3	0.0032	13.5	48
LS 90 L	1.8	1438	12.0	4	0.82	0.75	0.61	**79.4**	80	77.6	6	2.1	3.2	0.0037	15.2	48
LS 100 L	2.2	1436	14.6	4.8	0.81	0.73	0.59	**80.3**	81.2	79.3	5.9	2.1	2.5	0.0043	20	48
LS 100 L	3	1437	19.9	6.5	0.81	0.72	0.59	**82.8**	83.4	81.8	6	2.5	2.8	0.0055	22.5	48
LS 112 M**	4	1438	26.6	8.3	0.83	0.76	0.57	**81.7**	81.6	80.6	7.1	2.5	3.0	0.0067	24.9	49
LS 132 S	5.5	1447	36.7	11.1	0.83	0.79	0.67	**84.7**	85.6	84.6	6.3	2.4	2.8	0.014	36.5	49
LS 132 M	7.5	1451	49.4	15.2	0.82	0.74	0.61	**86.0**	86.2	84.4	7	2.4	2.9	0.019	54.7	62
LS 132 M	9	1455	59.1	18.1	0.82	0.74	0.62	**86.8**	87.2	86.4	6.9	2.2	3.1	0.023	59.9	62
LS 160 MP	11	1454	72.2	21	0.86	0.79	0.67	**87.7**	88.4	87.5	7.7	2.3	3.2	0.03	70	62
LS 160 LR	15	1453	98.6	28.8	0.84	0.78	0.69	**88.7**	89.3	88.3	7.5	2.9	3.6	0.036	86	62
LS 180 MT	18.5	1456	121	35.2	0.84	0.79	0.67	**89.9**	90.6	90.5	7.6	2.7	3.2	0.085	100	64
LS 180 LR	22	1456	144	41.7	0.84	0.79	0.68	**90.2**	91.0	90.8	7.9	3.0	3.3	0.096	112	64
LS 200 LT	30	1460	196	56.3	0.84	0.8	0.69	**90.8**	91.5	91.2	6.6	2.9	2.9	0.151	165	64
LS 225 ST	37	1468	241	69	0.84	0.8	0.7	**92.0**	92.7	92.7	6.3	2.7	2.6	0.24	205	64
LS 225 MR	45	1468	293	84	0.84	0.8	0.7	**92.5**	93.1	93.0	6.3	2.7	2.6	0.29	235	64
LS 250 ME	55	1478	355	102	0.84	0.8	0.71	**93.1**	93.3	92.7	7	2.7	2.8	0.63	320	66
LS 280 SC	75	1478	485	138	0.84	0.8	0.71	**93.5**	93.9	93.5	7.2	2.8	2.9	0.83	380	69
LS 280 MD	90	1478	581	165	0.84	0.8	0.71	**93.5**	93.8	93.5	7.6	3.0	3.0	1.03	450	69
LS 315 SN	110	1477	711	201	0.84	0.79	0.7	**94.1**	94.5	94.2	7.6	3.0	3.2	1.04	470	76
LS 315 MP	132	1484	849	238	0.85	0.82	0.74	**94.2**	94.4	93.8	7.6	2.9	3.0	2.79	750	70
LS 315 MR	160	1484	1030	287	0.85	0.82	0.74	**94.7**	94.7	93.9	7.7	2.9	3.0	3.27	845	70
LS 315 MR•	200	1486	1285	362	0.84	0.79	0.69	**94.9**	94.9	94.2	8.1	3.1	3.4	3.27	845	70

• Temperature rise class F
* This standard replaces the IEC 60034-2; 1996.
** These motors do not reach the level of efficiency IE1.

LS
totally enclosed three-phase asynchronous motors

Selection

IP 55 - 50 Hz - Class F - ΔT 80 K - 400 V Δ - S1

A

4 poles 1500 min^{-1}

	Rated power at 50 Hz	IM 1001 (IM B3)		IM 3001 (IM B5)		IM 2001 (IM B35)		IM 3601 (IM B14)		IM 2101 (IM B34)	
Type	P_N kW	Code	Qty	Code	Qty	Code	Qty	Code	Qty	Code	Qty
LS 100 L	2.2	EA4 22 208	2	EA4 22 210[2]	1	3973387	1	EA4 22 212	2		2
LS 100 L	3	EA4 30 208	3	EA4 30 210[2]	1	EA4 30 2G0	1	EA4 30 212	2	EA4 30 2H2	2
LS 112 M	4	MA4 40 202	5	MA4 40 204[2]	5	EA4 40 2G4	1	MA4 40 206	2	MA4 40 2H6	2
LS 132 S	5.5	EA4 55 208	5	EA4 55 210[2]	5	EA4 55 2G0	2	EA4 55 212	2	EA4 55 2H2	2
LS 132 M	7.5	EA4 75 208	5	EA4 75 210[2]	5	EA4 75 2G0	2	EA4 75 212	2	EA4 75 2H2	2
LS 132 M	9	EA4 90 202	5	EA4 90 204[2]	2	EA4 90 2G4	1	EA4 90 206	2	EA4 90 2H6	2
LS 160 MP	11	EA4 11 302	2	EA4 11 304[2]	1	EA4 11 3G4	1				
LS 160 LR	15	EA4 15 302	2	EA4 15 304[2]	2	EA4 15 3G4	1				
LS 180 MT	18.5	EA4 18 302	2	EA4 18 304[2]	1	EA4 18 3G4	2				
LS 180 LR	22	EA4 22 302	2	EA4 22 304[2]	1	EA4 22 3G4	2				
LS 200 LT	30	EA4 30 302	2	EA4 30 304	1	EA4 30 3G4	2				
LS 225 ST	37	EA4 37 302	2	EA4 37 304	1	EA4 37 3G4	2				
LS 225 MR	45	EA4 45 302	2	EA4 45 304	1	EA4 45 3G4	1				
LS 250 ME	55	EA4 55 302	1			EA4 55 3G4	1				
LS 280 SC	75	EA4 75 302	1			EA4 75 3G4	1				
LS 280 MD	90	EA4 90 302	1			EA0 00 201	1				
LS 315 SN	110	MA4 11 402	1			MA0 00 202	1				
LS 315 MP	132	MA4 13 402	1			MA0 00 203	1				
LS 315 MR	160	MA0 00 007	1			MA0 00 204	1				
LS 315 MR[1]	200		-				-				

1. Temperature rise class F.
2. Motors IM B5 / IM V1.

Selection example:

Speed:	1500 min^{-1} - 4 poles
Power:	4 kW
Mounting and position:	IM 2101 (IM B34)
Mains supply voltage:	400 V

Designation:
4P LS 112 M 4 kW IM 2101 (IM B34)
400 V

Code: EA4 40 2H6

LS
totally enclosed three-phase asynchronous motors

Selection

A

6 poles 1000 min-1

IP 55 - 50 Hz - Class F - ΔT 80 K - 400 V Δ - S1

IE1

Type	Rated power P_N kW	Rated speed N_N min-1	Rated torque M_N Nm	Rated current $I_{N\ (400V)}$ A	Power factor Cos Phi 4/4	Power factor Cos Phi 3/4	Power factor Cos Phi 2/4	Efficiency* IEC 60034-2-1; 2007 η 4/4	Efficiency* IEC 60034-2-1; 2007 η 3/4	Efficiency* IEC 60034-2-1; 2007 η 2/4	Starting current/ Rated current Id / In	Starting torque/ Rated torque Md/Mn	Maximum torque/ Rated torque M_M/Mn	Moment of inertia J kg.m2	Weight IM B3 kg	Noise LP db(A)
LS 56 M	0.045	860	0.5	0.29	0.66	0.59	0.52	34	31.5	25.3	2	1.7	1.7	0.00025	4	54
LS 56 M	0.06	850	0.7	0.39	0.67	0.6	0.53	33.4	30.9	25	2	1.7	1.7	0.00025	4	54
LS 63 M	0.09	860	1.0	0.46	0.8	0.7	0.63	35	32	26	2.1	1.6	1.6	0.0006	5.5	48
LS 71 M	0.12	950	1.2	0.75	0.51	0.44	0.38	45.6	40.5	32	3	2.4	3.0	0.0007	6.5	52
LS 71 M	0.18	945	1.8	0.95	0.52	0.46	0.38	52.8	48.8	40.7	3.3	2.3	2.9	0.0011	7.6	52
LS 71 L	0.25	915	2.6	1.15	0.6	0.52	0.43	51.9	49.6	42.2	3.1	2.0	2.2	0.0013	7.9	52
LS 80 L	0.25	955	2.5	0.85	0.67	0.64	0.48	62.8	62.7	56	3.9	1.6	1.8	0.0024	8.4	41
LS 80 L	0.37	950	3.7	1.1	0.72	0.67	0.57	65.8	59.7	59	4.3	1.7	2.2	0.0032	9.7	41
LS 80 L	0.55	950	5.5	1.8	0.64	0.6	0.47	68	63	55	4.9	2.1	2.6	0.0042	11	41
LS 90 S	0.75	930	7.7	2.1	0.77	0.66	0.54	**70.5**	69.3	63.5	4.7	2.4	2.6	0.0039	13.5	51
LS 90 L**	1.1	915	11.5	3	0.76	0.67	0.55	**70.7**	70.0	66.2	4.5	2.4	2.5	0.0048	15.2	51
LS 100 L**	1.5	905	15.8	4.2	0.74	0.62	0.52	**70.8**	70.8	65.0	5.6	2.5	2.7	0.0058	20	50
LS 112 M**	2.2	905	23.2	5.8	0.76	0.66	0.53	**73.2**	73.3	68.1	6	2.8	2.7	0.0087	24.2	51
LS 132 M**	3	957	30.3	6.8	0.78	0.71	0.59	**78.2**	79.3	77.2	6	2.0	2.6	0.018	38.3	55
LS 132 M	4	961	39.7	9.3	0.75	0.66	0.56	**81.4**	82.3	80.9	5.9	2.5	2.9	0.034	53.3	55
LS 132 M**	5.5	960	54.7	13.3	0.71	0.65	0.52	**81.8**	82.7	80.8	5.5	2.5	2.8	0.039	59.4	55
LS 160 M	7.5	969	73.9	16.3	0.79	0.74	0.63	**86.1**	86.4	84.9	4.7	1.7	2.5	0.089	77	56
LS 160 L	11	968	109	23.4	0.78	0.71	0.64	**86.77**	87.2	85.9	4.6	1.8	2.6	0.105	85	56
LS 180 LR	15	968	148	31.9	0.78	0.71	0.61	**87.7**	88.0	87.0	5.4	1.8	2.6	0.139	110	60
LS 200 LT	18.5	970	182	37	0.81	0.76	0.65	**88.8**	89.2	88.3	6.4	2.4	2.8	0.236	160	62
LS 200 L	22	972	216	43.6	0.81	0.76	0.65	**89.4**	89.7	88.8	6	2.0	2.7	0.295	190	62
LS 225 MR	30	968	296	59.5	0.81	0.79	0.72	**90.4**	91.2	91.0	6	2.2	2.5	0.39	235	63
LS 250 ME	37	978	361	71.1	0.81	0.79	0.69	**91.5**	92.1	92.0	6.2	2.3	2.5	0.85	305	65
LS 280 SC	45	978	439	86.5	0.81	0.79	0.69	**91.6**	92.2	91.9	6.2	2.3	2.5	0.99	340	65
LS 280 MC	55	978	537	106	0.81	0.79	0.72	**92**	93.1	93.4	6	2.4	2.5	1.19	385	65
LS 315 SN	75	983	729	142	0.82	0.78	0.67	**92.8**	92.9	92.3	6.5	2.5	2.7	1.3	438	65
LS 315 MP	90	980	877	164	0.85	0.83	0.76	**92.9**	93.1	92.4	7.2	2.4	2.9	3.74	760	74
LS 315 MR	110	980	1072	200	0.85	0.83	0.76	**93.3**	93.6	93.0	7.2	2.4	2.9	4.36	850	74
LS 315 MR	132	986	1278	242	0.83	0.8	0.72	**94.2**	94.3	93.7	6.6	2.40	2.50	4.36	830	74

* This standard replaces the IEC 60034-2; 1996.
** These motors do not reach the level of efficiency IE1.

LS
totally enclosed three-phase asynchronous motors

Selection

IP 55 - 50 Hz - Class F - ΔT 80 K - 400 V Δ - S1

A

6 poles 1000 min^{-1}

Type	Rated power at 50 Hz P_N kW	IM 1001 (IM B3) Code	Qty	IM 2001 (IM B35) Code	Qty
LS 132 S	3	MA6 30 202	1		-
LS 132 M	4	MA6 40 202	2		-
LS 132 M	5.5	MA6 55 202	1		-
LS 160 M	7.5	MA6 75 202	1	MA6 75 2A2	1
LS 160 L	11	MA6 11 302	1	MA6 11 3A2	1
LS 180 LR	15	MA6 15 302	1	MA6 15 3A2	1
LS 200 LT	18.5	MA6 18 302	1	MA6 18 3A2	1
LS 200 L	22	MA6 22 302	1	MA6 22 3A2	1
LS 225 MR	30	MA6 30 302	1	MA6 30 3A2	1
LS 250 ME	37		-		-
LS 280 SC	45		-		-
LS 280 MC	55		-		-
LS 315 SN	75		-		-
LS 315 MP	90		-		-
LS 315 MR	110		-		-
LS 315 MR	132		-		-

Selection example:

Speed:	1000 min^{-1} - 6 poles
Power:	18.5 kW
Mounting and position:	IM 1001 (IM B3)
Mains supply voltage:	400 V

Designation:
6P LS 200 LT 18.5 kW IM 1001 (IM B3) 400 V

Code: MA6 18 302

LS
totally enclosed three-phase asynchronous motors

Selection

A

8 poles 750 min^{-1}

IP 55 - 50 Hz - Class F - ΔT 80 K - 400 V Δ - S1

	Rated power	Rated speed	Rated torque	Rated current	Power factor			Efficiency IEC 60034-2; 1996			Starting current/ Rated current	Starting torque/ Rated torque	Maximum torque/ Rated torque	Moment of inertia	Weight	Noise
	P_N	N_N	M_N	$I_{N\ (400V)}$	Cos Phi			η			Id / In	Md/Mn	M_M/Mn	J	IM B3	LP
Type	kW	min-1	Nm	A	4/4	3/4	2/4	4/4	3/4	2/4				kg.m2	kg	db(A)
LS 71 L	0.09	690	1.3	0.5	0.55	0.45	0.4	44	42	36	2.8	1.3	1.5	0.001	8	40
LS 71 L	0.12	650	1.8	0.9	0.55	0.45	0.4	44	42	36	2.1	1.3	1.4	0.001	8	40
LS 80 L	0.18	705	2.4	0.79	0.63	0.54	0.45	52	48	43	2.9	1.5	1.9	0.003	9.7	41
LS 80 L	0.25	700	3.4	0.98	0.68	0.6	0.51	54	52	45	2.8	1.7	1.9	0.004	11.3	41
LS 90 L	0.37	685	5.2	1.2	0.72	0.63	0.52	62	62	56	3.8	1.7	1.8	0.004	13.5	43
LS 90 S	0.37	685	5.2	1.2	0.72	0.63	0.52	62	62	56	3.8	1.7	1.8	0.004	13.5	43
LS 90 L	0.55	670	7.8	1.7	0.72	0.61	0.52	63.5	62	59	3.5	1.7	1.7	0.005	15.2	43
LS 100 L	0.75	670	10.7	2.4	0.71	0.58	0.47	63.5	61.5	55	3.5	1.8	2.2	0.005	18	43
LS 100 L	1.1	670	15.7	3.7	0.68	0.6	0.49	63	62.5	58	3.7	2.0	2.2	0.007	21.8	43
LS 112 MG	1.5	710	20.2	4.7	0.64	0.55	0.43	72	69	62.5	3.8	2.0	2.1	0.015	24	49
LS 132 SM	2.2	713	29.5	6.1	0.68	0.56	0.45	77.1	77.5	71	4	1.7	2.0	0.025	45.6	54
LS 132 M	3	712	40.2	8	0.65	0.56	0.45	79.8	82.9	79	4.3	1.9	2.2	0.033	53.9	54
LS 160 M	4	718	53.2	11	0.63	0.55	0.43	83.3	83.4	81.3	3.9	1.7	2.3	0.068	84	66
LS 160 M	5.5	716	73.4	15.1	0.63	0.55	0.43	83.3	83.5	81.8	3.9	1.7	2.3	0.071	89	66
LS 160 L	7.5	714	100	20.6	0.63	0.55	0.43	83.4	84	82.6	3.9	1.9	2.3	0.09	101	66
LS 180 L	11	720	146	25.6	0.72	0.68	0.57	86	86.3	84.2	3.8	1.4	1.9	0.205	140	68
LS 200 L	15	725	198	32.9	0.75	0.7	0.57	87.7	87.9	86.3	4.4	1.6	2.1	0.27	185	65
LS 225 ST	18.5	725	244	42.4	0.72	0.66	0.54	87.5	87.7	86.2	4.2	1.6	2.1	0.33	210	65
LS 225 MR	22	725	290	51.9	0.7	0.63	0.51	87.4	87.2	85.1	4.4	1.9	2.3	0.4	240	65
LS 250 ME	30	732	391	60.7	0.78	0.74		91.5	92.2		5.8	1.6	2.4	0.86	312	65
LS 280 SC	37	731	483	73.8	0.79			91.6			5.6	1.6	2.4	0.92	334	65
LS 280 MC	45	730	589	88.5	0.8	0.76		91.7	92.6		5.4	1.6	2.3	1.13	378	65
LS 315 SP	55	738	712	105	0.81	0.78	0.71	93.2	93.2	92.2	5.4	1.8	2.4	3.1	660	74
LS 315 MR	75	738	971	143	0.81	0.78	0.71	93.6	93.8	93.1	5.4	1.8	2.4	4.38	815	74

LS
totally enclosed three-phase asynchronous motors

Selection

IP 55 - 50 Hz - Class F - ΔT 80 K - 400 V Δ - S1

A

8 poles 750 min^{-1}

Type	Rated power at 50 Hz P_N kW	IM 1001 (IM B3) Code	Qty	IM 2001 (IM B35) Code	Qty
LS 132 M	3		-		-
LS 160 M	4		-		-
LS 160 M	5.5		-		-
LS 160 L	7.5		-		-
LS 180 L	11		-		-
LS 200 L	15		-		-
LS 225 ST	18.5		-		-
LS 225 MR	22		-		-
LS 250 ME	30		-		-
LS 280 SC	37		-		-
LS 280 MD	45		-		-
LS 315 SP	55		-		-
LS 315 MR	75		-		-

LS
totally enclosed three-phase asynchronous motors

Selection

A

2 poles 3000 min-1

PTO thermal protection -n/c
IP 55 - 50 Hz - Class F - ΔT 80 K - 230 V Δ / 400 V Y and 400 V Δ - S1

IE1

Type	Rated power P_N kW	Rated speed N_N min-1	Rated torque M_N Nm	Rated current $I_{N\ (400V)}$ A	Power factor Cos Phi 4/4	3/4	2/4	Efficiency* IEC 60034-2-1; 2007 η 4/4	3/4	2/4	Starting current/ Rated current Id / In	Starting torque/ Rated torque Md/Mn	Maximum torque/ Rated torque M_M/Mn	Moment of inertia J kg.m2	Weight IM B3 kg	Noise LP db(A)
LS 56 M	0.09	2860	0.3	0.44	0.55	0.45	0.4	54	45.2	37.1	5.0	5.3	5.4	0.00015	3.8	54
LS 56 M	0.12	2820	0.4	0.5	0.6	0.55	0.45	58.7	54	45.2	4.6	4.0	4.1	0.00015	3.8	54
LS 63 M	0.18	2790	0.6	0.52	0.75	0.65	0.55	67.4	66.9	59.3	5.0	3.3	2.9	0.00019	4.8	57
LS 63 M	0.25	2800	0.9	0.71	0.75	0.65	0.55	67.8	67.3	59.2	5.4	3.2	2.9	0.00025	6	57
LS 71 L	0.37	2800	1.3	0.98	0.8	0.7	0.6	68.4	67.6	63.9	5.2	3.3	3.9	0.00035	6.4	62
LS 71 L	0.55	2800	1.9	1.32	0.8	0.7	0.55	75.7	75.2	71.1	6.0	3.2	3.1	0.00045	7.3	62
LS 71 L	0.75	2780	2.6	1.7	0.85	0.75	0.65	74.6	75.8	73.1	6.0	3.3	2.9	0.0006	8.3	62
LS 80 L	0.75	2840	2.5	1.64	0.87	0.8	0.68	**75.7**	76.1	73.3	5.9	2.4	2.2	0.0007	8.2	61
LS 80 L	1.1	2837	3.7	2.4	0.84	0.77	0.65	**77.3**	78.3	76.4	5.8	2.7	2.4	0.0009	9.7	61
LS 80 L	1.5	2859	5.0	3.2	0.83	0.76	0.62	**79.3**	80	78.1	7.0	3.2	2.8	0.0011	11.3	61
LS 90 S	1.5	2870	5.0	3.4	0.81	0.72	0.58	**80**	79.5	75.9	8.0	3.9	4.0	0.0014	12	64
LS 90 L	1.8	2865	6.0	3.6	0.86	0.8	0.69	**81.9**	82.5	81.4	8.0	3.6	3.6	0.0017	14	64
LS 90 L	2.2	2862	7.3	4.3	0.88	0.83	0.73	**82**	83	82	7.7	3.7	3.3	0.0021	16	64
LS 100 L	3	2868	10.0	6.3	0.81	0.73	0.59	**82.5**	82.6	80.1	7.5	3.8	3.9	0.0022	20	66
LS 100 L	3.7	2850	12.5	8	0.85	0.76	0.62	**82.7**	82.2	77.2	8.6	0.0	0.0	0.0022	21	66
LS 112 M	4	2877	13.3	7.8	0.85	0.78	0.65	**85**	85.3	83.7	7.8	2.9	2.9	0.0029	24.4	66
LS 112 MG	5.5	2916	18.0	10.5	0.88	0.81	0.71	**86.1**	86.4	84.7	9.0	3.1	3.5	0.0076	33	66
LS 132 S	5.5	2916	18.0	10.5	0.88	0.81	0.71	**86.1**	86.4	84.7	9.0	0.0	0.0	0.0076	34.4	72
LS 132 S	7.5	2905	24.5	14.7	0.85	0.78	0.63	**86**	85.8	83.2	8.7	0.0	0.0	0.0088	39	72
LS 132 M	9	2910	29.5	17.3	0.85	0.8	0.71	**87.9**	88.5	87.5	8.6	2.5	3.5	0.016	49	72
LS 132 M	11	2944	35.7	20.7	0.86	0.81	0.69	**88.2**	88.3	86.7	7.5	2.7	3.4	0.018	54	72
LS 160 MP	11	2944	35.7	20.7	0.86	0.81	0.69	**88.2**	88.3	86.7	7.5	2.7	3.4	0.019	62	72
LS 160 MP	15	2935	48.8	28.4	0.85	0.79	0.71	**89.3**	89.7	88.6	8.1	3.0	3.5	0.023	72	72
LS 160 L	18.5	2934	60.2	33.7	0.87	0.83	0.75	**90.09**	90.6	90.0	8.0	3.0	3.3	0.044	88	72
LS 180 MT	22	2938	71.5	39.9	0.87	0.84	0.76	**90.6**	91.2	90.8	8.1	3.1	3.1	0.052	99	72
LS 200 LT	30	2946	97.2	52.1	0.9	0.87	0.82	**91.5**	92.1	91.7	8.6	2.7	3.4	0.089	154	73
LS 200 L	37	2950	120	65	0.89	0.87	0.82	**92.1**	92.6	92.3	7.4	2.6	3.0	0.12	180	73
LS 225 MT	45	2950	146	78	0.9	0.87	0.82	**92.5**	92.7	92.7	7.5	2.8	3.1	0.14	200	73
LS 250 MZ	55	2956	178	96	0.89	0.86	0.8	**92.9**	93.6	92.5	8.3	3.1	3.4	0.173	235	78
LS 280 SC	75	2968	241	129	0.9	0.87	0.82	**93.5**	93.6	93.1	8.5	2.6	3.4	0.39	330	79
LS 280 MC	90	2968	290	154	0.9	0.88	0.83	**93.8**	94.0	93.6	8.4	2.6	3.3	0.47	375	79
LS 315 SN	110	2964	354	184	0.92	0.9	0.86	**94**	94.2	93.9	8.6	2.7	3.4	0.55	445	80
LS 315 MP	132	2976	424	227	0.89	0.87	0.82	**94.4**	94.2	93.1	7.6	2.8	2.9	1.67	715	83
LS 315 MR	160	2976	513	271	0.9	0.88	0.84	**94.6**	94.6	93.7	7.6	2.9	3.1	1.97	820	83
LS 315 MR•	200	2982	640	350	0.87	0.86	0.82	**94.8**	94.3	92.9	9.3	3.8	3.9	1.97	845	83

● Temperature rise class F

* This standard replaces the IEC 60034-2; 1996.

APPENDIX B

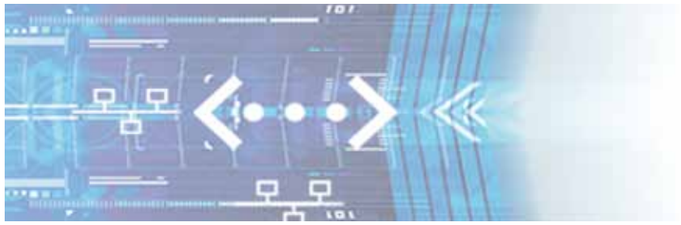
GR 63x25, 50 W

Versions of GR 63x25 / Ausführungen GR 63x25	*Page* / Seite
With gearbox / Als Getriebemotor	47
With brake / Als Bremsmotor	80
With controller / Mit Regelelektronik	86
With tacho generator / Mit Tachogenerator	82
With magnetic pulse generator / Mit magnetischem Impulsgeber	83
With incremental encoder / Mit Inkrementalgeber	84

Standard / Standard *On request* / auf Anfrage

- *General information about the characteristics of our commutated motors, see page 8*
- *The standard version has leads (300 mm)*
- *Special and high voltage windings available on request*
- *On request different shaft lengths and diameters or shaft on both sides are available as per our program*
- *Protection class IP 50, higher class available on request*
- *Motor shaft with ball bearing*

- Allgemeine Informationen über die Eigenschaften unserer Kollektormotoren siehe S. 8
- Der Motor wird standardmäßig mit Litzen (300 mm) geliefert
- Sonder- und Hochspannungswicklungen auf Anfrage erhältlich
- Auf Anfrage verschiedene Wellenlängen und -durchmesser bzw. beidseitige Wellen gemäß unserem Programm lieferbar
- Schutzart IP 50, auf Anfrage auch höher
- Die Motorwelle ist kugelgelagert



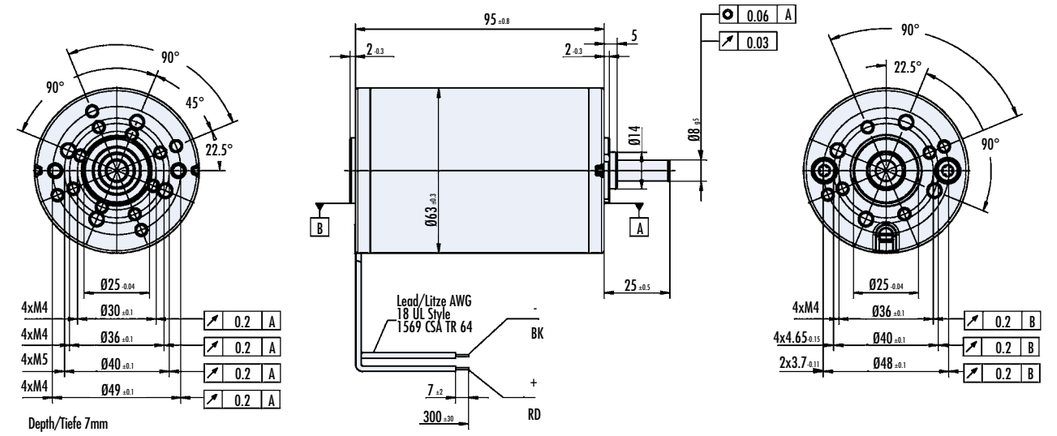
Data / Technische Daten		GR 63x25			
Rated voltage/ Nennspannung	VDC	12	24	40	60
Continuous rated speed/ Nenndrehzahl	rpm*)	3100	3300	3500	3300
Continuous rated torque/ Nenndrehmoment	Ncm*)	13.7	14	13.3	14.5
Continuous current/ Nennstrom	A*)	5.2	2.7	1.7	1.1
Starting torque/ Anlaufmoment	Ncm**)	82	108	118	116
Starting current/ Anlaufstrom	A**)	27	18	12	7.6
No load speed/ Leerlaufdrehzahl	rpm**)	3600	3600	3800	3600
No load current/ Leerlaufstrom	A**)	0.6	0.36	0.21	0.14
Demagnetization current/ Entmagnetisierstrom	A**)	50	24	16	9.5
Rotor inertia/ Trägheitsmoment	gcm^2	400	400	400	400
Weight of motor/ Motorgewicht	g	1200	1200	1200	1200

*) $\Delta\vartheta_w$ = 100 K; **) ϑ_R = 20°C

GR 63x25, 50 W

dunkermotoren
advanced motion solutions

Dimensions in mm / Maßzeichnung in mm

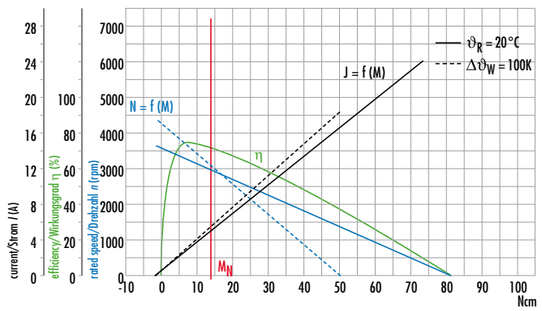


Shaft / Welle	
front / vorne	*back* / hinten
8 x 25 mm	-
5 x 20 mm	-
8 x 55 mm	-
8 x 55 mm	8 x 55 mm
5 x 11 mm	-

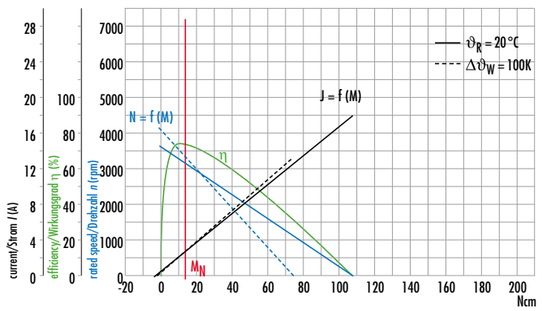
F_{axial} = max. 150N
F_{radial} = max. 150N

Characteristic diagram / Belastungskennlinien

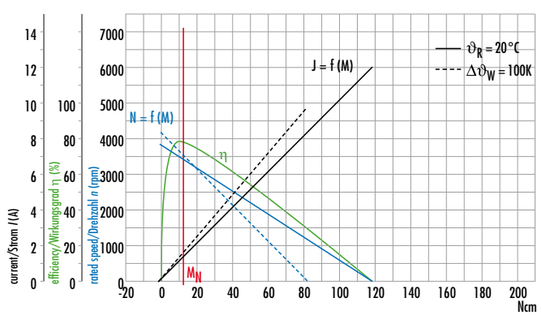
In accordance with EN 60034
Belastungskennlinien gezeichnet nach EN 60034



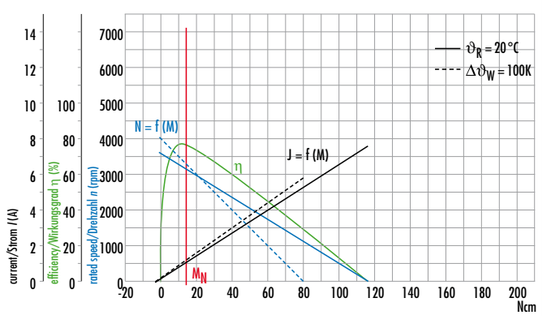
GR 63x25, 12V



GR 63x25, 24V



GR 63x25, 40V



GR 63x25, 60V

APPENDIX C

Smarter. Greener. Together.

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DVP-0139720-07

2014-07-04

DVP-ES2/EX2/SS2/SA2/SX2/SE&TP Operation Manual - Programming

DVP-ES2/EX2/SS2/ SA2/SX2/SE&TP

Operation Manual - Programming

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DVP-ES2/EX2/SS2/SA2/SX2/SE&TP

Operation Manual

Programming

Revision History

Issue	Description of Changes	Date
First version	The first edition is issued.	2010/02/26
Second version	The second edition is issued.	2011/03/03
Third version	1. Chapter 2.8 M Relay: Add M1037, M1119, M1182, M1308, M1346, and M1356, and update the description of the functions of M1055~M1057and M1183. 2. Chapter 2.13 Special Data Register: Add D1037, D1312, D1354, and D1900~D1931, and modify the attributes of the latched functions of D1062, D1114, D1115, and D1118. 3. Chapter 2.16 Applications of Special M Relays and D Registers: Update the description of the functions of RTCs; add M1037, D1037（Enable SPD function）, M1119（Enable 2-speed output function of DDRVI instruction）, M1308, D1312（Output specified pulses or seek Z phase signal when zero point is achieved）, and M1346（Output clear signals when ZRN is completed）; Easy PLC Link is changed to PLC Link, and the description is added. 4. Chapter 3.1 Basic Instructions (without API numbers) and Chapter 3.2 Explanations to Basic Instructions: Add NP and PN instructions, and add Chapter 3.7 Numerical List of Instructions (in alphabetic order)	2011/09/29

Issue	Description of Changes	Date
	5. Chapter 3.6 Numerical List of Instructions and Chapter 3.8 Detailed Instruction Explanation: Increase explanations of DSPA instruction, and add floating-point contact type comparison instructions FLD=, FLD>, FLD<, FLD<>, FLD<=, FLD>=, FAND=, FAND>, FAND<, FAND<>, FAND<=, FAND>=, FOR=, FOR>, FOR<, FOR<>, FOR<=, FOR>=; add the supplementary description of PLSR instruction and the description of K11~K19 in DTM instruction mode; update the description of API166 instruction.	
Fourth version	1. SE is added in the title of the manual. 2. Chapter 2.16: The default value in D1062 is K10. 3. API 15 in Chapter 3: The contents about S<D are deleted in program example 3. 4. API 148 and API 149 are added in Chapter 3. 5. The information related to DVP-SE is added. 6. The information related to DVP32ES-C is added. 7. The descriptions of the models are added in the contents. 8. Appendix A is added.	2012/07/01
Fifth version	1. API 113 is added. 2. API150 is updated. 3. Chapter 7 is updated.	2012/09/01
Sixth version	1. M1148, M1580, M1581, M1584, M1585, M1182, and M1183 are added to Chapter 2. 2. Chapter 3 is updated. API53, API 156, API 159, API69, API88, API143, API150, API155, API258, and API296-313 are added. 3. The description of API 178 is updated. 4. The description of the input/output mapping areas for DVP-ES2-C as a slave station is added to section 7.1.2. 5. C232, C249, and C250 are deleted from the description of the SE memory Map.	2013/02/20

Issue	Description of Changes	Date
	6. Appendix B is added. 7. Appendix C is added.	
Seventh version	1. The timer interrupts I805~I899 are added to Chapter2. The special auxiliary relays M1357~M1359, M1590, M1598, and M1599 are added to the table of special auxiliary relays. The descriptions of D1027 and D9998 in the table of special data registers are updated. D1056~D1059, D1150~D1153, D1246~D1247, and D9999 are added to the table of special data registers. The definitions of the pins in COM1 are added to the description of M1035. The new special auxiliary relays in the table of special data registers and the new special data registers in the table of special data registers are described in section 2.16. 2. API114, API115, API145, and API295 are added to Chapter 3. The descriptions of API17, API22, API23, API59, API78, API80, API81, API83, API101~API106, API112-API113, API150, API166, API179, and API197 are updated. 3. The information about M1040 is added to Chapter 5. 4. The description of the error code C450 is added to Chapter 6. 5. In Appendix C, the information about TP04P series text panels is changed to the information about TP series text panels. 6. Appendix D is added. It introduces the current consumption of slim PLCs/extension modules.	2014/07/04

DVP-ES2/EX2/SS2/SA2/SX2/SE&TP
Operation Manual
Programming

Contents

1 PLC Concepts

2 Programming Concepts

3 Instruction Set

4 Communications

5 Sequential Function Chart

6 Troubleshooting

7 CANopen Function and Operation

Appendix A

Appendix B

Appendix C

Appendix D

The DVP-ES2 series PLCs, the DVP-ES2-C series PLCs, the DVP-EX2 series PLCs, the DVP-SS2 series PLCs, the DVP-SA2 series PLCs, the DVP-SX2 series PLCs, the DVP-SE series PLCs, and the TP series text panels are listed below.

Series	Model name
DVP-ES2	DVP16ES200R, DVP16ES200T, DVP24ES200R, DVP24ES200T, DVP32ES200R, DVP32ES200T, DVP32ES211T, DVP40ES200R, DVP40ES200T, DVP60ES200R, DVP60ES200T, DVP32ES200RC, DVP32ES200TC
DVP-ES2-C	DVP32ES200RC, DVP32ES200TC
DVP-EX2	DVP20EX200R, DVP20EX200T, DVP30EX200R, DVP30EX200T
DVP-SS2	DVP14SS211R, DVP14SS211T
DVP-SA2	DVP12SA211R, DVP12SA211T
DVP-SX2	DVP20SX211R, DVP20SX211S, DVP20SX211T
DVP-SE	DVP12SE11R, DVP12SE11T
TP	TP04P-16TP1R, TP04P-32TP1R, TP04P-22XA1R, TP04P-21EX1R, TP70P-16TP1R, TP70P-32TP1R, TP70P-22XA1R, TP70P-21EX1R

PLC Concepts

This chapter introduces basic and advanced concepts of ladder logic, which is the mostly adopted programming language of PLC. Users familiar with the PLC concepts can move to the next chapter for further programming concepts. However, for users not familiar with the operating principles of PLC, please refer to this chapter to get a full understanding of PLC concepts.

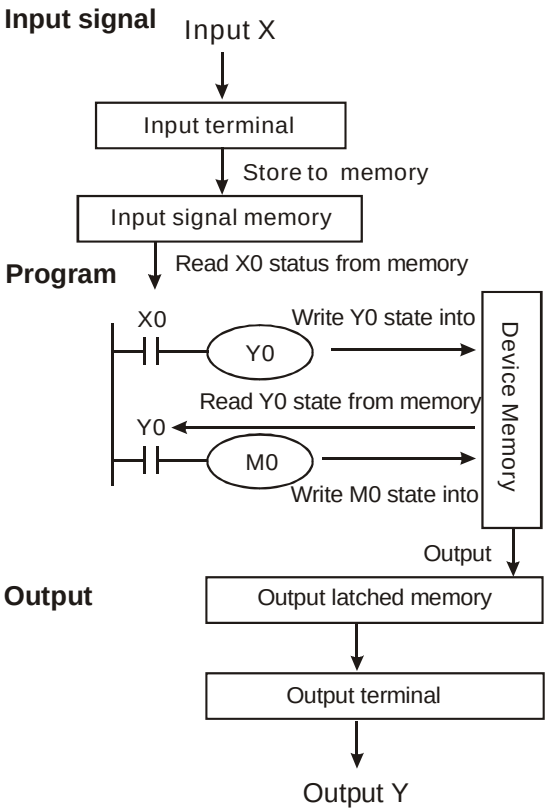
Chapter Contents

1.1 PLC Scan Method

PLC utilizes a standard scan method when evaluating user program.

Scanning process:

Scan input status	Read the physical input status and store the data in internal memory.
Evaluate user program	Evaluate the user program with data stored in internal memory. Program scanning starts from up to down and left to right until reaching the end of the program.
Refresh the outputs	Write the evaluated data to the physical outputs



Input signal:
PLC reads the ON/OFF status of each input and stores the status into memory before evaluating the user program.
Once the external input status is stored into internal memory, any change at the external inputs will not be updated until next scan cycle starts.
Program:
PLC executes instructions in user program from top to down and left to right then stores the evaluated data into internal memory. Some of this memory is latched.
Output:
When END command is reached the program evaluation is complete. The output memory is transferred to the external physical outputs.

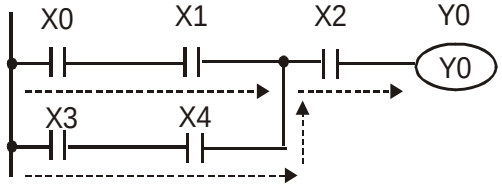
Scan time
The duration of the full scan cycle (read, evaluate, write) is called “scan time.” With more I/O or longer program, scan time becomes longer.

Read scan time	PLC measures its own scan time and stores the value (0.1ms) in register D1010, minimum scan time in register D1011, and maximum scan time in register D1012.
Measure scan time	Scan time can also be measured by toggling an output every scan and then measuring the pulse width on the output being toggled.
Calculate scan time	Scan time can be calculated by adding the known time required for each instruction in the user program. For scan time information of individual instruction please refer to Ch3 in this manual.

Scan time exception
PLC can process certain items faster than the scan time. Some of these items interrupts and halt the scan time to process the interrupt subroutine program. A direct I/O refresh instruction REF allows the PLC to access I/O immediately during user program evaluation instead of waiting until the next scan cycle.

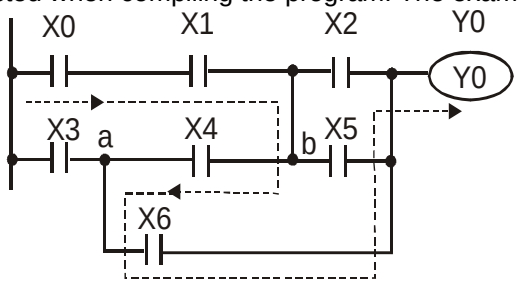
1.2 Current Flow

Ladder logic follows a left to right principle. In the example below, the current flows through paths started from either X0 or X3.

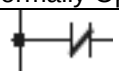


Reverse Current

When a current flows from right to left, which makes a reverse current logic, an error will be detected when compiling the program. The example below shows the reverse current flow.



1.3 NO Contact, NC Contact

NO contact	 Normally Open Contact, A contact
NC Contact	 Normally Closed Contact, B contact

1.4 PLC Registers and Relays

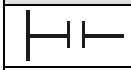
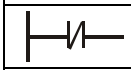
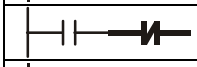
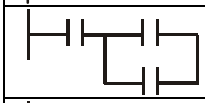
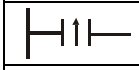
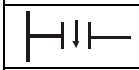
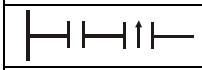
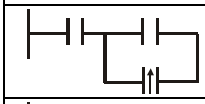
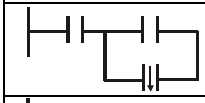
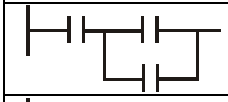
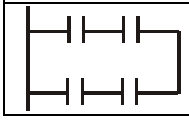
Introduction to the basic internal devices in a PLC

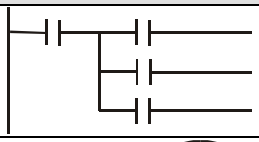
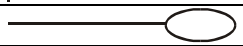
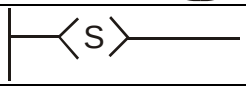
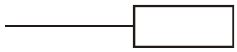
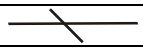
X (Input Relay)	Bit memory represents the physical input points and receives external input signals. ■ Device indication: Indicated as **X** and numbered in octal, e.g. X0~X7, X10~X17…X377
Y (Output Relay)	Bit memory represents the physical output points and saves the status to be refreshed to physical output devices. ■ Device indication: Indicated as **Y** and numbered in octal, e.g. Y0~Y7, Y10~Y17. ..Y377
M (Internal Relay)	Bit memory indicates PLC status. ■ Device indication: Indicated as **M** and numbered in decimal, e.g. M0, M1, M2…M4095
S (Step Relay)	Bit memory indicates PLC status in Step Function Control (SFC) mode. If no STL instruction is applied in program, step point S can be used as an internal relay M as well as an annunciator. ■ Device indication: Indicated as **S** and numbered in decimal, e.g. S0, S1, S2…S1023
T (Relay) (Word) (Dword)	Bit, word or double word memory used for timing and has coil, contact and register in it. When its coil is ON and the set time is reached, the associated contact will be energized. Every timer has its resolution (unit: 1ms/10ms/100ms). ■ Device indication: Indicated as **T** and numbered in decimal, e.g. T0, T1, T2…T255

C (Counter) (Relay) (Word) (Dword)	Bit, word or double word memory used for counting and has coil, contact and register in it. The counter count once (1 pulse) when the coil goes from OFF to ON. When the predefined counter value is reached, the associated contact will be energized. There are 16-bit and 32-bit high-speed counters available for users. ■ Device indication: Indicated as **C** and numbered in decimal, e.g. C0, C1, C2…C255
D (Data register) (Word)	Word memory stores values and parameters for data operations. Every register is able to store a word (16-bit binary value). A double word will occupy 2 consecutive data registers. ■ Device indication: Indicated as **D** and numbered in decimal, e.g. D0, D1, D2…D4999
E, F (Index register) (Word)	Word memory used as a modifier to indicate a specified device (word and double word) by defining an offset. Index registers not used as a modifier can be used as general purpose register. ■ Device indication: indicated as E0 ~ E7 and F0 ~ F7.

1.5 Ladder Logic Symbols

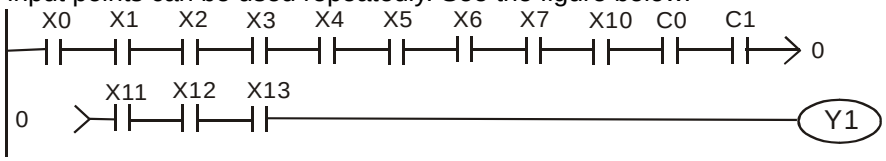
The following table displays list of WPLSoft symbols their description, command, and memory registers that are able to use the symbol.

Ladder Diagram Structure	Explanation	Instruction	Available Devices
	NO (Normally Open) contact / A contact	LD	X, Y, M, S, T, C
	NC (Normally Closed) contact / B contact	LDI	X, Y, M, S, T, C
	NO contact in series	AND	X, Y, M, S, T, C
	NC contact in series	ANI	X, Y, M, S, T, C
	NO contact in parallel	OR	X, Y, M, S, T, C
	NC contact in parallel	ORI	X, Y, M, S, T, C
	Rising-edge trigger switch	LDP	X, Y, M, S, T, C
	Falling-edge trigger switch	LDF	X, Y, M, S, T, C
	Rising-edge trigger in series	ANDP	X, Y, M, S, T, C
	Falling-edge trigger in series	ANDF	X, Y, M, S, T, C
	Rising-edge trigger in parallel	ORP	X, Y, M, S, T, C
	Falling-edge trigger in parallel	ORF	X, Y, M, S, T, C
	Block in series	ANB	None
	Block in parallel	ORB	None

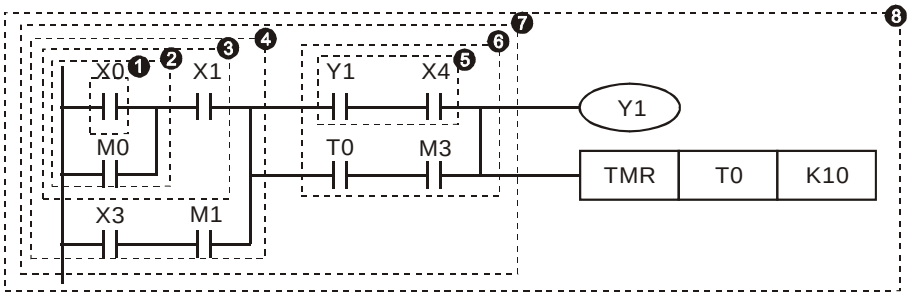
Ladder Diagram Structure	Explanation	Instruction	Available Devices
	Multiple output branches	MPS MRD MPP	None
	Output coil	OUT	Y, M, S
	Step ladder	STL	S
	Basic / Application instruction	-	Basic instructions and API instructions. Please refer to chapter 3 Instruction Set
	Inverse logic	INV	None

1.5.1 Creating a PLC Ladder Program

The editing of the program should start from the left side bus line to the right side bus line, and from up to down. However, the right side bus line is omitted when editing in WPLSoft. A single row can have maximum 11 contacts on it. If more than 11 contacts are connected, a continuous symbol “0” will be generated automatically and the 12th contact will be placed at the start of next row. The same input points can be used repeatedly. See the figure below:



When evaluating the user program, PLC scan starts from left to right and proceeds to next row down until the PLC reaches END instruction. Output coils and basic / application instructions belong to the output process and are placed at the right of ladder diagram. The sample program below explains the execution order of a ladder diagram. The numbers in the black circles indicate the execution order.

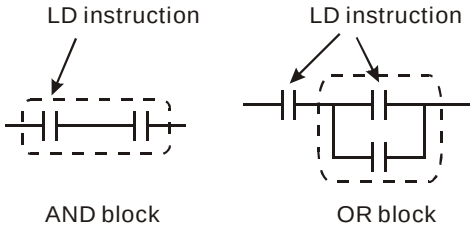


Execution order of the sample program:

1	LD	X0
2	OR	M0
3	AND	X1
4	LD	X3
	AND	M1
	ORB	
5	LD	Y1
	AND	X4
6	LD	T0
	AND	M3
	ORB	
7	ANB	
8	OUT	Y1
	TMR	T0 K10

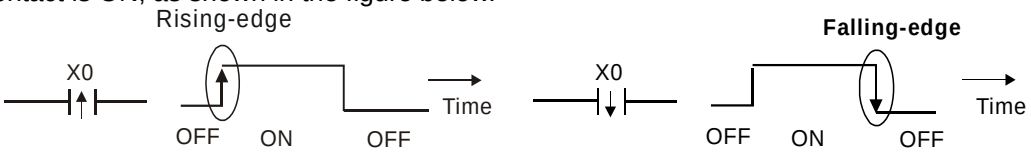
1.5.2 LD / LDI (Load NO contact / Load NC contact)

LD or LDI starts a row or block



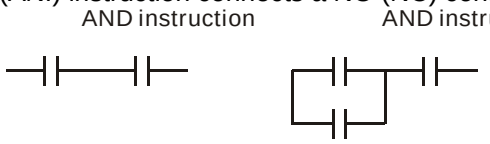
1.5.3 LDP / LDF (Load Rising edge trigger/ Load Falling edge trigger)

Similar to LD instruction, LDP and LDF instructions only act at the rising edge or falling edge when the contact is ON, as shown in the figure below.



1.5.4 AND / ANI (Connect NO contact in series / Connect NC contact in series)

AND (ANI) instruction connects a NO (NC) contact in series with another device or block.

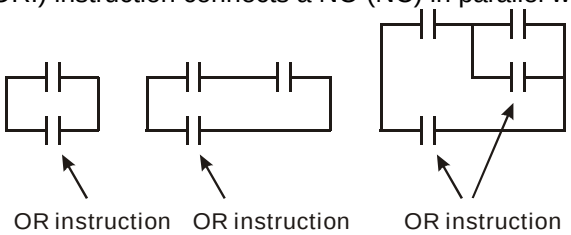


1.5.5 ANDP / ANDF (Connect Rising edge in series/ Connect Falling edge in series)

Similar to AND instruction, ANDP (ANDF) instruction connects rising (falling) edge triggers in series with another device or block.

1.5.6 OR / ORI (Connect NO contact in parallel / Connect NC contact in parallel)

OR (ORI) instruction connects a NO (NC) in parallel with another device or block.

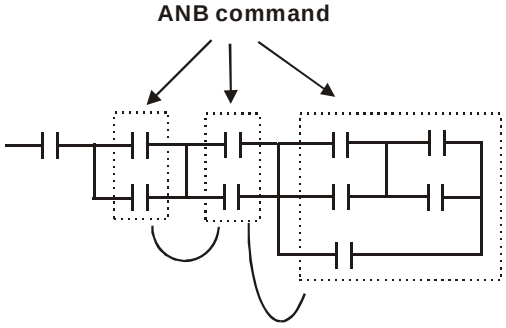


1.5.7 ORP / ORF (Connect Rising edge in parallel/ Connect Falling edge in parallel)

Similar to OR instruction, ORP (ORF) instruction connects rising (falling) edge triggers in parallel with another device or block

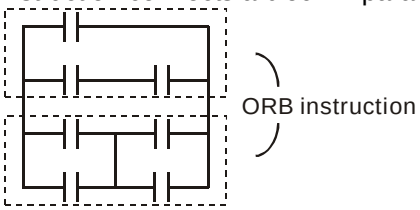
1.5.8 ANB (Connect block in series)

ANB instruction connects a block in series with another block



1.5.9 ORB (Connect block in parallel)

ORB instruction connects a block in parallel with another block



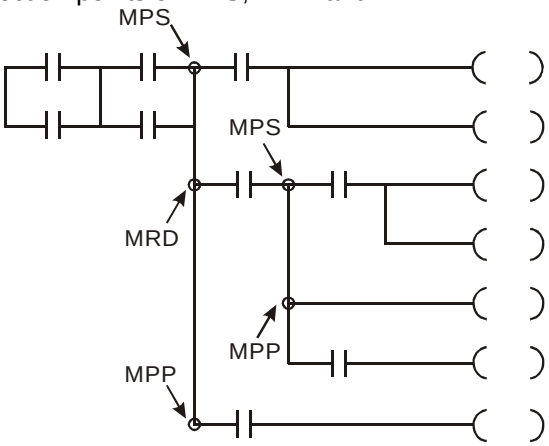
1.5.10 MPS / MRD / MPP (Branch instructions)

These instructions provide a method to create multiplexed output branches based on current result stored by MPS instruction.

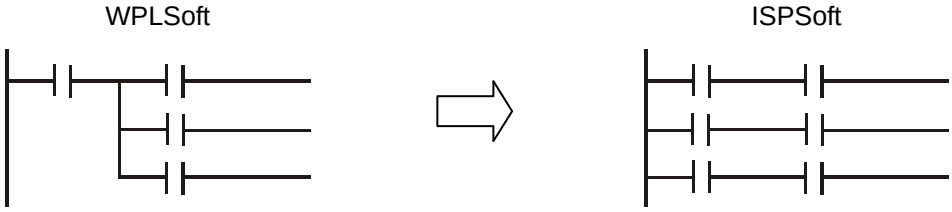
Branch instruction	Branch Symbol	Description
MPS	┬	Start of branches. Stores current result of program evaluation. Max. 8 MPS-MPP pairs can be applied
MRD	├	Reads the stored current result from previous MPS
MPP	└	End of branches. Pops (reads then resets) the stored result in previous MPS

Note: When compiling ladder diagram with WPLSoft, MPS, MRD and MPP could be automatically added to the compiled results in instruction format. However, sometimes the branch instructions are ignored by WPLSoft if not necessary. Users programming in instruction format can enter branch instructions as required.

Connection points of MPS, MRD and MPP:



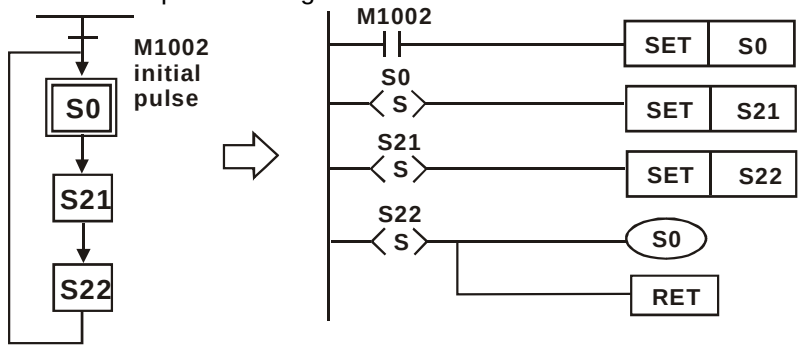
Note: Ladder diagram editor in ISPSoft does not support MPS, MRD and MPP instructions. To achieve the same results as branch instructions, users have to connect all branches to the left hand bus bar.



1.5.11 STL (Step Ladder Programming)

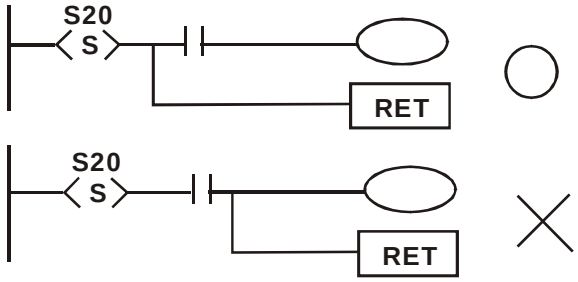
STL programming uses step points, e.g. S0 S21, S22, which allow users to program in a clearer and understandable way as drawing a flow chart. The program will proceed to next step only if the

previous step is completed, therefore it forms a sequential control process similar to SFC (Sequential Function Chart) mode. The STL sequence can be converted into a PLC ladder diagram which is called “step ladder diagram” as below.



1.5.12 RET (Return)

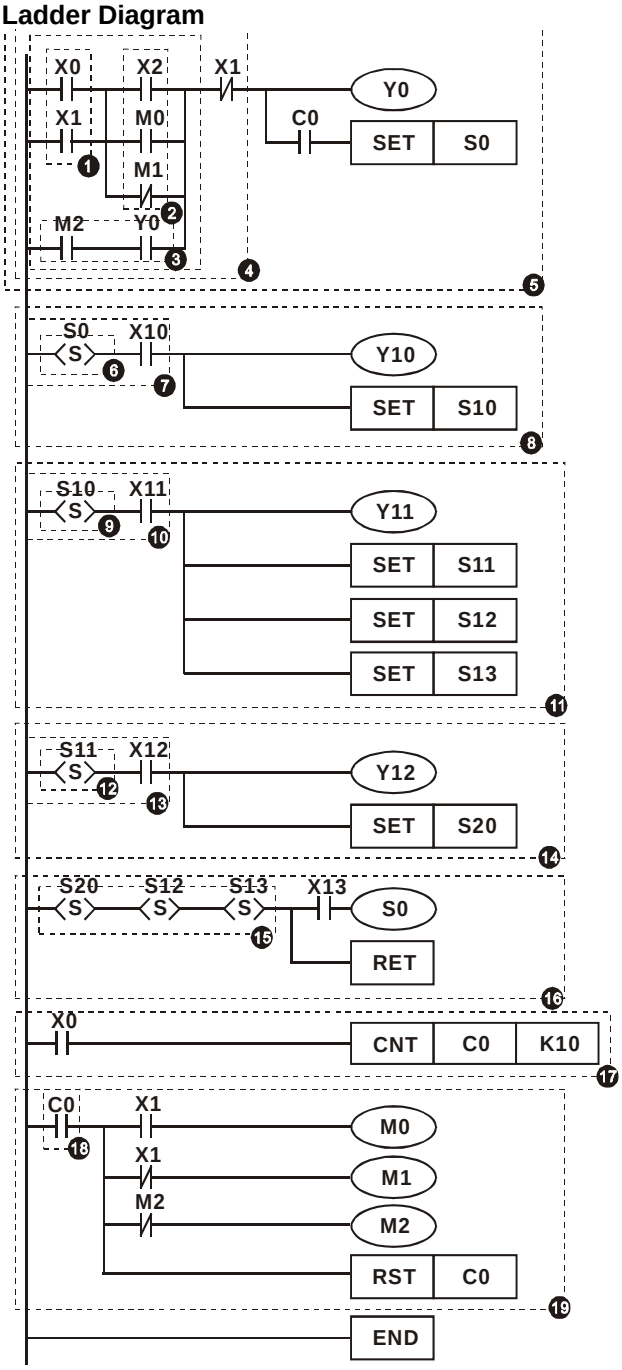
RET instruction has to be placed at the end of sequential control process to indicate the completion of STL flow.



Note: Always connect RET instruction immediately after the last step point indicated as the above diagram otherwise program error may occur.

1.6 Conversion between Ladder Diagram and Instruction List Mode

Ladder Diagram



Instruction

```
LD    X0
OR    X1
LD    X2
OR    M0
ORI   M1
ANB                 Block in series
LD    M2
AND   Y0
ORB                 Block in parallel
AN I  X1            ANI
OUT   Y0
AND   C0            Multiple outputs
SET   S0
STL   S0            Start of step ladder
LD    X10           S0 status operates with X10
OUT   Y10           Output Y10 and transfer of step point
SET   S10
STL   S10           Read S10 status
LD    X11           S10 operates with X11
OUT   Y11
SET   S11           Output Y11 and transfer of step points
SET   S12
SET   S13
STL   S11           Read S11 status
LD    X12           S11 operates with X12
OUT   Y12           Output Y12 and transfer of step points
SET   S20
STL   S20
STL   S12           Convergence of multiple status
STL   S13
LD    X13           Read X13 status and transfer of step point
OUT   S0
RET                 Return
LD    X0
CNT   C0 K10
LD    C0            Read C0
MPS
AND   X1
OUT   M0            Multiple outputs
MRD
AN I  X1
OUT   M1
MPP
AN I  M2
OUT   M2
RST   C0
END                 End of program
```

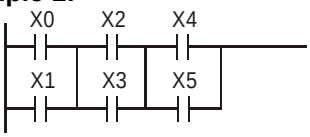
The output continues based on status of ❹

End of step ladder

1.7 Fuzzy Syntax

Generally, the ladder diagram programming is conducted according to the “up to down and left to right” principle. However, some programming methods not following this principle still perform the same control results. Here are some examples explaining this kind of “fuzzy syntax.”

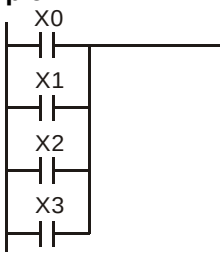
Example 1:



Better method		OK method	
LD	X0	LD	X0
OR	X1	OR	X1
LD	X2	LD	X2
OR	X3	OR	X3
ANB		LD	X4
LD	X4	OR	X5
OR	X5	ANB	
ANB		ANB	

The two instruction programs can be converted into the same ladder diagram. The difference between Better and OK method is the ANB operation conducted by MPU. ANB instruction cannot be used continuously for more than 8 times. If more than 8 ANB instructions are used continuously, program error will occur. Therefore, apply ANB instruction after a block is made is the better method to prevent the possible errors. In addition, it’s also the more logical and clearer programming method for general users.

Example 2:

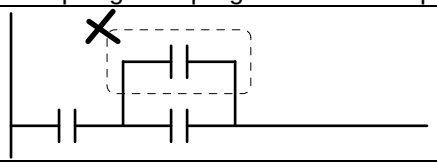
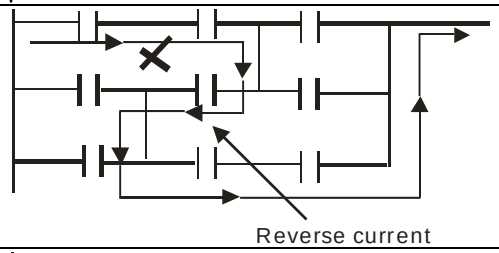
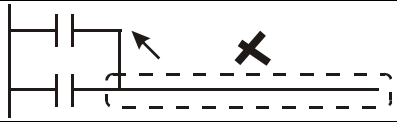


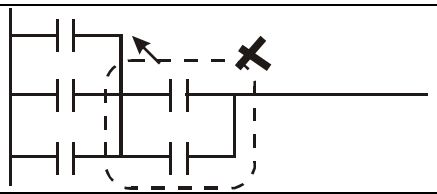
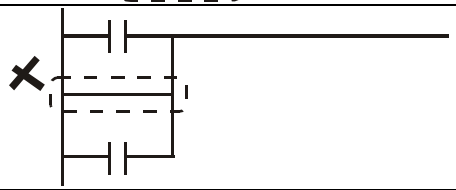
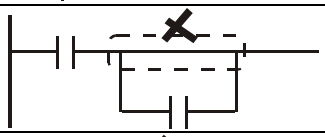
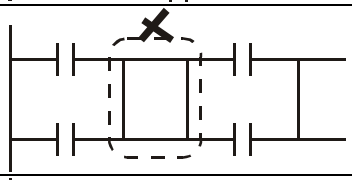
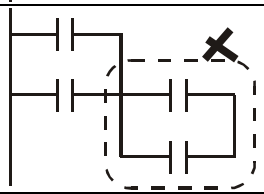
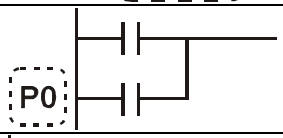
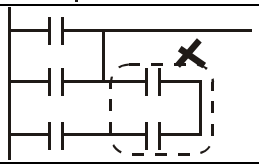
Good method		Bad method	
LD	X0	LD	X0
OR	X1	LD	X1
OR	X2	LD	X2
OR	X3	LD	X3
		ORB	
		ORB	
		ORB	

The difference between Good and Bad method is very clear. With longer program code, the required MPU operation memory increases in the Bad method. To sum up, following the general principle and applying good / better method when editing programs prevents possible errors and improves program execution speed as well.

Common Programming Errors

PLC processes the diagram program from up to down and left to right. When editing ladder diagram users should adopt this principle as well otherwise an error would be detected by WPLSoft when compiling user program. Common program errors are listed below:

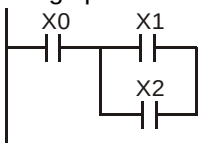
	OR operation upward is not allowed.
	“Reverse current” exists.
	Output should be connected on top of the circuit.

	Block combination should be made on top of the circuit.
	Parallel connection with empty device is not allowed..
	Parallel connection with empty device is not allowed.
	No device in the middle block.
	Devices and blocks in series should be horizontally aligned
	Label P0 should be at the first row of the complete network.
	“Reverse current” exists

1.8 Correcting Ladder Diagram

Example 1:

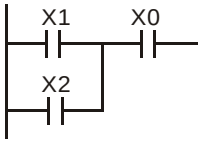
Connect the block to the front for omitting ANB instruction because simplified program improves processing speed



Instruction List

LD	X0
LD	X1
OR	X2
ANB	

⇩



Instruction List

LD	X1
OR	X2
AND	X0

APPENDIX D

2014-04-11

5012618703-B303

DOP-B03

High Color • Wide Screen • User-Friendly HMI Products

B03S211 / B03E211 Instruction Sheet

(1) Preface

Thank you for purchasing DELTA's DOP-B series. This instruction sheet will be helpful in the installation, wiring and inspection of Delta HMI. Before using the product, please read this instruction sheet to ensure correct use. You should thoroughly understand all safety precautions before proceeding with the installation, wiring and operation. Place this instruction sheet in a safe location for future reference. Please observe the following precautions:

- Install the product in a clean and dry location free from corrosive and inflammable gases or liquids.
- Ensure that all wiring instructions and recommendations are followed.
- Ensure that HMI is correctly connected to a ground. The grounding method must comply with the electrical standard of the country (Please refer to NFPA 70: National Electrical Code, 2005 Ed.).
- Do not disassemble HMI, modify or remove wiring when power is applied to HMI.
- Do not touch the power supply during operation. Otherwise, it may cause electric shock.

If you have any questions during operation, please contact our local distributors or Delta sales representatives.

The content of this instruction sheet may be revised without prior notice. Please consult our distributors or download the most updated version at http://www.delta.com.tw/ia.

(2) Safety Precautions

Carefully note and observe the following safety precautions when receiving, inspecting, installing, operating, maintaining and troubleshooting. The following words, DANGER, WARNING and STOP are used to mark safety precautions when using the Delta's HMI product. Failure to observe these precautions may void the warranty!

Installation

DANGER

- Comply with quick start for installation. Otherwise it may cause equipment damage.
- Do not install the product in a location that is outside the stated specification for the HMI. Failure to observe this caution may result in electric shock, fire, or explosion.
- Do not install the product in a location where temperatures will exceed specification for the HMI. Failure to observe this caution may result in abnormal operation or damage the product.
- Please note that this equipment has obtained EMC registration for commercial use. In the event that it has been mistakenly sold or purchased, please exchange it for equipment certified for home use.
- Do not use this product as an alarm device for disaster early warning that may result in personal injury, equipment damage, or system emergency stop.

Wiring

DANGER

- Connect the ground terminals to a class-3 ground (Ground resistance should not exceed 100Ω). Improper grounding may result in communication error, electric shock or fire.

Operation

WARNING

- The users should use Delta Screen Editor software to perform editing in Delta's HMI product. To perform editing and confirming HMI programs without using Delta Screen Editor software in Delta's HMI product may result in abnormal operation.
- To prevent the personal injury and equipment damage, when designing HMI programs, please ensure that a communication error occurred between Delta's HMI product and the connecting controller or equipment will not result in system failure or malfunction.
- Please be sure to backup the screen data and HMI programs in case they are lost, accidentally deleted or worse.

STOP

- Do not modify wiring during operation. Otherwise it may result in electric shock or personal injury.
- Never use a hard or pointed object to hit or strike the screen as doing this may damage the screen and let the screen has not respond at all, and then cause HMI to work abnormally.

Maintenance and Inspection

STOP

- Do not touch any internal or exposed parts of the HMI as electrical shock may result.
- Do not remove operation panel while power is on. Otherwise electrical shock may result.
- Wait at least 10 minutes after power has been removed before touching any HMI terminals or performing any wiring and/or inspection as an electrical charge may still remain in the HMI with hazardous voltages even after power has been removed.
- Turn the power off before changing backup battery and check system settings after finishing change. (all data will be cleared after changing battery).
- Be sure the ventilation holes are not obstructed during operation. Otherwise malfunction may result due to bad ventilation or overheating troubles.

Wiring Method

WARNING

- Do not use a voltage that will exceed specification for the HMI. Failure to observe this caution may result in electric shock or fire.
- Remove the terminal block from the HMI before wiring.
- Insert only one wire into one terminal on the terminal block.
- If the wiring is in error, perform the wiring again with proper tools. Never use force to remove the terminals or wires. Otherwise, it may result in malfunction or damage.
- For the power line that forced to take out, ensure to check wiring again and restart.

Communication Wiring

WARNING

- Comply with communication wiring specification for wiring.
- Wiring length should comply with the stated specification for the HMI.
- Proper grounding to avoid bad communication quality.
- To avoid noise and interference, the communication cable, all power cables, and motor power cable should be placed in separate conduits.

(3) Pin Definition of Serial Communication

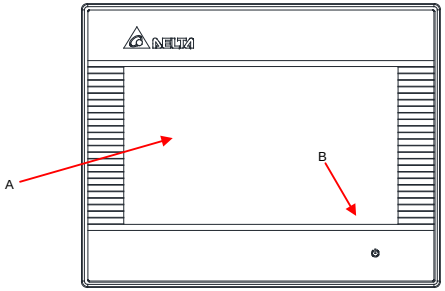
DOP-B03S211 / DOP-B03E211 COM1 and COM2 Ports

COM Port	PIN	MODE1		MODE2		MODE3	
		COM1	COM2	COM1	COM2	COM1	COM2
		RS-232	RS-485	RS-485	RS-485	RS-232	RS-422
PIN1	1			D+			TXD+
	2	RXD				RXD	
	3	TXD				TXD	
	4		D+		D+		RXD+
	5	GND		GND		GND	
	6			D-			TXD-
	7	RTS					
	8	CTS					
	9		D-		D-		RXD-

Note1: Blank = No Connection.

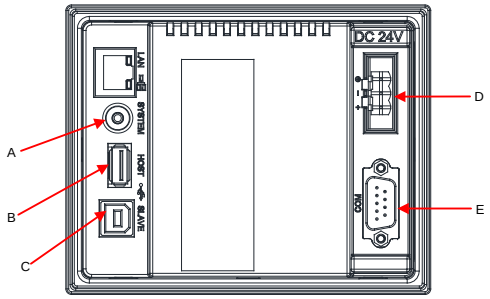
(4) Parts Names

DOP-B03S211 / DOP-B03E211 (Front View)



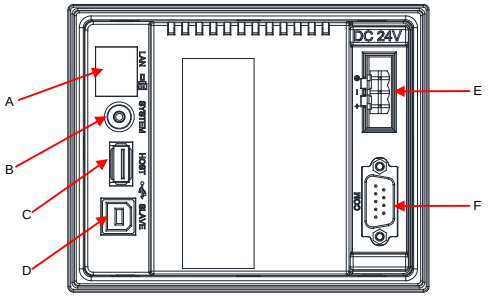
A	Touch Screen / Display		
B	Power LED Indicator (⏻)	Note: ⏻ Lights in green when HMI works normally.	

DOP-B03S211 (Rear View)



A	System Key	B	USB Host	C	USB Slave
D	Power Input Terminal	E	COM1		

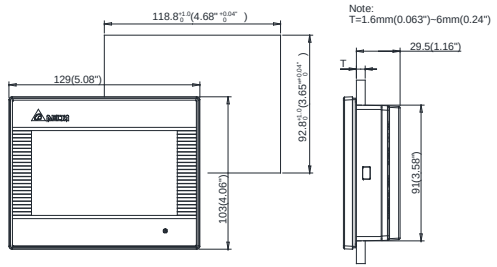
DOP-B03E211 (Rear View)



A	Ethernet Interface (LAN)	B	System Key	C	USB Host
D	USB Slave	E	Power Input Terminal	F	COM 1

(5) Dimensions

DOP-B03S211 / DOP-B03E211



(6) Specifications

MODEL		DOP-B03S211	DOP-B03E211
LCD MODULE	Display Type	4.3" TFT LCD (65536 colors)	
	Resolution	480 x 272 pixels	
	Backlight	LED Back Light (less than 20,000 hours half-life at 25°C) (Note 1)	
	Display Size	95.04 x 53.856mm	
Operation System		Delta Real Time OS	
MCU		32-bit RISC Micro-controller	
NOR Flash ROM		Flash ROM 128 MB (OS System: 30MB / Backup: 16MB / User Application: 82MB)	
SDRAM		64Mbytes	
Backup Memory		32Kbytes	
Buzzer		Multi-Tone Frequency (2K ~ 4K Hz) / 85dB	
USB		1 USB Slave Ver 2.0 1 USB Host Ver 1.1	
Serial COM Port	COM1	RS-232(supports hardware flow control) / RS-485	
	COM2	RS-422/RS-485	
Ethernet Interface		N/A	10M/100M
Perpetual Calendar		Built-in	
Cooling Method		Natural air circulation	
Safety Approval		CE / UL (Note 3)	
Waterproof Degree		IP65 / NEMA4 (Note 3)	
Operation Voltage (Note2)		DC +24V (-10% ~ +15%) (please use isolated power supply)	
Voltage Endurance		AC500V for 1 minute (between charging (DC24V terminal) and FG terminals)	
Power Consumption (Note 2)		4.8W	7.2W
Backup Battery		3V lithium battery CR2032 x 1	
Backup Battery Life		It depends on the temperature used and the conditions of usage, about 3 years or more at 25°C.	
Operation Temperature		0°C ~ 50°C	
Storage Temperature		-20°C ~ +60°C	
Ambient Humidity		10% ~ 90% RH [0 ~ 40°C], 10% ~ 55% RH [41 ~ 50°C], Pollution Degree 2	
Vibration		IEC 61131-2 compliant 5Hz≤f < 8.3Hz = Continuous: 3.5mm, 8.3Hz≤f≤150Hz = Continuous: 1.0g	
Shock		IEC 60068-2-27 compliant 15g peak for 11 ms duration, X, Y, Z directions for 6 times	
Dimensions (W) x (H) x (D) mm		129 x103 x 39	
Panel Cutout (W) x (H) mm		118.8 x 92.8	
Weight		Approx. 230g	Approx. 264g

NOTE

1) The half-life of backlight is defined as original luminance being reduced by 50% when the maximum driving current is supplied to HMI. The life of LED backlight shown here is an estimated value under 25°C normal temperature and humidity conditions.
2) The value of the power consumption indicates the electrical power consumed by HMI only without connecting to any peripheral devices. In order to ensure the normal operation, it is recommended to use a power supply which the capacity is 1.5 ~2 times the value of the power consumption.
3) Some models are in the process of application to certification. For more information, please consult our distributors.
4) The content of this instruction sheet may be revised without prior notice. Please consult our distributors or download the most updated version at http://www.delta.com.tw/ia/.