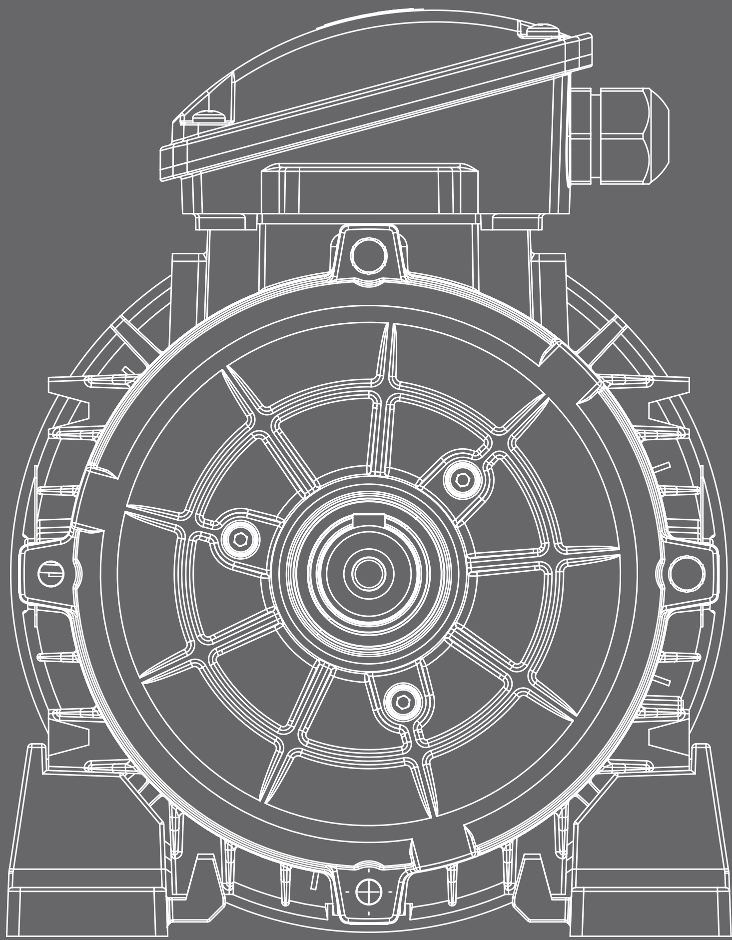
Volt electric motors



GENERAL CATALOGUE

2022-1

Volt electric motors

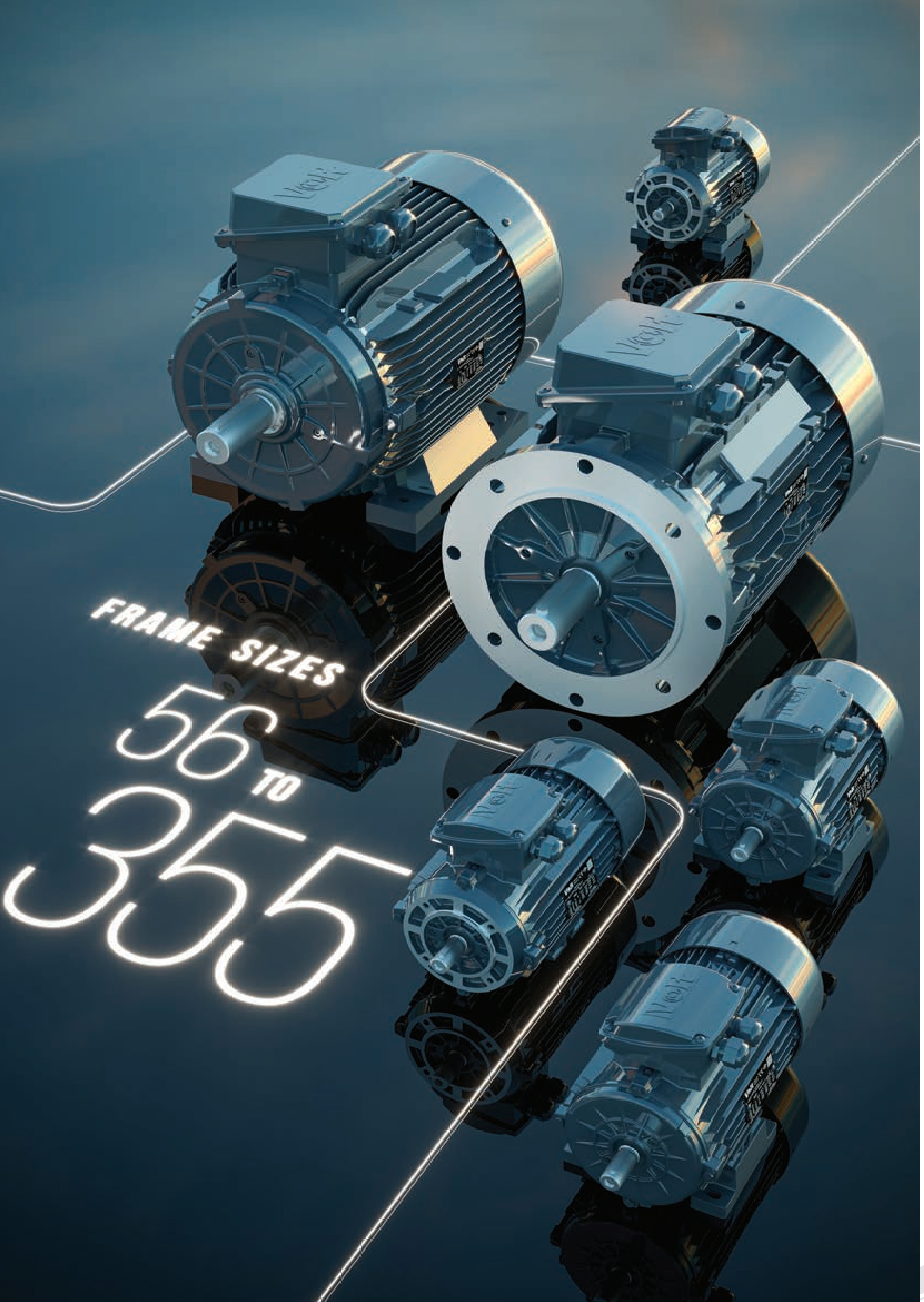
Volt Electric Motors, a subsidiary of Saya Group, is one of the largest electric motor manufacturers in Turkey in terms of technology, production capacity and product quality.

Volt Electric Motors, which provides huge export connections in a short time with its superior qualities in the world market it opened up with the aim of becoming a global brand, brings more prestige to Turkey in the foreign market with its achievements.

Proudly...

TABLE OF CONTENTS

TABLE OF CONTENTS



GENERAL

General purpose motors can be produced with 2-4-6 poles, three-phase motors with 50Hz at 380V and 400V, and single-phase motors with 50Hz at 220V and 230V. Special purpose motors with special shaft, varying speed powers, various voltage values and frequencies are also produced according to the demands of the customers.

The production and installation systems are in combined system formats in accordance with IEC 60034-7. The motors can also operate in a vertical position and other suitable installations.

GENERAL SPECIFICATIONS

Efficiency Class	IE5, IE4, IE3, IE2, IE1
Cooling System	IC411
Operation Type	S1
Protection Class	IP55
Operation Height	Max 1000m
Insulation Class	F
Temperature Rise Class	B
Vibration Class	B
Maximum Operating Ambient Temperature	40°C

Table 1. General Specifications

PTC thermistor application is added to the windings as standard in 180 frame and above motors. In smaller frames, PTC thermistor is added according to customer demand.

The best quality bearings specially selected for Volt Electric Motors are used. The motor shaft has a standardized cylindrical tip. It has a hole and a keyway at the tip. The seals on the shaft are for mechanical protection.

Terminal box and cover are made of aluminum or thermoplastic alloy in three-phase motors, and from thermoplastic material with capacitor housing in single-phase motors.

The standard position of terminal box is on upper drive end in three-phase motors, on upper propeller side in single-phase motors.

Ground connection: It is located inside the terminal box. In addition, the ground connection is also located on the motor housing.

The rotors are pressure-cast aluminum cage rotors. Dynamic rotor balancing is made with a half key.

The noise level is included in the TS EN 60034-9 standard. Vibration intensity: According to TS EN 60034-14 standard, it has “Normal” vibration intensity.

RAL 7031 gray color paint is used, which is not affected by normal industrial environments and suitable for single composition synthetic painting for subsequent applications.

THREE-PHASE INDUCTION MOTOR 2P & 4P					
		and below 3 kW		above 3 kW	
Frequency		50 Hz	60 Hz	50 Hz	60 Hz
Voltage Values	IE2	230V/400V	480V	400V/690V	480V
	IE3	230V/400V	460V/480V	400V/690V	460V/480V

THREE-PHASE INDUCTION MOTOR 6P					
		below 3 kW		and above 3 kW	
Frequency		50 Hz	60 Hz	50 Hz	60 Hz
Voltage Values	IE2	230V/400V	480V	400V/690V	480V
	IE3	230V/400V	460V/480V	400V/690V	460V/480V

Table 2: Voltage and frequency values

Voltage and frequency values of standard motors are shown in Table 2.

STANDARDS AND RECOMMENDATIONS

Standart No.	DESCRIPTION
IEC 60034-1	Rotating electrical machines - Part 1: Rating and performance
IEC 60034-2-1	Rotating electrical machines - Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)
IEC 60034-2-2	Rotating electrical machines - Part 2-2: Specific methods for determining separate losses of large machines from tests - Supplement to IEC 60034-2-1
IEC 60034-5	Rotating electrical machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification
IEC 60034-6	Rotating electrical machines - Part 6: Methods of cooling (IC Code (IEC 34-6:1991)
IEC 60034-7	Rotating electrical machines - Part 7: Classification of types of constructions and mounting arrangements (IM code)
IEC 60034-8	Rotating electrical machines - Part 8: Terminal markings and direction of rotation
IEC 60034-9	Rotating electrical machines - Part 9: Noise limits
IEC 60034-11	Rotating electrical machines - Part 11: Thermal protection (IEC 60034- 11:2004) / Note: Endorsement notice
IEC 60034-12	Rotating electrical machines - Part 12: Starting performance of single - Speed three - Phase cage induction motors
IEC 60034-14	Rotating electrical machines - Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher: Measurement, evaluation and limits of vibration severity
IEC 60034-15	Rotating electrical machines - Part 15: Impulse voltage withstand levels of form - wound stator coils for rotating a.c. Machines
IEC 60034-26	Rotating electrical machines - Part 26: Effects of unbalanced voltages on the performance of three - phase cage induction motors
IEC 60034-27-1	Rotating electrical machines - Part 27 - 1: Off-line partial discharge measurements on the stator winding insulation of rotating electrical machines
IEC 60034-27-3	Rotating electrical machines - Part 27 - 3: Dielectric dissipation factor measurement on stator winding insulation of rotating electrical machines
IEC 60034-27-4	Rotating electrical machines - Part 27 - 4: Measurement of insulation resistance and polarization index on winding insulation of rotating electrical machines
IEC 60034-28	Rotating electrical machines - Part 28: Test methods for determining quantities of equivalent circuit diagrams for three - phase low - voltage cage induction motors
IEC 60034-29	Rotating electrical machines - Part 29: Equivalent loading and superposition techniques - Indirect testing to determine temperature rise
IEC 60034-30-1	Rotating electrical machines - Part 30 - 1: Efficiency classes of line operated AC motors (IE code)
IEC 60027-4	Letter symbols to be used in electric technology - Part 4: Rotating electric machines
IEC 60252-1	AC motor capacitors - Part 1: General - Performance, testing and rating - Safety requirements - Guidance for installation and operation
IEC 60252-2	AC motor capacitors - Part 2: Motor start capacitors
IEC 1680	Acoustics - Test code for the measurement of airborne noise emitted by rotating electrical machines (ISO 1680:2013)
IEC 60085	Electrical insulation - Thermal evaluation and designation
TS EN 50347	General purpose three - Phase induction motors having Standard dimensions and outputs - Frame numbers 56 to 315 and flange numbers 65 to 740
ISO 9001:2015	Quality management systems - Requirements
ISO 14001:2015	Environmental management systems - Requirements with guidance for use
ISO 45001:2018	Occupational health and safety management systems - Requirements with guidance for use

Table 3: Standards and recommendations

TURKEY TSE EN 60034–1	GERMANY DIN VDE 0530 DIN EN 60034	GREAT BRITAIN BS EN 60034	RoHS COMPLIANT
TSE TS EN 600034-1	c UL us E235514	CE	ee

EFFICIENCY CLASSIFICATION OF LOW VOLTAGE MOTORS AS PER TS EN 60034-30

The TS EN 60034-30-1 standard plans to bring together different definitions found in different regions of the world in low voltage motors. It aims to eliminate the difficulties faced by motor manufacturers due to different standards, to enable users to understand products more easily and to access transparent information more easily.

IE (International Efficiency); defines efficiency classes for single-speed and three-phase squirrel cage motors.

These efficiency classes are;

Super Premium Efficiency IE4

Premium Efficiency IE3

High Efficiency IE2

Standard Efficiency IE1

IE4 class induction motors have been added in the TS EN 60034-30-1:2014 standard. It is intended to be 15% more efficient than the IE3 motor. In order to ensure the efficiency of IE4, it is desired to make innovations in the design and material technology of cage rotors.

The regulation calendar for the implementation of the directive establishing a framework for the setting of ecodesign requirements for energy-related products, which was put into effect with the council of ministers decision dated 23/6/2010 and numbered 2010/643, is presented below.

EFFICIENCY APPLICATION CALENDAR

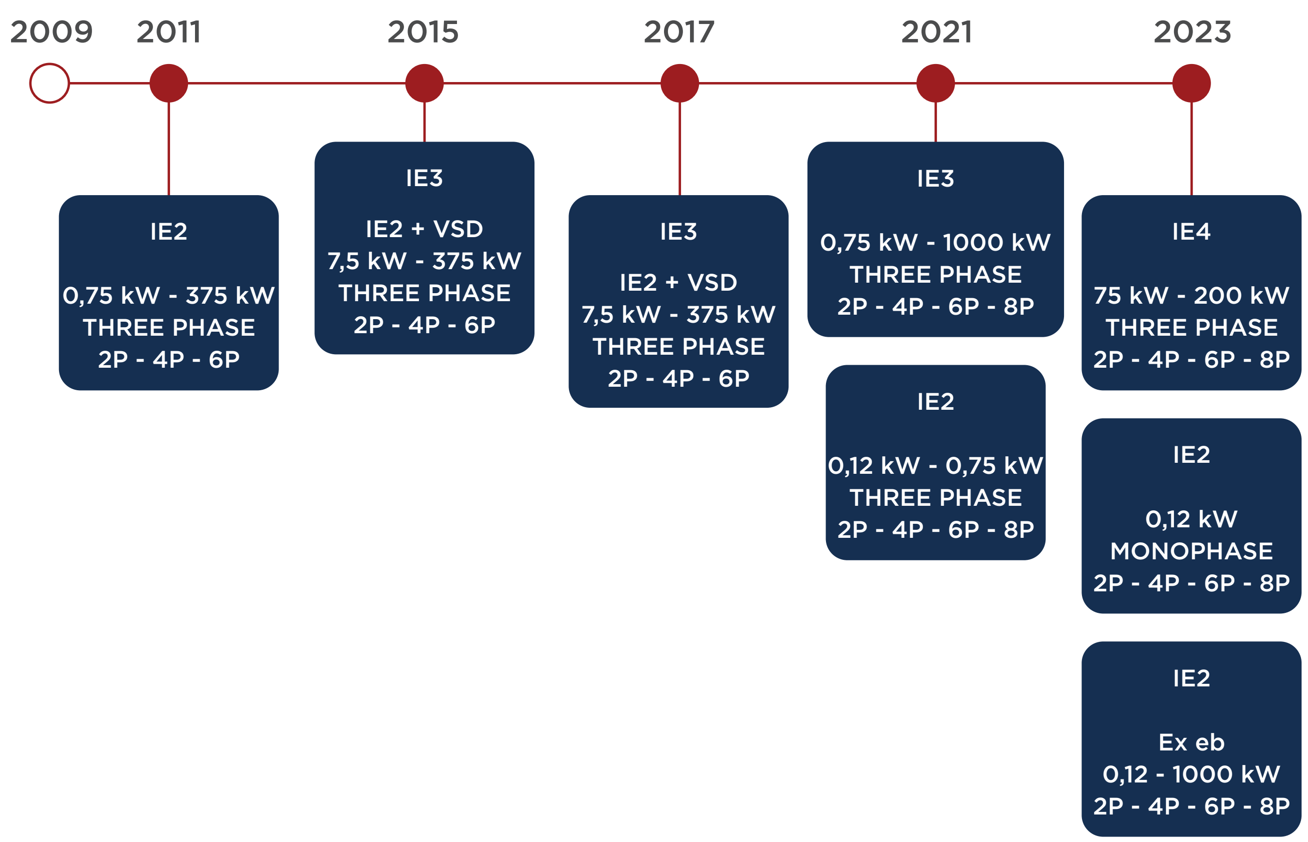


Figure 1: Efficiency Application Calendar

TABLES OF EFFICIENCY CLASS AS PER IEC 60034-30 (50 Hz)

PN kW	50 Hz IE2			50 Hz IE3			50 Hz IE4		
	2/3000	4/1500	6/1000	2/3000	4/1500	6/1000	2/3000	4/1500	6/1000
0,12	53,6	59,1	50,6	60,8	64,8	57,7	66,5	69,8	64,9
0,18	60,4	64,7	56,6	65,9	69,9	63,9	70,8	74,7	70,1
0,2	61,9	65,9	58,2	67,2	71,1	65,4	71,9	75,8	71,4
0,25	64,8	68,5	61,6	69,7	73,5	68,6	74,3	77,9	74,1
0,37	69,5	72,7	67,6	73,8	77,3	73,5	78,1	81,1	78
0,4	70,4	73,5	68,8	74,6	78	74,4	78,9	81,7	78,7
0,55	74,1	77,1	73,1	77,8	80,8	77,2	81,5	83,9	80,9
0,75	77,4	79,6	75,9	80,7	82,5	78,9	83,5	85,7	82,7
1,1	79,6	81,4	78,1	82,7	84,1	81	85,2	87,2	84,5
1,5	81,3	82,8	79,8	84,2	85,3	82,5	86,5	88,2	85,9
2,2	83,2	84,3	81,8	85,9	86,7	84,3	88	89,5	87,4
3	84,6	85,5	83,3	87,1	87,7	85,6	89,1	90,4	88,6
4	85,8	86,6	84,6	88,1	88,6	86,8	90	91,1	89,5
5,5	87	87,7	86	89,2	89,6	88	90,9	91,9	90,5
7,5	88,1	88,7	87,2	90,1	90,4	89,1	91,7	92,6	91,3
11	89,4	89,8	88,7	91,2	91,4	90,3	92,6	93,3	92,3
15	90,3	90,6	89,7	91,9	92,1	91,2	93,3	93,9	92,9
18,5	90,9	91,2	90,4	92,4	92,6	91,7	93,7	94,2	93,4
22	91,3	91,6	90,9	92,7	93	92,2	94	94,5	93,7
30	92	92,3	91,7	93,3	93,6	92,9	94,5	94,9	94,2
37	92,5	92,7	92,2	93,7	93,9	93,3	94,8	95,2	94,5
45	92,9	93,1	92,7	94	94,2	93,7	95	95,4	94,8
55	93,2	93,5	93,1	94,3	94,6	94,1	95,3	95,7	95,1
75	93,8	94	93,7	94,7	95	94,6	95,6	96	95,4
90	94,1	94,2	94	95	95,2	94,9	95,8	96,1	95,6
110	94,3	94,5	94,3	95,2	95,4	95,1	96	96,3	95,8
132	94,6	94,7	94,6	95,4	95,6	95,4	96,2	96,4	96
160	94,8	94,9	94,8	95,6	95,8	95,6	96,3	96,6	96,2
200 - 1000	95	95,1	95	95,8	96	95,8	96,5	96,7	96,3

Table 4: Efficiency class and values according to IEC 60034-30 (50 Hz)

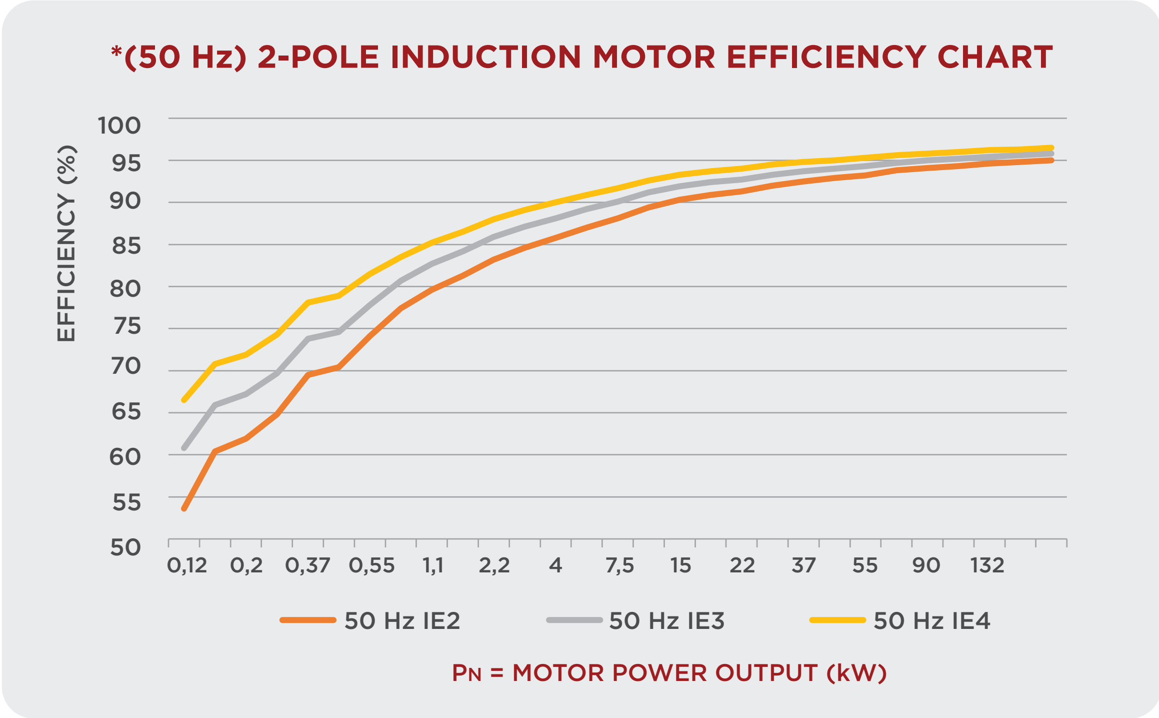


Chart 1: (50 Hz) 2-Pole Induction Motor Efficiency Chart

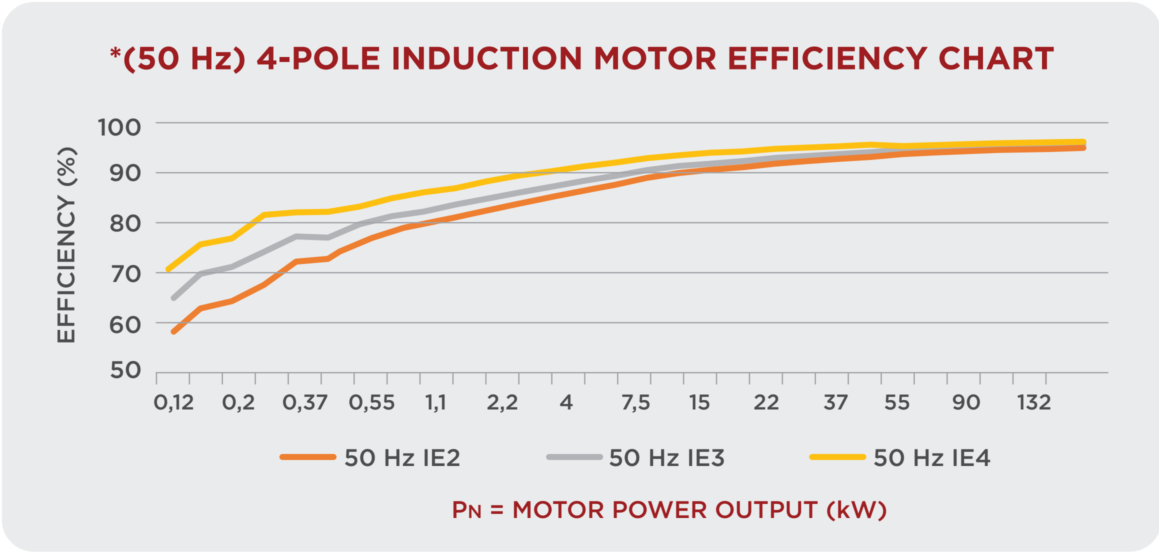


Chart 2: (50 Hz) 4-Pole Induction Motor Efficiency Chart

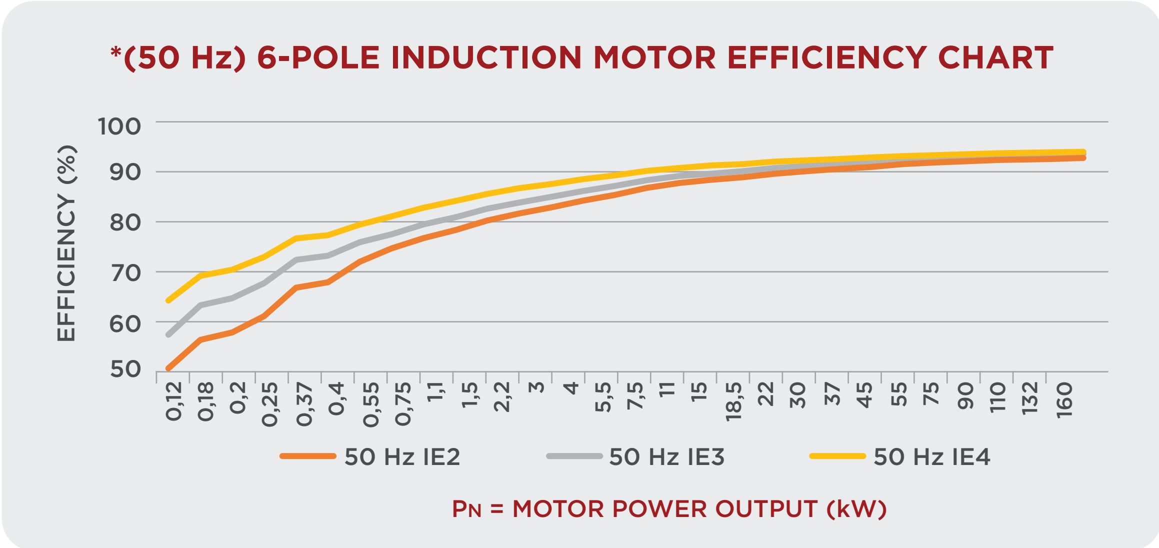


Chart 3: (50 Hz) 6-Pole Induction Motor Efficiency Chart

TABLES OF EFFICIENCY CLASS AS PER IEC 60034-30 (60 Hz)

PN kW	60 Hz IE2			60 Hz IE3			60 Hz IE4		
	2/3000	4/1800	6/1200	2/3000	4/1800	6/1200	2/3000	4/1800	6/1200
0,12	59,5	64	50,5	62	66	64	66	70	68
0,18	64	68	55	65,6	69,5	67,5	70	74	72
0,25	68	70	59,5	69,5	73,4	71,4	74	77	75,5
0,37	72	72	64	73,4	78,2	75,3	77	81,5	78,5
0,55	74	75,5	68	76,8	81,1	81,7	80	84	82,5
0,75	75,5	78	73	77	83,5	82,5	82,5	85,5	84
1,1	82,5	84	85,5	84	86,5	87,5	85,5	87,5	88,5
1,5	84	84	86,5	85,5	86,5	88,5	86,5	88,5	89,5
2,2	85,5	87,5	87,5	86,5	89,5	89,5	88,5	91	90,2
3,7	87,5	87,5	87,5	88,5	89,5	89,5	89,5	91	90,2
5,5	88,5	89,5	89,5	89,5	91,7	91	90,2	92,4	91,7
7,5	89,5	89,5	89,5	90,2	91,7	91	91,7	92,4	92,4
11	90,2	91	90,2	91	92,4	91,7	92,4	93,6	93
15	90,2	91	90,2	91	93	91,7	92,4	94,1	93
18,5	91	92,4	91,7	91,7	93,6	93	93	94,5	94,1
22	91	92,4	91,7	91,7	93,6	93	93	94,5	94,1
30	91,7	93	93	92,4	94,1	94,1	93,6	95	95
37	92,4	93	93	93	94,5	94,1	94,1	95,4	95
45	93	93,6	93,6	93,6	95	94,5	94,5	95,4	95,4
55	93	94,1	93,6	93,6	95,4	94,5	94,5	95,8	95,4
75	93,6	94,5	94,1	94,1	95,4	95	95	96,2	95,8
90	94,5	94,5	94,1	95	95,4	95	95,4	96,2	95,8
110	94,5	95	95	95	95,8	95,8	95,4	96,2	96,2
150	95	95	95	95,4	96,2	95,8	95,8	96,5	96,2
185	95,4	95	95	95,8	96,2	95,8	96,2	96,5	96,2
220 - 335	95,4	95,4	95				96,2	96,8	96,5
375 - 1000	95,4	95,8	95				96,2	96,8	96,5

Table 5: Efficiency class and values according to IEC 60034-30 (60 Hz)

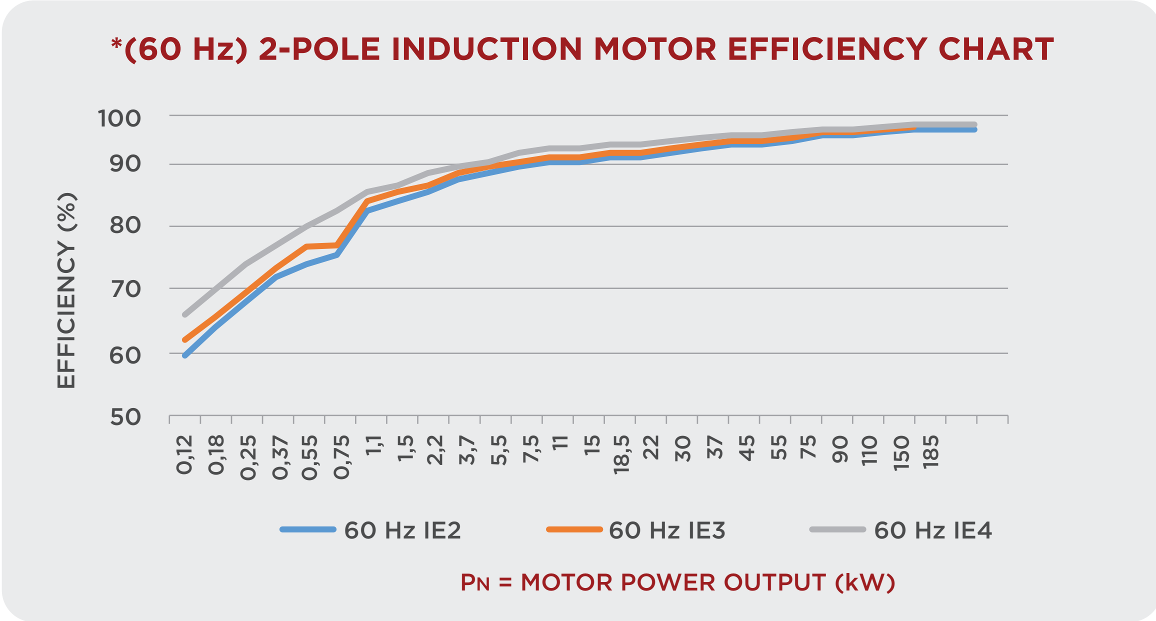


Chart 4: (60 Hz) 2-Pole Induction Motor Efficiency Chart

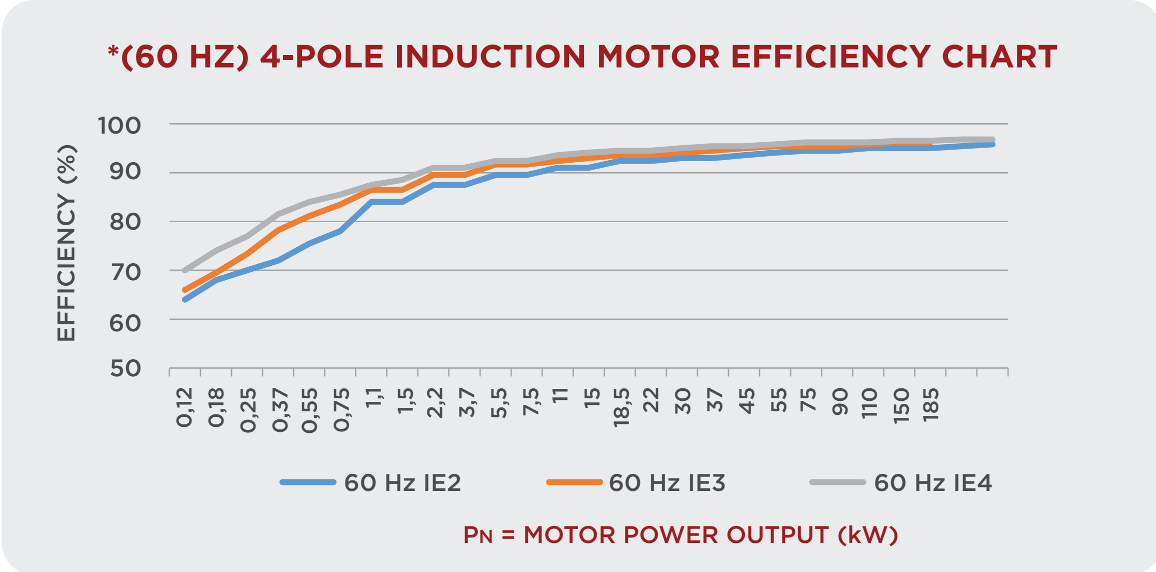


Chart 5: (60 Hz) 4-Pole Induction Motor Efficiency Chart

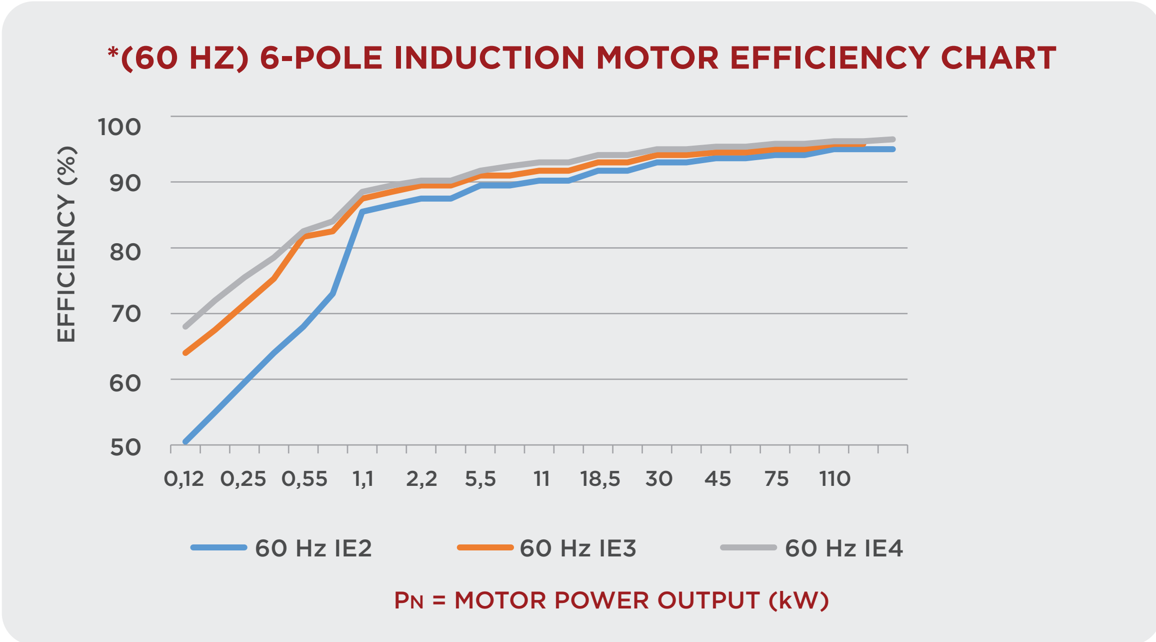


Chart 6: (60 Hz) 6-Pole Induction Motor Efficiency Chart

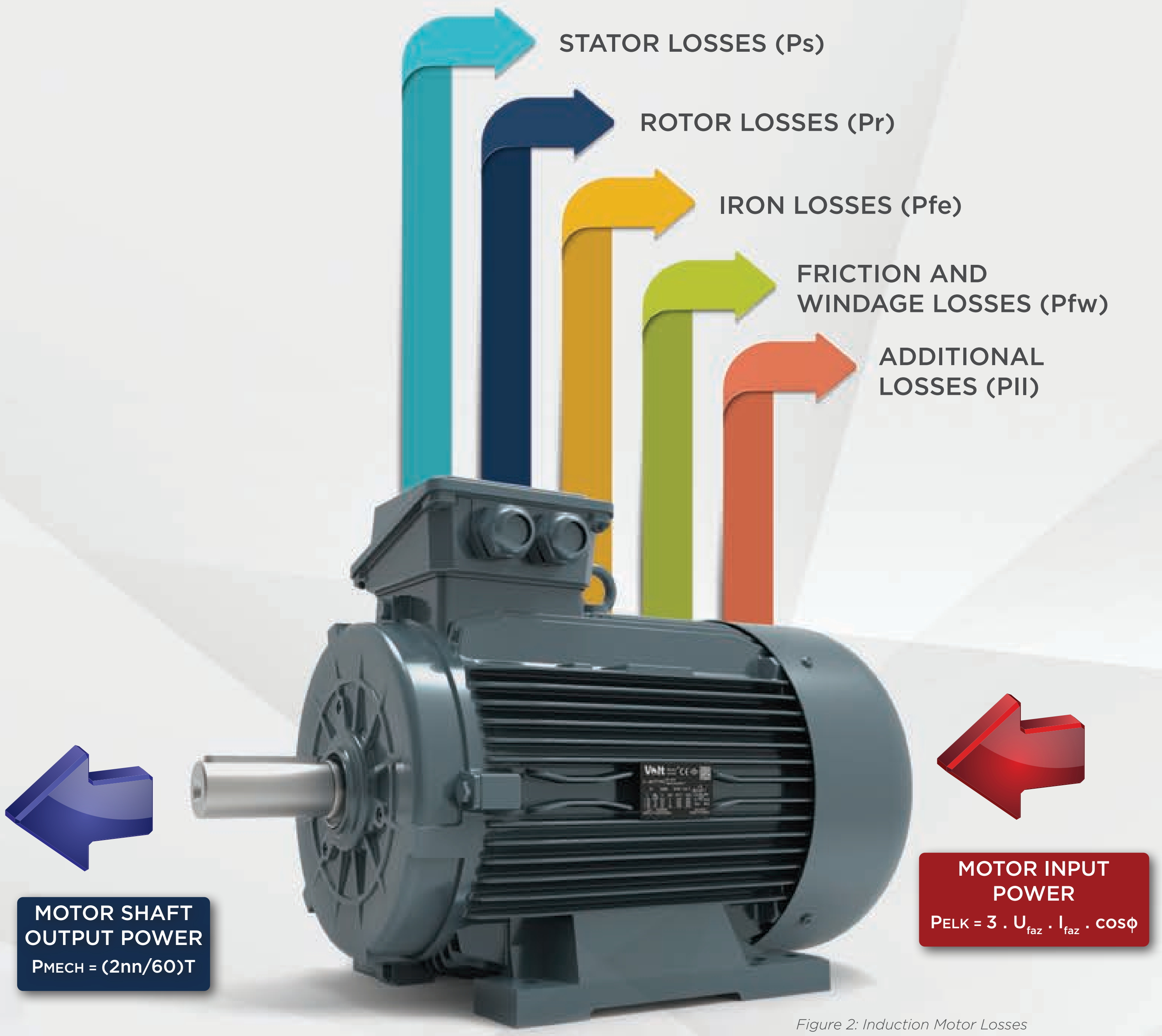


Figure 2: Induction Motor Losses

TO CALCULATE INDUCTION ELECTRIC MOTOR LOSSES

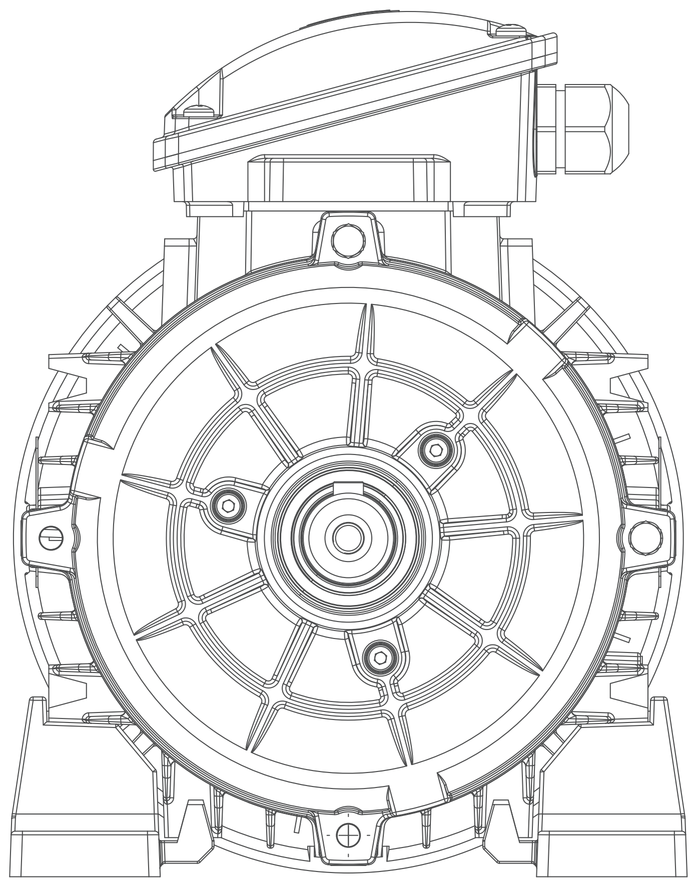
- **Direct method**
- **Indirect method**
- **PII (supplemantary losses) can be found in 3 different ways as follows.**

These methods are left to the discretion of the manufacturer.

- It is found by calculation as a result of load tests performed at different voltages and loads.
- For 0.1-1000 kW motors, it is taken as 2.5% - 1.0% of the motor input power at rated load.
- It is found by calculation method with alternative indirect method. The values at ambient temperature of 25°C (or the actual ambient temperature value) and after the winding temperature reaches thermal stability in the heat test of the motor are used in the calculation of the resistance values of the stator and rotor windings (for wound-rotor motor).

Since the additional losses losses are measured more precisely with the defined special methods and measurement and calculation methods, it has been observed that the supplemantary losses are more than 0.5% of the input power. The efficiency values calculated according to the new standard may be lower than those calculated according to the old standard.

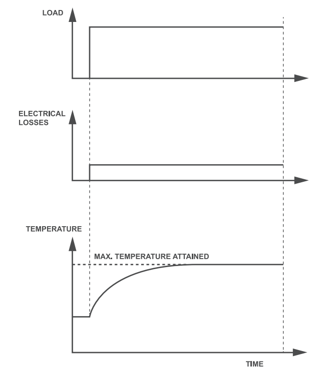
TS EN 60034-2-1: Along with the new calculation method in the 2014 standard, new efficiency values are declared in IE1, IE2, IE3 and IE4 efficiency classes in TS EN60034-30 standard.



TYPE OF DUTIES

S1
Continuous duty type

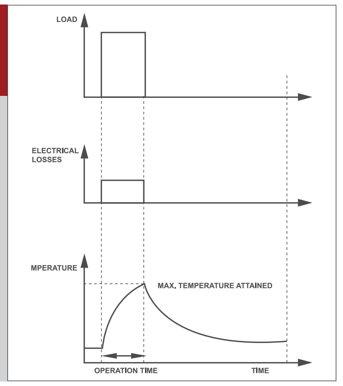
The motor operates under constant load until the thermal equilibrium is reached. If the rated type is not specified for the motor, it should be assumed to be the continuous duty type S1. These types of motors are used in pump, fan, ventilation and compressor applications.



S1 duty type-Continuous duty

S2
Short-time duty type

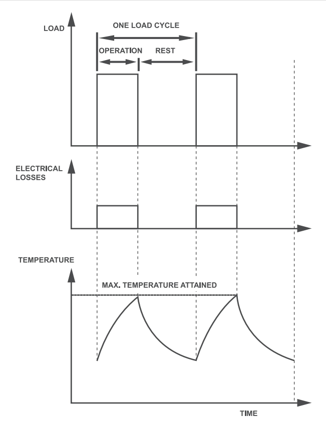
The motor operates under constant load until the thermal equilibrium is reached. During stopped time periods the motor cools down to ambient temperature. The operation times of 10, 3060 and 90 minutes are recommended. Dam covers, sirens and some cranes are examples of applications.



S2 duty type-Short-time duty

S3
Intermittent periodic duty type unaffected by starting time

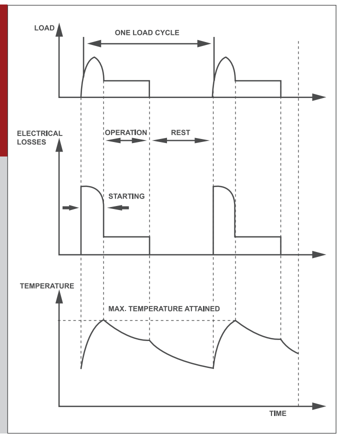
The operation times consist of operation with constant load followed by a time at rest. The starting current does not affect the temperature rise. Unless otherwise stated, the time of operation is 10 minutes. The relative time of operation can be 15%, 25%, 40% and 60% of the time. Motor valve systems and wire drawing machines are classified into 53 duty type.



S3 duty type-Intermittent periodic duty

S4
Intermittent periodic duty type affected by starting time

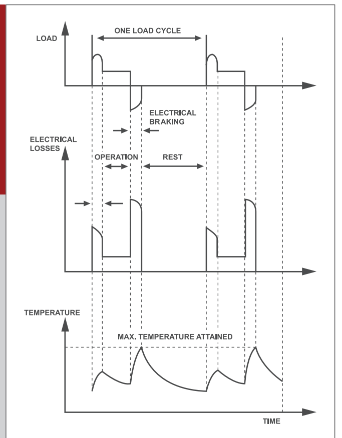
This system consists of identical duty cycle series. Each duty cycle consists of long starting time, a time of operation at constant load and a significant time at rest. Due to the very short time of operation, thermal equilibrium cannot be reached. Overhead cranes, typical cranes and lifts are examples of this type of application.



S4 duty type-Intermittent periodic duty with starting

S5
Intermittent periodic duty type affected by starting time and electric braking.

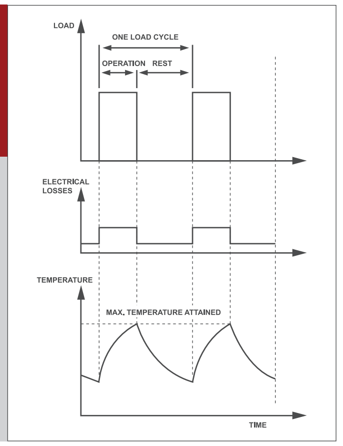
This system consists of identical duty cycle series. Each duty cycle consists of starting time, a time of operation at constant load, a rapid electric braking and a significant time at rest.



S5 duty type-Intermittent periodic duty with electric braking

S6
Continuous operation periodic duty type with intermittent load

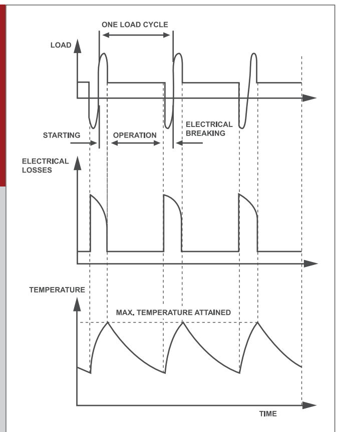
This system consists of identical duty cycle series. Each cycle consists of two parts. One is operation under constant load and the other is operation without load. Due to the very short time of operation, thermal equilibrium cannot be reached. Unless otherwise stated, the time of operation is 10 minutes. The relative time of operation can be 15%, 25%, 40% and 60% of the time. Conveyors, machining tools and hand tools are among 56 duty types.



S6 duty type-Continuous operation with intermittent load

S7
Continuous-operation periodic duty type affected by the starting time and electric braking

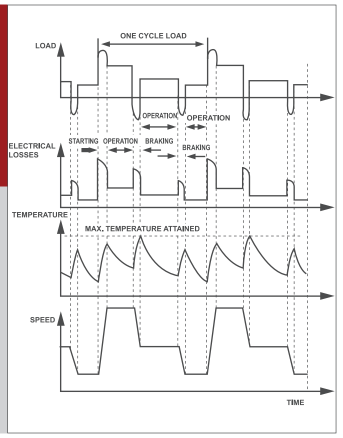
This system consists of identical duty cycle series. Each duty cycle consists of starting time, a time of operation at constant load and an electric braking. The braking method is too short to achieve thermal equilibrium.



S7 duty type-Continuous-operation periodic duty with electric braking

S8
Continuous-operation periodic duty with related repetitive load/ speed change

This system consists of identical duty cycles. Each cycle consists of a time of operation under constant load (according to a predetermined speed rotation) and one or more time of operation under other loads (according to different speed rotations). The period of duty cycle is too short to reach thermal equilibrium. This duty type is used in pole-changing motors. Applications that require different loads and different speeds fall into the S8 duty type.



S8 duty type - Continuous operation periodic duty with related load/speed changes

Figure 3: Types of duties in induction motor

PROTECTION CLASS

According to the TS EN 60034-5 standard, our motors are protected against solid and liquid substances. Our standard motors are produced in IP55 protection class. They are also produced to order in IP56, IP65 and IP66 protection limits. As shown in Table 6, in the IP (Ingress Progress) sequence, the first digit describes the protection against solids, while the second digit indicates protection against liquids.

IP 5 5

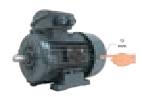
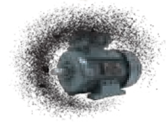
	Protection Against Solids			Protection Against Liquids	
	Not protected	0	0	Not protected	
	Protection against objects greater than 50 mm	1	1	Protection against vertically falling water	
	Protection against objects greater than 12 mm	2	2	Protection against water falling as a spray at any angle up to 15° from the vertical	
	Protection against objects greater than 2.5 mm	3	3	Protection against water falling as a spray at any angle up to 60° from the vertical	
	Protection against objects greater than 1 mm	4	4	Protection against water splashes from all directions.	
	Dust protection	5	5	Protection against water sprayed from all directions	
	Full protection against dust	6	6	Protection against strong water sprayed from all directions	

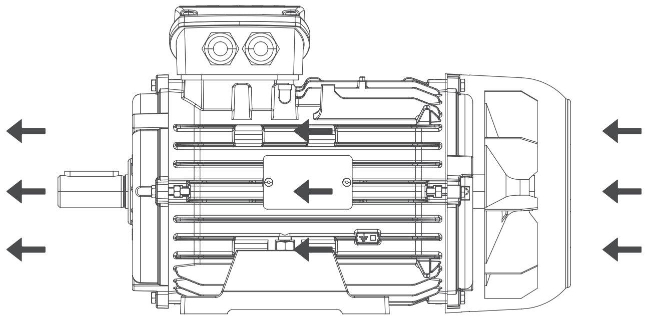
Table 6 Protection classes

MAIN COOLING TYPES AS PER TS EN 60031-6

Cooling is the transmission of the losses that occur in the motor and turn into heat to the external environment. The aim is to keep the temperature of insulating materials below the limit values. According to the TS 3210 EN 60034-6 standard, the cooling type applied in electrical machines is indicated with numbers and letters between "1-9" following the IC (International Cooling) code letters. Our motors with frame size between 56-355 are cooled from the outer surface by a cooling fan working inside the protection cover. The cooling type is IC 411 as Volt Electric Motors are fully enclosed fan cooled motors. IC410 Cooling type motors are also produced upon special requests. In Figure 4, the most used cooling types are given as an example of the TS 3210 EN 60034-6 standard.

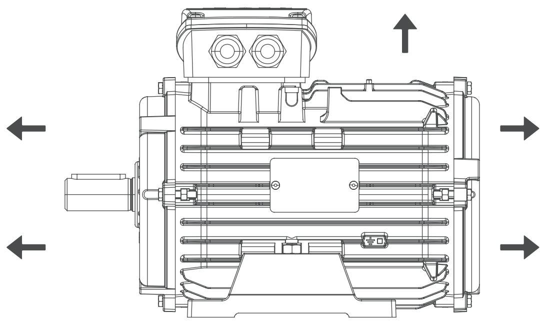
COOLING TYPES

IC411



The cooling air is supplied by a plastic fan connected to the motor shaft and operates in a perforated steel plate housing. The cooling process takes place outside the completely enclosed surface of the motor.

IC410



The cooling process takes place freely from the frame surface, without the propeller.

Figure 4: Cooling types

TYPE OF CONSTRUCTION AND INSTALLATION

The heights (H) from the base to the shaft axis are standardized in foot mounted induction motors. These axis heights define the frame size of the motor. In the same frame size, the longitudinal distance (B) of the foot fixing holes are made in different lengths (S, M, L) to create different "B" sizes of frames.

S - Short frame length
M - Medium frame length
L - Long frame length

Standardized construction sizes and standardized frame dimensions are shown in TS EN 60072-1 and TS EN 50347 standards. Frame dimensions and corresponding (H) axis heights are shown in Table 7.

FRAME SIZE

IEC Frame Size H (mm)

56	63	71	80	90	100	112
132	160	180	200	225	250	280
315	355	400	450	500	560	630
710	800	900	1000	1120	1250	1400

Table 7: Frame size

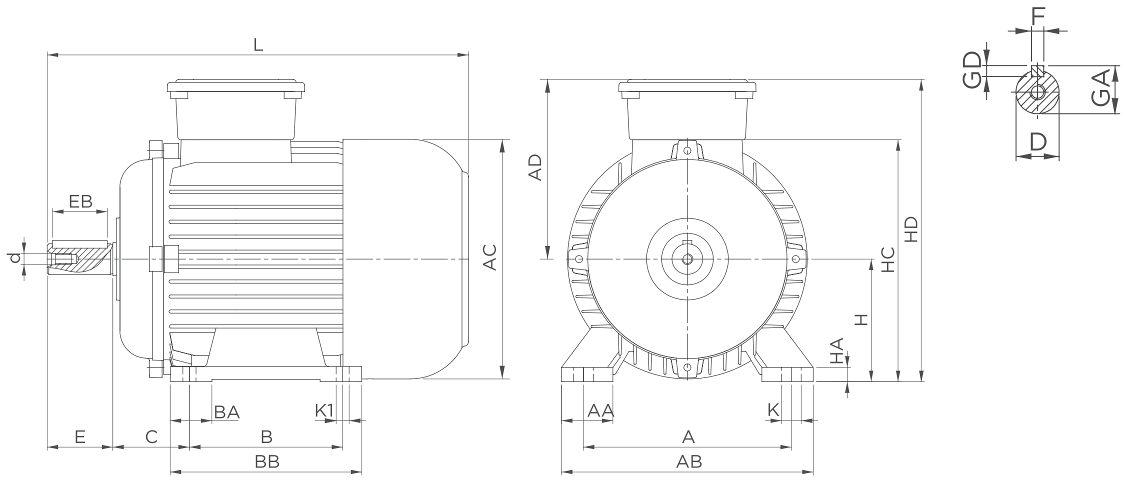
Three Phase Volt Electric Motors
It is produced in frame sizes 56- 63 - 71 - 80 - 90S - 90L - 100 - 112 - 132S - 132M - 160M - 160L - 180L - 180M - 200L - 225S - 225M- 250M - 280M - 315S-- 315M - 315L - 355.

Standardized Dimensions for Induction Motors:
In induction motors; powers, axis heights (frame sizes) and some external dimensions are standardized. Thanks to these standards, the interchangeability of motors and new project work have become easier. When ordering a motor, it is sufficient to specify the operating voltage, power, rotational speed, frame size, protection type and construction of the motor. The six basic standardized sizes prescribed for induction motors under IEC 60072-1 are:

1. Axis height H (frame size or construction size)
2. The transverse and longitudinal distances of the fixing holes A,B
3. The distance from the shaft shoulder to the axis of the fixing hole in the nearest leg, C
4. Diameter of shaft end, D
5. Length of shaft end from shaft shoulder, E
6. Diameter of fixing hole, K

TS EN 50347 covers standardized dimensions, key and keyway dimensions, power values, standard dimensions on flanges for flanged motors.

Type of Construction (IM):
The construction types of electric machines are standardized. According to TS 3211 EN 60034-7, construction types and mounting arrangements are standardized.



There are 5 main types of construction:
1. Foot mounted types (B3)
2. Foot and flange mounted types (B35 and B34)
3. Without foot, flange mounted types (B5 and B14)
4. Foot mounted, without endshield types (B15)
5. Without foot, without endshield types (B9)

Commonly used types are foot mounted, foot & flange mounted and without foot & flange mounted types.

The keyway width is F, the keyway is GD, the keyway depth is GE, the distance from the keyway to the shaft surface on the opposite side of the axis is GA.

The classification of the construction types and mounting arrangements of the motors was made in the TS 3211 EN 60034-7 section and abbreviated as IM (International Mounting). The symbolization of this section consists of two separate codes.

Code I: It covers only the motors with bearing shields and one shaft end. The letter B denotes horizontal shaft motors, while the letter V denotes vertically mounted motors. These types of motors (with bearing shields and one shaft end) are indicated by the letters B or V followed by a number. Some of the most used are listed below.

Code II: This section covers all electric motors designed for general and private use.
It is classified with 4 numbers following the letters IM. The meanings of the numbers are given below.
It is shown in Table 26.

The **1st** digit indicates the class of the construction type, 2nd and 3rd digits the installation (assembly) order and **4th** digit indicates the shaft end.

STANDARD ROTATION DIRECTION

When the shaft end of the 3-phase induction motor is viewed from the pulley (drive-D) end, the clockwise rotation direction is the standard rotation direction of the motor. When it is desired to change the rotation direction, it is sufficient to change the place of two phases.

When the shaft end of the 1-phase induction motor is viewed from the pulley (drive-D) end, counterclockwise rotation is the standard rotation direction of the motor.

Figure 5: 3 Phase Induction motor return line
Figure 6: 1 Phase Induction motor return line

TERMINAL SYMBOLS OF INDUCTION MOTORS

In electric machines, the terminals are marked with standard symbols to facilitate the correct and short connection of the terminals. The symbols determined according to TS EN 60034-8 are used in Volt Electric Motors. These symbols are shown in Table 8.

Rank No	Description	Symbols According to IEC 60034-8
1	Three Phase Power	L1 - L2 - L3
2	Three Phase and Single Phase Power Neutral Wire	N
3	Single Phase Power	L - N
4	Three Phase, Single Speed Stator Winding (6 Terminals)	Input U1 - U2 V1 - V2 W1 - W2 Output
5	Three Phase, Single Speed Stator Winding (3 Terminals)	U - V - W
6	Single Phase Motor Winding Main Winding, Auxiliary Winding	U1 - U2 Z1 - Z2
7	Three Phase, Two Speed Dahlander Winding	1U - 1V - 1W (High) 2U - 2V - 2W (Low)
8	Three Phase, Two Speed PAM Winding or Two Separate Windings	8U - 8V - 8W 6U - 6V - 6W
9	Three Phase Rotor Winding	K-L-M

Table 8: Terminal symbols of induction motors

SURFACE SOUND PRESSURE LEVEL UdB(A)

The limits of the noise level in general purpose electric motors are specified in TS EN 60 034-9. According to this standard, A-sound power level LWA limit values are given in Table 8 and Table 9. There is a correlation between the surface sound pressure level LPA and LWA in dB (A) unit as LpA= LWA-10log (-to).

LPA represents the sound pressure level in the free field located on the reflecting plane at a distance of 1 meter from the motor surface, and LWA represents the sound power level S0=1 m2 (reference area) determined according to this standard.

As can be seen in Table 9 and Table 10, the noise level S in Volt Electric Motors, that is, in the area of the measuring surface, is well below the limit values according to the standard. The surface sound pressure level in dB (A) and the average of the sound pressure measurements made at different locations at a distance of 1 meter from the LpA motor surface are given in Table 11.

SURFACE SOUND PRESSURE LEVEL UdB(A)						
Frame Type	2 Pole dB(A)		4 Pole dB(A)		6 Pole dB(A)	
	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
56	42	47	40	43	*	*
63	52	57	41	44	*	*
71	54	59	45	48	43	46
80	58	63	49	52	46	49
90	62	67	54	57	53	56
100	66	71	55	58	56	59
112	68	73	58	61	58	61
132	69	74	62	65	61	64
160	70	75	63	66	63	66
180	77	82	67	70	69	72
200	78	83	70	73	70	73
225	81	86	71	74	66	69
250	82	87	72	75	67	70
280	84	89	73	76	68	71
315	87	92	76	79	72	75
355	87	92	87	90	72	75

Table 9: Measurement results according to frame types

NO-LOAD SOUND POWER LEVEL LWA ACCORDING TO TS EN 60034-9 (dB)						
Output Power, Pn kW	2 Polep		4 Pole		6 Pole	
	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
1,0<PN≤2,2	78	85	70	71	70	71
2,2<PN≤5,5	83	88	73	76	73	76
5,5<PN≤11	88	91	78	81	77	80
11<PN≤22	91	94	85	88	81	84
22<PN≤37	93	100	88	91	84	87
37<PN≤55	95	101	91	95	87	91
55<PN≤110	97	104	95	98	91	95
110<PN≤220	100	107	99	102	96	99
220<PN≤400	103	109	102	105	98	101
440<PN≤1000	105	110	105	108	99	102

Table 10: no-load sound power level LWA according to TS EN 60034-9 (dB)

SOUND POWER LEVEL LWA AT RATED LOAD (dB)						
Output Power, Pn kW	2 Pole		4 Pole		6 Pole	
	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
1,0<Pn≤2,2	80	87	75	76	77	78
2,2<Pn≤5,5	85	90	78	81	80	83
5,5<Pn≤11	90	93	83	86	84	87
11<Pn≤22	93	96	89	92	87	90
22<Pn≤37	95	102	92	95	90	93
37<Pn≤55	97	103	94	98	92	96
55<Pn≤110	101	108	101	104	100	104
110<Pn≤220	102	109	102	105	100	104
220<Pn≤400	103	109	102	105	98	101
400<Pn≤1000	107	112	107	110	102	105

Table 11: Sound power level LWA at rated load (dB)

INSULATION CLASSES

The heating characteristic of Volt Electric Motors is in class B thanks to its high efficiency insulation materials and design. The stator windings, consisting of double-layer enamel-coated copper and aluminum conductors, are in class H. Full insulation of the phase windings (in each groove) and the winding heads is provided by a high quality H class varnish impregnation system (total 180 °C). Other insulation materials are in class F. Thus, a winding structure that can withstand up to 155 °C is provided. The standard predicted maximum temperature rise is 105 °K at an ambient temperature of 40 °C and a maximum altitude of 1000 m. The table shows the classification of insulation materials according to the heat they withstand.

UL (Underwriters Laboratories Inc.) certification is an approval of products by UL, an independent product safety certification company. UL is an independent product safety certification company based in the United States, mainly focused on safety. Volt Electric Motors is able to offer UL approved products to both standard products and OEM customers upon request.

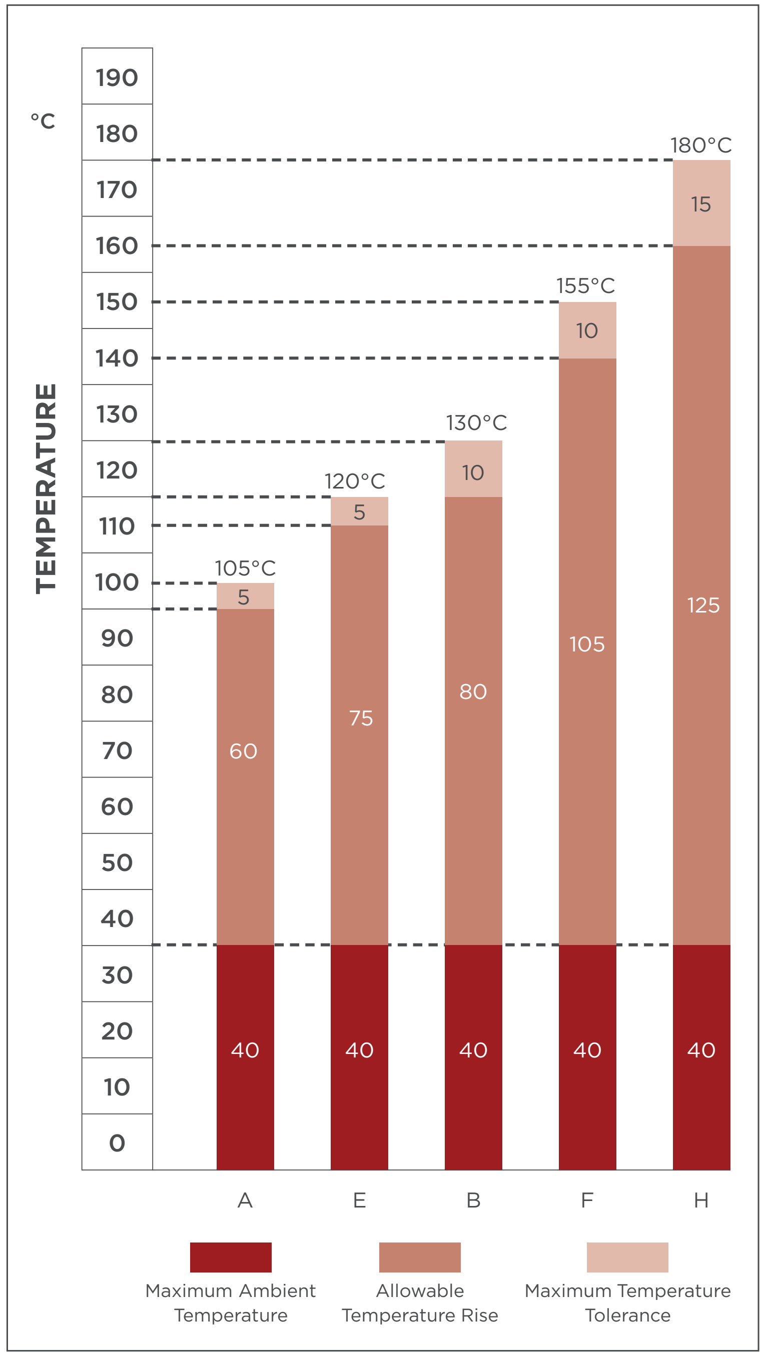


Figure 7: Table of insulation classes

Maximum Permissible Values $t_{ambient}$		Unit	Insulation Classes				
			A	E	B	F	H
Total Winding Temperature	$(t_{ambient} + \Delta t + t_{tolerance})$	°C	105	120	130	155	180
Winding Temperature Increase	(Δt)	K	60	75	80	105	125
Ambient Temperature	$(t_{ambient})$	°C	40	40	40	40	40
Tolerance	$(t_{tolerance})$	K	5	5	10	10	15

Table 12: Insulation Classes

VIBRATION CLASSES AS PER IEC 60034-14

Permissible vibration intensities have been determined by IEC 60034-14 standards, and these values given in Table 13 constitute the upper limits recommended by motor manufacturers. According to this standard, three different vibration intensity levels are determined. Vibration levels of Volt Electric Motors are within normal limits and meet the provisions of the standard. All our rotors are dynamically balanced with a half key.

Vibration Level	Shaft Height (mm)	56 ≤ H ≤ 132			132 < H ≤ 280			H > 280		
	Support	Displace-ment µm	Velocity mm/s	Accel-eration m/s2	Displace-ment	Velocity	Accel-eration	Displace-ment	Velocity	Displace-ment
A	Free Suspension	25	1,6	2,5	35	2,2	3,5	45	2,8	4,4
	Rigid Mounting	21	1,3	2	29	1,8	2,8	37	2,3	3,6
B	Free Suspension	11	0,7	1,1	18	1,1	1,7	29	1,8	2,8
	Rigid Mounting				14	0,9	1,4	24	1,5	2,4

Table 13: Vibration classes as per IEC 60034-1429

Rating "A" applies to machines without special vibration conditions.

Grade "B" applies to machines with special vibration conditions. Rigid mounting is not accepted for machines with a shaft height of less than 132 mm.

The displacement/velocity and velocity/acceleration interaction frequencies are respectively 10 Hz and 250 Hz.

WORKING CONDITIONS

Volt Electric Motors are manufactured at 40°C ambient temperature, at altitudes up to 1000 m above sea level and in S1 continuous operation type. Since the performance of the motor will decrease at values exceeding this temperature and altitude, the rated power of the motor should be reduced according to the given ratios.

Temperature Controlled Protection Elements:

The protection of motors is provided by fuses, thermal relays, thermal magnetic switches and thermistors. Fuses act as protection against short circuits of motors, cables, relays and switches, if used, soft starters and speed controllers, but they alone cannot protect the motor against overload and overheating. Thermal relays and thermal magnetic switches are adjusted to the rated current of the motor, they protect the motor by breaking the circuit in case of overload and overcurrent. However, some factors other than overloading can also cause the motor to burn out. In cases such as staying in two phases, decreasing or cutting of cooling air, extreme ambient temperature or uneven ambient conditions (such as low ambient temperature where the thermal relay is located, high ambient temperature where the motor is located), working at high altitude, excessive starting/stopping, long starting and braking, the thermal relay may not provide protection even though the stator winding temperatures rise to the permissible limit values. In such cases, the winding temperatures of the motor must not be allowed to rise above the prescribed values. The safest protection for this purpose is temperature-controlled protection.

In temperature-controlled protection, two main types of protection elements are used:

•Bimetal circuit breakers (microthermostats)

•Semiconductor temperature sensors (PTC thermistors)

Micro Thermostats:

They are bimetal circuit breakers with two or three elements connected in series. They open the circuit above the limit temperature. And they close below the limit temperature. There are NC (Normally Close) and NO (Normally Open) contact types. It is selected according to the insulation class of the motor and the highest temperature limit value allowed for the windings. The stator is placed between the phase windings. Thermostat leads are brought to the terminal board of the motor. A monotype set of thermostats is used for every power motor.

Micro thermostat protection terminals are connected in series with the contactor coil circuit that controls the motor's energy contactor. The bimetallic circuit breaker opens if the temperature in the motor windings rises above the limit value. The energy contactor opens and the motor stops since the thermostat circuit is connected in series with the motor's energy contactor coil circuit. Volt Electric Motors places micro thermostat elements on motor windings upon special order.

PTC (Positive Temperature Coefficient) Thermistor and Relay:

PTC thermistors are electronic circuit elements whose electrical resistance increases as the temperature of the environment or the contact surface increases. They are a thermally sensitive semiconductor resistors. Electrical resistances increase at a certain temperature. The temperature at which the resistances rise very suddenly is called the "nominal trip temperature" (NAT). The nominal trip temperature is selected according to the insulation class of the motor to be protected and the permissible limit temperature value. There is monotype set and relay for every power motor. It is quite economical in large powerful motors.

Set of PTC thermistor elements are placed between the stator windings of the motor. The PTC relay is located on the motor control panel. Relay connection may be different according to the manufacturers. The relay controls the power contactor of motor. The thermistor elements give the relay a warning signal close to the permissible limit temperature and an open signal at the permissible limit temperature. The relay that receives the open signal starts to operate and opens the energy contactor. Thus, it protects the windings from burning, except for sudden overcurrent rise and sudden overvoltage change.

3 PTC thermistors, one for each 3 phases, are used in the stator windings as standard in the frames of 180 and above in Volt Electric Motors PTC thermistor or bimetal thermostat can be used in smaller frames, depending on the customer's request.

Our single-phase motors are manufactured according to a rated voltage of 220 volts and a frequency of 50 Hz as standard. Our three-phase motors are manufactured according to rated voltages of 380V and 400V and a frequency of 50 Hz, upon special request, production is made according to voltages from 480V to 660V and frequencies of 50-60 Hz. Variations of ±5% in rated voltage and ±2% in frequency do not cause a significant change in motor power. The temperature value of the continuous operation motors at the lower and upper limit values of the permissible voltage change can exceed the permissible temperature increase limit by up to 10K according to the winding insulation class. In Table 14, we can see how ±10% at rated voltage and ±5% at rated frequency affect the electrical performance values of the motor (the effects of voltage and frequency differences on motor performance).

Winding Heater Tape

In the stator windings of electric motors, humidity may occur depending on the working conditions and ambient conditions of the motor. Generally, when the motor stops working for a certain period of time, the motor's internal temperature rises and during the cooling phase of the motor, humid air can enter from the outside through the felts on the shaft through the low pressure formed around the winding. This may adversely affect the winding insulation performance. Anti-condensation heater tape should be used to prevent this from happening when the motor is used in high humidity ambient conditions. These tapes, placed in the tubing on the winding, can be supplied externally to 220V or 400V and produce energy from 25 watts to 200 watts, preventing the humidity formed in the motor from condensing and damaging the windings.

Choosing the Motor Connection Type

Drive Supply Voltage	Motor Winding Details	Suitable Connection Type
Single-phase 220V - 230V	230VΔ / 400VY	Δ (DELTA)
	220VΔ / 380VY	
	380VΔ / 660VY	NOT CONNECTED!
	400VΔ / 690VY	
Three-phase 380V - 400V	230VΔ / 400VY	Y (STAR)
	220VΔ / 380VY	
	380VΔ / 660VY	Δ (DELTA)
	400VΔ / 690VY	

Table 14: Choosing the motor connection type

PWM (Pulse Width Modulation): Today, most of the frequency inverters used in industrial facilities work with the PWM technique. The drive output voltage waveform consists of a series of square wave signals of constant amplitude but variable duration.

Switching Frequency (Carrier Frequency/PWM Frequency): The number of switching elements per unit time is also called the carrier frequency. As the carrier frequency increases, the acoustic noise decreases as the vibrations at frequencies that can be perceived by the human ear (20 Hz - 20 kHz) decrease in the motor. However, the losses in the semiconductor elements increase and the drive overheats.

As the Switching Frequency Increases;

- Sound decreases,
- Voltage rise rate (du/dt) increases,
- Voltage increases between the neutral and the grounding conductors,
- Electromagnetic noise increases.

Bearing Currents: In drive operated motors, currents called neutral currents flow through the bearings. It is recommended to use isolated bearings and shaft grounding to prevent these currents, especially for large motors.

Cable Distance: The cable length between the drive and the motor should be a maximum of 10 meters. Du/dt filter should be used when the cable length is required to be longer.

Suitability of Motors for Use with the Drive

The voltage applied to the motor burns due to the impedance difference in the cable between the motor winding and the drive.

It increases the voltage at the motor terminals in the given time.

The voltage peak value seen at the motor terminals in the given time should not exceed the A curve for motors with a rated voltage up to 500V and the B curve for motors with a rated voltage between 500V and 690V. The A and B curves determined in accordance with IEC 60034-25 are shown in Figure 8 below.

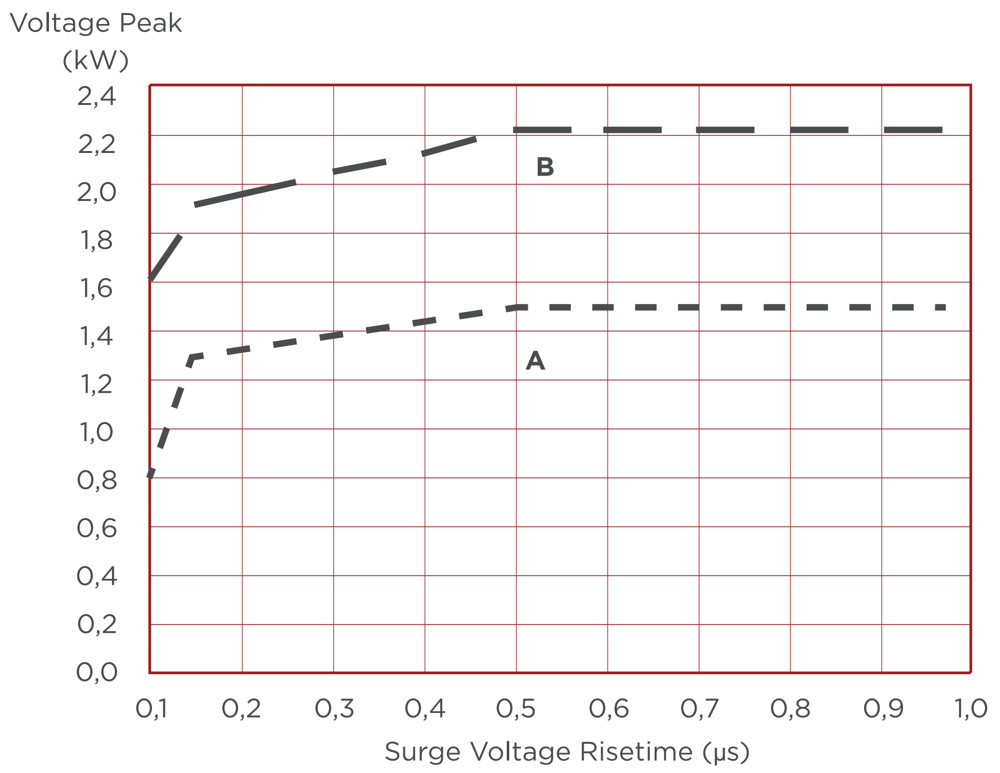


Figure 8: Voltage peak values

In line with this information, the strength of the insulation system is of great importance in motors suitable for use with the drive.

Motor Winding: Motor windings are only damaged if the cast iron, voltage or rise time is exceeded. If the voltage reflected from the motor terminal exceeds the maximum permissible voltage level, an event called 'Partial Discharge' or Corona occurs. As a result, small voltage jumps occur between two conductors or between conductors and earth. Although cracks in the winding insulation are microscopic, they can result in motor burnout if repeated periodically. Therefore, it is of great importance how good the motor winding insulation is. It is recommended to use corona wire to strengthen the winding insulation in our motors.

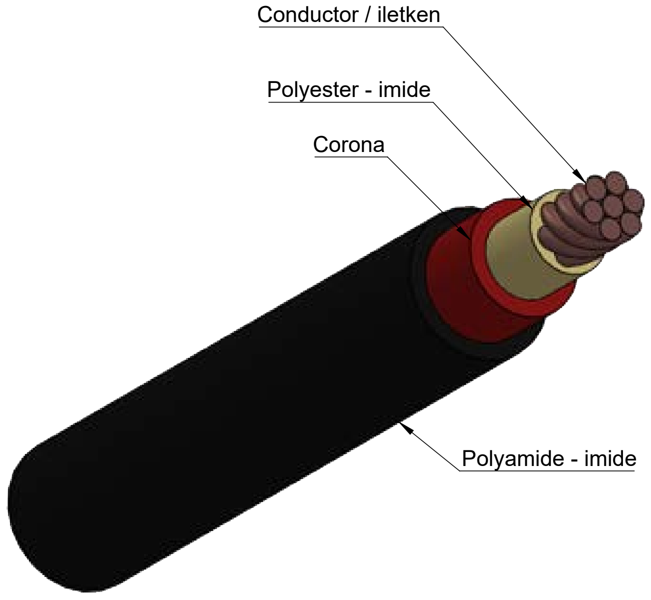


Figure 9: Corona Wire

Varnish: An air bubble that may remain in the enamel layer used in motor insulation can reduce the insulation withstand voltage by 20% - 35%. Vacuum varnish method is used in our motors in order to minimize the risk of air bubbles that may remain in the enamel layers.

VOLTAGE AND FREQUENCY

Our standard motors are suitable for inverter applications in the above conditions. You can contact us for changes.

ELECTRICAL PERFORMANCE VALUES	VOLTAGE (V)		FREQUENCY (Hz)	
	110%	90%	105%	95%
Starting and Rated Torque	1,21	0,81	0,95	1,11
Synchronous Speed	1	1	1,05	0,95
Rated Speed	1,01	0,98	1,05	0,95
Displacement %	0,83	1,23	Very small	Very small
Full load displacement	1,01	0,985	1,05	0,95
Idle current	1,10 - 1,16	0,90 - 0,88	0,95 - 0,94	1,05 - 1,06
Starting current	1,10 - 1,12	0,90 - 0,88	0,95 - 0,94	1,05 - 1,06
Rated voltage	0, 93	1,11	Small drop	Small drop
Temperature rise	0,97 - 0,96	1,06 - 1,07	Small drop	Small drop
Overload working capacity	1,21	0,81	Small drop	Small drop
Magnetic noise	Small drop	Small drop	Small drop	Small drop
Rated Efficiency	1,05 - 1,1	0,985	Small drop	Small drop
Power factor (Cos ϕ)	0,97	1,01	Small drop	Small drop

Table 15: Effects of voltage and frequency differences on motor performance

If the frequency is increased without changing the voltage, the magnetic flux density will decrease. If the frequency decreases, the magnetic circuit density increases. If the magnetic flux overly increases, the motor operates at a saturation level The rotation torque of the motor is proportional to the square of the magnetic flux density. The power of the motor is the product of th speed and the torque. In other words, the motor power changes depending on the speed and torque value. Motors are produced by designing in accordance with rated voltage and rated frequency. Three-phase Volt Electric Motors are produced according to the mains voltage of our country, 380V and 400V 50 Hz. However, standard voltage values varie across countries. Our company produces motors in different voltages and frequencies upon special order.

50 Hz	60 Hz				
Rated Voltage V	Mains Voltage V	RPM	Rated Power V	Rated Torque V	Rated Voltage A
220	220	1,20	1,00	0,83	1,00
	240	1,20	1,10	0,91	1,00
380	380	1,20	1,00	0,83	1,00
	400	1,20	1,05	0,87	1,00
	415	1,20	1,09	0,91	1,00
	440	1,20	1,15	0,96	1,00
	460	1,20	1,20	1,00	1,00
	480	1,20	1,33	1,10	1,00
400	400	1,20	1,00	0,83	1,00
	415	1,20	1,03	0,86	1,00
	440	1,20	1,10	0,91	1,00
	460	1,20	1,15	0,96	1,00
	480	1,20	1,20	1,00	1,00
415	415	1,20	1,00	0,83	1,00
	440	1,20	1,05	0,87	1,00
	460	1,20	1,10	0,91	1,00
	480	1,20	1,15	0,96	1,00
440	440	1,20	1,00	0,83	1,00
	460	1,20	1,05	0,87	1,00
	480	1,2	1,09	0,91	1,00
500	500	1,20	1,00	0,83	1,00
	550	1,20	1,10	0,91	1,00
660	660	1,20	1,00	0,83	1,00

Table 16: Performance values for a motor manufactured for 50 Hz and operated at 60 Hz

Motors manufactured according to 50 Hz rated frequency can be used practically in mains with 60 Hz rated frequency. However, the increase in frequency causes speed and torque changes in the motor. If the voltage of the motor changes with the frequency, the motor power also changes. If the motor, which is produced to operate in mains with 50 Hz, is operated at 60 Hz and different mains voltages, the operating characteristic of the motor will also change.
The approximate coefficients to be used to find the approximate operating values are given in Table 16.

BEARINGS USED IN ELECTRIC MOTORS

Classification of Bearings:

Bearings are divided into ball bearings and roller bearings according to their rolling elements. Bearings are also divided into two groups as radial bearings and thrust bearings according to the direction of the load carried. Ball bearings are generally used in small type electric motors and these bearings work by carrying loads in the radial direction.

Bearing Clearance:

When one of the inner or outer rings of the bearings is fixed, the other ring moves in the radial or axial direction. The amount of this movement is called bearing clearance. Bearing clearances are considered in two directions, radial and axial.

The bearings must be seated on the shafts as precisely as possible. The radial clearance of the installed bearing is only allowed to be of a certain size. Various criteria are taken into account in order to obtain these working conditions. Differential thermal expansions in the bearing rings and connected parts cause the bearing to contract. Tight fit reduces bearing clearance. In general, the running clearance is smaller than the unmounted bearing clearance. The clearance of the unmounted bearing must be selected in accordance with the different operating conditions and application tolerances. Therefore, besides bearings with normal clearance, there are also bearings with smaller and larger clearances. In electric motor production, manufacturers should lubricate properly in order to prevent direct metal contact between bearing radial raceways and wear of surfaces according to shaft size tolerances. Greases, liquid oils and solid oils can be used to lubricate bearings. Lubrication reduces friction, hence wear, and prevents rusting. Oil can also take on the role of cooling and sealing. Greases are commonly used as lubricants in electric motors. The greases used in the bearings of Volt Electric Motors have been determined as a result of long research and trials and give excellent life.

Assembly-Disassembly and Maintenance of Bearing:

Before starting the bearing assembly, the parts to be mounted must be measured. The main principle in measurements is that the part to be measured and the measuring instrument are at the same temperature. A micrometer should be used to measure the inner and outer diameters of the shafts, and a hole micrometer should be used to measure the hole diameters. Any diameter should normally be measured in at least two separate sections and in more than one plane. The assembly environment must be extremely clean and tidy. After all kinds of tools and measuring devices required for assembly are brought to the assembly place and the order in which assembly operations are to be carried out, the bearing is removed from its packaging. If possible, if the bearings removed from their packaging are handled with a clean glove, not with bare hands, rust caused by hand sweat will be prevented.

Assembly of Bearings:

The most important points to consider in assembly:
Never hit a bearing directly with a hammer. If possible, press and mounting apparatus should be used.

- The tight-fit ring is mounted first.
- The mounting force is always transmitted through the mounted ring. In other words, if the inner ring is mounted on the shaft, force is applied from the edge of the inner ring.
- After the assembly is terminated, the required radial and axial clearance should be checked. Compliance with the rules ensures the silent and smooth operation of the bearing. It is possible to make some judgments based on the noise that the bearing makes during operation. For example, irregular, scratch-like noises and vibrations heard while the bearing is rotating indicate that the bearing is contaminated. A louder, rumble-like sound is evidence of damage to the surface of the raceways or bearing elements. A smooth metallic and high-pitched sound indicates that there is not enough oil or grease in the raceways. If your bearings are operated without oil, they will deteriorate in a short time. If the bearing overheats in a short time during operation, it should be mounted and checked immediately, since there is an error in the assembly or lubrication system. Mounting methods are divided into three classes as mechanical, hydraulic and thermal according to the application of the required force. Since the bearings in the electric motor are usually mounted mechanically, this issue will be emphasized.

Mechanical assembly is a method generally used for bearings with a bore diameter of less than 100 mm. If mechanical force is to be applied with a hammer, the bearing must be hit over the bushing or stop prepared from soft alloy. The bushing or dolly should only touch the rings, not the cage or bearing elements. The bore and outer diameters of the bushing should be machined to be slightly less than the wall thickness of the bearing ring that the mounting force will push. When installing the bearing, it must be pushed until the ring disc side rests against the shaft flange or a spacer. The tight-fit ring must also be secured against axial bearing.

Disassembly of Bearings:

When disassembling a bearing, it is necessary to work with appropriate tools and carefully, as during assembly. Just like in assembly, the bearing is not hit with a hammer. In general, the force required for disassembly is greater than the force used for assembly. During disassembly, force should not be applied to the cage or bearing elements.

Cleaning of the Bearings:

Bearings that have been disassembled for maintenance or contaminated after use should be thoroughly cleaned and washed with kerosene and a brush in at least two separate baths, one for cleaning and the other for washing. To control the result of this cleaning operation, a thin oil lubricated bearing is rotated by hand. There should be no irregularity, no noise, no roughness should be felt. Noise control can be made by hand or with a noise control device, if possible. If desired, the bearing is then measured and checked, and its condition and whether it can be used again is examined. The cleaned bearing must be lubricated with a suitable oil or grease. The bearing should be stored in packaging to prevent dust and contamination.

No greasing is applied to the closed bearings used in Volt Electric Motors. Closed bearings are checked and disposed of appropriately. Suitable ones are cleaned and packaged.

COMPONENTS

TABLE OF MATERIAL USED IN MOTORS

FRAME TYPE	FRAME						FAN	FAN COVER		B3 COVER		FLANGE COVER				TERMINAL BOX	
	FIXED FOOT		FITTED FOOT		WITHOUT FOOT							B5		B14			
	ALUMINUM	CAST IRON	ALUMINUM	CAST IRON	ALUMINUM	CAST IRON	PLASTIC	PLASTIC	SHEET METAL	ALUMINUM	CAST IRON	ALUMINUM	CAST IRON	ALUMINUM	CAST IRON	PLASTIC	ALUMINUM
56			✓		✓		✓		✓	✓		✓		✓		✓	
63	✓				✓		✓		✓	✓		✓		✓		✓	
71	✓		✓		✓		✓	✓		✓		✓		✓		✓	
80	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓		✓	✓
90	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓		✓	✓
100	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓		✓	✓
112	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓		✓		✓	✓
132		✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
160		✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓
180		✓	✓		✓	✓	✓		✓	✓	✓		✓				✓
200		✓	✓		✓	✓	✓		✓		✓		✓				✓
225		✓				✓	✓		✓		✓		✓				✓
250		✓				✓	✓		✓		✓		✓				✓
280		✓				✓	✓		✓		✓		✓				✓
315		✓		✓		✓	✓		✓		✓		✓				✓
355		✓				✓	✓		✓		✓		✓				✓

Table 17: Volt Electric Motors material table

Cable Gland

FRAME SIZE	CABLE GLAND
56	M20 x 1
63	M20 x 1
71	M20 x 1
80	M20 x 1
90	M20 x 1
100	M20 x 1
112	M25 x 2
132	M25 x 2
160	M32 x 2
180	M32 x 2
200	M50 x 2
225	M50 x 2
250	M50 x 2
280	M50 x 2
315	M63 x 2
355	M80 x 2

Table 18: Cable Gland

TREE-PHASE

BEARINGS USED IN VOLT ELECTRIC MOTORS

Bearings Used in Single-Phase Motors

In Volt Electric Motors, bearings produced with special radial clearance and grease are used, which ensure serial and flawless operation with minimum friction loss of movement. The following table contains the bearings used in Volt Electric Motors.

FRAME	NUMBER OF POLES	HOUSING MATERIAL	DE BEARING	NDE BEARING
63	2P,4P,6P	Aluminum	6201	6201
71	2P,4P,6P	Aluminum	6202	6202
80	2P,4P,6P	Aluminum	6204	6202
90	2P,4P,6P	Aluminum	6204	6203
100	2P,4P,6P	Aluminum	6206	6204

Table 19: Bearings used in single-phase motors

Bearings Used in Three-Phase Motors

FRAME	NUMBER OF POLES	HOUSING MATERIAL	DE BEARING	NDE BEARING
56	2P,4P,6P	Aluminum	6200	6200
63	2P,4P,6P	Aluminum	6201	6201
71	2P,4P,6P	Aluminum	6202	6202
80	2P,4P,6P	Aluminum	6204	6204
90	2P,4P,6P	Aluminum	6205	6205
100	2P,4P,6P	Aluminum	6206	6205
112	2P,4P,6P	Aluminum	6206	6205
132	2P,4P,6P	Aluminium, Cast Iron	6208	6208
160	2P,4P,6P	Aluminum	6309	6309
	2P,4P,6P	Cast Iron	6309	6209
180	2P,4P,6P	Aluminium, Cast Iron	6310	6210
200	2P,4P,6P	Aluminium, Cast Iron	6312	6212
225	2P,4P,6P	Cast Iron	6313	6212
250	2P,4P,6P	Cast Iron	6315	6313
280	2P	Cast Iron	6315	6315
280	4P,6P	Cast Iron	6316	6316
315	2P	Cast Iron	6316	6316
	4P,6P	Cast Iron	6318	6318
355	2P	Cast Iron	6318	6318
	4P,6P	Cast Iron	6321	6321

Table 20: Bearings used in three-phase motors

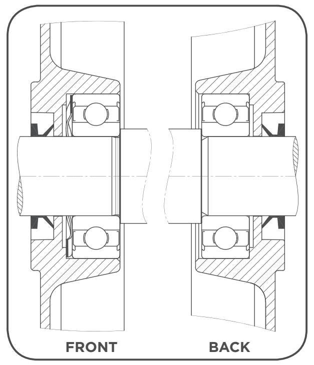


Figure 10: No fixed bearing application

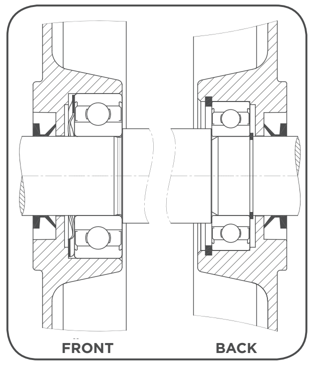
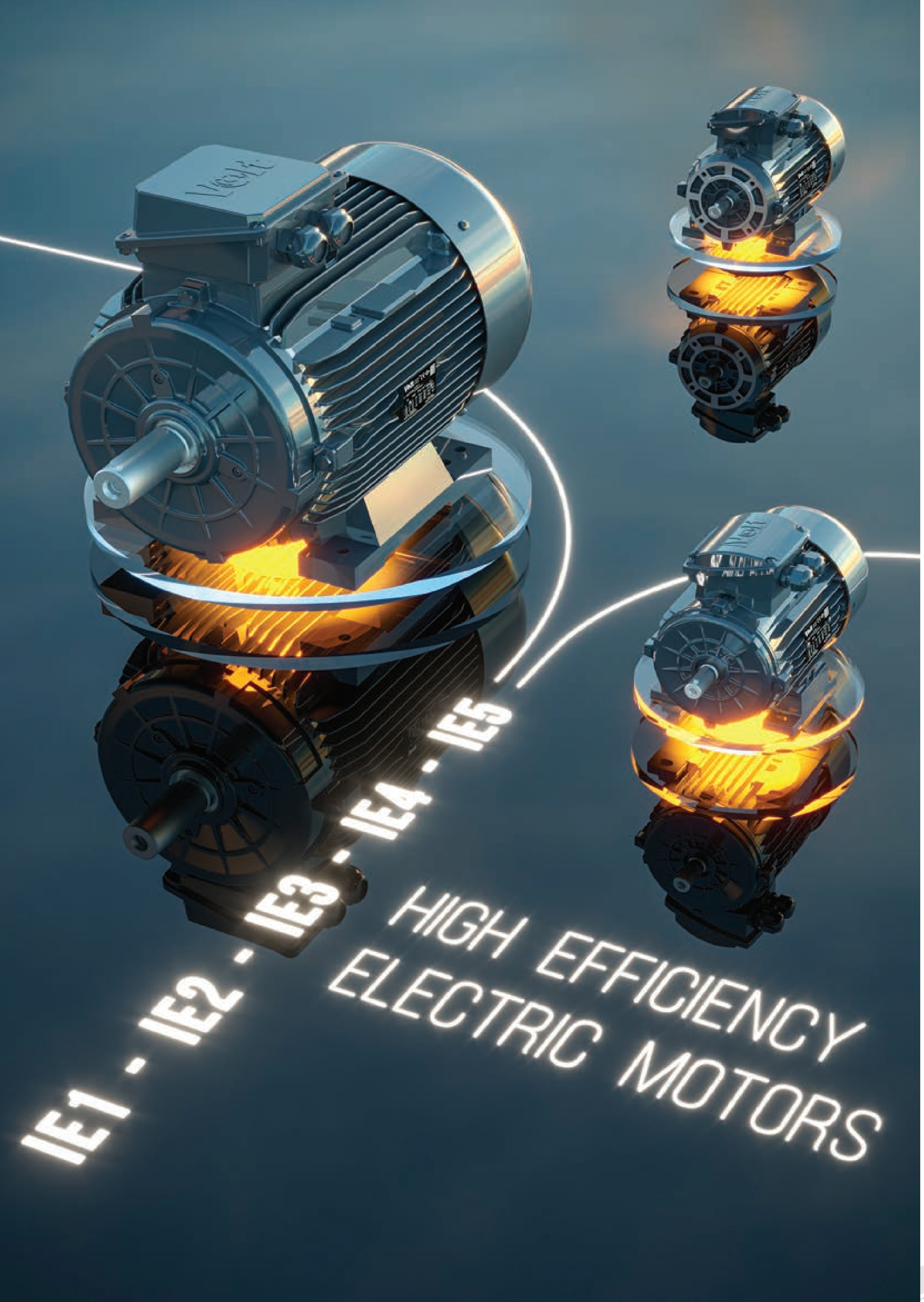


Figure 11: There is a fixed bearing application

Deep groove ball bearings with sealed on both sides (ZZ) are used in frame types 160-355 (Figure 11) and frame types 56-132 (Figure 10).

In some cases, for some applications in frame types 56-132, a structure like Figure 11 can be developed to prevent axial movement of the shaft. Rubber dust seals (V-ring) are placed on the front and rear covers.



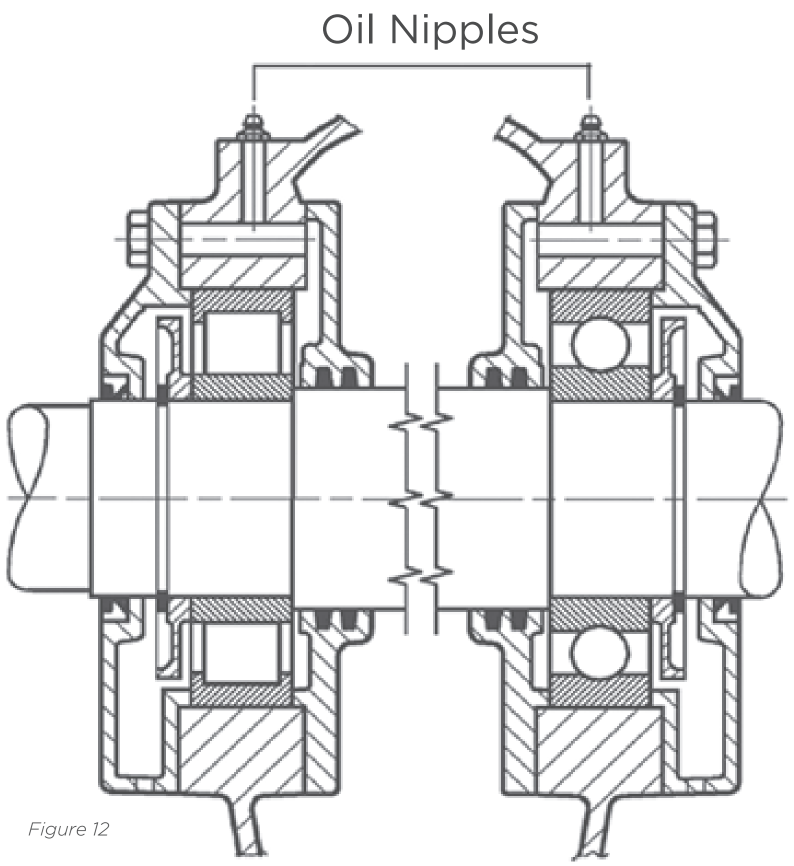


Figure 12

Drive Side:
Removable Housing (NU XXX)

Fan Side:
Fixed Housing (6 XXX)

Housing of cylindrical bearings are used in applications with high radial loads, rapid speed changes and high speeds. Such bearings have a higher load carrying capacity compared to ball bearings. Please contact us for special applications in motors with frame types 200 and above.

Bearings Used in Lubrication

FRAME	NUMBER OF POLES	FRAME MATERIAL	DE BEARING	NDE BEARING
200	2P,4P,6P	Aluminium, Cast Iron	NU312	6312 C3
225	2P,4P,6P	Cast Iron	NU313	6313 C3
250	2P,4P,6P	Cast Iron	NU315	6313 C3 -6315 C3
280	2P	Cast Iron	NU315	6315 C3
	4P,6P	Cast Iron	NU316	6316 C3
315	2P	Cast Iron	NU316	6316 C3
	4P,6P	Cast Iron	NU318	6318 C3

Table 21: Bearings used in lubricated motors

DUST SEAL DIMENSIONS IN THREE-PHASE MOTORS			
FRAME TYPE	NUMBER OF POLES	DIMENSIONS (mm)	
		DE DUST SEAL	NDE DUST SEAL
56	2P,4P,6P	9	9
63	2P,4P,6P	10,5	10,5
71	2P,4P,6P	13	13
80	2P,4P,6P	18	18
90	2P,4P,6P	22	22
100	2P,4P,6P	27	27
112	2P,4P,6P	27	27
132	2P,4P,6P	36	36
160	2P,4P,6P	40	40
180	2P,4P,6P	45	45
200	2P,4P,6P	54	54
225	2P,4P,6P	58	58
250	2P,4P,6P	58	58
280	2P	67	67
	4P,6P	72	72
315	2P	72	72
	4P,6P	81	81

Table 22: Dust seal dimensions in three-phase motors

DUST SEAL DIMENSIONS IN SINGLE-PHASE MOTORS			
FRAME TYPE	NUMBER OF POLES	DIMENSIONS (mm)	
		DE DUST SEAL	NDE DUST SEAL
56	2P,4P,6P	9	9
63	2P,4P,6P	10,5	10,5
71	2P,4P,6P	13	13
80	2P,4P,6P	18	18
90	2P,4P,6P	22	22
100	2P,4P,6P	27	27

Table 23: Dust seal dimensions in single-phase motors

NDE OIL SEAL DIMENSIONS IN THREE-PHASE MOTORS			
FRAME TYPE	NUMBER OF POLES	DIMENSIONS (mm)	
		DE OIL SEAL	NDE OIL SEAL
56	2P,4P,6P	25*40*7	25*40*7
63	2P,4P,6P	25*40*7	25*40*7
71	2P,4P,6P	25*40*7	25*40*7
80	2P,4P,6P	25*40*7	25*40*7
90	2P,4P,6P	25*40*7	25*40*7
100	2P,4P,6P	30*47*7	25*40*7
112	2P,4P,6P	30*47*7	25*40*7
132	2P,4P,6P	40*55*8	40*55*8
160	2P,4P,6P	45*60*8	45*60*8
180	2P,4P,6P	50*65*8	50*65*8
200	2P,4P,6P	60*80*10	60*80*10
225	2P,4P,6P	65*85*10	65*85*10
250	2P,4P,6P	75*100*10	65*85*10
280	2P	75*100*10	75*100*10
	4P,6P	80*100*10	80*100*10
315	2P	80*100*10	80*100*10
	4P,6P	90*110*10	90*110*10
355	2P	90*110*10	90*110*10
	4P,6P	105*125*13	105*125*13

Table 24: Oil seal dimensions in three-phase motors

OIL SEAL DIMENSIONS IN SINGLE-PHASE MOTORS			
FRAME TYPE	NUMBER OF POLES	DIMENSIONS (mm)	
		DE OIL SEAL	NDE OIL SEAL
56	2P,4P,6P	25*40*7	25*40*7
63	2P,4P,6P	25*40*7	25*40*7
71	2P,4P,6P	25*40*7	25*40*7
80	2P,4P,6P	25*40*7	25*40*7
90	2P,4P,6P	25*40*7	25*40*7
100	2P,4P,6P	30*47*7	25*40*7

Table 25: Oil seal dimensions in single-phase motors

KEY DIMENSIONS ACCORDING TO FRAME TYPES

FRAME	NUMBER OF POLES	MEASUREMENT (mm)
56	2P,4P,6P	3*3*14
63	2P,4P,6P	4*4*16
71	2P,4P,6P	5*5*22
80	2P,4P,6P	6*6*32
90	2P,4P,6P	8*7*40
100	2P,4P,6P	8*7*50
112	2P,4P,6P	8*7*50
132	2P,4P,6P	10*8*70
160	2P,4P,6P	12*8*90
180	2P,4P,6P	14*9*100
200	2P,4P,6P	16*10*100
225	2P	16*10*100
	4P,6P	18*11*125
250	2P,4P,6P	18*11*125
280	2P	18*11*125
	4P,6P	20*12*125
315	2P	18*11*125
	4P,6P	22*14*140
355	2P	22*14*140
	4P,6P	28*16*200

Table 26: Key dimensions

CONSTRUCTION AND INSTALLATION TYPES

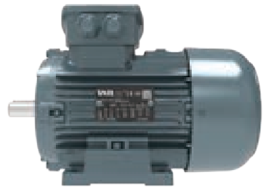
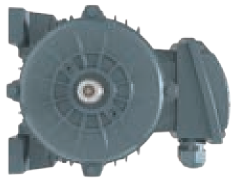
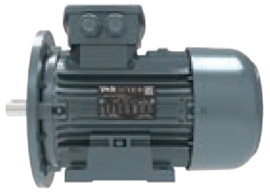
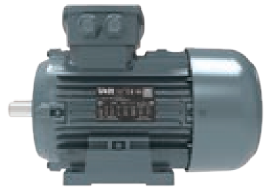
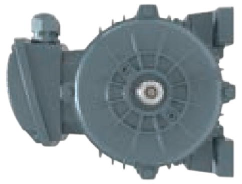
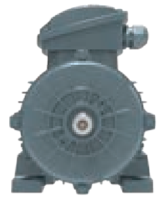
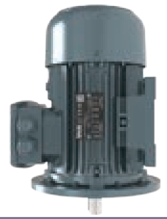
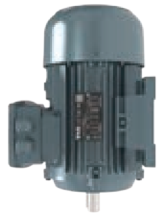
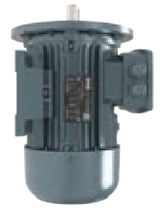
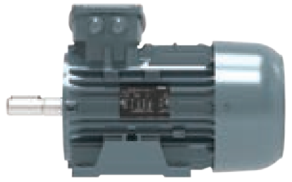
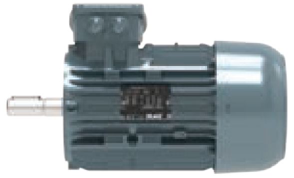
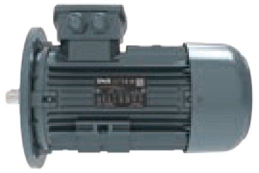
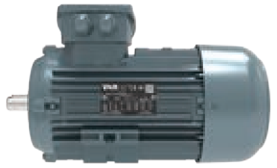
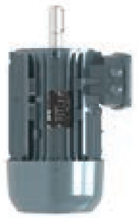
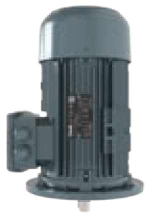
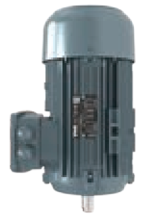
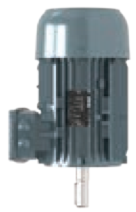
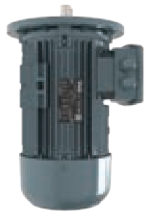
FOOT MOUNTED MOTOR		FOOT MOUNTED FLANGE MOTOR	
		B35	B34
B3	B6	B35	B34
			
B7	B8	V15	V17
			
V5	V6	V36	V37
			
FOOT MOUNTED, WITHOUT ENDSHIELD	WITHOUT FOOT, WITHOUT ENDSHIELD	WITHOUT FOOT, FLANGE MOUNTED MOTOR	
		B5 FLANGE	B14 FLANGE
B15	B9	B5	B14
			
	V8	V1	V18
			
	V9	V3	V19
			

Table 27: Construction and assembly configurations

READING THE NAMEPLATE OF THREE PHASE MOTOR

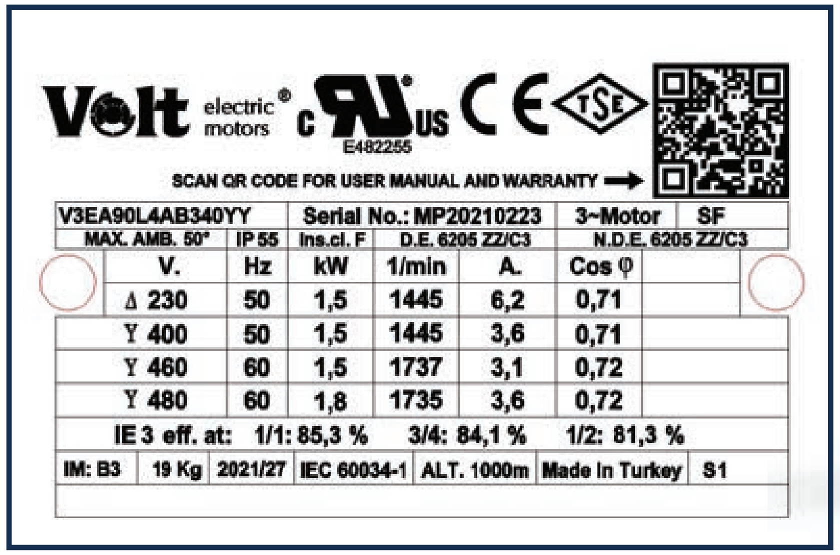
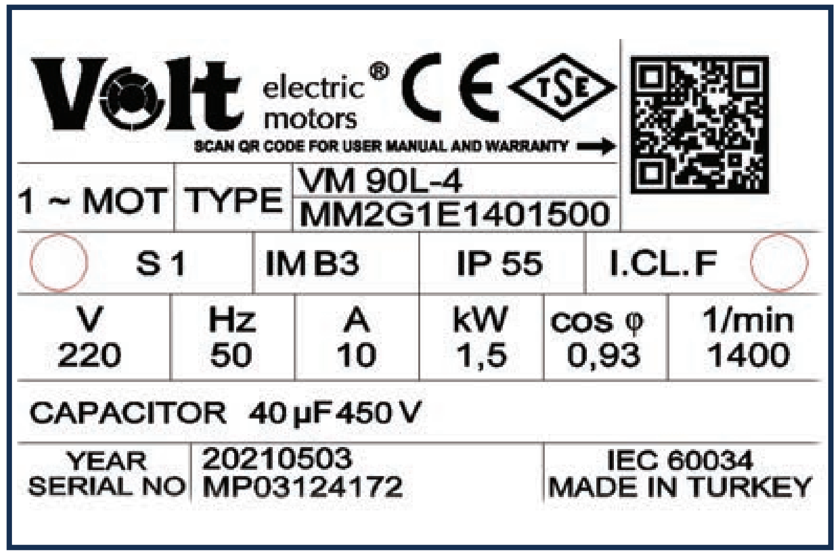


Figure 13: Three-phase electric motor nameplate

THREE-PHASE ELECTRIC MOTOR NAMEPLATE	
3-Motor	Three-Phase Electric Motor
Volt Motor Code	V3EA90L4AB340YY
Series No.	MP20210223
TSE	Mark of Compliance with the Turkish Standards
CE	Mark of Compliance with the European Union Standards
QR Code	Technical Documents
S1	Duty Type
Max. Operating Temp.	40°C
IP55	Protection Type
I.CL.F	Insulation Class : F
D.E./N.D.E.	DE Bearing 6205 ZZ/C3 / NDE Bearing 6205 ZZ/C3
230V/50 Hz	Motor; 400 V 50 Hz. A is connected in the mains.
480V/60 Hz	Motor; 480 V 60 Hz. Y is connected in the mains. Rated Voltage
A	
kW	Rated Power Coefficient
Cos0	Number of laps per minute at rated operational values
1/min	Efficiency Class IE3, at 100%, 75% and 50% load efficiency values
IE3 eff.	Construction Type: Foot Mounted Type Covered Motor
IMB3	Motor Weight
19 Kg	Production Year/Week
2021/22	Induction Motor Standard
IEC 60034-1	Operation Height
ALT.1000m	UL Compliance Mark - UL Approval Mark
UL	UL Uygunluk Logosu - UL Onay Logosu

Table 28: Construction and assembly configurations

READING THE NAMEPLATE OF SINGLE PHASE MOTOR



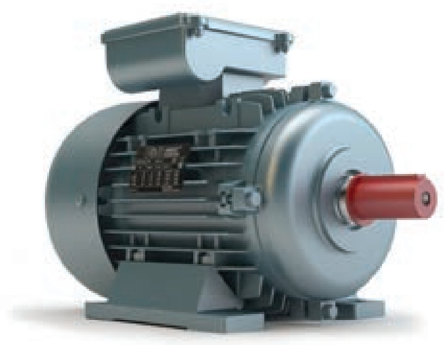


Figure 14: Single-phase electric motor nameplate

SINGLE-PHASE ELECTRIC MOTOR NAMEPLATE	
1-Mot	Single-Phase Motor
TYPE VM	Motor Frame Type- Number of Poles
Volt Motor Code	MM2G1E1401500
TSE	Mark of Compliance with the Turkish Standards
CE	Mark of Compliance with the European Union Standards
QR Code	Technical Documents
S1	Duty Type
IMB3	Construction Type: Foot Mounted Type Covered Motor
IP55	Protection Type
I.CL.F	Insulation Class : F
220V / 50 Hz	Motor; 220V 50 Hz
A	Rated Voltage
kW	Rated Power
Cos0	Rated Power Coefficient
1/min	Number of laps per minute at rated operational values
Capacitors	40 /F 450V
Series No.	MP03124172
Year of Manufacture	20210503
IEC 60034	Induction Motor Standard
19 Kg	Motor Weight
2021/22	Production Year/Week
IEC 60034-1	Induction Motor Standard

Table 29: Construction and assembly configurations

DESCRIPTIONS OF MOTOR CODE

V3E	A	80	M	2	A	B3	*
↓	↓	↓	↓	↓	↓	↓	↓
Phase and Efficiency	Frame Material	Frame Type	Frame Size	Number of Poles	Power	Construc-tion Type	See Option Table
I	II	III	IV	V	VI	VII	VIII

PHASE AND EFFICIENCY CLASSES (I)	
V1E	Volt Motor 3-Phase IE1, S3, Multi-Speed
V2E	Volt Motor 3-Phase IE2
V3E	Volt Motor 3-Phase IE3
V4E	Volt Motor 3-Phase IE4
VSS	Volt Motor 1-Phase Start and Permanent Capacitor
VSP	Volt Motor 1-Phase Permanent Capacitor

FRAME MATERIAL (II)	
A	Aluminium Frame
G	Cast Iron Frame

FRAME SIZE (III)	
56-355	Height of the Shaft Axis from the Ground

FRAME LENGTH (IV) (IEC 50347)	
S	Short
M	Medium
L	Long

Table 30: Motor code structure

POWER (VI)
A*-B*-C*-D-E....Z

** Letters are given from the lowest power to the highest power that can be produced in the relevant frame.*

PHASE AND EFFICIENCY CLASSES (I)	
B3	Foot mounted B3, B6, B7, B8, V5, V6 / V19
B5	Without foot, Flange mounted B5, V1, V3
B14	Without foot, Flange mounted B14, V18, V19
B35	Foot & Flange mounted B35, V15, V36
B34	Foot & Flange mounted B34, V17, V37
B9	Without foot, without Endshield B9, V8, V9

NUMBER OF POLES (RPM) (V)	
2	2 Pole, 3000 rpm
4	4 Pole, 1500 rpm
6	6 Pole, 1000 rpm
4/2	4/2 Pole, 1500/3000 rpm
8/4	8/4 Pole, 750/1500 rpm
8/6	8/6 8/6 Pole, 750/1500 rpm

OPTION (VIII)
Special production according to customer demands

TERMINAL CONNECTIONS

STATOR WINDING	STANDARD END MARK	COLOR OF CABLE ENDS
Main Winding	U1- U2	Black-Blue
Auxiliary Winding	Z1-Z2	White-Red

Table 31: Standard terminal connection of single phase induction motor

Standard Terminal Connection of Single Phase Induction Motor

The ends of the main winding and auxiliary windings that make up the stator windings are coded with colored cables in Volt Electric Motors as seen in the table below. The ends of the main winding (Black-Blue) are connected to the terminals U1 and U2 in the terminal table, the ends of the auxiliary winding (White-Red) are connected to the terminals Z1 and Z2.

Terminal Connection of Single Phase Permanent Capacitor Motors

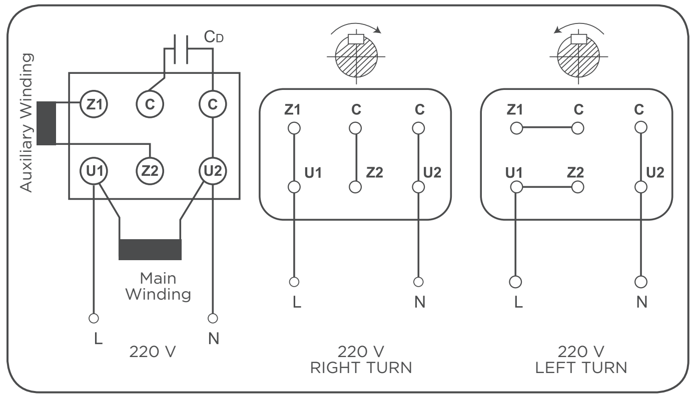


Figure 15: Terminal connection of single phase permanent capacitor motors

Change of Rotation Direction: The rotation direction of the motor with the terminal board connection of the motor with permanent circuit capacitor is shown in the figure above. The meaning of the right and left turn expressed in the figures is as follows.

Right Turn: When viewed from the opposite side of the drive shaft end of the motor, clockwise is the rotation direction.

Left Turn: When viewed from the opposite side of the drive shaft end of the motor, counter-clockwise is the rotation direction.

Terminal Connection of Single Phase Start and Permanent Capacitor Motors

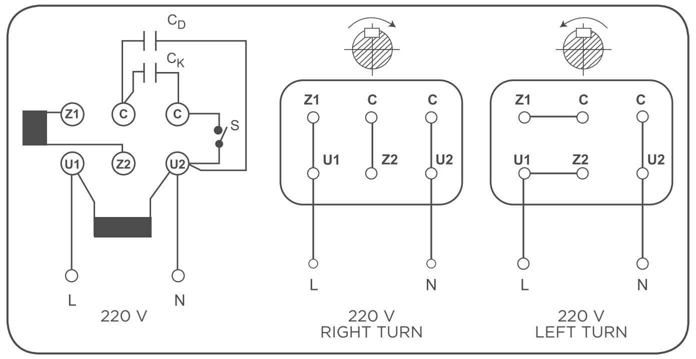


Figure 16: Terminal connection of single phase start and permanent capacitor motors

Volt Electric terminal cable connection of single phase induction motors is made according to the left rotation of the motor (bridges in horizontal position).

If the motor will rotate in the opposite direction, the bridge between U1-Z2, between U1-Z1 and the bridge between Z1-C is taken between C-Z2 (bridges in vertical position) as shown in Figure 15.

The mains leads (L-N) are always connected to the U1-U2 terminals of the motor.

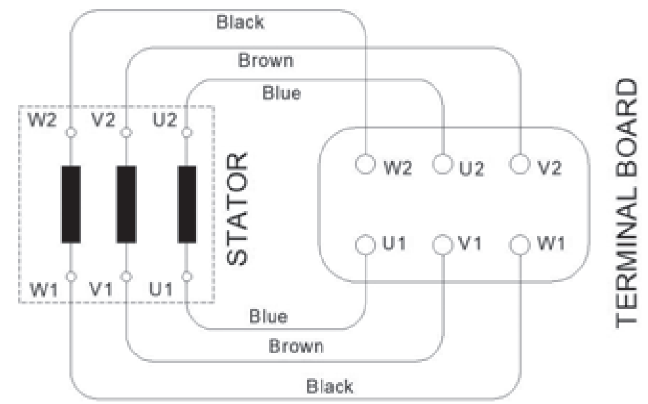


Figure 17: Connecting the stator winding leads to the terminal board

Connecting the Stator Winding Leads to the Terminal Board: The connection of the three phase winding leads of the stator to the motor terminal board is as shown in Figure 16. In this connection, the input terminals (U1, V1, W1) are connected to the same row in the terminal table, and the output terminals (U2, V2, W2) are cross-connected to the opposite terminal. In Volt Electric three-phase motors, the input and output leads of the stator phase windings are coded with colored cables. In addition, the end connection screws on the terminals are marked with standard letters. This coding provides convenience in terminal connection and determination of winding ends. The color codes of the cables are as shown in the figure below.

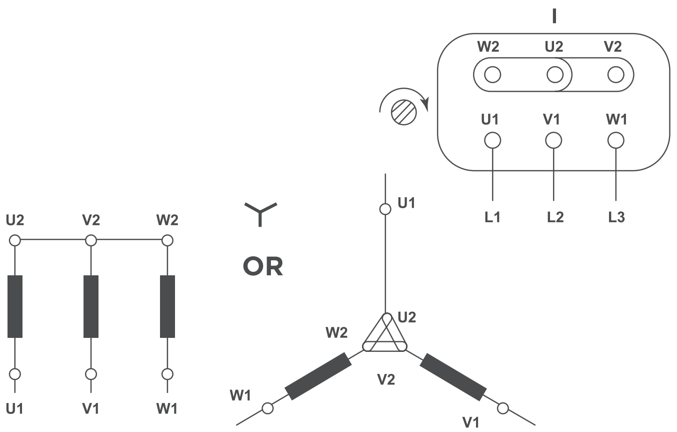


Figure 18: (Y) connection of stator winding

(Y) Connection of Stator Winding: Three-phase induction motor stator windings are connected in star or delta. Volt Electric Motors up to 3 kW (including) on 2 and 4 poles, and 2.2 kW (including) on 6 poles, are star connected in 380 V mains. As seen in the figure on the left, Star connection is the connection obtained by combining the output ends of the stator windings. The terminals U2, V2, W2 are combined for star connection. Three-phase mains (L1, L2, L3) is connected to U1, V1, W1 terminals.

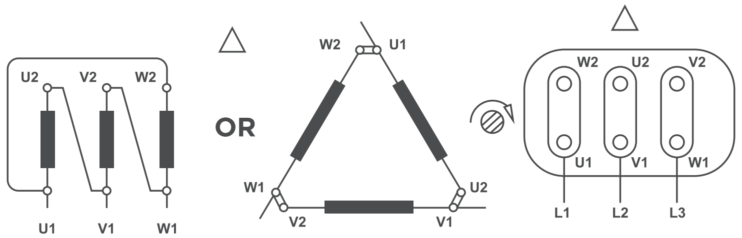


Figure 19: Delta (Δ) connection of stator winding leads

Interphase Delta (A) Connection of Stator Winding: If the motor, which should be operated at 380V in a 3-phase mains (Y), is accidentally connected to (A) in the same mains, a voltage greater than V3 will be applied to the phase windings. While the phase winding voltage of the motor is 220 V, 380 V is applied instead. The phase current passing through the motor windings increases as much as the rate of increase in voltage, that is, V3 times. The motor is in danger of burning. If the motor that needs to be connected to 380 V in a 3-phase mains (A) is operated connected to the same mains (Y), the voltage applied to the motor windings drops to 1/V3 = 0.58 (220V). The motor runs at low voltage. The motor cannot be loaded at the nameplate power as the torque will decrease with the power.

NUMBER OF POLES	STAR (Y) CONNECTION 380V (Y) - 400V (Y) (50Hz)	DELTA (Δ) CONNECTION 380V (Δ) - 400V (Δ) (50Hz)
2 AND 4	$P_{MOTOR} \leq 3$ kW	$P_{MOTOR} > 3$ kW
6	$P_{MOTOR} \leq 2,2$ kW	$P_{MOTOR} > 2,2$ kW

Table 32: (y) and triangle (Δ) connection methods of Volt Electric Motors

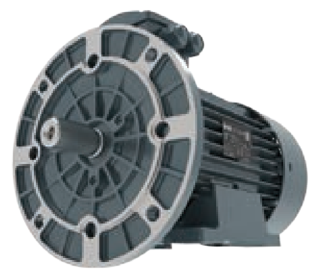
Terminal Connection of Two-Speed Induction Motors: The number of revolutions of induction motors varies according to the number of poles of the stator windings or the frequency of the voltage applied to the motor. If the frequency is constant, different rotational speeds are obtained either from separate windings with different pole numbers or from a different pole number connection in the same winding. Accordingly, we can consider two-speed motors in two groups.

- Two-speed motors with two separate windings.
- Two-speed motors with one winding.

1. Two-Speed Motors with Two Separate Windings:

If two independent windings with different pole numbers are wound on the same stator grooves, we will have a two-speed motor with two windings. In such a motor, whichever winding is applied with three-phase voltage, the rotational speed appropriate to the number of poles of that winding is obtained. In this type of windings, the star (Y) or delta (A) connection of the winding is made inside the stator. Three ends of each winding are removed from the terminal board. For example, for a 6/4 pole two-winding two-speed motor, 6-pole winding ends 6U - 6V – for two-pole two-winding two-speed motor, 6-pole winding ends 6U-6V-6W, 4-pole winding ends 4U-4V-4VVV

Two-winding two-speed motors are not economical. Because two separate windings are placed in the stator grooves, which are considered for one winding. Therefore, lower power is obtained compared to two-speed motors with one winding. In other words, the production of single-winding two-speed motors is limited. It is applied for the number of poles with unequal coefficients, since its design and connections are easy.



2. Two-Speed Motors with One Winding:

Two-speed motors with one winding are considered in two groups.

2.1 Motors with Dahlander winding
2.2 Motors with PAM winding

2.1 Motors with Dahlander Winding:

Its design and connections are easy. However, in this connection type, the pole number ratio is 2/T. In other words, it is like 4/2 poles or 8/4 poles. If a connection is made from a winding to obtain two different pole numbers, this connection is called “Dahlender connection” and this type of motors is called “motors with Dahlender winding”. In the Dahlender connection, the winding is designed for the small number of revolutions, that is, for the large number of poles. Each phase winding has middle ends. Phase windings input ends are marked with 1U -1V -1W, middle ends are marked with 2U - 2V - 2W. These 6 terminals are output to the terminal board.

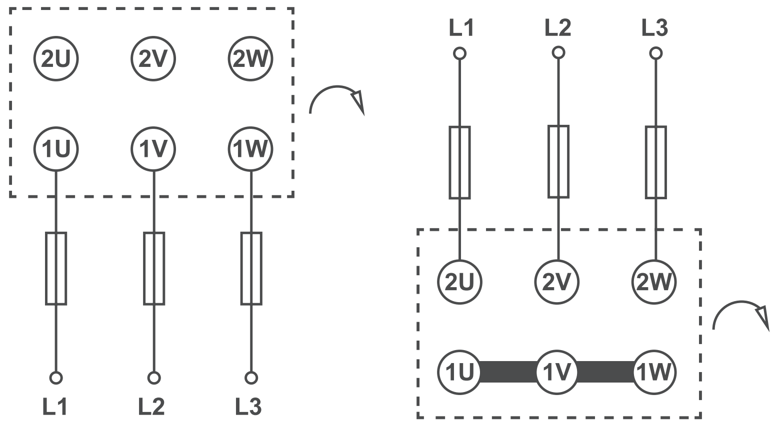


Figure 20: Terminal board in Dahlender connection and two different quick connectors

Dahlender Motors Terminal Connection:

The ends of the Dahlender connected windings are connected as shown in the terminal table below. In Dahlender connection, the rotation directio of the motor at both speeds should be the same as shown in Figure 22. In order to obtain the same rotation direction and to connect the 2U - 2V - 2W terminals in the same order in the terminal board, the marks of the middle ends of the phase groups must be changed in two phases. For example, 2W instead of 2U middle end of 1U first phase, 2U instead of 2W middle end of 1W third phase. If this change has been made, the motor shown in Figures 20 and 21 will rotate in the same direction at both speeds. Motors with Dahlender winding are double layer winding. In the single layer winding application, strong harmonics occur in large pole number (slow speed) operation and these strong harmonics have a negative effect on the starting of the motor. For this reason, single layer Dahlender winding is not used.
Volt Electric Motors with Dahlender winding are double layer winding. Motors are with 4/2 or 8/4 pole. Phase windings are connected in delta (A) inside the stator. When three-phase voltage is applied to the input terminals of the phase windings (1U-1V-1VV), the windings are connected in series delta and low speed is obtained with a large number of poles. By bridging the 1U-1V-1VV ends, when three-phase voltage is applied to the middle ends of the phase windings (2U-2V-2VV), the windings are connected in parallel star and the motor rotates at high speed with a small number of poles.

Series Delta- Parallel Star (A-YY) Connection and Winding Charts:

It is the most applied connection in motors with Dahlender winding. The power and current of the motor change at both speeds. It has great power at high speed. It is widely used in reciprocating pumps, compressors, belt conveyors and alike. Volt Electric Motors with Dahlender winding are D/YY connection.

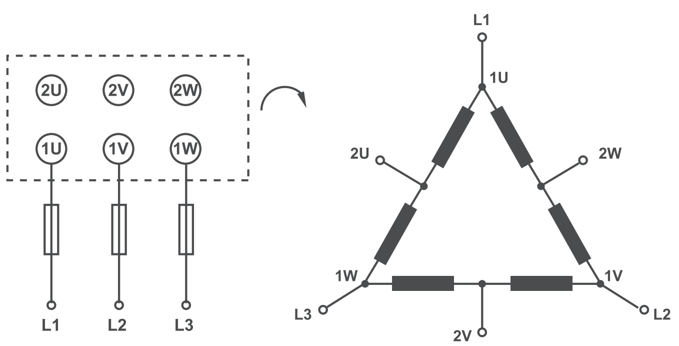


Figure 21: 2P=4 pole serial delta low speed connection

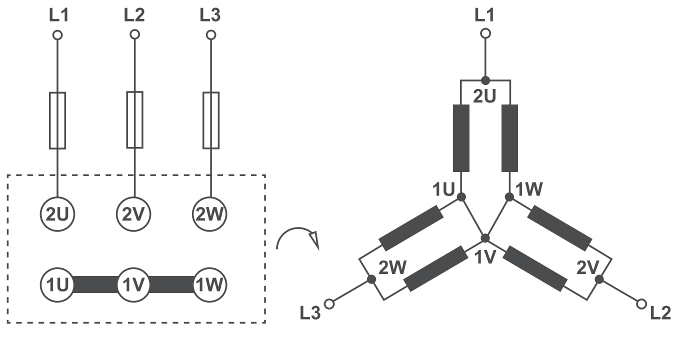


Figure 22: 2P=2 pole parallel star high speed connection

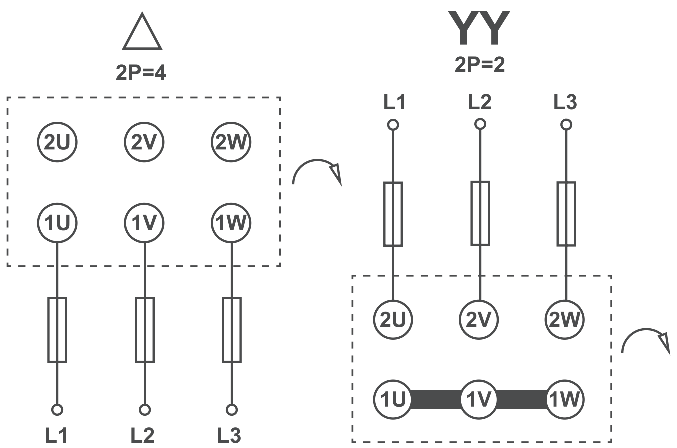


Figure 23: Terminal board connection of motor with Dahlender winding, 4/2 pole and A/ YY connection

Serial Star - Parallel Star (Y-YY) Connection and Winding Chart:

It is another type of connection applied in motors with Dahlender winding. In the stator, a star (Y) connection is made by combining the output ends of each phase group connection. In this connection, the motor power and torque change proportionally with the number of revolutions. Motors with serial star - parallel star (Y/YY) connection are called Dahlender winding motors with different torques. It is the preferred connection in the drive of fans, blowers, centrifugal pumps and alike.

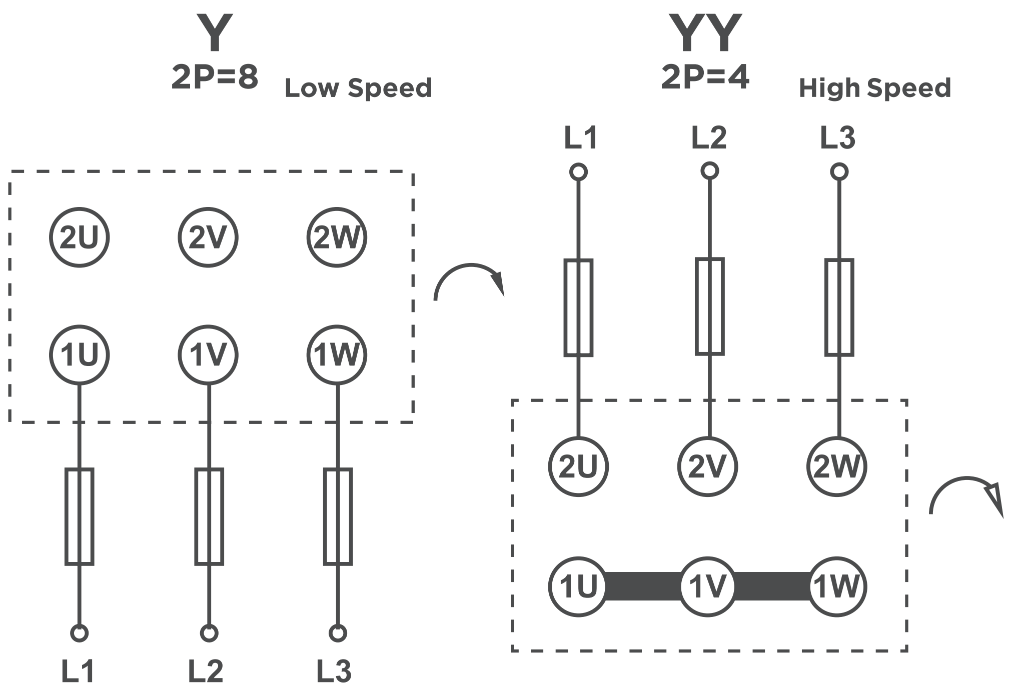
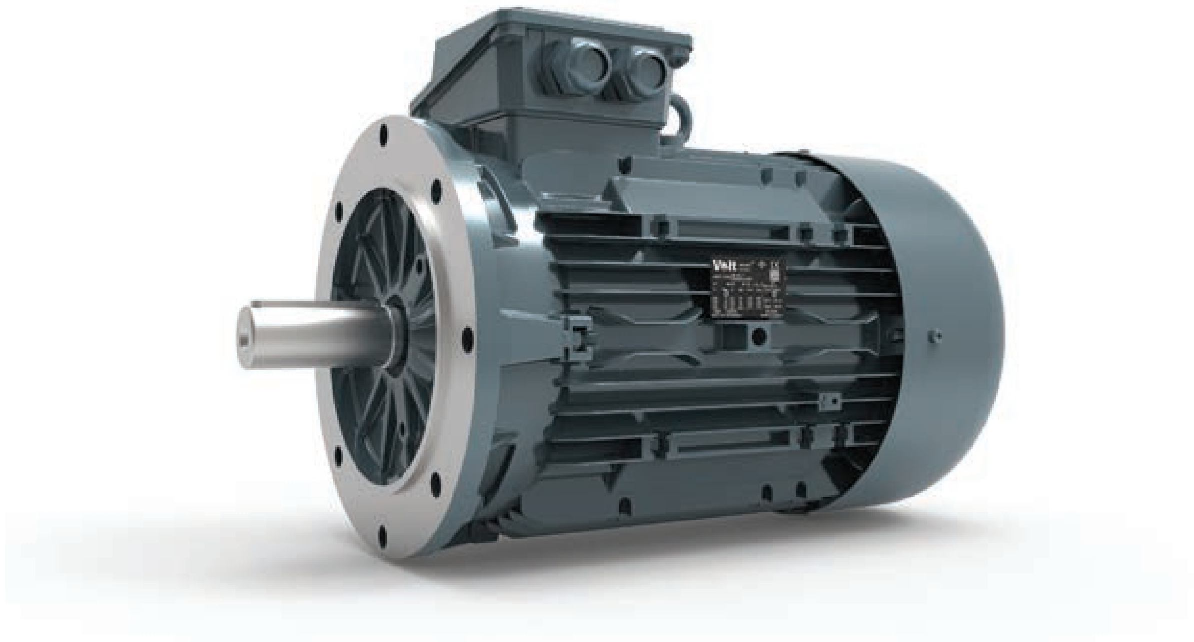


Figure 24: Terminal board connection of motor with Dahlender winding and Y/ YY connection



VOLT MOTOR APPLICATION RECOMMENDATIONS

INCIDENT	PROBABLE REASON	SOLUTION
Motor Fails to Start	Cable connections are wrong	Check whether the connections are correct or not
	Cable connections are loose	Check the connections for loosening
	Motor is overloaded	Reduce the load
	Locked rotor	Check if the motor idles
	Incorrect star-delta starter	Check the duration of star connection
		Check the connection of star-delta starter contactor
	Motor stuck to single or two phases	Check the connection of star-delta starter contactor
Motor Fails to Start	No energy	Check the motor if it is energized
	Cable connections are wrong	Check whether the connections are correct or not
	Mechanical locking	Manually check that the shaft rotates freely
	Fuse has blown	Check whether the fuse is blown or not
Motor Stalls	One of the phases is missing	Please check phases
	Wrong motor size selection	Choose suitable motor size
	Motor is overloaded	Reduce the load
	Low voltage	Check that the voltage coming to the motor ends corresponds to the voltage written on the nameplate.
	Leakage to frame	Check for leakage to frame
Motor Starting Takes Long	Low voltage	Check that the voltage coming to the motor ends corresponds to the voltage written on the nameplate.
	Motor is overloaded	Reduce the load
	Bearing	Check the condition of the bearing
	Capacitor (Single-phase)	Check if the capacitor is faulty
	Incorrect drive settings	Reduce motor start time from drive settings
	Incorrect star-delta starter	Decrease the duration of star connection
Motor Starts and Stops	Fuse has blown	Check if the fuse corresponds to the nominal value
	Capacitor (Single-phase)	Check if the capacitor is faulty
	Cable connections are loose	Check the connections for loosening
Motor Spins in Reverse Direction	Incorrect phase sequence	Swap any two phases at the terminal
Motor Overheats	Motor is overloaded	Reduce the load
	Cable connections are wrong	Check whether the connections are correct or not
	Low voltage	Check that the voltage coming to the motor ends corresponds to the voltage written on the nameplate.
	Ambient temperature too high	Observe the permissible temperature range, reduce the load if necessary or check the insulation class and use a suitable special motor
	Insufficient cooling	Check the function of the motor propeller
		Check if the air ducts of the propeller bowl are open
	Bearing defective	Replace the bearings
	Unbalanced voltage	Check the phase voltages
	One of the phases is missing	Please check phases
	Leakage to frame	Check for leakage to frame
	Interphase leakage	Check if there is a short circuit between U1-V1,U1-W1,V1-W1
There is a Sound in the Motor	One of the phases is missing	Please check phases
	Improper air space	Check the bearings and housing of bearings
	Propeller friction	Check the propeller assembly
	Damaged bearing	Replace the bearings
	Broken propeller	Replace the propeller
	System connected to the motor	Disconnect the motor from the system and check the idle sound
	Cable connections are loose	Check the connections for loosening
	Winding broken	Check if there is a break between U1-,U2,V1-V2,W1-W2
There is Leakage to Frame	Cover	Check if the cover is touching the winding
	Cover screw	Check if the cover screw is touching the winding
	Grounding screw	Check if the grounding screw is touching the cables in the terminal.
	Centrifugal switch	Check if the centrifugal switch is touching the frame
Bearing Fails	Insufficient or excessive lubrication	Check bearing oil
	Excessive or unbalanced load	Check the motor load
	Rotation speed	Check whether the rotation speed is excessive or not
	Motor temperature	Check if the motor is overheating
	Environmental factors	Check for dirt or water ingress
Motor Vibrates	System connected to the motor	Disconnect the motor from the system and check the idle sound
	Shaft	Check the shaft for damage
	Motor housings	Check the motor housings
	High voltage	Check that the voltage coming to the motor ends corresponds to the voltage written on the nameplate.

Table 33 Volt Electric Motors application recommendations

Kazım Karabekir Caddesi No: 84 35735 İZMİR
Phone: 0232 877 10 60 (pbx) Fax: 0232 877 10 59

voltmotor.com