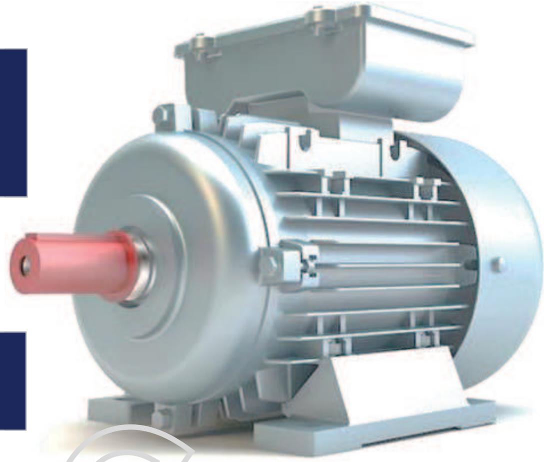
PROMOTE
ARAŞTIRMA VE TEKNOLOJİ GELİŞTİRME

AsynMotor



Tek Fazlı Asenkron Motor
Single Phase Asynchronous (Induction) Motor

Robust & Efficienct

High efficiency

Robust design

Low torque ripple due to optimized amper.turns ratio

High start-up torque

Low start-up current

Low thermal resistance between winding and housing

Aluminium or copper rotor design

Low stray load loss due to design with low harmonic content

Motor design for different mounting arrangements (B3, B5, B14...)

Single phase design for submersible pump applicaiton, rewindable or encupsulated

High Efficiency Industrial Motors

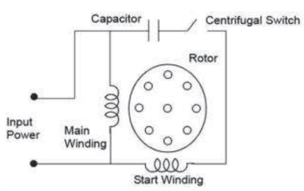
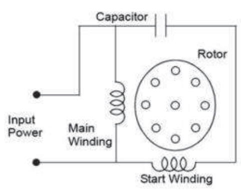
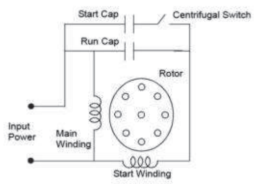
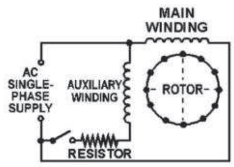
Single Phase Asynchronous Motor

Single phase induction motor is an AC motor where electrical energy is converted to mechanical energy to perform some physical task. This type of induction motor requires only one power phase for their proper operation. They are commonly used in low power applications, in domestic and industrial use.

Simple construction, cheap cost, better reliability, eases to repair and better maintenance are some of its markable advantages.

Stator has two type windings, **Main Winding** and **Auxiliary Winding**. Usually, the Auxiliary winding is magnetically perpendicular to the main winding. In 1Ø induction motor the winding with more turns is known as main winding. While the other wire is called as auxiliary winding.

Comparison of main types of single phase induction motor

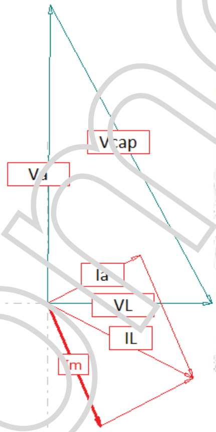
				
Type	Capacitor Start/Induction Run	Permanent Split Capacitor	Capacitor Start/Capacitor Run	Resistance Start/Induction Run
Horsepower range	1/8 to 10	1/20 to 1/3	1/2 to 20	1/20 to 1/3
Load-starting ability	Hard starting loads. Develop 300% of full load torque	Easy starting loads. Develop 150% of full load torque	Hard starting loads. Develop 250% of full load torque.	Easy starting load. Develop %150 of full load torque
Starting current	Medium, 3 to 6 times of full load current	High, 5 to 7 times of full load current	Medium. 3 to 5 times of full load current	Medium.
Characteristics	Simple construction, long service, good general-purpose motor suitable for most applications	Inexpensive, simple construction, nearly constant speed with varying load	Simple construction, long service with medium maintance, requires more space due to large capacitor	Simple construction
Electrically reversible	Yes	Yes	Yes	Yes
Typical Uses	Reciprocating compressor, conveyor, vacuum pump.	Fan, centrifugal pump, a load that increasesas speed increases	Conveyor, barn cleaner, elevator, silo unloader	Fans

Electrical & Magnetic Design

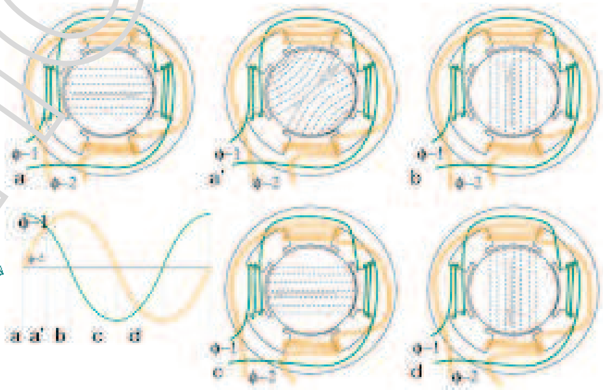
Asynchronous motor design is performed by using analytical model and optimized with this model. Next step is to check the design by the means of FEM or BEM analysis. Auxilary and main winding amper-turn ratio shoud be optimized for low torque ripple, lower current and higher efficiency. Euler's theory says that a rotating magnetic filed in airgap of electric motor can be obtained if auxilary and main windings are placed mechanically at 90° and they should be supplied currents that have phase angle of 90° according to each other. For circular path rotating field, the amplitude of two field should be the same. If not the path of rotating filed will be eliptical. In general single phase induction motor has eliptical path rotating field and this decreases efficiency and increases torque ripple and vibration.

2, 4 and 6 poles desing can be performed for different application.

For reliability the capacitor rated voltage should be selected according to calculated capacitor voltage in phasor diagram at no load.



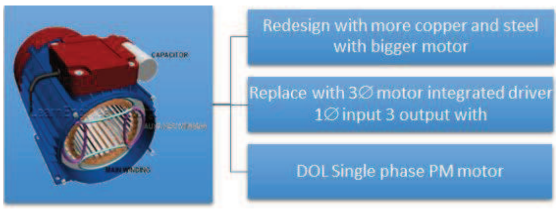
Phasor diagram of a well optimized single phase motor



Rotating filed with split phase

Future Efficiency Regulation for Single Phase Motors

Most of the current design of single phase industrial induction motor doesn't reach IE1 and IE2 energy levels as showm below table. 0.55kW and below rated power of single phase motors reach IE1 level but don't reach IE2 level. 0.55kW and above rated power of them don't reach IE1 and IE2 level. After 2018 year, a new efficiency regulation of IE2 may be mandatory. In this case all single phase motor should be modified or should be replaced by another technology. Promote AS has know-how to modify of current design and replacement technology for split phase motor technology.



Typical efficiency of industrial single phase motor and IE1 and IE2 energy requirements

rpm	3000							
kW	0.18	0.25	0.37	0.55	0.75	1.1	2.2	3
Eff [%]	62	70	65	70	67	72	79	80
IE1	52.8	58.2	63.9	69	72.1	75	79.7	81.5
IE2	53.6	64.8	69.5	74.1	77.4	79.6	83.2	84.6

rpm	1500								
kW	0.12	0.18	0.37	0.55	0.75	1.1	1.5	2.2	3
Eff [%]	57	65	65	69	74	75	77	78	80
IE1	50	57	66	70	72.1	75	77.2	79.7	81.5
IE2	59.1	64.7	72.7	77.1	79.6	81.4	82.8	84.3	85.5

rpm	1000						
kW	0.18	0.25	0.37	0.55	0.75	1.1	1.5
Eff [%]	52	60	63	67	70	72	72
IE1	45.5	52.1	59.7	65.8	70	72.9	75.2
IE2	56.6	61.6	67.6	73.1	75.9	78.1	79.8