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Three-phase motor driven with single phase

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TABLE OF CONTENTS

1	Preliminary tasks:	3
1.1	Check out the Leybold Didactic GMBH folder SYNCHRONOUS MACHINES 1: SYNCHRONOUS MOTOR (And see also the appendix, page 6). Error! Bookmark not defined.	
1.2	How does a synchronous motor work? How does it differ from the operation of the induction motor? Error! Bookmark not defined.	
1.3	In what kind of applications synchronous motors are being used? Error! Bookmark not defined.	
1.4	What is connected to connection points F1 and F2? Error! Bookmark not defined.	
1.5	How to start a synchronous motor? (see Leybold Instruction and Annex p. 7, chapter 1.4.3 Explanation) Error! Bookmark not defined.	
1.6	How to change the direction of a synchronous motor? Draw a basic diagram? Error! Bookmark not defined.	
2	Laboratory work:.....	6
2.1	Laboratory work 1:	6
2.2	Laboratory work 2: Error! Bookmark not defined.	
2.3	Laboratory work 3: Error! Bookmark not defined.	
	BIBLIOGRAPHY	11

1 Preliminary tasks:

1.1.1 How to connect a three-phase motor to a 1-phase motor?

How to switch a Δ -coupled 3-phase motor to 1-phase? Draw a picture.

To adapt a Δ -connected 3-phase motor for single-phase operation, we can employ a static phase converter method, which involves the utilization of a capacitor to create phase displacement. The motor's three-phase winding remains intact, and a capacitor is used to shift the phase, allowing the motor to start and operate on a single-phase power supply. The capacitor is employed to introduce a phase shift, much like the principle used in single-phase induction motors. However, it's important to note that the motor's output and efficiency are reduced to approximately 2/3 of its rated capacity when operated in this manner.

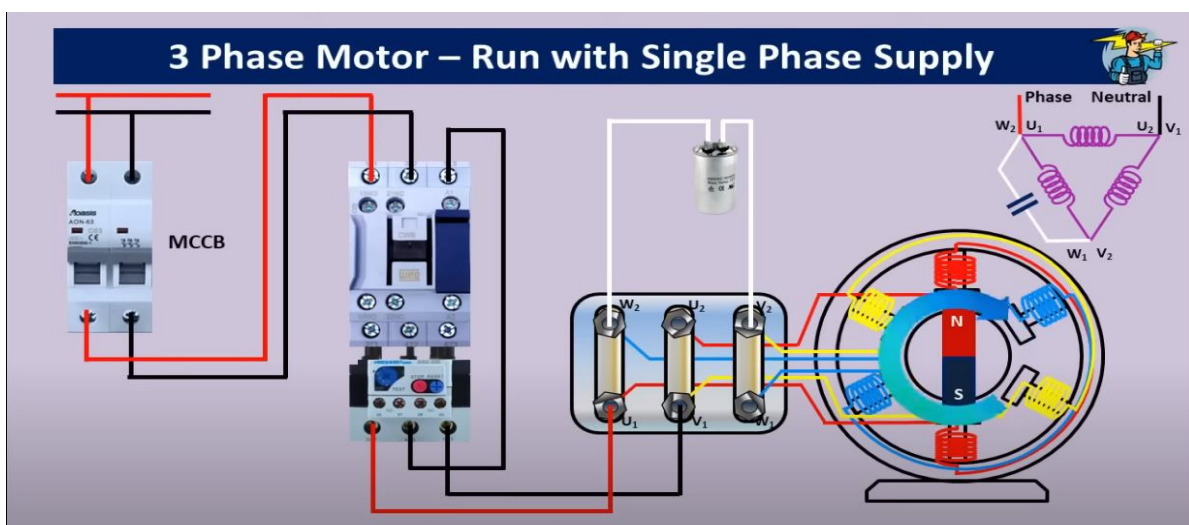


Figure 1 3- phase motor runs with single phase

1.1.2 How to connect a Y-coupled 3-phase motor to a 1-phase motor? Draw a picture.

Converting a Y-coupled 3-phase motor to run on a single-phase power supply also involves the use of a capacitor to create a phase shift. The specific connection and capacitor placement may vary depending on the motor's winding configuration, but the basic principle remains the same.

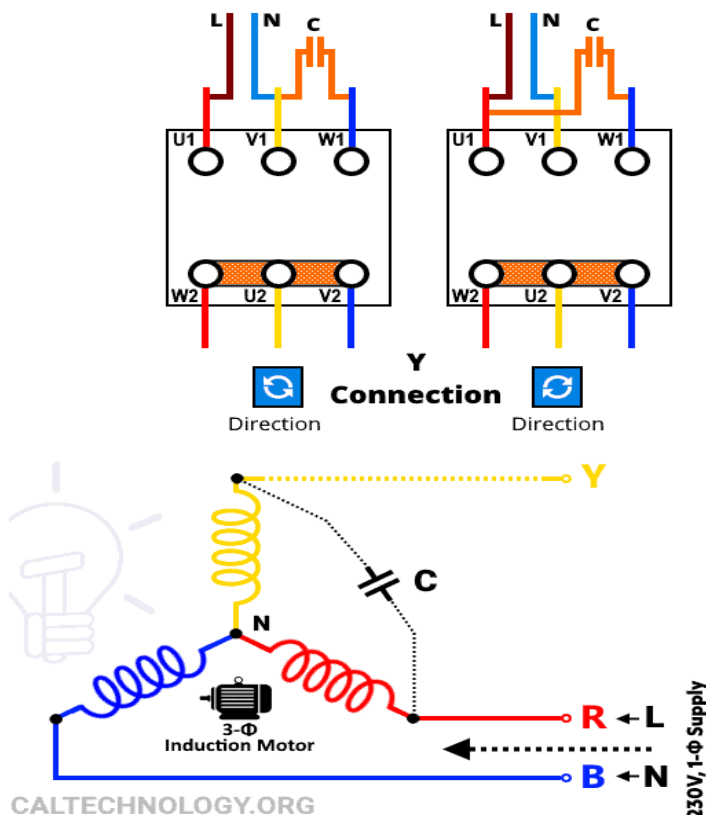


Figure 2 a Y-coupled 3-phase motor to a 1-phase motor

1.1.3 How to size the capacitor to be used (how to know what is the optimal amount of capacitance)?

Capacitor selection: 70 μF for every kilowatt (70 $\mu\text{F}/\text{kW}$)

1.1.4 Why are these motors connected differently?

Three-phase motors are typically used with three-phase power supplies for greater efficiency and torque. When they are connected to 1-phase power supplies, they may not operate as efficiently or provide the same level of performance. The different connections (Δ or Y) correspond to the motor's internal winding configuration, which affects its voltage and current requirements.

1.2 How do you reverse the rotational direction of these 1-phase driven motors?

To reverse the rotational direction of a single-phase motor, you can typically achieve this by swapping the connections of the start capacitor winding.

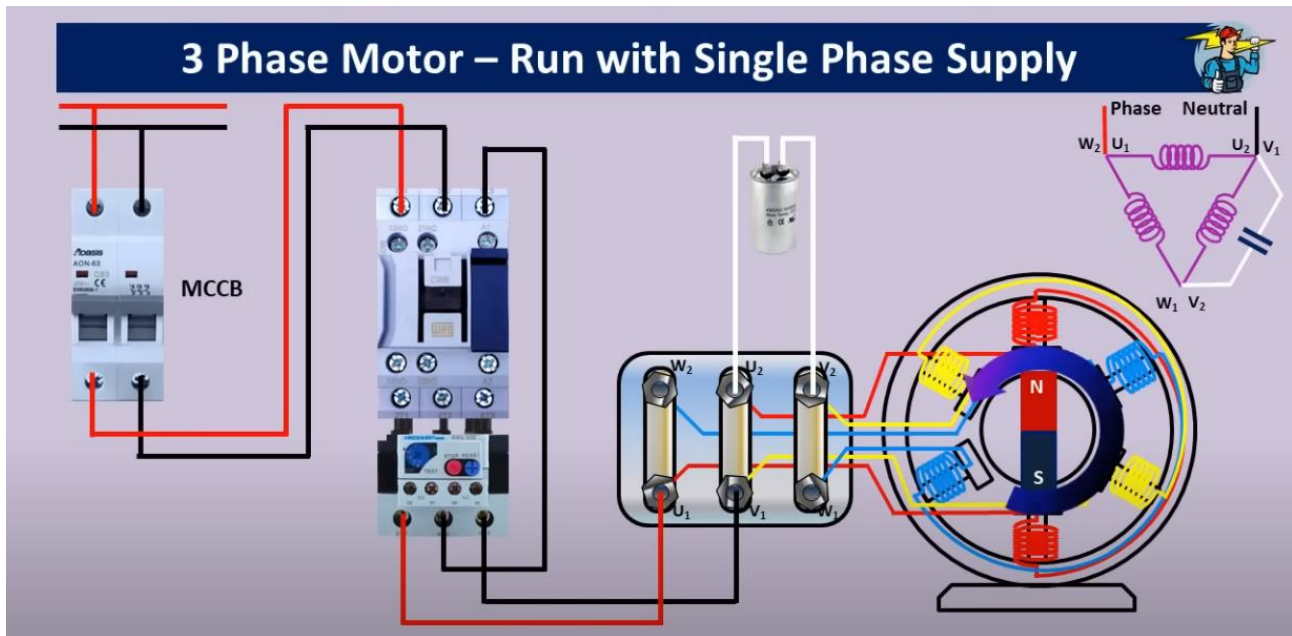


Figure 3 Delta connected 3phase motor reversed.

2 Laboratory work:

2.1 Laboratory work 1:

Connect the 3-phase motor with one phase. Use the capacitors of a capacitor motor (try both). Measure the no-load current, power and $\cos \varphi$.

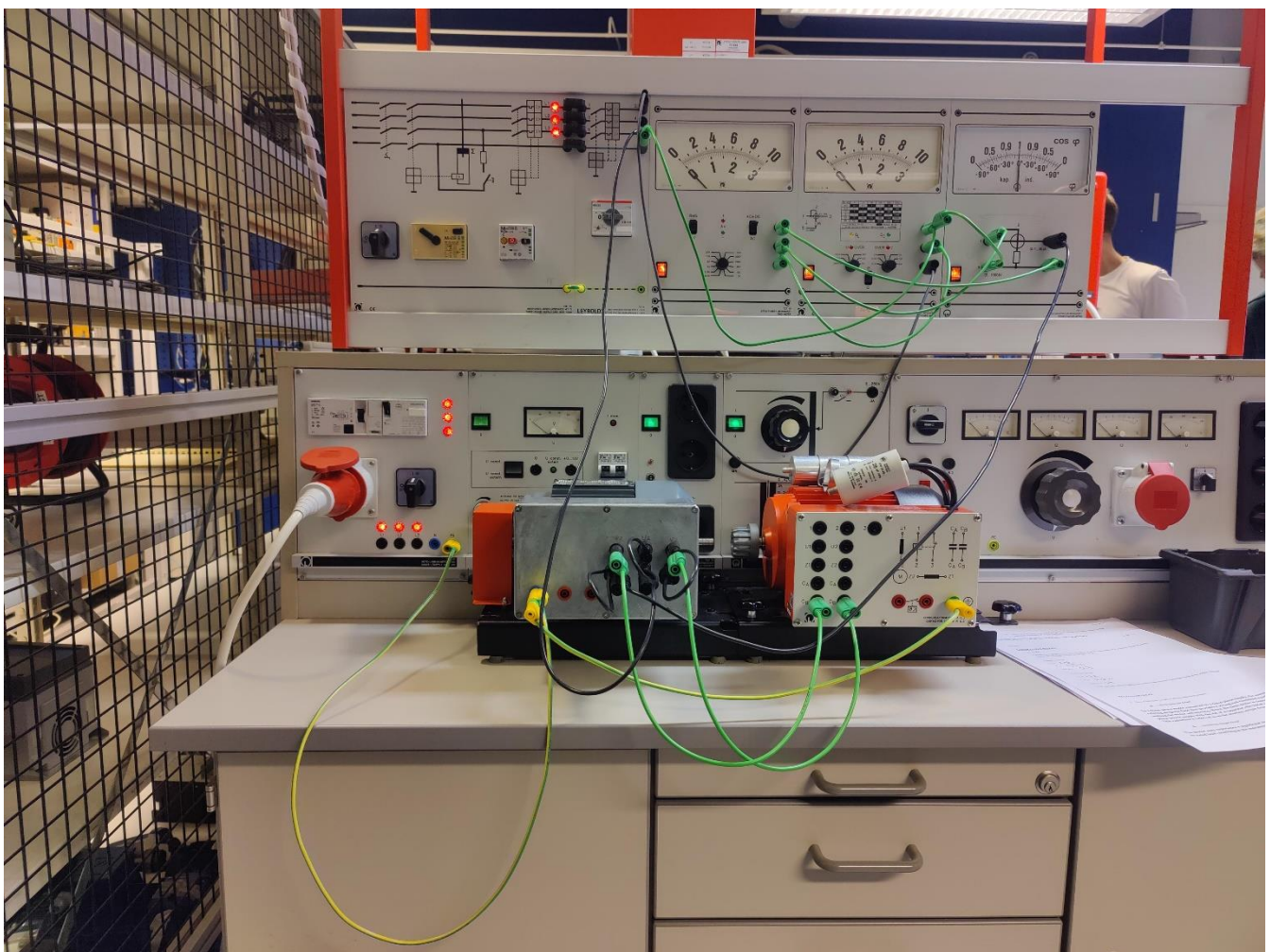


Figure 4 Laboratory connections 1

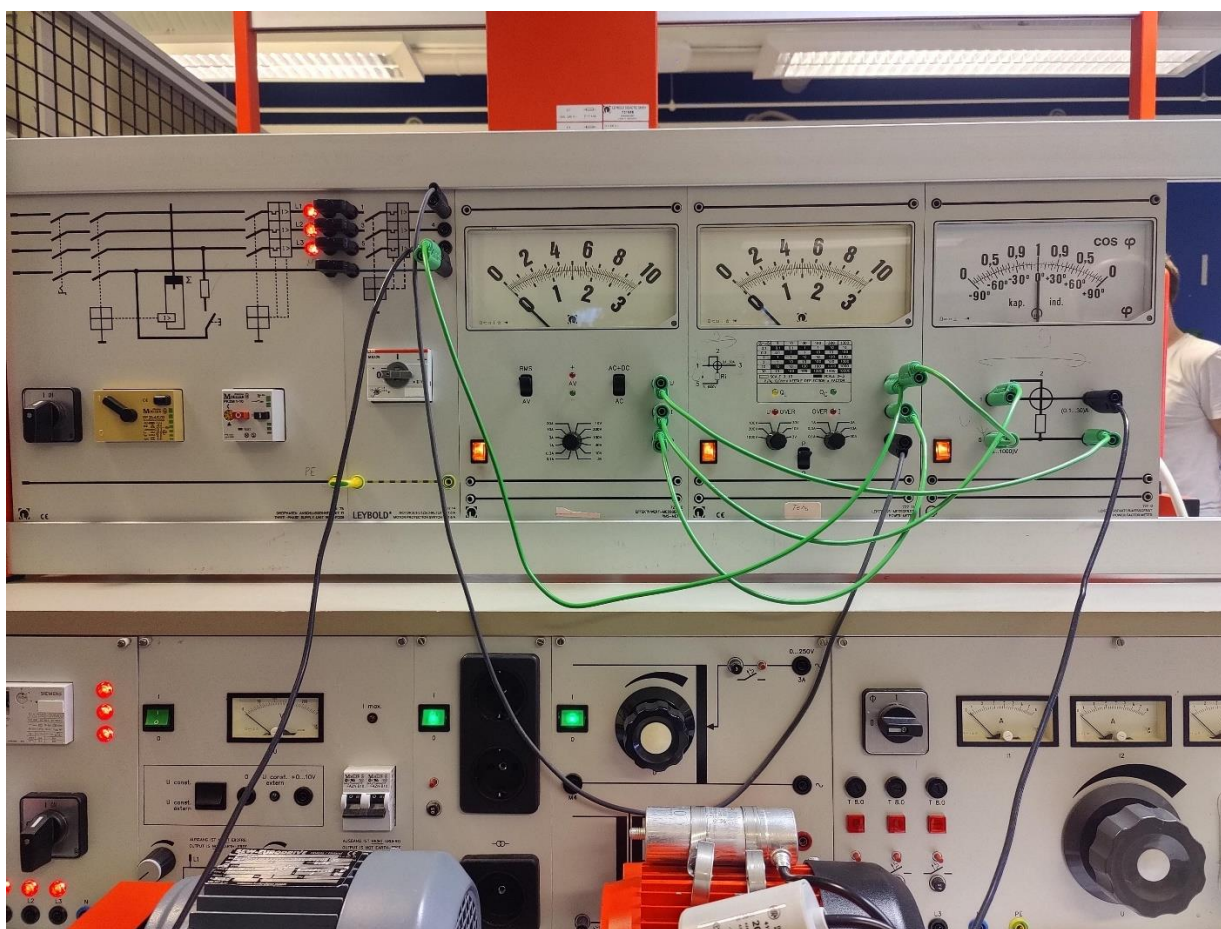


Figure 5 Laboratory connections 2

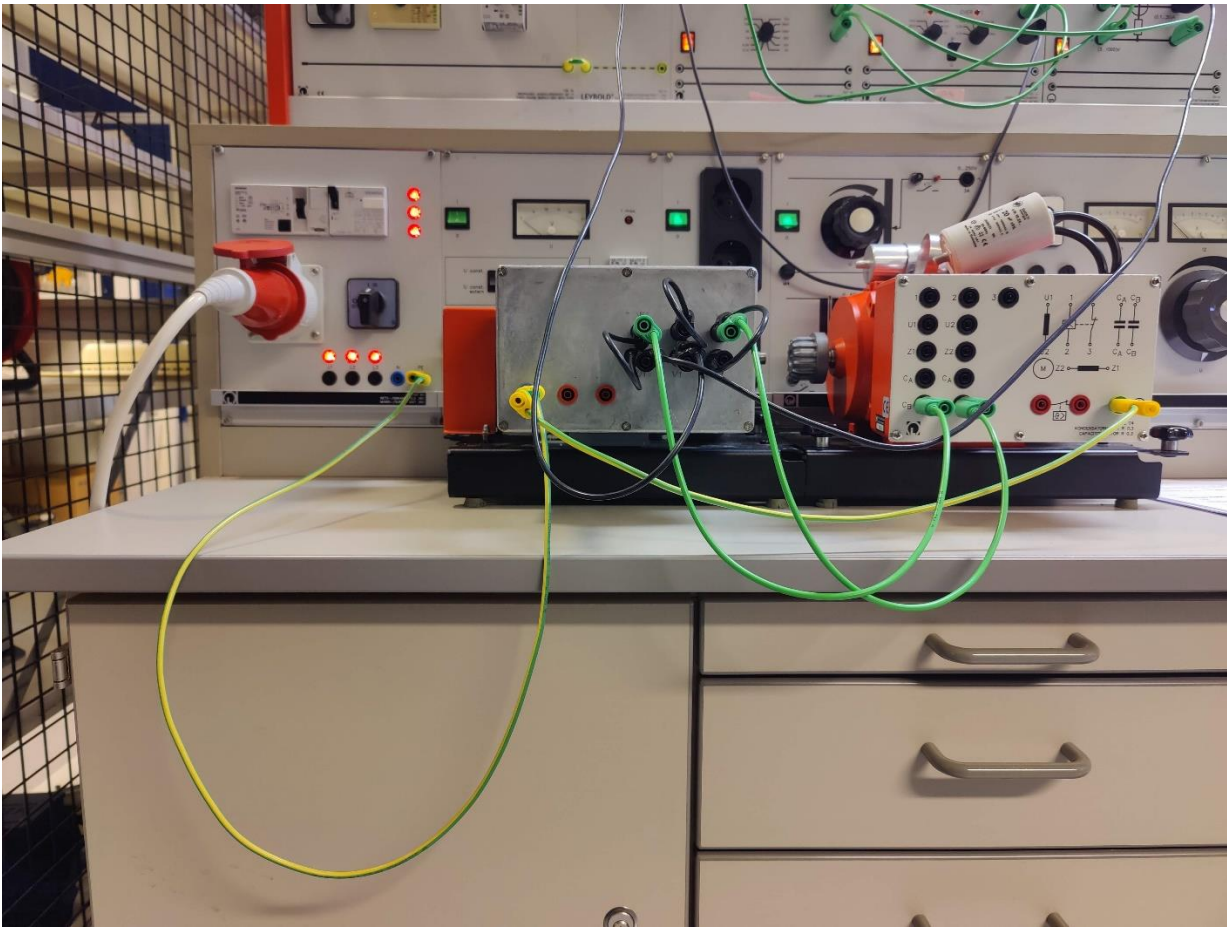


Figure 6 Laboratory connections 3

Capacitor 10 μF

$$I_1 = 1,4\text{A}$$

$$P_1 = 105\text{W}$$

$$\cos \varphi = 0,3$$

Capacitor 20 μF :

$$I_2 = 1,2\text{A}$$

$$P_2 = 140\text{W}$$

$$\cos \varphi = 0,4$$

Can you tell which capacitor is closer to the correct size by the sound of the engine running?

The larger capacitor 20 (uF) is closer to the correct size we can feel the different.



Figure 7 Motor name plate

And by calculation we can choose the correct one

“Capacitor selection: 70 μ F for every kilowatt (70 μ F/kW)”

This motor's power is 0,3 kW

So capacitor has $70 \mu F * 0,3 = 21 \mu F$ will be the correct one

2.2 RELATED ARTICLES

2.2.1 How much does a 1-phase driven induction motors...

a. ...starting torque drop?

In a three-phase motor connected to a three-phase supply, the motor generates a rotating magnetic field that provides a strong and consistent starting torque, making the motor self-starting. When the same motor is connected to a single-phase power supply with the aid of a capacitor, the initial torque is reduced. This reduction is referred to as the starting torque drop.

b. ...maximum torque drop?

The motor may experience a significant reduction in torque when subjected to its rated load, resulting in the maximum torque drop.

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