



SEINÄJOEN AMMATTIKORKEAKOULU  
SEINÄJOKI UNIVERSITY OF APPLIED SCIENCES

Kiet Vu, Tarek Helal

---

## **ELECTRIC DRIVES laboratory works 2023**

Frequency converter drives

Assignment  
Autumn 2023  
SeAMK Faculty  
Degree Programme



## TABLE OF CONTENTS

1	Preliminary tasks: .....	4
1.1	What determines the coupling used (star/delta)? .....	4
1.2	What cables should be used when using the inverter and why? .....	4
1.3	What kind of interference does the inverter cause? .....	5
1.4	What type of inverter is the Yaskawa V 1000? (scalar, vector, DTC) .....	5
1.5	When is a thermal relay also needed when using an inverter (frequency converter)? .....	6
1.6	Design below the connections of the inverter to be made in the laboratory: which terminals will the cables be connected to? .....	6
2	Laboratory work: .....	7
2.1	Laboratory work 1: .....	7
3	Bibliography .....	15



Figure 1 Frequency converter



Figure 2 Controlled 3-phase motor = 1.1 kW, 4-pole,  $I_n = 2.7$  A.

## **1 Preliminary tasks:**

What determines the coupling used (star/delta)?

The choice between a star (Y) or delta ( $\Delta$ ) motor connection is primarily determined by the motor's winding configuration and the inverter's output voltage.

- Star (Y) Connection: This configuration is used for motors with windings that have a higher voltage rating. It is typically used when the inverter's output voltage matches the motor's rated voltage when connected in a star configuration.

- Delta ( $\Delta$ ) Connection: Delta connections are used for motors with windings designed for lower voltage. In this configuration, the inverter's output voltage is usually lower than the motor's rated voltage when connected in delta.

### **1.1 What determines the coupling used (star/delta)?**

The choice between a star (Y) or delta ( $\Delta$ ) motor connection is primarily determined by the motor's winding configuration and the inverter's output voltage.

- Star (Y) Connection: This configuration is used for motors with windings that have a higher voltage rating. It is typically used when the inverter's output voltage matches the motor's rated voltage when connected in a star configuration.

- Delta ( $\Delta$ ) Connection: Delta connections are used for motors with windings designed for lower voltage. In this configuration, the inverter's output voltage is usually lower than the motor's rated voltage when connected in delta.

### **1.2 What cables should be used when using the inverter and why?**

When using an inverter like the YASKAWA V1000, it's important to use appropriate motor cables, typically shielded and rated for variable frequency drive (VFD) applications. Common cable types include:

- **Shielded Motor Cable:** This cable type is shielded to reduce electromagnetic interference (EMI) and radio-frequency interference (RFI). It helps maintain signal integrity and protects against external interference.
- **Multi-Conductor Cable:** The number of conductors depends on the motor and application requirements. For a 3-phase motor, a 4-conductor cable is often used.
- **Cable Size (Gauge):** The cable size should be selected based on the motor's current requirements and the distance between the inverter and the motor. Refer to the inverter's manual for sizing guidelines.

Using the appropriate cables is crucial to ensure reliable and safe operation, reduce interference, and protect the equipment.

### **1.3 What kind of interference does the inverter cause?**

Inverters can generate electromagnetic interference (EMI) and radio-frequency interference (RFI). This interference can affect nearby electronic devices and systems. To mitigate this interference, inverters are often equipped with built-in filters, and it's essential to use shielded cables and proper grounding techniques to minimize the impact of EMI and RFI.

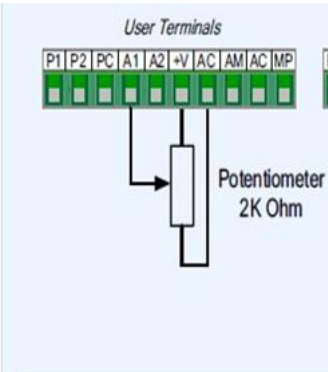
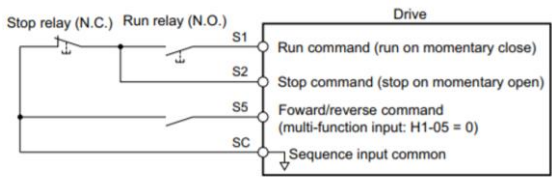
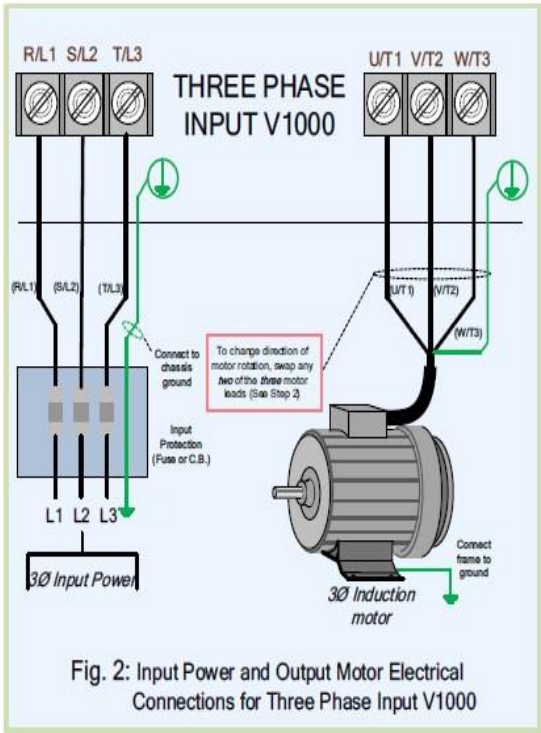
### **1.4 What type of inverter is the Yaskawa V 1000? (scalar, vector, DTC)**

The YASKAWA V1000 is a vector control inverter. It provides precise control of motor speed and torque, making it suitable for a wide range of applications. Vector control enables the inverter to maintain high performance and efficiency, especially in demanding industrial environments.

1.5 When is a thermal relay also needed when using an inverter (frequency converter)?

A thermal relay, also known as a motor overload relay, is used to protect the motor from overheating due to excessive current. In some applications, it may be used in conjunction with an inverter to provide additional motor protection.

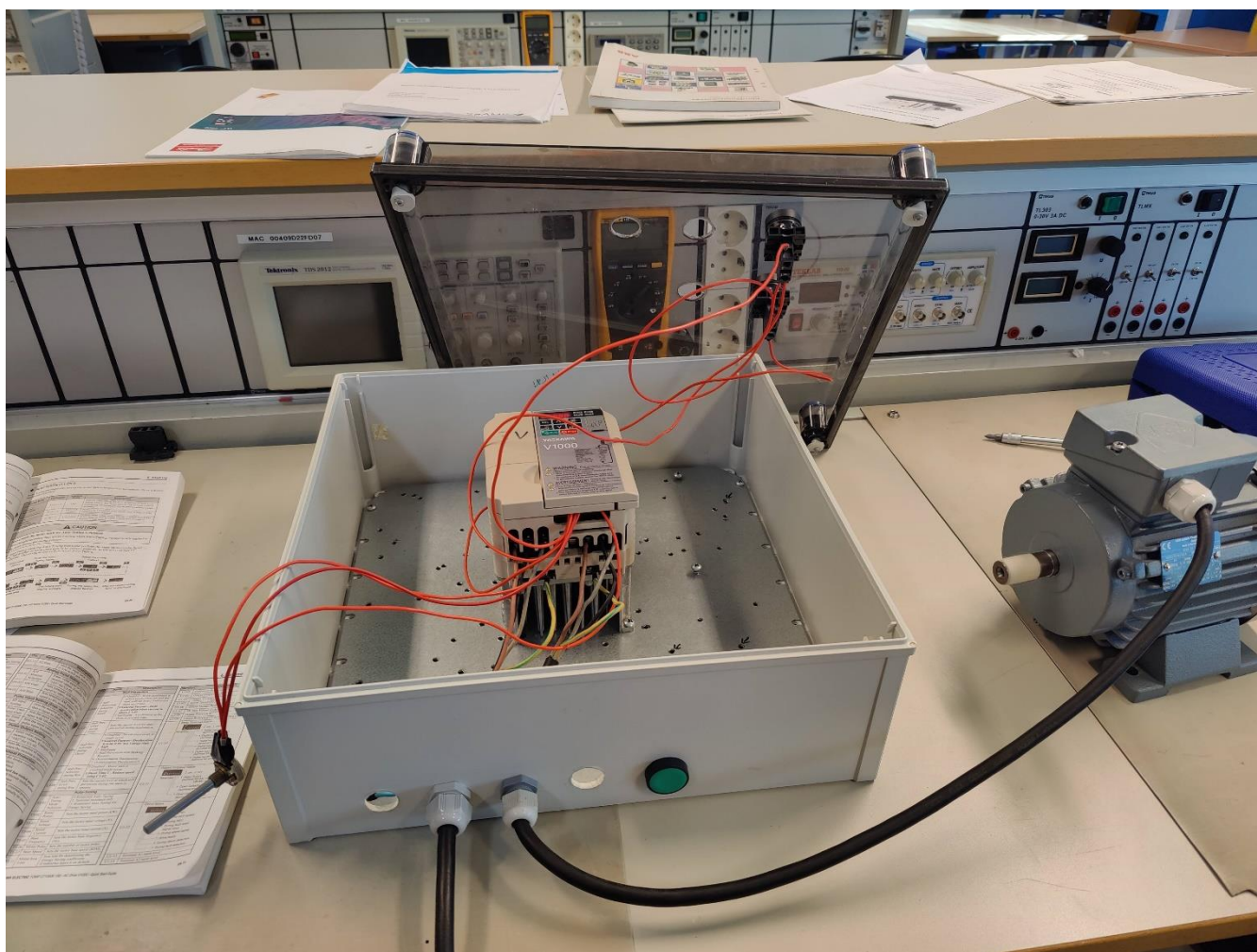
1.6 Design below the connections of the inverter to be made in the laboratory: which terminals will the cables be connected to?



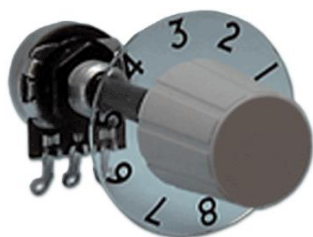
## 2 Laboratory work:

### 2.1 Laboratory work 1:

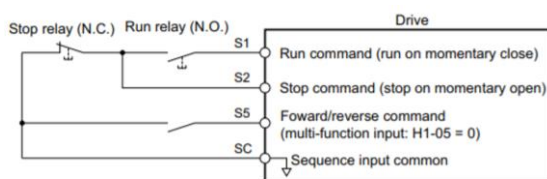
1. Install a 3-phase inverter in an empty cabinet



2. Install the speed adjustment potentiometer on the side of the cabinet POTE 1 (0-4,7 k $\Omega$ )



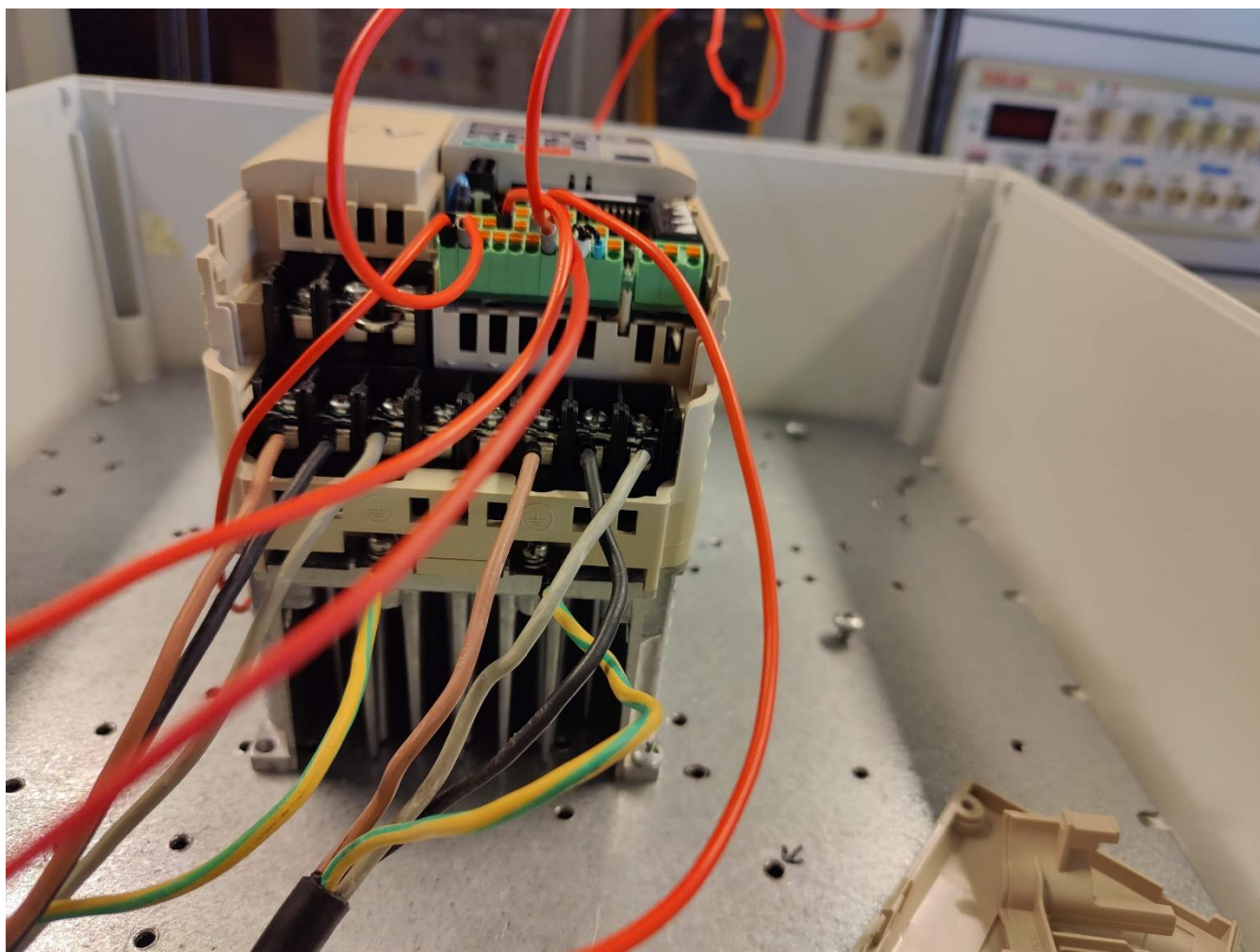
### 3. Install the START and STOP buttons

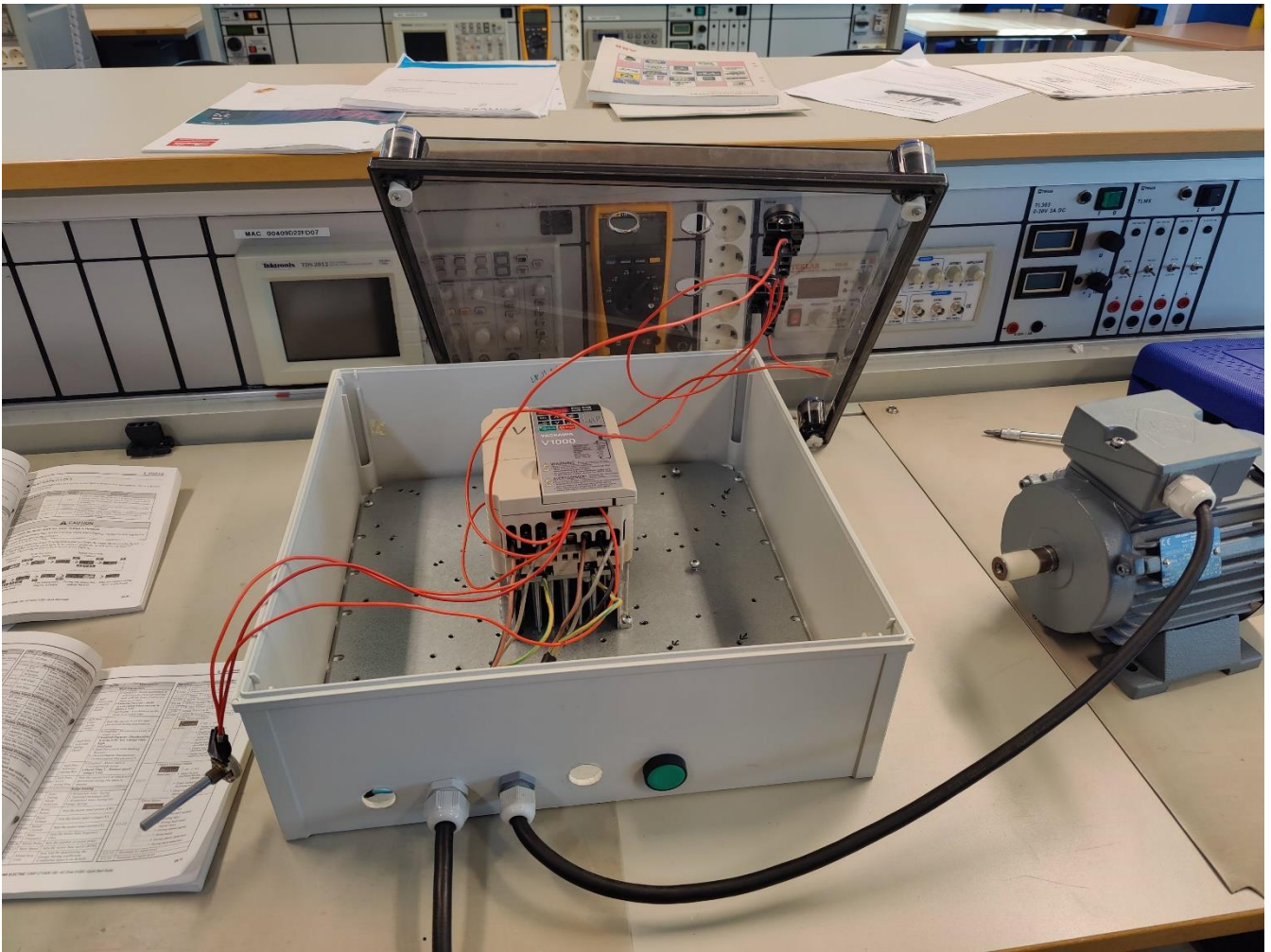


**Figure 3.2 3-Wire Sequence**

Directional switching -> parameter H1-05 = 0

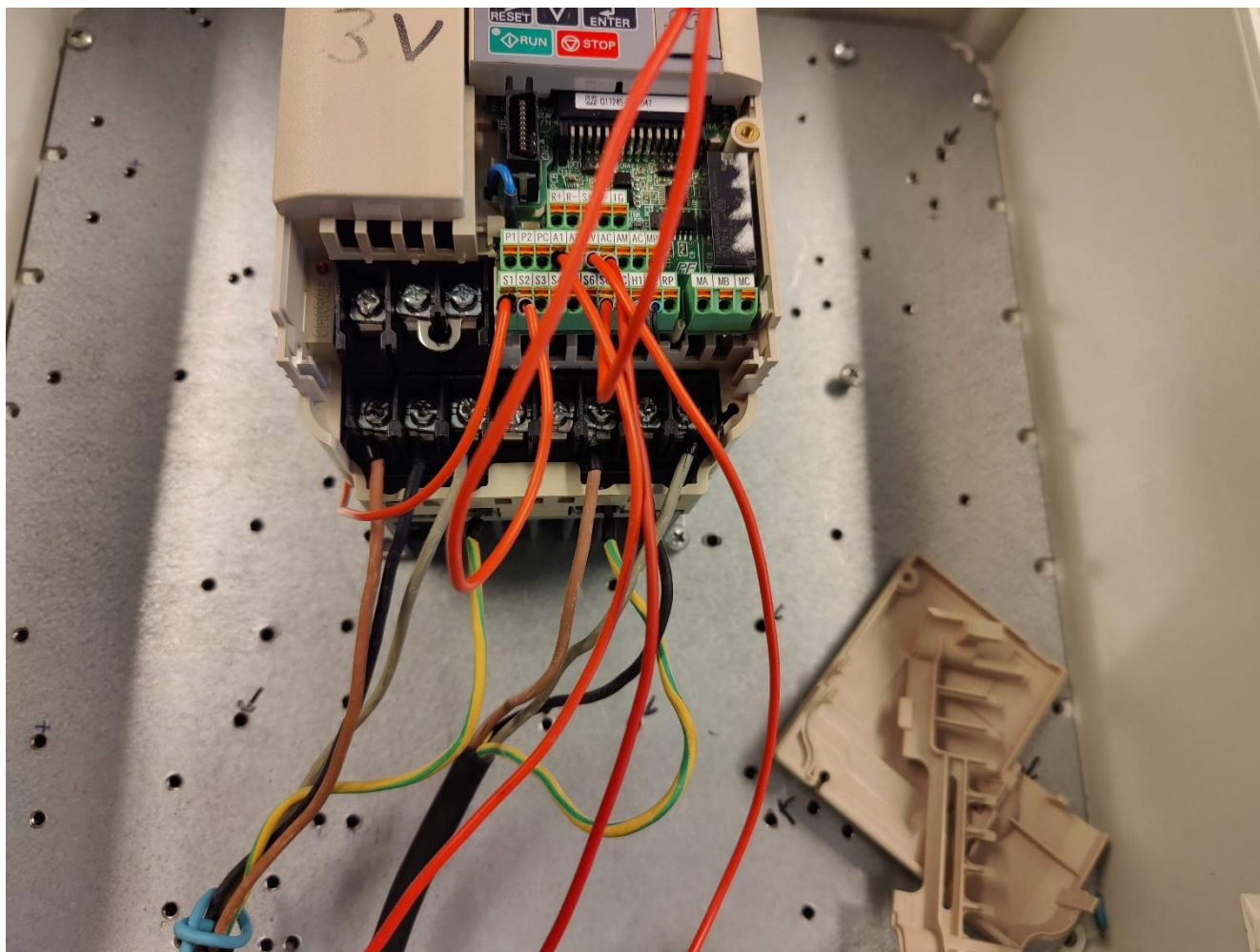






4. Wire the motor cable from the drive to the motor with Flex 4x1,5 cable

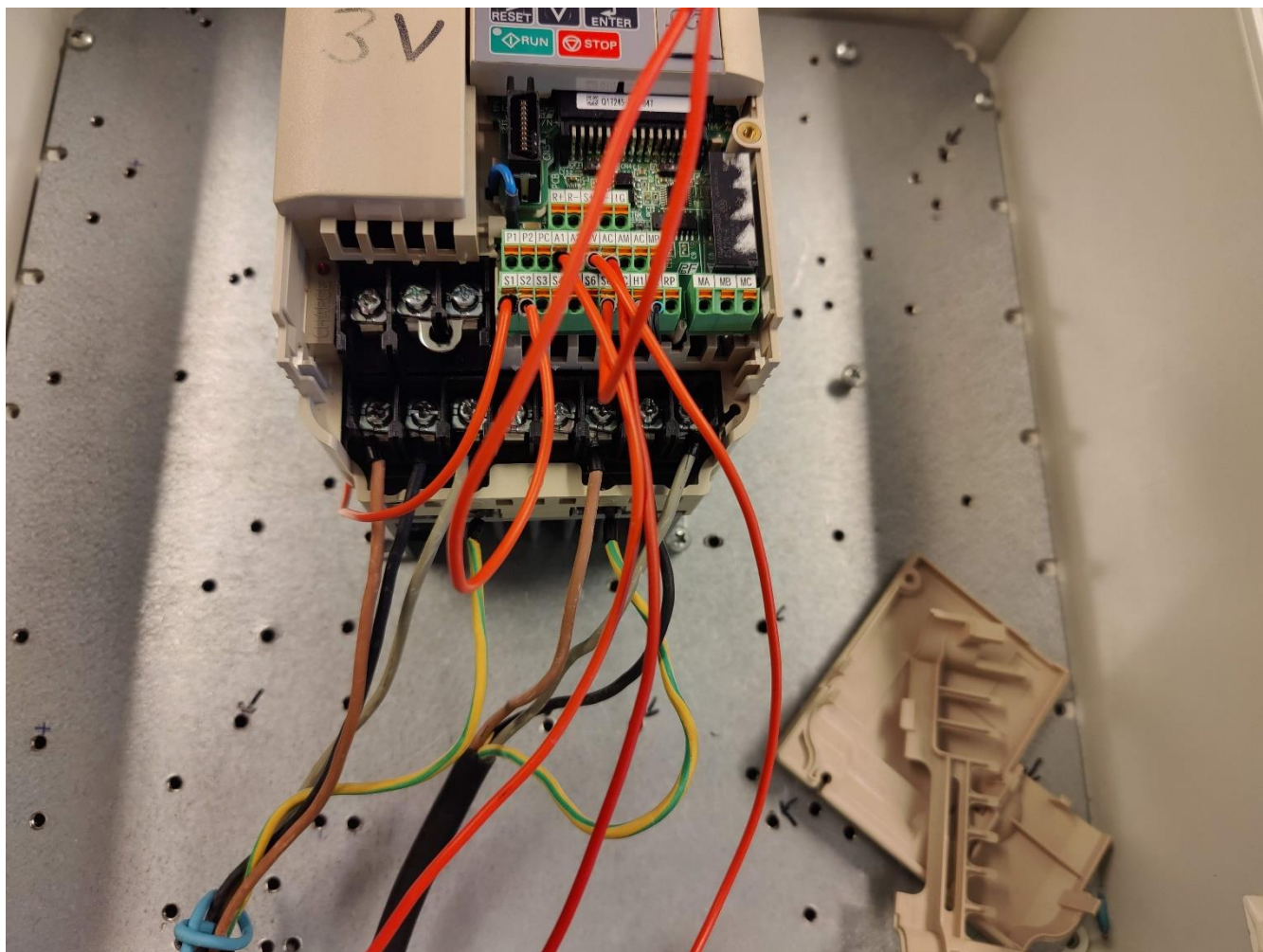




S1 s2 sc



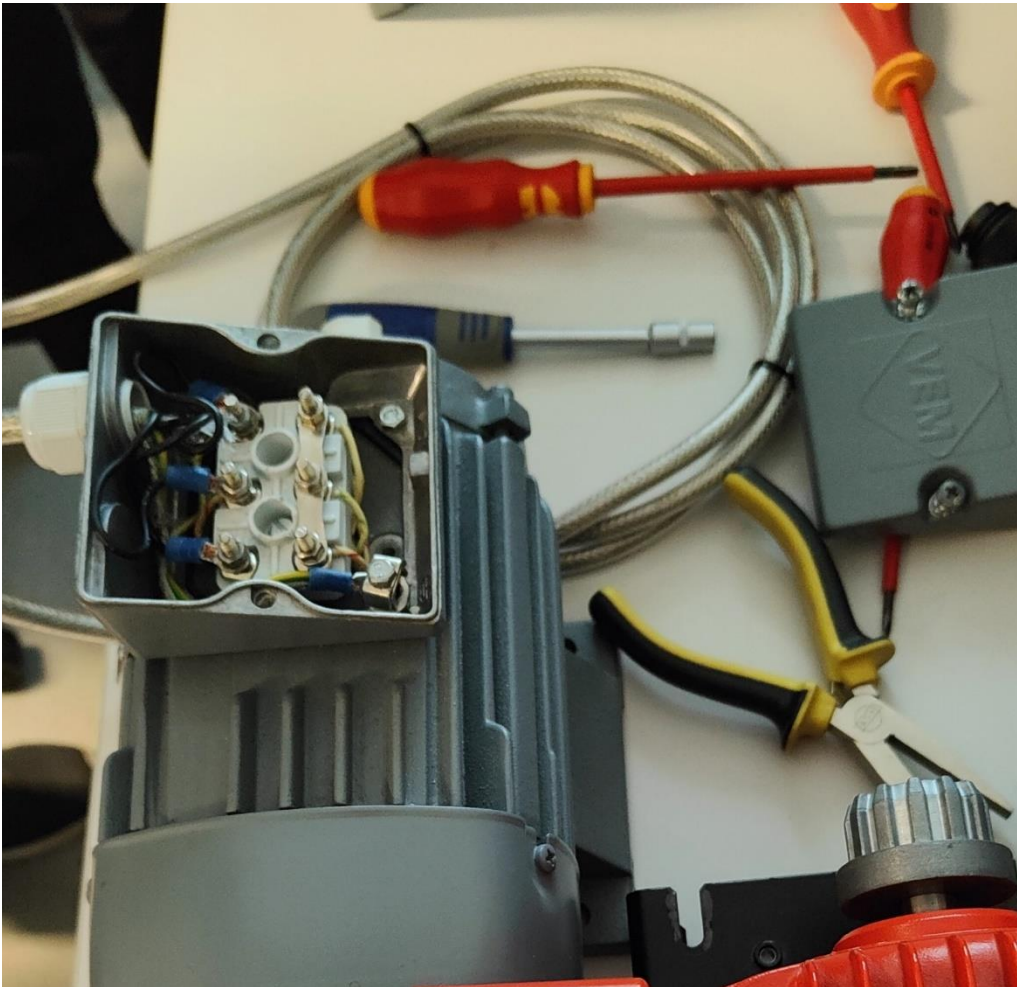
5. Wire the speed control knob and buttons



A1 +v ac

6. Connect the induction motor to the correct connection (star or delta?)

- Star



7. Program the YASKAWA inverter (set power, voltage, current, speed), etc.

**Parameters Setting:**

- We checked that b1-01 is set to "1" (Frequency reference from analog input).

Parameter	Name	Setting
A1-02	Control Method Selection	= 0
A1-07	A1-07 DriveWorksEZ Function Selection	= 1
b1-01	Frequency Reference Selection 1	= 1
b1-02	Run Command Selection 1	= 0
E1-04	Maximum Output Frequency	= 50
E1-05	Maximum Voltage	= 400
E1-06	Base Frequency	= 50
E1-07	Mid Output Frequency	= 10
E1-09	Minimum Output Frequency	= 2.5
H1-05	Multi-Function Digital Input Terminal	= 0

## Auto-Tuning

### By using nameplate values:

- T1-02, motor output power
- T1-03, Motor Rated Voltage
- T1-04, Motor Rated Current
- T1-05, Motor Base Frequency
- T1-06, Number of Motor Poles
- T1-07, Motor Base Frequency

### 8. Test the operation of the inverter (potentiometer speed)

During the testing phase, we carefully manipulated the potentiometer speed control knob to adjust the motor's speed. Our observations confirmed that the motor responded accurately to these adjustments. We noted that the motor displayed smooth acceleration and deceleration, reflecting the precise control achieved through the potentiometer settings.

### 3 Bibliography

1. YASKAWA V1000 Technical Manual. Retrieved from <https://inverterdrive.com/file/Yaskawa-V1000-Cimr-VC-Manual>.