Intelligent motor controller

1. Purpose of the exercise:

The purpose of the exercise is to get to know the functions of the intelligent motor controller for protecting and controlling electric drives.

2. Tasks to be completed:

- To get acquainted with the operation of the LCD and the protection functions of the UMC motor controller.
- To set the protections of the UMC controller for the motor available on the station.
- Execution of three options (direct, star-delta, reversing) motor starts by the UMC controller.
- To test the protection functions of the UMC controller by activating possible disturbances at the station, such as overload, power failure, and temperature increase.
- To observe the controller's operation according to previously set settings.

3. Theoretical introduction

Induction motor starting methods:

- Direct-on-line (full-voltage) start - In direct-on-line starting, the motor is connected directly to the mains through a switch or electromechanical contactor. After switching on the power, still with the rotor stationary, the motor draws a large starting current. At the same time, the starting torque does not increase, which is the most significant disadvantage of direct motor starting. When inrush currents flow too long, they can cause the motor to overheat and the mains voltage to drop. The multiplicity factor of the starting currents is in the following ranges: 4-8 for squirrel-cage induction motors. In the case of a direct start-up, this method

is used for low-power motors of the order of several or dozen kilowatts (depending on the power supply network).

- Star-delta starting - The star-delta switch limits the starting currents of induction motors. For the start-up time, the motor (stator winding) is star-connected, then, after the motor reaches a speed close to synchronous, manual (or automatic) delta switching is performed.
  This solution reduces the starting current three times. However, the starting torque is reduced three times. It is the reason why this type of starting is used for light (light duty) starts.
- Reversing start - a direct-on-line start in two directions of rotation. Although the direction of rotation of the motor can be changed after stopping the motor, it is not possible to change the direction of movement while the motor is running. It is performed using automatic switching of electromechanical contactors.

Boot methods implemented by the controller

Among the types of work of our engine, we can choose:

- direct-on start,
- reverse start,
- star-delta starting.

In order to select the appropriate starting method, set the switch on the mock-up to the position:

- 1 for a direct-on start,
- 2 for a reversible drive,
- 3 for a star-delta starting.

Please note that the main circuit must be on before any start-up, the function switch must be in the correct position, and the UMC must be correctly configured using the LCD panel. After that, the engine can be started using the buttons and the control panel. Any operation on the function switch is prohibited when the engine is running!

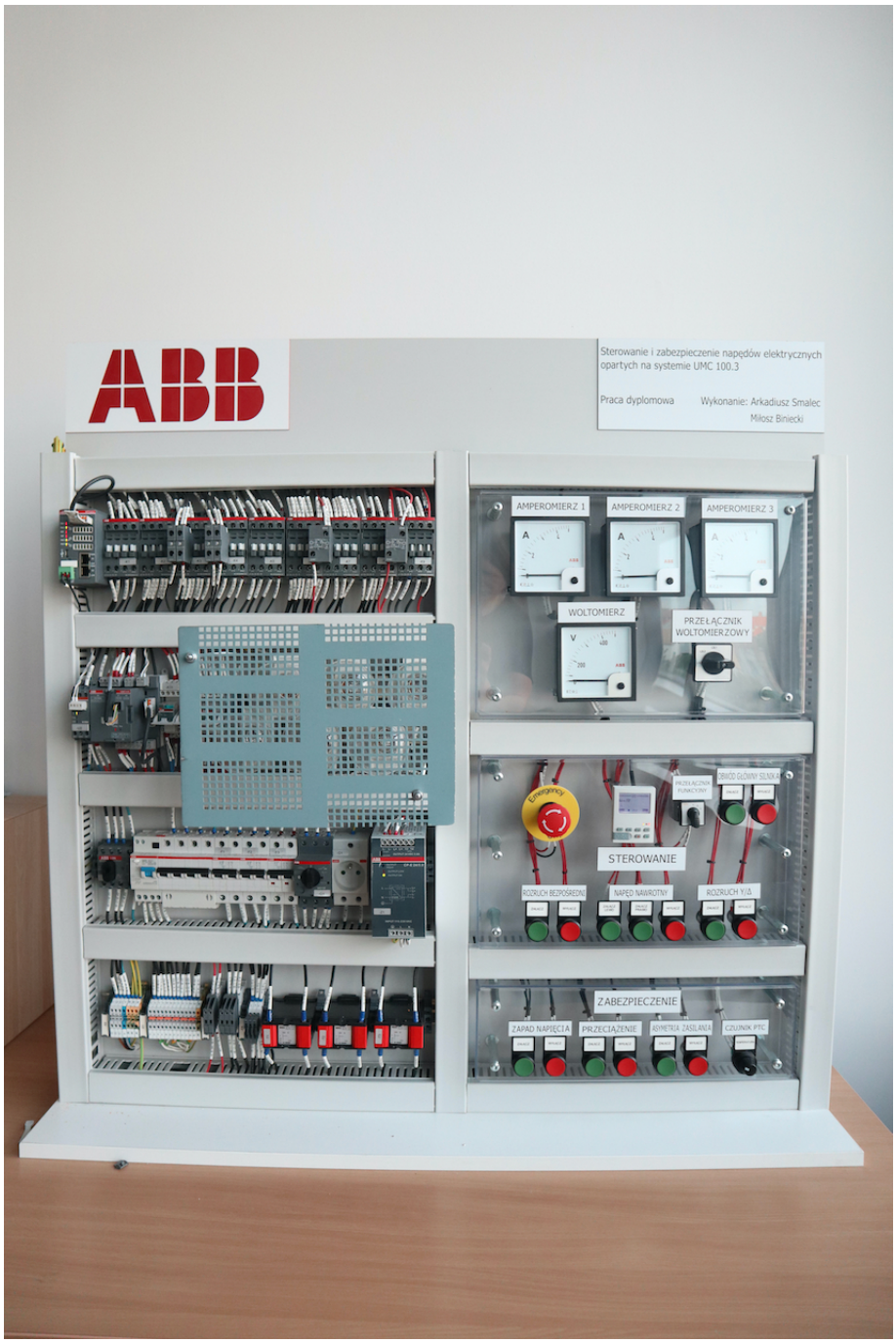

Figure 1. A laboratory stand for testing the UMC 100 motor controller.

Induction motor protection

- overcurrent protection - protects the motor against overload and short-circuit currents,
- temperature protection - protects against overheating in the motor windings,
- undervoltage and overvoltage protection.

The security given by an intelligent controller:

The UMC 100.3 controller has many functions to protect the electric motor. There are, among others, security features such as:

- Current by setting threshold values for trip and alarm levels.
- Undervoltage and overvoltage by setting threshold values for trip and alarm levels.
- Phase failure detection.
- Stall protection during motor start-up and regular operation.
- Thermistor motor protection (PTC).
- Ground fault detection.
- Motor protection is based on power control.
- Quality control of the supply voltage.
- Protection based on PT100 or PT1000 sensors.
- Analog inputs are used, for example, to confirm operation or control the status of the contactor (protection against "glued contractor").

In addition, the user can select the trip class for the controller (5E, 10E, 20E, 30E, and 40E)

Diagnostics, monitoring, and measurements

The intelligent controller allows you to monitor the engine's operating status and receive diagnostic information through:

- LEDs directly placed on the controller (signaling readiness, work, failure),
- LCD panel (signaling diodes, text messages, and current measurements),
- a computer connected directly to the controller equipped with Asset Vision Basic software for UMC100.3 diagnostics and configuration,

- communication bus.

4. Guidance questions - check yourself

- Do you distinguish and identify the methods of starting an induction motor?
- Can you list and characterize the protections of an induction motor?
- Do you know the advantages of an intelligent controller to control and protect an induction motor?

5. Exercise program

A. **Protection setting:**

- Current
- Voltage
- Powerful
- Thermal
- Engine stalls
- Phase loss
- Reconnection while repowering the phase

B. **Simulating emergency states:**

- Power failure
- Overload
- Phase imbalance
- Thermal overload

C. The effectiveness of protections while simulating emergency states checking and analyzing.

A 2.2kW ABB motor is connected to the stand. During the exercise, the machine is idling. Classic 200W incandescent bulbs were used to simulate the voltage dip and overload. Power asymmetry is realized by switching the power circuit to the contactor with one of the phases unpowered.

Slowly changing overload is realized thanks to the potentiometer connected to the PTC outputs of the UMC controller.