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Laboratory Assignments in Control Systems

Report

Assignemt
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CONTENT

1. PURPOSE AND GOAL OF THE LAB WORK

1.1 Purpose and goal of the work

The primary purpose of this project was to gain proficiency in assembling and programming a control system. The goal was to understand the intricacies involved in both assembling and programming, with a specific focus on connecting to a programmable logic controller (PLC) using TwinCAT.

1.2 What did you learn during the work?

Throughout the duration of this course, I acquired valuable knowledge in circuit drawing and expanded my understanding of programming. The practical aspects of assembling and programming a control system enhanced my skills significantly. This experience not only broadened my comprehension of the subject matter but also provided hands-on insights into the complexities involved.

1.3 What was the most difficult part?

The most challenging aspect of the project was identifying and resolving bugs during the testing phase. Debugging electrical systems requires a keen attention to detail and problem-solving skills. Additionally, ensuring a polished and professional finish to the system posed its own set of challenges. However, overcoming these difficulties contributed significantly to my growth and proficiency in the field.

1.4 Why do panels and switchgears always have to undergo a commissioning inspection? Use the Electrical Safety Act as a source and mark the source in your answer.

Commissioning inspection: The commissioning inspection is required to verify that the electrical installation does not cause any danger or disturbance and that it fulfils the safety and electromagnetic compatibility requirements. The commissioning inspection is the responsibility of the installer of the electrical installation. (chaper 1 section 43 and section 46)

2 ANSWER THE QUESTIONS BELOW

2.1 Potential equalization

2.1.1 What is meant by potential equalization?

Potential equalization refers to the process of ensuring that all conductive parts of an electrical system are at the same electrical potential or voltage. This is achieved by connecting all conductive parts together using low-impedance bonding connections. The purpose of potential equalization is to prevent differences in electrical potential between conductive parts, which can lead to electrical shocks, equipment malfunctions, or damage. By equalizing the potential, any stray current or voltage differences are eliminated, ensuring the safety and proper functioning of the electrical system.

(SFS-EN 60204 H4, 6.3.3, 8.2)

2.1.2 How should protective conductors be identified?

Protective conductors identification is by colour alone, the bicolour combination GREEN-AND-YELLOW shall be used throughout the length of the conductor. This colour identification is strictly reserved for protective conductors/protective bonding conductors. The identification of protective conductors is crucial for maintaining electrical safety standards.

(SFS-EN 60204 13.2.2)

2.1.3 When there is no need to protective grounding of parts exposed to voltage?

When the electrical equipment is stationary, mobile, or movable items and when there is no external supply connected (for example when an on-board battery charger is not connected), there is no need to connect such equipment to an external protective conductor. Therefore, in this scenario, there is no need for protective grounding of parts exposed to voltage.

(SFS-EN 60204 6.2.4, 8.2.5, 4.1)

2.2 Wires and cables

2.2.1 How wires and cables should be chosen in general?

In general, wires and cables should be chosen based on specific requirements and guidelines.

- Select wires and cables with voltage and current ratings that match or exceed the requirements of the electrical system.

- Determine the appropriate conductor size based on the current-carrying capacity required for the load.

- Ensure that the selected wires and cables comply with relevant standards in the provided source for electrical equipment.

Overall, the selection of wires and cables should take into account factors such as the type of conductor, location, application, mechanical strength, and insulation requirements to ensure safe and reliable electrical installations.

(SFS-EN 60204 13.1.1; 13.2.1 ; 13.2.4; 13.3)

2.2.2 What things determine the load capacity of the wire and cable?

The load capacity of the wire and cable is determined by several factors. These factors include the insulation material, the number of conductors in a cable, the design (sheath), the methods of installation, grouping, and ambient temperature. Additionally, the current-carrying capacity can also depend on the relationship between the period of the duty cycle and the thermal time constant of the cable in specific applications. The manufacturer may provide more specific information on cable dimensioning for these types of applications.
(SFS-EN 60204 12.3, 12.4, 12.6.2)

2.2.3 What colors are allowed to use to identify conductors (other than protective and the neutral conductor)?

The allowed colors to identify conductors (except the protective and neutral conductors)

are:

BLACK: AC and DC power circuits;

RED: AC control circuits;

BLUE: DC control circuits;

ORANGE: excepted circuits in accordance with 5.3.5.

(SFS-EN 60204 13.2.4)

2.2.4 How to identify a protective conductor?

A protective conductor can be identified in several ways. One method is by using the bicolour combination of GREEN-AND-YELLOW throughout the length of the conductor. Another method is by marking or labeling the conductor with the symbol IEC 60417-5019 for protective earth, or with the letters PE. Additionally, a combination of these identification methods can also be used. The text does not specify any other methods of identifying a protective conductor, so these are the only options provided.

(SFS-EN 60204 5.3.5, 12.7.1, 13.2.4)

2.2.5 How to identify a neutral conductor?

To identify a neutral conductor, one should use the color blue, specifically an unsaturated blue known as "light blue," and avoid using this color for any other conductors that may cause confusion. This recommendation is based on the IEC 60445:2010 standard.
(SFS-EN 60204 13.2.3)

2.2.6 What colors are recommended to use with insulated single-core cables?

The recommended colors to use with insulated single-core cables for identification are:

- − BLACK: For AC and DC power circuits.
- − RED: For AC control circuits.
- − BLUE: For DC control circuits.

(SFS-EN 60204 13.2.4)

2.3 Testing and verification

2.3.1 What kind of tests should be carried out on the electrical equipment of machines if the machine does not have its own product standard? Write down all tests listed in the standard.

The machine lacks a specific product standard of its own. Therefore, it is imperative to conduct tests to verify the compliance of electrical equipment with its technical manual. This entails confirming the continuity of the protective bonding circuit and ensuring adherence to the requirements for protection through automated disconnection.

To ensure comprehensive evaluation, the following tests are conducted:

Insulation Resistance Test (SFS-EN 60204 18.3)

Voltage Test (SFS-EN 60204 18.4)

Protection Against Residual Voltages Test (SFS-EN 60204 18.5)

Functional Tests (SFS-EN 60204 18.6)

Retesting After Modification (SFS-EN 60204 18.7)

Conditions for Protection by Automatic Disconnection of Supply (SFS-EN 60204 18.2)

These tests collectively serve to validate the electrical equipment's compliance, ensuring the integrity of the protective bonding circuit and confirming that the machine meets the stipulated standards for protection through automated disconnection.

2.3.2 Tests applicable to machinery which does not have its own product standard may include one or more of the tests mentioned in the previous paragraph. However, which or which tests (verifications) must always be done?

When machinery does not have its own product standard, the verifications must always include the following tests:

a) Verification that the electrical equipment complies with its technical documentation.

b) Verification of continuity of the protective bonding circuit (Test 1 of 18.2.2).

c) In the case of fault protection through calculation or measurement, or by information supplied by the customer, the verification that the supply source impedance on-site does not exceed the value specified by the manufacturer of the electrical equipment (see 17.2 c), fourth bullet).

These tests must always be done regardless of whether the machinery has its own product standard or not.

2.3.3 Which electrical installations of building electrification must undergo a commissioning inspection in accordance with SFS standard EN-60204, e.g. here at Frami A?

The electrification of building systems at Frami A involves commissioning inspections in line with the SFS standard EN-60204. This standard focuses on safety in machinery and associated electrical components.

At Frami A, commissioning inspections cover:

Control panels, wiring, and electrical components for manufacturing equipment.

Power distribution systems supporting machinery within the building.

Safety measures, emergency stop systems, and protective devices integrated with machinery.

Arrcording to SFS standard EN-60204 ensures safety, compliance with electrical rules, and proper operation. Commissioning examinations are conducted before these installations are put into service to confirm compliance with requirements and intended functionality. This approach guarantees the safety and effectiveness of electrical installations for industrial machinery at Frami A.

3 TWINCAT LOGIC PROGRAMS

TwinCAT logic programs will be attached below.

BIBLIOGRAPHY

Finnish Standard Association. (2018). Safety of machinery - Electrical equipment of machines - Part 1: General. (SFS-EN 60204-1:2018).

Electrical Safety Act (1135/2016)