

SELECTION OF SENSORS FOR ELECTRIC MOTOR PROTECTION SYSTEM

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Annotation: This article discusses the importance of diagnosing and monitoring the technical condition of electrical equipment to ensure reliability and stable operation. It emphasizes the creation of multi-parameter protection systems to prevent failures in electric motors caused by voltage fluctuations, current overloads, short circuits, and temperature variations. The study highlights the use of current and voltage sensors in protection systems, particularly for low-power asynchronous motors. A current transformer and a resistive voltage divider were applied in laboratory experiments to monitor current and voltage values. For high-power motors, the use of Rogowsky coils and voltage transformers is considered more efficient. The paper also analyzes the principles of sensor selection, signal amplification, and the technical advantages of resistive dividers in low-power protection systems.

Keywords: Electrical equipment, reliability, diagnostic monitoring, protection system, electric motor, current transformer, Rogowsky coil, voltage sensor, resistive divider, voltage transformer, multi-parameter protection

The technical condition of electrical equipment is carried out primarily by checking the level of reliability and parameters. It is possible to create more reliable and sensitive protection systems from the information obtained from the diagnostic monitoring of the technical condition.

To ensure more stable working conditions, the reserve and reliability indicators in the motors need to be considered. Suppose two identical motors are used as a backup in a system. If one of them fails, the other motor will run at full system load.

Acute voltage fluctuations, current overloads, short circuits, temperature changes, etc. in such cases, the establishment and application of a multi-parameter protection system to prevent equipment, source and load failures are of particular importance.

During the operation of electric motors, non-standard and possible accident cases can be divided into the groups stated below:

- Abnormal and accident modes occurring in the network (voltage above or below the nominal value, frequency change, etc.)
- Non-standard currents and accidents (inter-phase short-circuits in three-phase motors, breakage in stator or rotor windings, leakage of insulation due to temperature rise caused by overload or short-circuit currents, etc.)

In the laboratory, a current transformer was used to control the current value in the protection system designed for a low-power asynchronous motor. In high-power motors, the introduction of the Ragowsky windings is considered to be more promising than the current sensors [2-5].

Voltage sensors based on electrical, electromagnetic, electromechanical, electro-thermal, electro-optical and other similar physical effects are widely used in theoretical and practical research.

The measurement procedure, which is the selection of the appropriate type of sensors, is determined by the type and level of voltage. It is important to amplify the signals to record low voltages in the measurement circuit and reduce the received signals to an acceptable level at high voltages [6-8].

Voltage dividers (resistive, capacitive and inductive), voltage transformers, electronic voltage sensors, etc. are generally used as voltage sensors (Figure 1).

A resistive divider was used to control the voltage value in the protection system designed for the low-power electric motor. The resistive divider is considered simpler and technically more economical.

Voltage transformers are often used as voltage sensors in high-power motors. Due to the large dimensions of voltage transformers, it is more expedient to use a resistive shunt and a resistive divider as voltage sensors, where possible [7, 8].

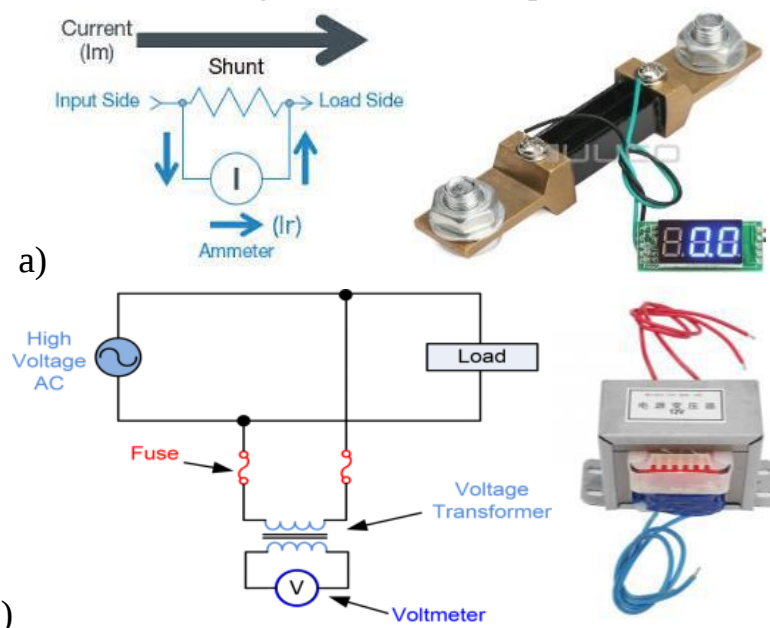


Fig. 1. Constructive and principle scheme of voltage sensors:
a) resistive shunt; b) voltage transformer

Several methods are used to measure temperature. These include fiber-optic temperature sensors, electrical resistance thermometers, thermographic methods, thermocouple-based temperature sensors, etc. (Figure 2).

As a contact temperature sensor for determining the temperature value in high-powered motors, the thermocouple is considered the most suitable.

The main advantage of a thermocouple-based module sensor is the transmission of a signal with a direct relay output. Based on the signal received from the sensor, it is possible to both protect the motor and perform diagnostic analysis of the recorded data, as well as set up special alarm systems by displaying the data on special displays. Thanks to this, it is possible to ensure a more reliable and stable operation of the motor.

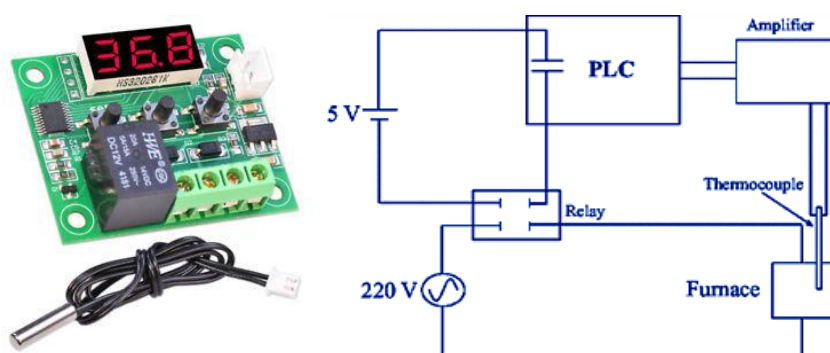


Fig. 2. Constructive and principle scheme of temperature sensor

Experiments were carried out on the electric motor according to the three important parameters mentioned above, and a protection system based on automatic control with relay output was installed. (Figure 2)

The operation of the relay is determined by the electrical signal received from the sensors. Based on the electrical signals, in any abnormal and accident situation, the relay motor controlled by the protection system is disconnected from the mains. MLE00137 of type relay was used to protect the motor.

This type of relay is distinguished by its compactness, large process switching capabilities, start-up speed, etc. This relay is able to provide normal operation when the supply voltage of the working winding is in the range of 6-15 V.

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