# METHODS OF DEVELOPING A MICROCONTROL CONTROL SYSTEM FOR REACTIVE POWER COMPENSATION

**Khamraev Ogabek**
Urganch State University, Technical Faculty, 3rd level student of electrical engineering, electrical mechanics and electrical technologies (by networks)
E-mail: ogabekxamrayev678@gmail.com
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**Abstract:** Control of reactive power sources criteria reactive power supplies, combined microprocessor-based control systems compared studied and the possibility of its technical and economic indicators.

**Keywords:** Capacitors, transistors, microcontrollers, reactors, switching.

Let's take a closer look at the inductive-capacitive reactive power compensator based on the equalization of the angle between current and voltage operating in the high-harmonic filter mode with the help of capacitors. The analysis of the technical solutions of the standard circuit for inductive-capacitive reactive power compensators showed that the use of static and dynamic compensators has a number of important disadvantages:

- static compensators have very high switching currents; a sharp decrease in the reliability of dynamic compensators due to the generation of currents when step thyristors are activated;

Based on the above-mentioned basis and to eliminate the above-mentioned shortcomings, we will consider a microprocessor control system for a six-step compensator of reactive power.

Figure 1 shows the power diagram of a six-speed reactive power compensator consisting of three capacitor batteries of different capacities, non-controlled valves T1-T6 and diode-transistor switches made of VD1-VD12 and VT1-VT4 elements, high harmonic filters. L1-L6.

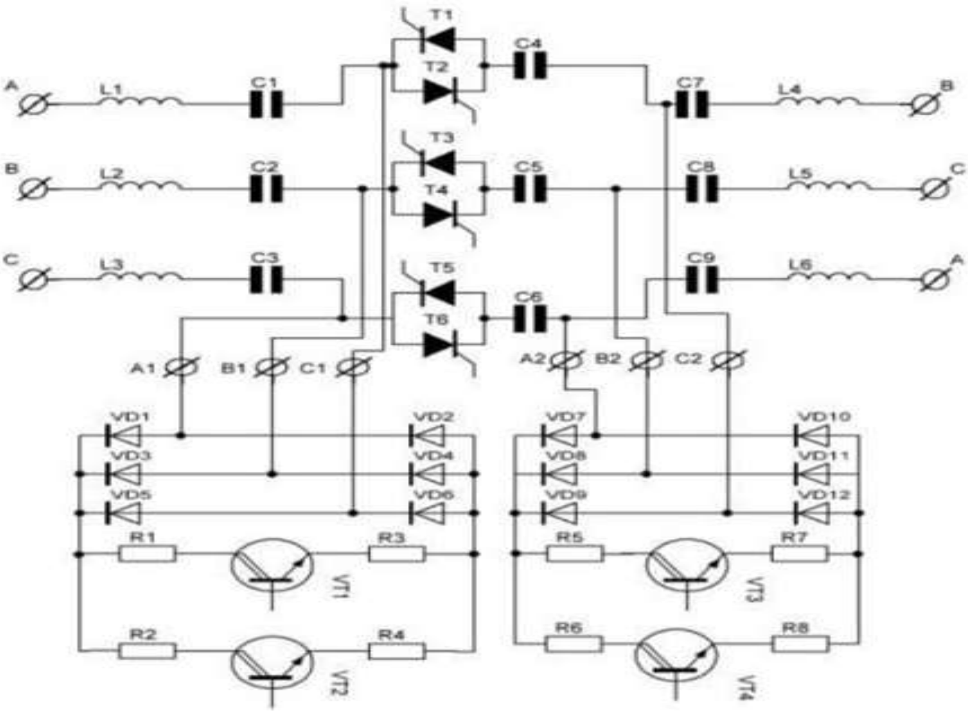



**Figure 1. Voltage cut-off diagram of a six-speed reactive power compensator.**

The first stage allows you to change the order of contacts by switching the transistor block (VD1-VD6, VT1, VT2) to active mode. The second stage works in the same way, only replacing the elements (VD7-VD12, VT3, VT4). The third stage is based on the zero reduction of thyristors T1-T6 during the phase transition.

The remaining three steps are a combination of replacing the first three [2].

To obtain the following control algorithm for a six-stage reactive power compensator, the designed microcontroller control system should be used. Figure 2 shows the block diagram of the microcontroller control system. This system uses the Atmega128 microcontroller from Atmel. The main elements of the circuit are based on current and voltage sensors, thyristor control circuits and IGBT transistors, an input / output device and a computer communication device that allows setting the compensation parameters of various loads.

The specified block diagram can be operated in two modes without the help of the operator and with the help of a computer using the RS232 interface, the reactive power system can be remotely accessed via the RS485 interface.

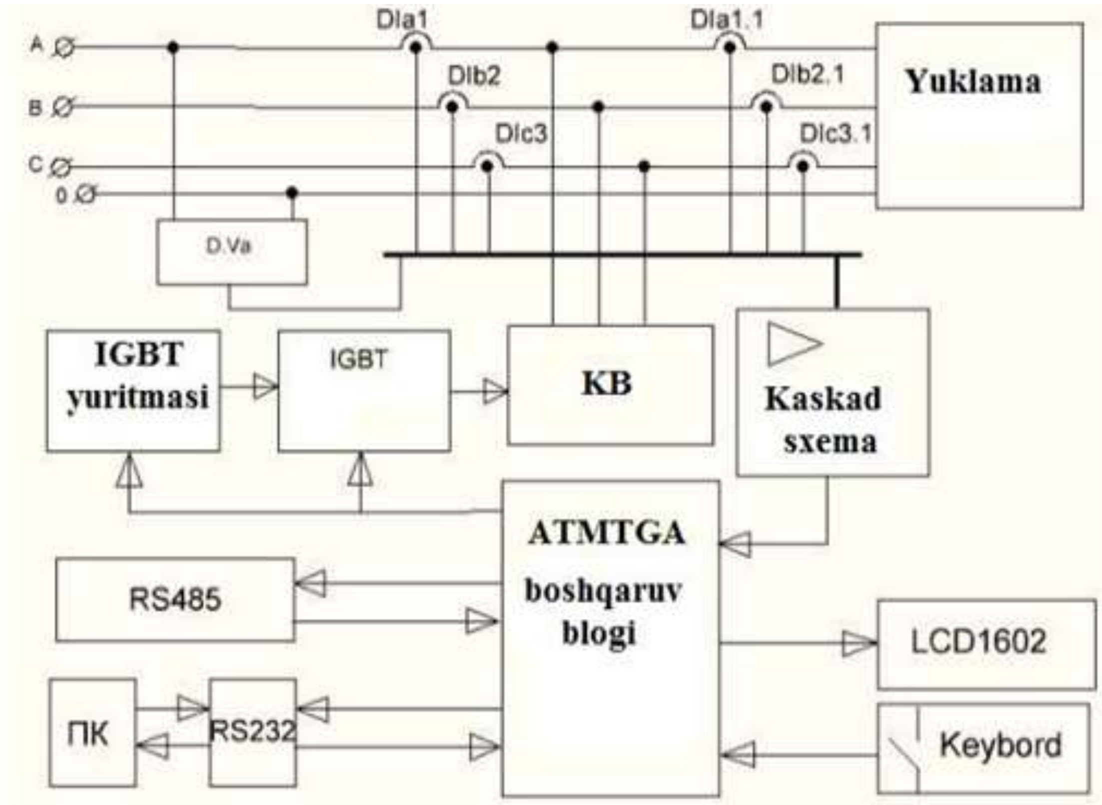



**Figure 2. Block diagram of the microcontroller control system for reactive power compensation.**

The developed microcontroller control system differs from existing systems in several features:

- the price is low compared to existing analogues;
- ease of introduction of management system;
- control features of the power unit (soft input of stages).

Studies have shown that this system can be used in different AC networks showed the possibility of using the best parameters in comparison with existing analogs that work with loads.

The implementation of such systems significantly increases the economic efficiency of the plan and improves network parameters, which increases the operating time of the operating equipment and its reliability.

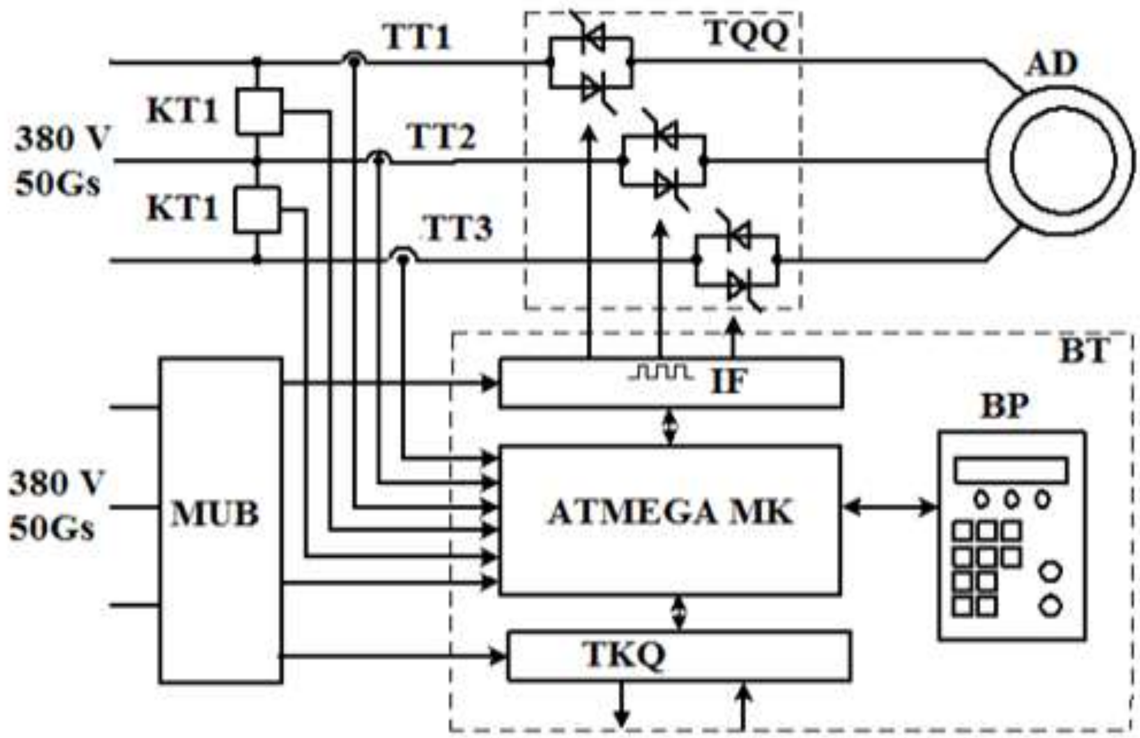
When justifying and choosing a system of electric drive Conveyor equipment, it is necessary to take into account that the AC electric drive based on asynchronous motors is most often used. Small operation with short-circuit conveyors is usually used by deep-phase short-circuited rotor or rotor-type asynchronous motors, which have a high starting torque. The limit power of these electrical devices does not exceed 100 - 200 kW, because there is a significant decrease in the initial torque due to the voltage drop in the network, which makes it difficult to unload the loaded conveyor.

For large length and performance conveyors, as a rule, an electric drive with phase rotor asynchronous motors is used, which provides limitation of starting currents and accelerations. At the same time, in order to reduce dynamic loads, initialization stages are used to select gaps in transmissions and to create initial tape tension and to reduce the immediate increase in engine torque to create many initialization stages, which helps to generate elastic vibrations in the traction body and move it to the drum. In conveyor systems, use contact cycles with the number of initial steps of 10 – 12 and transfer them to a function of time or a function of time and current.

Smooth start relay-contact devices have an important drawback - start resistors dissipate in the form of thermal energy and large losses of electrical energy during the start-up process. Currently, soft start (UPP) devices in a number of modifications, including braking functions, are increasingly common. The UPP program provides the following: limitation of starting current and angular acceleration, protection against mechanical shocks of the asynchronous motor with smooth start-up, adjustment of acceleration and braking time. Softstarter devices have a variety of applications: pumps, fans, compressors, conveyors, heavy-duty and inertial mechanisms.

The functional system of the electric motor soft starter is given. According to it, TQQ is a thyristor covering device; AD - asynchronous engine; Control system - BT,IF - control pulse phase system; MK - microcontroller; MUB – i / u device; BP-control panel; IP - power source; TT1, TT2, TT3– initial current control, regulation and overcurrent protection; KT1, KT2 are voltage sensors designed to reduce the voltage of the stator winding of the asynchronous motor and protect it from voltage regulation.

The microcontroller is the main device of the TKQ, it controls the destruction of thyristors, relays built into the TKQ, performs the functions of software protection and control. The IF unit delivers clear pulses for the thyristors, which shift to a variable angle relative to the natural switching torque, as a result of which the voltage at the output of the TKQ theoretically changes to zero. Locking of thyristors occurs naturally - when changing the polarity of the sinusoidal voltage from the anode to the cathode clamps.



A soft starter starts an electric motor with a smooth increase in stator voltage while regulating current or torque. The advantage of TKQ compared to traditional commissioning methods is that the user has a wide range of software tools to configure the device for a specific application. These possibilities are provided by motor stator switches and a wide range of regulation of the parameters of the voltage variation diagram according to the selection of the control method.

The following control methods can be used in TKQ: stator clamps, motor current, motor torque.

Torque control is the perfect way to start. In this case, TKQ monitors the desired torque value, which ensures starting with the minimum possible current value. The use of a control system with engine torque control provides a linear schedule of speed changes over time, that is, starting at constant acceleration.

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