



## **NON-CONTACT STARTER FOR SINGLE-PHASE CONSUMERS SUPPLIED FROM RENEWABLE SOURCES.**

**Mustaev R.A.**

Assistant, Karshi Institute of Engineering and Economics.

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In order to quickly and reliably perform reactive power compensation in power supply systems with renewable energy sources, it is recommended to use non-contact automatic control devices.

Considering this in detail, a single-phase non-contact starter has been developed, and the design of this single-phase non-contact starter is simple, reliable and responds quickly to the processes occurring in the network.

This non-contact switching device is designed for the supply and distribution of electricity and consumers, capacitor batteries used for reactive power compensation, single-phase electric motors, active and active-inductive loads to a 220 V source and the frequency is 50 Hz. serves for switching.

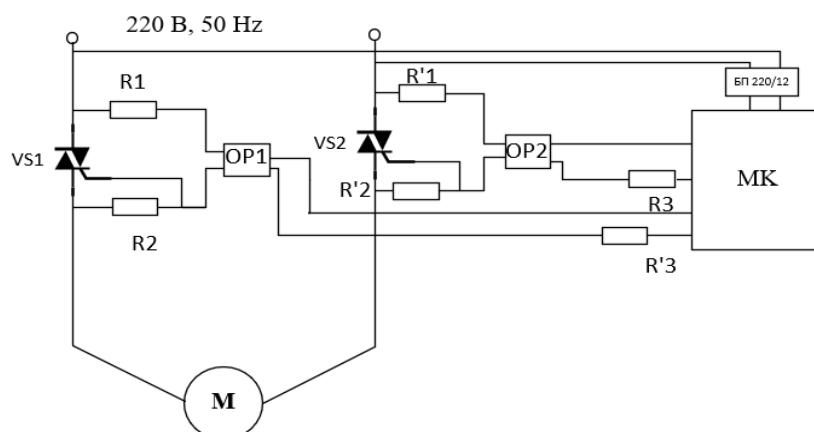
Switching devices of this type are distinguished by their quick and operative operation, compactness, and the absence of electric arc during operation, thus increasing the reliability of the power supply system [1].

The switching unit of this contactless starter consists of a power triac, and the control circuit consists of a resistor, an optocoupler, and a microcontroller (Figure 1).

The switching unit and the control unit are connected to the 220 V network of the power supply system with renewable energy sources. When the microcontroller is given the command to turn on via the remote control buttons ("START" and "STOP"), the control current flows through the resistor R3 and the poles of the optocouplers OP1, OP2 are opened. In this case, the control current is supplied to the control circuit of the transistor VS1, VS2 through the resistor R1 connected to the supply source. Through the resistor R2, the control current that provides the transition of the second half cycle is transferred to the control pole of the triac. In this case, the circuit breaker connects the electric motor to the network and begins to transfer the load current. If the electric motor needs to be disconnected from the network, press the "STOP" button on the control unit. In this case, the microcontroller stops the control current supplied to the optocoupler and the optocoupler stops working. This causes the circuit to stop



the current supplying the control pole and the electric motor is disconnected



from the network [2].

Figure 1. Scheme of a single-phase non-contact starter.

VS1, VS2 – transistor; OP1, OP2 optocoupler, MK microcontroller, BP supply block.

Elements of a single-phase non-contact starting device: VS1, VS2 transistors, optocouplers, "START" and "STOP" buttons, R1, R2, R3, R'1, R'2, R'3 resistances, Arduino UNO microcontroller, control unit supply source.

Transistors are semiconductor elements that enable switching of alternating current consumers. It is necessary to take into account the current and start-up time of the switching consumer. This triac has a 170 A starting current of 8.3 ms; It can withstand 160 A starting current for 10 ms. As technical parameters, the current to be supplied to the control pole is 50 mA and the voltage values are 1.5 V; network frequency 50 Hz; the maximum reverse voltage value is 800 V. Operating temperature ranges from -40 0C to +-125 0C [3].

Optocouplers (optoresistors) are used in circuits connecting high-voltage power circuits with low-voltage control circuits by providing high isolation. Their technical parameters are the maximum control current of 1 A and the maximum control voltage of 240 V, the required voltage for their supply is 1.5 V, the average current consumption is 10 mA. Their insulation resistance is 1500 V [4].

Buttons "PUSK" and "STOP" are used to control the state of the output signals of the microcontroller, when pressing them, a 5 V supply voltage is applied to the pins of the microcontroller.



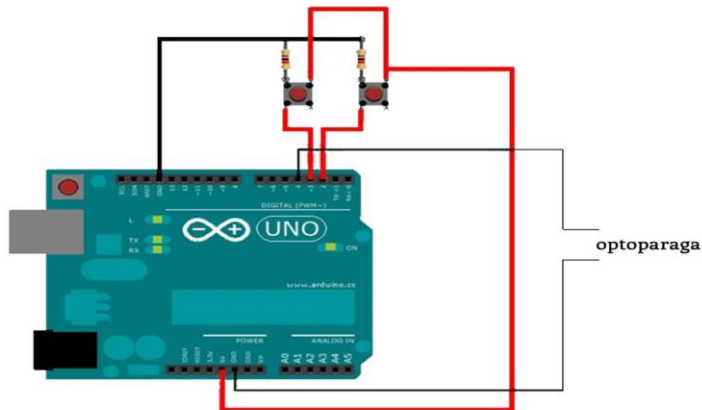


Figure 2. Connection diagram of the control unit elements to the microcontroller.

Arduino UNO microcontroller (Figure 3) was used for this launch device, its technical parameters are listed below.



Figure 3. Microcontroller Arduino UNO.

In the scheme, the control body is an Arduino UNO platform assembled on the basis of an ATmega 328 microcontroller. The technical specifications of the Arduino UNO platform are as follows.

- The operating voltage is 5 V
- Input voltage 7-12 V
- The maximum value of the input voltage is 6-20 V
- Digital input, output 14 analog 6
- Input and output constant current 40 mA
- Flash memory 32 kB
- Quick memory 2 kB
- Frequency of output signals is 16 MHz
- The size is 6.9 cm long by 5.3 cm wide.

In addition to Arduino UNO, many other types of microcontrollers can be used. They differ from each other mainly by the number of digital and analog input and output connection points.





a)

b)

c)

**a) Figure 4. Overview of Arduino microcontrollers.**

b) Arduino NANO; b) Arduino Leonardo; c) Arduino MEGA;

Writing a program in the memory of these microcontrollers and its software is also very simple. The size and very compact connection points do not cause inconvenience in circuit assembly.

A program based on the C++ programming language was used for the Arduino UNO microcontroller. To write a program for the microcontroller, the Arduino IDE program and compiler, which works on Windows, Mac OS and Linux operating systems, are used. The use of this program is absolutely free and free of charge. Ready programs are loaded into microcontrollers through the USB port.

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