

**MICROCONTROLLER-BASED CONTROL SYSTEM FOR
AN OFFSET PRINTING MACHINE**

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Abstract: *The article considers a microcontroller control system that allows the operation of an electric drive of a printing plant. Functional elements have been selected for this system.*

Аннотация: *В статье рассмотрена микроконтроллерная система управления, позволяющая осуществлять работу электропривода полиграфического производства. Для данной системы подобраны функциональные элементы.*

Аннотация: *Мақолада матбаа технологияларида қўлланиладиган электрюртмани ишга тушириш имконини берувчи микроконтроллерли бошыарув тизими кўриб чиқилган. Тизим учун керакли функционал элементлар танлаб олинган.*

Using electric drives, almost all mechanisms of machines, equipment, cranes, ventilation systems, and so on are set in motion. Modern automated production is impossible to imagine without electric drives.

Offset printing in modern polygraphy is the simplest and most inexpensive method used in printing production (Fig. 1).

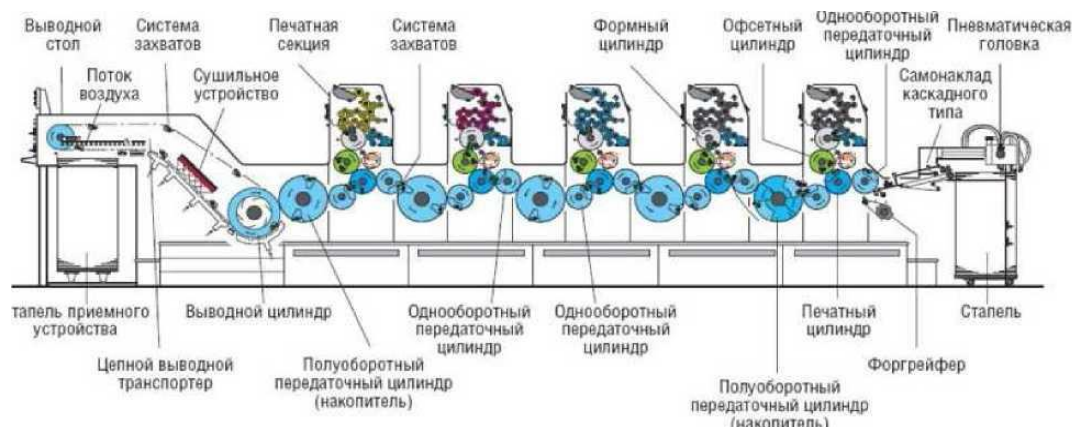


Figure 1 – Operating principle of an offset printing machine

In this work, a control system for starting a brushless DC motor was developed. Brushless motors have a number of advantages, such as high efficiency, which increases their operating time when powered by an autonomous source; the absence of moving contacts; better weight and size characteristics compared to other electric motors of similar power; and a wide range of speeds and torque. The main element in controlling a brushless motor is the feedback device — the rotor position sensor, known as the Hall sensor SS41. A Hall sensor is a device that measures the intensity of an electromagnetic field. Its operating principle is based on the Hall effect (Fig. 2), the essence of which lies in the movement and redistribution of charge carriers in a conductor under the influence of a magnetic field, causing a potential difference to appear.

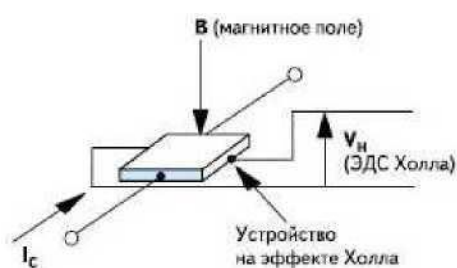


Figure 2. Hall Effect

It is located next to the stator of the brushless motor to provide feedback. To start the motor, a frequency generator signal is used. The received signal is sent to the Arduino Nano microcontroller through an optocoupler.

To implement control of the brushless motor, a control board is used, which performs the following functions:

- electrical power supply to individual components such as the Hall sensor;
- conversion of AC to DC;
- commutation of the windings of the brushless motor to connect them to a DC power source with different polarities.

For commutation of the motor windings, the logical Arduino Nano microcontroller is used, which controls the INT100S drivers [2].

To develop applications based on Arduino, software is required for writing and uploading programs into the microcontroller. These functions are performed using the Arduino IDE. The Arduino development environment includes a built-in code editor, a toolbar, and a text output window. To upload programs, the IDE must be connected to the hardware part of the microcontroller.

Any program written in the Arduino IDE is called a sketch. A sketch is written in a text editor that provides tools for performing various operations such as inserting/deleting and finding/replacing text. During saving or compiling the sketch, explanations or error messages appear in the message area in case of incorrect code (Fig. 3).

```
#define knopka 52
```

```
#define in1
```

```
#define in2 10
```

#define holla 1

For commutating the motor windings, the logical Arduino Nano microcontroller is used, which controls the INT100S drivers.

An external motor-start signal, designated as PWM, is supplied through the current-limiting resistor R11 from an external generator. The Arduino receives the generator signal through a high-speed optocoupler with a transistor output (VU1) on port 8, where R12 is a pull-up resistor. The voltage to the base and collector of the optocoupler's transistor is supplied by the microcontroller.

The Hall sensor, which provides feedback, is powered by the microcontroller and sends the rotor position signal to input 2. Inputs 9 and 10 supply the PWM signal to the drivers, generated by the Arduino. Each microcontroller input controls one driver.

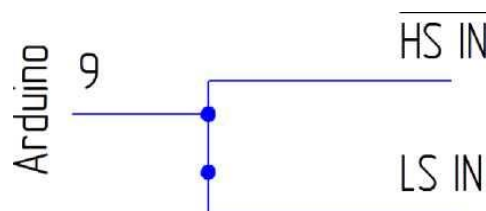


Figure 4. Example of connecting the driver inputs and Arduino pin 9 with a jumper

Simultaneous delivery of a signal from one microcontroller port to the 2nd and 3rd inputs of the INT100S driver is provided by a jumper connecting both driver inputs (Fig. 4).

During the course of the work, the Arduino IDE software, methods of designing and programming control systems using the Arduino microcontroller were studied. In addition, a motor control program was developed, and the equipment was configured and adjusted.

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