Laboratory work No. 5

**Goal of research:**

Utilizing PWM in encoder mode.

**Software:**

STM32CubeIDE, Matlab.

**General information:**

Schematic of the system being developed:

*Required HAL functions*

Running the timer in PWM generation mode.

*HAL\_TIM\_PWM\_Start(htim, Channel)*

* *htim* – the pointer to the configuration structure of TIM\_HandleTypeDef type;
* *Channel* – timer channel.

Changing the value of the comparison register (PWM duty cycle).

*\_\_HAL\_TIM\_SET\_COMPARE(\_\_HANDLE\_\_, \_\_CHANNEL\_\_, \_\_COMPARE\_\_)*

* *\_\_HANDLE\_\_* – the pointer to the configuration structure of TIM\_HandleTypeDef type;
* *\_\_CHANNEL\_\_* – timer channel;
* *\_\_COMPARE\_\_* – the value of the comparison register.

Running the timer in the encoder mode.

*HAL\_TIM\_Encoder\_Start(htim, Channel)*

* *htim* – the pointer to the configuration structure of TIM\_HandleTypeDef type;
* *Channel* – timer channel.

Getting the current value of the counter register (number of encoder cycles).

*\_\_HAL\_TIM\_GET\_COUNTER(\_\_HANDLE\_\_)*

* *\_\_HANDLE\_\_* – the pointer to the configuration structure of TIM\_HandleTypeDef type.

**The order of work:**

*Part I. Developing a program using a code generator.*

1. Start STM32CubeIDE, in the opened window select the path to your working folder. There should be no Russian letters in the path to the working folder and the project name. In this folder should be stored all laboratory works.

2. This work should be done on the basis of the previous work.

3. Based on the documentation, determine which pins are connected to the motor with encoder, the encoder on the motor and the external encoder.

4. In the graphical initialization window of the controller (name.IOC), it is necessary to set the frequency of the processor according to the variant. The clock source should be an external quartz resonator.

5. In the graphical initialization window of the controller (name.IOC), it is necessary to configure the pins defined in the previous step for PWM generation, motor direction control, operation with two encoders.

6. In the graphical initialization window of the controller (name.IOC), set the Prescaller, Counter Period for the Timers defined in the previous steps. The frequency of the PWM signal should be 1kHz.

7. Implement the following program algorithm:

- Using an external encoder, set the speed and direction of rotation of the motor;

- According to the data received from the encoder on the motor, determine the actual speed of rotation of the motor;

- Implement in a periodic interrupt from the timer:

* calculation of a new control action for the motor;
* Set a new control action for the motor by changing the value of the comparison register;
* Send a data packet to Simulink consisting motor rotation speed and the actual rotation speed.

**Tasks:**

1. Perform all of the steps in Part I.

Demonstrate all assignment items one by one to the instructor.

**Variants:**

|  |  |
| --- | --- |
| Variant no. | Frequency |
| 1 | 180 |
| 2 | 170 |
| 3 | 160 |
| 4 | 150 |
| 5 | 140 |
| 6 | 130 |
| 7 | 120 |
| 8 | 110 |
| 9 | 100 |
| 10 | 175 |
| 11 | 165 |
| 12 | 155 |