AVT kits

Universal Stepper Motor Controller

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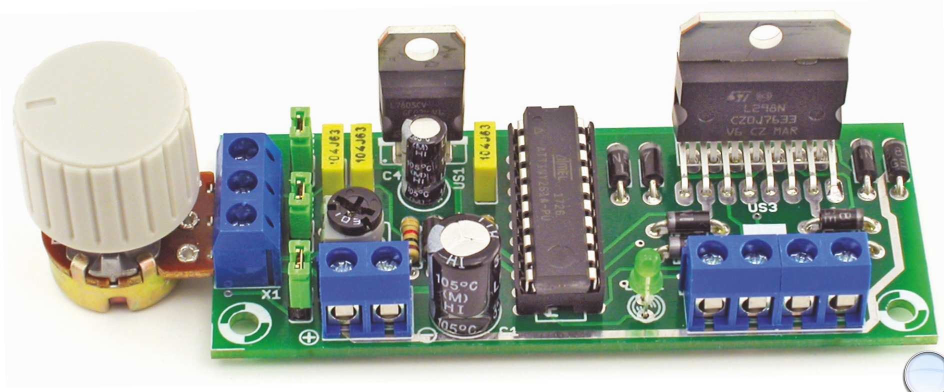
AVT 3225



ZOOM

ASSEMBLY DIFFICULTY

This controller allows the construction of advanced mock-up mechanisms, extension of machines and tools such as milling machines or drills but can also be useful in photography to build a drive for taking timelapses and 360° photos.
Controller allows stepper motors bipolar (4-wire) and unipolar (5-, 6- or 8-wire) to be continuously adjusted in speed and direction using a single potentiometer.

Features

- infinitely variable speed and direction of rotation (with the same potentiometer)
- speed control divided into two ranges (1 ÷ 10 and 7 ÷ 100 cycles per second)
- microstep control with 1/64 or 1/8 step resolution
- suitable for bipolar (4 wires) and unipolar (5 or 6 wires) motors
- timer function, time steplessly adjustable from 0.5 ÷ 70 s
- supply voltage range (rated motor voltage) 8 ÷ 25 V
- output current up to 2 A per channel (coil)

Circuit description

Range of changes in the speed of the motor axis is divided into two sub-ranges of 1...10 or 7...100 cycles per second. This selection can be made using the appropriate jumper. Microstep control with a resolution of 1/64 or 1/8 step. Microstep operation involves rotating the magnetic field of the stator in a much smoother way than in full and half-step control. By working with the microstep, smaller steps and more accurate positioning can be achieved. When the motor is controlled at low frequencies with a full step or half-step, the movement becomes discontinuous and is characterised by high levels of noise and vibration. With a small step, the energy provided to the rotor at one step is only a fraction of the energy of a full step and is so small that it can easily be absorbed and cushioned by the internal friction in the motor and its inertia. No vibration is then generated, and the motor rotor will not run out at any time beyond its desired position. Microstep control also enables much quieter motor operation. The controller

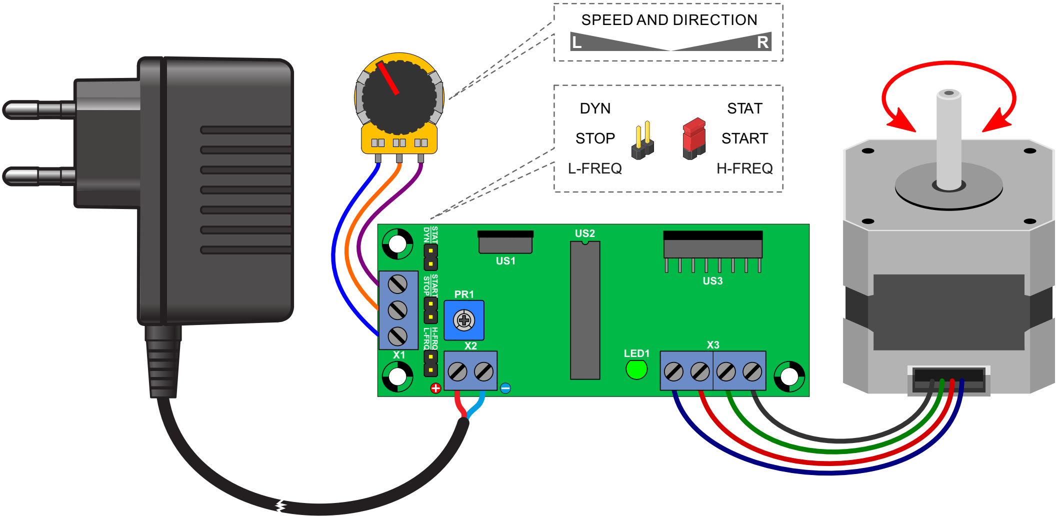


Fig. 1.

described must be supplied with voltage in the range 8...24 VDC and the maximum output current is up to 2 A/channel (coil) with appropriate heat sink. Without the heat sink, the controller can safely be used with up to 250 mA per channel/coil. In addition, the controller is equipped with a timer function (time is continuously adjustable in the range of 0.5...70 s). The START/STOP jumper configures the controller for continuous or timed operation. Time is set using a potentiometer and the countdown is triggered by briefly short-circuiting the jumper pinsSTART/STOP. Figure 1 shows the configuration of the controller along with the most important elements of its design. Schematic diagram of the circuit is shown in Figure 2. Correct power supply is ensured by the 7805 stabiliser together with capacitances C1-C4. Power stage is implemented on the well-known L298 IC, which incorporates two H-bridges. Its operation is controlled by an ATtiny261 microcontroller, or more precisely by a program in its memory. Micro-step control is achieved by controlling the motor windings with a PWM waveform. The PWM modulation characteristics are triangular in shape. Such a solution is uncomplicated and effective in most cases of motor operation. Jumpers on the controller board are used to configure the circuit. The jumper described as HFRQ/L-FRQ is used to change the speed sub-band. If fitted, a higher sequence frequency will be selected, approximately 7...100 cycles per second (i.e., full waveform periods per channel). The circuit operates at a lower resolution of 1/8 step. Absence of a jumper means a lower sequence frequency, i.e., approximately 1...10 cycles per second, and a higher microstep resolution of 1/64. The STAT/DYN jumper determines whether the motor will be de-energised during standstill - static standstill (jumper on), or the power supply will be maintained - dynamic standstill (jumper off). At a static stop, almost free motor shaft movement is possible, during dynamic stop, the motor shaft is locked in its position, and here it must be remembered that current flows through the coils, which will cause the motor to heat up. This controller has a timed operation function. It is switched on when the START/STOP connector is short-circuited and lasts for a time proportional to the position of potentiometer PR1. Time is counted from the moment the START/STOP jumper is removed. It is best to replace the jumper with a reset-type monostable button. If the jumper remains on, the controller will operate at all times. A potentiometer attached to screw connector X1 is used to adjust the direction and speed - in the middle position the motor is stopped, turning the potentiometer causes a gradual Increase of its speed. Instead of this potentiometer, a potentiometer joystick can be attached, in which case the rotation of the motor will be proportional to the direction and angle of the joystick.

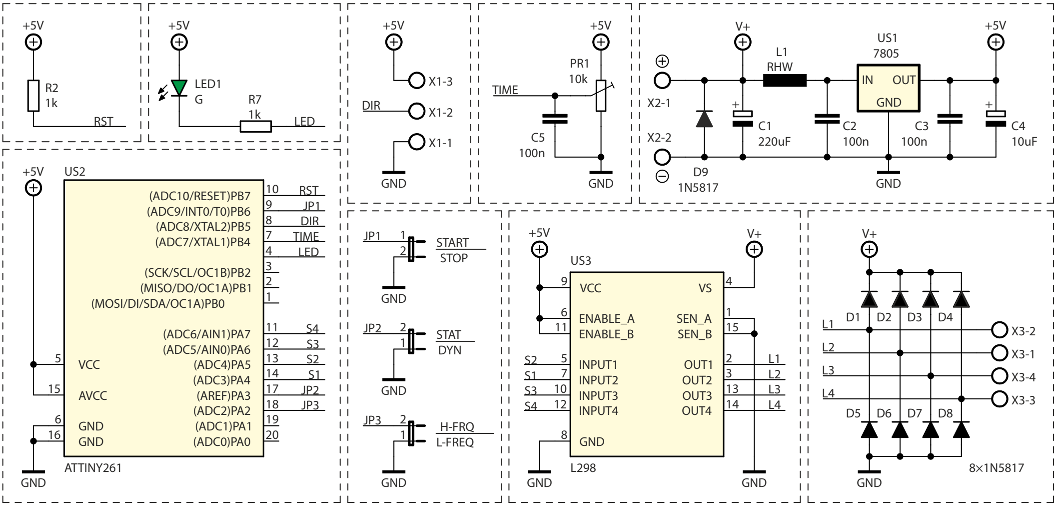


Fig. 2. Schematic diagram

Mounting and start-up

Appearance of the printed circuit is shown in Figure 3. Controller board dimensions are 33×83 mm. The circuit is built using through-hole components, so this mounting can be performed by even less experienced hobbyists. Correctly assembled circuit is operational as soon as it is energized. If the motor will draw more than 250 mA per channel, the L298 circuit requires an additional heat sink. It is recommended to additionally solder 0.8-1 mm silver foil on the exposed, i.e., not soldermasked, tracks to further improve the current-carrying capacity of the tracks. This applies when the current of one coil/channel will exceed 500 mA. The circuit has been designed to control the propulsion of the camera trolley
. It is perfect for achieving very low stepper motor speeds. Note, however, that despite the high resolution of the microstep control, on some motors the shaft movement may not be perfectly smooth and slight vibrations may occur. Therefore, it is best to choose motors with a high number of steps per revolution, e.g. 200 (1.8°) or 400 (0.9°).

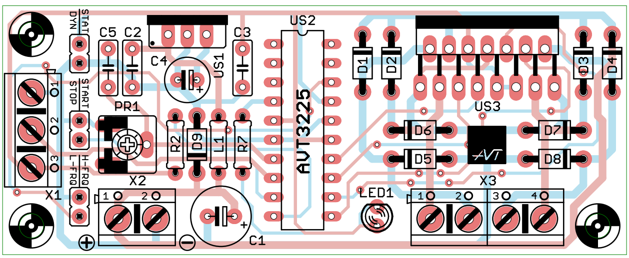
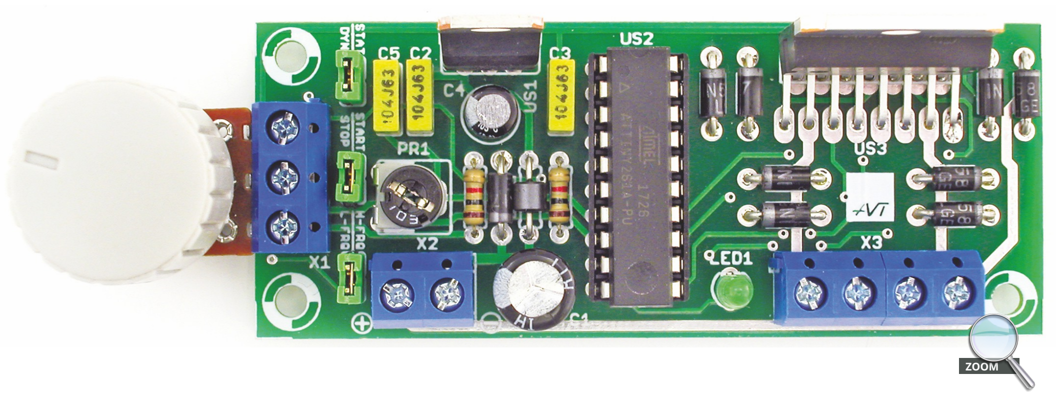


Fig. 3 Mounting diagram



List of components

Resistors:

R1, R2:..................1 kΩ

PR1:......................mounting potentiometer 10 kΩ

Capacitors:

C1: ....220 µF

C2, C3, C5: ....100 nF

C4: ....100 µF

Semiconductors:

D1-D9:..................1N5817

LED1:....................LED 3mm (any colour)

US1:......................7805

US2:......................ATtiny261

US3:......................L298

Other:

L1: ....ferrite bead

X1: ....ARK3/5 + potentiometer 10 kΩ

X2: ARK2/5

X3: ....2×ARK2/5

goldpin 6 straight pins + 3 Jumpers

! Start mounting from soldering the components onto the board in order of size from smallest to largest. Photographs of the mounted kit may be helpful. To access the high-resolution images as links, download the PDF.

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