



ESMC-02

**Description**

Easy to use stepper motor controller.  
 Bipolar output works with 4,6 and 8 lead hybrid stepper motors.  
 Microstep selectable by DIPswitch. Step size full, 1/2, 1/4 1/8th step.  
 On-board clock with adjustable frequency..  
 Programmable number of steps clockwise and anti-clockwise.  
 Simple pushbutton operation.  
 Direct inputs to stepper controller allows easy interface to external microcontroller.  
 DIP switch mode selection.  
 Operating voltage:7.5V to 30V DC.  
 Ideal for robotic control and automation uses.  
 Thermal protection.  
 3.5mm mounting holes  
 Small size: L=80, W=49, H=15 mm

**Specification**

|                          |                |
|--------------------------|----------------|
| Max motor current        | 750mA          |
| Operating voltage        | 7.5V to 30V DC |
| Max step frequency       | 500kHz         |
| Min internal clock freq. | 200Hz*         |
| Max internal clock freq. | 4.3kHz*        |
| Standby current          | 13mA           |

\*+-10%

**Connections**

| Pin       | Description                   |
|-----------|-------------------------------|
| +V        | Positive supply voltage input |
| 0V        | Supply input GND              |
| CW        | Clockwise input control       |
| ACW       | Anti-clockwise input control  |
| COM       | Switch input common. (0V)     |
| M1        | Motor coil A1                 |
| M2        | Motor coil A2                 |
| M3        | Motor coil B1                 |
| M4        | Motor coil B2                 |
| CONN12/J1 | External I trip reference     |
| CONN10/J2 | External control I/F          |

**Overview**

The ESMC-02 operates in 3 main modes;

Mode 1.

Simple pushbutton. In this mode, the controller turns the motor clockwise or anti-clockwise in response to the switch inputs at a step speed set by the on-board clock (VR1).  
 In mode 1, you can select single step or continuous operation.

Mode 2.

Programmed operation. In this mode, the controller turns the motor clockwise or anti-clockwise by a pre-programmed number of steps.

In mode 1 and 2, the step frequency has an adjustable clock of approximately 200Hz to 4.3kHz  
 A no-overshoot mode is selectable in which the motor will not step beyond the limits for programmed operation.  
 When setting up programmed operation, single step mode can be selected to allow programming of a precise number of steps.

DIP switch 1 settings\*

- switch 1 = program the number of steps (ON = setup)
- switch 2 = pushbutton or programmed operation (ON = programmed OFF= pushbutton)
- switch 3 = no overshoot mode (ON = no overshoot) (only applicable to mode 2)
- switch 4 = single step mode (ON= single step) (applicable to mode 1 and setup for mode 2)

\*DIP switch 1 switches must be set before powering up the PCB for the modes to operate.

DIP switch 2 settings (step size)

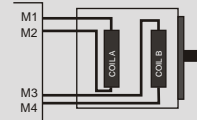
- 1=ON 2=ON : Full step
- 1=OFF 2=ON: Half step
- 1=ON 2=OFF : Quarter step
- 1=OFF 2=OFF :eighth step (Both switches to the left)

Mode 3.

Direct interfacing to the stepper motor controller IC.  
 This mode allows the user to control the stepper motor controller IC directly using +5V logic signals for STEP, DIRECTION, SLEEP and ENABLE.  
 To use mode 3, the link J2 must be removed before power up, this disables the on-board microcontroller.

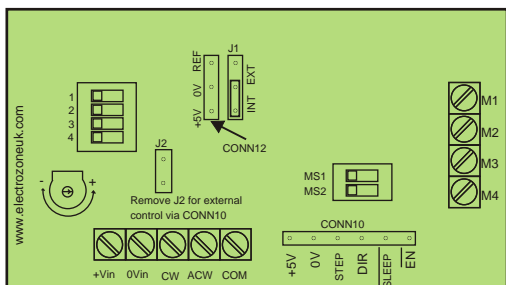
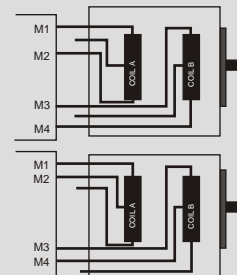
**Connecting a 4 wire stepper motor**

Follow the diagram on the right to see how to connect the two coils of a 4 wire stepper motor to the motor outputs of the PCB.  
 To find out which wires are coils A and B, simply measure the resistance between the wires. You will find that there is a low resistance between the ends of each coil.



**Connecting a 6 wire stepper motor**

A 6 wire stepper motor can be connected using the wires from either end of the coil as shown above right, or by using the connection from the centre of the coils as shown below right.

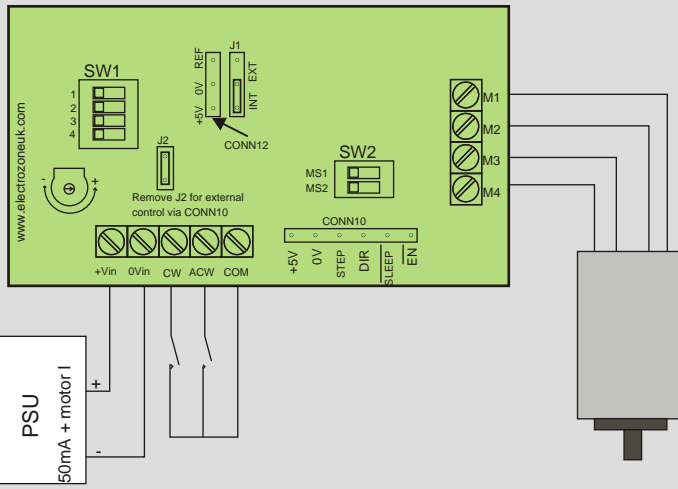


Height=16mm

## Pushbutton operation (mode 1)

To select pushbutton mode, place all DIP switch 1 switches into the OFF position before powering the PCB. (all switches left)

In this mode, the motor simply turns continuously clockwise or anti-clockwise while the CW or ACW switch inputs are connected to COM (internally connected to 0V). If the single step (DIP switch 4) switch is set to ON, the motor will move by a single step with each switch press. Single step mode should only be used in full step mode



The diagram on the left shows the PCB connected to a 4 wire motor with normally open switches connected for clockwise and anti-clockwise movement.

The SW1 DIP switches are all set to OFF which means that the PCB acts as a simple pushbutton motor controller.

The SW2 DIP switches (micro-stepping select) are shown set to 1/8. therefore, if a motor with 200 steps per revolution (1.8 degree per step) is connected, then the motor will turn 1600 steps through a complete revolution.

DIP switch 2 can be changed while the PCB is powered. The internal clock changes the step speed, therefore the motor will change its speed according to the DIP switch 2 settings. ie the motor will turn 8 times faster in full step mode than in 1/8 step mode.

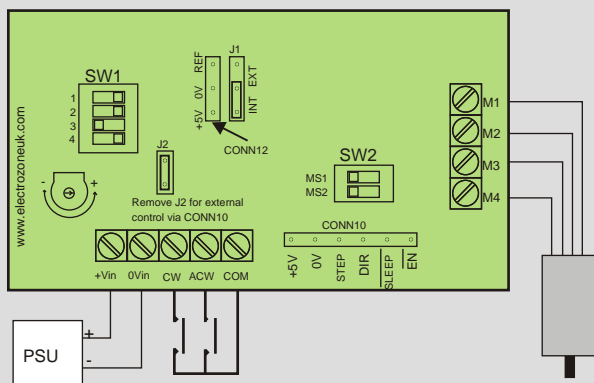
## Programmed operation (mode 2)

Programming of the module allows you to set the number of steps following a trigger while in programmed operation, (mode 2).

Program the number of steps as follows;

- 1) Switch off power to the PCB
- 2) Set SW1 DIP switch 1 and 2 to ON (right)
- 3) Power up the PCB
- 4) Press the CW switch input and hold down to see the motor turn clockwise, you can release the switch and re-press until the motor reaches the required position
- 5) When the motor has rotated to the position needed, release the switch.
- 6) You can now program the number of steps anti-clockwise in the same way, or do not press the ACW switch for the PCB to automatically select the same number of steps for anti-clockwise as clockwise.
- 7) When you have programmed the required number of steps, switch DIP switch 1 to the OFF position (LEFT) to store the settings into memory. They will remain in memory after removal of power but can be reprogrammed as many times as required.

Place DIP switch 4 into the ON position (right) before programming to allow programming in single step mode where you have to release the switch after each step to allow precise programming of the number of steps.



Example:

The diagram on the left shows the PCB set up for programmed operation in single step mode with overrun allowed.

After applying power, press the switch connected to CW. Each press will advance the motor 1 step. When finished, press the ACW switch the required number of steps for the other direction. Or do not press the switch connected to ACW to set the same amount of steps for both directions.

When programming is complete, switch SW1 DIP switch 1 into the OFF position to store the settings

Press the CW switch and the motor will step as programmed and then stop and wait for the next press of the CW or ACW switch.

## External control (Mode 3)

This mode allows the user to directly control the stepper motor driver IC through an external interface. The control lines for STEP, DIRECTION, SLEEP and ENABLE are found on CONN10 along with +5V and 0V. Below is a description of the control lines;

### Step input (STEP)

A low to high transition advances the motor by one increment, with the size of the step depending on the state of the SW2 switches.

### Direction input (DIR)

The state of this logic input will determine the direction of motor rotation.

### Sleep input (SLEEP)

A logic LOW on this input shuts down much of the internal circuitry including the outputs to minimize the power consumption.

A logic HIGH on this input allows normal operation.

### Enable input (EN)

This enable input is active LOW and enables all of the motor outputs. When this is logic HIGH, all of the motor outputs are disabled.

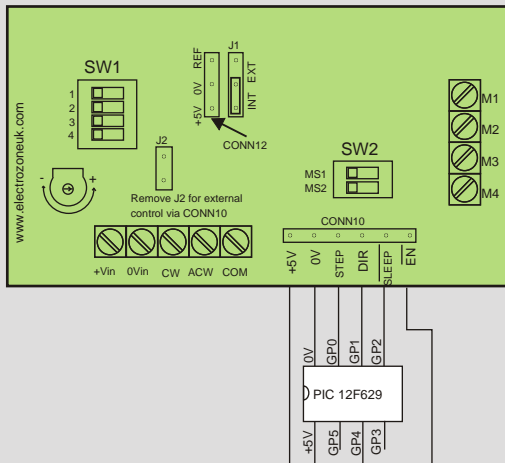
Inputs to the motor controller including STEP, DIR and the microstepping control SW2 are all active independent of the enable input.

### J2 Jumper link for external control select

J2 must be removed before applying power if external control (mode 3) is to be used.

If mode 3 is to be used and J2 is not removed before applying power, damage could result.

| Parameter                | Min  | Max    |
|--------------------------|------|--------|
| Minimum STEP pulse width | 1uS  |        |
| Minimum STEP low time    | 1uS  |        |
| Maximum STEP frequency   |      | 500Khz |
| Logic LOW                | 0V   | 1.5V   |
| Logic HIGH               | 3.5V | 5V     |
| Wake up time after SLEEP |      | 1mS    |
| +5V output current       |      | 50mA   |



The diagram on the left shows how easily the ESMC-02 can be connected to a microcontroller. In this case, the I/O ports of a PIC12F629 have been used to control STEP, DIR, SLEEP and ENABLE. The +5V output from CONN10 powers the microcontroller and no other circuitry is required. Using this method, the microcontroller can be used to incorporate complex sequencing quickly and easily. GP3 and GP5 are left unused can be connected for trigger inputs

\*Note: The Jumper (J2) has been removed to allow external control.

## External current limiting

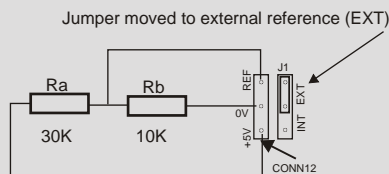
Jumper link (J1) allows selection of internal (INT) or external (EXT) current limiting.

Connector (CONN12) allows the user to connect an external current limiting reference.

Current limiting with internal reference is set at 500mA.

The equation for external current limiting reference is  $I_{tripmax} = V_{ref}/4$

Reference input Impedance is approximately 160K ohms.



The diagram on the left shows an external current limit reference connected to CONN12. Observe J1 in the external position (EXT).  
 $V_{ref} = (R_b / (R_a + R_b)) \times 5$   
 $V_{ref} = 1.25V$   
 Therefore:  $I_{tripmax} = 1.25/4 = 312.5mA$