Controlling stepper motors with MINI-MAX and PRO-MAX

Overview

Stepper motors are synchronous electrical machines for converting electrical energy into mechanical energy. There are 4 basic methods to control stepper motors:

- One-phase-ON method
- Two-phase-ON method
- Half-step method
- Microstep method

For detailed information about how stepper motors work, please refer to our Application Note AN9: Theory of stepper motor operation.

Although micro-controllers can control stepper motors with precision and accuracy, stepper motors can not be connected to a microcontroller directly. Most stepper motors consume currents on the order of few hundred milliamperes to several amperes with voltage requirements ranging from 3VDC to 48VDC and even beyond. Micro-controllers typically have output current capability of only a few milliamperes and output voltages up to 5V. For this reason, it is necessary to use a driver between the micro-controller and stepper motors. BiPOM electronics offers two boards with drivers to control stepper motors: MOTOR-1 and DIO-1 peripheral boards.

Using MOTOR-1 and MINI-MAX/51 boards to control the stepper motors

This example shows how to control a stepper motor (Part#: 26MO48B2U) with MINI-MAX/51 and MOTOR-1 boards. Other stepper motors can also be used.

Parameters of 26MO48B2U are as follows:

Numbers of phases	4
Motor type	Unipolar
Step Size (deg)	7.5
Cont. Holding Torque (N-cm)	1.1
Nominal Voltage (V)	12
Resistance Per Winding (Ohms)	110

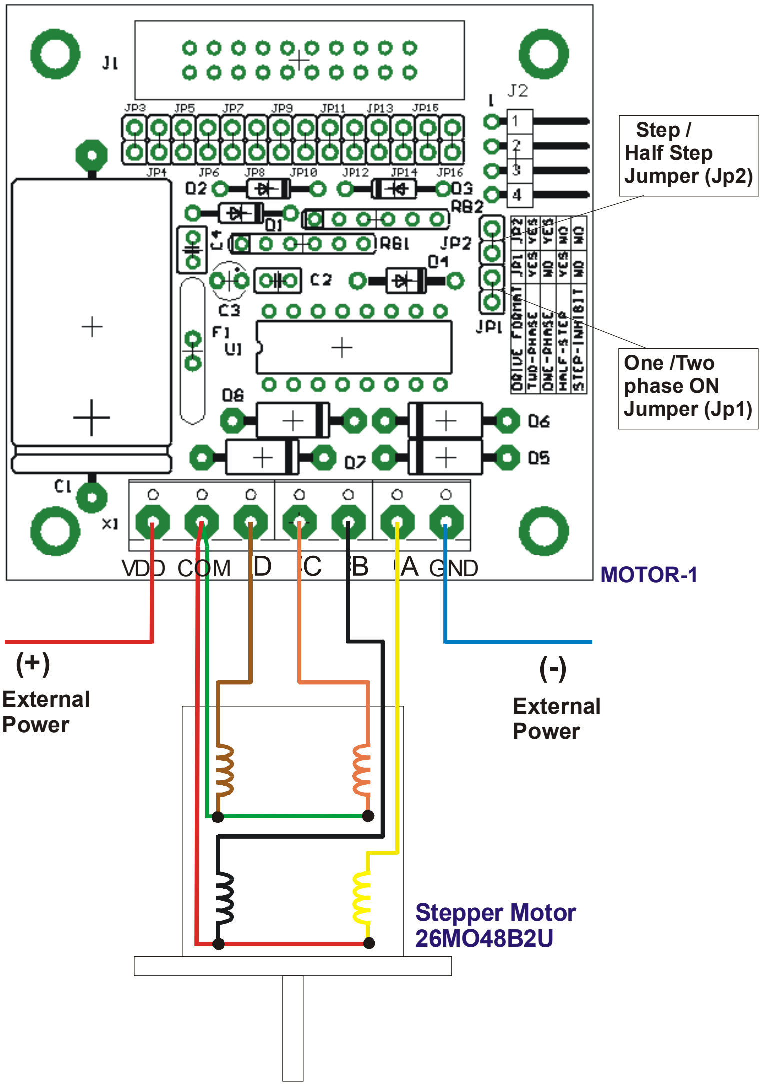
Installation

Before making the connections, turn the power off to MINI-MAX/51 by unplugging the power jack.

Figure 1 shows how to connect the stepper motor and external supply to the MOTOR-1 board. External power supply to drive the motor should be connected to VDD and GND terminals of X2. 26MO48B2U requires a nominal supply voltage 12VDC. For other stepper motors, the nominal voltage for those motors should be applied between VDD and GND. For example, for a 6VDC stepper motor, apply 6VDC between VDD and GND. Positive side of the power supply should be connected to VDD and negative side of the power supply should be connected to GND.

26MO48B2U has a current requirement of 110 mA, which can be easily provided by MOTOR-1 board that can drive motors up to 1A. Jumpers J1 and J2 select the drive format (one-phase, two-phase, or half-step).

Figure 1



DRIVE FORMAT	JP1	JP2
TWO-PHASE	YES	YES
ONE-PHASE	NO	YES
HALF-STEP	YES	NO
STEP-INHIBIT	NO	NO

Example:

For configuring wave-drive format as: Two-phase sequence and half-step mode
Jumpers should be: Half Step JP2 - present, Phase JP1 - present
For enabling driver chip:
JP16-present
JP3-absent, JP4-absent, JP5-absent
Selecting P1.2 as pin for direction control:
JP11- present
JP9- absent, JP10- absent, JP12- absent, JP13- absent
Selecting P3.2 as pin for step control:
JP3- present
JP4- absent, JP5- absent, JP6- absent, JP8- absent

For more details for Stepper motor driver peripheral board MOTOR-1 you can download directly here: http://bipom.com/documents/peripherals/motor-1.pdf

Figure 2 shows how everything is connected together. MOTOR-1 Stepper motor driver peripheral board is plugged on top of the MINI-MAX/51 microcontroller board.

When turn on the power the motor executing one round clockwise for one second, stopping for one second, executing one round anticlockwise (for one second again), stopping for one second and repeating all it. In this example we defined speed to one round per second, but in depending from application it can be changed.

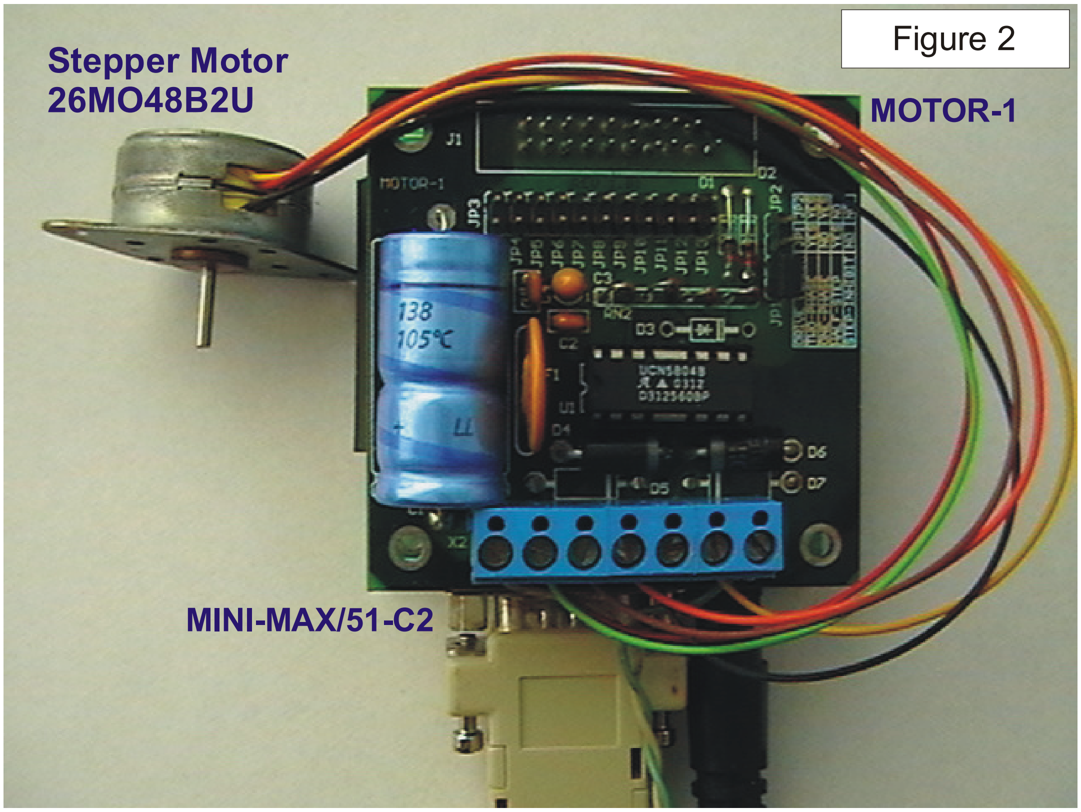


Figure 2

Parts List

MINI-MAX/51-C	- 8051-based Microcontroller Board
MOTOR-1	- Stepper motor driver peripheral board
26MO48B2U	- Stepper motor
External power	- 12VDC/110mA

Software

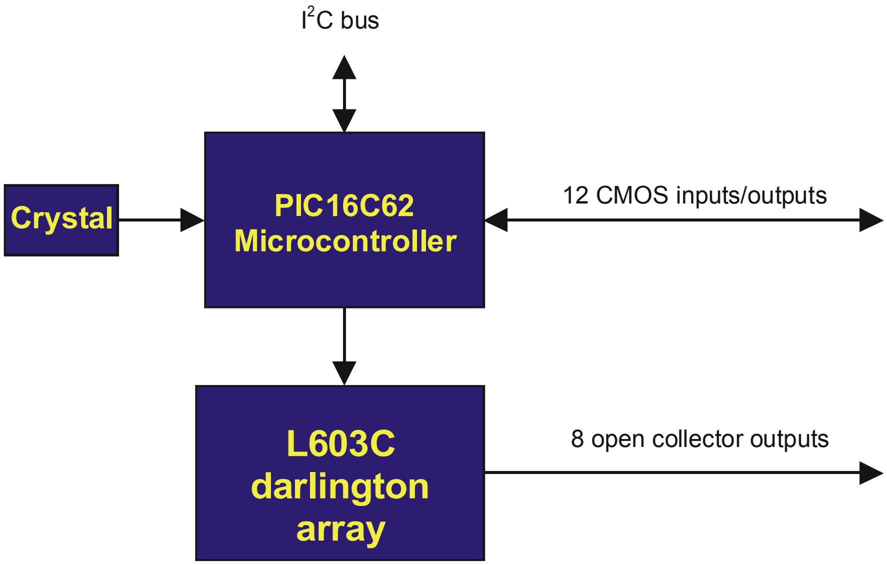
The complete mt1step example is part of our BASCOM51 programming package (available in version 2.16h and higher). It is under bascom51\examples\stepper\mt1step folder.

The mt1step example program a enabling Stepper motor driver chip UCN5804 embedded in MOTOR-1 board with P3.2 port on the microcontroller. Using the P1.1 port the program define direction of rotating ‘0’ and generate 96 pulses per one second on the P3.5 port (96 half-steps) that equal one round on the stepper motor. After that the program disable UCN5804 chip and make delay time for one second, changing rotating direction to '1', execute one round and again make delay time for one second.
It is repeating, while power is switched on.

Using DIO-1 and MINI-MAX/51 boards to control the stepper motors

In this example we will show how with MINI-MAX/51 and DIO-1 boards we can to control stepper motor type 26MO48B2U. DIO-1 communicates with the MINI-MAX/51 through the I2C serial bus. 12 CMOS inputs/outputs are general purpose and not used for stepper motor control. Open collector outputs are connected directly to the stepper motor.

Shown below is a block diagram of the DIO-1 board:

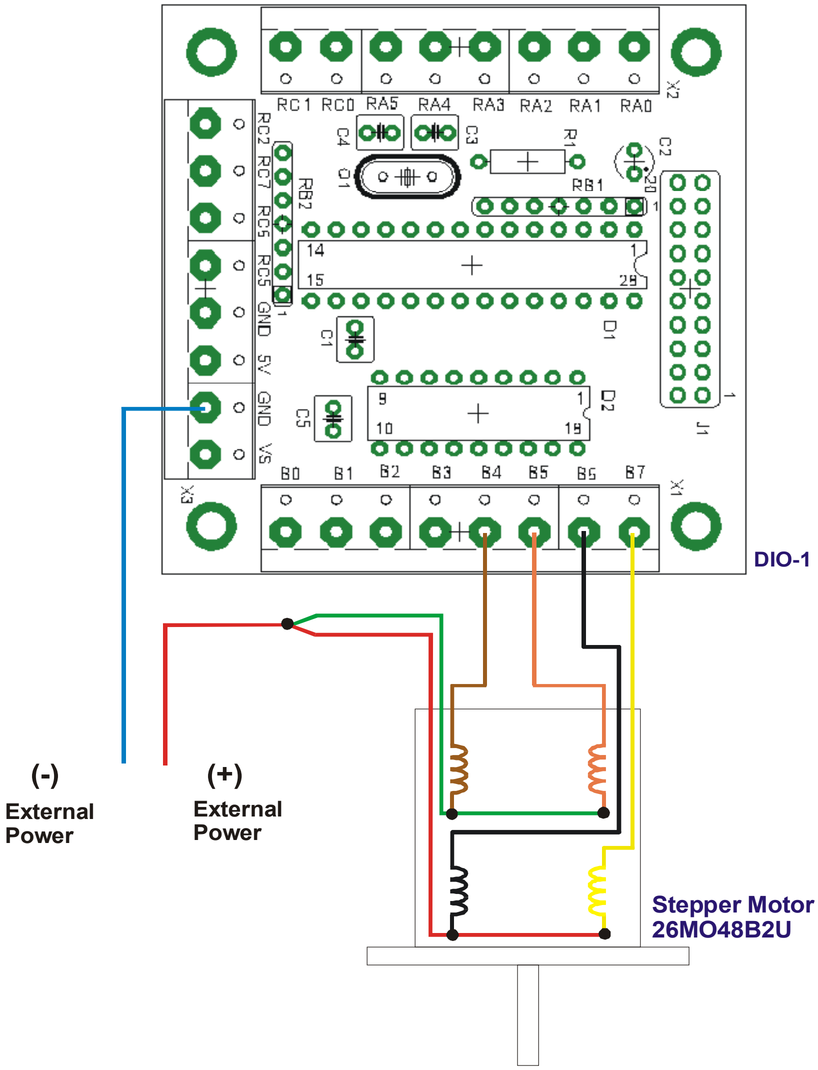

I²C bus
Crystal
PIC16C62
Microcontroller
12 CMOS inputs/outputs
L603C
darlington
array
8 open collector outputs

Installation

Before all connections, turn the power off to MINI-MAX/51 by unplugging the power jack. Figure 3 shows how to connect the stepper motor and external supply to the DIO-1 board. One side of each of the motor coils should connect to one of the open-collector outputs (B4-B7). The other side of each motor coil should connect together and to external supply +12VDC.

NOTES:
1. When connecting external power to the board should be to observe the polarity!
2. When connecting stepper motor to the board should be to observe the wire colors!

Figure 3



For more details for I/O Expander Board board - DIO-1 you can download directly here:
http://bipom.com/documents/peripherals/dio1.pdf

DIO-1 I/O expander board should plugged on top of the MINI-MAX/51 microcontroller board (like on Figure 2, but instead of MOTOR-1 board, is plugged DIO-1 board).

Parts List

MINI-MAX/51	- 8051-based Microcontroller Board
DIO-1	- Stepper motor driver peripheral board
26MO48B2U	- Stepper motor
External power	- 12VDC/110mA

Software

The complete dio1step example is part of our BASCOM51 programming package (available in version 2.16h and higher). It is under bascom51\examples\stepper\dio1step folder.

In the beginning dio1step example program fill the table with phases status for each step (0..7) from the step sequence and send commands to the slave microcontroller for setting safety values of the all ports and setting time interval (3 seconds) for software Watch Dog Timer (WDT) embedded in slave microcontroller. If read values are correct (have communication between host and slave), the program set direction of rotating (**Motor_DIR** bit variable) and number steps for executing (**Motor_Steps**) to **Steps_For_Round** (96 steps per round). These parameters are input parameters for **Motor_Run** subroutine, which in depending of the direction increment or decrement index variable. Index variable determine current phases combination for current step. The stepper motor speed is define of **Motor_Speed** constant and in this example is define as 10mS that equal on the one round per second. In depending from application this speed may be changed and also may be and variable for the program. In the end of **Motor_Run** subroutine the host send commands to the slave microcontroller for reload WDT and setting the safety values PORTB (switch off stepper motor).