Stepper Motor Driver Board

Instruction Note
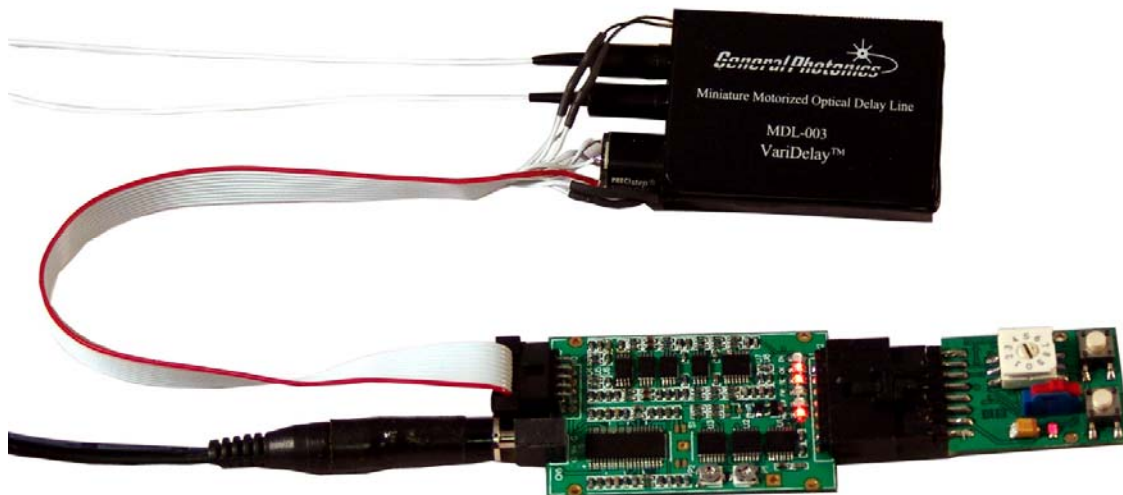
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Specifications:

General:

Operating temperature	$0 \sim 50\ ^\circ C$
Storage temperature	$-20 \sim 70\ ^\circ C$
Humidity	Relative humidity 85% without condensation
Power supply	+12V~+32V (1A)
Control Interfaces	TTL levels and clock signal (See Table 1)

Physical Features:

|	
Dimensions	1.4" (W) × 2.0" (L) × 0.3" (H) (without connector)
Weight	50g (2 Oz.)
Input/Output cables	Power, motor driver, and control
Input connector (to control circuit)	8-pin SIP 0.1 inch grid
Output connector (to motor)	10-pin dual line 2mm grid
Power jack	Male barrel power jack, ID 1.3mm (positive)
	OD: 3.8mm (negative)

Electrical Characteristics:

Operating voltage	+12~+32V DC
Operating current	<1A
Motor control mode	Constant current
Motor start frequency	>500Hz
Motor running frequency	>8000Hz
Motor coil control type	PWM
PWM frequency	>20KHz
Stepper drive mode	Full step, ½ step and ¼ step
Directional control	CW/CCW
Input logic signal	Low 0~0.6V
	High 1.6~20V
	TTL compatible
Output logic signal	0~5V, TTL compatible
Input control signals	Direction, Enable, Clock
Output signals	Home sensor trigger, far end sensor trigger
Travel limit protection	Current disabled when a limit sensor is triggered
Status indicator LEDs	Power, Direction, Enable, Clock, Forward, Reverse

Product Description:

This driver board is designed to drive the stepper motor of the MDL-003 Motorized Delay Line. It can also drive any two phase stepper motor whose drive requirements fall within the board's voltage and current limits.

Note that all references to the home and far-end sensors apply only if the board is being used with an MDL-003. For the MDL-003, the home sensor indicates the minimum delay position, and the far end sensor indicates the maximum delay position. Forward scanning means that the delay is increasing, and reverse scanning means that the delay is decreasing.

Dimensions and Interface Descriptions:
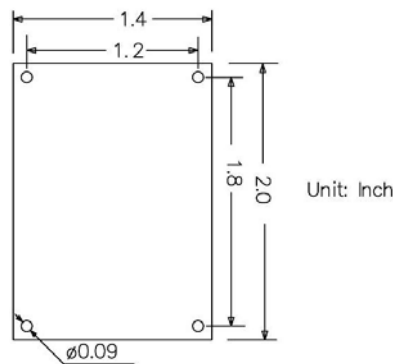
Figure 1 Mechanical drawing (dimensions given in inches)

The board has 4 mounting holes, one in each corner of the board. The mounting hole diameter is 0.09 inches (2.2mm), for use with 2mm screws.
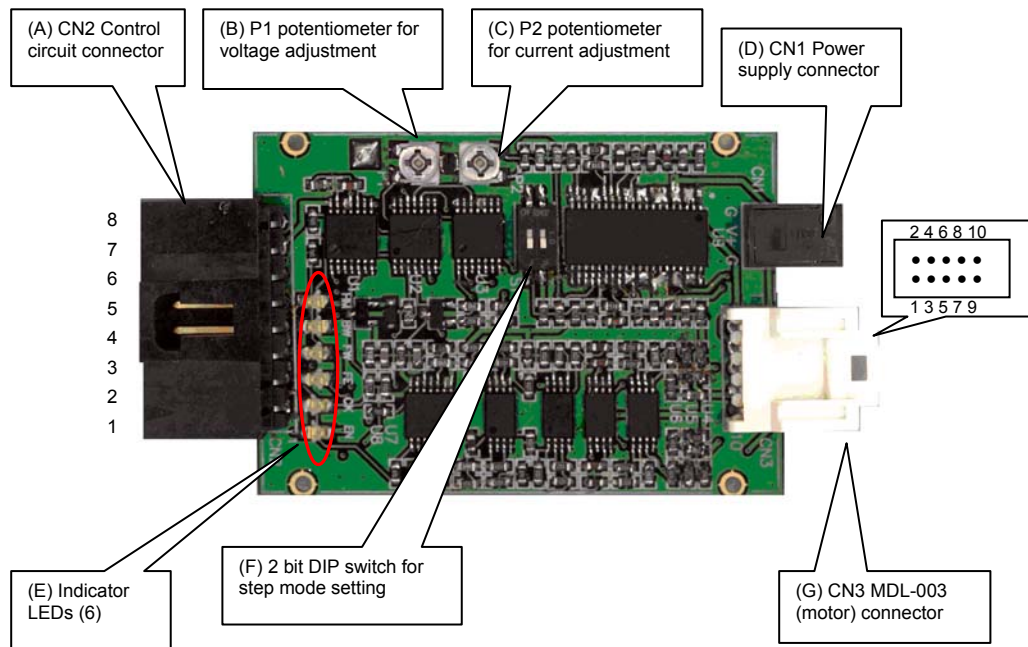
Figure 2 Stepper Motor driver board (top view)

The functions of the connectors and interfaces in the diagram are described below.

A) CN2: Control circuit connector

If the manual control add-on board is being used, it plugs into this connector.

If the driver board is being used without the manual control add-on board, then the input pins that need to be connected to control the MDL are pins 1, 2, 3, and 8. Output pins 4 and 5 can be used to monitor the status of the limit sensors. Pin 7 is a +5V power supply for the manual control add-on board. It does not need to be connected if the manual control board is not being used.

Table 1 CN2 connector pinout

Pin #	Name	I/O	Description	Function
1	Direction	I	Motor rotation direction control	Low=CW High=CCW
2	Enable	I	Motor enable/disable	Low=disable, High=enable
3	Clock input	I	Clock signal supplied to the board	Controls MDL speed
4	HMTR	O	Home position sensor trigger	Low=not triggered High= triggered
5	FETR	O	Far end position sensor trigger	Low=not triggered High= triggered
6	Clock output	O	Clock pulse applied to the motor	Output level: TTL
7	+5V	O	Positive 5V power output	Output current limit 50mA
8	Ground	-	System ground	

B) P1: Potentiometer for motor drive voltage adjustment

The motor drive voltage can be adjusted using potentiometer P1. For a motor working in constant current mode, motor output torque is not very sensitive to changes in drive voltage. The voltage is factory preset to 10.5V. In most cases, it is not necessary to change the setting. The voltage range is from 2V to input power voltage minus 1.5V.

C) P2: Potentiometer for motor drive current adjustment

The average motor drive current can be adjusted to fit different load torques using potentiometer P2. Potentiometer P2 adjusts both motor phase currents evenly. The current adjustment range is from 0.05A to 1A. Larger currents can provide larger motor output torques. The current is factory preset to match the requirements of the MDL-003 stepper motor. If the board is being used with an MDL-003, it is not necessary to change the current setting.

D) CN1: Power supply connector

   Type: Power jack
   Inner conductor: Diameter 1.3mm, Positive
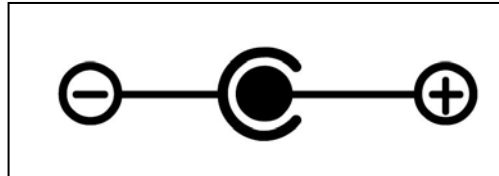   Outer conductor: Diameter 3.8mm, Negative

Figure 3 Power jack configuration

E) Indicator LEDs

There are 6 indicator LEDs on the board. Table 2 provides the readout key.

Table 2 LED indicator function description

#*	Symbol	Function	Description
1	EN	Enable	LED on: enable signal high
2	CK	Clock	LED on: receiving input clock signal
3	FE	Far end sensor status	LED off: far end sensor not connected LED on: far end sensor connected LED blinking: far end sensor triggered
4	FW	Direction CCW	LED blinking: motor direction CCW (control signal TTL high)
5	BW	Direction CW	LED blinking: motor direction CW (control signal TTL low)
6	HM	Home sensor status	LED off: home sensor not connected LED on: home sensor connected LED blinking: home sensor triggered

*LEDs numbered from bottom to top in Figure 2.

F) 2-bit DIP switch for motor step mode selection

This 2-bit DIP switch is for stepper motor step control. The board can drive the motor in full, ½ and ¼ step modes. Fractional modes can be used for smoother motor motion and less noise. The default setting is ¼-step mode.

Bit numbers and ON/OFF status are labeled on the board.
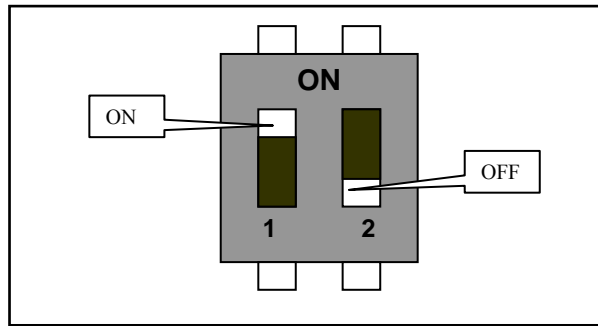
Figure 4 DIP switch position and status

Table 3 Dip switch position key (motor step mode)

Bit 1	Bit 2	Step mode	Clock Pulse frequency factor
OFF	OFF	¼	4X
OFF	ON	½	2X
ON	OFF	½	2X
ON	ON	Full	1X

G) CN3: MDL-003 (or other stepper motor) drive connector

Table 4 CN3 connector pinout

Pin #	Name	I/O	Function
1	B−	O	Motor coil phase B −
2	B+	O	Motor coil phase B +
3	A−	O	Motor coil phase A −
4	A+	O	Motor coil phase A +
5	Home1	I	Home position sensor terminal 1
6	Home2	I	Home position sensor terminal 2
7	Far end 1	I	Far end position sensor terminal 1
8	Far end 2	I	Far end position sensor terminal 2
9	NC	–	Not connected
10	NC	–	Not connected

If the board is being used to control an MDL-003, the MDL-003 optical head's electrical cable plugs into this connector.

If the board is being used to control a different stepper motor, pins 1-4 are the two-phase drive signals for the motor.

Setup and Operation:
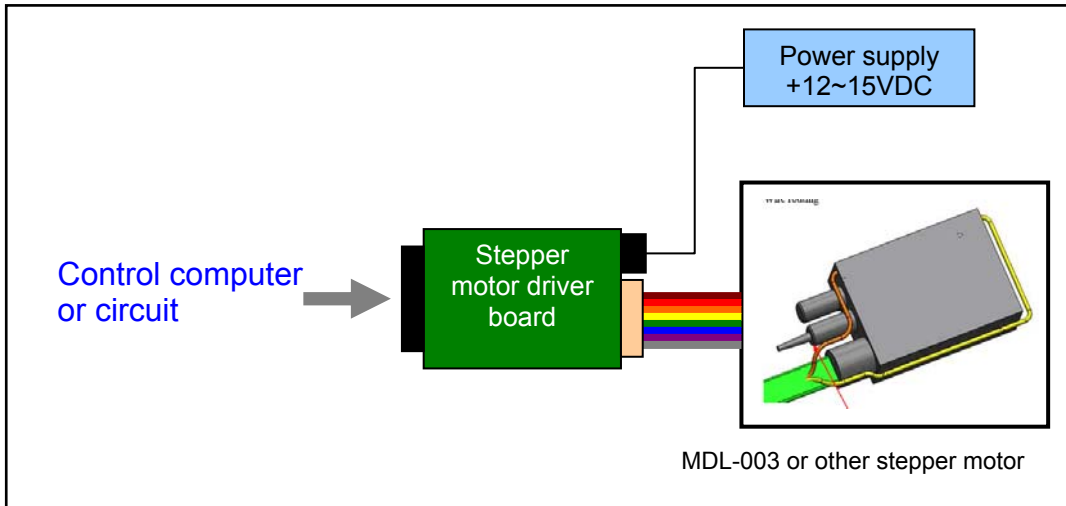
Figure 5 Setup diagram

The electrical connections necessary to operate an MDL-003 or other stepper motor using this driver board are shown in Figure 5.

1. Power supply: The board requires +12~+32VDC (1A).
2. MDL-003: The MDL-003 electrical cable plugs directly into the 10-pin connector on the right side of the board, as shown in the figure.
3. Control circuit: The user needs to provide 3 inputs to drive the motor.

    a. Enable/Disable signal (pin 2): TTL levels.
        High (5V): enabled
        Low (0V): disabled

    b. Clock pulse (pin 3): Square wave TTL levels 0/5V.

        Pulse: ⊓ , minimum width 2µs
             recommended: 50% duty cycle
        The clock rate controls the MDL scan speed. Depending on the step mode, the motor moves ¼, ½, or 1 full step per clock pulse received.

    c. Directional signal (pin 1): TTL levels.
        High: CCW, MDL-003 reverse direction
        Low: CW, MDL-003 forward direction

    If the board is being used to drive an MDL-003, the MDL scan status also depends on the state of the home and far end position sensors. With the MDL cable connected to the board, the board will automatically sense the state of the position sensors.

The truth table for MDL-003 motor control is given below.

Table 5 MDL-003 motor control truth table

Position Sensors		Control Input			Motor status
Home	Far end	Direction	Enable	Clock	
Dis	X	X	X	X	Stop
X	Dis	X	X	X	Stop
Cond	Cond	L	L	Inactive	Stop
Cond	Cond	L	L	Active	Stop
Cond	Cond	L	H	Inactive	Hold
Cond	Cond	L	H	Active	Forward
Cond	Cond	H	L	Inactive	Stop
Cond	Cond	H	L	Active	Stop
Cond	Cond	H	H	Inactive	Hold
Cond	Cond	H	H	Active	Reverse
Trd	Cond	L	L	Inactive	Stop
Trd	Cond	L	L	Active	Stop
Trd	Cond	L	H	Inactive	Hold
Trd	Cond	L	H	Active	Forward
Trd	Cond	H	L	Inactive	Stop
Trd	Cond	H	L	Active	Stop
Trd	Cond	H	H	Inactive	Stop
Trd	Cond	H	H	Active	Stop
Cond	Trd	L	L	Inactive	Stop
Cond	Trd	L	L	Active	Stop
Cond	Trd	L	H	Inactive	Stop
Cond	Trd	L	H	Active	Stop
Cond	Trd	H	L	Inactive	Stop
Cond	Trd	H	L	Active	Stop
Cond	Trd	H	H	Inactive	Hold
Cond	Trd	H	H	Active	Reverse

Key:
Dis   Disconnected
X   N/A; motor state not dependent on the state of this variable
Cond   Connected but not triggered
Trd   Triggered

Manual Control Add-on Board

An optional manual control add-on board is available. This board allows the user to control the MDL-003 or other stepper motor without the use of an external control circuit. It provides controls for setting the scanning rate and for performing either continuous scanning or manual forward or reverse motion control.

Manual control board dimensions: 1 x 1.25 inches.
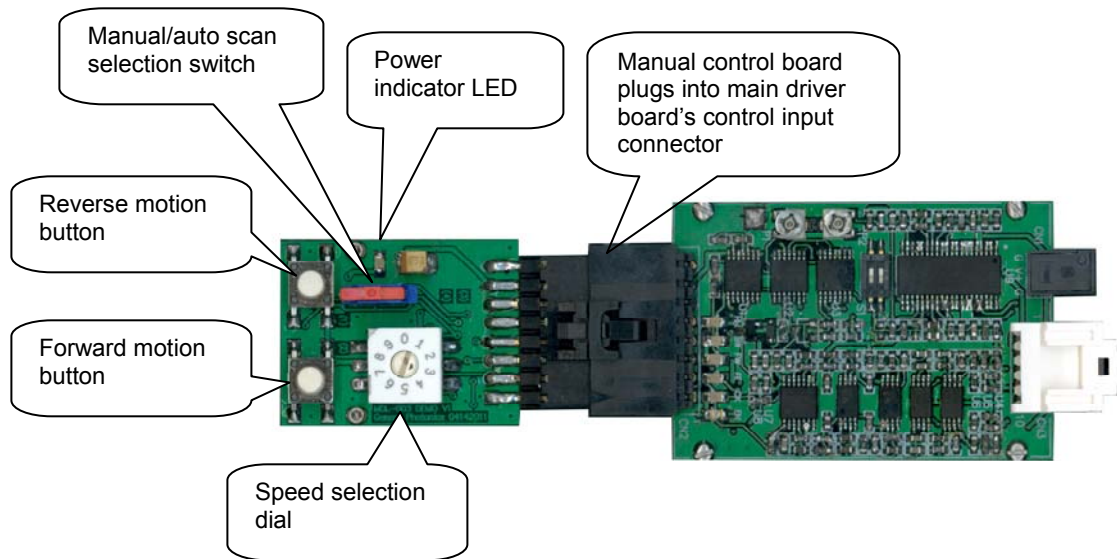
Figure 6 Driver board with manual control add-on board

To use the manual control add-on board, connect it to the main driver board's control input connector, as shown in Figure 6. The power indicator LED should turn on if the power to the main board is connected. The controls are as follows:

Manual/auto switch: Selects between manual delay control and continuous scanning back and forth over the full range of the MDL.
Switch position towards main board: auto scan
Switch position towards push-buttons: manual control. In this position, the forward and reverse buttons can be used to change the delay setting.

Speed selection dial: This is a numbered dial that controls the frequency of the clock pulse sent to the main driver board. Depending on the state of the step selection dip switch on the main board, the MDL motor will make one full, half, or quarter step per clock pulse.

Note: dial settings 8 and 9 are not used. If the dial is in either of these positions, the MDL will not respond to the forward or reverse buttons or the auto-scan setting.

Dial setting	Clock pulse frequency
0	16 Hz
1	31 Hz
2	63 Hz
3	125 Hz
4	250 Hz
5	500 Hz
6	1000 Hz
7	2000 Hz
8	N/A
9	N/A

Forward button: MDL moves in the direction of increasing delay, at a speed determined by the speed selection dial and step mode settings, as long as the button is held down. When it reaches the maximum delay, it stops, and holding down the button has no further effect.

Reverse button: MDL moves in the direction of decreasing delay, at a speed determined by the speed selection dial and step mode settings, as long as the button is held down. When it reaches the minimum delay, it stops, and holding down the button has no further effect.