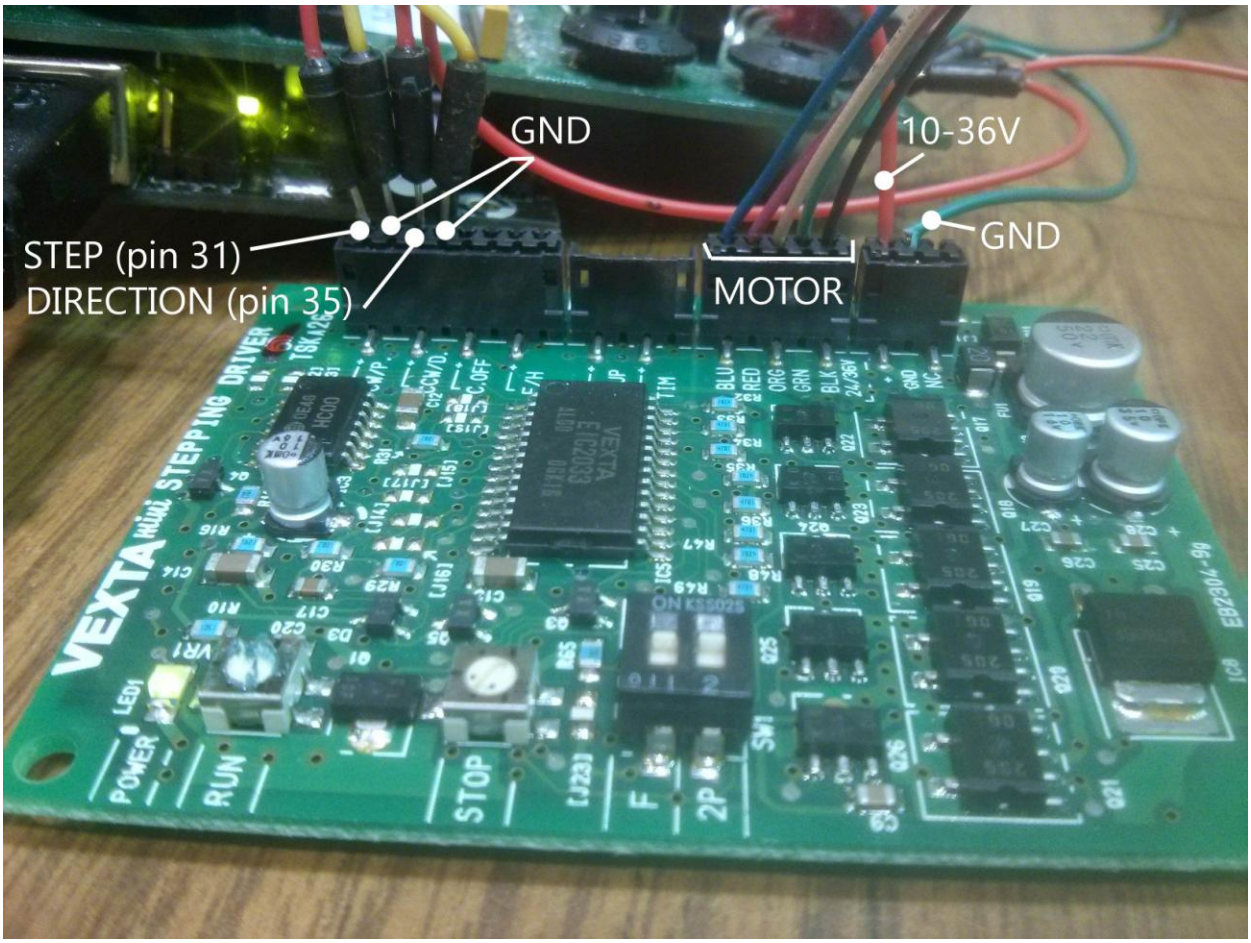
5-Phase Stepper Motors

- Proper wiring:



- Here is a LINK to AccelStepper library for Arduino

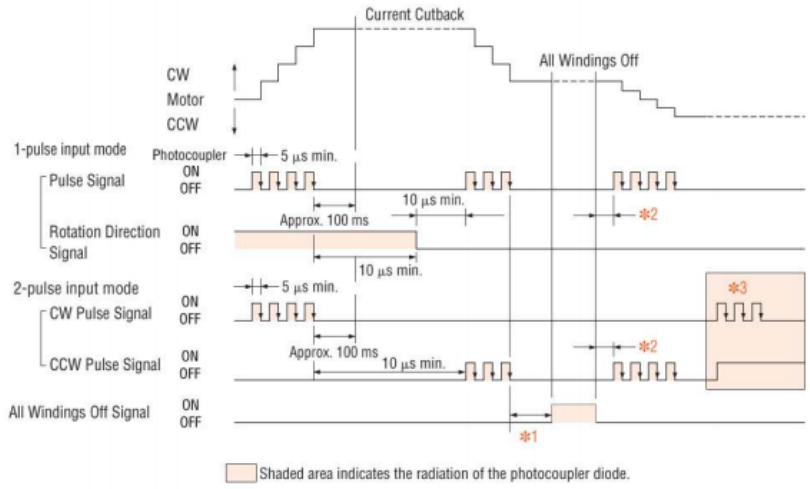
Test Code for Arduino:

```
#include <phys253.h>            //***** from 253 template file

#include <LiquidCrystal.h>      //***** from 253 template file

#include <servo253.h>           //***** from 253 template file

#include "WProgram.h"

#include <HardwareSerial.h>

#define STEP_PIN 31                         // Connect the driver's step pin to pin 31

#define DIRECTION_PIN 35            // Connect the driver's direction pin pin 35

// This is the minimum delay between step commands (in microseconds)
```

```
// It prevents the motor from going too fast.
// If the delay between step commands is too low, the RPM will be too high
#define MIN_DELAY 150
void setup()
{
        portMode(0, INPUT) ;        //***** from 253 template file
        portMode(1, INPUT) ;        //***** from 253 template file
        // Don't attach RCServo0 or 1. Pins are used for stepper motor instead.
        //RCServo0.attach(RCServo0Output) ;
        //RCServo1.attach(RCServo1Output) ;
        RCServo2.attach(RCServo2Output) ;   //***** from 253 template file
        // Display instructions on screen
        LCD.setCursor(0,0);
        LCD.print("Btn=rot Knob=vel");
        LCD.setCursor(0,1);
        LCD.print("Speed: ");
}
void loop()
{
        // Display the velocity on the screen
        // Velocity set using knob 6
        // Knob multiplied by
        int velocity = knob(6);
        LCD.setCursor(7,1);
        LCD.print("     ");
        LCD.setCursor(7,1);
        LCD.print(velocity);
        // Computes the step delay based on the knob value
        // MIN_DELAY prevents delay from ever being 0 (would cause infinite RPM)
        int stepDelay = (102400)-(velocity*10)+MIN_DELAY;
        // If startbutton pressed: rotate clockwise direction
        // If stopbutton pressed:  rotate counter-clockwise direction
        if (startbutton())
```

```
		{
			MoveSteps(10, stepDelay);
		}
		else if (stopbutton())
		{
			MoveSteps(-10, stepDelay);
		}
}
void MoveSteps(int steps, unsigned int microsecondStepDelay)
{
		// Set direction based on the value of steps
		// If steps are positive = clockwise rotation
		// If steps are negative = counter-clockwise rotation
		if (steps < 0)
		{
			digitalWrite(DIRECTION_PIN, LOW); // Set counter-clockwise direction
		}
		else
		{
			digitalWrite(DIRECTION_PIN, HIGH); // Set clockwise direction
		}
		// Moves desired number of steps
		// Motor rotates one step when STEP_PIN changes from HIGH to LOW
		for(int i = 0; i < abs(steps); i++)
		{
			digitalWrite(STEP_PIN, HIGH);
			delayMicroseconds(microsecondStepDelay/2);
			digitalWrite(STEP_PIN, LOW);
			delayMicroseconds(microsecondStepDelay/2);
		}
}
```

● Timing Chart



Note: 10 µs or more is the standard interval time for switching from CW to CCW. Note that the interval time varies greatly depending on the motor and load inertia.

*1 Wait a period of time to allow the motor oscillations to end before inputting the "All Windings Off" signal. This time varies with the load inertia, the load torque and the starting pulse rate. The signal input must be stopped before the motor stops.

*2 Never input step pulse signals immediately after switching the "All Windings Off" input signal to the "photocoupler OFF" state, or the motor may lose synchronism. In general, a minimum interval of 100 ms is required.

*3 The motor will not operate properly when inputting a pulse signal while either the CW or CCW pulse is in the "photocoupler ON" state.

●Description of Input/Output Signals

Pulse Input and Rotation Direction Signals

1-Pulse Input Mode

Pulse Input Signal
"Pulse" signal is input to the PLS/CW −terminal. When the photocoupler state changes from "ON" to "OFF", the motor rotates one step. The direction of rotation is determined by the rotation direction signal.

Rotation Direction Input Signal
The "Rotation Direction" signal is input to the DIR/CCW −terminal.
A "photocoupler ON" signal input commands a clockwise direction rotation. A "photocoupler OFF" signal input commands a counterclockwise direction rotation.

2-Pulse Input Mode

CW Pulse Input Signal
"Pulse" signal is input to the CW/P − terminal. When the photocoupler state changes from "ON" to "OFF", the motor rotates one step in the clockwise direction.

CCW Pulse Input Signal
"Pulse" signal is input to the CCW/D − terminal. When the photocoupler state changes from "ON" to "OFF", the motor rotates one step in the counterclockwise direction.

All Windings Off Input Signal
When the "All Windings Off" (A.W.OFF) signal is in the "photocoupler ON" state, the current to the motor is cut off and motor torque is reduced to zero. The motor output shaft can then be rotated freely by hand. This signal is used when moving the motor by external force or to manual home position.

Step Angle Select Input Signal
When the "Step Angle Select" (F/H) signal is in the "photocoupler ON" state, half step mode has been selected; When the F/H signal is in the "photocoupler OFF" state, full step mode has been selected. (When using this input to select the step angle, the step angle switch should be set to "F" position).

Current Cutback Release Input Signal
When the "Current Cutback Release" (C UP) signal is in the "photocoupler ON" state, the "Automatic Current Cutback" function is not activated.

Excitation Timing Output Signal
The excitation timing signal is output once each time the excitation sequence returns to step "0" in synchronization with input pulse. The excitation sequence is designed to complete one cycle as the motor shaft rotates 7.2°. A signal is output every 10 pulses in full step mode and every 20 pulses in half step mode. (When the "Excitation Timing" signal is output, the transistor turns ON.)

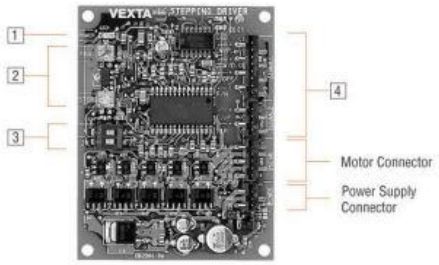
♦How to Use Function Select Switches

Step Angle Select
When the step angle select switch is set to "F" position, the setting is for full step. When set to "H" position, the setting is for half step.

Note:
The step angle can be set with not only the step angle select switch but the step angle select signal input. The unused step angle selection method should be set to FULL STEP. When either of them is set to HALF STEP, the setting is for half step.

Pulse Input Mode
When the pulse input mode select switch is set to "2P" position, the 2-pulse input mode is set. When the pulse input mode select switch is set to "1P" position, the 1-pulse input mode is set.

Connection and Operation



1 Signal Monitor Display

Indicator	Color	Function
POWER	Green	Power input display

2 Current Adjustment Potentiometers

Indicator	Name	Functions
RUN	Motor run current potentiometer	For adjusting the motor running current
STOP	Motor stop current potentiometer	For adjusting the motor current at standstill

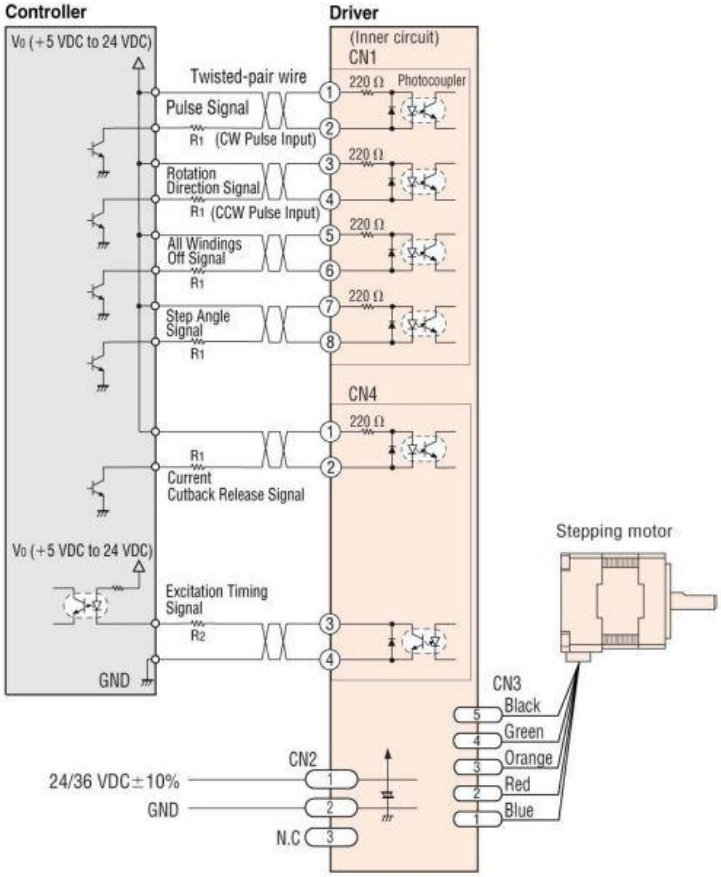
3 Function Select Switches

Indicator	Switch Name	Functions
F/H	Step angle select switch	Switches the motor's step angle. F: Full step, H: Half step
2P/1P	Pulse input mode switch	Switches between 1-pulse input mode and 2-pulse input mode

4 Input/Output Signals

Connector	Input/Output	Pin No.	Terminal Name
CN1	Input signal	1	Pulse Signal (CW Pulse Signal)
		2	
		3	Rotation Direction Signal (CCW Pulse Signal)
		4	
		5	All Windings Off Signal
		6	
		7	Step Angle Select Signal
		8	
CN4	Input signal	1	Current Cutback Release Signal
		2	
	Output signal	3	Excitation Timing Signal
		4	

Connection Diagrams



Notes:

- Keep the voltage Vo between 5 VDC and 24 VDC. When Vo is equal to 5 VDC, the external resistance R1 is not necessary. When Vo is above 5 VDC, connect R1 to keep the current between 10 mA and 20 mA, and connect R2 to keep the current below 10 mA.
- Use twisted-pair wire of AWG 28 or thicker and 6.6 feet (2 m) or less in length for the signal line.
- Note that as the length of the pulse signal line increases, the maximum transmission frequency decreased. (→Technical Reference Page F-36)
- Suitable wire size for the CN1, CN2, CN3 and CN4 connector is between AWG 28 and AWG26. Use AWG 26 for the power line. When assembling the connectors, use the hand-operated crimp tool for contact 911790-1(AMP). The crimp tool is not provided with the package.
- Signal lines should be kept at least 3.9 inches (10 cm) away from power lines (power supply lines and motor lines). Do not bind the signal line and power line together.
- If noise generated by the motor lead wire causes a problem, try shielding the motor lead wires with conductive tape or wire mesh.
- Incorrect connection of DC power input can lead to driver damage. Make sure that the polarity is correct before turning power on.

♦ Power Supply

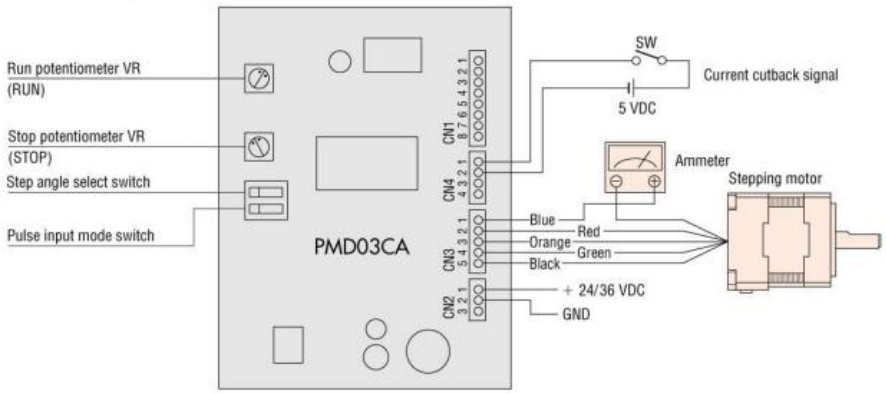
Keep the input power voltage to either 24 VDC±10% or 36 VDC±10%. Use a power supply that can supply sufficient input current.

● Adjusting the Driver Output Current

The rated output current is set at the factory. If it is necessary to change the current setting, follow the procedures described below.

♦Connecting an Ammeter

①Connect a DC ammeter between the motor and pin ① of CN3 connector as shown below.



②After connecting the DC ammeter to the motor, turn on the power. (The excitation status at this point is fixed: power on reset.)

③When the power is turned on, the motor enters a 4 phase excitation state, and +directional current flows through the blue motor lead wire. (Even if 4-5 phase excitation has been selected, the motor enters a 4 phase excitation state when the power is turned on. Adjust the current in this state.)

④The value measured by the ammeter represents the total current in two phases. The current for one phase is equivalent to half of the ammeter value. (When setting the current to 0.3 A/phase, adjust the current level until the ammeter reads 0.6 A.)

Notes:

- Never input pulse signals.
- Select "photocoupler OFF" for "All Windings Off" signal. (Select "photocoupler OFF" when the switch is open.)
- When the RUN current is adjusted, the current at motor standstill also changes.

♦Adjusting the Motor Running Current

Set "Current Cutback Release" signal to the "photocoupler ON" state when adjusting the RUN current.

(1)Adjust the motor RUN current with the RUN potentiometer.
Adjusting range
PMD03CA: 0.07 A/phase to 0.35 A/phase

(2)The motor running current is set for rated current at the time of shipping, but it can be readjusted using the RUN potentiometer. The running current can be lowered to suppress temperature rise in the motor/driver, or lower running current in order to allow a margin for motor torque or to reduce vibration.

Note:

- The motor RUN current should be less than the motor rated current.

♦Adjusting the Current at Motor Standstill

Set "Current Cutback Release" signal to the "photocoupler OFF" state when adjusting the current while the motor is stopped.

(1)Adjust the current at motor standstill with the STOP potentiometer.
Adjusting range
PMD03CA: 0.07 A/phase to 0.28 A/phase

(2)At the time of shipping, the current at motor standstill is set for half of rated current. The STOP potentiometer can be used to readjust the current at motor standstill to the current value required to produce enough holding torque.

$$\text{Holding torque [oz-in (N·m)]} = \frac{\text{Maximum holding torque [oz-in (N·m)]} \times \text{Current at motor standstill [A]}}{\text{Motor rated current [A]}}$$

List of Motor and Driver Combinations

Type	Model	Motor Model	Driver Model
Standard	**PMC33□3**	PMM33□2	PMD03CA
	PMC35□3	PMM35□2	
MG Geared	**PMC33□1-MG3.6**	PMM33□-MG3.6	
	PMC33□1-MG7.2	PMM33□-MG7.2	
	PMC33□1-MG10	PMM33□-MG10	
	PMC33□1-MG20	PMM33□-MG20	
	PMC33□1-MG30	PMM33□-MG30	
HG Geared	**PMC33□1-HG50**	PMM33□-HG50	
	PMC33□1-HG100	PMM33□-HG100	

- Enter **A** (single shaft) or **B** (double shaft) in the box (□) within the model numbers