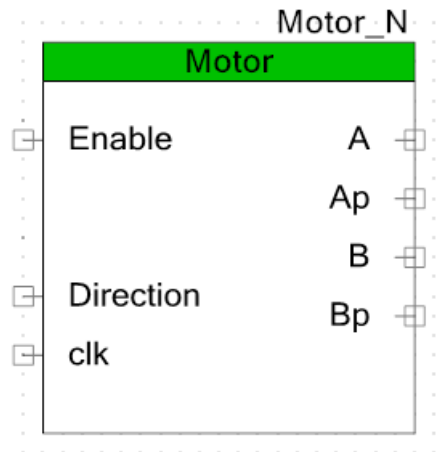# Motor Shield Module (MSM)

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Features

- Multiple phase options for Stepper Motor
- Multiple polarity options
- Configurable step type
- Configurable frequency driver
- Easy enable capability

General Description

The MSM component provides a simple driver for stepper motors with or without the use of the motor shield. The MSM is designed to take in various parameters based on the user's type of motor and preferences, and then output the correct signals to drive the motor through four signal wires: A, Ap, B, and Bp.

The output from the MSM can be connected to any four desired output pins. However, the responsibility to correctly hook up the wires to the stepper motor falls on the user. Here are some general guidelines when determining how to hook up the motor:

- If polarity of wires is not known, then using a multimeter you can find the polarities by using the following to reason out the wires:
    - For 6-lead stepper motor:
        - The resistance between Coil End A and Coil End B is DOUBLE the resistance between Coil End A to the Center Tap 1.
        - The resistance between Coil End B and Coil End A is DOUBLE the resistance between Coil End B to the Center Tap 1.
        - The resistance between Coil End C and Coil End D is DOUBLE the resistance between Coil End C to the Center Tap 2.
        - The resistance between Coil End D and Coil End C is DOUBLE the resistance between Coil End D to the Center Tap 2.

For other stepper motors, please consult your user manual for the motor to find the correct leads for the module.

Input/Output Connections

This section describes the various input and output connections for the MSM.

Input	May Be Hidden	Description
clock	Y	The clock input defines the signal to count. The speed of the stepper motor is directly controlled by the speed of the clock. Each coil goes high for ¼ of each clock cycle. If clock parameter is set to be off, then the clock input is hidden and the default clock speed of the motor is set to 6 kHz.
enable	Y	The enable input works in conjunction with software enable and trigger input (if the trigger input is enabled) to enable the period counter. The enable input is not visible if the **Enable Mode** parameter is set to **Software Only**. This input is not available when the fixed-function PWM implementation is chosen.
Direction	N	The direction input specifically addresses the direction in which the user wants the motor to step. A low value corresponds to rotating in the clockwise direction, while a high value corresponds to rotating in the counter clockwise direction.
Step	Y	The step input will force the stepper motor to make one full rotation each time a new high signal is sent. This input is only present when the **Step_Type** parameter is set to **single step**.

Output	May Be Hidden	Description
A, Ap, B, Bp	N	The four leads that control the signal sent to the four coils inside the stepper motor to allow the motor to step according to users settings.

Component Parameters

Drag a MSM component onto your design and double click it to open the **Configure** dialog. The **Configure MSM** dialog contains two tabs: **Basic** and **Built-in.**

Hardware versus Software Configuration Options

Hardware configuration options change the way the project is synthesized and placed in the hardware. You must rebuild the hardware if you make changes to any of these options. Software configuration options do not affect synthesis or placement. When setting these parameters before build time you are setting their initial value, which may be modified at any time with the APIs provided. Most parameters described in the next sections are hardware options. The software options are noted as such.

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Configure Tab

Clock

This parameter allows you to choose to run the motor on custom clock speed (feed in at the clock input), or to use the default clock speed (6 kHz) ofor the motor.

Enable Mode

The **Enable Mode** parameter defines what hardware and software combination is required to enable the overall functionality of the PWM. Options include:

- **Software Only** – The PWM is only enabled when the enable bit in the control register is set by software. The enable input is not visible when the enable mode is set to **Software Only**.

- **Hardware Only** – The PWM is only enabled while the hardware enable input is active (high). In this mode, the PWM_Start() API must be called for proper initialization of the component, to avoid unexpected behavior.

- **Hardware And Software –** The PWM is enabled while both the bit in the control register and the hardware input are active (high).

Step Pattern

The **Step Pattern** parameter defines the stepping functionality of the MSM. This parameter affects the number of steps that the motor takes. Options include:

- **Continuous** – Sets up the stepper motor to continue stepping while a high signal is applied to the enable pin.

- **Single Step** – Sets up the stepper motor to perform one single step in the direction specified by the direction parameter. Step will occur for each rising signal sent to the **Step** input.

Step Type

The **Step Type** parameter defines the step driving motion of the MSM. This parameter affects the drive strength of the stepper motor. Options include:

- **Full Step** – Sets up the stepper motor to perform a full step, in which two opposing coils are high at the same time to maximize the output drive of the motor.

- **Wave Step –** Sets up the stepper motor to perform a wave step, in which only one coil is high at any given time and each coil is high in one cycle for one quarter of the time.

- **Half Step** – Sets up the stepper motor to perform a half step, in which the stepping drive alternates in the form: A high -> Ahigh Bhigh -> B high -> B high Ap high -> etc. Note that this type will result in a drive that is approximately one quarter that of the maximum drive strength of the motor.

Clock Selection

There is a default internal clock in this component. You have the option to attach a clock source instead of the default clock of 6 kHz.

Application Programming Interface

Application Programming Interface (API) routines allow you to configure the component using software. The following table lists and describes the interface to each function. The subsequent sections cover each function in more detail.

By default, PSoC Creator assigns the instance name "Motor_1" to the first instance of a component in a given design. You can the rename the instance to any unique value that follows the syntactic rules for identifiers. The instance name becomes the prefix of every global function name, variable, and constant symbol. For readability, the instance name used in the following table is "Motor."

Input	Description
Motor_Start()	Initializes the PWM with default customizer values.
Motor_Stop()	Disables the PWM operation. Clears the enable bit of the control register for either of the software controlled enable modes.
Motor_Reset()	
Motor_SetDirection()	
Motor_Init()	Initializes component's parameters to those set in the customizer placed on the schematic.
Motor_Enable()	Enables the Motor block operation.