

FOLLOW DIGITAL TORQUE COMMAND (BI-POLAR PWM COMMAND)

Available on

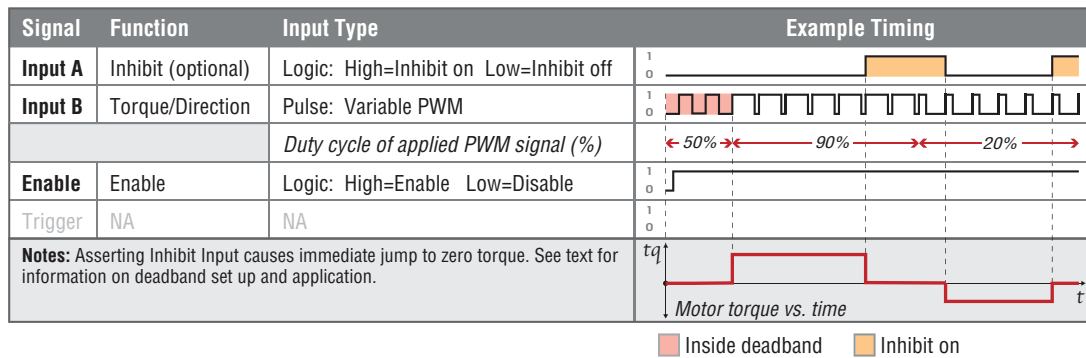
MCVC + MCPV

MODE DESCRIPTION

Connect a digital PWM waveform from your PLC or other device, and ClearPath will produce torque proportional to the duty cycle of the PWM waveform.

Assert the Enable Input to energize the motor. Control motor torque by applying a PWM signal to Input B. Motor torque changes in proportion to the duty cycle of the applied PWM signal. Assert the Inhibit signal (Input A) to immediately turn off torque. See figure below and read text for timing and PWM requirements.

Torque Control Follow Digital Torque Command (Bi-Polar PWM Command)



I/O FUNCTIONS

Enable Input - Asserting this input energizes the motor shaft.

Input A - This input forces the torque to zero regardless of the input PWM duty cycle.

Input B - This input is connected to a PWM signal whose duty cycle represents the desired torque.

Output (HLFB) - See HLFB section for available modes.

Notes:

- PWM input frequency range: 20 Hz to 30 kHz.
 - If the PWM signal is off for 50mS (or more) the PWM input is considered off. This is interpreted by ClearPath as a zero-torque command.
 - Disable time = 10 mS
 - To command ClearPath to zero torque, assert the Inhibit: Input (Input A). Deassert Input A to resume normal operation.
- or**
- Set a PWM deadband: to help reliably command zero torque. Refer to text on following pages for details on deadband setup.

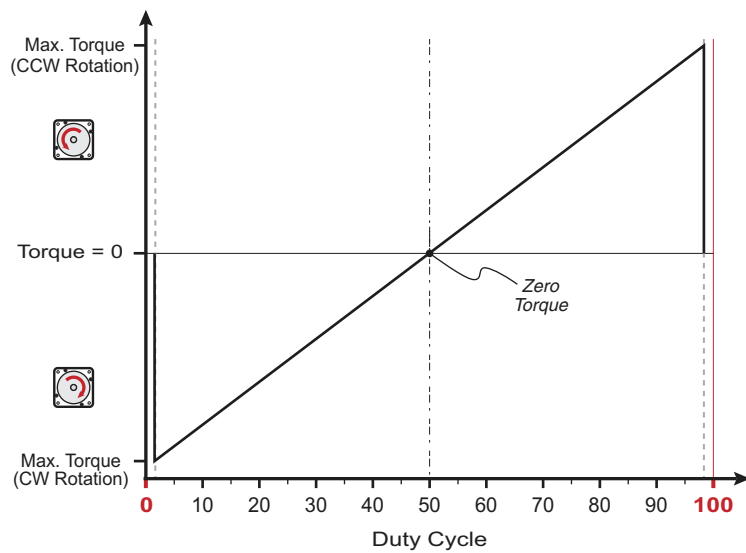
MODE CONTROLS

The screenshot shows the Mode Controls interface with the following settings and annotations:

- Max Torque Command** (% of max): 10. Annotation: Enter max. desired motor torque (i.e., full scale torque).
- PWM Deadband** (+/- %): 0. Annotation: Enter deadband setting (optional). See text for description of deadband operation.
- Max Speed** (RPM): 100.0. Annotation: Enter max. speed limit (ClearPath will shut down if this speed limit is exceeded).
- Over-speed Timeout** (ms): 20. Annotation: Enter value to specify how long ClearPath can spin at **Max Speed** before shutting down.
- Torque Limit**: OVR Setup... button. Annotation: Click to open Torque Limit Setup dialog.
- Invert PWM Input**: . Annotation: Check box to invert how PWM duty cycle is measured by ClearPath.
- Torque Override Indicator**: OVR indicator light. Annotation: When lit, the main torque limit is being overridden by a secondary, user-set torque limit (e.g., when an axis is homing, the main torque limit may be overridden by the separate homing torque limit setting).
- Hardware Input Status LEDs**: Light = Input asserted (on), Dark = Input de-asserted (off).
- PWM Meter**: Displays duty cycle of PWM source connected to Input B. Current value: 80% Duty Cycle.
- Displays commanded torque (when using hard controls)**: Torque (% of Peak) display. Current value: 5.99.
- Displays commanded torque (when using Soft Controls)**: Torque (% of Peak) display. Current value: 0.
- Displays HLFB output status**: Servo On output display. Current value: Servo On.
- Override Inputs**: . Annotation: Check to turn on Soft Controls. Override cannot be activated when ClearPath is hardware enabled.
- Soft Inputs and LEDs**: Emulate hardware inputs. For use only when Soft Controls are active. **Caution: motor may spin when enabled.**
- PWM Soft Slider**: Emulates PWM input (for use with Soft Controls).

Relationship of PWM duty cycle to motor torque

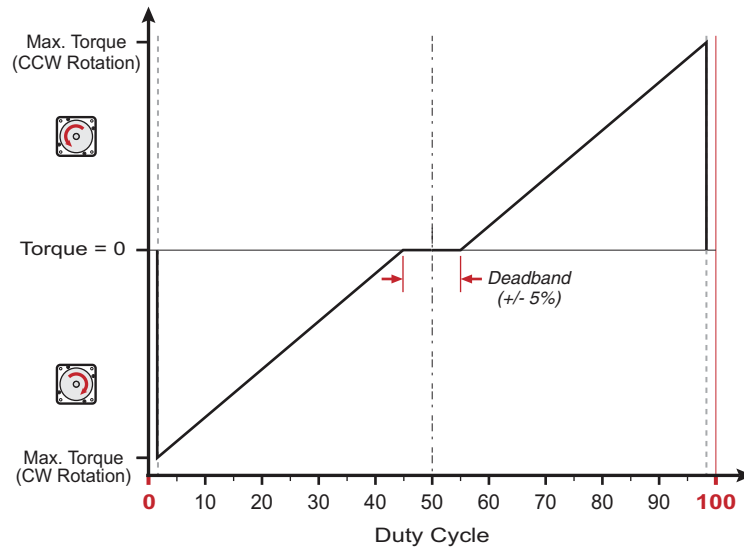
- Shaft torque increases in the CW direction as PWM duty cycle decreases from 50% to 0%.
- Shaft torque increases in the CCW direction as PWM duty cycle increases from 50% to 100%.
- As PWM duty cycle approaches 50% from either direction, motor torque approaches 0.
- 0% and 100% duty cycle (static low and static high conditions) are not valid PWM states. ClearPath interprets these values as zero-torque commands.
- PWM minimum on time and minimum off time = 300nS.



PWM duty cycle vs. motor torque

SETTING A PWM DEADBAND

The deadband expands the range about the 50% PWM mark that is interpreted as the “zero torque setting” by ClearPath. This gives the user a reliable way to ensure that motor torque is completely turned off when the PWM duty cycle is set at (or “close enough” to) 50%.



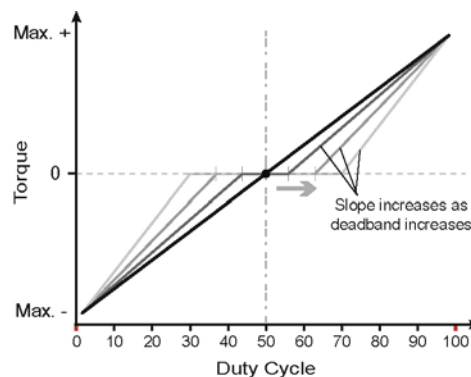
+/- 5% PWM deadband setting

Why use a deadband?

In bi-polar mode, turning off torque is achieved, in theory, by applying a 50% duty cycle PWM signal to Input B. However, it can be difficult to set a perfect 50% duty cycle. In fact, a very small amount of torque may still be produced by the motor, *even when duty cycle is apparently set to 50%*. A deadband helps guarantee torque is fully off when you expect it to be.

Example: If the user sets a +/-5% deadband, any PWM signal with a duty cycle between 45% and 55% (i.e., in the deadband) is interpreted as a zero-torque command by ClearPath.

Note: As deadband setting increases, the slope of torque vs. duty cycle increases as illustrated below.



FOLLOW DIGITAL TORQUE COMMAND (UNIPOLAR PWM COMMAND)

Available on

MVC + MCPV

MODE DESCRIPTION

Connect a digital PWM waveform from your PLC or other device, and ClearPath will generate torque that is proportional to the duty cycle of the PWM waveform.

Assert the Enable Input to energize the motor. Motor torque is controlled by applying a variable PWM signal to Input B. 0% PWM duty cycle commands zero torque, and 100% duty cycle commands full-scale torque. Direction of shaft rotation is controlled by the state of Input A. See Inputs and Timing table below.

Torque Control Variable Torque With Unipolar PWM Input Control

Signal	Function	Input Type	Example Timing
Input A	Direction	Logic: High=CW Low=CCW	
Input B	Torque	Pulse: Variable PWM <i>Duty cycle of applied PWM signal (%)</i>	
Enable	Enable	Logic: High=Enable Low=Disable	
Trigger	NA	NA	
Notes:			<p>Motor torque vs. time</p>

I/O FUNCTIONS

Enable Input - Asserting this input energizes the motor shaft.

Input A - This input selects the direction of the applied torque.

Input B - This input is connected to a PWM signal whose duty cycle represents the desired torque.

Output (HLFB) - See HLFB section for available modes.

Notes:

- PWM input frequency range: 20 Hz to 30 kHz.
- If the PWM signal is off for 50mS (or more) the PWM input is considered off. This is interpreted by ClearPath as a zero-torque command.
- Disable time = 10 mS

MODE CONTROLS

Enter max. torque desired (i.e. full scale torque).

Enter max. speed limit (ClearPath will shut down if this speed limit is exceeded.)

Enter value to specify how long ClearPath can spin at **Max Speed** before shutting down.

Click to open Torque Limit Setup dialog.

Max Torque Command
(% of max)

Max Speed
(RPM)

Over-speed Timeout
(ms)

Torque Limit

OVR Setup...

Invert PWM Input

Check box to invert how PWM duty cycle is measured by ClearPath.

NO CHECK

Duty cycle is % of period high

CHECK

Duty cycle is % of period low

Torque Override Indicator

When lit, the main torque limit is being overridden by a secondary, user-set torque limit (e.g., when an axis is homing, the main torque limit may be overridden by the separate homing torque limit setting).

Hardware Input Status LEDs
Light = Input asserted (on)
Dark = Input de-asserted (off)

PWM Meter - Displays duty cycle of PWM source connected to Input B.

Displays commanded torque (when using hard controls).

Inputs and Commands

Override Inputs

Enable On/Off

Input A CW/CCW

Input B Duty Cycle

Torque (% of Peak)

ServoOn Output

Soft Inputs and LEDs
Emulate hardware inputs. For use only when Soft Controls are active. **Caution: motor may spin when enabled.**

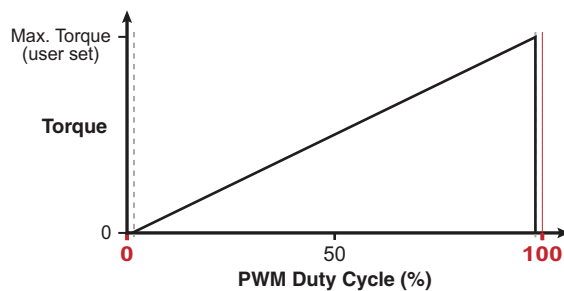
PWM Soft Slider
Emulates PWM input (for use with Soft Controls).

Displays commanded torque (when using Soft Controls).

Displays HLFB output status.

Motor torque vs. PWM duty cycle:

- Motor torque is proportional to PWM duty cycle (i.e. torque increases as duty cycle increases). See figure below.
- 0% and 100% duty cycle signals (static low and static high respectively) are invalid PWM states, interpreted by ClearPath as “PWM turned off”. This is the equivalent of a zero-torque command.



PWM duty cycle vs. torque

- For CW torque, set Input A high. For CCW torque, set Input A low.
- PWM minimum on time and minimum off time = 300nS

FOLLOW DIGITAL TORQUE COMMAND (FREQUENCY COMMAND)

Available on



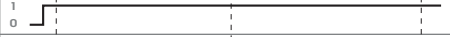
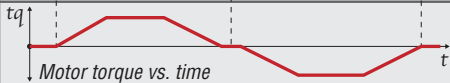
MVC + MCPV

MODE DESCRIPTION

Connect a digital variable frequency waveform from your PLC or other device, and ClearPath will produce torque that is proportional to the frequency of the waveform.

Assert the Enable Input to energize the motor. Control torque by applying a variable frequency pulse train to Input B. Pulse frequency is proportional to commanded torque. Direction in which torque is applied (CW/CCW) is controlled by the state of Input A. See Inputs and Timing table below.

Torque Control Variable Torque With Frequency Input Control

Signal	Function	Input Type	Example Timing
Input A	Direction	Logic: High=CW Low=CCW	
Input B	Torque	Pulse: Variable Frequency	
Enable	Enable	Logic: High=Enable Low=Disable	
Trigger	NA	NA	
Notes:			

I/O FUNCTIONS

Enable Input - Asserting this input energizes the motor shaft.

Input A - This input selects the direction of the applied torque.

Input B - This input is connected to a pulse train whose frequency represents the desired torque.

Output (HLFB) - See HLFB section for available modes.

Notes:

- Input frequency range: 20 Hz to 700 kHz.
- If the frequency signal is off for 50mS or more the input is considered off. This is interpreted by ClearPath as a zero-torque command.
- Disable time = 10 mS

MODE CONTROLS

Set Min/Max Frequency. During operation, motor torque is controlled by Input B signal frequency. With settings shown below, a 10 kHz input signal will command the motor to its Max Torque Command (10% of peak), and a signal of 1 kHz or less will command zero torque.

Enter max. desired motor torque (i.e., full scale torque).

Enter max. speed limit (ClearPath will shut down if this speed limit is exceeded)

Enter value to specify how long ClearPath can spin at **Max Speed** before shutting down.

Click to open Torque Limit Setup dialog.

Torque Override Indicator
When lit, the main torque limit is being overridden by a secondary, user-set torque limit (e.g., when an axis is homing, the main torque limit may be overridden by the separate homing torque limit setting).

Hardware Input Status LEDs
Light = Input asserted (on)
Dark = Input de-asserted (off)

Frequency Meter
Displays frequency of signal connected to Input B.

Displays commanded torque (when using hard controls).

Inputs and Commands

Enable On/Off

Input A CW/CCW

Input B Frequency
1.995 kHz

Torque (% of Peak)
1.11

ServoOn Output
Servo On

Override Inputs

Soft Inputs and LEDs
Emulate hardware inputs. For use only when Soft Controls are active. **Caution: motor may spin when enabled.**

PWM Soft Slider
Emulates PWM input (for use with Soft Controls).

Displays commanded torque (when using Soft Controls).

Displays HLFb output status.