

FOLLOW DIGITAL VELOCITY COMMAND (BI-POLAR PWM COMMAND WITH INHIBIT)

Available on

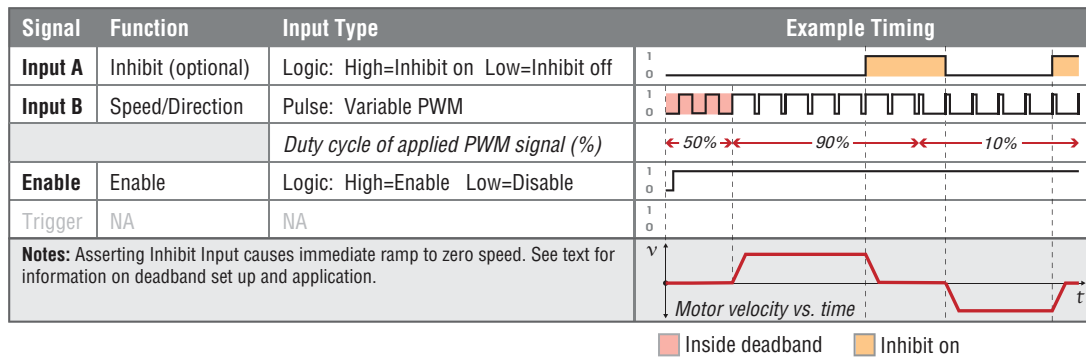
MCVC + MCPV

MODE DESCRIPTION

Connect a digital PWM waveform from your PLC or other device, and ClearPath will run at a velocity proportional to the duty cycle of that waveform. Or, use the PWM output from an H-bridge driver of a brushed motor setup and ClearPath becomes a high-performance drop-in replacement.

Assert the Enable Input to energize the motor. Control motor speed and direction by modulating the duty cycle of the PWM signal. Assert the Inhibit signal (Input A) to immediately ramp to zero velocity. See figure below and read text for timing and PWM requirements.

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



I/O FUNCTIONS

Enable Input - Asserting this input energizes the motor shaft.

Input A - This input forces the speed 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 velocity.

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

Notes:

- PWM input frequency range: 20 Hz up to 30 kHz.
- The output of a standard H-bridge driver for a DC brush motor is bipolar PWM, so it can be used to allow ClearPath to replace a DC brush motor without changing anything else in the system.
- A 50% PWM duty cycle means zero speed; near 100% and near 0% duty cycle correspond to opposite directions at the user-defined maximum speed.
- Input A can be used to command zero speed at any time (overriding the PWM). Or, if duty cycle drift is preventing the

axis from stopping when it should, a deadband can be specified so that any duty cycle that falls within +/- the deadband amount from 50% is considered a command for zero speed.

- If the PWM signal is off for 50mS or more the PWM input is considered off. This is interpreted by ClearPath as a zero-velocity command.
- Disable time = 10 mS
- For applications with the highest sensitivity to velocity accuracy, consider using frequency input control (described later in this manual).

MODE CONTROLS

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

Enter optional deadband setting. See text for description of deadband operation.

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

Click to open Torque Limit Setup dialog.

Enter maximum desired motor acceleration rate.

Check here to set motor deceleration rate to same value as acceleration rate.

Enter maximum desired motor deceleration rate.

Adjust settings for RAS™ (or optional g-Stop™) to convert standard trapezoidal move profiles into profiles that reduce noise, resonance, and vibration.

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 velocity (when using hard controls).

Inputs and Commands

Enable On/Off

Input A Inhibit

Input B Duty Cycle 80% Duty Cycle

Commanded Velocity (RPM) 59.0

Servo On Output Servo On

Override Inputs

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.**

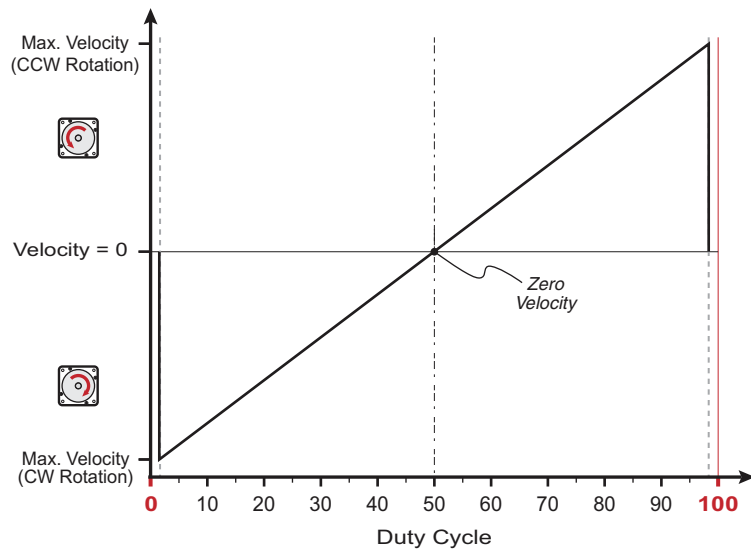
PWM Soft Slider
Emulates PWM input (for use with Soft Controls).

Displays commanded velocity (when using Soft Controls).

Displays HLFB output status

Relationship of PWM duty cycle to motor velocity

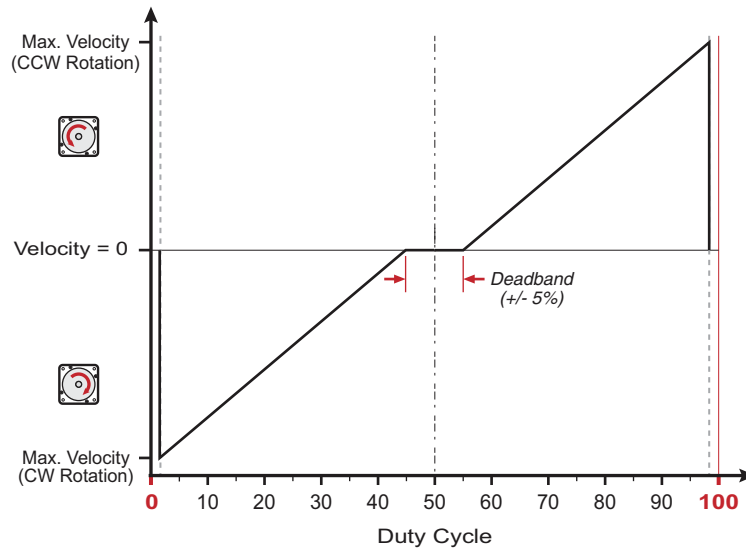
- Shaft velocity increases in the CW direction as PWM duty cycle decreases from 50% to 0%.
- Shaft velocity increases in the CCW direction as PWM duty cycle increases from 50% to 100%.
- As PWM duty cycle approaches 50%—from either direction—motor velocity approaches 0.
- In practice, 0% and 100% (static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



Graph of PWM duty cycle vs. motor velocity

SETTING A PWM DEADBAND (OPTIONAL)

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



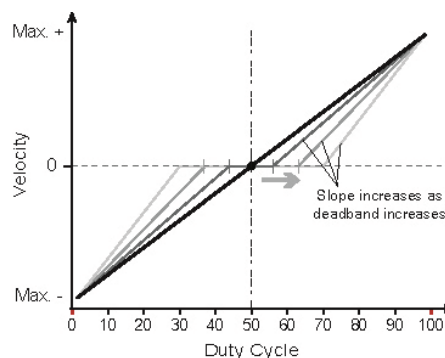
+/- 5% PWM dead band setting

Why use a deadband?

In bi-polar mode, stopping the motor (i.e. commanding “zero velocity”) is achieved, in theory, by applying a 50% duty cycle PWM signal to Input B. However, it can be technically challenging to set a perfect 50% duty cycle. In fact, some very low speed motion may still be observed at the motor shaft *even when duty cycle is apparently set to 50%*. A deadband helps to ensure that actual motor velocity is zero (with no drift) when you expect it to be.

Example: If the user sets a +/- 5% dead band, any PWM signal with a duty cycle between 45% and 55% will be interpreted as a zero-velocity command by ClearPath. See figure above.

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



FOLLOW DIGITAL VELOCITY (BIPOLAR PWM COMMAND WITH VARIABLE TORQUE)

Available on

MCVC + MCPV

MODE DESCRIPTION

Control velocity and maximum torque independently and concurrently with this mode. Connect a digital PWM waveform from your PLC or other device to Input B, and ClearPath will run at a velocity proportional to the duty cycle of that waveform. Connect a separate digital or PWM signal to Input A to independently vary your motor's torque limit.

I/O FUNCTIONS

Enable Input - Asserting this input energizes the motor shaft.

Input A - This input is connected to a signal whose level or PWM duty cycle represents the desired torque limit.

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

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

Assert the Enable Input to energize the motor.

Velocity Control (Input B). Motor velocity is controlled by sending a PWM signal to Input B. Velocity is commanded as follows:

- Shaft velocity increases in the CW direction as PWM duty cycle decreases from 50% to 0%.
- Shaft velocity increases in the CCW direction as PWM duty cycle increases from 50% to 100%.
- As PWM duty cycle approaches 50%—from either side—motor velocity approaches 0.
- In practice, 0% and 100% (static low and static high conditions) are not valid PWM states. ClearPath treats these cases as zero-velocity commands.
- All changes in velocity occur at the user-defined acceleration rate.
- Set a PWM deadband to help reliably command zero velocity.
- PWM minimum on time and minimum off time = 300nS.

Torque Limit Control (Input A). Vary your motor's maximum torque between the "standard" Torque Limits and the Alternate Torque Limits using either digital or PWM control methods.

For **digital torque limit control**, toggle between the Torque Limits and Alternate Torque Limits by changing the state of Input A as follows:

- Deassert input A to operate using purely the "standard" Torque Limits.

- Assert input A to operate using purely the Alternate Torque Limits.

For **PWM torque limit control**, you can vary the active torque limit linearly between the two torque limit settings by varying the PWM duty cycle sent to Input A as follows:

- Apply a 0% duty cycle (static low) to operate using purely the "standard" Torque Limits.
- Apply a 100% duty cycle (static high) to operate using purely the Alternative Torque Limits.
- Apply a duty cycle anywhere in between 0% and 100% to create a linear combination of the two limits.

Additional Notes:

- PWM input frequency range: 20 Hz up to 30 kHz.
- If the PWM signal is off for 50mS or more the PWM input is considered off.
- Disable time = 10 mS.

MODE CONTROLS

Max Speed (RPM)
1,000

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

PWM Deadband (+/-%)
0

Enter optional deadband setting. See text for description of deadband operation.

Relax Time (ms)
50.

Enter timespan over which changes made to torque limit occur.

Torque Limit OVR Setup...

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).

Active Torque Limits (% of Max)
-23.4 to +23.4

Displays torque limit values that are currently in effect.

Max Accel (RPM/s)
5,000

Enter maximum desired motor acceleration rate.

Decel = Accel

Check here to set motor deceleration rate to same value as acceleration rate.

Max Decel (RPM/s)
500

Enter maximum desired motor deceleration rate.

Profile Conversion
RAS™ 25 ms
Setup...

Adjust settings for RAS™ (or optional g-Stop™) to convert standard trapezoidal move profiles into profiles that reduce noise, resonance, and vibration.

Click to open Torque Limit Setup dialog.

Invert Torque PWM Input
 Invert Speed 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

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

PWM Meter (Torque Limiting)
Displays duty cycle of PWM signal connected to Input A.

PWM Meter (Velocity)
Displays duty cycle of PWM signal connected to Input B.

Displays commanded velocity (when using hard controls).

Inputs and Commands

Override Inputs

Enable On/Off

Input A Torque Limiting
No PWM

Input B Velocity
80% Duty Cycle

Cmd. Velocity (RPM)
590

Servo On Output
Servo On

Check to turn on Soft Controls. Override cannot be activated when ClearPath is hardware enabled.

Soft Enable Control
Check to enable. For use only when Soft Controls are active. **Caution:** motor may spin when enabled.

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

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

Displays commanded velocity (when using Soft Controls).

Displays HLFB output status

FOLLOW DIGITAL VELOCITY COMMAND (UNIPOLAR PWM INPUT)

Available on
MCVC + MCPV

MODE DESCRIPTION

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

Assert the Enable Input to energize the motor. Once enabled, motor velocity is controlled by sending a PWM signal to Input B. 0% PWM duty cycle commands zero velocity, and 100% (minus a little) duty cycle commands full-scale velocity. Changes in velocity occur at the user-defined acceleration rate.

Direction of travel (CW/CCW) is controlled by the state of Input A. See Inputs and Timing table below.

Velocity Control Follow Digital Velocity Command (Unipolar PWM Command)

Signal	Function	Input Type	Example Timing
Input A	Direction	Logic: High=CW Low=CCW	
Input B	Velocity	Pulse: Variable PWM	
		Duty cycle of applied PWM signal (%)	
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 rotation.

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

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

Notes:

- PWM input frequency range: 20 Hz up 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-velocity command.
- Disable time = 10 mS
- For applications with the highest sensitivity to velocity accuracy, consider using frequency input control (described in next section).

MODE CONTROLS

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

Max Speed (RPM)
2,000

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

Invert PWM Input

Click to open Torque Limit Setup dialog.

Torque Limit
OVR Setup...

Max Accel (RPM/s)
5,000

Enter maximum desired motor acceleration rate.

Decel = Accel

Check here to set motor deceleration rate to same value as acceleration rate.

Max Decel (RPM/s)
500

Enter maximum desired motor deceleration rate.

Profile Conversion
RAS™ 51 ms
Setup...

Adjust settings for RAS™ (or optional g-Stop™) to convert standard trapezoidal move profiles into profiles that reduce noise, resonance, and vibration.

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 velocity (when using hard controls).

Inputs and Commands

Enable On/Off

Input A CW/CCW

Input B Duty Cycle
50% Duty Cycle

Commanded Velocity (RPM)
1,001

Servo On Output
Servo On

Override Inputs

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.**

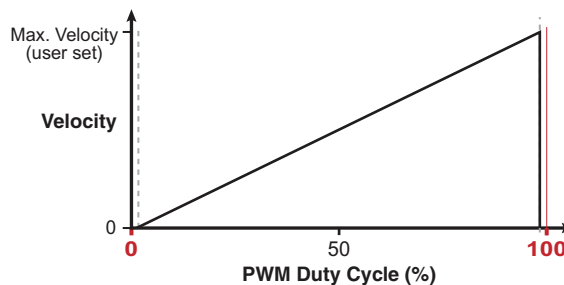
PWM Soft Slider
Emulates PWM input (for use with Soft Controls).

Displays commanded velocity (when using Soft Controls).

Displays HILFB output status.

Motor velocity vs. PWM duty cycle :

- Motor velocity is proportional to PWM duty cycle (velocity increases as duty cycle increases). See figure below.
- In practice, 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-velocity command.



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

FOLLOW DIGITAL VELOCITY COMMAND (FREQUENCY INPUT)

Available on





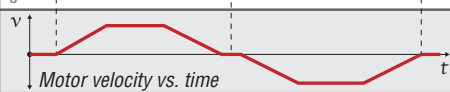
MVC + MCPV

MODE DESCRIPTION

Connect a digital variable frequency waveform from your PLC or other device, and ClearPath will run at a velocity proportional to the frequency of the waveform.

Assert the Enable Input to energize the motor. Then, control velocity by applying a variable frequency pulse train to Input B. Pulse frequency is proportional to commanded velocity. Direction of travel (CW/CCW) is controlled by the state of Input A. See Inputs and Timing diagram below.

Velocity Control Follow Digital Velocity Command (Frequency Input Control)

Signal	Function	Input Type	Example Timing
Input A	Direction	Logic: High=CW Low=CCW	
Input B	Velocity	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 rotation.

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

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

Notes:

- Input frequency range: 20 Hz to 700 kHz.
- Actual motor speed in RPM is given by the following equation $[(\text{Input Freq.} - \text{Min Freq.}) / (\text{Max Freq.} - \text{Min Freq.}) * \text{User Defined Max Velocity}]$. For **Example**, a 120 kHz pulse train with 100 kHz Min Frequency and 200 kHz Max frequency will result in a rotational speed of 20% of the user-defined Max Velocity.
- If the frequency signal is off/interrupted for 50mS or more the input is considered off. This is interpreted by ClearPath as a zero-velocity command.
- Disable time = 10 mS

MODE CONTROLS

Set Min/Max Frequency. During operation, motor speed is controlled by Input B signal frequency. With the settings below, a 15kHz signal at Input B will cause the motor to spin at the Max Speed setting (2000 RPM); a 5 kHz (or lower) signal will command zero speed.

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

Enter maximum desired motor acceleration rate.

Check here to set motor deceleration rate to same value as acceleration rate.

Enter maximum desired motor deceleration rate.

Adjust settings for RAS™ (or optional g-Stop™) to convert standard trapezoidal move profiles into profiles that reduce noise, resonance, and vibration.

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 input signal source connected to Input B.

Displays commanded velocity (when using hard controls).

Inputs and Commands

Enable On/Off

Input A CW/CCW

Input B Frequency

Commanded Velocity (RPM)

Servo On Output

Override Inputs

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

Frequency Soft Slider
Emulates frequency input source (for use with Soft Controls).

Displays commanded velocity (when using Soft Controls).

Displays HILFB output status.