# YASKAWA

Application Note

# Configuring the Phoenix IB IL PWM module for use with the MPiec controller

Applicable Product: MPiec, MotionWorks IEC

Yaskawa Electric America
2121 Norman Drive South
Waukegan, IL 60085
1-800-927-5292

| Subject: Application Note | Product: MPiec – Phoenix IB IL PWM 2 PAC | Doc#:  AN.MCD.09.094 |
|---|---|---|
| Title: Configuring the Phoenix IB IL PWM module for use with the MPiec controller | | |

## Application Overview

This document highlights the various steps to configure and use the Phoenix PWM module with the MPiec controller over MECHATROLINK II to get pulse or step and direction output. A sample program that explains how the control word can be used to obtain motion on a step and direction drive is also provided.

## Application Highlights:

Industry: Actuators that require step and direction or pulse signals from an IEC system
Major Features: pulse or step and direction outputs from an MPiec system

## Products Used:

| Component | Product and Model Number |
|---|---|
| Servopack | Sigma-5 AP |
| Motor | SGMAV |
| Controller | MPiec |
| Software | MotionWorks IEC |
| Third Party Devices | Phoenix IB IL PWM 2 PAC |

## Application Solution and Benefits:

General automation applications that require pulse signals or step and direction inputs can be supported on the MPiec series controller platform by using the Phoenix IB IL PWM 2 PAC block on the MECHATROLINK Phoenix bus coupler (IL MII BK DI8 DO4 – PAC). The signals from the MPiec controller can be used to control the PWM module in any one of the four following modes. The modes are PWM mode, frequency generator, single pulse generator and pulse and direction.

## Implementation Method of Core Operation
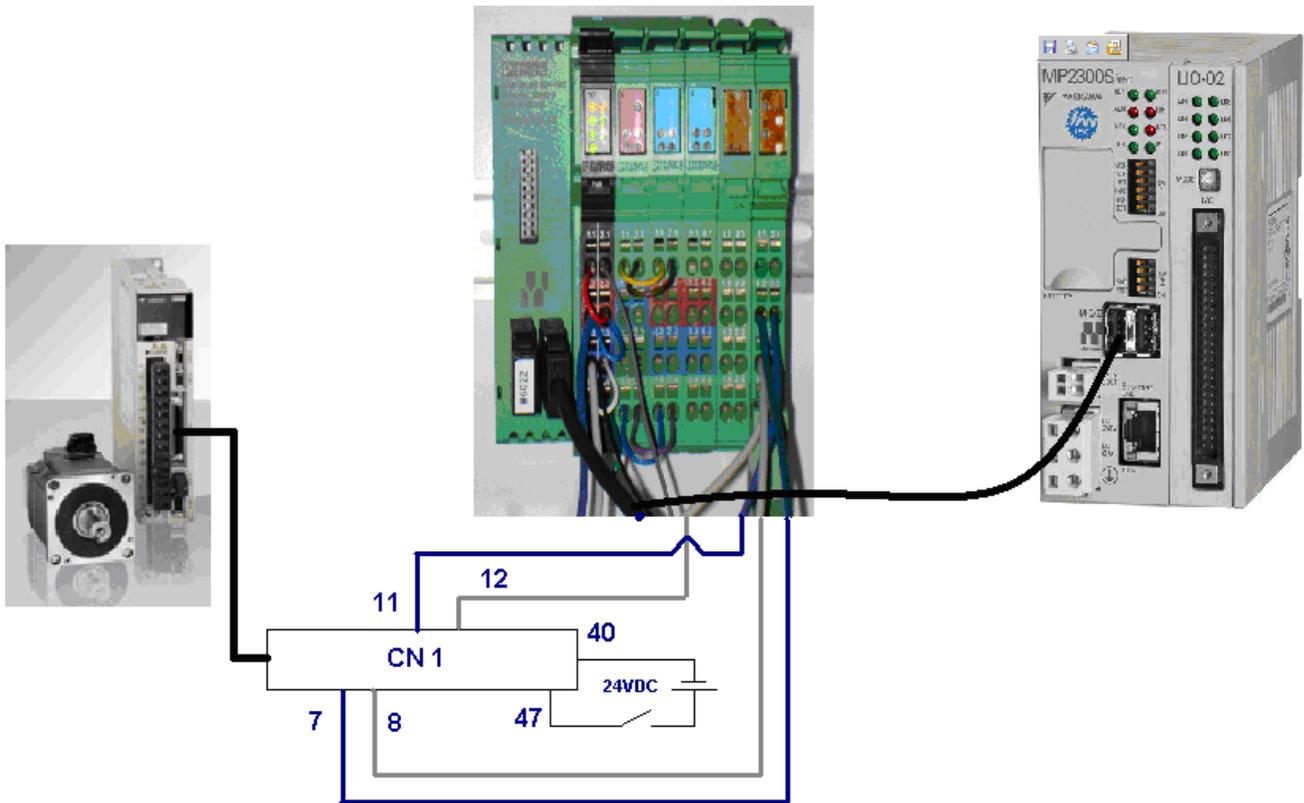


Figure 1: Hardware setup

Figure 1 is an illustration of the hardware set up used to test system functionality. The Phoenix PWM module IB IL PWM 2 PAC was added on to the bus coupler IL MII BK DI8 DO4 – PAC. Communication to the MPiec controller was through the MECHATROLINK II cable. The PWM module in this test scenario was used to output pulse and direction signals. The wiring for pulse and direction was done as shown in Figure 1. This test used a Sigma-5 AP servopack in position mode accepting step and direction signals.

The first step in configuring the system after wiring is complete is to use the configuration tool in MotionWorks IEC and use the auto discovered configuration. This enables the tool to load the discovered hardware. The Phoenix bus coupler is automatically discovered and is shown in the hardware tree as shown in Figure 2.

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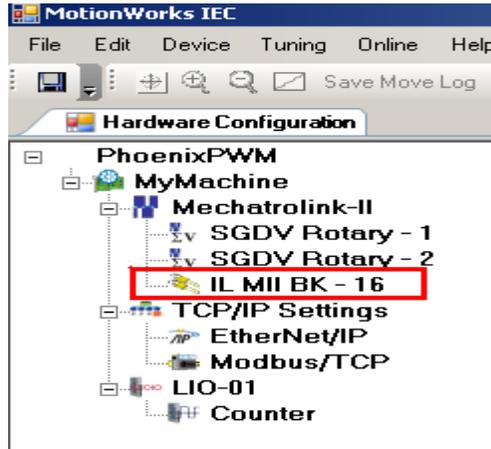


Figure 2: Hardware configuration in Configuration Tool

Save the configuration, disconnect the configuration tool and cycle power on the machine. The project in MotionWorks IEC should have the variables for the phoenix modules allocated as shown in Figure 3.

| <MII Bus Coupler> - MechatrolinkIO - 1:16 (* Modify Variable Names, Not Group Name!! *) | | | | | |
|---|---|---|---|---|---|
| ML116_DI_00 | FALSE | BOOL | VAR_GL... | Digital Input #0 | %IX8.0 |
| ML116_DI_01 | FALSE | BOOL | VAR_GL... | Digital Input #1 | %IX8.1 |
| ML116_DI_02 | FALSE | BOOL | VAR_GL... | Digital Input #2 | %IX8.2 |
| ML116_DI_03 | FALSE | BOOL | VAR_GL... | Digital Input #3 | %IX8.3 |
| ML116_DI_04 | FALSE | BOOL | VAR_GL... | Digital Input #4 | %IX8.4 |
| ML116_DI_05 | FALSE | BOOL | VAR_GL... | Digital Input #5 | %IX8.5 |
| ML116_DI_06 | FALSE | BOOL | VAR_GL... | Digital Input #6 | %IX8.6 |
| ML116_DI_07 | FALSE | BOOL | VAR_GL... | Digital Input #7 | %IX8.7 |
| ML116_DO_00 | FALSE | BOOL | VAR_GL... | Digital Output #0 | %QX6.4 |
| ML116_DO_01 | FALSE | BOOL | VAR_GL... | Digital Output #1 | %QX6.5 |
| ML116_DO_02 | FALSE | BOOL | VAR_GL... | Digital Output #2 | %QX6.6 |
| ML116_DO_03 | FALSE | BOOL | VAR_GL... | Digital Output #3 | %QX6.7 |

Figure 3: Phoenix bus coupler variables

Note that, only the 8 digital inputs and 4 digital outputs were automatically assigned variable names. A quick check of the IO configuration under the hardware tab will reveal the memory area allocated for the Phoenix device. In this test, IB4 to IB35 were assigned for inputs and QB2 to QB 33 were assigned for outputs. Note that QB6 was the last used output byte on the basic bus coupler module.

The output and input word details for the PWM module are shown in Figures 4 and 5.

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Output words 0 and 1

| | | | 0 | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 1 | 0 | 1 | RDO2 | N | | | Frequency (11 bits) | | | | | | | | | | | | Target position (16 bits) | | | | | | | | | | | | |

| | | | | |
|---|---|---|---|---|
| RDO2 | Direction and output DO2 | R = 0 (DO2 = 0) | Down or reverse |
| | | R = 1 (DO2 = 1) | Up or forwards |
| N | Reset | Rising edge | Positioning counter resets to $0000000_{hex}$ |

Figure 4: Output words on the PWM module

Input words 0 and 1

| | | | 0 | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 1 | 0 | 1 | DO2 | R | Res. | | | Positioning counter (25 bits) | | | | | | | | | | | | | | | | | | | | | | | |

| | | | |
|---|---|---|---|
| DO2 | Image of output DO2 | | |
| R | Ready | Ready = 0 | Pulse output process active |
| | | Ready = 1 | Pulse output process completed |
| Res. | Reserved | | |

Figure 5: Input words on the PWM module

The next task is to map these words to the appropriate addresses in MotionWorks IEC such that appropriate commands from the    II controller can be issued to obtain motion through the PWM module using step and direction signals. Create the outputs variables at the addresses as shown in Figure 6. Note that byte 6 was the last byte used for digital outputs on the bus coupler. Bytes 9 and 8 are mapped to word 0 on the output of the PWM module. Bytes 11 and 10 are mapped to word 1 on the output of the PWM module (for position). Create input variables as shown in Figure 7. The last byte used by the digital inputs on the bus coupler was 8. Bytes 11 and 10 on the input group map to word 0 on the input of the PWM. Byte 11 is a reflection of the control word (part of output byte 9). Bytes 10, 13 and 12 will give the user positioning counter information. Bit 11 on input word 0 can be used to determine if the pulse output process has been completed (last command sent).

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| ⊟ <MII Bus Coupler> - MechatrolinkIO - 1:16 (* Modify Variable Names, Not Group Name!! *) | | | | | |
|---|---|---|---|---|---|
| ML116_DI_00 | FALSE | BOOL | VAR_GL... | Digital Input #0 | %IX8.0 |
| ML116_DI_01 | FALSE | BOOL | VAR_GL... | Digital Input #1 | %IX8.1 |
| ML116_DI_02 | FALSE | BOOL | VAR_GL... | Digital Input #2 | %IX8.2 |
| ML116_DI_03 | FALSE | BOOL | VAR_GL... | Digital Input #3 | %IX8.3 |
| ML116_DI_04 | FALSE | BOOL | VAR_GL... | Digital Input #4 | %IX8.4 |
| ML116_DI_05 | FALSE | BOOL | VAR_GL... | Digital Input #5 | %IX8.5 |
| ML116_DI_06 | FALSE | BOOL | VAR_GL... | Digital Input #6 | %IX8.6 |
| ML116_DI_07 | FALSE | BOOL | VAR_GL... | Digital Input #7 | %IX8.7 |
| ML116_DO_00 | FALSE | BOOL | VAR_GL... | Digital Output #0 | %QX6.4 |
| ML116_DO_01 | FALSE | BOOL | VAR_GL... | Digital Output #1 | %QX6.5 |
| ML116_DO_02 | FALSE | BOOL | VAR_GL... | Digital Output #2 | %QX6.6 |
| ML116_DO_03 | FALSE | BOOL | VAR_GL... | Digital Output #3 | %QX6.7 |
| ⊞ **Input Variables for PWM module** | | | | | |
| ⊟ **Output Variables for PWM module** | | | | | |
| pwm_o7 | 16#00 | BYTE | VAR_GL... | | %QB7 |
| pwm_o8 | 16#00 | BYTE | VAR_GL... | speed2 | %QB8 |
| pwm_o9 | 16#B0 | BYTE | VAR_GL... | control and speed (176: stop, 191: go) | %QB9 |
| pwm_o10 | 16#00 | BYTE | VAR_GL... | position2 | %QB10 |
| pwm_o11 | 16#50 | BYTE | VAR_GL... | position1 | %QB11 |
| pwm_o12 | 16#00 | BYTE | VAR_GL... | | %QB12 |
| pwm_o13 | 16#00 | BYTE | VAR_GL... | | %QB13 |

Figure 6: Output bytes mapped to PWM output words

| ⊟ <MII Bus Coupler> - MechatrolinkIO - 1:16 (* Modify Variable Names, Not Group Name!! *) | | | | | |
|---|---|---|---|---|---|
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| ML116_DI_02 | FALSE | BOOL | VAR_GL... | Digital Input #2 | %IX8.2 |
| ML116_DI_03 | FALSE | BOOL | VAR_GL... | Digital Input #3 | %IX8.3 |
| ML116_DI_04 | FALSE | BOOL | VAR_GL... | Digital Input #4 | %IX8.4 |
| ML116_DI_05 | FALSE | BOOL | VAR_GL... | Digital Input #5 | %IX8.5 |
| ML116_DI_06 | FALSE | BOOL | VAR_GL... | Digital Input #6 | %IX8.6 |
| ML116_DI_07 | FALSE | BOOL | VAR_GL... | Digital Input #7 | %IX8.7 |
| ML116_DO_00 | FALSE | BOOL | VAR_GL... | Digital Output #0 | %QX6.4 |
| ML116_DO_01 | FALSE | BOOL | VAR_GL... | Digital Output #1 | %QX6.5 |
| ML116_DO_02 | FALSE | BOOL | VAR_GL... | Digital Output #2 | %QX6.6 |
| ML116_DO_03 | FALSE | BOOL | VAR_GL... | Digital Output #3 | %QX6.7 |
| ⊟ **Input Variables for PWM module** | | | | | |
| pwm_i9 | 16#00 | BYTE | VAR_GL... | | %IB9 |
| pwm_i10 | 16#00 | BYTE | VAR_GL... | position1 | %IB10 |
| pwm_i11 | 16#B8 | BYTE | VAR_GL... | reflection of control word | %IB11 |
| pwm_i12 | 16#00 | BYTE | VAR_GL... | position3 | %IB12 |
| pwm_i13 | 16#50 | BYTE | VAR_GL... | positon2 | %IB13 |
| pwm_i14 | 16#00 | BYTE | VAR_GL... | | %IB14 |
| pwm_i15 | 16#00 | BYTE | VAR_GL... | | %IB15 |
| pwm_i16 | 16#00 | BYTE | VAR_GL... | | %IB16 |

Figure 7: Input bytes mapped to PWM input words

A simple program to run the move shown in Figure 8 is given in Figure 10.
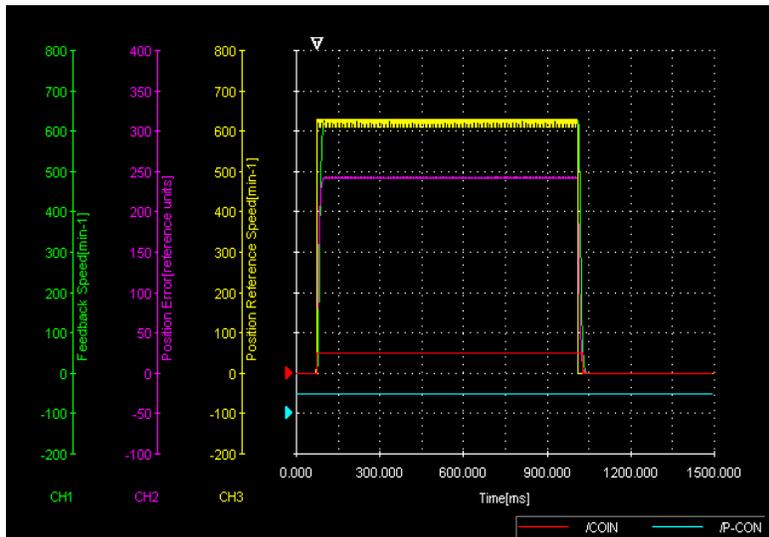


Figure 8: Test move

The current status of the system can be observed from byte 11 on the input (Figure 9). The status indicates that the mode is pulse and direction and that positioning has been completed
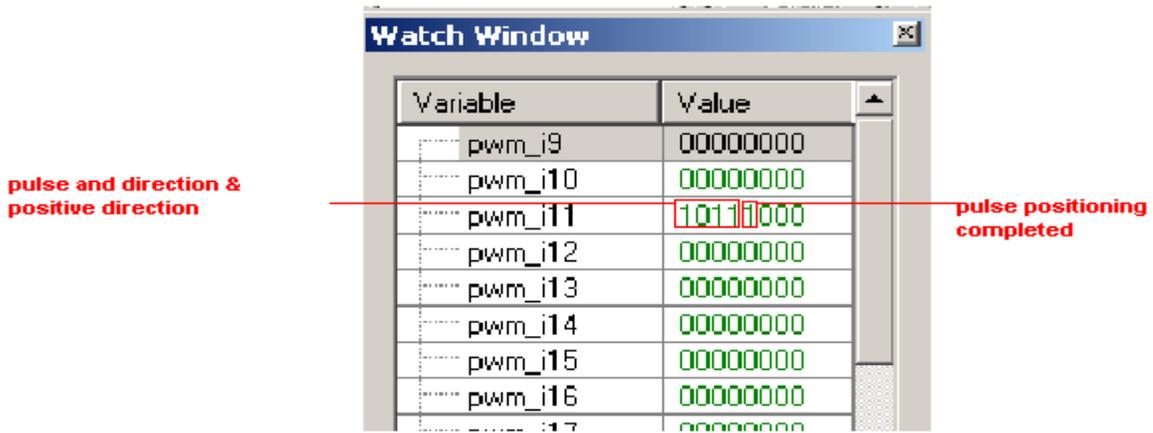


Figure 9: Watch window with input bytes

In Figure 10, the first step is to move a desired position into word 1 of the output. This is done using byte 11 (pwm_o11).
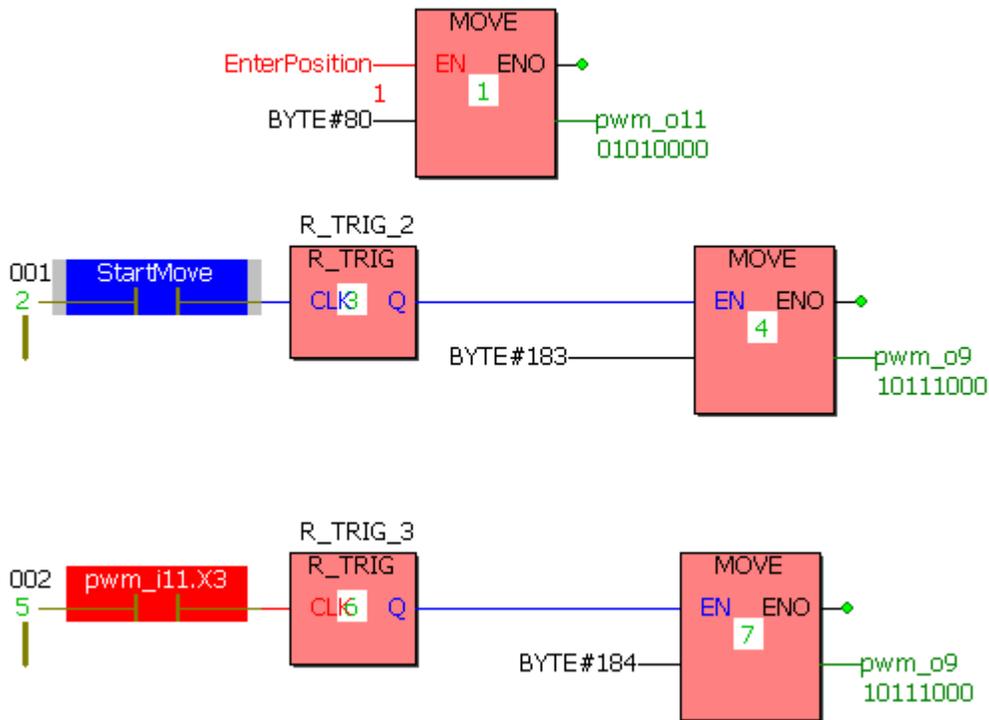


Figure 10: Program to run test move

The variable 'StartMove' makes the control word 10110111 which gives a target frequency (111 0000 0000) to the PWM module and starts the command. Pwm_i11.X3 (bit 3 on input byte 11) is monitored to verify end of command. This BOOL variable is used to rest the position counter after the move is complete.
The state of the program while the move is being executed is shown in Figure 11.
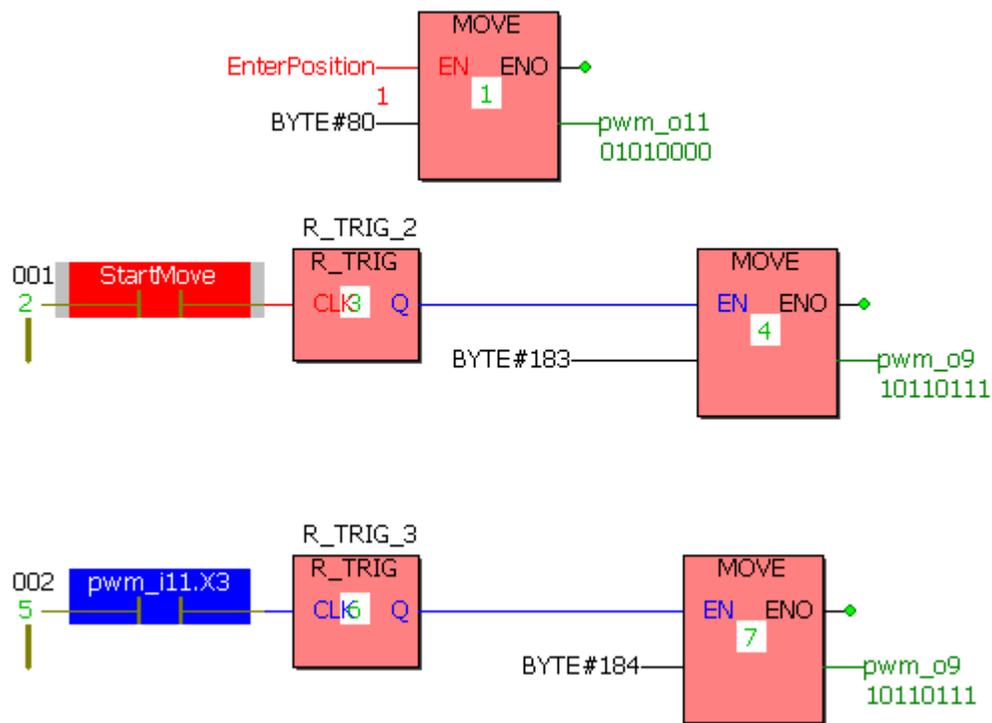
Figure 11: State of control word while motion is being commanded

It should be noted that acceleration and deceleration cannot be controlled through the PWM module. Therefore, acceleration and deceleration parameters on the driven unit should be used to implement this in motion. Results of using these parameters to obtain smoother performances without losing positioning capabilities are shown in Figures 12, 13, and 14. The effects of Pn216, Pn217 and a combination of using Pns 216 and 217 are given in these three figures. Please refer to user manuals for a detailed explanation on the effects of the two parameters on Sigma-5 AP systems.
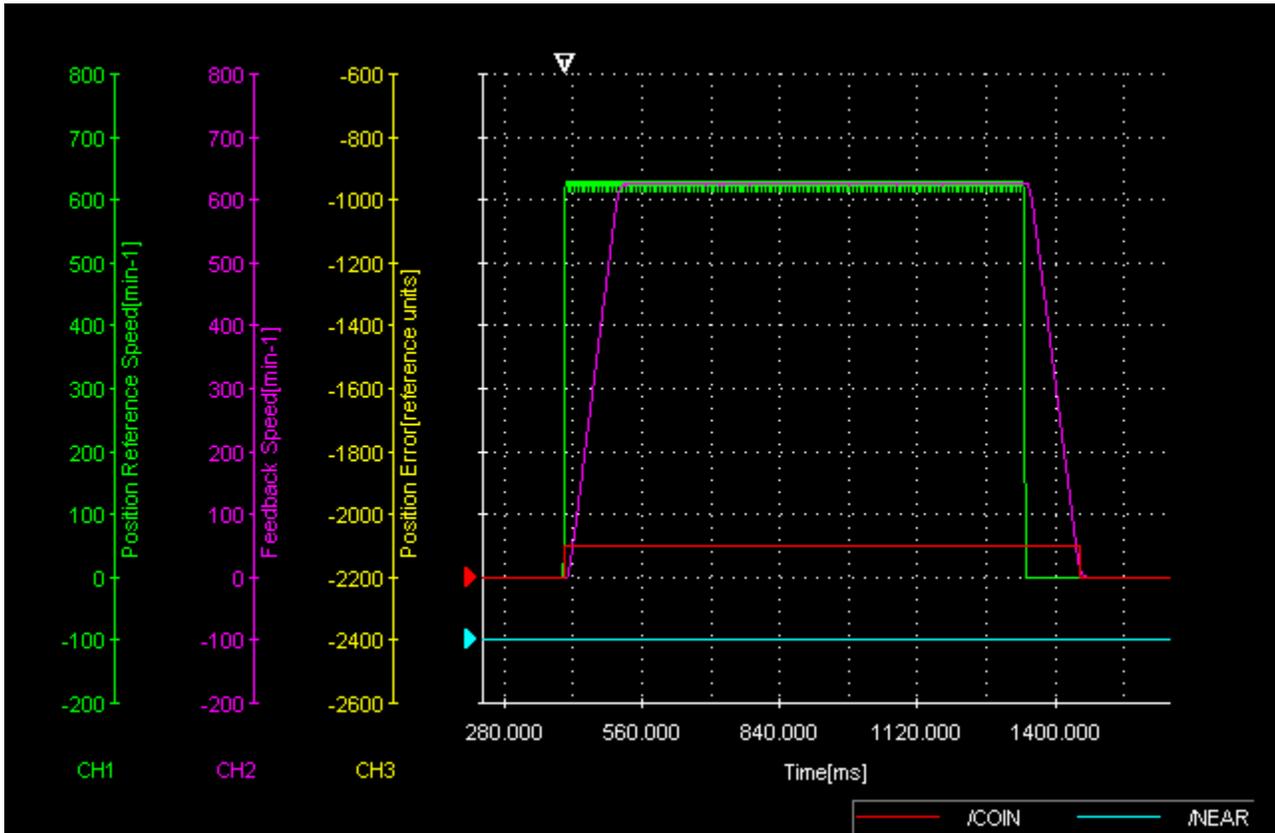
Figure 12: Pn 216 = 0, Pn 217 = 1000

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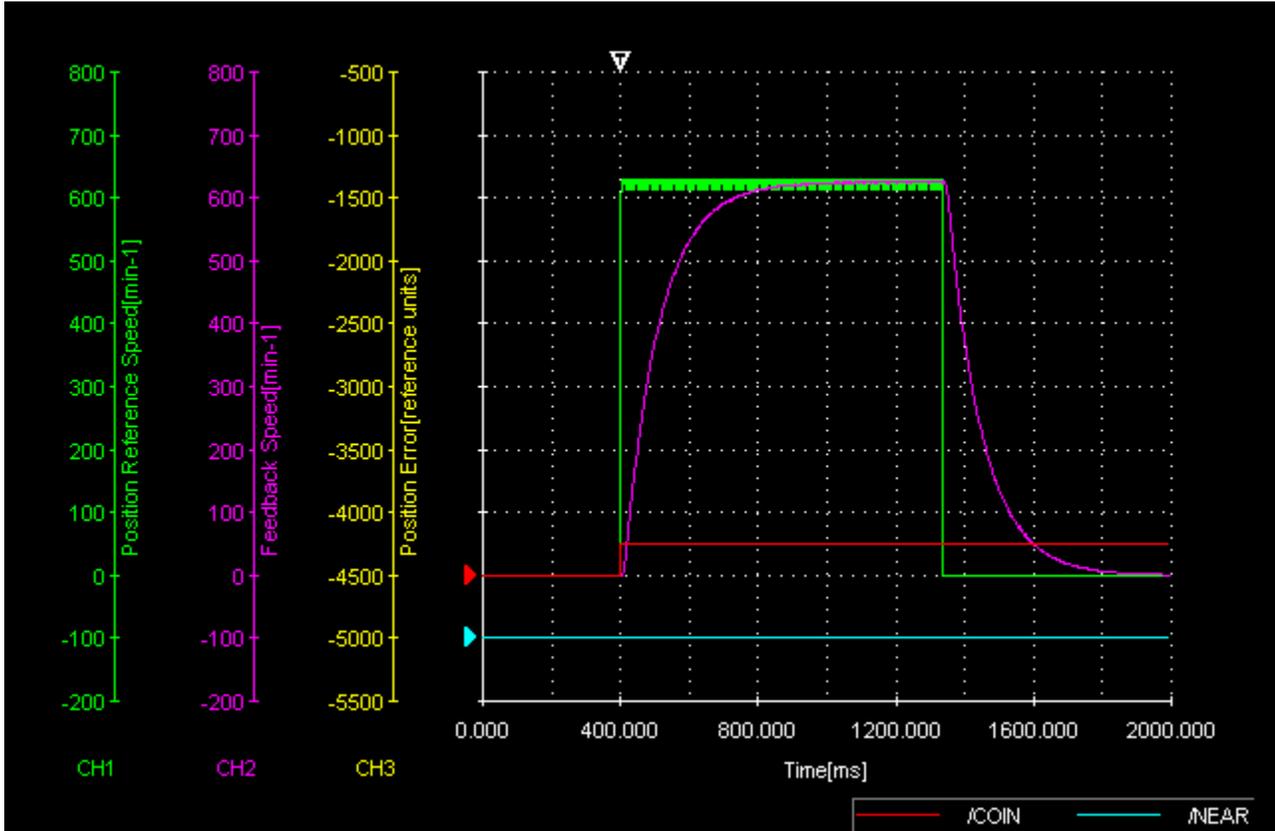
Figure 13: Pn 216 = 1000, Pn 217 = 0
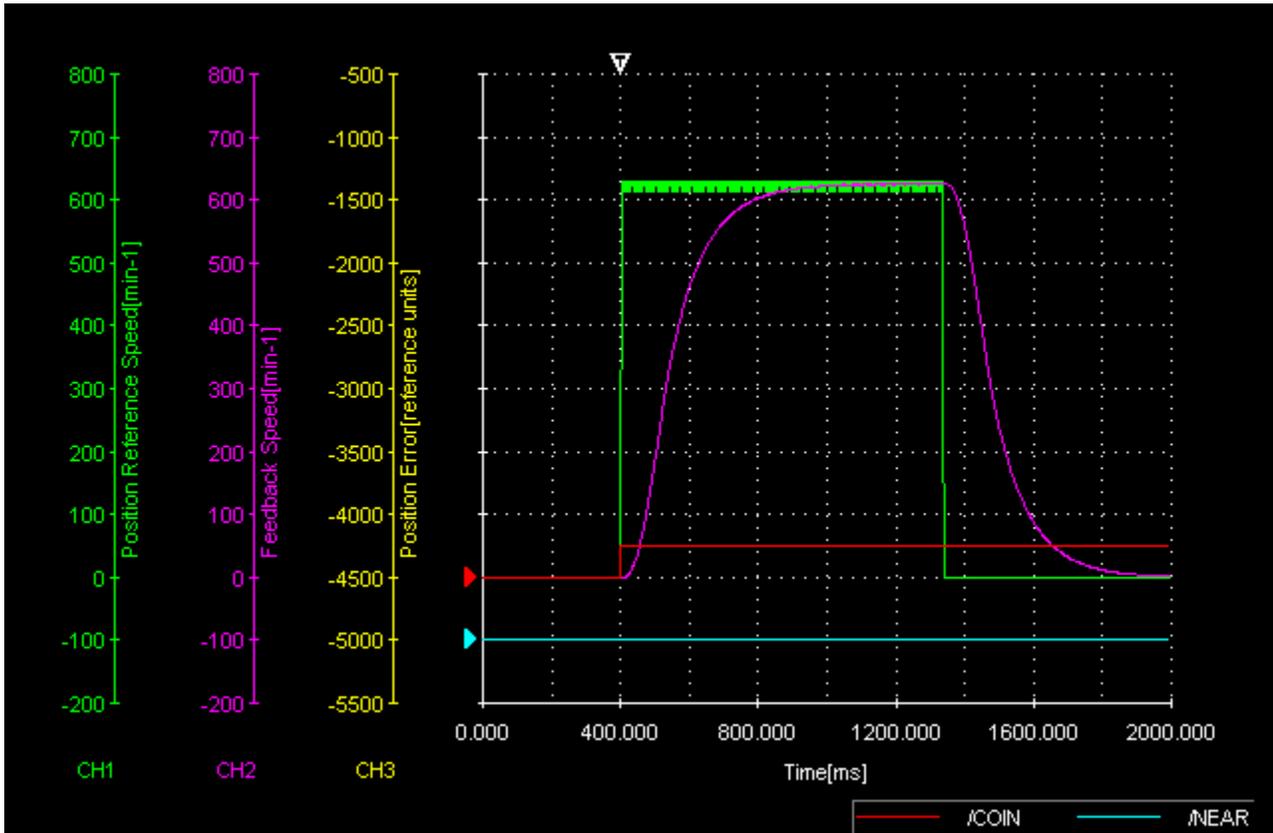
Figure 14: Pn 216 = 1000, Pn 217 = 1000