

**Applied Processor and Measurement, Inc.**

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## **Model 205 Pulse Width Modulation Controller - Release Notes**

**S/W Revision: 4.2**

**Release Date: 12/14/2023**

**Doc. No.: 00215-20, rev -**

**Used On: Model PWMC-205 (version 4.x h/w and s/w)**

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### **1.0 Summary**

The Model 205 PWM Controller software revision 4.2 was developed to include peak and hold PWM capability for the standard PWMC-205 product. The Model 205 uses digital Field Programmable Gate Array (FPGA) technology which allows for precision control of the peak and hold output pulse allowing for high frequency (25 KHz) and high resolution (0.1% duty cycle resolution) operation.

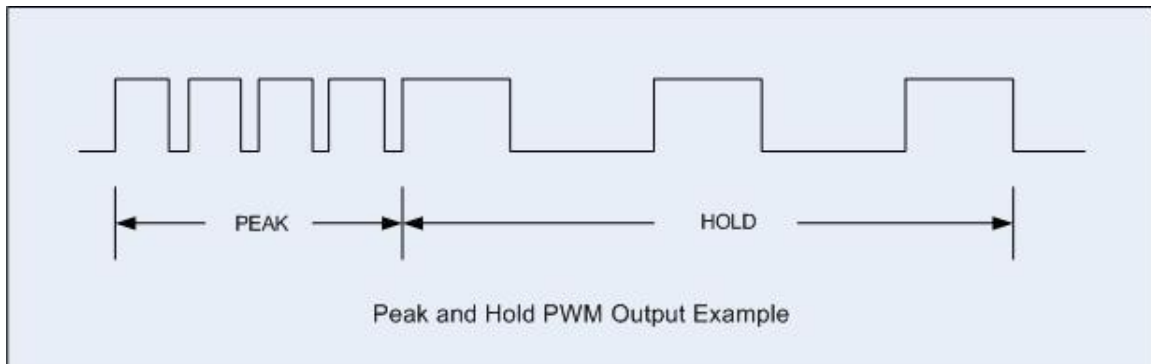
The Model 205 may be configured to apply a period of high frequency, high duty cycle initial pull-in for solenoid applications. The feature allows the user to set-up pull-in (peak) pulse frequency, peak pulse duty cycle and peak period (time). The peak and hold cycle may be manually controlled via the front-panel pushbuttons, controlled via the analog input, controlled via the RS-232 command interface, and triggered via the opto-isolated digital input.

## **2.0 Model 205 – Peak and Hold PWM Output**

The following paragraphs describe the operational instructions for the Model 205 PWM Controller functioning with Peak and Hold PWM control. Sections in these release notes describe how to operate the peak and hold PWM feature addition only. For basic operating instructions, please refer to the Model 205 PWM Controller User's Manual.

### **2.1 Peak and Hold PWM Waveform**

The figure below illustrates a PWM waveform and a PWM waveform with an initial peak, pull-in pulse. For solenoid applications, the pull-in pulse provides an initial pulse of higher average current. Note that the peak portion of the PWM waveform is only executed at the start or turn-on of the PWM output.



There are 5 components to the Peak and Hold PWM output: Peak Frequency, Peak Duty Cycle, Peak Time, Hold Frequency, and Hold Duty Cycle.

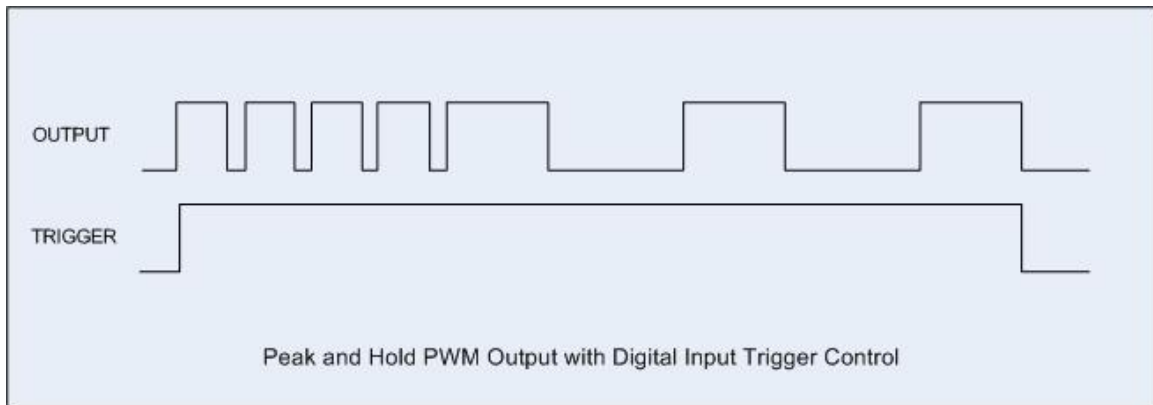
## **2.2 PWM Controller Operation in Peak and Hold PWM Output Mode**

When the PWM Controller is set to operate in the Peak and Hold PWM Output Mode, the initial pull-in peak pulse is executed every time the controller executes a mode change from the Off mode to the manual mode. A cycle may also be triggered using the digital input. Peak and hold parameters may be either set manually, or duty cycles may be controlled via the analog inputs.

The Model 205 allows the user to set all the peak and hold parameters using the RS-232 interface or the power-on configuration menu. Refer to section 2.3 below for the additional RS-232 interface command set to program the peak parameters. Additionally, the Peak Frequency, Duty Cycle, and Peak Time and the Hold Frequency and Hold Duty Cycle are available on the LCD / pushbutton front-panel interface for manual adjustment. The LCD displays and allows for adjustments on multiple screens (pages). Hold parameters and the operating mode are adjusted on LCD page 1. Peak parameters, including the peak and hold operation, are adjusted on LCD page 2.

The Peak and Hold Duty Cycles may also be set using the external analog inputs. A 0 to 5V signal may be applied to the analog port connector on the Model 205 to adjust the duty cycle from 0 to 100%. Refer to the standard Model 205 User Manual for information on analog control of the duty cycle. The analog signal will operate on the duty cycle during the peak and hold cycle. Also note that the analog input must be stable approximately 20 msec prior to a peak trigger and a hold cycle.

The controller may be configured to use the opto-isolated digital input to trigger the PWM output sequence. The output will be started with the peak pulse on the digital input and will turn off when the digital input is removed (see figure below). Please refer to the Model 205 User's Manual for specifications and connection information on the opto-isolated digital input. Note that when operating in the peak and hold mode, the digital input serves only as a digital input trigger for the peak and hold PWM output. When in normal PWM output mode, the digital input is a simple enable / disable PWM control input.



The digital input is filtered in the Model 205 FPGA control logic. The digital input trigger must be present for a timed period (both on engagement and removal) before the signal is accepted. This feature prevents nuisance triggers and re-triggers of the peak and hold sequence. The time of the digital input (debounce) filter is adjustable via controller configuration. See sections 2.3 and 2.4 of this document for setting the debounce filter time using the RS232 interface or the power on configuration menu on the built-in pushbutton / LCD interface.

### **2.2.1 PWM Peak and Hold Operation Control**

When using the front-panel LCD/pushbutton interface to adjust the peak and hold controller operation the 'Stat' field adjustment on LCD display page 1 controls overall operation. The 'Oper' field on LCD page 2 controls the peak and hold feature only.

To access page 1 or 2, move the cursor to the 'Pg 1' or 'Pg 2' field on the display using the 'SELECT' pushbutton. When in the page field, pressing either 'UP' or 'DOWN' will change the display page.

On page 1, the Stat field will allow for manual peak and hold trigger (from 'Off' to 'Man').

There are 3 modes of analog control provided: analog control of the hold duty cycle (Adt), analog control of the hold frequency and duty cycle (Ain), and analog control of the peak duty and hold duty cycle (Ad2). Because the screen scrolls the selections, it is recommended that when using analog control modes to use the digital input trigger.

On page 2, the Oper field allows for peak and hold operation to be turned off ('Off'), set to a manual trigger mode ('P&H'), or set to a digital input triggered mode ('TPH'). When the peak and hold mode is 'Off', the unit will operate as a standard Model 205.

Note that all parameters may be saved in EEPROM using the power-on configuration screen method, an RS232 command, or by pressing the UP and DOWN keys simultaneously with the cursor in the Stat field on page 1.

#### **2.2.1.1 Example PWM Peak and Hold Operation Control**

Use the sequence below to set-up the Model 205 to manually operate peak and hold output sequences using the LCD/Pushbutton interface.

- a. on page 1 of the display, make sure the controller is in the 'Off' mode (Stat field)
- b. change the display to page 2 to display the peak and hold parameters
- c. adjust the peak frequency, peak duty cycle and peak time as required
- d. set the operation mode (Oper field) to the 'P&H' mode
- e. return to display page 1
- f. set the hold frequency and hold duty cycle
- g. cursor down to the Stat field on the display
  - press the UP pushbutton to manually trigger a peak and hold output
  - press the DOWN pushbutton to manually stop the output

Use the sequence below to set-up the Model 205 to use the digital input to operate peak and hold output sequences. In this case, the analog inputs are used to control the peak duty cycle and the hold duty cycle.

- a. on page 1 of the display, make sure the controller is in the 'Off' mode (Stat field)
- b. change the display to page 2 to display the peak and hold parameters
- c. adjust the peak frequency and peak time as required
- d. set the operation mode (Oper field) to the 'TPH' mode
- e. return to display page 1
- f. cursor down to the Stat field on the display
- g. select the 'Ad2' mode (analog inputs)
- h. since scrolling from 'Off' to 'Ad2' causes the analog input to change the hold frequency, scroll back to the frequency field and adjust the hold frequency as required
- i. the digital input will now trigger the peak and hold sequence (note that the analog inputs will control the peak and hold duty cycles during triggered operation)

### **2.2.2 PWM Controller Analog Input Connections**

The following table represents the analog input connections for control of the peak and hold duty cycle parameters. For standard Model 205 PWM connections, please refer to the standard controller User's Manual.

Pin Number	Signal Model 205 with peak and hold Single-Ended Inputs	Signal Model 205 with peak and hold Differential Inputs
1	Ain mode – Hold Frequency Control Ad2 mode – Peak Duty Cycle Control	Ain mode – Hold Frequency Control + Ad2 mode – Peak Duty Cycle Control +
2	Hold Duty Cycle Control	Ain mode – Hold Frequency Control – Ad2 mode – Peak Duty Cycle Control –
3	No Connection	Hold Duty Cycle Control +
4	No Connection	Hold Duty Cycle Control –
5	5V Output (25mA max)	5V Output (25mA max)
6	GND (common to PWR- input terminal)	GND (common to PWR- input terminal)
7	Digital Input +	Digital Input +
8	Digital Input –	Digital Input –

The analog input port pin orientation is shown in the Model 205 User Manual, figure 3.4-1.

### **2.3 Remote (RS-232) Interface Commands**

Additional commands have been provided to set the peak and hold PWM operating mode and the peak PWM parameters. Note the command additions below.

Y <CR>	- display peak PWM parameters
Y1 <CR>	- enable peak and hold PWM output
Y0 <CR>	- disable peak and hold PWM output
YFxxxxx <CR>	- set peak PWM frequency, where xxxxx = [100..25000] Hz
YDxxx.x <CR>	- set peak PWM duty cycle, where xxx.x = [0.0..100.0] %
YTxxx.x <CR>	- set peak PWM time, where xxx.x = [0.1 to 5000] msec
YBxxxxx <CR>	- set digital input filter time, where xxxxx = [0 to 50000] counts 1 count = 10 usec
M1 <CR>	- enable digital input as peak and hold output trigger
M0 <CR>	- disable digital input
Ax <CR>	- set analog input control mode x = 0 = analog input off x = 1 = analog input controls (hold) duty cycle x = 2 = analog inputs control (hold) frequency and duty cycle x = 3 = analog inputs control peak duty cycle and hold duty cycle
E <CR>	- enable output (in peak and hold mode, this will trigger the output)
S <CR>	- stop output

#### Notes:

- The peak duty cycle may be set to 100.0%. In this case, the frequency setting is not used. Note that while the peak duty cycle setting of 0% is allowed, it does not translate to any usable output.
- The CFN command may be used to save the peak and hold parameters (this command saves all settings in the controller to EEPROM for the next start-up).
- It is intended that the peak cycle be a high frequency component of the peak and hold PWM output. It may be possible to input settings that are meaningless. For example, a peak frequency setting of 100 Hz with a time of 0.1 msec will not provide a peak and hold output (100 Hz is 10 msec). Please be sure to check your settings.
- The frequency setting is automatically coerced to the nearest value that the PWM Controller supports (see the F command, frequency setting and specifications in the Model 205 User's Manual)

## **2.4 Power-on Menu Configuration**

The Model 205 controller may be configured using the power-on configuration LCD/pushbutton menu. To access the menu, hold the SELECT key down while powering on the unit. After the start-up messages are displayed, the controller will prompt the user to release the SELECT key. The first parameter will be displayed. Use the UP and DOWN keys to adjust the parameter and the SELECT key to advance to the next numeric location, and to advance to the next parameter. At the end, there is a choice to return to default settings, exit (no save) or save the parameters (in EEPROM).

Note that all parameters are not always displayed when using this LCD/pushbutton configuration screens. For example, if the mode is set to 'Ad2' where the analog inputs control both the peak duty cycle and the hold duty cycle, these parameters will be skipped in the settings sequence.

It is recommended that after a configuration is completed, that the controller be re-started.

### **2.4.1 Factory Settings**

The peak PWM parameters are set at the factory as follows:

Setting	Value	RS232 port Set Command	RS232 port Read Command
Peak Frequency	1000 Hz	YF1000	Y
Peak Duty Cycle	100.0 %	YD100	Y
Peak Time	5 msec	YT5	Y
Hold Frequency	1Hz	F1	R
Hold Duty Cycle	0.0%	D0	R
Peak and Hold Mode Operation	off	Y0	Y
Analog Input Control	off	A0	R
Digital Input Mode	off	M0	L
Digital Input Debounce Filter	800 usec	YB80	Y
Output Enable	off	S	R

### **3.0 Notes**

None.

### **3.1 User Manual References**

There is no new User's Manual for this revision. This document (release notes) serves as the description of the change and instructions on usage of this software revision.

### **4.0 Revision History**

<u>Date</u>	<u>Revision</u>	<u>Description</u>
12/14/2023	Rev -	original release

### **5.0 Contact Information**

For further information and controller purchase contact:

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