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Difference of PLS instruction between S7-200 CN and S7-200 SMART

SIMATIC S7-200 CN, S7-200 SMART

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1 Overview

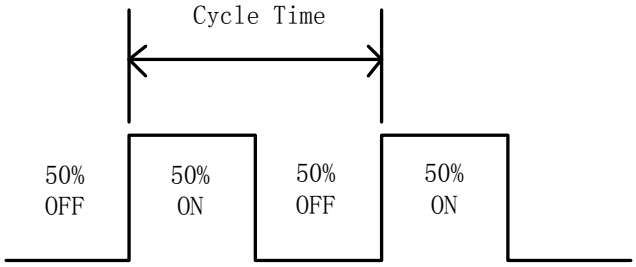
This frequently asked question (FAQ) on the topic of PLS (Pulse output) instruction which used to control PTO (Pulse train output) and PWM (Pulse width modulation). This document shows the difference of PLS usage between S7-200 CN and S7-200 SMART PLC and how to use these PLS instruction.

2 Introduction

2.1 Basic knowledge related to PLS instruction

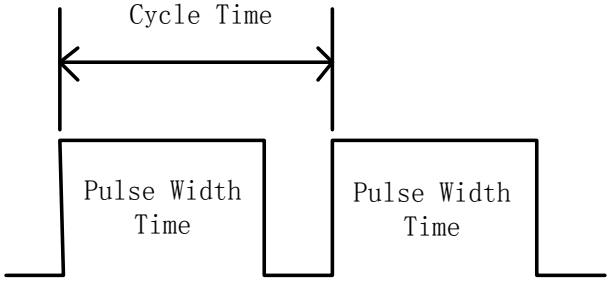
PTO

PTO provides a square wave with a 50% duty cycle output for a specified number of pulses at a specified frequency. PTO can produce either a single train of pulses or multiple trains of pulses using a pulse profile. You specify the number of pulses and the frequency.



PWM

PWM provides three channels that allow a fixed cycle time output with a variable duty cycle. Refer to the figure below. You can specify the cycle time and the pulse width in either microsecond or millisecond increments.



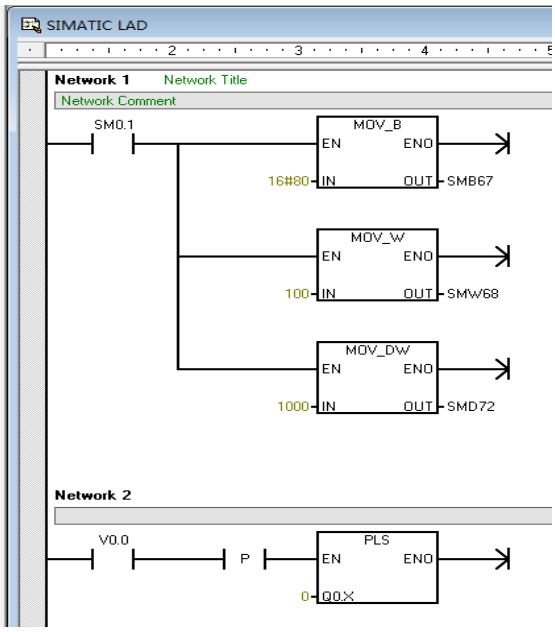
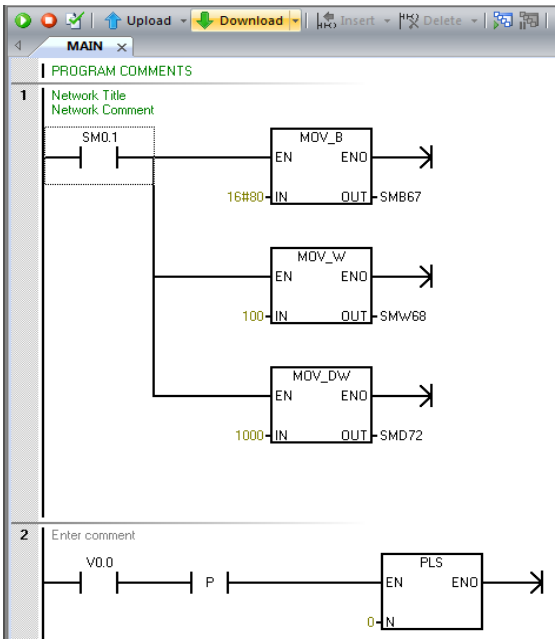
2.2 Difference of PLS between S7- 200 CN and S7-200 SMART.

2.2.1 Compatibility of PLS between S7-200 CN and S7-200 SMART

STEP 7 Micro/Win SMART can open the PLS program of S7-200 CPU.

After compiling the project, the new PLS instruction will be generated as below picture

Table 2-1

V4.0 STEP 7 MicroWIN SP9	STEP 7-MicroWIN SMART
	

NOTE After open the project via STEP 7-Micro or WIN SMART, user need to modify the value of SMB67, see chapter 2.2.2.

2.2.2 The differences in "control word" and "cycle time"

- PTO generates single pulse or multi segment pulses
- configuration of PTO control word is different

S7-200 CN control word of SM67 (Q0.0) and SM77 (Q0.1) definition:

Table 2-2

Q0.0	Q0.1	Control word Meaning	Value	
SM67.0	SM77.0	PTO/PWM update time	0= No update	1= update
SM67.1	SM77.1	PWM update pulse width	0= No update	1= update
SM67.2	SM77.2	PTO update pulse count	0= No update	1= Update
SM67.3	SM77.3	PTO/PWM time base	0= 1μs/tic	1= 1ms/tick
SM67.4	**SM77.4**	**PWM update method**	**0=Asynchronous**	**1=Synchronous**
SM67.5	SM77.5	PTO single/multi segment	0= Single	1= Multiple
SM67.6	**SM77.6**	**PTO/PWM mode select**	**0= PTO**	**1= PWM**
SM67.7	SM77.7	PTO/PWM enable	0= Disable	1= Enable

S7-200 SMART control word of SM67 (Q0.0), SM77 (Q0.1) and SM567 (Q0.3) definition:

Table 2-3

Q0.0	Q0.1	Q0.3	Control word Meaning	Value	
SM67.0	SM77.0	SM567.0	PTO/PWM update	0= No update	1= Update
SM67.1	SM77.1	SM567.1	PWM update pulse	0= No update	1= Update
SM67.2	SM77.2	SM567.2	PTO update pulse	0= No update	1= Update
SM67.3	SM77.3	SM567.3	PTO/PWM time base	0= 1μs/tic	1= 1ms/tick
SM67.4	**SM77.4**	**SM567.4**	**Reserved**	**Reserved**	**Reserved**
SM67.5	SM77.5	SM567.5	PTO single/multi segment	0= Single	1= Multiple
SM67.6	**SM77.6**	**SM567.6**	**PTO/PWM mode select**	**0= PWM**	**1= PTO**
SM67.7	SM77.7	SM567.7	PTO/PWM enable	0= Disable	1= Enable

According to the two tables above, control word bit4 and bit6 of S7-200 CN and S7 200 SMART are different.

NOTE

Example:

- Use PLC generating PTO single pulse.
- Do not change frequency.
- When the PLC is S7-200 CN then SMB67 value is 16#80.
- When the PLC is S7 200 SMART then SMB67 value is 16#C0.

2.2.3 PTO frequency or PWM cycle time value are different between S7-200 CN and S7-200 SMART PLC

- For S7-200 CN SMW68 stands for PTO cycle time. The value is setup in range of 2ms to 65,535ms or 10μs to 65,535μs.
- For S7-200 SMART SWM68 stands for PTO frequency. The value is setup in range of 1 to 65,535 Hz.

User can use following formula calculate the frequency:

$$CT_{Final} = CT_{Initial} + (\Delta CT * PC)$$

$$F_{Initial} = 1 / CT_{Initial}$$

$$F_{Final} = 1 / CT_{Final}$$

Table 2-4

Symbol	Meaning
$CT_{Initial}$	Starting cycle time (s) for this segment
ΔCT	Delta cycle time (s) for this segment
PC	Quantity of pulses in this segment
CT_{Final}	Ending cycle time (s) for this segment
$F_{Initial}$	Starting frequency (Hz) for this segment
F_{Final}	Ending frequency (Hz) for this segment

NOTE

Example:

- Send 20Hz pulse via PLC.
- F=1/CT, 20Hz= 1/CT, CT =0.05s=50ms
- When the PLC is S7-200 CN then SMW68 value is 50.
- When the PLC is S7 200 SMART then SMW68 value is 20.

2.2.4 The difference in “pulse number” and “respond time”

PTO pulse count value is different between S7-200 CN and S7-200 SMART PLC.

S7-200 SMART PLC PTO pulse count value:

- Number of pulses: 1 to 2,147,483,647

Frequency:

- 1 to 100,000Hz (multiple-segment)
- 1 to 65,535Hz (single-segment)

Table 2-5

Pulse count/frequency	Reaction
Frequency < 1 Hz	Frequency defaults to 1Hz
Frequency > 100,000Hz	Frequency defaults to 100,000Hz
Pulse count = 0	Pulse count defaults to 1 pulse
Pulse count > 2,147,483,647	Pulse count defaults to 2,147,483,647 pulses

S7-200 CN PTO pulse count value

- Number of pulses: 1 to 4,294,967,295
- Cycle time: 10μs to 65,535μs
- 2ms to 65,535ms

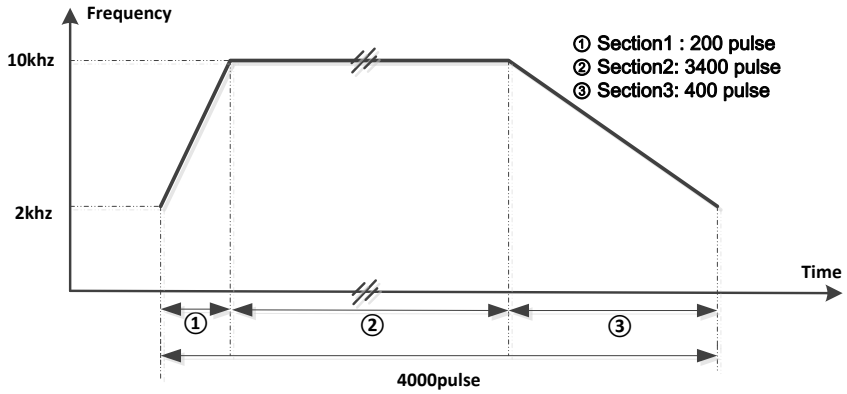
Table 2-6

Pulse count/cycle time	Result
Cycle time < 2 time units	Cycle time default value is 2 time units
Pulse count= 0	Pulse count default set point is 1 pulse

3 Example for S7-200 SMART

Make a program which can carry out the escribed curve below:

Figure 3-1



There are 3 speed set point sections described in the figure 3-1:

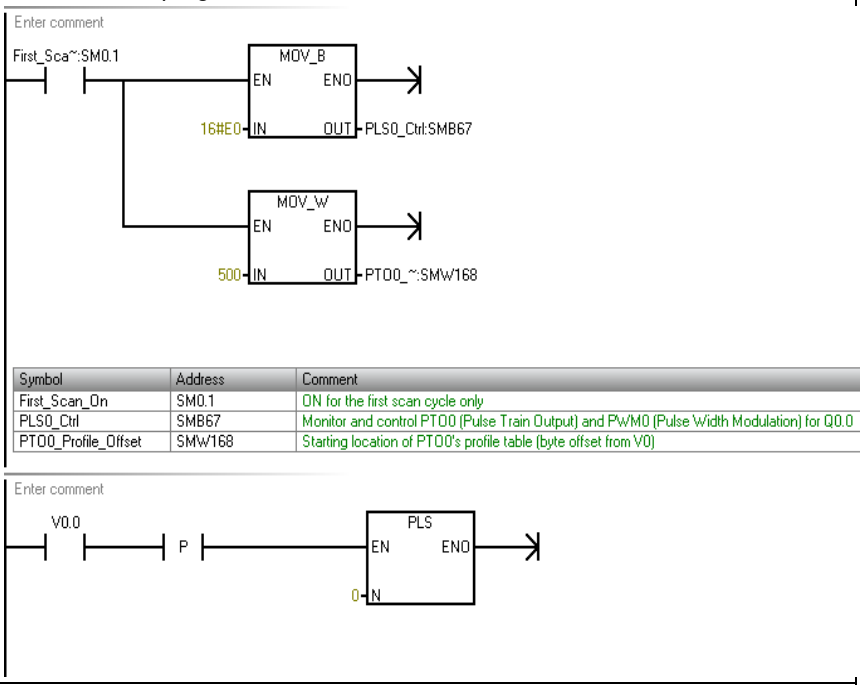
- Section 1 : ramp up motor
- Section 2 : motor running with fixed speed
- Section 3: ramp down motor

In this case, PTO generator should work in the following way:

- 2kHz start and end pulse frequency
- 10kHz max pulse frequency
- Pulse number is 4000

Table 3-1

<table>
<tr><th>Step No.</th><th>Description</th></tr>
<tr><td>1.</td><td>Hardware:
• S7-200 SMART PLC: 6ES7288-1ST40-0AA0</td></tr>
<tr><td>2.</td><td>• Set PTO control word value SMB67=16#E0, set the starting location of the profile table (byte offset from V500):SMW68=500.</td></tr>
<tr><td>3.</td><td>• Set Profile table value as Figure 3-1 in PLC:
<table>
<tr><th>Address</th><th>Value</th><th></th><th>explanation</th></tr>
<tr><td>VB500</td><td>3</td><td>Numbers of steps</td><td></td></tr>
<tr><td>VD501</td><td>2,000</td><td>Start frequency(Hz)</td><td rowspan="4">Section 1</td></tr>
<tr><td>VD505</td><td>10,000</td><td>End frequency(Hz)</td></tr>
<tr><td>VD509</td><td>200</td><td>Pulse number</td></tr>
<tr><td>VD513</td><td>10,000</td><td>Start frequency(Hz)</td><td rowspan="3">Section 2</td></tr>
<tr><td>VD517</td><td>10,000</td><td>End frequency(Hz)</td></tr>
<tr><td>VD521</td><td>3,400</td><td>Pulse number</td></tr>
<tr><td>VD525</td><td>10,000</td><td>Start frequency(Hz)</td><td rowspan="3">Section3</td></tr>
<tr><td>VD529</td><td>2,000</td><td>End frequency(Hz)</td></tr>
<tr><td>VD533</td><td>400</td><td>Pulse number</td></tr>
</table></td></tr>
</table>

Step No.	Description
4.	• Make PLC program as below: 
5.	• Test function.

4 Contact

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5 History

Table 4-1

Version	Date	Modifications
V1.0	02/2017	First version