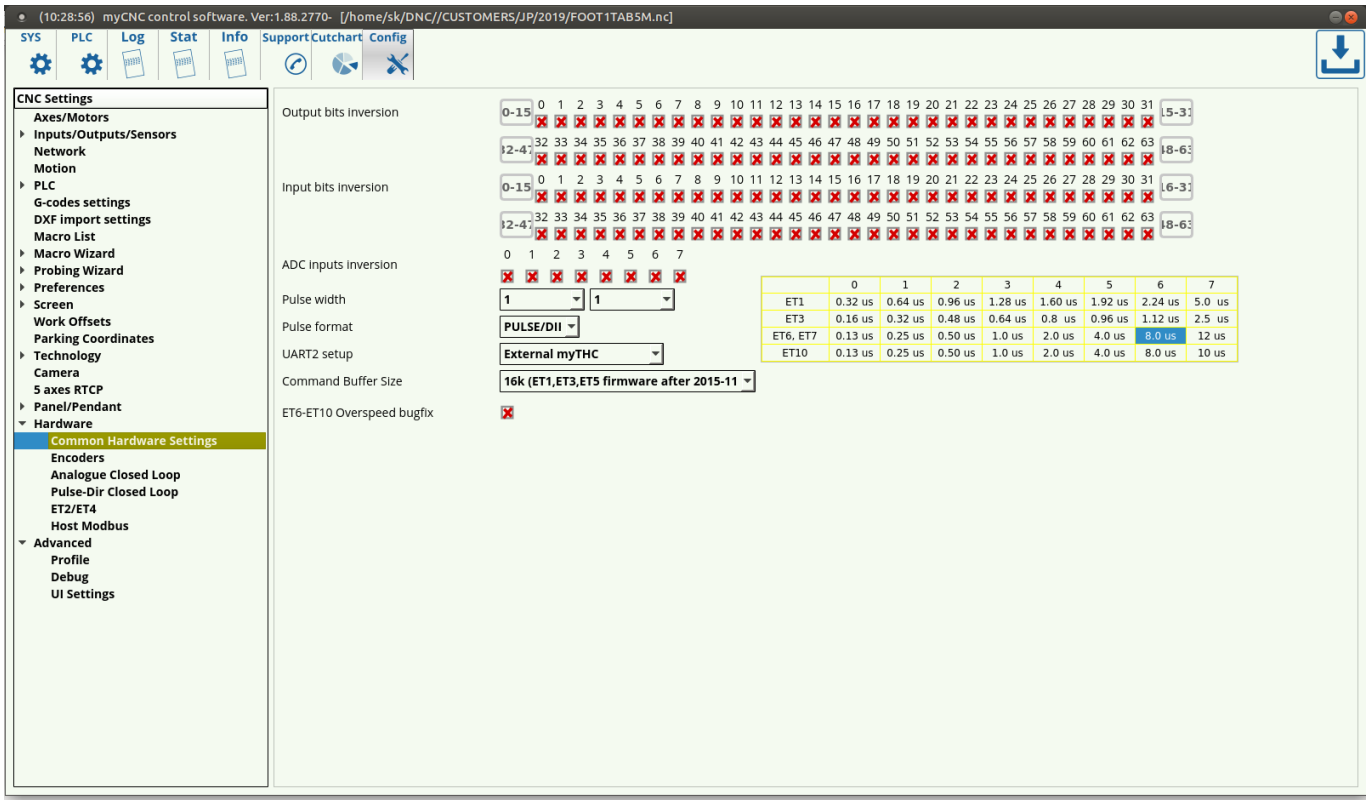
MyCNC Pulse Width Setup

- In myCNC software, navigate to **Settings**
- Open the **Hardware** tab
- Open the **Common Hardware Settings** tab. The following GUI will be presented:

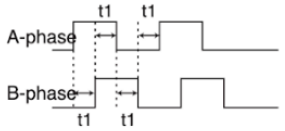
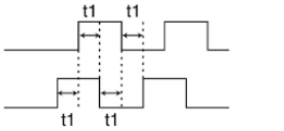
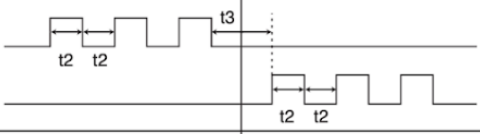
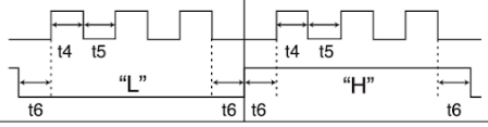


- Select the appropriate **Pulse Width**

Selecting the Appropriate Pulse Width for your motor

A common procedure required for proper motor operation is selecting the appropriate pulse width for the signal going from the controller to the step/servo motor on the CNC machine. A minimum pulse width is usually noted by the motor manufacturer so as to ensure that the motor can register the signals going to it from the controller (if the pulse width is lower, then the motor cannot “see” the impulse being sent from the controller to the machine).

As seen in the following instructions from Panasonic's MINAS A5-series AC Servo Motor & Driver, the pulses have to have a minimum width for the machine to register the signal, ranging from 0.25 to 0.5 µs for the pulse width of the 4 Mpps input and from 5 to 10 µs for the 500 kpps input (obtained as being double of t1 in the charts):

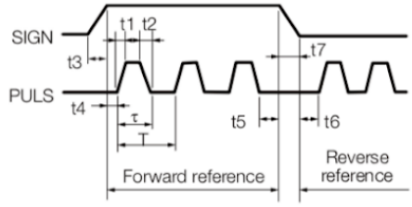
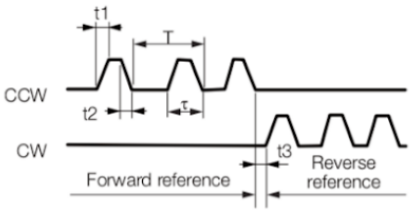
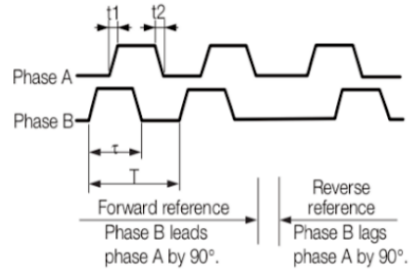
1	0 or 2	90˚ phase difference 2-phase pulse (A + B-phase)	PULS SIGN	 B-phase delays from A by 90˚.	 B-phase advances to A by 90˚.
	1	Positive direction pulse train + Negative direction pulse train	PULS SIGN		
	3	pulse train + Signal	PULS SIGN		

- PULS and SIGN represents the outputs of pulse train in put circuit. Refer to the fig. of P.3-30, "Input Circuit".
- In case of negative direction pulse train + positive direction pulse train and pulse train + sign, pulse train will be cap tured at the rising edge.
- In case of 2-phase pulse, pulse train will be captured at each edge.

• Permissible max. input frequency, and min. necessary time width of command pulse input signal.

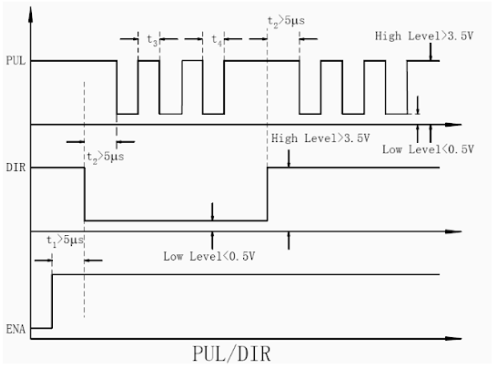
Input I/F of PULS/SIGN signal		Permissible max. input frequency	Min. necessary time width (μs)					
			t_1	t_2	t_3	t_4	t_5	t_6
Pulse train interface exclusive to line driver		4Mpps	0.25	0.125	0.125	0.125	0.125	0.125
Pulse train interface	Line driver interface	500kpps	2	1	1	1	1	1
	Open collector interface	200kpps	5	2.5	2.5	2.5	2.5	2.5

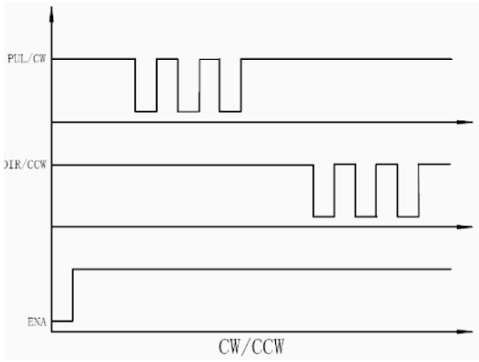
As another example, the Yaskawa's E-7-Series AC Servo Drive also imposes a similar constraint on the minimum widths. The τ in the graph corresponds to the width of the impulse itself, while the T corresponds to the entire period of the signal. The manual advises a minimum τ-T of 0.125 μs to 0.5 μs, depending on the pulse train setup:

Pulse Train Reference Form	Electrical Specifications		Remarks
Sign and pulse train (SIGN and PLUS signals) Maximum reference frequency: 4 Mpps (maximum reference frequency for open-collector output: 200 kpps)		t1, t2, t3, t7 ≤ 0.025 μs t4, t5, t6 ≥ 0.5 μs τ ≥ 0.125 μs T-τ ≥ 0.125 μs	SIGN is high for a forward reference and low for a reverse reference.
CW and CCW pulse trains Maximum reference frequency: 4 Mpps (maximum reference frequency for open-collector output: 200 kpps)		t1, t2 ≤ 0.025 μs t3 ≥ 0.5 μs τ ≥ 0.125 μs T-τ ≥ 0.125 μs	–
Two-phase pulse trains with 90° phase differential (phases A and B) Maximum reference frequency: 1 Mpps* (maximum reference frequency for open-collector output: 200 kpps)		t1 ≤ 0.1 μs t2 ≤ 0.1 μs τ ≥ 0.5 μs T-τ ≥ 0.5 μs	–

A step motor also requires a minimum pulse width, which is considerably higher than that of a servo

motor (around ten to twenty times higher higher when comparing the specs for the Leadshine step motor below to the Yaskawa servo drive):





Remark:

a) ENA must be ahead of DIR by at least 5us. Usually, ENA+ and ENA- are NC (not connected).
b) DIR must be ahead of PUL active edge by 5us to ensure correct direction;
c) Pulse width not less than t3;
d) Low level width not less than t4.

Model	t3	t4	Model	t3	t4
EM402	10 us	10 us	EM806-AC	2.5 us	2.5 us
EM503	2.5 us	2.5 us	3EM606	2.5 us	2.5 us
EM705	2.5 us	2.5 us	3EM806	2.5 us	2.5 us
EM806	2.5 us	2.5 us	3EM806-AC	2.5 us	2.5 us

As such, the pulse impulses sent from the controller to the motor have to have a certain minimum width for the motor to be able to register those signals. However, that signal width also cannot be too large due to the signal overlap that would otherwise occur due to each individual signal interfering with the next one. This is done by ensuring the controller sends impulse signals at a rate that is lower than the period of the impulse at its maximum frequency, resulting in impulse signals that do not interfere with one another while the width of the signal is wide enough for the motor to register the impulse.

These constraints on the minimum and the maximum pulse width create a permissible range of pulse widths for each motor depending on its hardware specifications and the particular speeds it is required to be operated at. Such an optimal pulse width for the controller based on these particular specifications can be calculated.

Pulse Width Calculations

- Choose the speed at which your machine will be moving in **[meters / minute]**
- Convert the **[meters / minute]** speed with which the machine will move to the number of **[revolutions / second]** of the screw/belt/etc based on the **[meters / revolution]** value of the screw/belt on your machine (this screw/belt value is specific to each hardware setup)
    - *For example, if the desired **[meters / minute]** speed of the machine is equal to 5 meters/minute, and the **[meters / revolution]** value of the screw/belt is 5 millimeters/revolution, the **[revolutions / second]** value will be calculated as follows:*

```
5 meters/minute ÷ 60 seconds/minute · 1000 millimeters/meter ≈ 80
millimeters/second
```

```
80 millimeters/second ÷ 5 millimeters/revolution = 16 revolutions/second
The value for the [revolutions / second] will be equal to 16
revolutions/second
```

- Locate the minimum **[seconds / step]** value of your step/servo motor (the minimum time it takes the motor to process each individual impulse). This minimum time should be provided in the motor manual.
  - *For example, this time T can be equal to 8 · 10^-6 seconds or 8 µs*
- Using the **[revolutions / second]** value and the minimum allowed **[seconds / step]** value of the motor, calculate how many **[steps / revolution]** the stepper driver will have to make.
  - *For example, if the minimum allowable value for the motor is 8 µs/step (8 · 10^-6 seconds/step), and the machine will produce 16 revolutions/second, then the maximum value for the **[steps / revolution]** will be calculated as follows:*

```
1 ÷ (16 revolutions/second · 8 · 10^-6 seconds/step) = 7812.5
steps/revolution
The value for the number of [steps / revolution] will be equal to 7812.5
steps/revolution
```

- As discussed earlier, the value selected on the stepper motor must be equal or smaller than the number of **[steps / revolution]** obtained from the previous step for the motor to register the signal and function properly.
  - *For example, if the **[steps / revolution]** value has been calculated to be 7812.5 steps/revolution, then if the stepper driver allows for 3200, 6400, and 12800 steps/revolution, 6400 steps/revolution will be selected as it is the closest value that's equal to or lower than 7812.5 steps/revolution*
- Using the **[revolutions / second]** value and the updated stepper driver **[steps / revolution]** value, calculate the actual **[seconds / step]** value of the motor. This actual **[seconds / step]** value will always be equal or higher than the minimum allowable **[seconds / step]** value of the motor due to selecting a lower **[steps / revolution]** value in the previous steps.
  - *For example, if the **[revolutions / second]** value was equal to 16 revolutions/second and the stepper driver **[steps / revolution]** value was equal to 6400 steps/revolution, the actual **[seconds / step]** value of the motor will be calculated as follows:*

```
1 ÷ (16 revolutions/second · 6400 steps/revolution) = 9.76 · 10^-6
seconds/step = 9.76 µs/step
The value for the [seconds / step] will be equal to 9.76 µs/step.
```

- The value for the **Pulse Width** in myCNC software must be set to be equal or to the next closest value that is higher than the actual **[seconds / step]** value of the motor.
  - *For example, if the **[seconds / step]** value was equal to 9.76 µs/step, and an ET6 or an ET7 board was used, 12 µs would be selected from the chart in the **Common Hardware Settings** tab as it is the closest value that's higher than 9.76 µs*

	0	1	2	3	4	5	6	7
ET1	0.32 us	0.64 us	0.96 us	1.28 us	1.60 us	1.92 us	2.24 us	5.0 us
ET3	0.16 us	0.32 us	0.48 us	0.64 us	0.8 us	0.96 us	1.12 us	2.5 us
ET6, ET7	0.13 us	0.25 us	0.50 us	1.0 us	2.0 us	4.0 us	8.0 us	12 us
ET10	0.13 us	0.25 us	0.50 us	1.0 us	2.0 us	4.0 us	8.0 us	10 us

- The 12 µs corresponds to Setting 7 in the chart, thus the **Pulse width** value should be set to 7 in myCNC software.
    - *NOTE: The first value in the **Pulse Width** line refers to the first four directions the controller can move in (for example, the X+, X-, Y+ and Y- axes), while the second value refers to the other two axes of the controller (for example, the vertical Z+ and Z- axis). These values are set to be different if the controller used on the vertical axis is separate from that used on the horizontal, and are left the same if a single controller is used. If two controllers are desired, the calculations for these values need to be performed separately based on the desired speed for each axis*



- The pulse width setup is now complete.

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