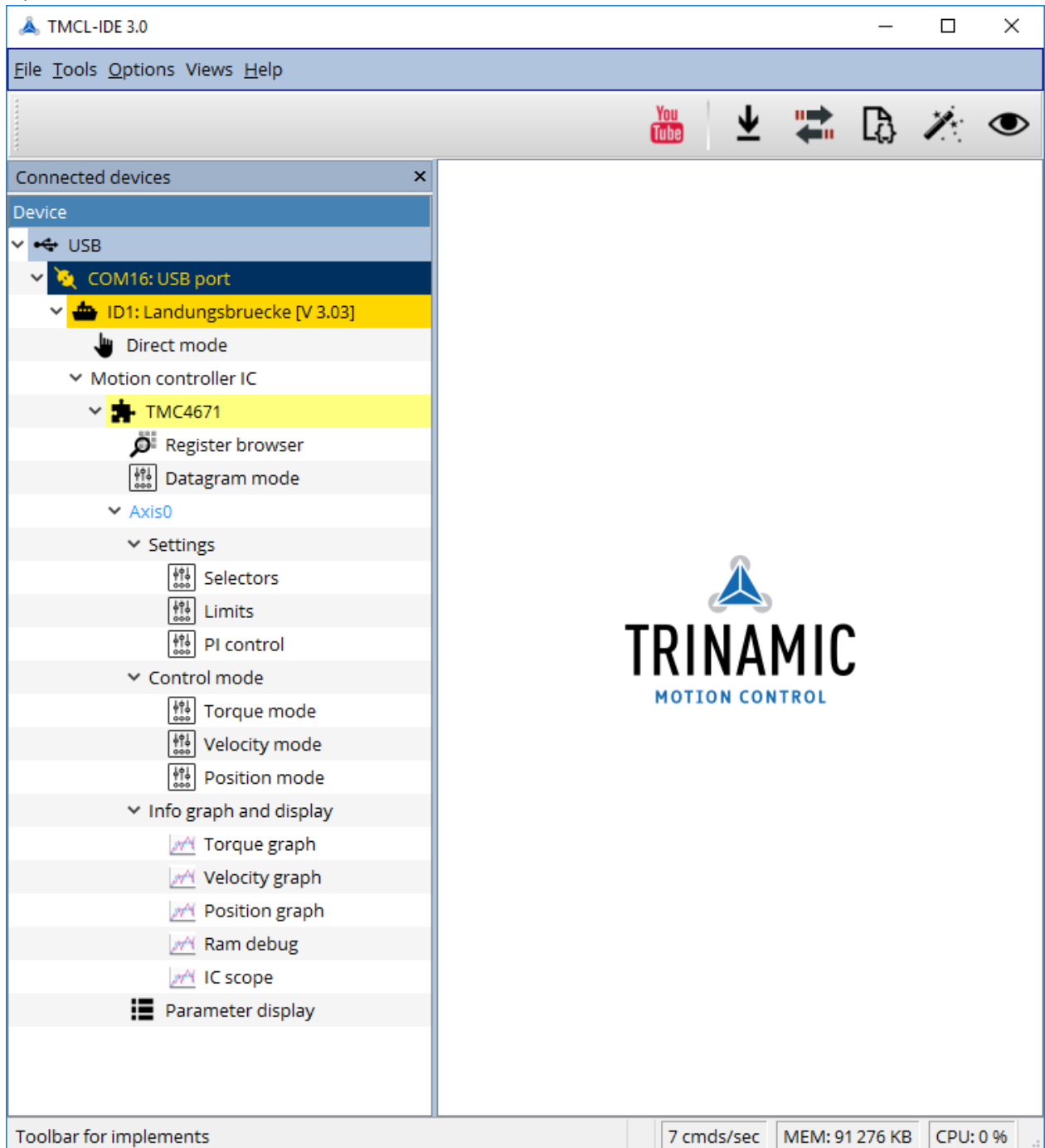
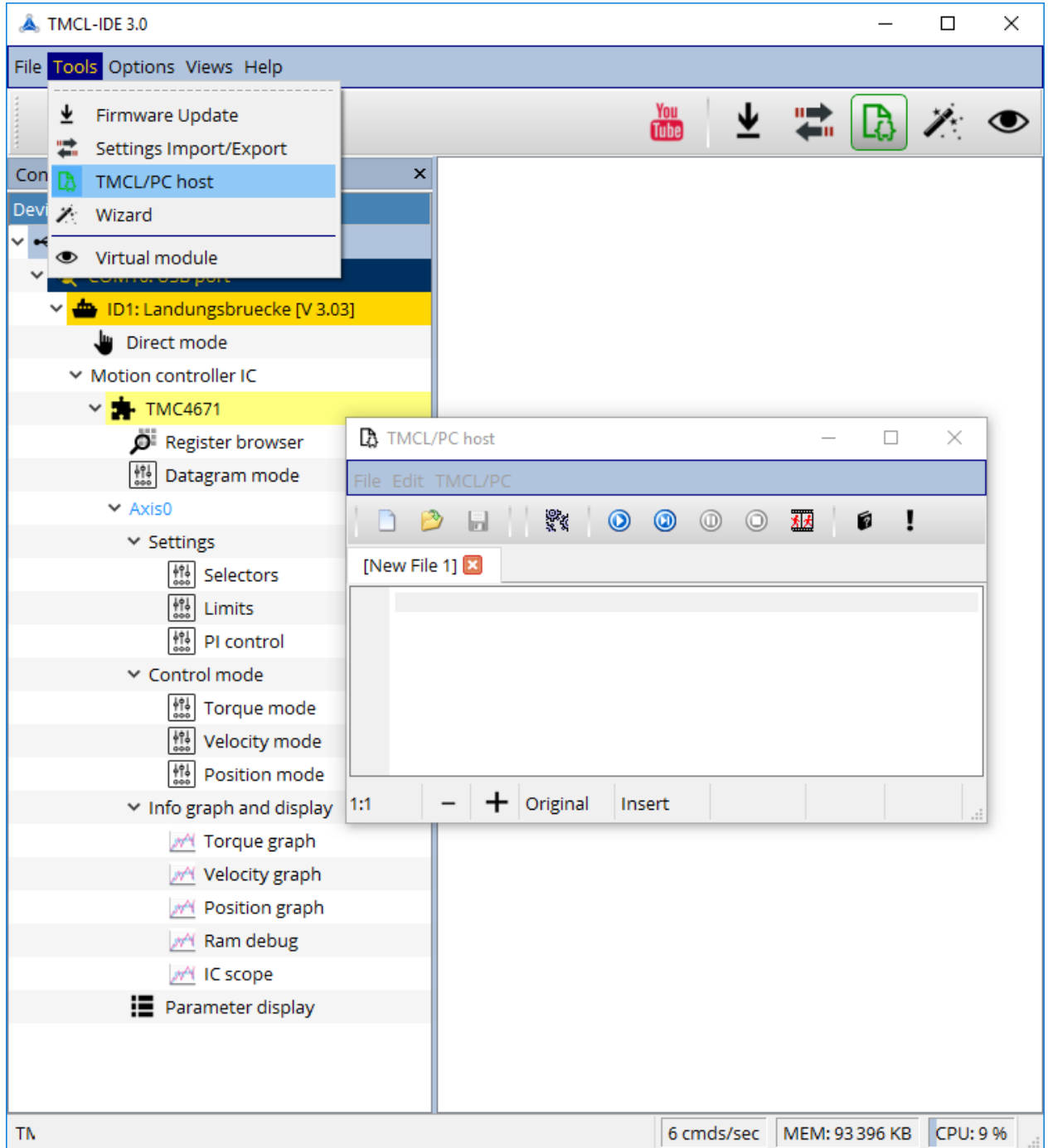


How-to configure your BLDC motor with encoder and/or hall signals for the TMC4671 and store the parameters into the TMCL PC/HOST tool to load the parameters after power cycling

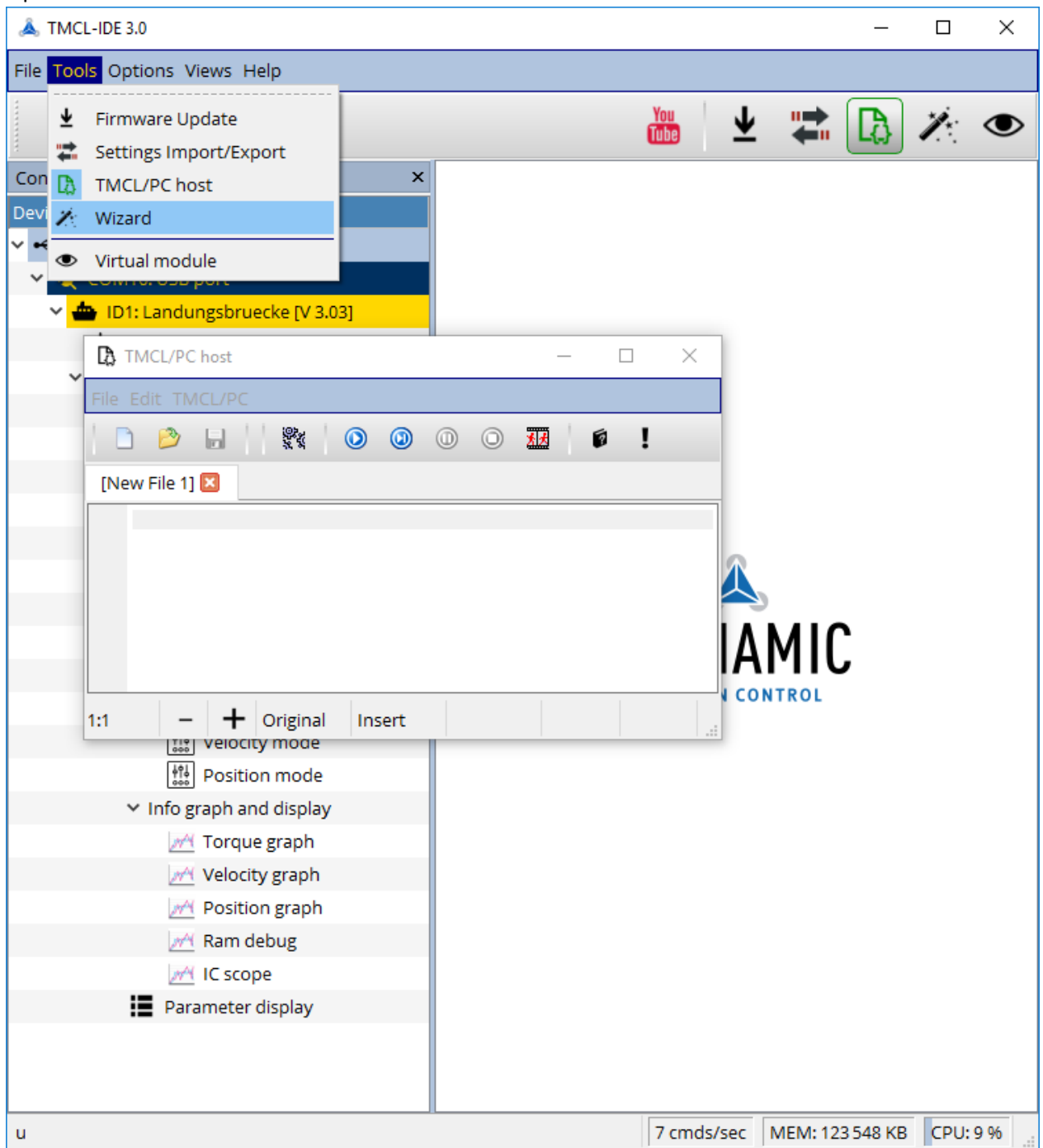
1. Connect everything
2. Connect power supply connector
3. Turn power on
4. Open TMCL IDE



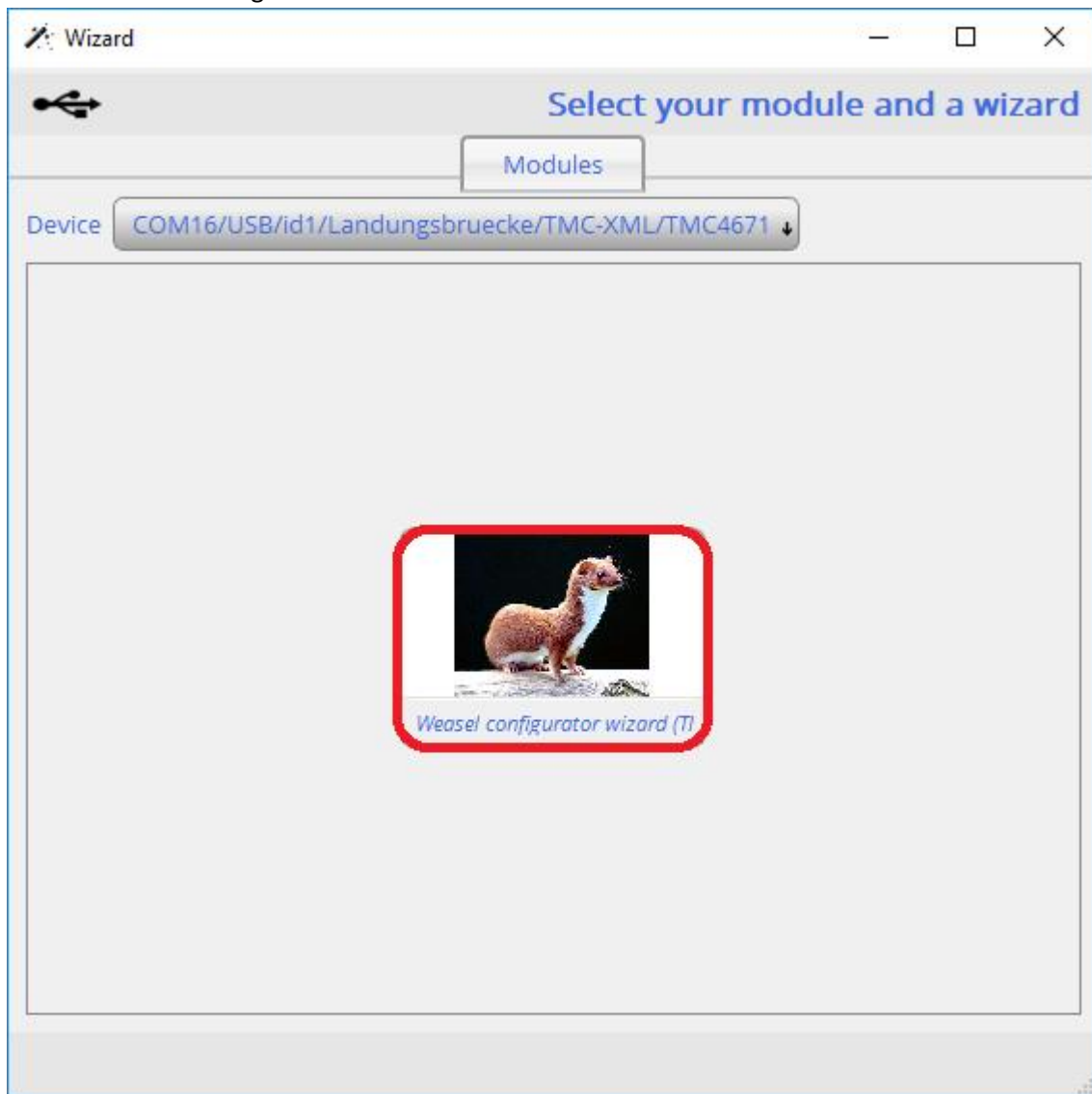
5. Connect USB
6. Open menu → Tools → TMCL PC/HOST

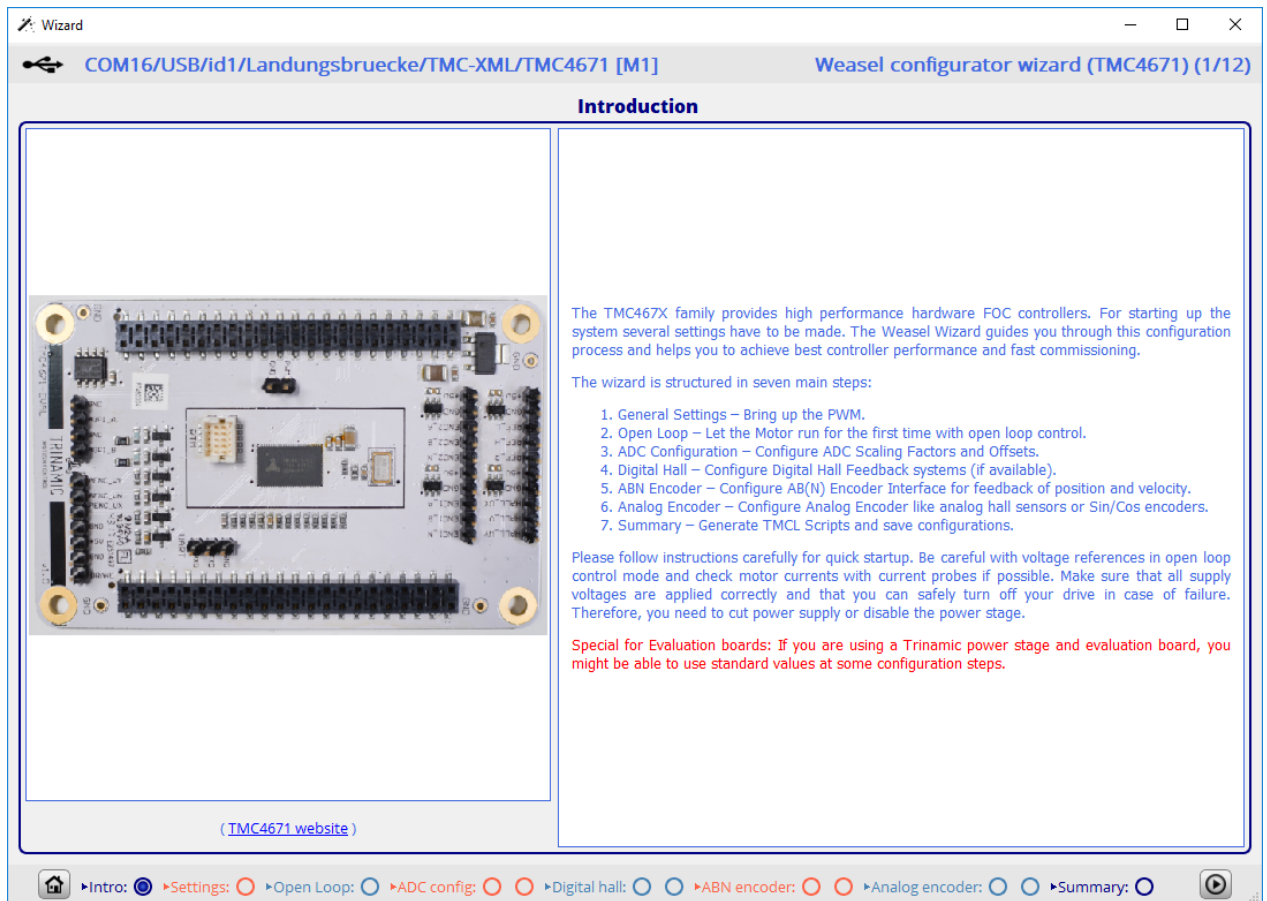



7. Open the Wizard



8. Click on Weasel configurator wizard





9. On the bottom right you'll find a small arrow  that will step through all the different configuration pages. The Wizard first steps you through the main settings, driving the motor on open loop mode to e.g. estimate motor pole counts, to configure your ADC signals, digital hall signals, ABN encoder signals, analog encoder signals and will end with a summary.

10. Main settings page (The starting point)

COM16/USB/id1/Landungsbruecke/TMC-XML/TMC4671 [M1] Weasel configurator wizard (TMC4671) (2/12)

Main settings

Which basic parameters must be checked?

Before starting up the motor with open loop control, the PWM has to be adjusted to your power module/inverter. If you are using a standard evaluation board from Trinamic, you can set Default values with the respective buttons.

- Choose Motor_Type according to your motor and power stage. The TMC4671 supports DC motors, two phase stepper motors (FOC2) and BLDC/PMSM motors (FOC3).
- Set number of pole pairs according to your motor. If you don't know the number of pole pairs of your motor, we can determine the number of pole pairs in the next steps. You can also determine this value from your motor's nameplate data using the formula below. Stepper Motors usually have 50 pole pairs (1.8°).
 - $p_{pole} = (60 * f_{nom} [Hz]) / n_{nom} [rpm]$ e.g. $n_{nom} = 3000 rpm, f_{nom} = 200 Hz, p = 4$
 - $p_{pole} = 360 / (step_angle * 4)$ e.g. $step_angle = 1.8°, p = 50$
- Set polarities of PWM signals according to your gate driver specification for High Side and Low Side switches. If you don't set the polarity bit, a high input signal shall result in a closed switch.
- You can use the Signals 2, C and OC to trigger external hardware. Choose polarities according to your application.
- Set PWM_MAXCNT (b18) to change switching frequency.
 - Calculation: $PWM_MAXCNT = 1 / (f [Hz] * 10 ns) - 1$
- Set Brake Before Make (BBM) times according to your power stage. These values can be defined separately for high side and low side switches.

Buttons: [Set defaults for DC motor](#) [Set defaults for stepper motor](#) [Set defaults for BLDC/PMSM motor](#) [PWM off](#)

Addr	Name	Value
0x18	N_POLE_PAIRS	4
0x19	MOTOR_TYPE	Three phase BLDC motor
0x17	PWM_POLARITIES[0]	<input type="checkbox"/> polarity of Low Side (LS) gate control signal
0x17	PWM_POLARITIES[1]	<input type="checkbox"/> polarity of High Side (HS) gate control signal
0x1A	PWM_CHOP	centered PWM for FOC
0x1A	PWM_SV	<input type="checkbox"/> use Space Vector PWM
0x18	PWM_MAXCNT	3999
0x19	PWM_BBM_L	5
0x19	PWM_BBM_H	5

[Export to TMCL/PC host](#)

Navigation: [Intro](#) [Settings](#) [Open Loop](#) [ADC config](#) [Digital hall](#) [ABN encoder](#) [Analog encoder](#) [Summary](#)

11. At this page you can simply click on the **Set defaults for BLDC/PMSM motor** button

COM16/USB/id1/Landungsbruecke/TMC-XML/TMC4671 [M1] Weasel configurator wizard (TMC4671) (2/12)

Main settings

Which basic parameters must be checked?

Before starting up the motor with open loop control, the PWM has to be adjusted to your power module/inverter. If you are using a standard evaluation board from Trinamic, you can set Default values with the respective buttons.

- Choose Motor_Type according to your motor and power stage. The TMC4671 supports DC motors, two phase stepper motors (FOC2) and BLDC/PMSM motors (FOC3).
- Set number of pole pairs according to your motor. If you don't know the number of pole pairs of your motor, we can determine the number of pole pairs in the next steps. You can also determine this value from your motor's nameplate data using the formula below. Stepper Motors usually have 50 pole pairs (1.8°).
 - $p_{pole} = (60 * f_{nom} [Hz]) / n_{nom} [rpm]$ e.g. $n_{nom} = 3000 rpm, f_{nom} = 200 Hz, p = 4$
 - $p_{pole} = 360 / (step_angle * 4)$ e.g. $step_angle = 1.8°, p = 50$
- Set polarities of PWM signals according to your gate driver specification for High Side and Low Side switches. If you don't set the polarity bit, a high input signal shall result in a closed switch.
- You can use the Signals 2, C and OC to trigger external hardware. Choose polarities according to your application.
- Set PWM_MAXCNT (b18) to change switching frequency.
 - Calculation: $PWM_MAXCNT = 1 / (f [Hz] * 10 ns) - 1$
- Set Brake Before Make (BBM) times according to your power stage. These values can be defined separately for high side and low side switches.


Buttons: [Set defaults for DC motor](#) [Set defaults for stepper motor](#) [Set defaults for BLDC/PMSM motor](#) [PWM off](#)

Addr	Name	Value
0x18	N_POLE_PAIRS	4
0x19	MOTOR_TYPE	Three phase BLDC motor
0x17	PWM_POLARITIES[0]	<input type="checkbox"/> polarity of Low Side (LS) gate control signal
0x17	PWM_POLARITIES[1]	<input type="checkbox"/> polarity of High Side (HS) gate control signal
0x1A	PWM_CHOP	centered PWM for FOC
0x1A	PWM_SV	<input type="checkbox"/> use Space Vector PWM
0x18	PWM_MAXCNT	3999
0x19	PWM_BBM_L	5
0x19	PWM_BBM_H	5

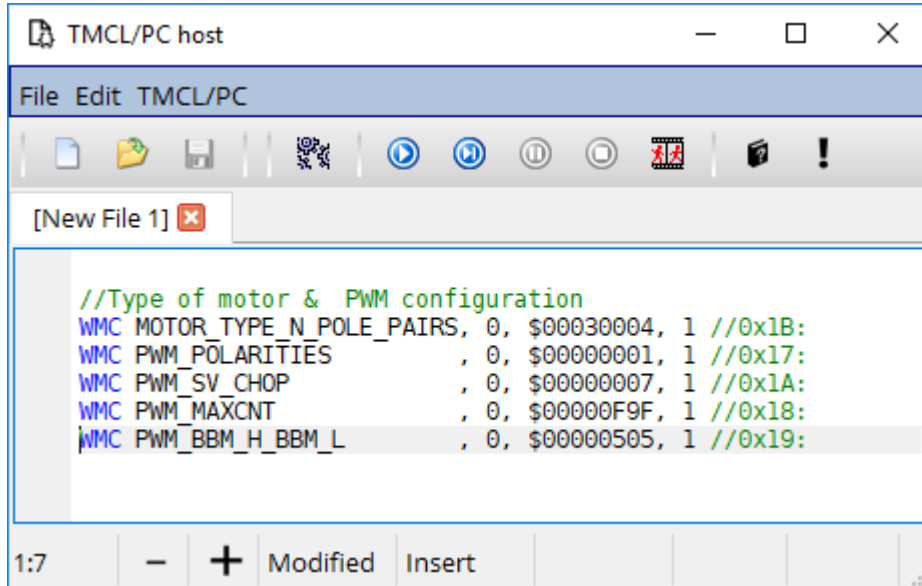
[Export to TMCL/PC host](#)

Navigation: [Intro](#) [Settings](#) [Open Loop](#) [ADC config](#) [Digital hall](#) [ABN encoder](#) [Analog encoder](#) [Summary](#)


12. Click on

 **Export to TMCL/PC host**

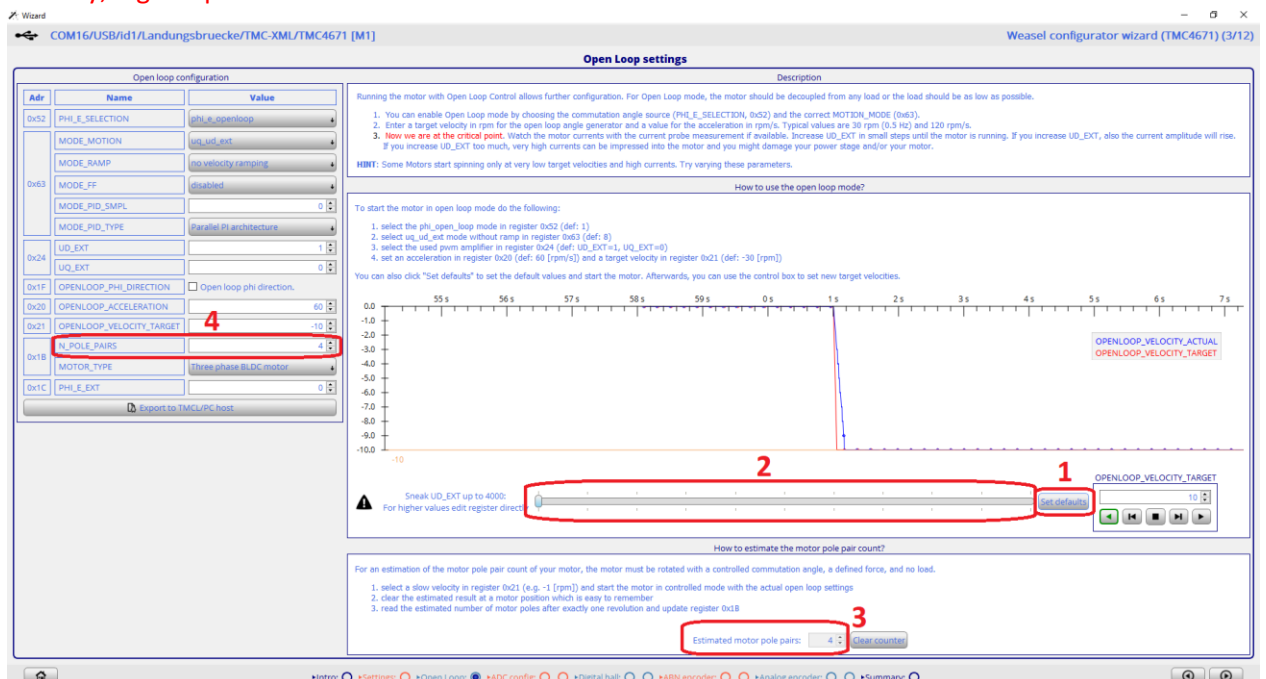
13. This will list the parameters in the TMCL/PC host which allows to load those values when power cycling or having another session at another time.



```
//Type of motor & PWM configuration
WMC MOTOR_TYPE_N_POLE_PAIRS, 0, $00030004, 1 //0x1B:
WMC PWM_POLARITIES, 0, $00000001, 1 //0x17:
WMC PWM_SV_CHOP, 0, $00000007, 1 //0x1A:
WMC PWM_MAXCNT, 0, $00000F9F, 1 //0x18:
WMC PWM_BBM_H_BBM_L, 0, $00000505, 1 //0x19:
```

14. Continue by clicking 
15. On the next page Open Loop settings you can simply click on **1 Set defaults** and afterwards use the **2 slider** to increase the PWM of the open loop voltage controlled mode UD_EXT.

WARNING: Increase UD_EXT carefully to avoid motor damage. If possible measure the motor current otherwise increase the slider in small steps until the motor starts turning with a smooth velocity, e.g. 10rpm.



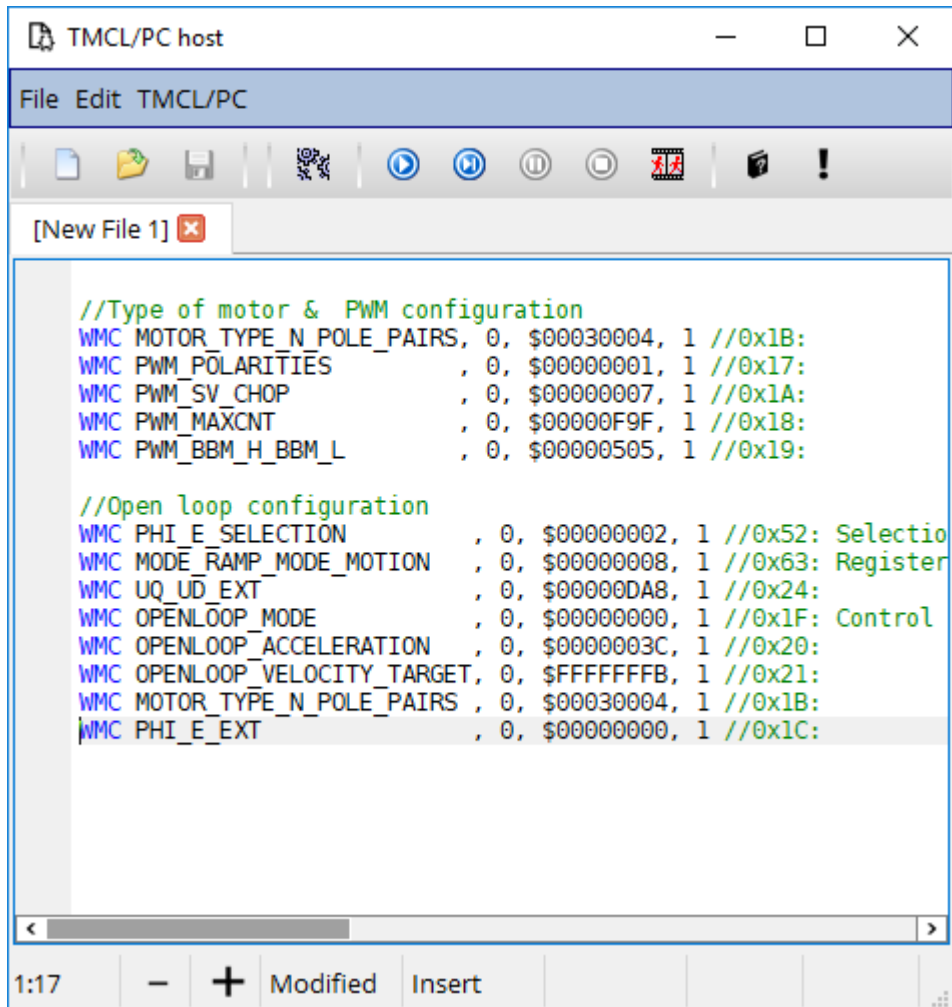
The screenshot shows the 'Open Loop settings' page in the Weasel configurator wizard. On the left, a table lists various parameters with their addresses, names, and values. The 'N_POLE_PAIRS' parameter is highlighted with a red box and labeled with a red '4'. In the center, there is a graph showing 'OPEN_LOOP_VELOCITY_ACTUAL' and 'OPEN_LOOP_VELOCITY_TARGET' over time. Below the graph, a slider for 'UD_EXT' is shown, with a red box around it labeled with a red '2'. To the right of the slider, a button labeled 'Set defaults' is highlighted with a red box and labeled with a red '1'. At the bottom, there is a section for 'Estimated motor pole pairs' with a value of '4' and a 'Clear counter' button, labeled with a red '3'.

Addr	Name	Value
0x52	PHI_E_SELECTION	phi_e_openloop
0x63	MODE_MOTION	ud_ext
	MODE_RAMP	no velocity ramping
	MODE_FF	disabled
	MODE_PID_SMP	0
0x64	MODE_PID_TYPE	Parallel PI architecture
	UD_EXT	1
0x24	UD_EXT	0
	UD_EXT	0
0x1F	OPEN_LOOP_PHI_DIRECTION	<input type="checkbox"/> Open loop phi direction
0x20	OPEN_LOOP_ACCELERATION	60
0x21	OPEN_LOOP_VELOCITY_TARGET	-10
0x1B	N_POLE_PAIRS	4
0x18	MOTOR_TYPE	Three phase BLDC motor
0x1C	PHI_E_EXT	0

16. As soon as the motor is tuning smoothly you can countercheck the motor pole count by resetting the counter and turn the motor for one revolution. The estimated motor pole pair count can be read in the edit box on the bottom **3**. If it differs from the set N_POLE_PAIR settings on the left **4** please change it there.

17. Click on

 Export to TMCL/PC host



The screenshot shows a window titled "TMCL/PC host" with a menu bar (File, Edit, TMCL/PC) and a toolbar with various icons. The main text area contains the following code:

```
//Type of motor & PWM configuration
WMC MOTOR_TYPE_N_POLE_PAIRS, 0, $00030004, 1 //0x1B:
WMC PWM_POLARITIES          , 0, $00000001, 1 //0x17:
WMC PWM_SV_CHOP              , 0, $00000007, 1 //0x1A:
WMC PWM_MAXCNT               , 0, $00000F9F, 1 //0x18:
WMC PWM_BBM_H_BBM_L         , 0, $00000505, 1 //0x19:

//Open loop configuration
WMC PHI_E_SELECTION          , 0, $00000002, 1 //0x52: Selection
WMC MODE_RAMP_MODE_MOTION    , 0, $00000008, 1 //0x63: Register
WMC UQ_UD_EXT                , 0, $00000DA8, 1 //0x24:
WMC OPENLOOP_MODE            , 0, $00000000, 1 //0x1F: Control
WMC OPENLOOP_ACCELERATION    , 0, $0000003C, 1 //0x20:
WMC OPENLOOP_VELOCITY_TARGET, 0, $FFFFFFFB, 1 //0x21:
WMC MOTOR_TYPE_N_POLE_PAIRS , 0, $00030004, 1 //0x1B:
WMC PHI_E_EXT                , 0, $00000000, 1 //0x1C:
```

The status bar at the bottom shows "1:17", a minus sign, a plus sign, and the text "Modified Insert".

18. Continue by clicking



19. ADC selection page

Wizard

COM16/USB/Id1/Landungsbruecke/TMC-XML/TMC4671 [M1]

Weasel configurator wizard (TMC4671) (4/12)

ADC selection

How to select the correct ADC inputs?

The TMC467X has different ADC inputs for phase current measurement and you can also provide digitalized phase current values via SPI. All these input signals are provided to the internal ADC scaler component of the controller. You can configure the ADC Scaler to fit your hardware design. Choose the correct ADCs by matching your hardware design. The ADC signals should look like sinusoidal signals. For stepper motors they have a phase of 90° and for BLDC/PMSM motors they should have a phase of 120°.

Offsets and gains can be configured in the next steps of this wizard.

Addr	Name	Value
	ADC_I0_SELECT	ADCS0_I0_RAW (sigma delta ADC)
	ADC_I1_SELECT	ADCS0_I1_RAW (sigma delta ADC)
0x0A	ADC_I0_SELECT	IUX = ADC_I0 (default)
	ADC_I1_SELECT	IY = ADC_I1 (default)
	ADC_I0_SELECT	IWX = ADC_I0 (default)
	ADC_I1_SELECT	IY = ADC_I1 (default)
	ADC_I0_SELECT	IWX = ADC_I0 (default)
	ADC_I1_SELECT	IY = ADC_I1 (default)

Export to TMC4671 host

External ADC inputs via register

ADC_I1_EXT
ADC_I0_EXT

Sigma-Delta ADC inputs

39,050
31,540

ADCSD_I1_RAW
ADCSD_I0_RAW

ADC Type

Sigma-Delta ADC inputs **1**

Load Sigma-Delta defaults

Turn motor slowly **2**

ADC_I0_RAW and ADC_I1_RAW

39,050
31,540

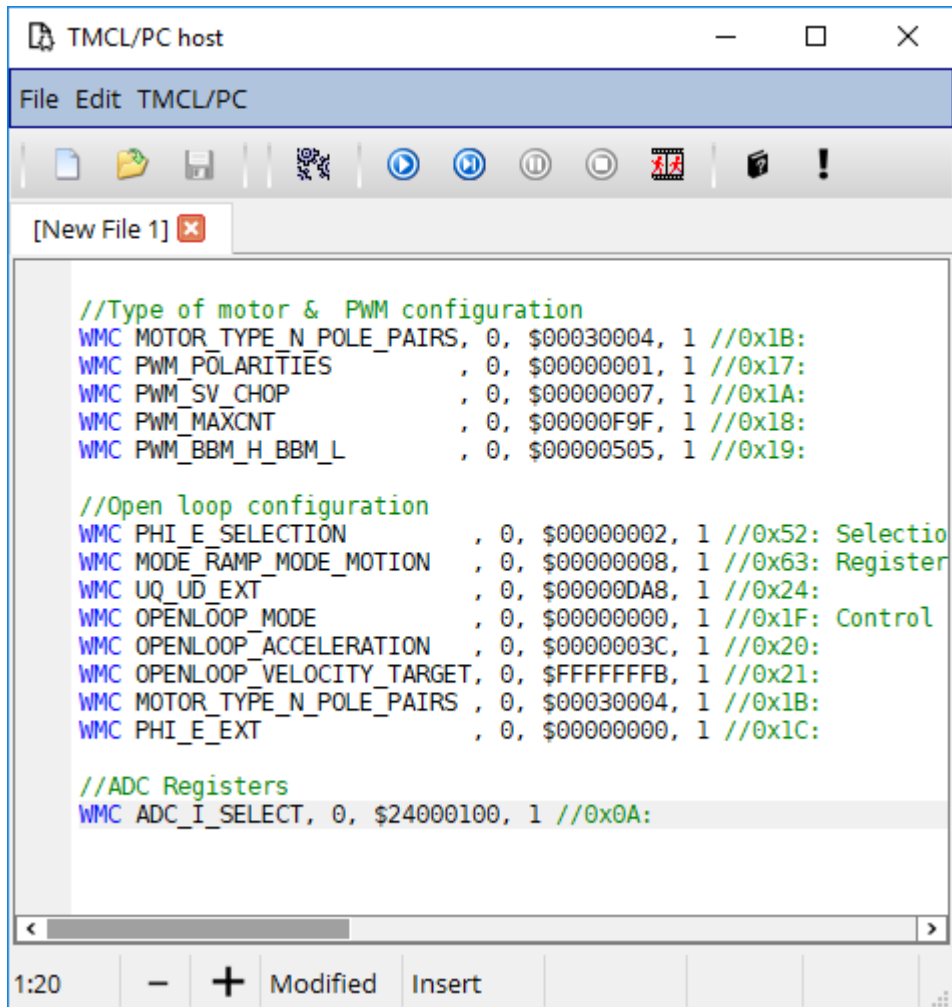
ADC_I0_RAW
ADC_I1_RAW

•Intro: •Settings: •Open Loop: •ADC config: •Digital hall: •ABIN encoder: •Analog encoder: •Summary:

20. You can click on Load Sigma-Delta defaults button **1** and afterwards the Turn motor slowly button **2**.

21. Click on

 Export to TMCL/PC host



The screenshot shows a window titled "TMCL/PC host" with a menu bar (File, Edit, TMCL/PC) and a toolbar. The main text area contains the following code:

```
//Type of motor & PWM configuration
WMC MOTOR_TYPE_N_POLE_PAIRS, 0, $00030004, 1 //0x1B:
WMC PWM_POLARITIES          , 0, $00000001, 1 //0x17:
WMC PWM_SV_CHOP              , 0, $00000007, 1 //0x1A:
WMC PWM_MAXCNT               , 0, $00000F9F, 1 //0x18:
WMC PWM_BBM_H_BBM_L         , 0, $00000505, 1 //0x19:

//Open loop configuration
WMC PHI_E_SELECTION          , 0, $00000002, 1 //0x52: Selection
WMC MODE_RAMP_MODE_MOTION    , 0, $00000008, 1 //0x63: Register
WMC UQ_UD_EXT                , 0, $00000DA8, 1 //0x24:
WMC OPENLOOP_MODE            , 0, $00000000, 1 //0x1F: Control
WMC OPENLOOP_ACCELERATION     , 0, $0000003C, 1 //0x20:
WMC OPENLOOP_VELOCITY_TARGET , 0, $FFFFFFFB, 1 //0x21:
WMC MOTOR_TYPE_N_POLE_PAIRS , 0, $00030004, 1 //0x1B:
WMC PHI_E_EXT                 , 0, $00000000, 1 //0x1C:

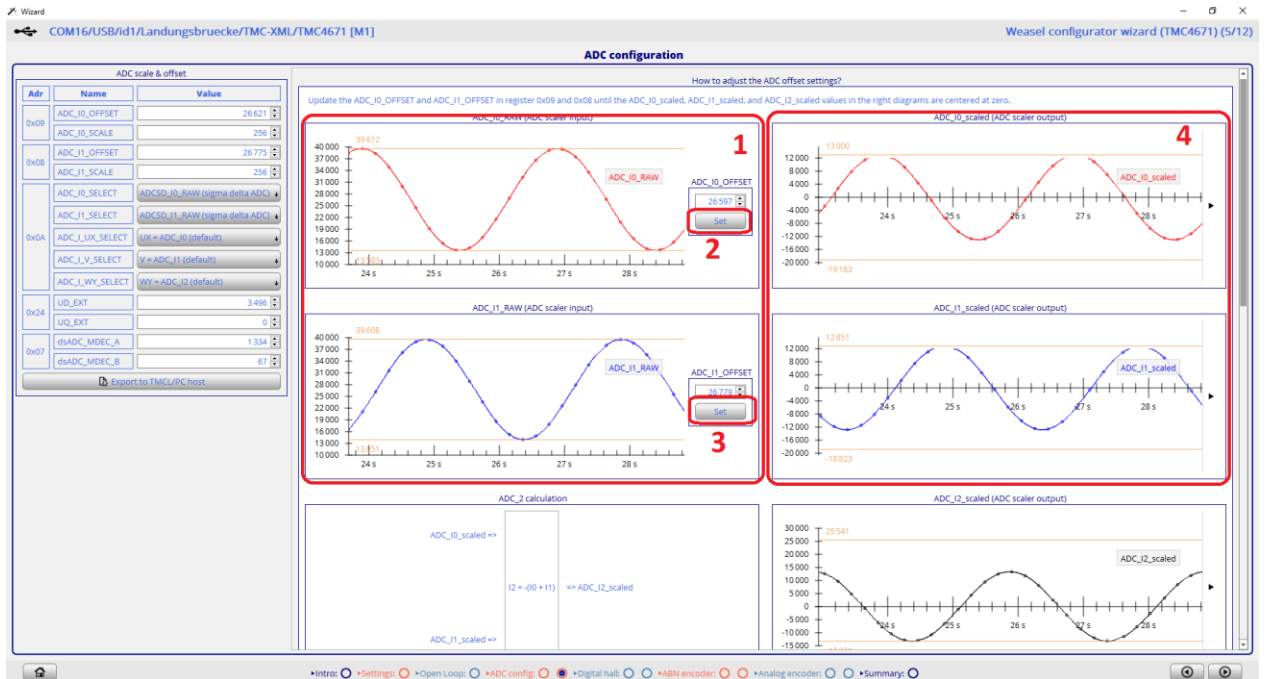
//ADC Registers
WMC ADC_I_SELECT, 0, $24000100, 1 //0x0A:
```

The status bar at the bottom shows the time 1:20, zoom controls (-, +), and the text "Modified Insert".

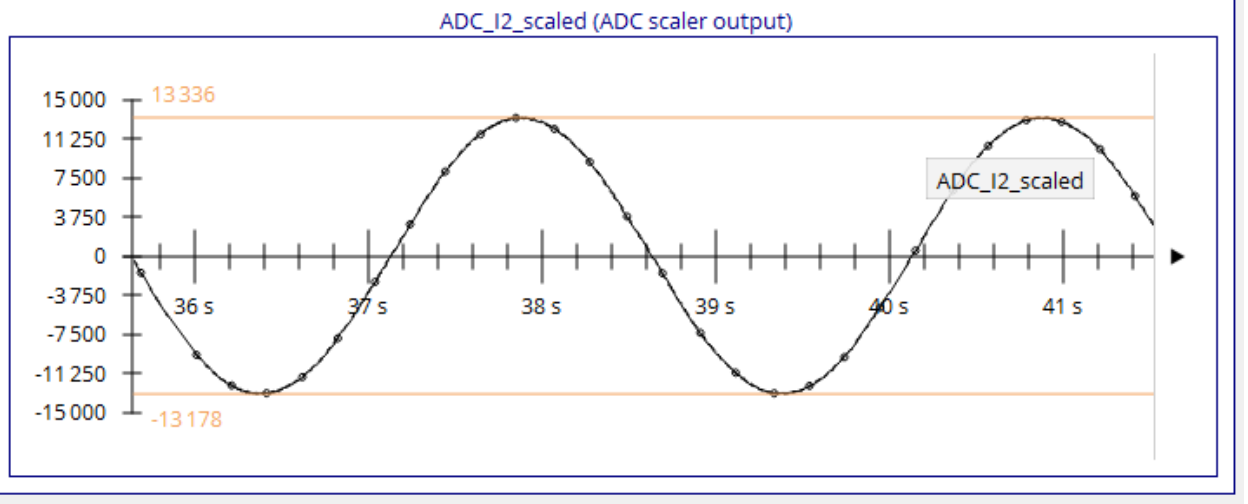
22. Continue by clicking



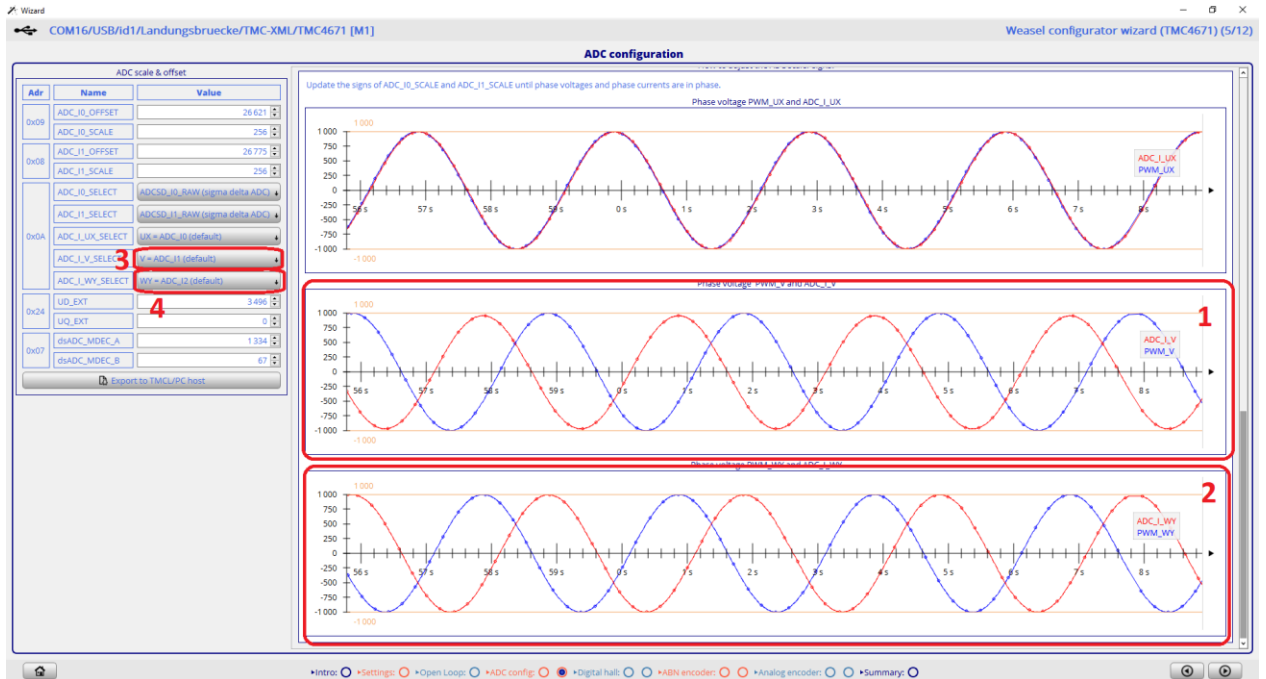
23. ADC configuration page



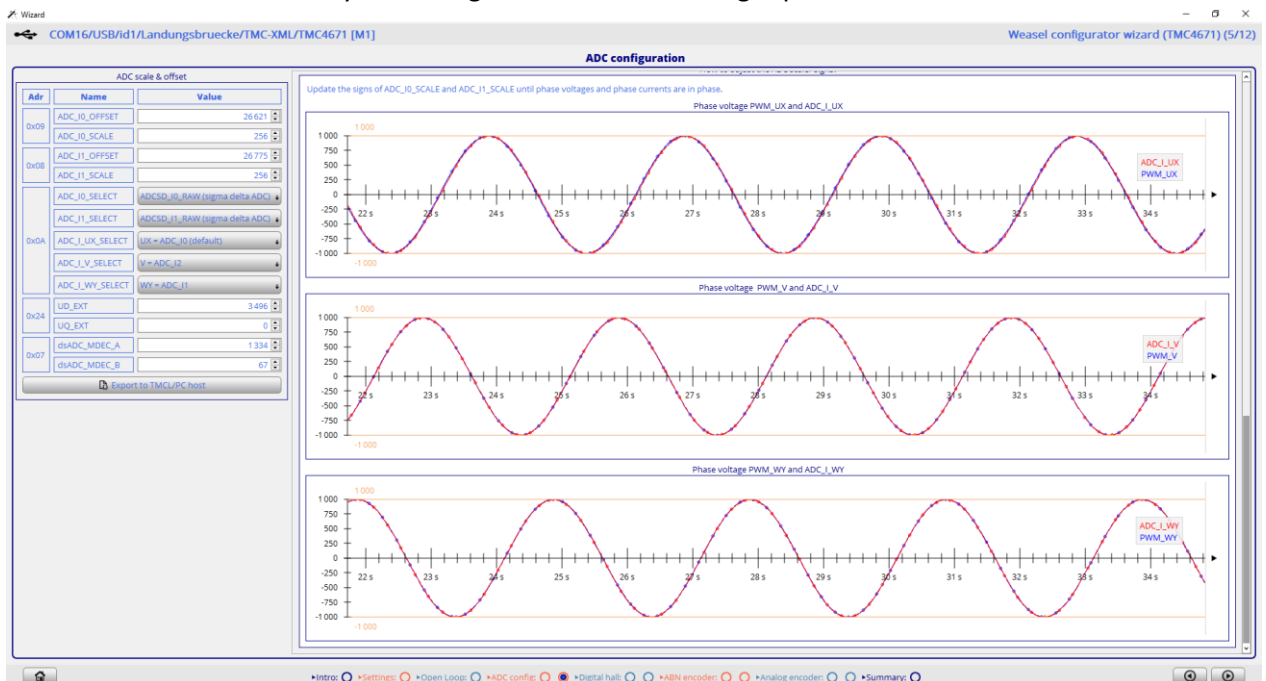
24. Let the motor run until you have some data collected on the left graphs **1** that show the raw values of the ADC.
25. Now you can click on the **Set** button **2** and **3** to automatically compensate the offset (amplitude).
26. On the right side **4** you'll see the corrected ADC scaler values.
27. When scrolling down you'll see the ADC_I2_scaled output value that is being calculated with ADC_I0_scaled and ADC_I1_scaled.



28. Now please check on the bottom of the page that the PWM and ADC_I values are in phase. In this example PWM_V and ADC_I_V **1** and PWM_WY and PWM_I_WY **2** are not in phase.

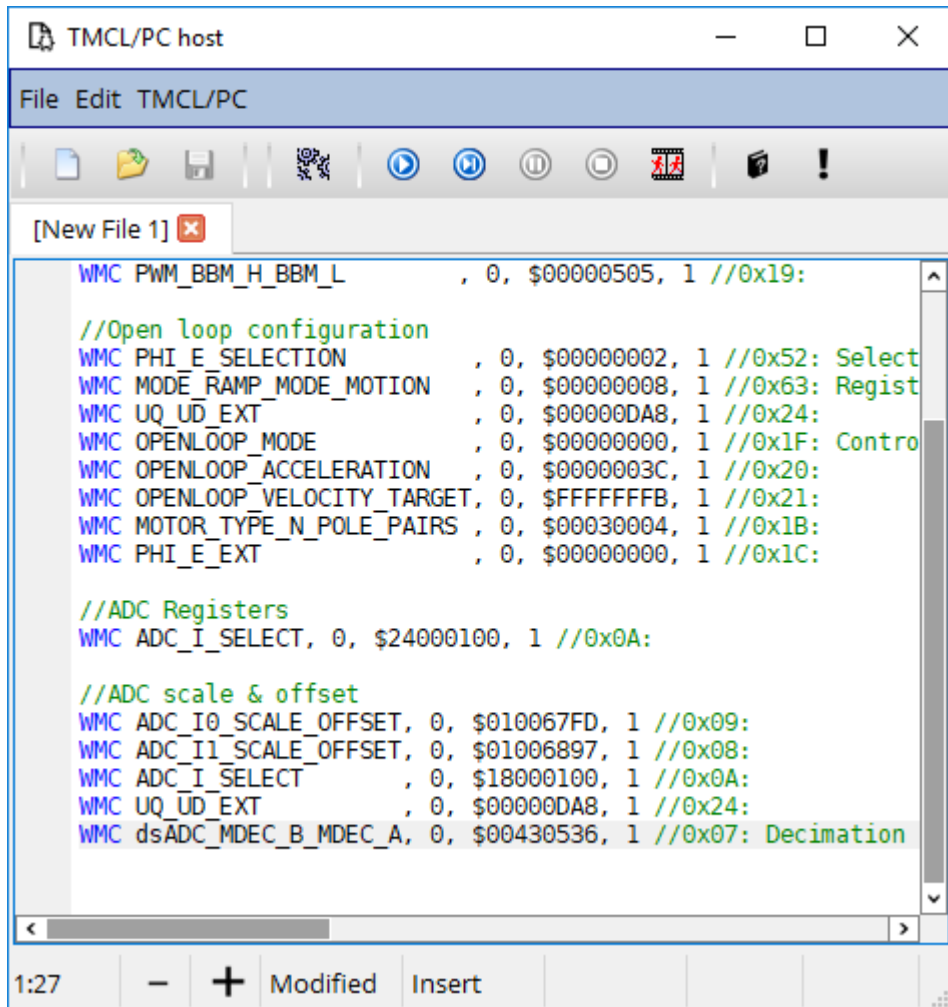


29. By switching the ADC_I_V_SELECT value to ADC_I2 **3** and ADC_I_WY_SELECT to ADC_I1 **4** we can fix that mismatch. We mainly set the right ADC value to the right phase.



30. Click on

 Export to TMCL/PC host



The screenshot shows a window titled "TMCL/PC host" with a menu bar (File, Edit, TMCL/PC) and a toolbar. A tab labeled "[New File 1]" is active. The main text area contains the following code:

```
WMC PWM_BBM_H_BBM_L      , 0, $00000505, 1 //0x19:

//Open loop configuration
WMC PHI_E_SELECTION       , 0, $00000002, 1 //0x52: Select
WMC MODE_RAMP_MODE_MOTION , 0, $00000008, 1 //0x63: Regist
WMC UQ_UD_EXT             , 0, $00000DA8, 1 //0x24:
WMC OPENLOOP_MODE         , 0, $00000000, 1 //0x1F: Contro
WMC OPENLOOP_ACCELERATION , 0, $0000003C, 1 //0x20:
WMC OPENLOOP_VELOCITY_TARGET, 0, $FFFFFFFB, 1 //0x21:
WMC MOTOR_TYPE_N_POLE_PAIRS , 0, $00030004, 1 //0x1B:
WMC PHI_E_EXT             , 0, $00000000, 1 //0x1C:

//ADC Registers
WMC ADC_I_SELECT, 0, $24000100, 1 //0x0A:

//ADC scale & offset
WMC ADC_I0_SCALE_OFFSET, 0, $010067FD, 1 //0x09:
WMC ADC_I1_SCALE_OFFSET, 0, $01006897, 1 //0x08:
WMC ADC_I_SELECT       , 0, $18000100, 1 //0x0A:
WMC UQ_UD_EXT          , 0, $00000DA8, 1 //0x24:
WMC dsADC_MDEC_B_MDEC_A, 0, $00430536, 1 //0x07: Decimation
```

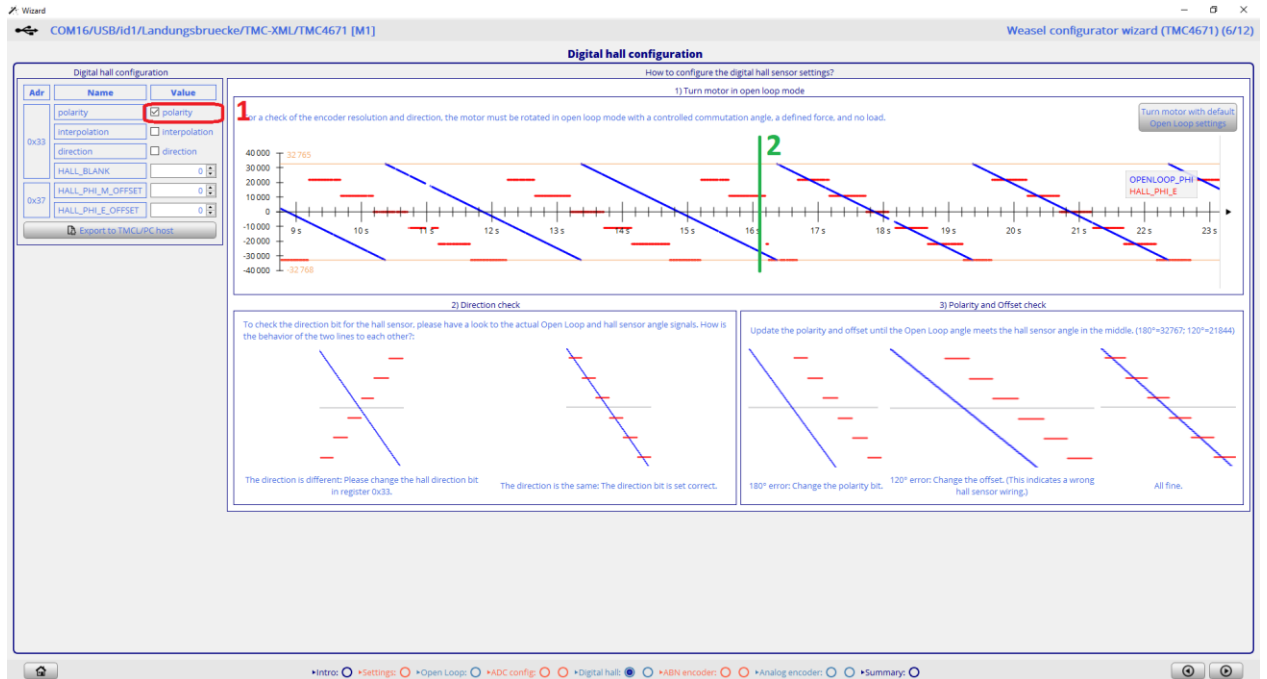
The status bar at the bottom shows the time "1:27", a minus sign, a plus sign, and the text "Modified Insert".

31. Continue by clicking



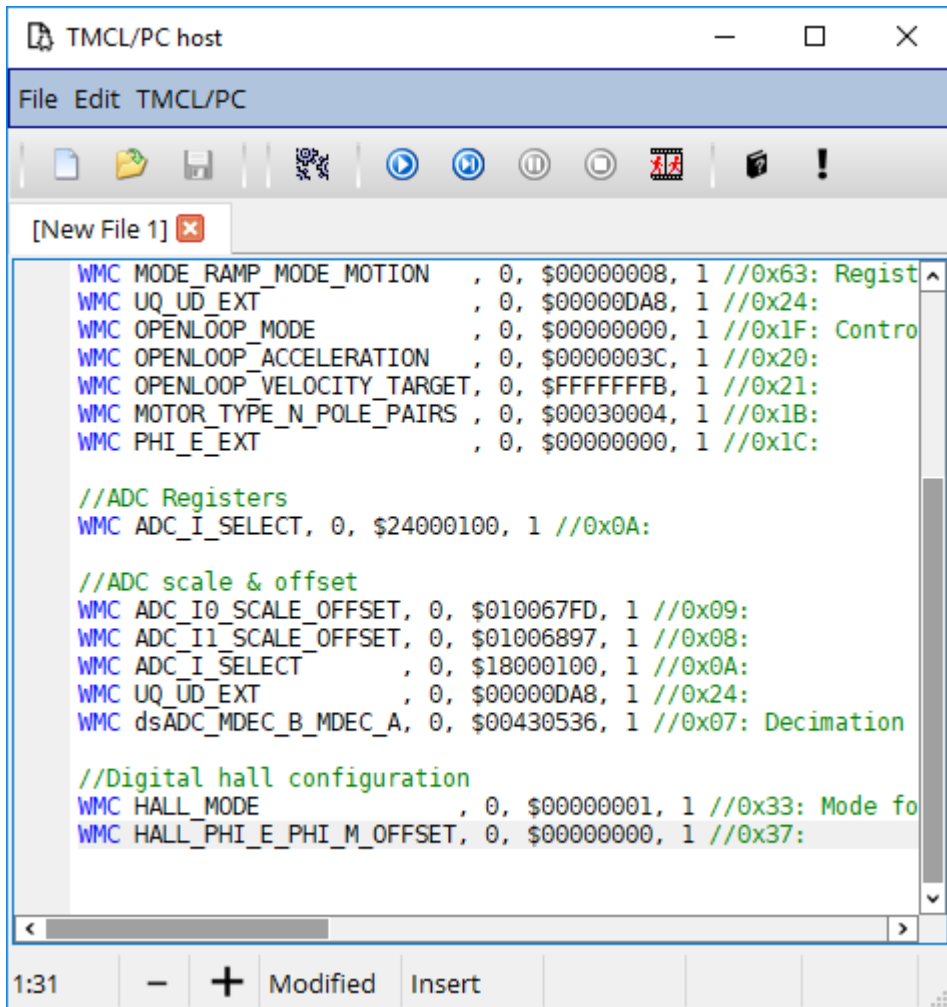
32. **Digital hall configuration** page

33. In this window you just need to follow the instructions. In our example the polarity **1** needs to be set to have the hall signals match. You can see the effect of toggling the polarity bit at **2**



 Export to TMCL/PC host

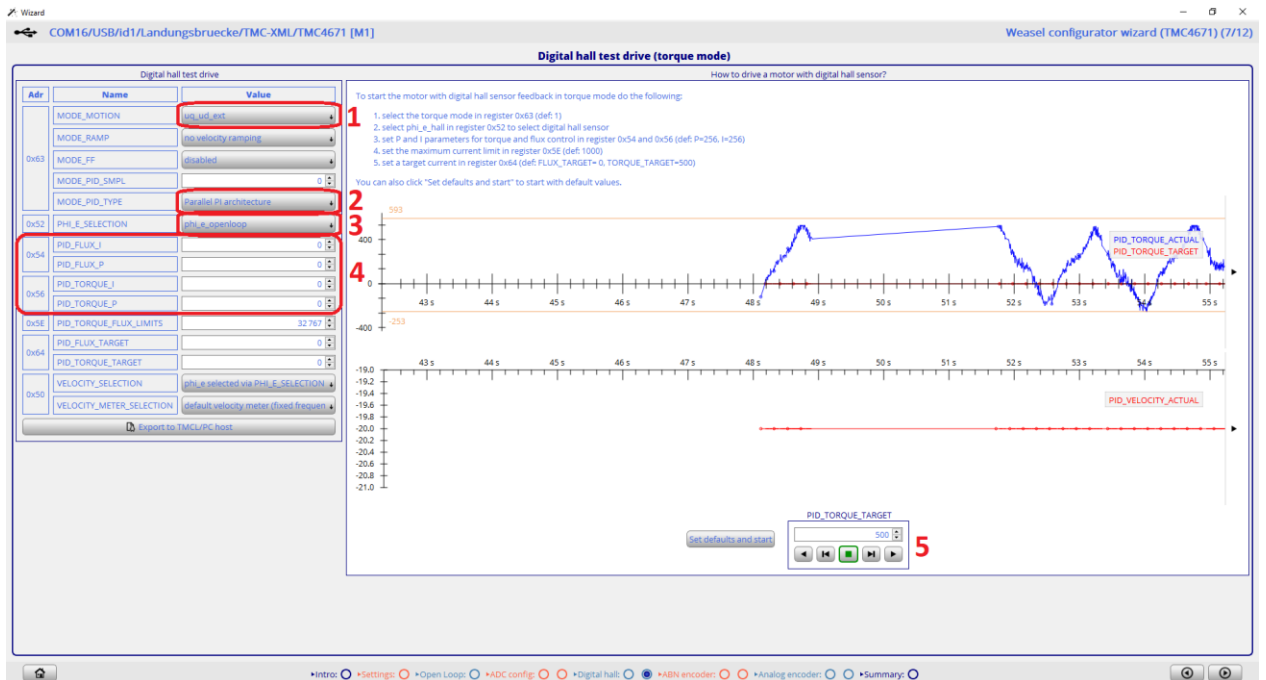
34. Click on



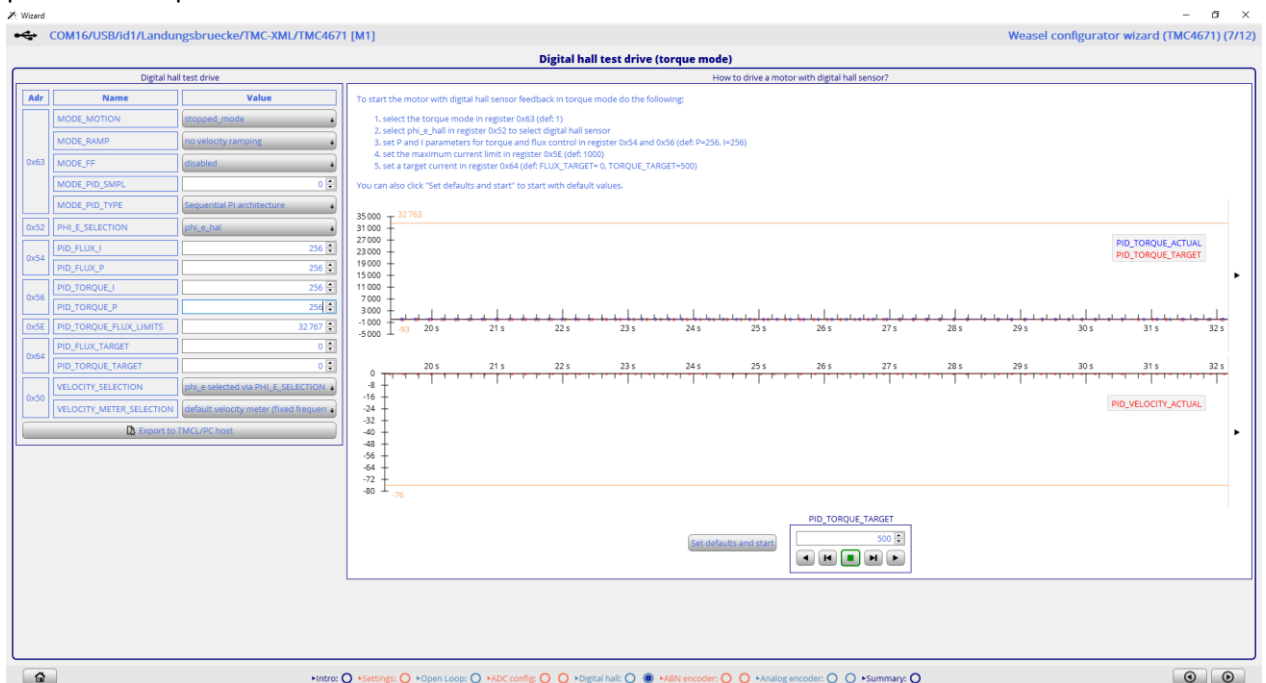
35. Continue by clicking



36. Digital hall test drive (torque mode) window

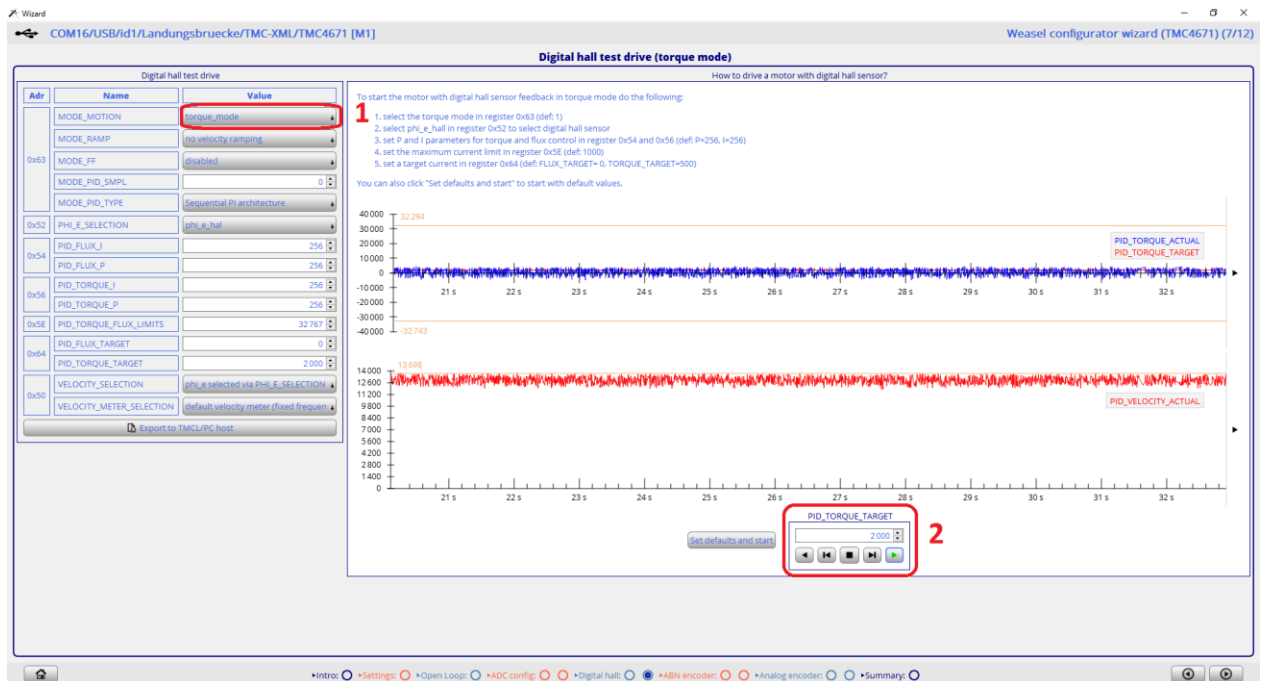


37. Please go in stopped mode **1**, select the sequential PI architecture **2**, select ϕ_{e_hal} at **3** and put default PI parameters into **4**



38. Now you can switch MODE_MOTION **1** to torque mode and start by clicking the "play" button **2**.
Note: If the motor does not start turning, increase the current to e.g. 1000 or 2000. But be

careful.



39. Encoder configuration window

TBD

40. When finished and on the last page you get a summary of the register settings of the TMC4671

41.