

Documentation for the „ModuleControl“ Config Tool

info@cpr-robots.com

July 2nd, 2017

The software SingleModule is a small tool to test and parametrize the CPR motion controller. It is a Windows software and not part of the CPR product spectrum.

1. Installation

Rename the installer to .exe if the ending is different.

Double-click on the installer and follow the directions.

ModuleControl requires the Microsoft Chart Control (DataVisualization package). Install e.g. from

<https://www.microsoft.com/de-de/download/details.aspx?id=14422>

2. Safety

This tool allows direct access and change of parameter. Results may be unexpected!



- Always stay out of reach of the robot
- Always have the emergency stop in reach
- Start with small values, small motions, and increase on success
- Start with a 'fault tolerant' robot axis, e.g. joint 1 which can rotate a long way without collision, or joint 4 which is small

3. Operation

The screenshot shows the 'CPR Module Control V03-005' application window. It features a central circular display representing a motor joint, with a red dot indicating its current position. The interface includes several control panels and buttons:

- Configuration Panel:** Includes checkboxes for DO1-DO4 and DI1-DI4. The 'Protocol' is set to 'CPRCANV2', 'CAN ID' is '0x10', 'Gear Scale' is '278', and 'Gear Zero' is '0'.
- Control Panel:** Includes 'Position SetPoint [°]' and 'Current Position [°]' digital displays, both showing '00000'. Below them is a 'Current: 0 mA' display. A 'Status' indicator shows 'Not connected' with a green light.
- Buttons:** 'Zero Position', 'Start Referenc', 'Align Rotor', 'Connect', 'Reset Errors', and 'Motor Enable'.
- Log Messages:** A scrollable area at the bottom showing system logs, including a message: '09:46:566 INFO Changed Protocol to CPRCANV2'.

Callout boxes provide the following information:

- Protocol:** CAN for Mover4, CANV2 for igus, SRA, Mover6
- ID:** 0x10 for base joint, 0x20, ...
- Action:** Then press 'Connect', 'Reset Errors' and 'Motor Enable'
- Result:** Now you can move the joint with the wheel.

3.1 Connect

Use the connect button to initialize the hardware connection. The PCAN-USB adapter has to be inserted. The Status message changes from 'not connected' to another value:

- 'module dead' means that the module with this ID does not answer. Change the ID. The Mover4 has the IDs 0x10, 0x20, 0x30 and 0x40 for the joints starting at the base joint.
- 'com watch dog' or similar means that the module answers, but is still in an error state, as to be expected after start up.

3.2 Reset Errors

Press the 'Reset Errors' button. This resets the current status to 0x04 'Motor not enabled'

3.3 Motor Enable

Press the 'Motor Enable' button. Now the status message should change to 'no error'

3.4 Move Wheel

Now you can move the joint with the middle wheel. Be careful and move the wheel slowly.



The motion velocity of the joint depends on the selected GearScale.

- Refer to the robot ini file to set the correct value (approx. 65 for Mover4, 278 for igus robolink, 5000 for SRA)
- Start with small motions
- Keep one hand placed on the emergency stop when starting or changing values!

3.5 Zero Position

Sets the joint in its current state to zero position. Requires reset and Enable afterwards.

3.6 Start Reference

Starts a reference motion if the joint module is configured for this. This is typical for stepper driver in the modular robot controller.



- The joint module starts the reference search motion as specified in the stepper page until there is a reference switch signal
- The joint may need to be driven into an appropriate position before starting
- Speed and direction can be changed in the Stepper tab.
- The user has to observe the motion and stop if it does not work as expected.

After hitting the reference switch the joint module stops and resets its position to a value specified in the Stepper tab, or it start a search motion to touch the reference switch from both sides with reduced velocity.

3.7 Align Rotor

Only for torque motor: moves the rotor, to a specified position and aligns the rotor value with the motor encoder value.

3.8 GearScale and GearZero

The CPR communication protocols send setpoint values in encoder tics to the joint modules. Depending on the encoder, ... the value to get from joint degrees to encoder tics varies. It can be set here, together with an offset value.



Pay attention!

It is only possible to set the values when not connected. Setting these values is critical for the motion amplitude. A low value leads to a very small motion, a large value might lead to fast, unexpended motions!

3.9 Position, Velocity and Torque Control

The joint modules can be operated in these three modes (torque control available only in few joint modules).

4. Tab „Chart“

Using the tab „Chart“ a sine motion can be applied to the drive. Further parameter like the current or the remaining error are displayed over the time.

- Speed: Sets the speed of the sine motion from 0% to 100%. Try without connected joint at first!
- Amplitude of the motion in °
- The start check box starts the motion. The motion setpoint starts at zero, or resumes at the last value after interruption.

5. Tab „Configuration“

Using the tab „Configuration“ the main parameters of the motion board can be set.

- Press “Read Configuration” to load the data from the board
- Update the data. E.g. set ‘overcurrent’ to zero to disable the overcurrent monitoring.
- Press ‘Set’ besides the text field to write your settings to the board.

6. Tab „AbsEncoder“

Reading / changing of parameter for joint integrated absolute encoder. To be detailed.

7. Tab „TinyCtrl“

Shutdown of the embedded robot controller TinyCtrl via CAN bus.

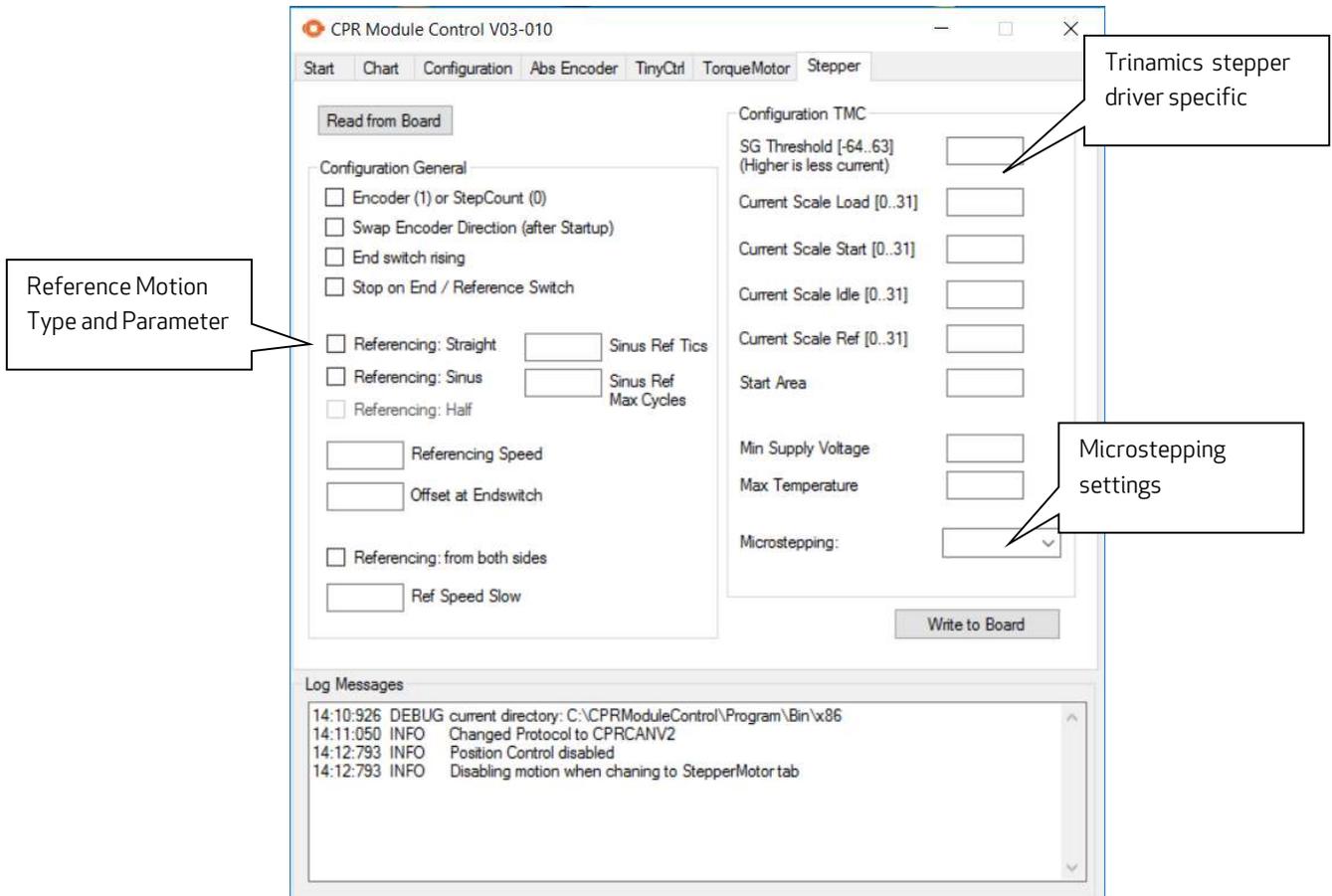
8. Tab „TorqueMotor“

Reading / changing of parameter for torque motor joints. To be detailed.

9. Tab „Stepper“

Reading / changing of parameter for DIN rail stepper joint modules.

Firmware version 0x42-0x020B, April 2017



Section Configuration General:

- Encoder (1) or StepCount (0): If checked the joint works closed loop with a quadrature encoder. If unchecked then an open loop algorithms is used, the position changes based on the commanded steps. The second works reliable if there is only low, constant load. If the motor stalls, it will not be detected. The StepCount value should only be used with microstepping up to 1:64, especially with higher velocities.
- End switch rising: When checked then the module reacts on a rising edge of the end switch. When unchecked the module reacts on a falling edge.
- Stop on end switch: When checked, the joint always stops when reaching an end switch
- Referencing Mode:
 - Referencing: Straight
The joint moves with velocity and direction as defined in 'Referencing Speed' until a reference switch edge is reached. Afterward a fine search is triggered, or the position is stored directly. This method requires the joint to be on the correct side before starting the reference motion!
 - Referencing: Sinus
The joint will perform an oscillating motion with increasing amplitude. The amplitude increments are defined in 'Sinus Ref Tics'. The maximum number of cycles is defined in 'Sinus Ref Max Cycle'.

The motion speed is defined by 'Referencing Speed', but the sign of this speed is ignored here. To avoid damages in case of collision a specific 'Current Scale Ref' can be set.

- Referencing: Half – Not implemented yet
- Referencing speed: The velocity used for the reference motion, integer value. Start with small values. Use negative numbers to change direction.
- Offset at Endswitch: When reaching the reference switch the joint position is set to this value. This allows to adjust differences between the zero position and the reference switch. Positive and negative integer values are allowed.
- Referencing from both sides:
To find a more precise reference point a fine search motion can be triggered after reaching the reference switch. The module then moves twice across the reference switch with low velocity, so that two trigger points approaching from the right and from the left are found. The reference point is defined as the middle, and the Offset is added.
 - Ref Speed Slow: For this fine search motion a smaller velocity can be set

Section Configuration TMC

The stepper driver use the Trinamic TMC 2660 driver. They allow to operate with current adjust using the StallGuard2 and CoolStep technologies. These algorithms need to be parametrized. Please refer to the chip datasheet for an explanation of the parameter, here is a short version:

- SG Threshold: Parameter parametrizing the StallGuard functionality
- Current Scale: The max Current allowed during operation, from 0 (1/31 of the full possible current) to 31 (full current). This also defines the minimal current which is a fraction of this value. The StallGuard and CoolStep technologies adapt the motor current between these borders depending on the motor load. Increase this value if the motor stalls.
 - Load: Current Scale for load conditions, when the joint is moving
 - Start: When starting or working with low rpm
 - Idle: When the joint is not moving this setting is applied.
 - Referencing: This value is used during referencing. It allows e.g. to set a lower value then in operation to avoid damages when the joint collides e.g. during sinus reference motion.
- Microstepping: Allows to set the microstepping from 1 (full step) to 1/256. The most smooth motions are possible with 1/256 microstepping. When operating without encoder a microstepping of 1/64 or lower is recommended due to increased load on the microcontroller.