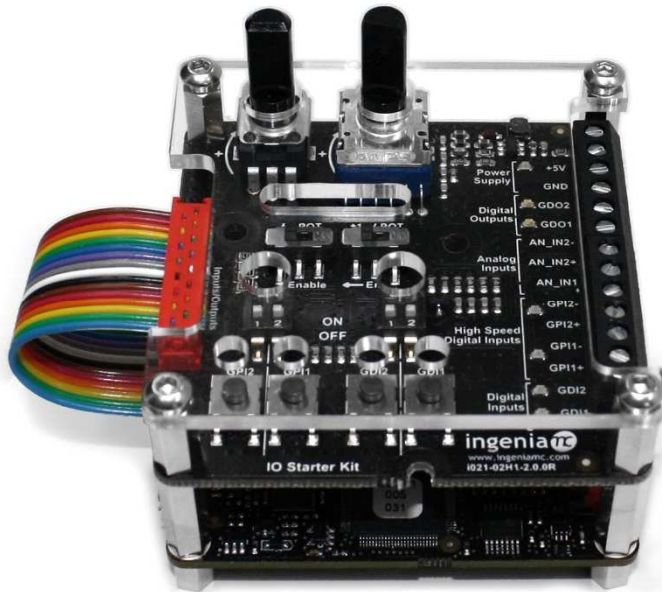
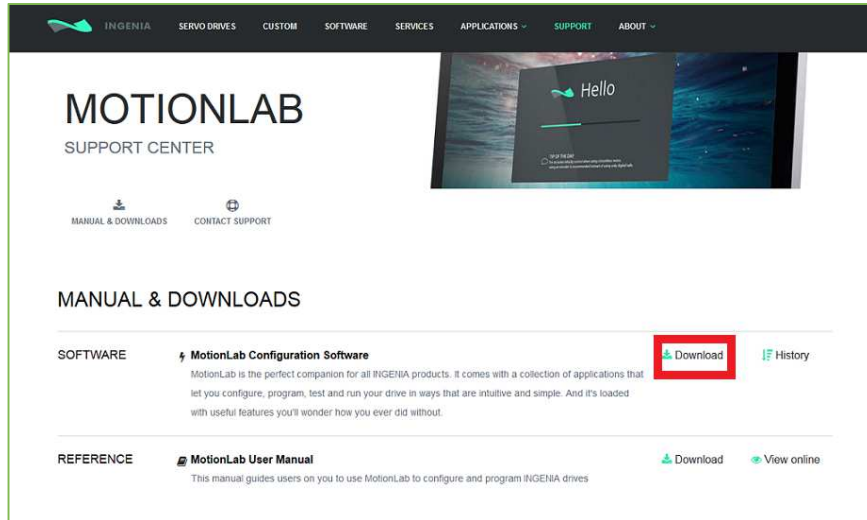


# | DEVELOPER'S KIT

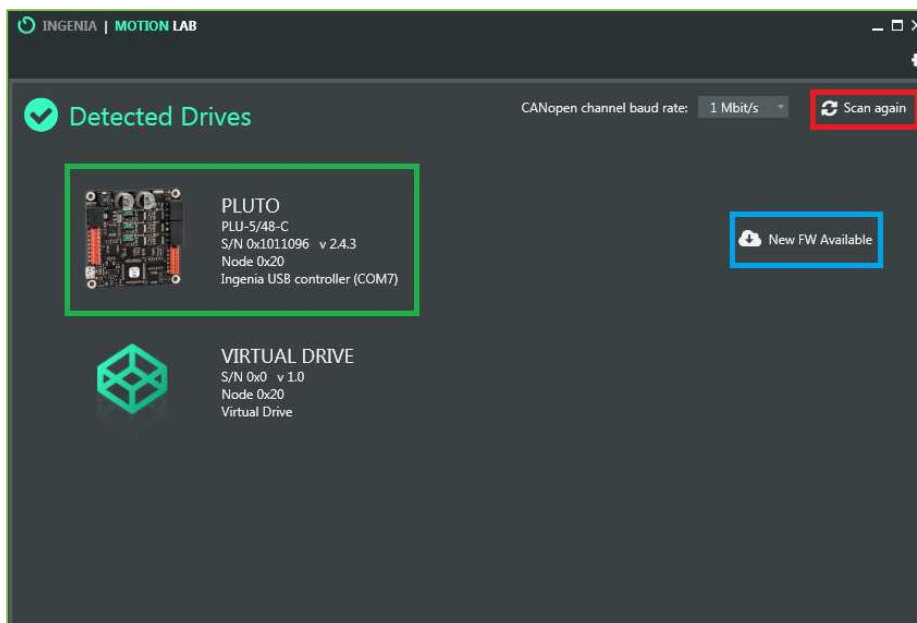
PROGRAMMING



## Installing & Configuring MotionLab

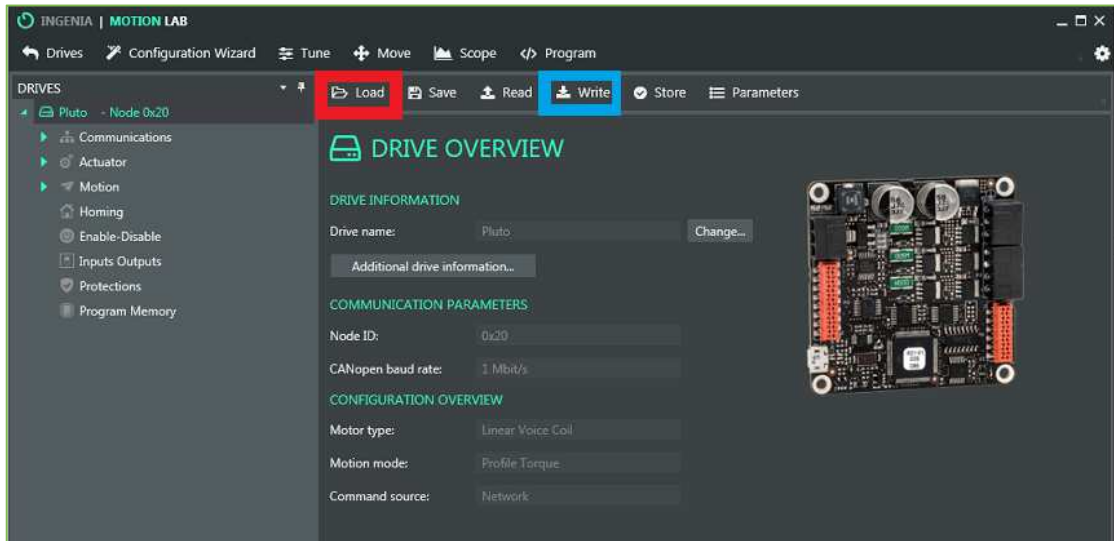


1. Head to [Ingenia MotionLab](#) and click on the 'Download' button in the software section.
2. Run the prompted download and complete the setup as you would any other program.
3. While downloading, connect the provided Flash drive to your computer
4. Run MotionLab.



5. If your drive has an update, click on 'New FW Available' then click on automatic update in the box that pops up.

6. Select your drive by clicking near the green box above. This will take you to a new screen. If you do not see your drive:
  - a. Ensure that your drive is connected to the computer.
  - b. Click on **scan again**.



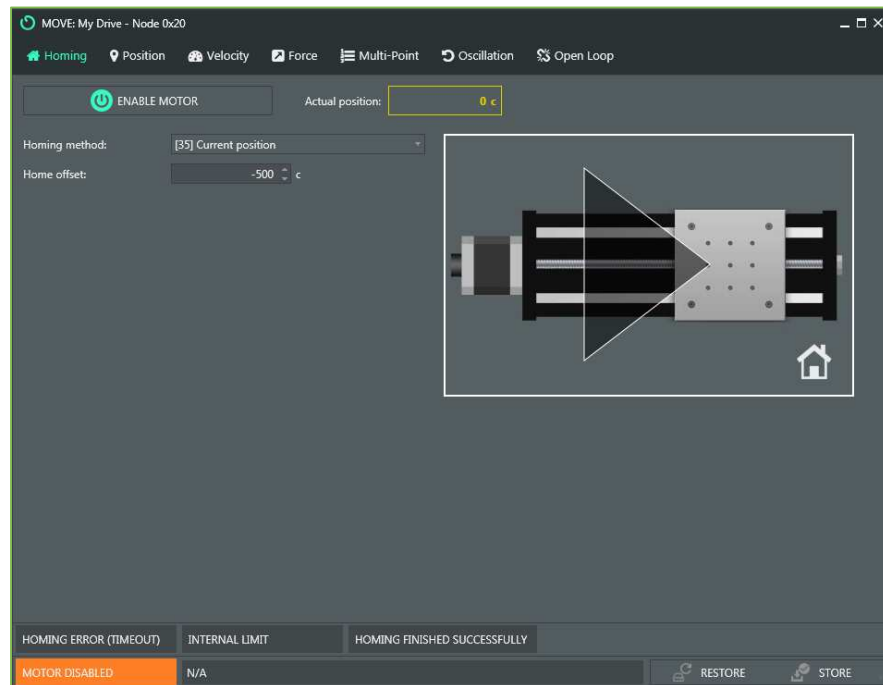
7. Click on 'Load' and use the directory to pull up the contents of the flash drive. Load the .xdc file named after the actuators part number. If you don't know the part number, check the engravings on the actuator itself.
8. Once loaded, click on 'Write' to load the parameters to the drive. At this point your drive is fully configured and ready to use.

### Move Overview



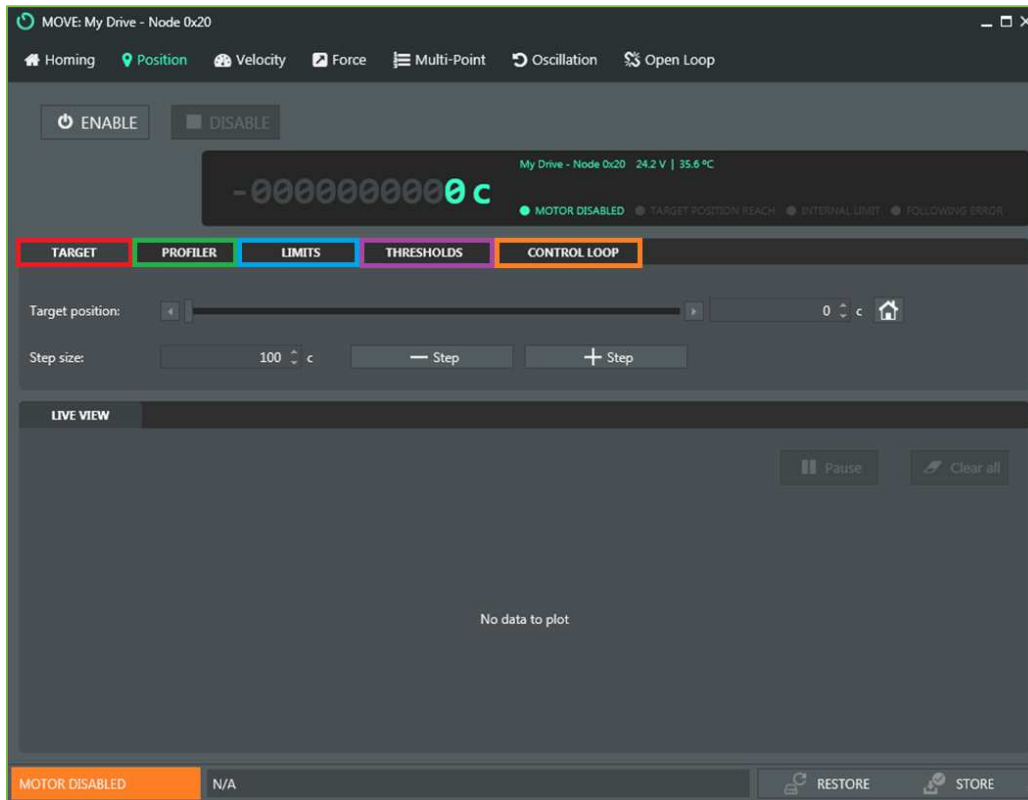
This section will discuss the different functions and parameters found within the 'Move' window. Entering this window is done by clicking on the top of the main Motionlab window. This action will bring up a new window.

Homing: Sets the read value of the shaft location



1. Homing method - Chooses the type of homing procedure. I suggest using either Negative Mechanical Limit or Positive Mechanical limit for initial calibration. These methods will push the shaft all the way in, or all the way out respectively.
2. Homing offset - This is the value that will be written to the corresponding homing position. In the above picture, the current position of the shaft will be set to -500 counts.

## Position: Moves shaft to a designated position



### TARGET:

1. Target position – sets the shaft to the specified position.
  - a. You can set an accurate desired position with the box to the right of the bar.
2. Step size – sets a wanted step size for use with the '- step' and the '+ Step' buttons.

### PROFILE:

1. Profile velocity – controls speed that shaft attains wanted position.
2. Profile acceleration – controls acceleration of shaft towards wanted position.
3. Profile deceleration – controls stop speed of shaft when reaching wanted position.

### LIMITS:

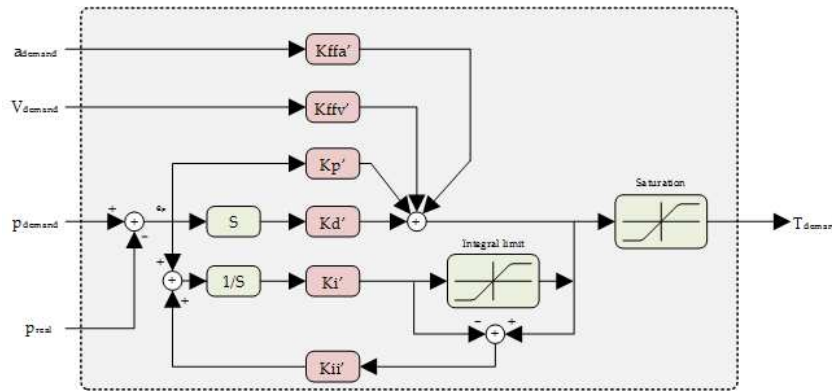
1. Minimum absolute position – sets lower limit of shaft position
2. Maximum absolute position – sets upper limit of shaft position.

THRESHOLDS:



1. Position window – sets accepted range of position values relative to target value in which the controller will stop trying to correct the shafts current position.
2. Position window time – sets the measuring time for the controller to check if position is correct
3. Following error window – has a similar concept as the position window. I suggest making this value the same as the position window.
4. Following error timeout – sets a measurement time for the shaft position. If the shaft is not in the specified position for this time an error will be produced.

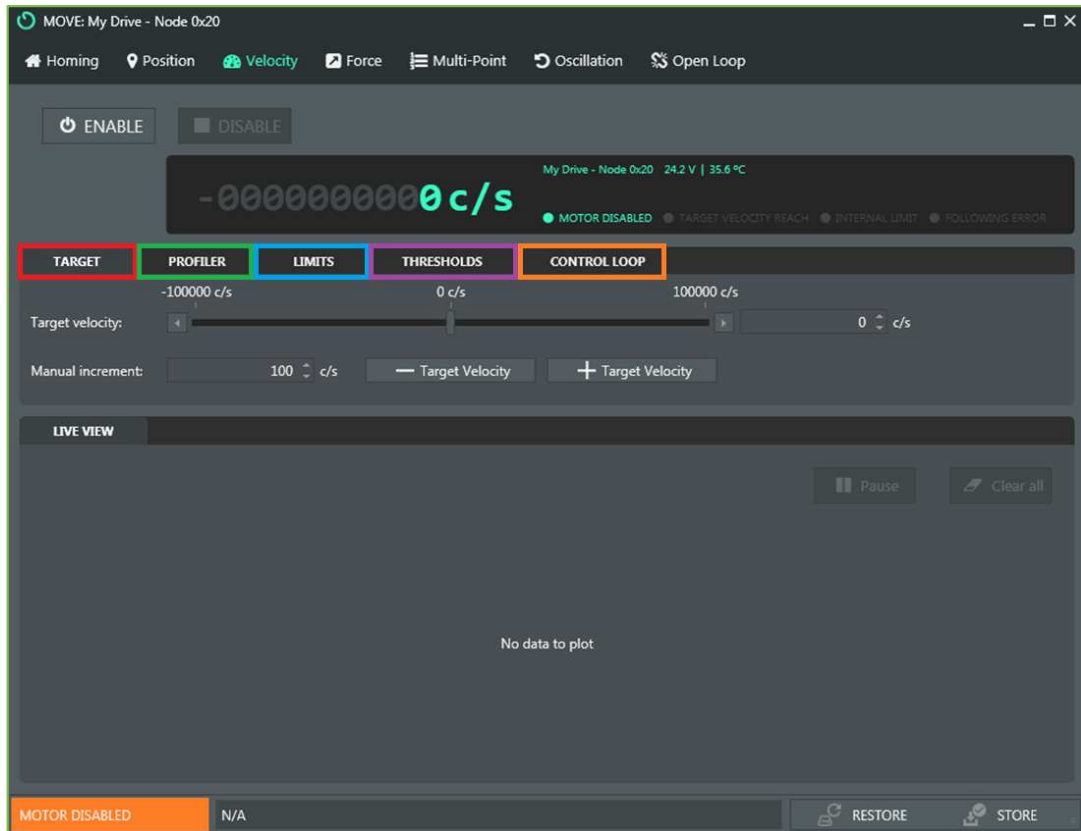
\*CONTROL LOOP:



1. Proportional gain – sets proportional constant ( $K_p'$ ) for PID loop.
2. Integral gain – sets integral constant ( $K_i'$ ) for PID loop
3. Derivative gain – sets derivative constant ( $K_d'$ ) for PID loop.
4. Integral AW gain – sets integral anti-windup ( $k_{ii}'$ ) constant
5. Velocity FF gain – Sets velocity feedforward ( $K_{ffv}'$ ) constant
6. Acceleration FF gain – sets acceleration feedforward ( $k_{ffa}'$ ) constant.
7. Integral Limit – puts a limit on the integral gain's contribution.

\*This window only controls the position PID loop. It does not affect the force and velocity PID.

Velocity: Increases speed that shaft moves toward end of stroke.



**TARGET:**

1. Target Velocity – sets desired instantaneous velocity value
2. Manual increments – sets a wanted step size for use with the ‘- Target velocity’ and the ‘+ Target velocity’ buttons.

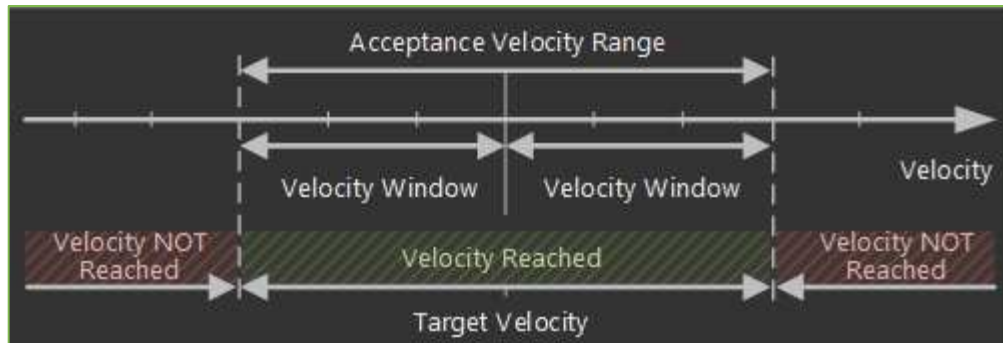
**PROFILER:**

1. Profile acceleration - Defines the maximum allowed acceleration.
2. Profile deceleration - Defines the maximum allowed deceleration.

**LIMITS:**

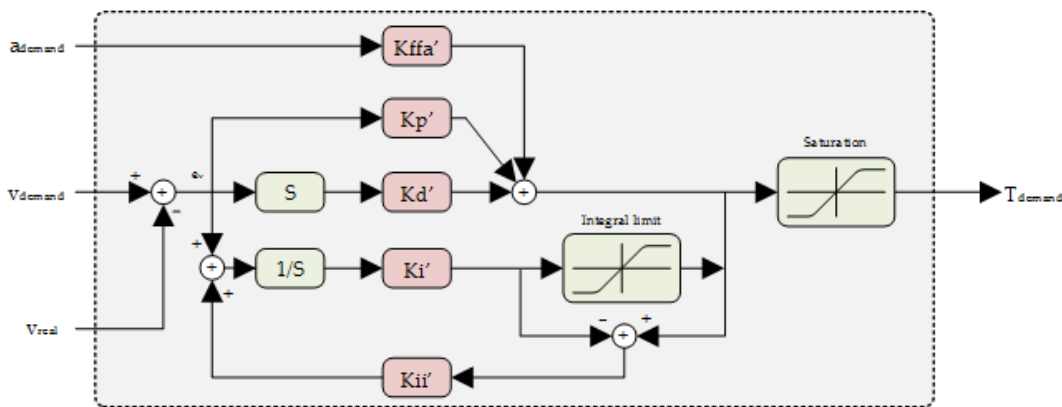
1. Maximum profile velocity - Define the maximal allowed velocity in each direction during a profiled motion.

THRESHOLDS:



1. Velocity window – Defines the acceptable window for error. A higher window means a lower tolerance for reaching a specific target velocity.
2. Velocity window time- Indicates the configured time (in ms), during which the actual velocity within the velocity window is measured. If the actual velocity is within the velocity window for a velocity window time, the target is reached
3. Velocity threshold- Indicates the configured zero velocity threshold time. If the actual velocity is above the velocity threshold longer than velocity threshold time, the motor is seen as moving.
4. Velocity threshold time- Indicates the configured zero velocity threshold time. If the actual velocity is above the velocity threshold longer than velocity threshold time, the motor is moving.

\*\*CONTROL LOOP:

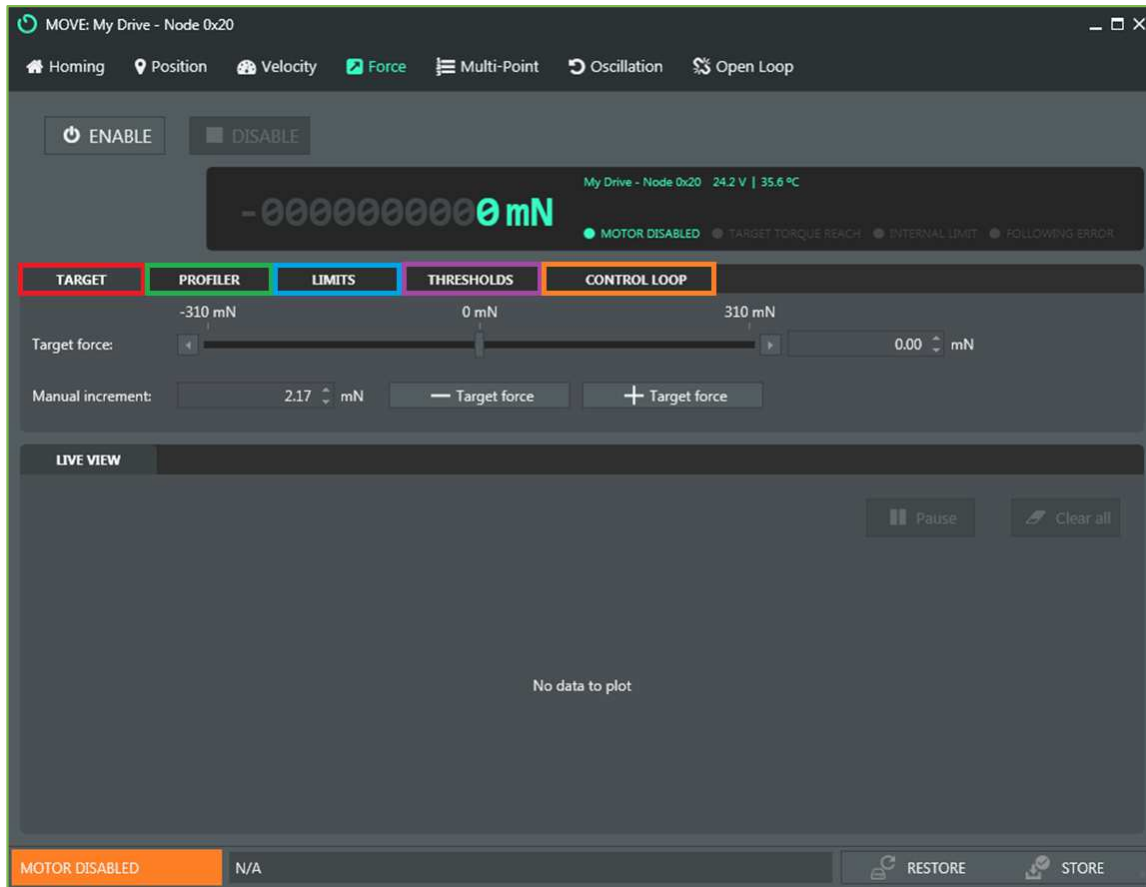


1. Proportional gain – sets proportional constant ( $K_p'$ ) for PID loop.
2. Integral gain – sets integral constant ( $K_i'$ ) for PID loop
3. Derivative gain – sets derivative constant ( $K_d'$ ) for PID loop.
4. Integral AW gain – sets integral anti-windup ( $k_{ii}'$ ) constant
5. Acceleration FF gain – sets acceleration feedforward ( $k_{ffa}'$ ) constant.
6. Integral Limit – puts a limit on the integral gain's contribution.

\*\*This only controls the velocity PID loop. The force/position PID is unaffected.



Force: Increases Push/Pull force on shaft



**TARGET:**

1. Target force – Sets the desired instantaneous torque value.
2. Manual increment – Sets incremental torque value for use with ‘- Target force’ and ‘+ Target force’ buttons.

**PROFILER:**

1. Force Slope – defines slope of force increase towards target force.

**LIMITS:**

1. Negative force limit – indicates maximum pulling force
2. Positive force limit – indicates maximum pushing force

**THRESHOLDS:**

1. Force window – Defines the acceptable window for torque/force error. A higher window means a lower tolerance for reaching a specific target torque/force.



## Position:

1. Position box – Sets the desired position
2. Capture – Captures the desired position
3. Repeat Sequence – Toggles repeat actions after the entire list of positions is reached.
4. Pause before repeating – Sets delay before repeat sequence is performed

## Additional Position Parameters:

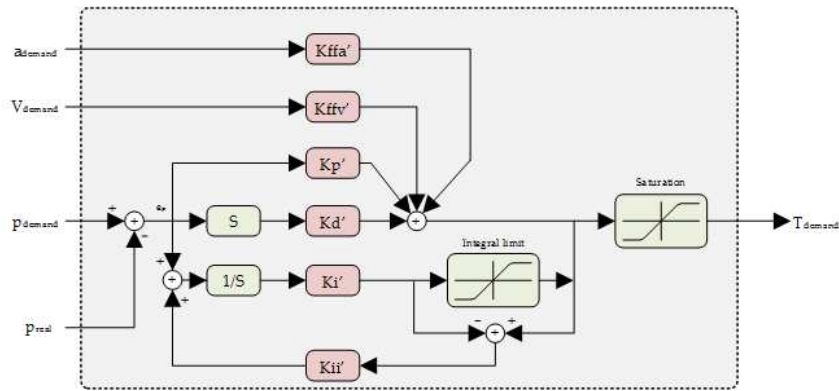
1. Profile Parameters
  - a. Profile velocity – controls speed that shaft attains wanted position.
  - b. Profile acceleration – controls acceleration of shaft towards wanted position.
  - c. Profile deceleration – controls stop speed of shaft when reaching wanted position.
2. Limit Parameters
  - a. Minimum absolute position – sets lower limit of shaft position
  - b. Maximum absolute position – sets upper limit of shaft position.

## 3. Threshold Parameters



- a. Position window – sets accepted range of position values relative to target value in which the controller will stop trying to correct the shafts current position.
- b. Position window time – sets the measuring time for the controller to check if position is correct
- c. Following error window – has a similar concept as the position window. I suggest making this value the same as the position window.
- d. Following error timeout – sets a measurement time for the shaft position. If the shaft is not in the specified position for this time an error will be produced.

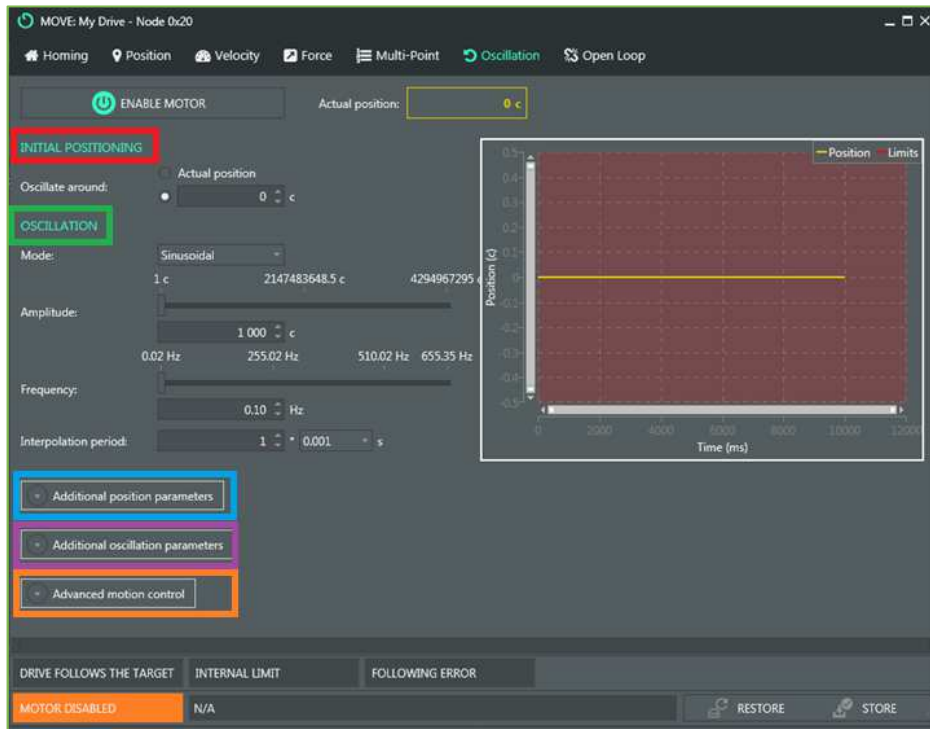
## Advanced Motion Control:



1. Position Loop Parameters

- a. Proportional gain – sets proportional constant ( $K_p'$ ) for PID loop.
- b. Integral gain – sets integral constant ( $K_i'$ ) for PID loop
- c. Derivative gain – sets derivative constant ( $K_d'$ ) for PID loop.
- d. Integral AW gain – sets integral anti-windup ( $k_{ii}'$ ) constant
- e. Velocity FF gain – Sets velocity feedforward ( $K_{ffv}'$ ) constant
- f. Acceleration FF gain – sets acceleration feedforward ( $k_{ffa}'$ ) constant.
- g. Integral Limit – puts a limit on the integral gain's contribution.

Oscillation: Moves the shaft back and forth between specified bounds



**Initial Positioning:**

1. Oscillate around: defines the initial position that the shaft will oscillate around.

**Oscillation:**

1. Mode: allows you to choose between a sinusoidal or square oscillation profile.
2. Amplitude: defines zero to peak oscillation height. The actual oscillation travel distance will be twice this value
3. Frequency: defines the frequency of oscillation.
4. Interpolation Period:

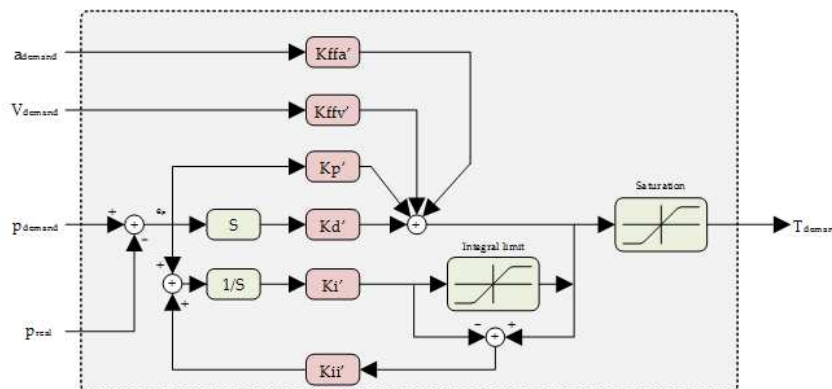
**Additional Position Parameters:**

1. Profile Parameters
  - a. Profile velocity – controls speed that shaft attains wanted position.
  - b. Profile acceleration – controls acceleration of shaft towards wanted position.
  - c. Profile deceleration – controls stop speed of shaft when reaching wanted position.
2. Threshold Parameters
  - a. Position window – sets accepted range of position values relative to target value in which the controller will stop trying to correct the shafts current position.
  - b. Position window time – sets the measuring time for the controller to check if position is Correct

**Additional Oscillation Parameters:**

1. Limit Parameter
  - a. Minimum absolute position – sets lower limit of shaft position
  - b. Maximum absolute position – sets upper limit of shaft position.
2. Threshold Parameters
  - a. Following error window – has a similar concept as the position window. I suggest making this value the same as the position window.
  - b. Following error timeout – sets a measurement time for the shaft position. If the shaft is not in the specified position for this time an error will be produced.

**Advanced Motion Control:**



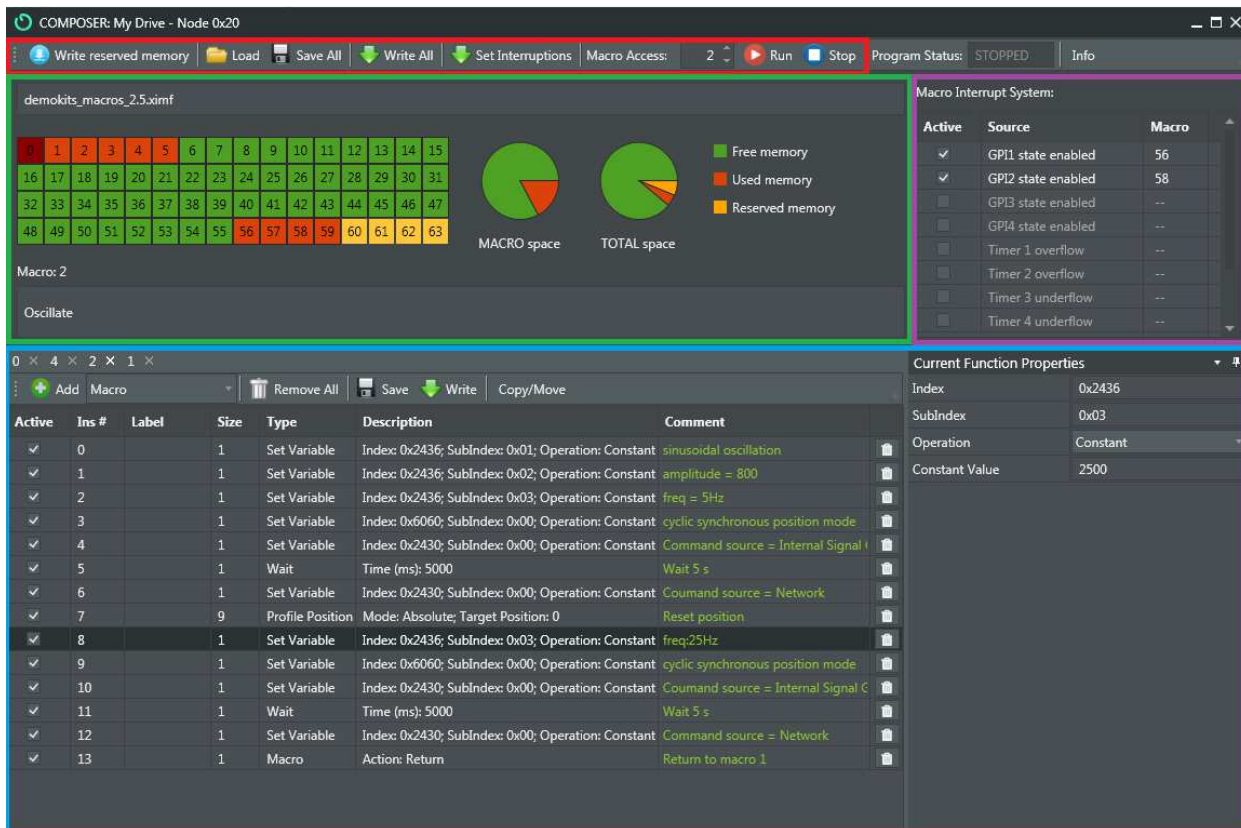
### 1. Position Loop Parameters

- a. Proportional gain – sets proportional constant ( $K_p'$ ) for PID loop.
- b. Integral gain – sets integral constant ( $K_i'$ ) for PID loop
- c. Derivative gain – sets derivative constant ( $K_d'$ ) for PID loop.
- d. Integral AW gain – sets integral anti-windup ( $k_{ii}'$ ) constant
- e. Velocity FF gain – Sets velocity feedforward ( $K_{ffv}'$ ) constant
- f. Acceleration FF gain – sets acceleration feedforward ( $k_{ffa}'$ ) constant.
- g. Integral Limit – puts a limit on the integral gain's contribution.

## Program:



This section will display the controller’s ability to run and create macros. Entering this window is done by clicking ‘Program’ on the top of the main Motionlab window. This action will bring up a new window. The image below shows an example of an oscillate function. See [Ingenia Knowledge Base](#) for examples of how to execute most move functions. Any other inquiries can be sent to [example@sensata.com](mailto:example@sensata.com)



### Program Control:

1. Write reserved memory
2. Load – Brings up explorer to choose a preexisting file.
3. Save All – Saves the current macro set up.
4. Write All – Writes all macros to the controller
5. Set Interruption – Writes interruptions to the controller. Used with [Interrupt Designation](#).
6. Run – Runs the selected macro.
7. Stop – Force stops all programs.

## Macro Access:

- Lets you choose which macro to edit.
- Macro 0 will work on controller startup.

## Macro Programming:

1. Add – Adds the selected item from the dropdown box to the current macro.
2. Dropdown – Selects the program function that you want to add to the macro. Requires the ‘Add’ button to place.
3. Remove All – Deletes all functions from the current macro.
4. Save – Saves the current macro.
5. Write – Writes the selected macro to the controller
6. Copy/Move – Copies or moves the current macro to a macro number of your choosing.
7. Current Function Properties – Allows you to edit the highlighted

## Interrupt Designation:

1. Active – Checking the box will allow the interrupt to be written to the controller. You need to press ‘Set Interruptions’ in the **Program Control** section.
2. Source – Selects the type of interrupt you want to use.
3. Macro – Designates the macro that will be called when the interrupt is triggered.

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