Getting Started

A guide for commissioning a Control Techniques drive using Connect

Issue 2

Contents

1 INTRODUCTION 3

2 ESTABLISH A CONNECTION TO THE DRIVE 4

2.1 CONNECTING TO THE DRIVE VIA BLUETOOTH 5

2.2 CONNECTING TO THE DRIVE VIA ETHERNET 8

2.3 CONNECTING TO THE DRIVE VIA SERIAL 10

3 CONFIGURE THE DRIVE USING CONNECT 12

4 COMMISSION THE DRIVE AND MOTOR USING CONNECT 19

5 HOW TO GUIDES 35

5.1 HOW AND WHEN TO TUNE THE POSITION LOOP 35

5.2 HOW AND WHEN TO USE INERTIA COMPENSATION 37

6 ADDITIONAL INFORMATION 39

6.1 MECHANICAL BRAKE CONTROLLER LOGIC 39

6.1.1 RFC-S closed-loop permanent-magnet motor brake controller 39

6.1.2 RFC-A closed-loop induction motor brake controller 41

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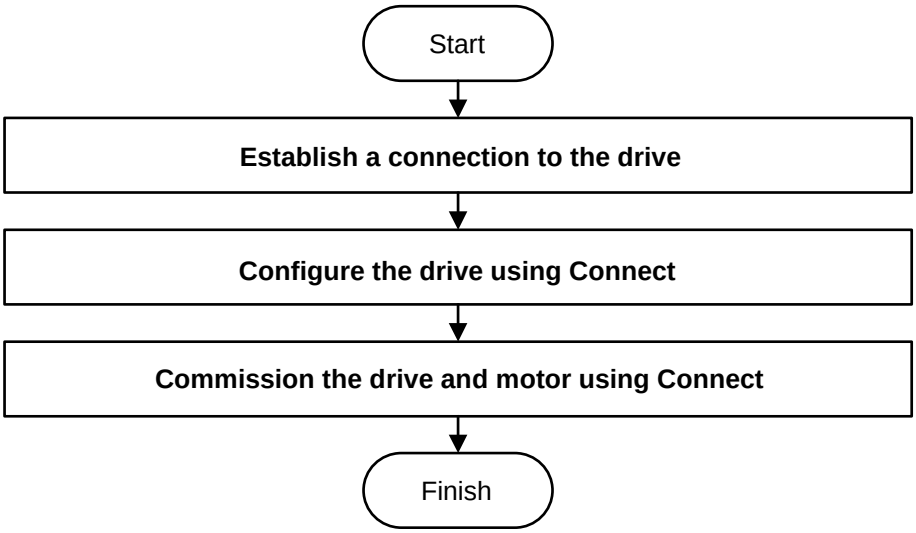
1 Introduction

This document guides the user through the required steps to establish a connection to the drive using Control Techniques Connect and progress through the drive configuration screens in order to configure and commission the drive and motor.

The steps required to get the axis working are as follows:



The end result is a Control Techniques drive that has been configured as per the users requirements and commissioned with a motor tune that is best suited to the application, i.e. biased towards low acoustic noise, or biased towards a dynamic response at the cost of higher acoustic noise levels.

HINT: The information in this manual is backed up by training videos on YouTube.

Nidec Drives Support - YouTube

HINT: This guide is for Unidrive M and Digitax HD drives only – other models use the legacy view found in Connect version 2 and earlier.

2 Establish a connection to the drive

This section describes how to establish a connection to the drive using the following connection methods:

- Bluetooth – see section **2.1 Connecting to the drive via Bluetooth**.
- Ethernet – see section **2.2 Connecting to the drive via Ethernet**.
- Serial – see section **2.3 Connecting to the drive via Serial**.

HINT: Guidance on forming a connection to the drive via AoE (ADS over EtherCAT) or EoE (Ethernet over EtherCAT) is available in the following user guides:

- **Using a Beckhoff PLC and TwinCAT 3 with a Control Techniques drive over EtherCAT** (AoE and EoE).

These guides can be obtained from your local Control Techniques Drive Centre / Distributor or the Control Techniques | Nidec Drives website.

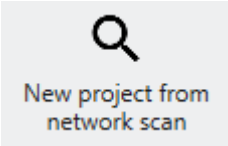
2.1 Connecting to the drive via Bluetooth

HINT: It has been assumed that a KI-Keypad Plus has been connected to the drive and that the drive has been powered on.

1. Open the Connect PC software by double clicking the “Connect” icon.

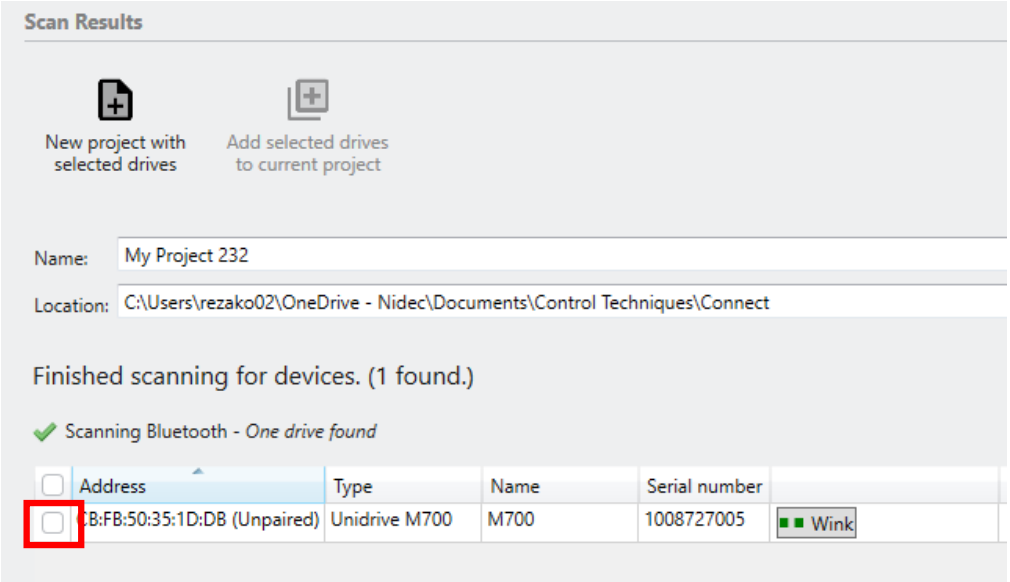
2. Ensure the version of Connect is a minimum V3.0.0. If an earlier version is installed please upgrade to V3.0.0; the software file may be obtained from your local Control Techniques Drive Centre / Distributor or the Control Techniques | Nidec Drives website.

3. When Connect opens select “New project from network scan”.



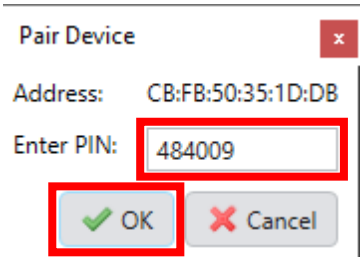
4. Select the communications type, in this case Bluetooth, to locate the drives to be configured:

5. When an unpaired drive is found it will appear in the following way, tick the checkbox to begin the pairing process.

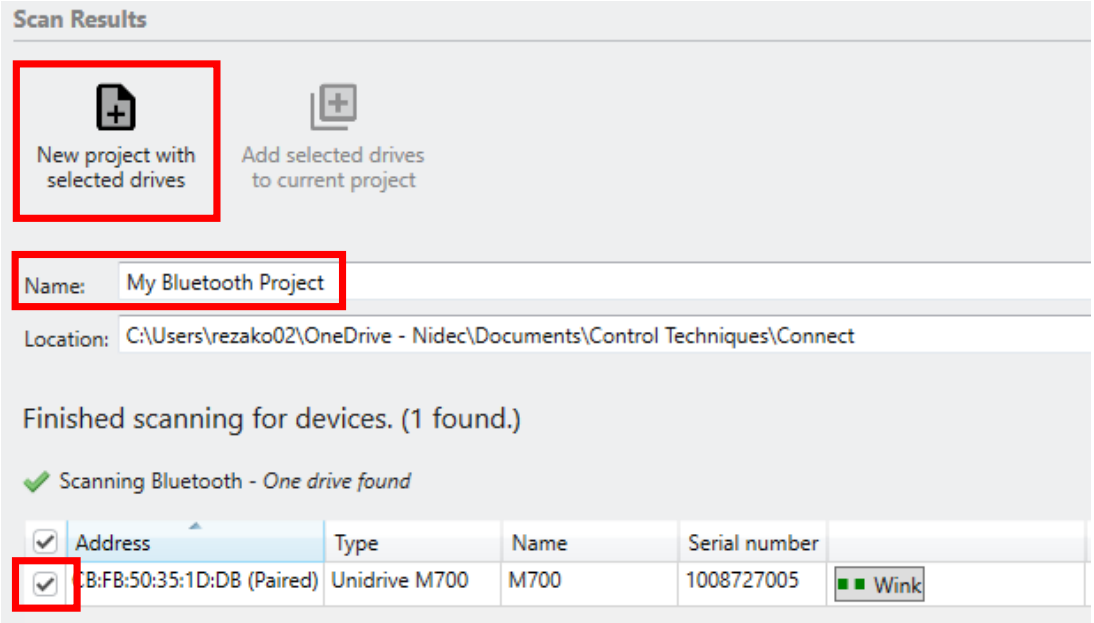


HINT: A drive can be identified by using the Wink button which causes the keypad display to flash, this is especially useful in scenarios where multiple drives appear in the list of found devices.

6. The “Pair Device” dialog box will be displayed in Connect and the pairing screen will be displayed on the KI-Keypad Plus simultaneously. Enter the pairing code as it appears on the KI-Keypad Plus and click “OK”:



7. The pairing process is now complete.
   Give the project a meaningful name, esure the drive has been selected and click “New project with selected drive”.



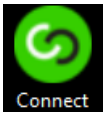
HINT: A drive can be identified by using the Wink button which causes the keypad display to flash, this is especially useful in scenarios where multiple drives appear in the list of found devices.

8. Go to section **3 Configure the drive using Connect** for the next steps on configuring the drive.

2.2 Connecting to the drive via Ethernet

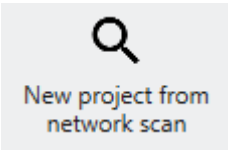
HINT: It has been assumed that the drive has been connected the programming PC via an Ethernet network and that the drive has been powered on.

1. Open the Connect PC software by double clicking the “Connect” icon.

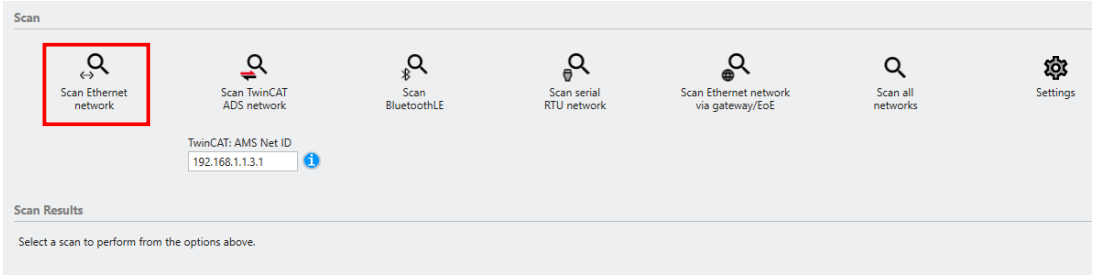


2. Ensure the version of Connect is a minimum V3.0.0. If an earlier version is installed please upgrade to V3.0.0; the software file may be obtained from your local Control Techniques Drive Centre / Distributor or the Control Techniques | Nidec Drives website.

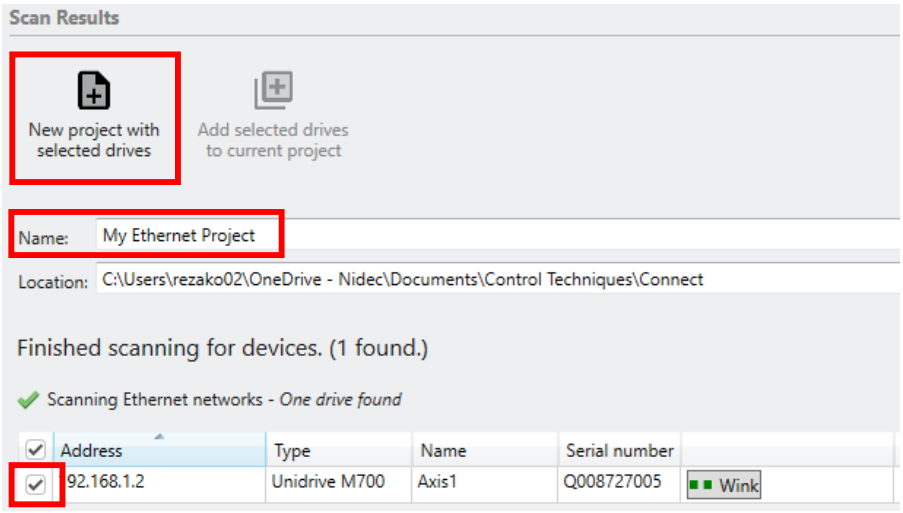
3. When Connect opens select “New project from network scan”.



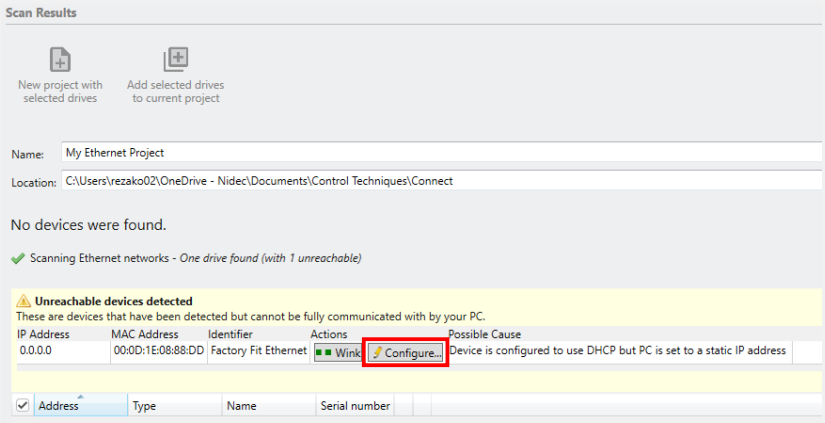
4. Select the communications type, in this case Ethernet, to locate the drives to be configured:



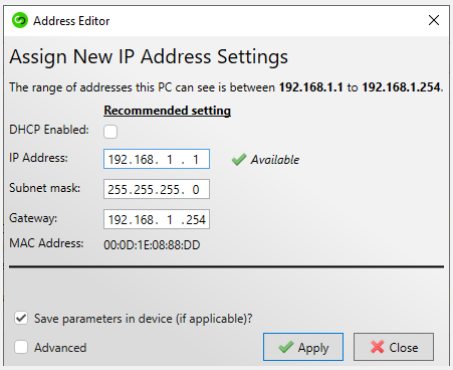
5. Any drive found will be visible in the “Scan Results” list.
   Give the project a meaningful name, esure the drive has been selected and click “New project with selected drive”.



HINT: By default, the drive will be configured to use DHCP. If the network adapter of the programming PC is set to use a static IP address the drive will not be reachable. In this scenario the scan results will appear in the following way:



Use the Configure... button to open the Address Editor, where a static IP address can be set:

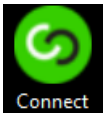


6. Go to section **3 Configure the drive using Connect** for the next steps on configuring the drive.

2.3 Connecting to the drive via Serial

HINT: It has been assumed that the drive has been connected to the programming PC via a serial connection and that the drive has been powered on.

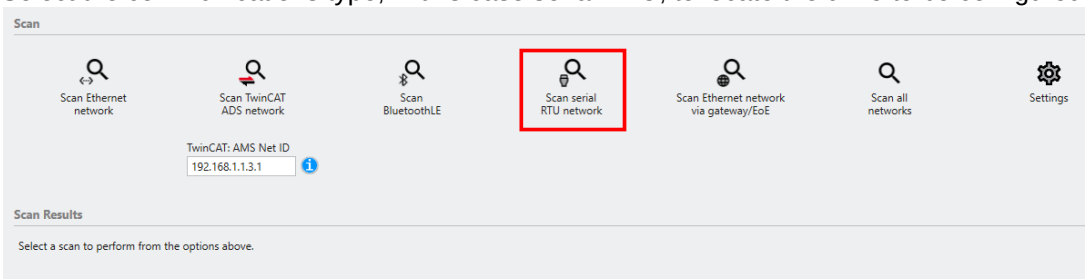
1. Open the Connect PC software by double clicking the “Connect” icon.



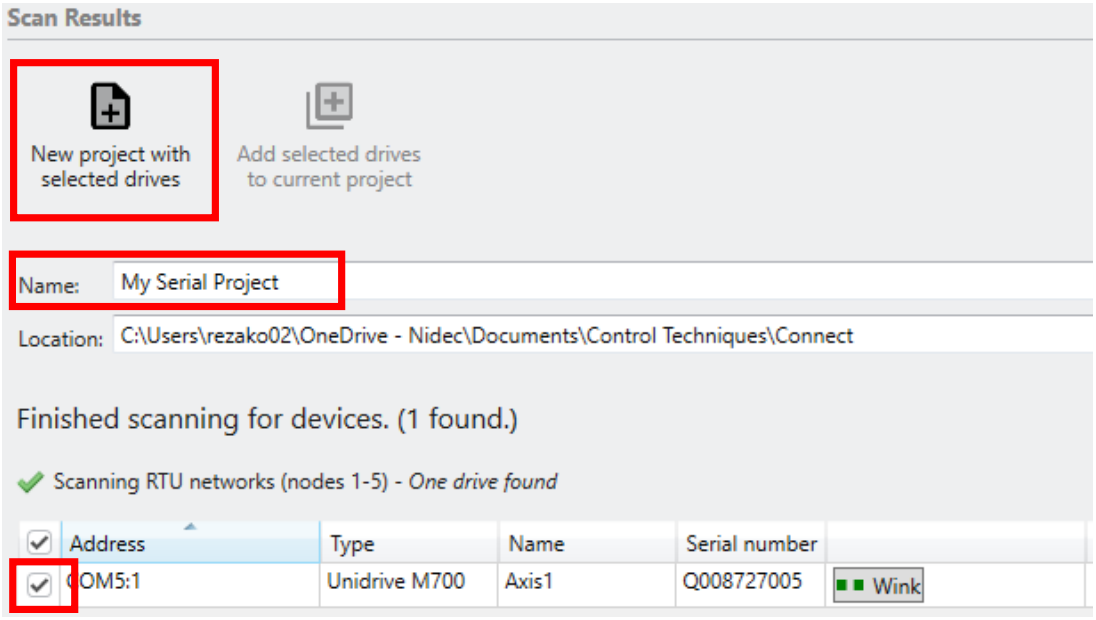
2. Ensure the version of Connect is a minimum V3.0.0. If an earlier version is installed please upgrade to V3.0.0; the software file may be obtained from your local Control Techniques Drive Centre / Distributor or the Control Techniques | Nidec Drives website..

3. When Connect opens select “New project from network scan”.

4. Select the communications type, in this case serial RTU, to locate the drive to be configured:



5. Any drive found will be visible in the “Scan Results” list.
Give the project a meaningful name, esure the drive has been selected and click “New project with selected drive”.

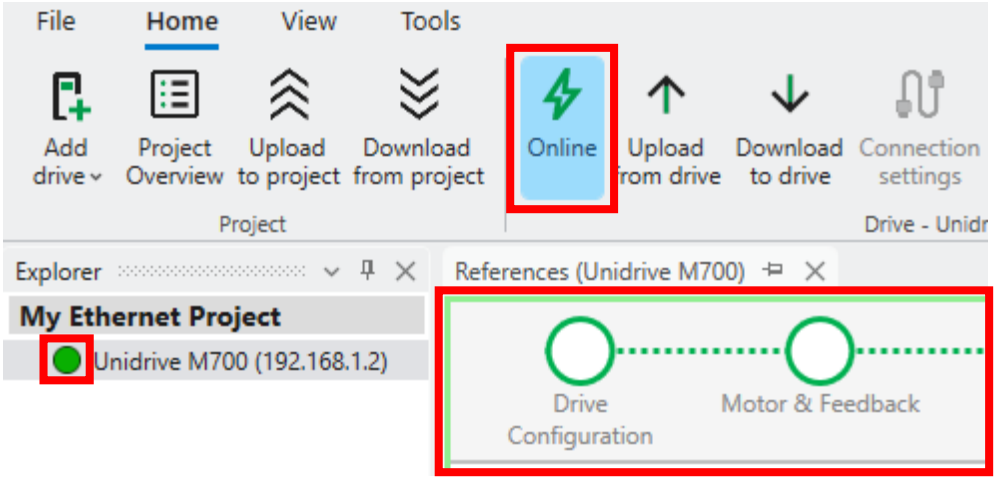


6. Go to section **3 Configure the drive using Connect** for the next steps on configuring the drive.

3 Configure the drive using Connect

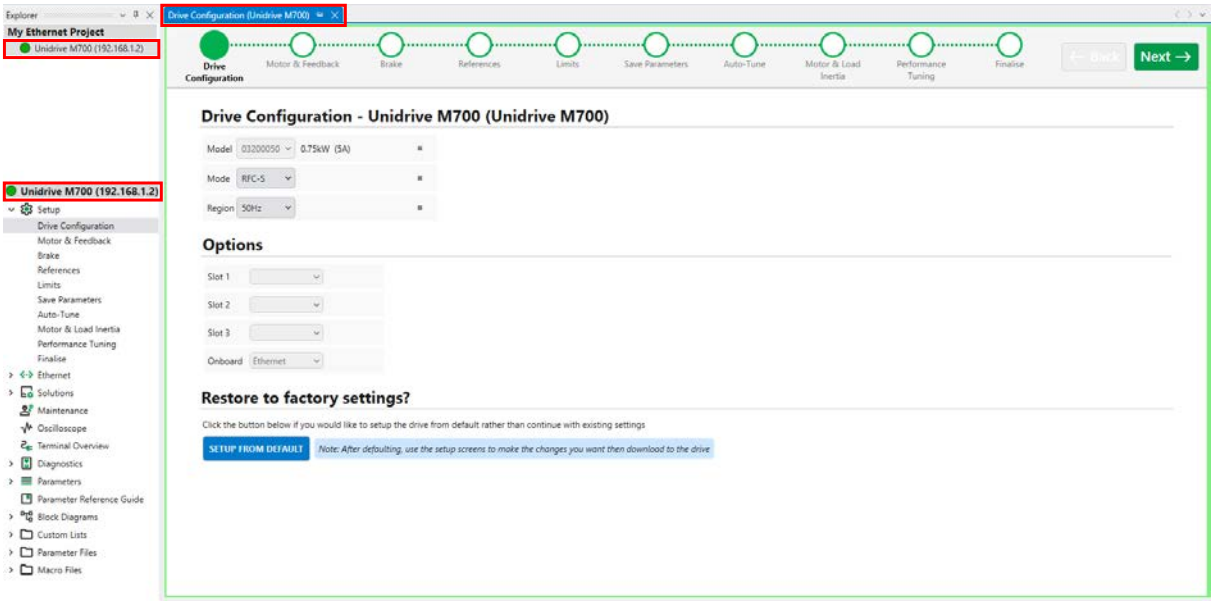
Create a new Connect project to configure and commission the drive for the motion application:

1. When the project opens, all drives on the network will be “Online” as indicated by the blue highlight on the “Online” button, the green dot next to each drive node in the Explorer tree, and the green border around the active tab page.



This means that any changes made take direct effect in the drive.

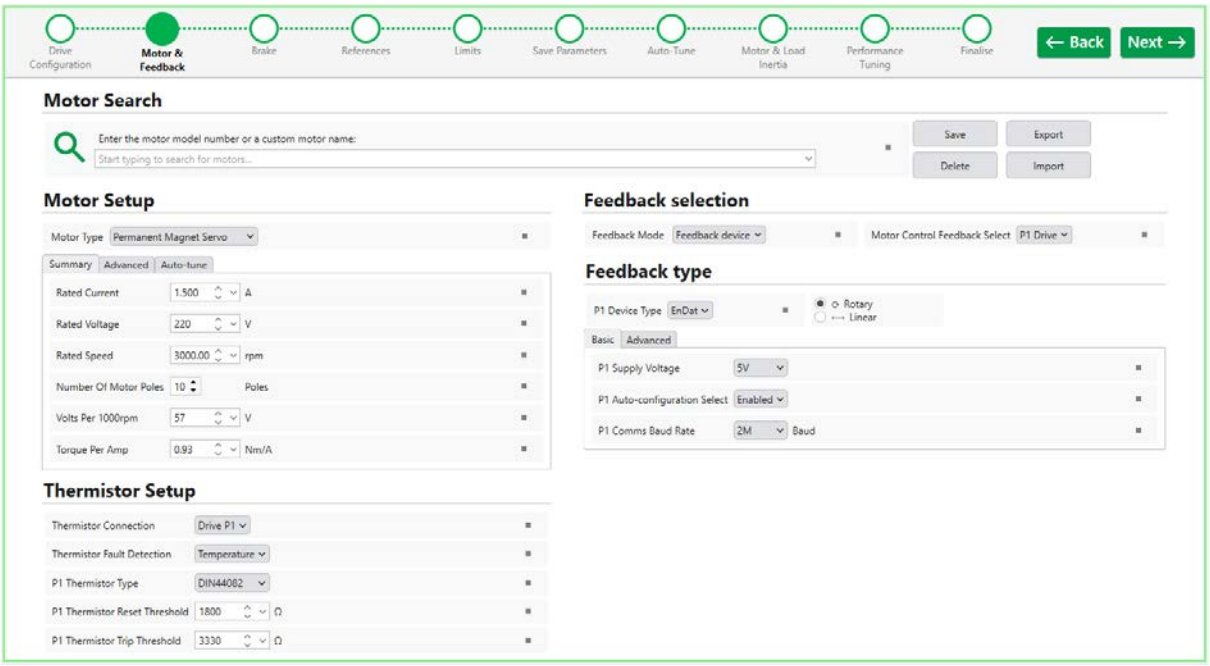
2. The first drive in the Explorer list is selected and has it’s drive setup wizard opened.



On this page the user can default the drive to remove any previous setup, change the operating mode to match the motor that has been connected to the drive, and select the region e.g. 50Hz or 60Hz.
The guided setup section is selected by either the “Next” and “Back” buttons, or by directly selecting a section by clicking on the circle section markers.

When finished, click “Next” move to the motor and feedback setup.

3. Setup the motor and feedback device on the “Motor and Feedback” page. The required data for the motor and feedback device will be available on the motor name plate or the technical data sheet for the motor.



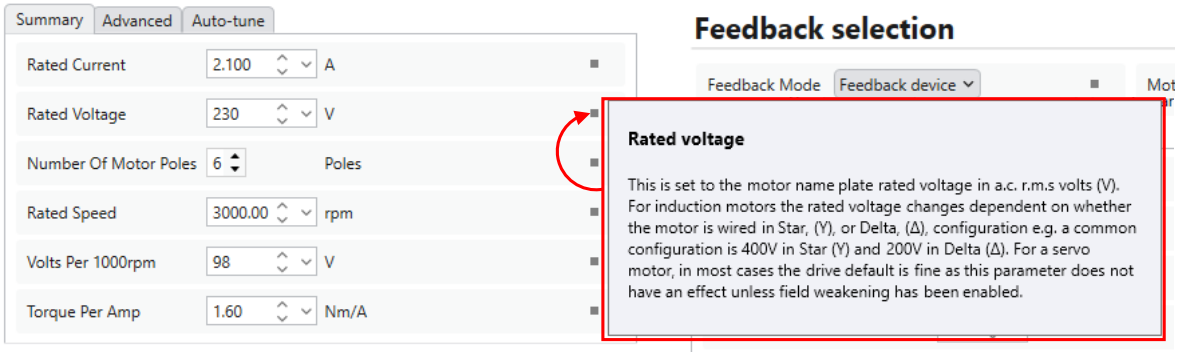
The user must configure the motor, feedback device and thermistor setup here.

For a permanent magnet motor, the user must set the **Torque Per Amp** field on the motor feedback step. If the value of Kt isn't provided on the rating plate, it approximated by dividing the Motor rated torque by the Motor rated current. For an induction motor, the drive calculates the Kt value from the motor data. This value is used by the motor and load inertia calculation step, which helps make the motor tuning simple with a single slider.

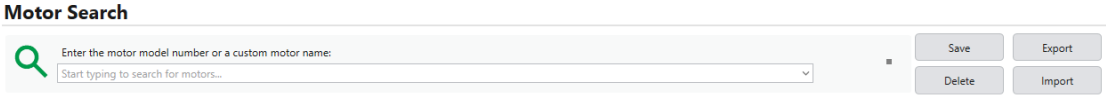
HINT: The Motor rated torque for an induction motor is calculated from:

Rated Torque (Nm) = (Rated Power (W) x 60) / (2 x π x Motor Rated Speed (rpm))

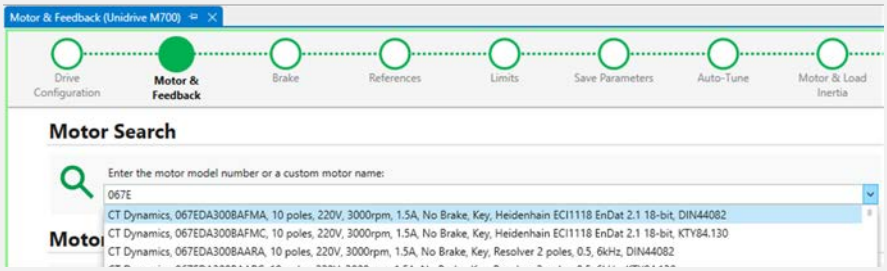
Help is provided throughout Connect using small help trigger squares ■:



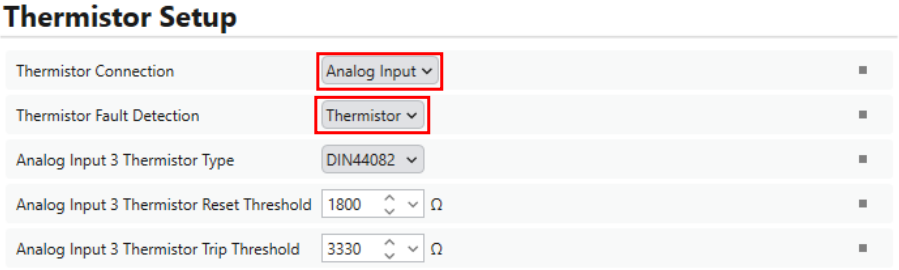
It is possible to save a motor and encoder configuration for later use; these are searchable too.



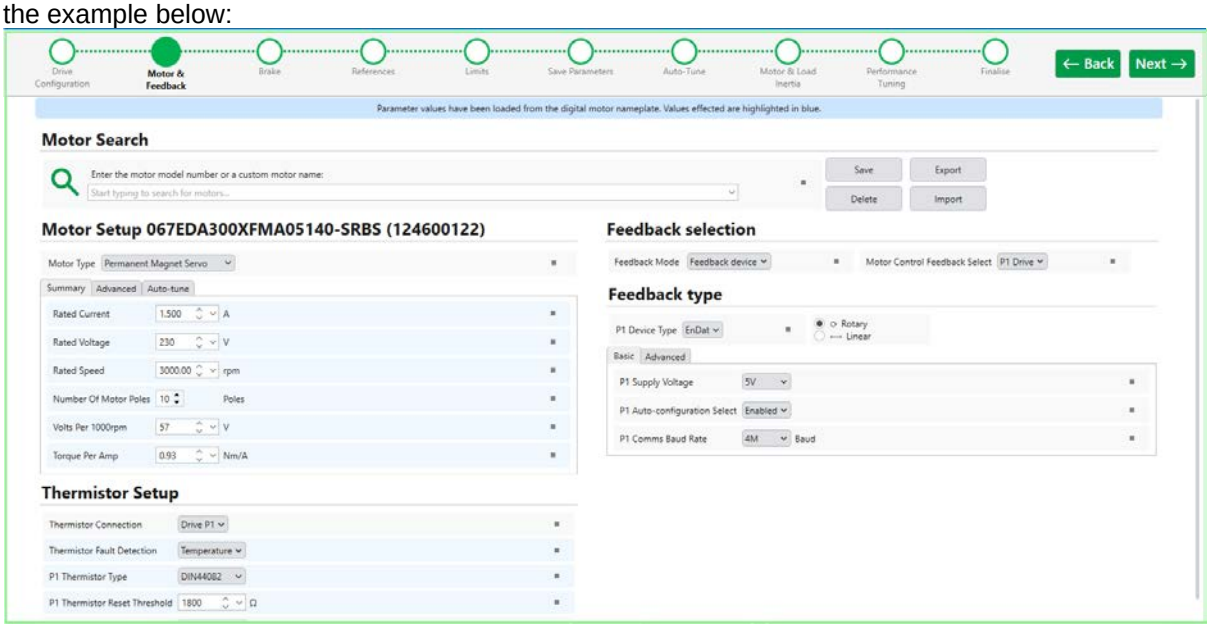
HINT: Control Techniques Dynamics permanent-magnet servo motors and Leroy Somer induction motors and permanent-magnet process motors may be found using the motor search:



For induction motors, where the thermistor is not typically connected to the encoder interface D Type, and instead, is connected to a terminal on the drive (e.g. Analogue input 3). Set Analogue Input 3 Mode to Thermistor.



If the drive is either a Digitax HD or a Unidrive M with firmware >=V01.61.01.00 and the motor is one from Control Techniques Dynamics that has an electronic nameplate loaded into the encoder, the motor and encoder data is setup automatically where the “Motor & Feedback” page looks like the example below:

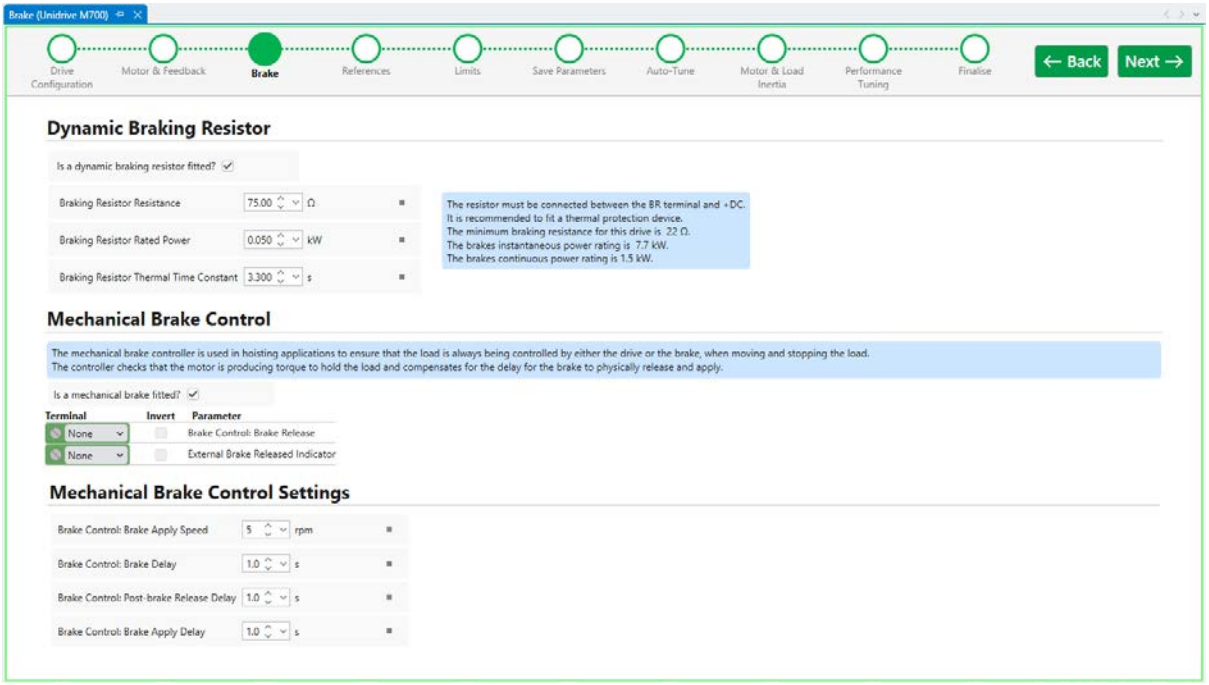


The light blue highlight shows that the electronic nameplate has been loaded. In addition, for EnDat 2.2, EnDat 3.0 and BiSS-C encoders the “Encoder type” fields are also configured automatically.

When finished, click “Next” to move to the brake setup.

4. The brake setup page allows braking resistor properties to be configured. The braking resistor is used to dissipate motor energy when slowing down. The settings provide protection for the braking resistor in addition to a thermal overload circuit which is typically provided with the resistor.

   It can also be used to set up the drives mechanical brake controller. The mechanical brake controller releases and applies the mechanical brake automatically, making sure that the load is always controlled by either the motor or the mechanical brake. It is typically used in hoisting applications. For the majority of applications, assigning the “Brake Control: Brake Release” Output, setting the time for the brake to physically release the load in “Brake Control: Post-brake Release Delay”, and the time for the brake to physically apply and hold the load in “Brake Control: Brake Apply Delay” is sufficient.

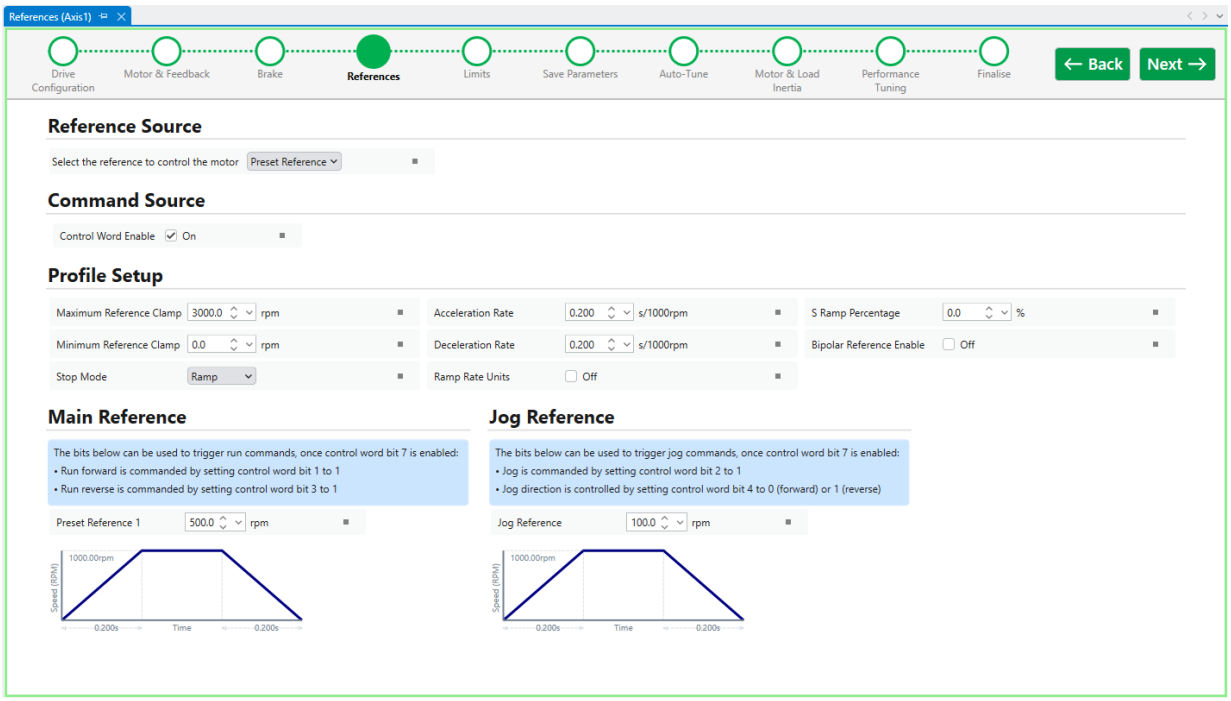


For more information on the mechanical brake controller logic and timings see section **6.1 Mechanical brake controller logic**.

When finished, click “Next” to move to the reference setup.

5. The reference setup page for a simple motion profile will be displayed, this is where the maximum reference clamp, the main speed reference source / value and rates are defined for the motion profile, along with a secondary speed reference for jogging.

> **HINT:** Normally, the maximum reference clamp must be set to the motor rated speed, however, in some applications this is increased and may be adjusted from this page.

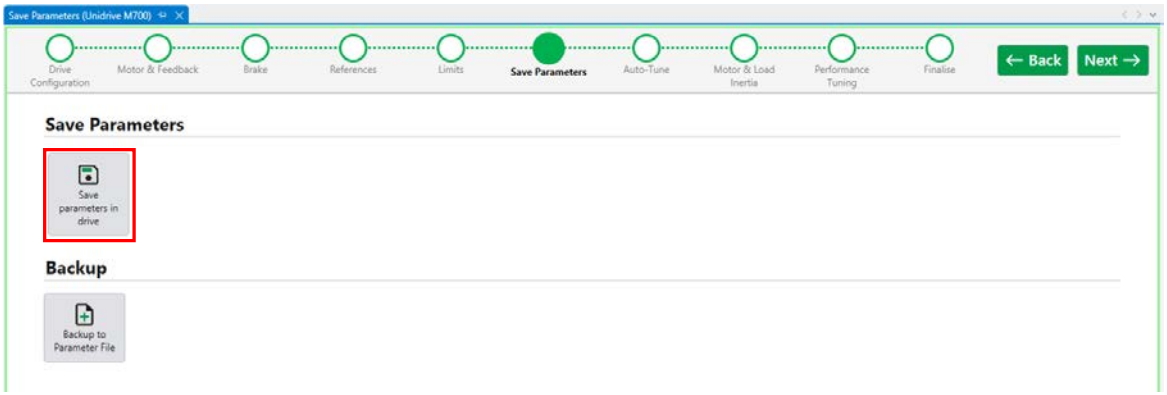


When finished, click “Next” to move to the Limits setup.

6. The limits page allows the user to assign digital inputs to become hardware limit inputs. If the application doesn’t have hardware limits, leave the digital input assignments empty and move to the next step.

When finished, click “Next” to move to the Save Parameters page.

7. The save parameters page allows the parameters configured so far to be saved. It is advised to do this prior to the commissioning activities since the power might have to be removed to correct a hardware issue as a result of a failed Autotune test, such as a reversed motor or encoder wiring.

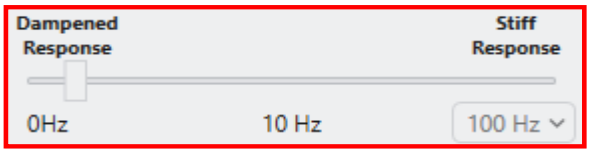


This completes the configuration section of the guided setup. The next section of the manual describes the commissioning of the drive and motor using the remaining steps in the guided setup.

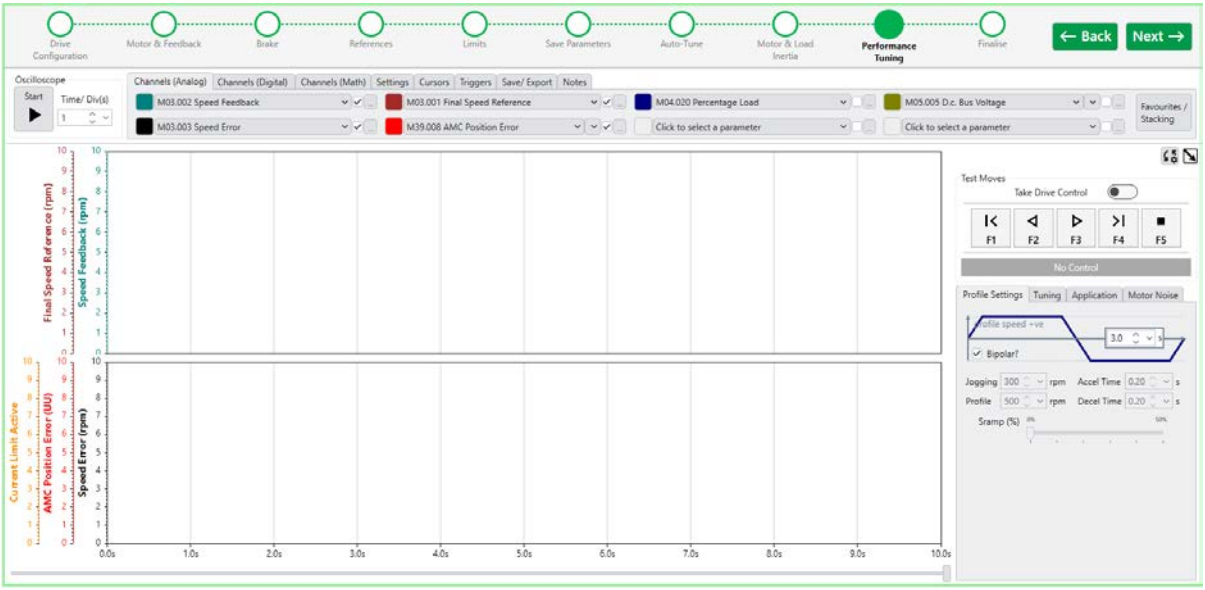
4 Commission the drive and motor using Connect

This section describes the process of commissioning the drive and motor in the application using the tools provided in the guided setup, which consist of:

- Auto-tune to measure the electrical properties of the motor such as resistance and inductance.
- An inertia-auto-tune to measure the inertia of the motor and load. Once this measurement is taken, tuning the axis is simplified to a single slider. It is **strongly** recommended to run this test.

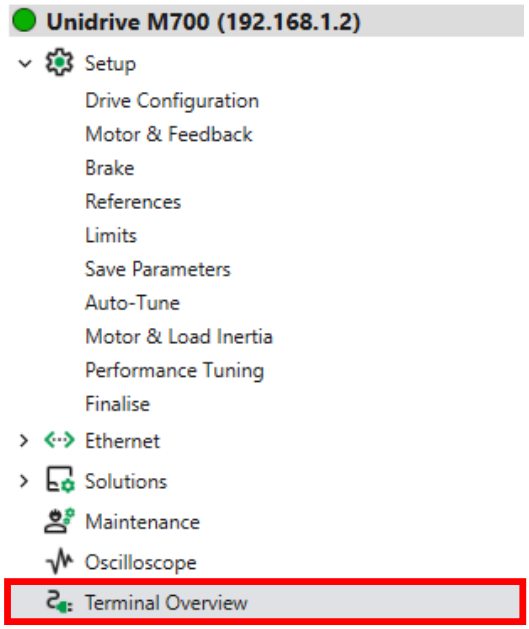


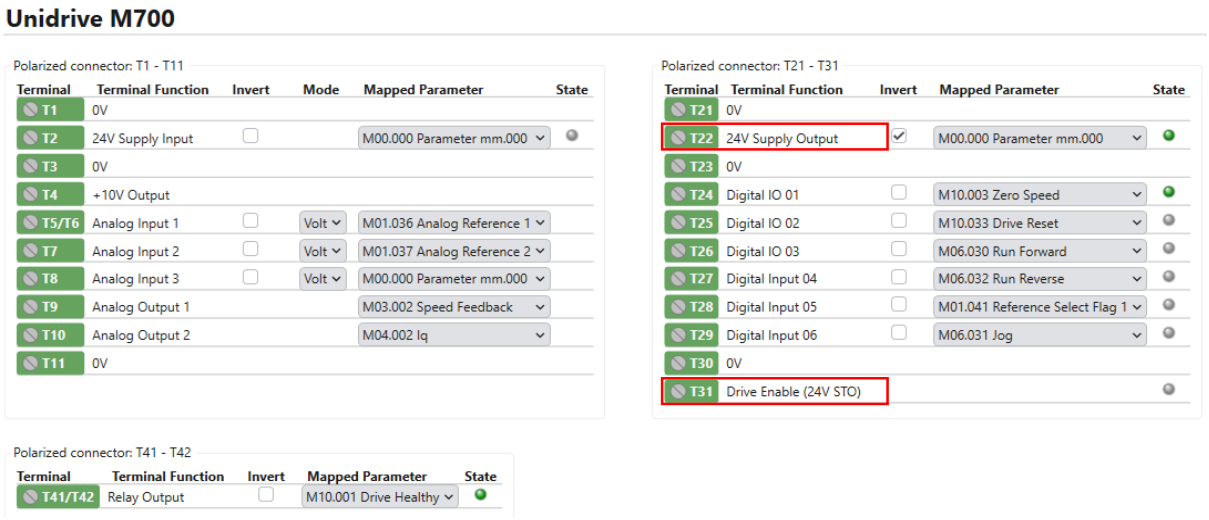
- Performance tuning and test moves. This page is a “one stop shop” with test move controls, motion profile setup, oscilloscope, and tuning controls on a single page, ideal for site commissioning using a laptop.



Use the following steps to commission the motor and drive in the application.

1. Wire a switch or similar device to the drives STO input(s) where 24V is connected to the STO input(s) to enable the drive. The drive will not be able to run the motor until such a device is fitted. The terminals that supply 24V and host the STO input(s) are shown by the "Terminal Overview" in the device explorer.





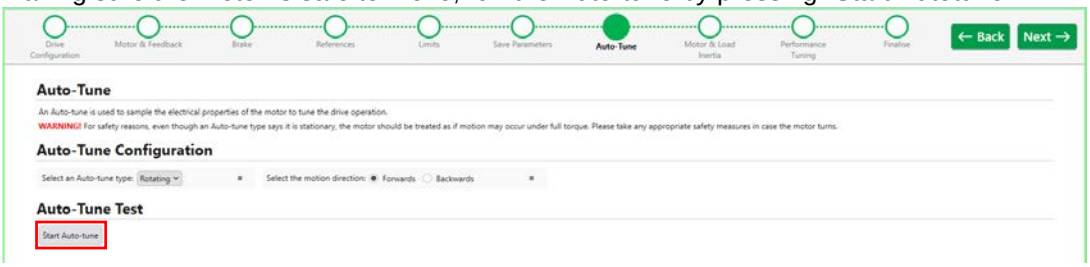
SAFETY: Remove power from the drive before attempting to modify the drive or motor electrical connections.

2. Before attempting to run the Auto-tune ensure the STO switch is open i.e. 24V is not connected to the STO terminal(s).

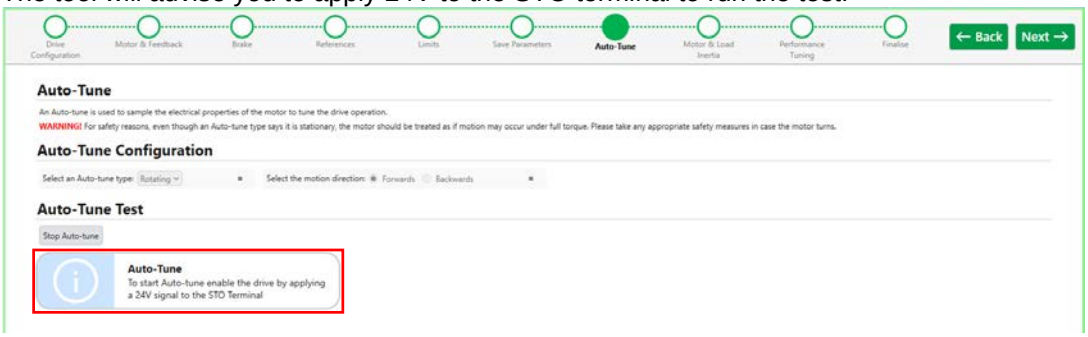
3. The default setup for the Auto-tune will be suitable for most applications. Additional controls are provided for expert users.

HINT: If an electronic motor nameplate is in use, this step is not required – skip to the "Motor and load inertia" page which is described in step 4 below.

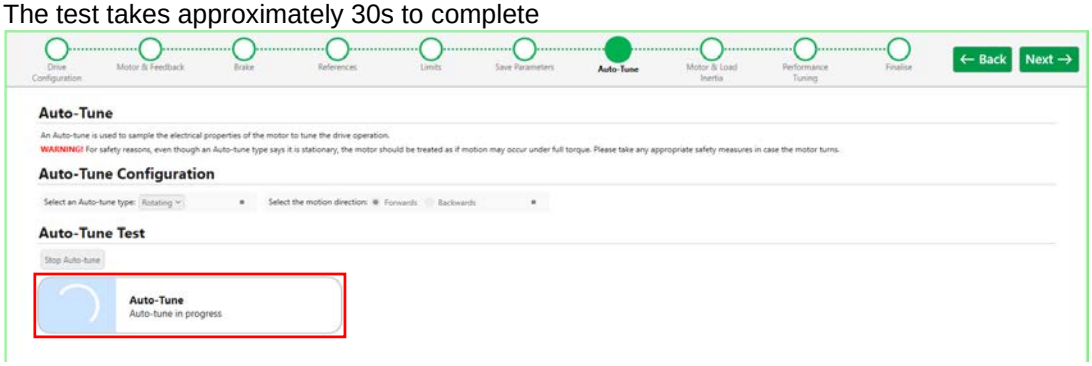
Making sure the motor is safe to move, run the Auto-tune by pressing "Start Autotune"



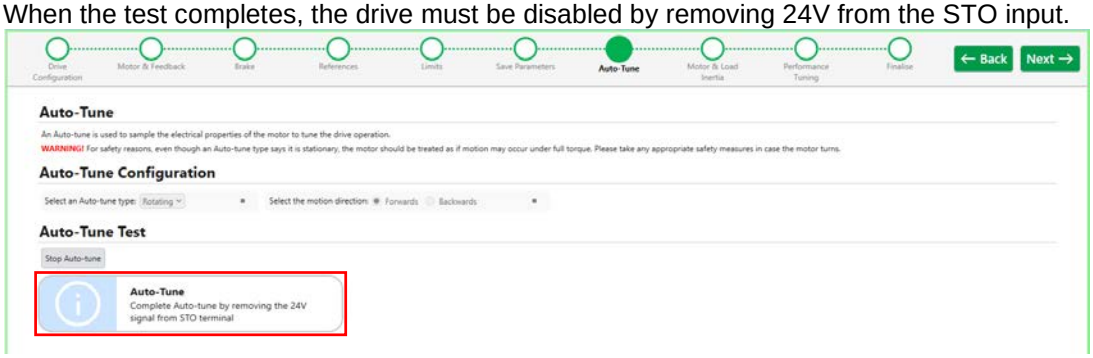
The tool will advise you to apply 24V to the STO terminal to run the test.



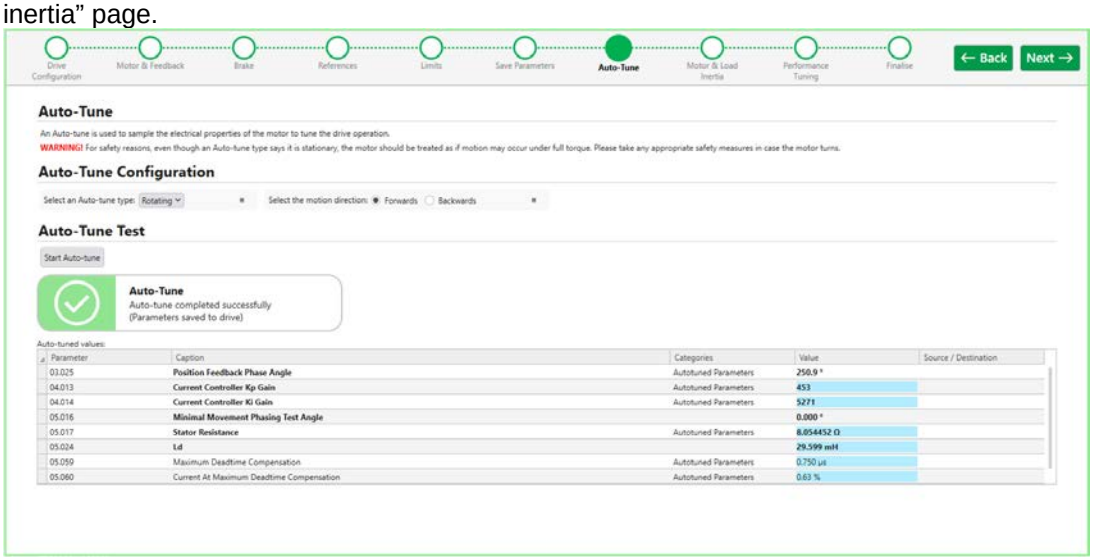
The test takes approximately 30s to complete



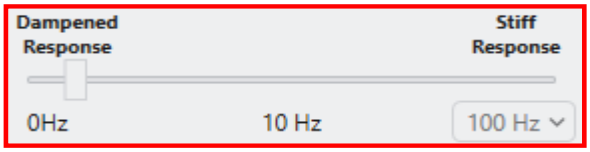
When the test completes, the drive must be disabled by removing 24V from the STO input.



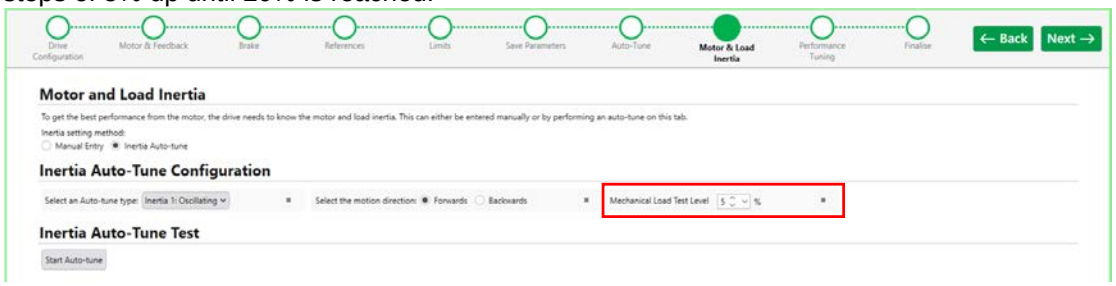
The electrical property autotune is completed. Click next to move to the “Motor and load inertia” page.



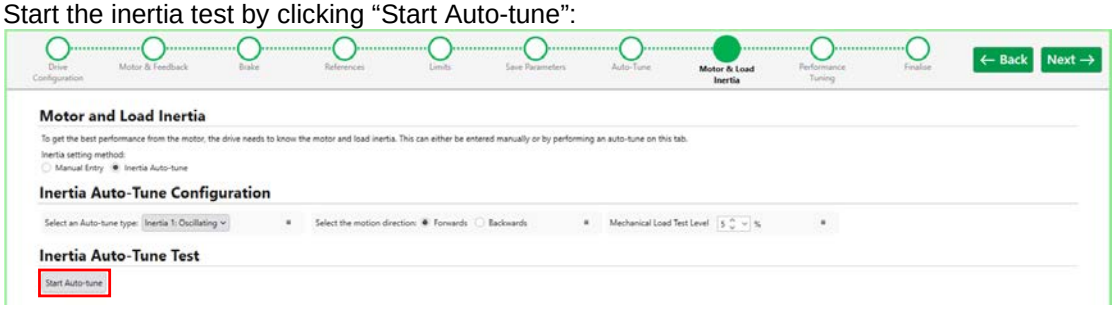
4. The “Motor and load inertia” page configures a test to measure the motor and load inertia. This test is important as it allows the speed loop gains to be configured using a single control slider:



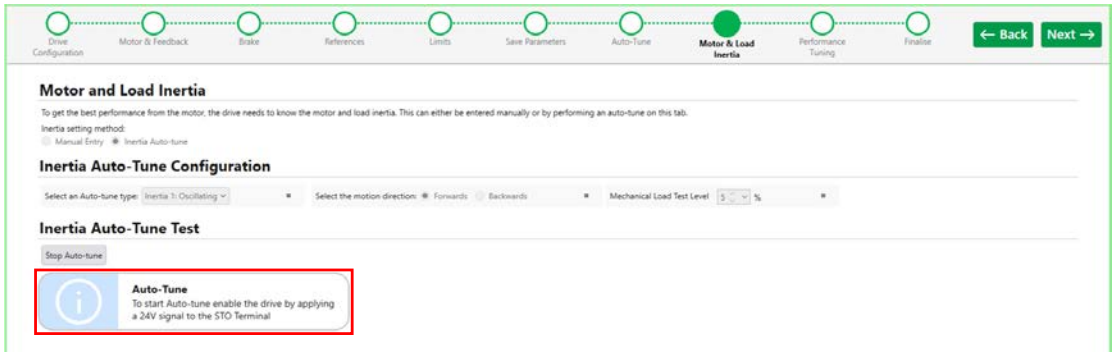
If the motor has a load connected, the default settings will be OK for most systems. Where there is no load i.e. a bare motor shaft it is recommended to increase the “Mechanical Load Test Level” to 5%. If the test fails to identify the inertia, increase the mechanical load test in steps of 5% up until 20% is reached.



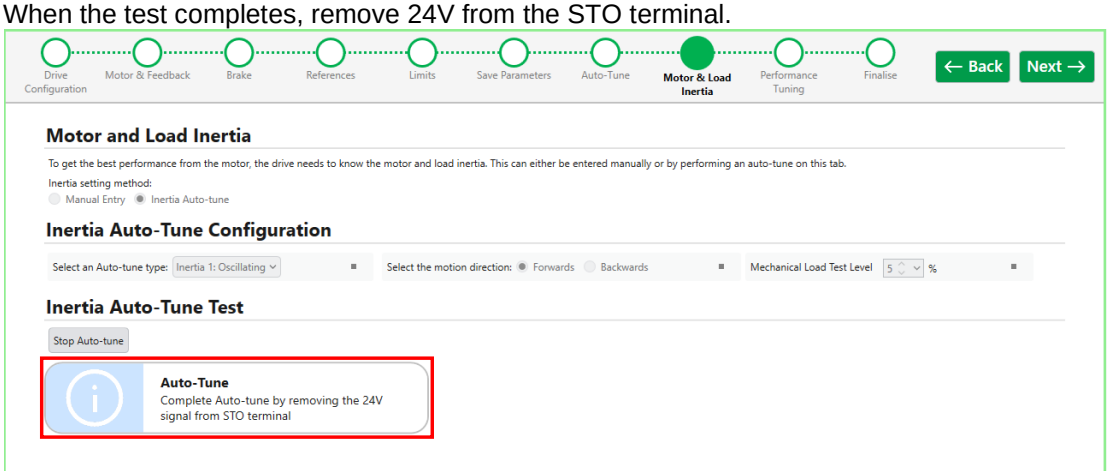
Start the inertia test by clicking “Start Auto-tune”:



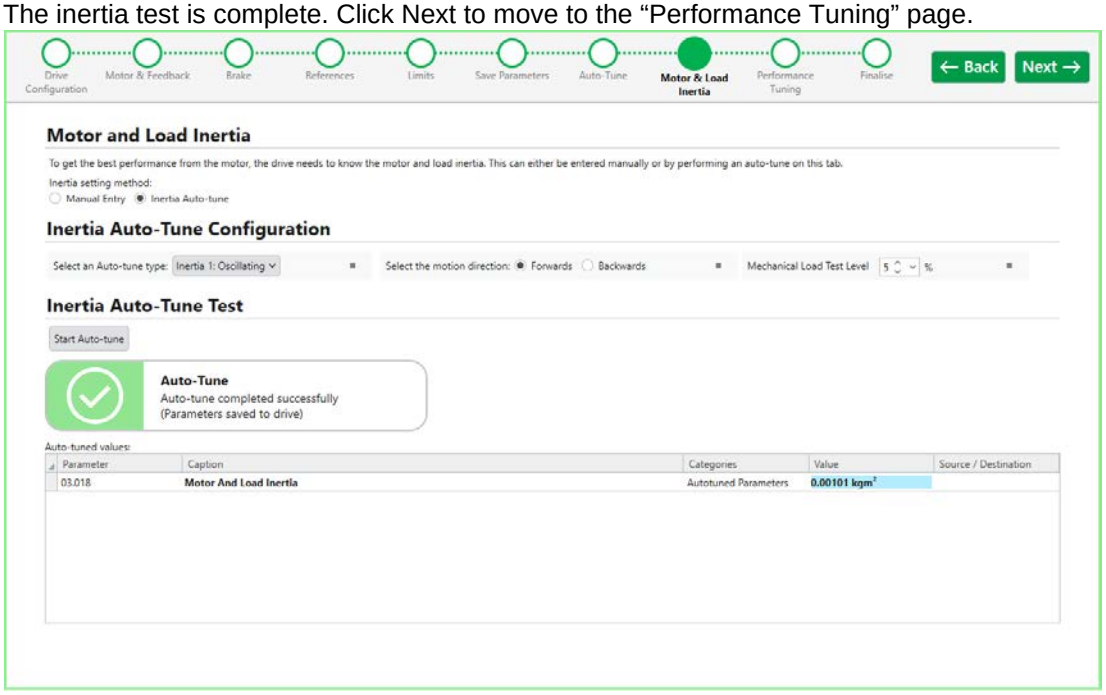
The tool will advise you to close the STO switch to apply 24V to the STO terminal and run the test.



When the test completes, remove 24V from the STO terminal.



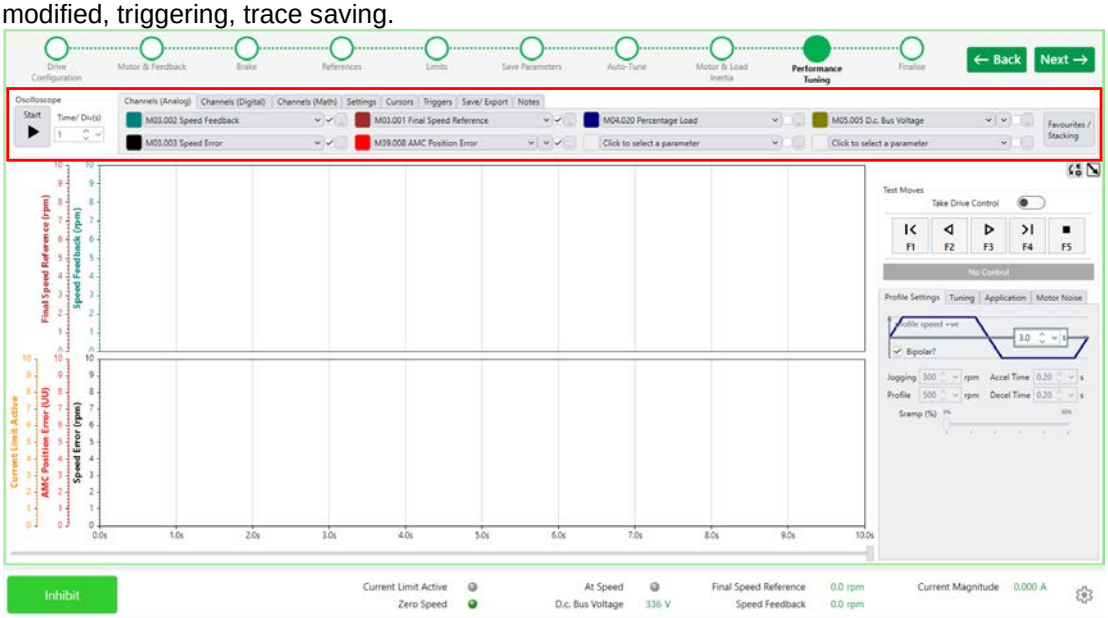
The inertia test is complete. Click Next to move to the “Performance Tuning” page.



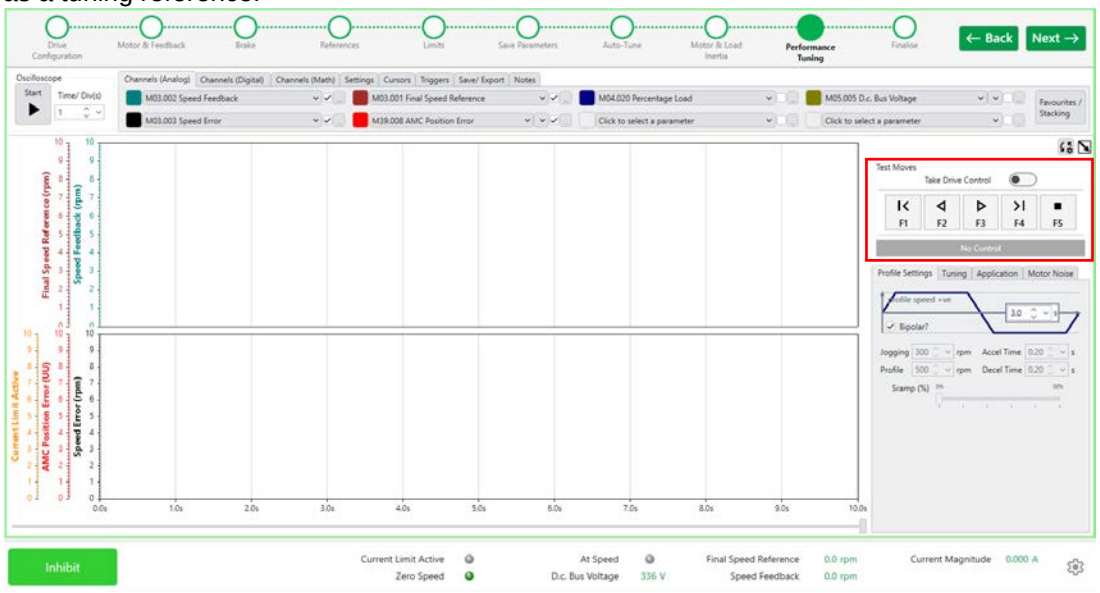
5. The “Performance Tuning” page provides a set of tools on a single page, optimised for laptop use, that are used to commission the drive and motor. The different sections of the tool are described below:

   Oscilloscope – to show what is happening to the motor speed while jogging or tuning takes place:

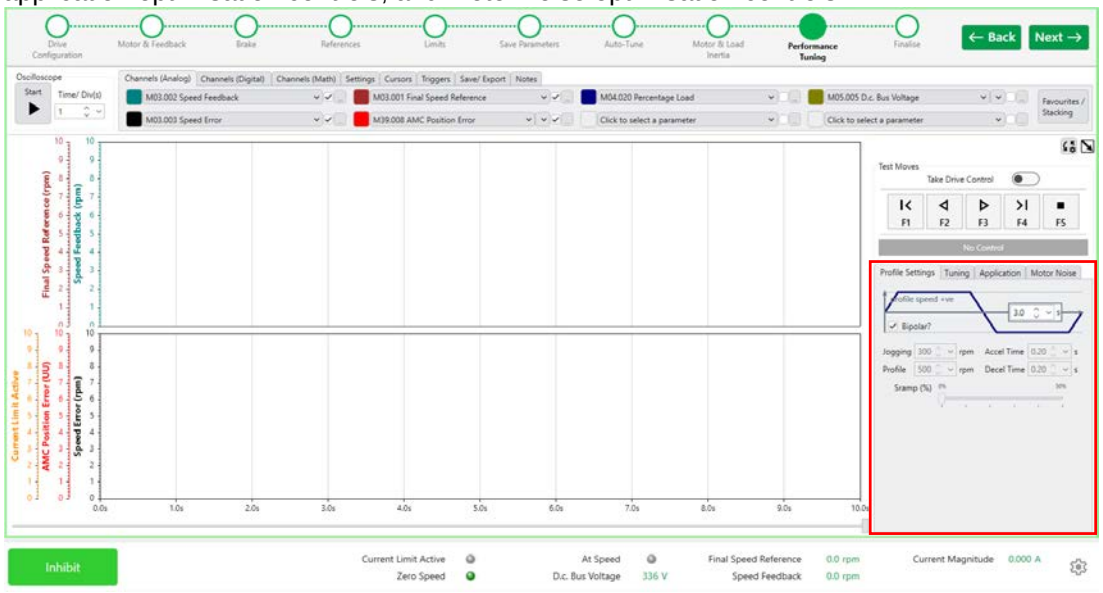
   Oscilloscope controls – start and stop the trace, allow channels to be added / removed / modified, triggering, trace saving.



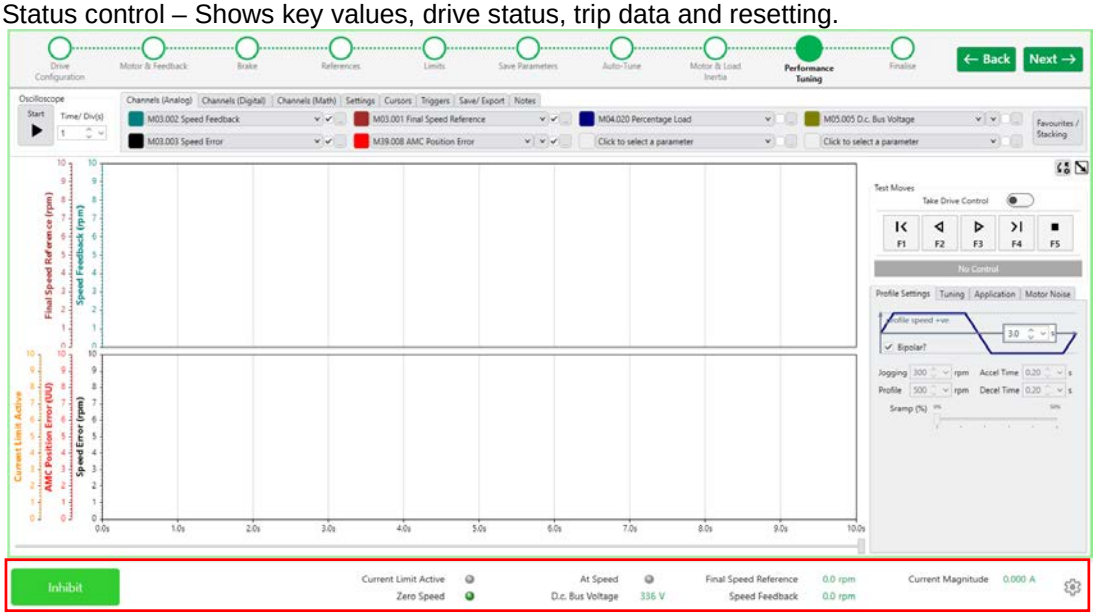
Test move commands – enable the test controls, jog forward / backwards, automatic running as a tuning reference.



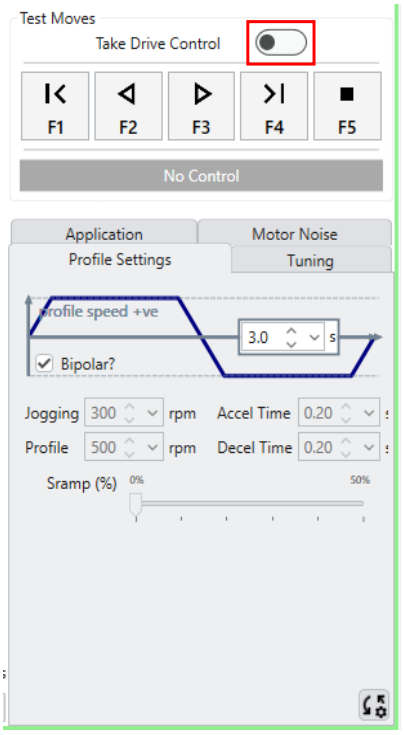
Commissioning tabs – configure the test move motion profile, speed and position loop tuning, application optimisation controls, and motor noise optimisation controls.



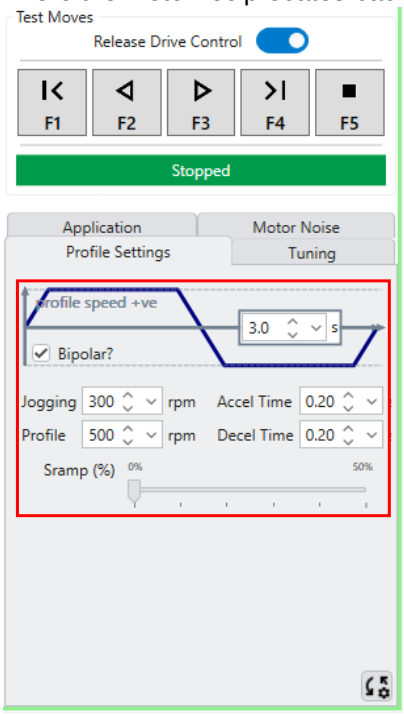
Status control – Shows key values, drive status, trip data and resetting.



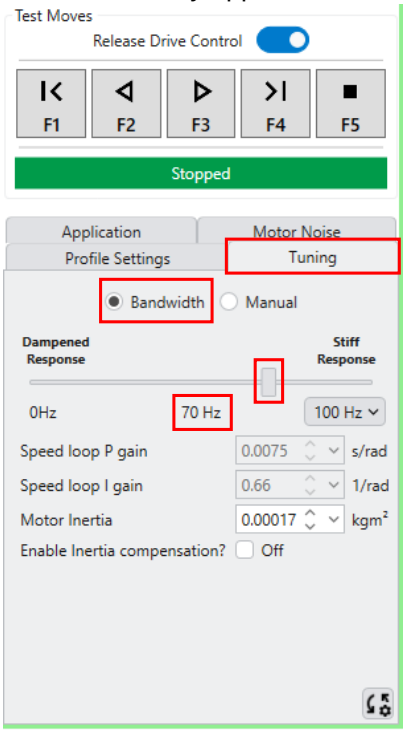
6. Begin commissioning by jogging the axis (slowly) to determine if the motor direction is correct for the application. Ensure it is safe to move the motor. Click on “Take Drive Control” and then apply 24V to the STO input.



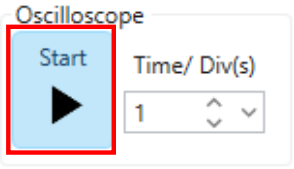
Configure the motion profile settings used when the test moves are running. This includes the jog speed, automatic running speed, acceleration and deceleration times, S ramp percentage, the overall profile time, and whether the automatic running is in one direction, or bipolar where the motor reciprocates back and forth.



Select the Tuning tab, and then select “Bandwidth” mode. This will give moderate tuning suitable for many applications, with headroom to increase the gains further if required.

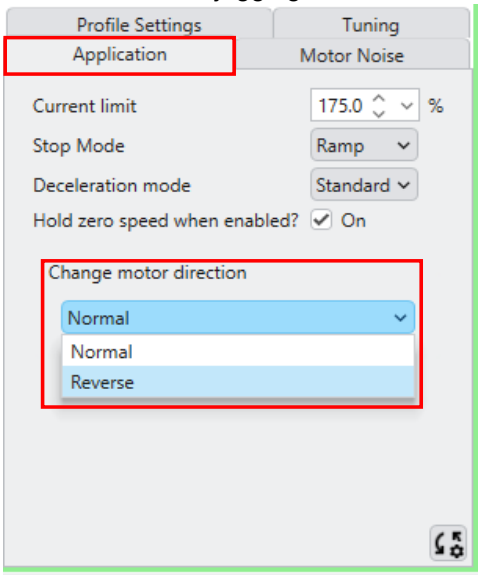


Start the oscilloscope by pressing the Oscilloscope start/stop button.



Jog the axis forward by pressing F4 or clicking on the Jog Forward button.

Verify that the movement is stable and that the forward direction of rotation is correct for the application. If the movement is unstable, modify the tuning slider until the desired performance is achieved. If the motor is turning the wrong way when jogging forward, remove 24V from the STO Input, select the Application tab, and then set the “Change Motor Direction” control to “Reverse”. Re-apply 24V to the STO terminal and verify that the motor direction is now correct when jogging forward.

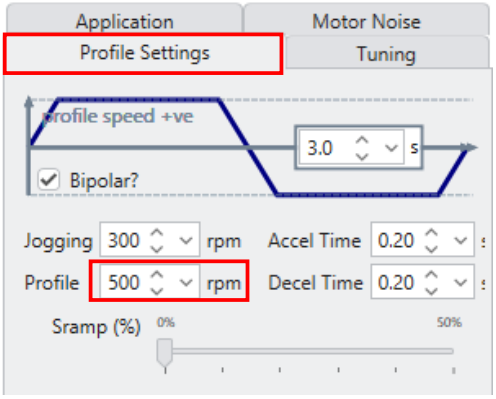


7. If the application axis has hardware limit switches connected, test them by jogging into them gently and prove that the axis stops and that the switches have been connected to the correct terminals.

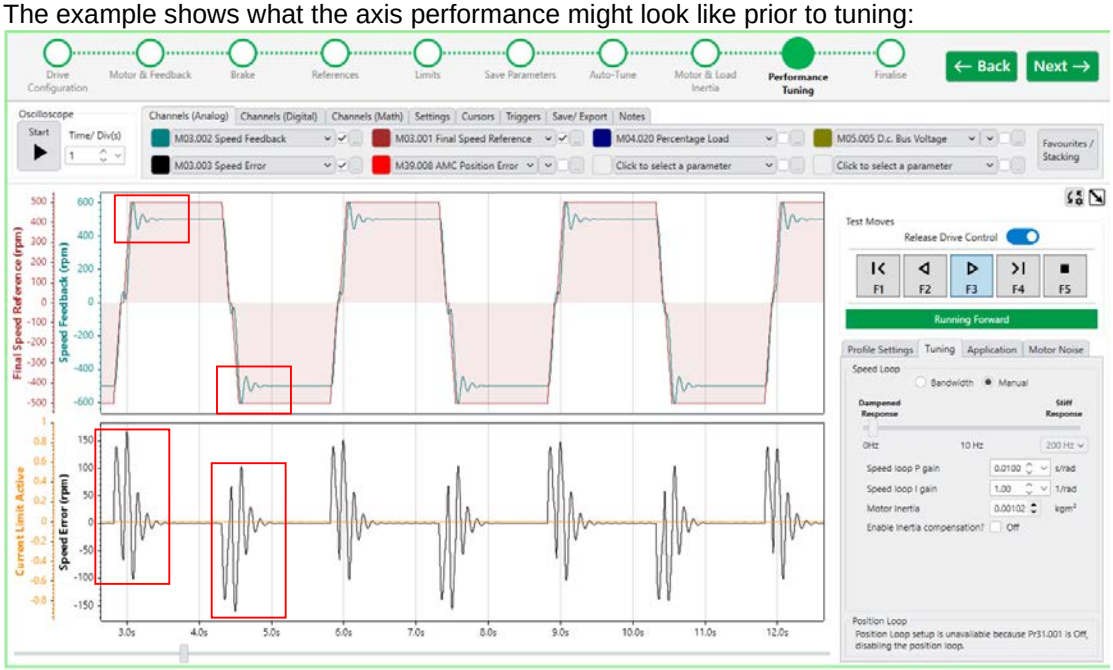
8. Verify the step response of the motor and load by enabling automatic running. Before tuning using these commands make sure that if the axis has physical limits that it is placed in the centre of these limits and that Bipolar mode is selected so that the axis moves back and forth. To stop the axis press F5 or click the stop button:

Select the initial direction of travel when automatic running using F2 (backwards) or F3 (Forwards) or by clicking the Run Forwards, Run Backwards buttons:

It is recommended to start with a slow Run speed and then gradually increase to make sure the axis doesn't move too far on the first try. The speed can be increased while running but bear in mind that the higher the speed, the further the axis will travel.

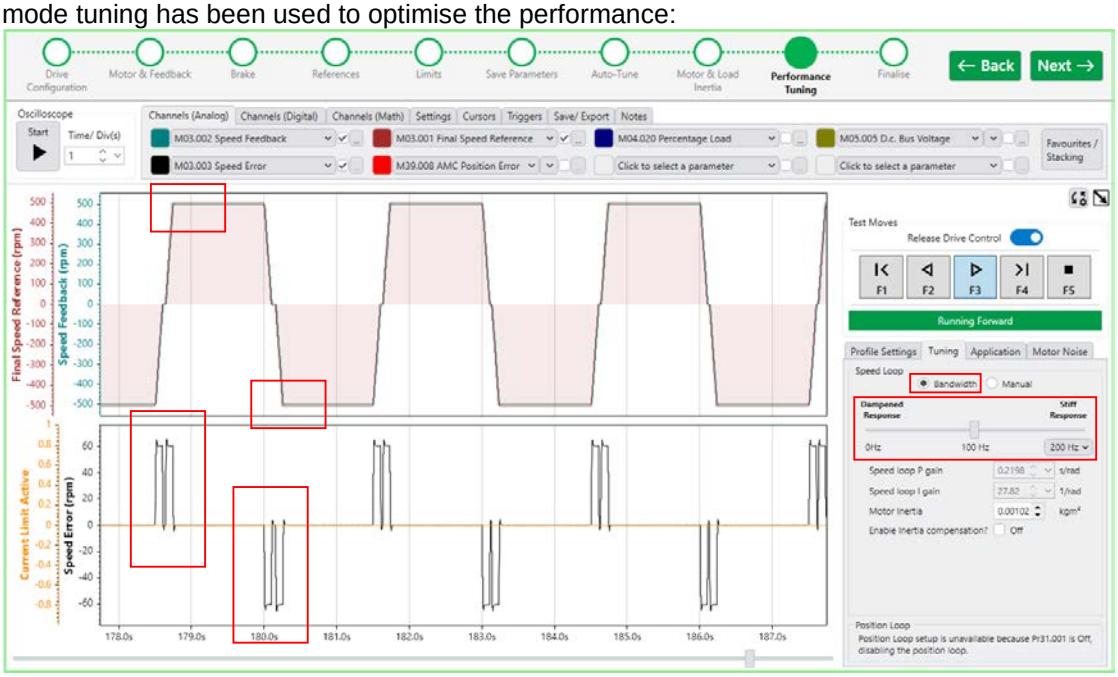


9. Once the correct automatic run profile is running, the axis may be tuned further. Observe Final Speed Reference Pr3.001 and Speed Feedback Pr3.002 overlaid with each other, and the Speed Following Error Pr3.003 on a separate trace. Ensure there is no significant overshoot when stopping or when reaching the speed reference. If there is overshoot the gains can be increased. When doing this check that the drive isn't going into current limit by observing Pr10.009; this may be placed on the same trace as the speed following error. The example shows what the axis performance might look like prior to tuning:



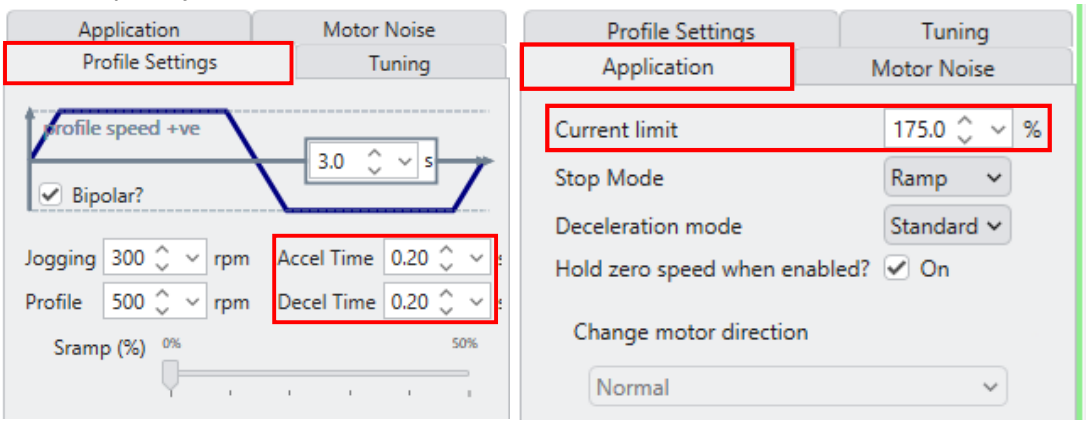
In the previous example trace it can be seen that there is significant speed overshoot caused by the load inertia and default gains. The speed following error shows oscillations when accelerating and decelerating. All of these artifacts can be tuned out easily using "Bandwidth" mode and adjusting the slider control to achieve the desired performance.

The example below shows an optimised result for the same application where Bandwidth mode tuning has been used to optimise the performance:

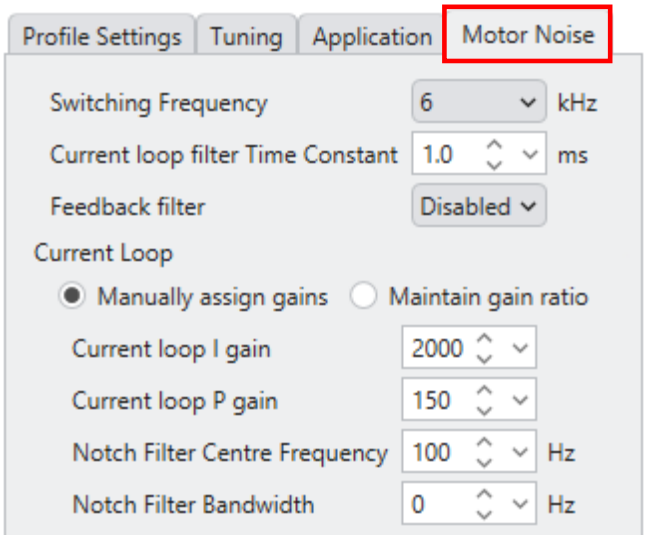


From the previous trace it can be seen that there is no significant speed overshoot, the speed following error isn't oscillating, and the drive isn't going into current limit.

If the drive is observed going into current limit, (Current Limit Active trace goes to 1), it is an indication that the drive is going into constant torque due to hitting the current limit. This can be resolved by increasing the current limits on the Application tab or by decreasing the acceleration and deceleration rate. It is further recommended to verify that the drive and motor combination have been sized correctly for the application in terms of their torque and current capability.



10. If the motor is sounds noisy with the tuned values select the "Motor Noise" tab:

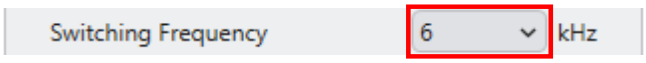


For most applications it is recommended to use a Current Loop Filter Time Constant of 1.0ms, unless the application is ultra-dynamic and needs a very fast response where a lower value is needed. A 1.0ms filter gives a 160Hz response bandwidth, where most systems will be well tuned at between 50Hz and 100Hz.

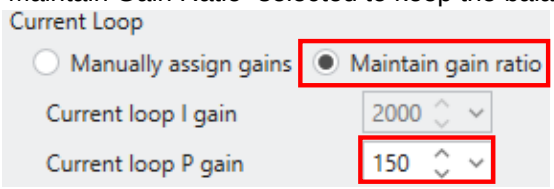
This helps in the following situations:

- The speed reference or speed feedback contains a noise component e.g. if the feedback device is of low resolution.
- If the speed loop gains have been raised to the point where the motor noise has become unacceptable, and the required speed loop performance hasn't been reached.
- The application often runs with a low motor speed where encoder quantisation noise is an issue.
- There is mechanical resonance affecting the feedback.

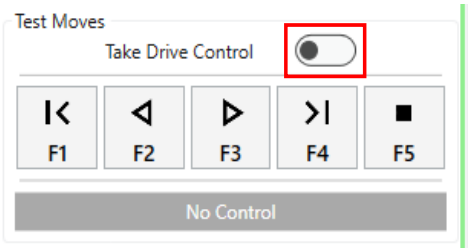
Provided the drive and motor is rated for a higher switching frequency, increasing the switching frequency can reduce audible noise from the motor.



If the motor has a continuing 1kHz tone after the adjusting the switching frequency and the current loop filter, the noise can be improved by making a small reduction in the Current loop P Gain with “Maintain Gain Ratio” selected to keep the balance between the current loop P and I gains.

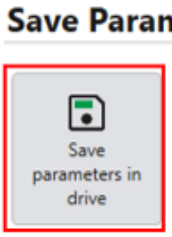


11. Disable the drive by removing 24V from the STO input, and then disable the test move control by clicking on the “Release Drive Control”. When drive control has been released it looks as shown below:

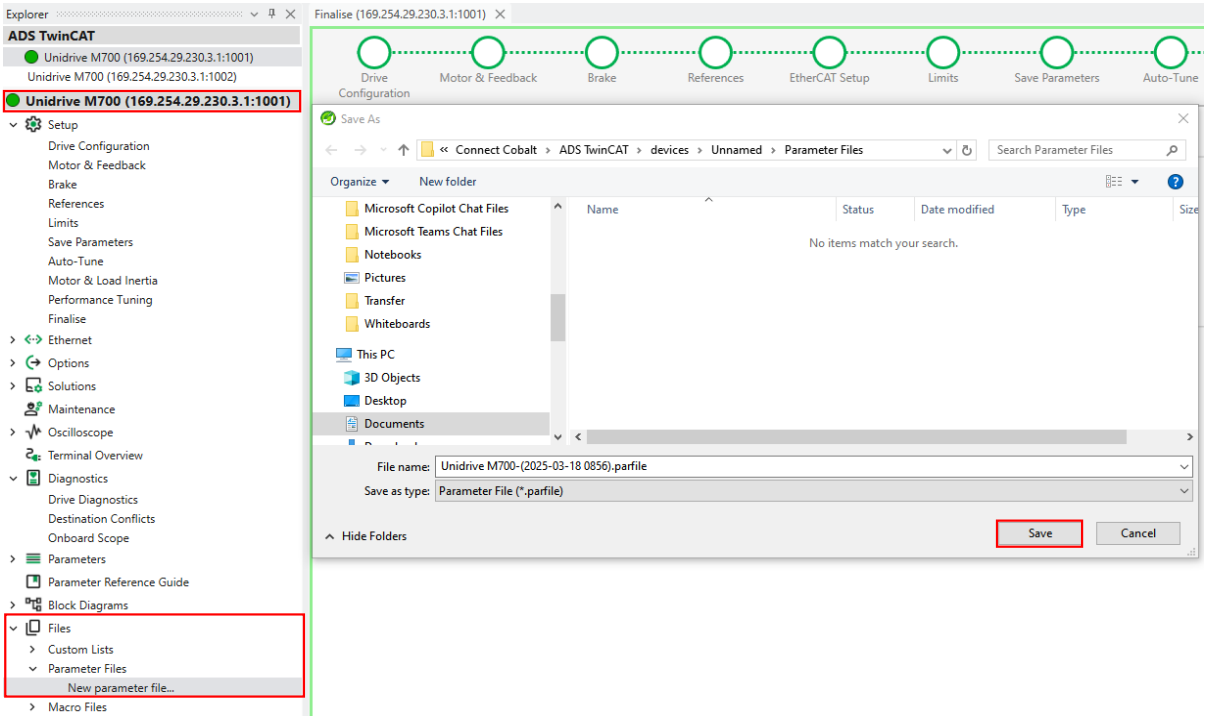


Click Next to move to the “Finalise” page.

12. Save the tuned parameters in the drive by clicking the “Save Parameters” button:



13. It is advised to make a parameter file once tuning has been completed by selecting “Files” > “Parameter Files” > “New parameter file…”. This file preserves the final setup of the drive, regardless of what happens to the Connect project later on, and forms a useful future reference of the configuration. Click “Save” to create the parameter file. The file is automatically time and date stamped, e.g. Unidrive M700-(2025-03-18 0856).parfile was created at 8:56 on 18/3/2025.

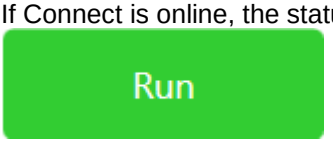


5 How to guides

5.1 How and when to tune the Position Loop

The axis position loop in the drive is activated when the AMC is enabled or when an option module that enables the AMC is in use such as a SI-EtherCAT module and the drive is powered on, where:

- The drive is enabled by applying 24V to the STO terminal.
- The drive is healthy i.e. no trips.
- MC_Power has been used, successfully, to power on the axis.
- If a keypad is fitted, the display indicates “Run”.
- If Connect is online, the status in the bottom left shows “Run”.

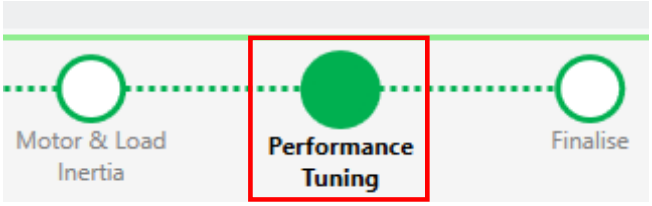


The position loop should be tuned when the application software is written, and the machine is running with the worst-case production motion profile, i.e. the most dynamic motion profile coupled with the highest load that will be experienced by the system while running.

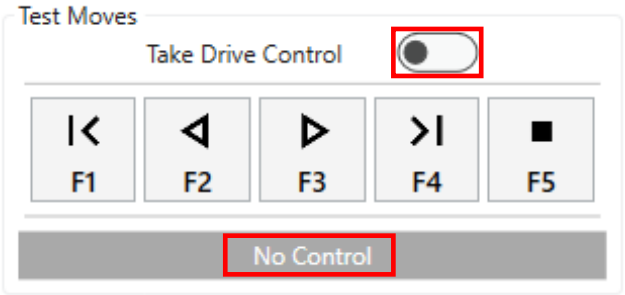
In many cases the default position loop p gain of 25.00 will give reasonable performance, but in cases where there are tight tolerances, the position loop performance can be increased to suit the requirement.

Before attempting to tune the position loop the speed loop must be tuned first as described in section **4 Commission the drive and motor using Connect**.

With the machine running its worst-case motion profile, open Connect and go to the Performance Tuning step

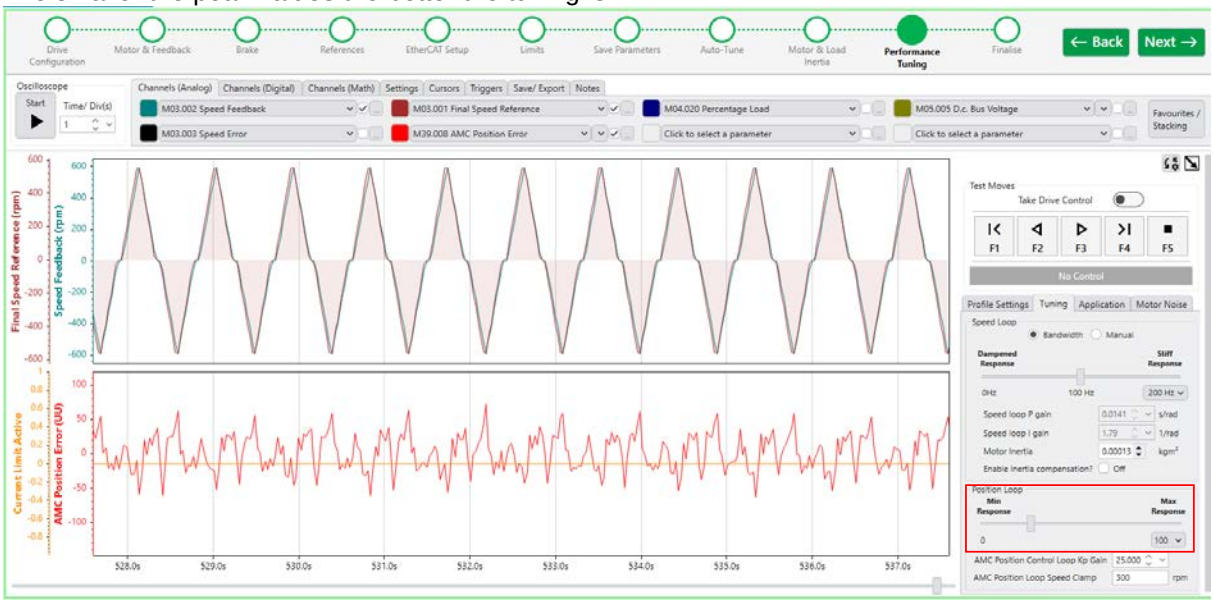


Don’t enable the test move control. The test moves status must say “No Control” to leave the application software in control of the drive and therefore the drive position loop active, ready for tuning.

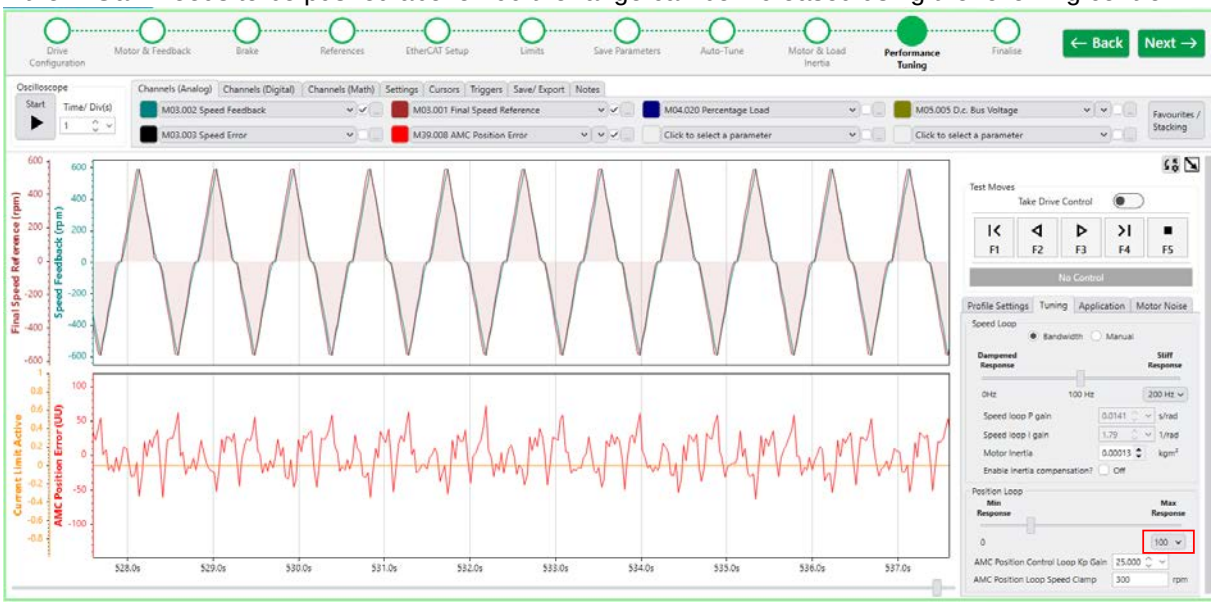


Move the position loop p gain slider to optimise the tuning and observe the red AMC Position Loop Error trace. Move the slider to the right to increase the position loop gain and increase the response.

The smaller the peak values the better the tuning is.



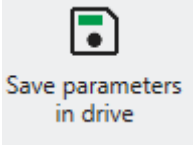
If the P Gain needs to be pushed above 100 the range can be increased using the following control:



Care must be taken when increasing the gain as it is possible to increase the gain until the system stability limit is reached and the axis motor will make additional noise or worst case oscillate. Small steps are recommended when tuning.

If the tuning has reached the best possible position error and axis noise compromise, it is possible to reduce the error further by adding Jerk to the motion profile if one has not already been used. Even very high Jerk values can make a big difference to the peak position following error values when beginning and ending acceleration or deceleration.

When the optimal value has been reached save the parameters in the drive.



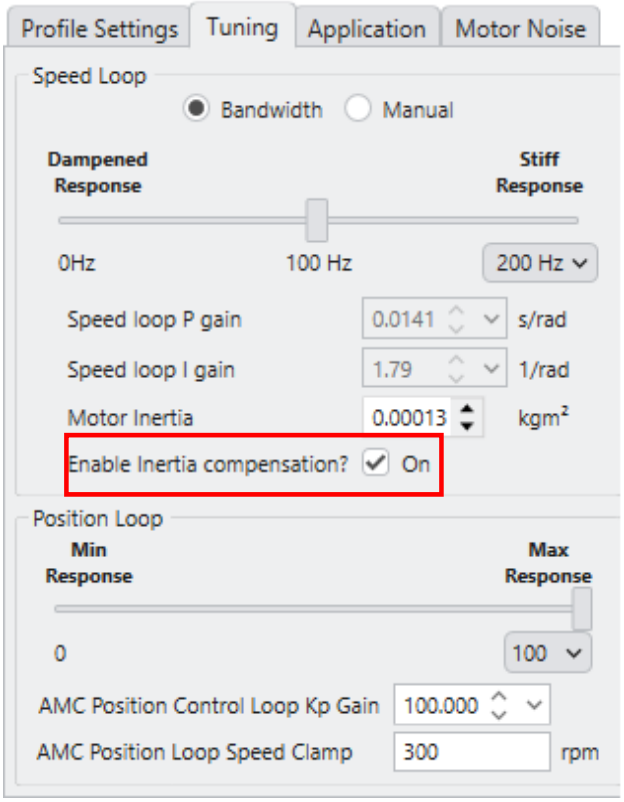
5.2 How and when to use inertia compensation

Inertia compensation, as the name suggests should only be used when there is significant load inertia and / or large acceleration rates. If the inertia is low or the acceleration rates are also low then this feature will not benefit the performance of the axis and is best not used.

Inertia compensation engages a Torque Feedforward term in the drive which, assuming the motor and load inertia has been measured correctly, applies a torque reference to the drive in proportion to the motion profile acceleration output and the inertia value. This helps reduce speed loop following error during acceleration and deceleration, at the cost of slightly increased motor noise.

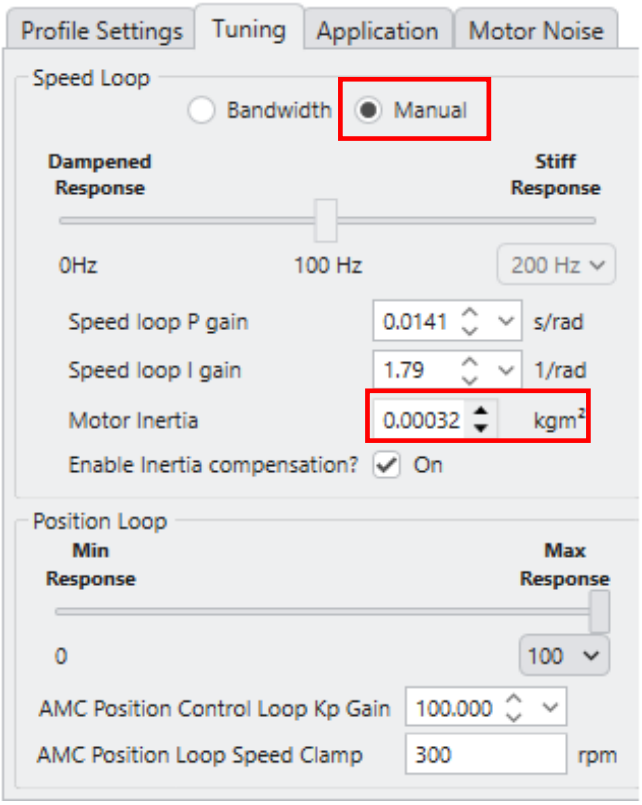
Before using this feature the speed and position loops must be tuned first as described in sections **4 Commission the drive and motor using Connect** and **5.1 How and when to tune the Position Loop**.

To use the inertia compensation check the Enable inertia compensation checkbox on the Performance Tuning step of the guided setup.



If motor noise induced by the inertia compensation term must be reduced, or the amount of inertia compensation must be increased to further improve the following error, select manual speed loop tuning to disconnect the inertia value from the speed loop gain setting. Then decrease the inertia value to reduce motor noise or increase the inertia to increase the output of the inertia compensation.

Before modifying the “Motor Inertia” make a note of the original value so it can be restored later if required.



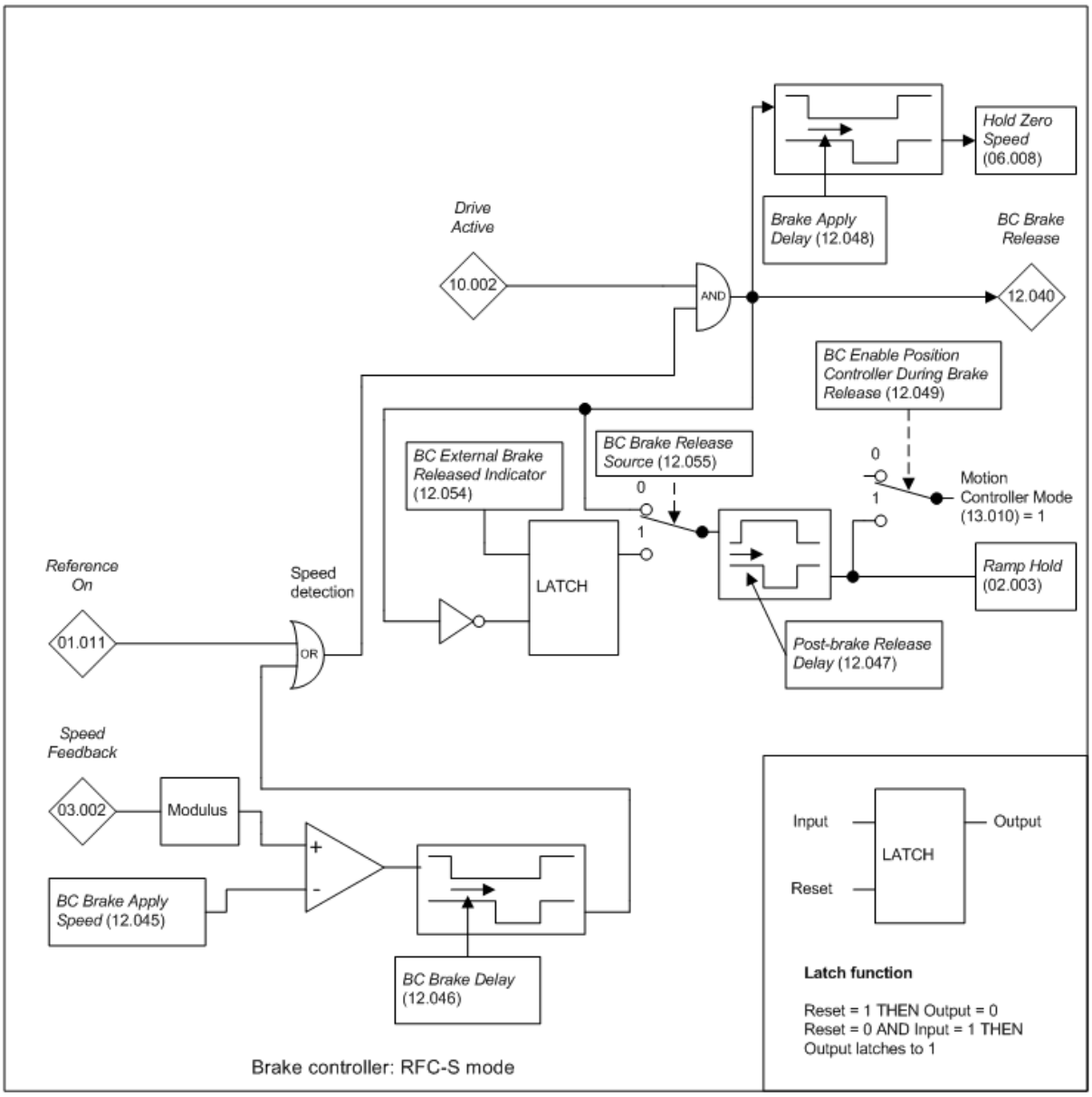
HINT: If the Inertia has been modified to tune the output of the Inertia Compensation feature, and Bandwidth mode tuning is later required, the inertia must be restored to its original value before selecting bandwidth mode, otherwise the speed loop gains may be calculated incorrectly.

6 Additional information

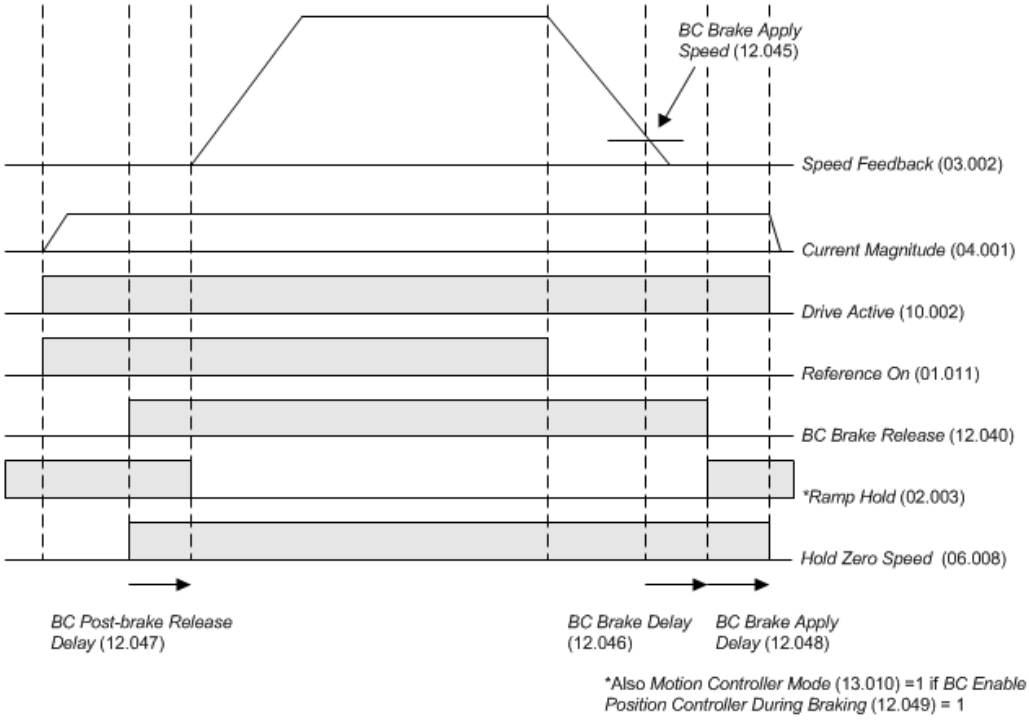
6.1 Mechanical brake controller logic

6.1.1 RFC-S closed-loop permanent-magnet motor brake controller

This section indicates the logic and timing diagrams for the brake controller in RFC-S mode for closed-loop permanent-magnet motors to help illustrate the functionality and timing.



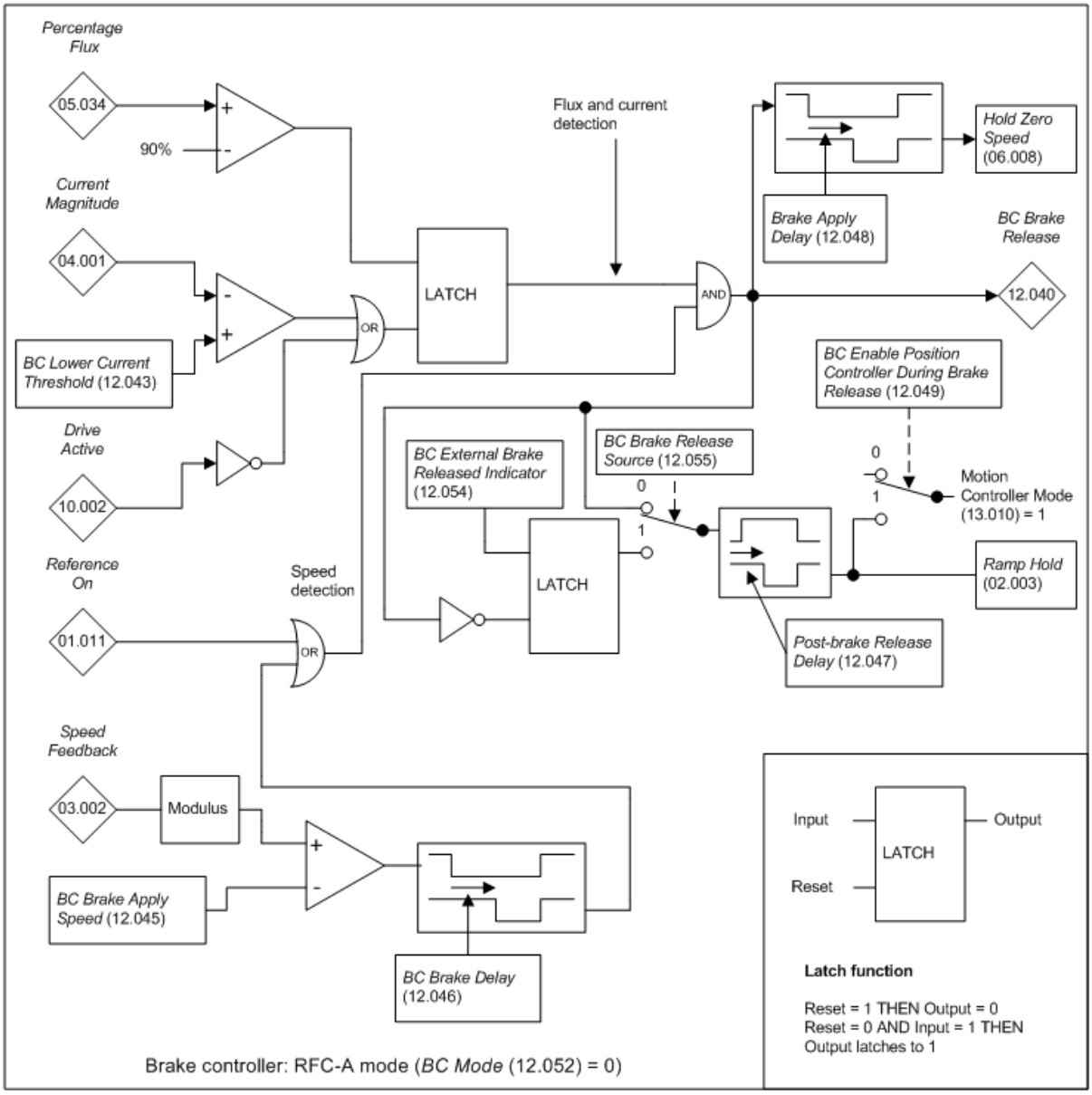
Brake controller: RFC-S mode



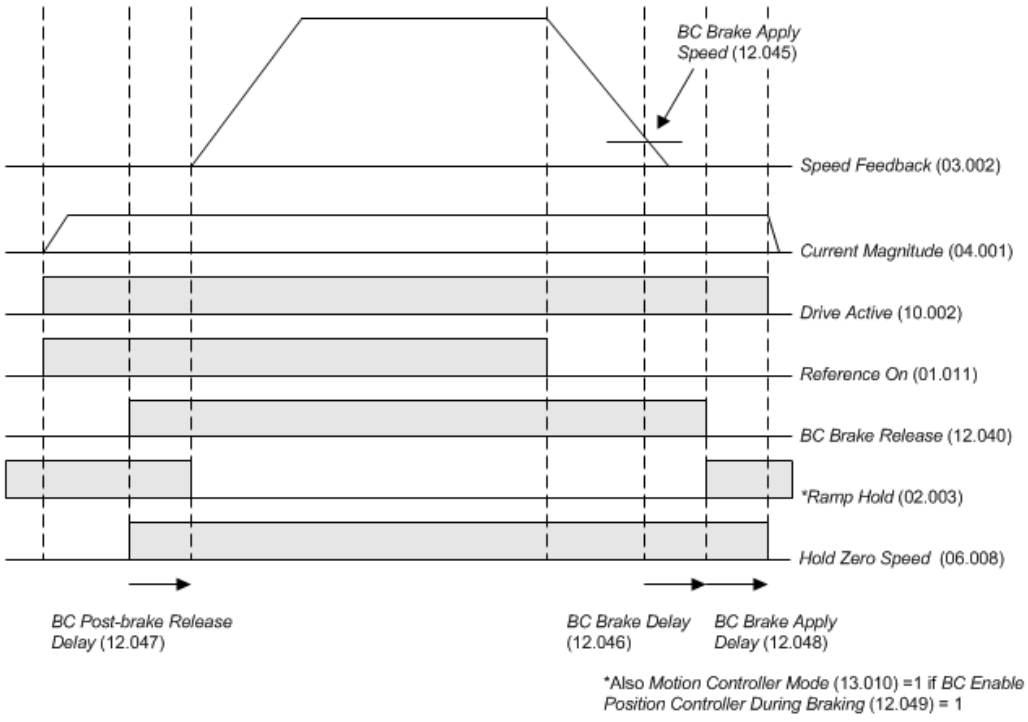
Brake controller sequence: RFC-A mode (*BC Mode* (12.052) = 0) and RFC-S mode

6.1.2 RFC-A closed-loop induction motor brake controller

This section indicates the logic and timing diagrams for the brake controller in RFC-A mode for closed-loop induction motors to help illustrate the functionality and timing.



Brake controller: RFC-A mode (*BC Mode* (12.052) = 0)



Brake controller sequence: RFC-A mode (*BC Mode* (12.052) = 0) and RFC-S mode

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