



Getting Started

A guide for commissioning a Control Techniques drive using Connect



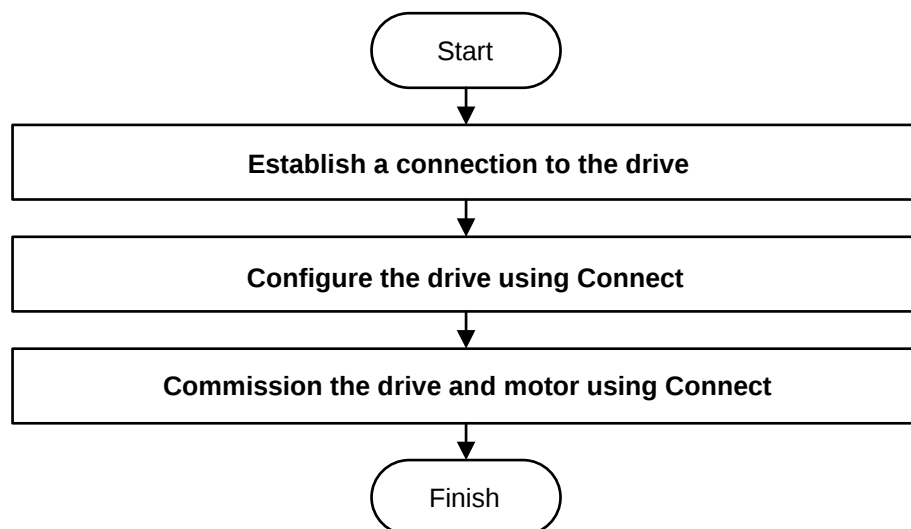
Contents

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
		43

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.

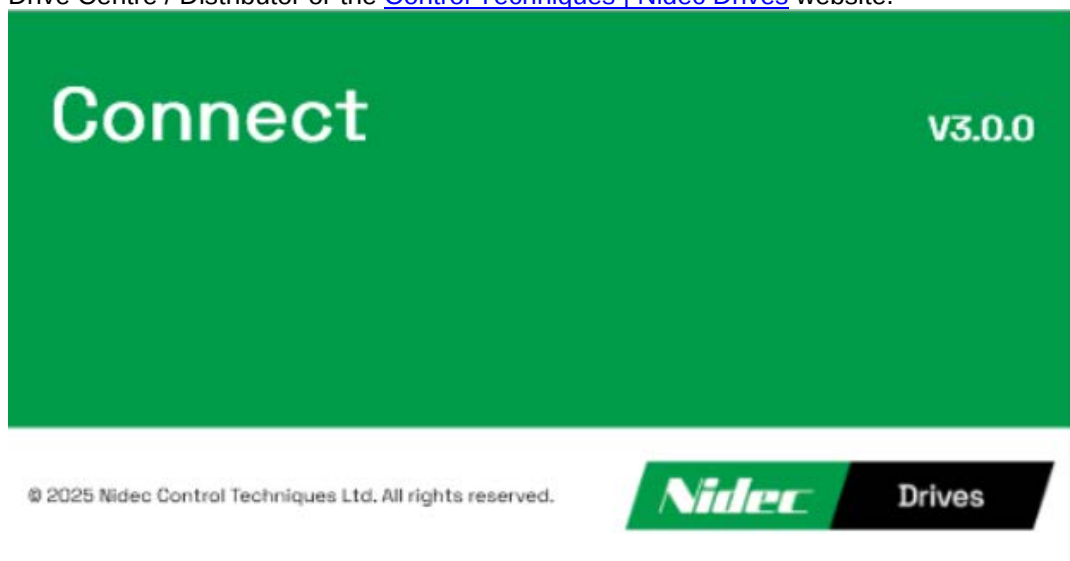
2.1 Connecting to the drive via Bluetooth

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

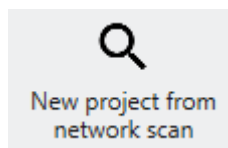
1. Open the Connect PC software by double clicking the “Connect” icon.



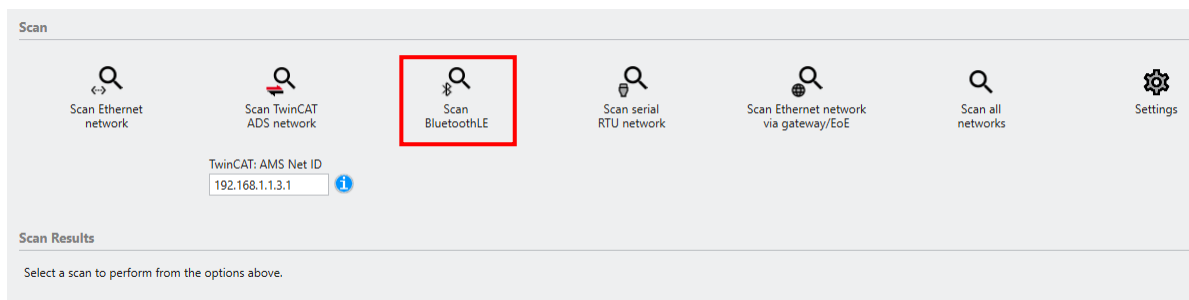
2. Ensure the version of Connect is a minimum V3.0.0. If an earlier version is installed please upgrade to V3.0.0; the software file may be obtained from your local Control Techniques Drive Centre / Distributor or the [Control Techniques | Nidec Drives](#) website.



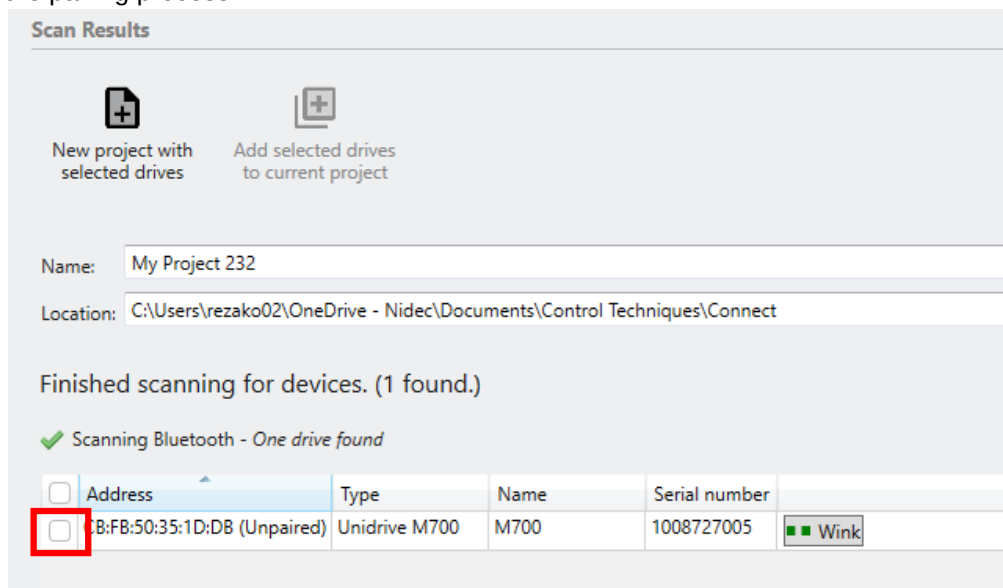
3. When Connect opens select “New project from network scan”.



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

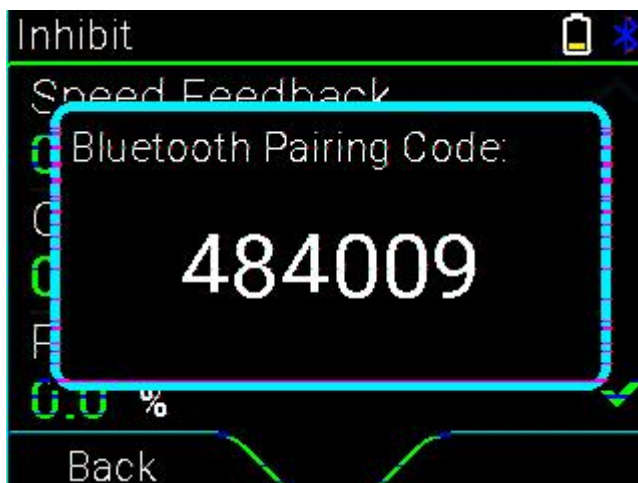
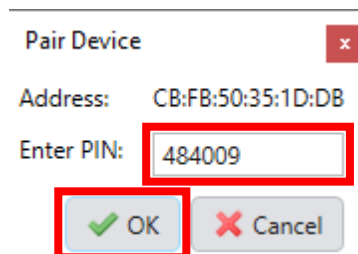


5. When an unpaired drive is found it will appear in the following way, tick the checkbox to begin the pairing process.



HINT: A drive can be identified by using the 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, ensure the drive has been selected and click “New project with selected drive”.

Scan Results


New project with selected drives


Add selected drives to current project

Name:

Location: C:\Users\rezako02\OneDrive - Nidec\Documents\Control Techniques\Connect

Finished scanning for devices. (1 found.)

✓ Scanning Bluetooth - One drive found

☒	Address	Type	Name	Serial number	
☒	CB:FB:50:35:1D:DB (Paired)	Unidrive M700	M700	1008727005	

HINT: A drive can be identified by using the  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.

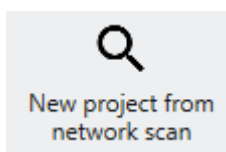
1. Open the Connect PC software by double clicking the “Connect” icon.



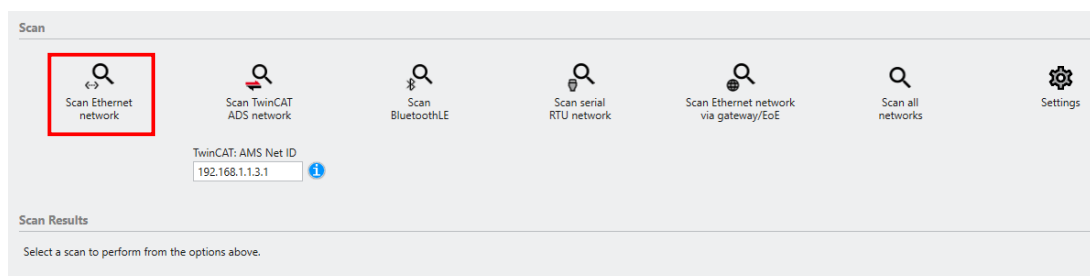
2. Ensure the version of Connect is a minimum V3.0.0. If an earlier version is installed please upgrade to V3.0.0; the software file may be obtained from your local Control Techniques Drive Centre / Distributor or the [Control Techniques | Nidec Drives](#) website.



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:



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

Scan Results



New project with selected drives



Add selected drives to current project

Name: **My Ethernet Project**

Location: C:\Users\rezako02\OneDrive - Nidec\Documents\Control Techniques\Connect

Finished scanning for devices. (1 found.)

✓ Scanning Ethernet networks - One drive found

☒	Address	Type	Name	Serial number	
☒	192.168.1.2	Unidrive M700	Axis1	Q008727005	 Wink

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:

Scan Results



New project with selected drives



Add selected drives to current project

Name: My Ethernet Project

Location: C:\Users\rezako02\OneDrive - Nidec\Documents\Control Techniques\Connect

No devices were found.

✓ Scanning Ethernet networks - One drive found (with 1 unreachable)

Unreachable devices detected
These are devices that have been detected but cannot be fully communicated with by your PC.

IP Address	MAC Address	Identifier	Actions	Possible Cause
0.0.0.0	00:0D:1E:08:88:DD	Factory Fit Ethernet	 	Device is configured to use DHCP but PC is set to a static IP address

☒	Address	Type	Name	Serial number	
☒					

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

Address Editor

Assign New IP Address Settings

The range of addresses this PC can see is between 192.168.1.1 to 192.168.1.254.

Recommended setting

DHCP Enabled: ☐

IP Address: 192.168.1.1  Available

Subnet mask: 255.255.255.0

Gateway: 192.168.1.254

MAC Address: 00:0D:1E:08:88:DD

☒ Save parameters in device (if applicable)?

☐ Advanced

- 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.

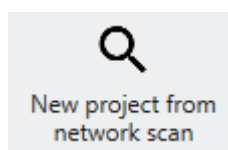
1. Open the Connect PC software by double clicking the “Connect” icon.



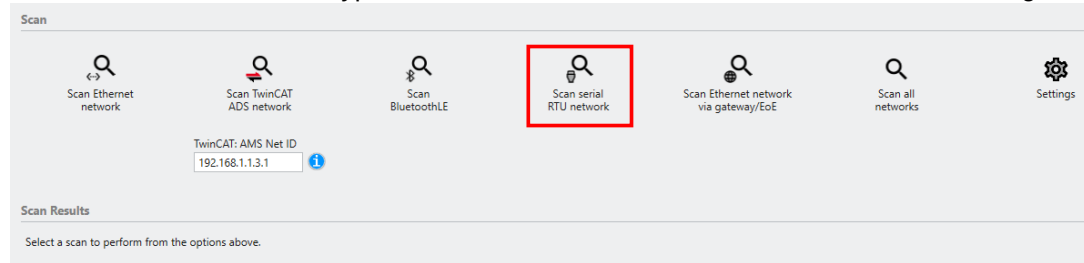
2. Ensure the version of Connect is a minimum V3.0.0. If an earlier version is installed please upgrade to V3.0.0; the software file may be obtained from your local Control Techniques Drive Centre / Distributor or the [Control Techniques | Nidec Drives](#) website..



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:



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

Scan Results


New project with selected drives


Add selected drives to current project

Name:

Location:

Finished scanning for devices. (1 found.)

✓ Scanning RTU networks (nodes 1-5) - One drive found

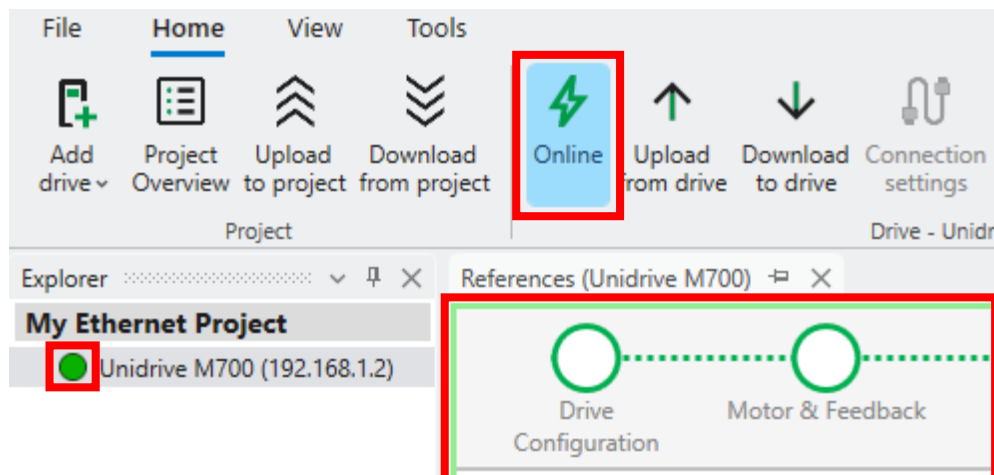
☒	Address	Type	Name	Serial number	
☒	COM5:1	Unidrive M700	Axis1	Q008727005	 Wink

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

3 Configure the drive using Connect

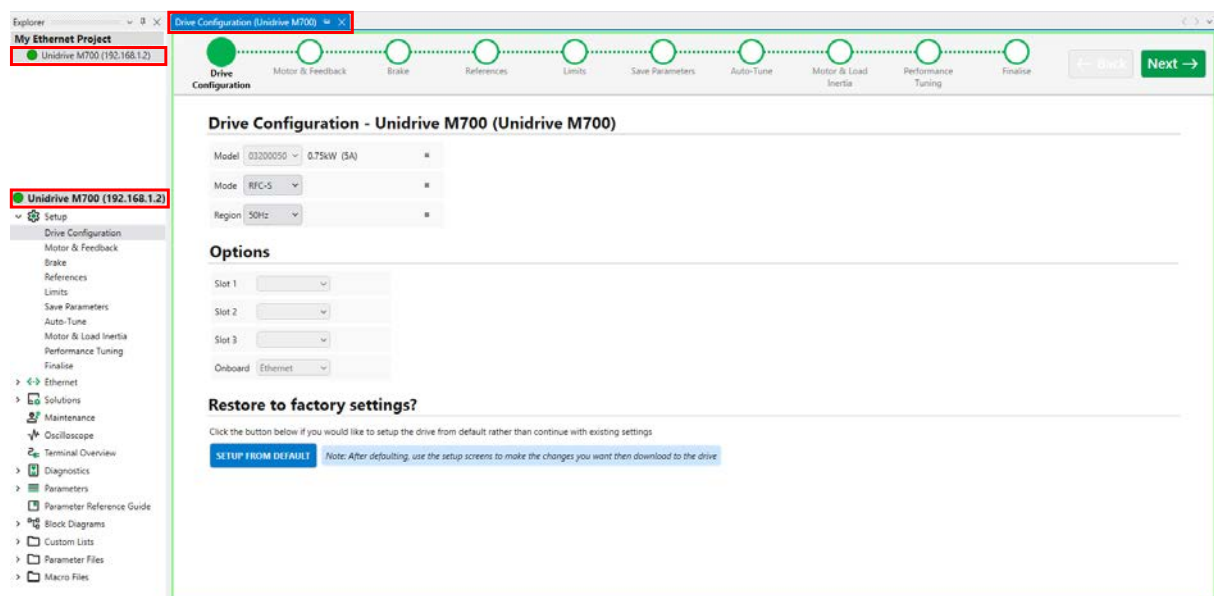
Create a new Connect project to configure and commission the drive for the motion application:

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 its 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.

- 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 is 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:

$$\text{Rated Torque (Nm)} = (\text{Rated Power (W)} \times 60) / (2 \times \pi \times \text{Motor Rated Speed (rpm)})$$

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.

Motor Search

Enter the motor model number or a custom motor name:

Start typing to search for motors...

Save

Export

Delete

Import

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:

Motor & Feedback (Unidrive M700)

Drive Configuration

Motor & Feedback

Brake

References

Limits

Save Parameters

Auto-Tune

Motor & Load Inertia

Motor Search

Enter the motor model number or a custom motor name:

067E

CT Dynamics, 067EDA300BAFMA, 10 poles, 220V, 3000rpm, 1.5A, No Brake, Key, Heidenhain EC11118 EnDat 2.1 18-bit, DIN44082

CT Dynamics, 067EDA300BAFMC, 10 poles, 220V, 3000rpm, 1.5A, No Brake, Key, Heidenhain EC11118 EnDat 2.1 18-bit, KTY84.130

CT Dynamics, 067EDA300BAARA, 10 poles, 220V, 3000rpm, 1.5A, No Brake, Key, Resolver 2 poles, 0.5, 6kHz, DIN44082

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.

Thermistor Setup

Thermistor Connection

Analog Input

Thermistor Fault Detection

Thermistor

Analog Input 3 Thermistor Type

DIN44082

Analog Input 3 Thermistor Reset Threshold

1800

Ω

Analog Input 3 Thermistor Trip Threshold

3330

Ω

Page 14 of 43

If the drive is either a Digitax HD or a Unidrive M with firmware $\geq V01.61.01.00$ 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:

Parameter values have been loaded from the digital motor nameplate. Values effected are highlighted in blue.

Motor Search

Enter the motor model number or a custom motor name:

Start typing to search for motors...

Save Export
Delete Import

Motor Setup 067EDA300XFMA05140-SRBS (124600122)

Motor Type: Permanent Magnet Servo

Summary Advanced Auto-tune

Rated Current	1.500	A
Rated Voltage	230	V
Rated Speed	3000.00	rpm
Number Of Motor Poles	10	Poles
Volts Per 1000rpm	57	V
Torque Per Amp	0.93	Nm/A

Thermistor Setup

Thermistor Connection	Drive P1
Thermistor Fault Detection	Temperature
P1 Thermistor Type	DIN44082
P1 Thermistor Reset Threshold	1800

Feedback selection

Feedback Mode: Feedback device Motor Control Feedback Select: P1 Drive

Feedback type

P1 Device Type: EnDat Rotary Linear

Basic Advanced

P1 Supply Voltage	5V
P1 Auto-configuration Select	Enabled
P1 Comms Baud Rate	4M Baud

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.

- 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.

Brake (Unidrive M700)

Drive Configuration Motor & Feedback **Brake** References Limits Save Parameters Auto-Tune Motor & Load Inertia Performance Tuning Finalise

Dynamic Braking Resistor

Is a dynamic braking resistor fitted? ☒

Braking Resistor Resistance 75.00 Ω

Braking Resistor Rated Power 0.050 kW

Braking Resistor Thermal Time Constant 3.300 s

The resistor must be connected between the BR terminal and +DC. It is recommended to fit a thermal protection device. The minimum braking resistance for this drive is 22 Ω . The brakes instantaneous power rating is 7.7 kW. The brakes continuous power rating is 1.5 kW.

Mechanical Brake Control

The mechanical brake controller is used in hoisting applications to ensure that the load is always being controlled by either the drive or the brake, when moving and stopping the load. The controller checks that the motor is producing torque to hold the load and compensates for the delay for the brake to physically release and apply.

Is a mechanical brake fitted? ☒

Terminal	Invert	Parameter
None	☐	Brake Control: Brake Release
None	☐	External Brake Released Indicator

Mechanical Brake Control Settings

Brake Control: Brake Apply Speed 5 rpm

Brake Control: Brake Delay 1.0 s

Brake Control: Post-brake Release Delay 1.0 s

Brake Control: Brake Apply Delay 1.0 s

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.

- 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.

References (Axis1)

Drive Configuration Motor & Feedback Brake **References** Limits Save Parameters Auto-Tune Motor & Load Inertia Performance Tuning Finalise

Reference Source

Select the reference to control the motor **Preset Reference**

Command Source

Control Word Enable ☒ On

Profile Setup

Maximum Reference Clamp 3000.0 rpm Acceleration Rate 0.200 s/1000rpm S Ramp Percentage 0.0 %

Minimum Reference Clamp 0.0 rpm Deceleration Rate 0.200 s/1000rpm Bipolar Reference Enable ☐ Off

Stop Mode **Ramp** Ramp Rate Units ☐ Off

Main Reference

The bits below can be used to trigger run commands, once control word bit 7 is enabled:

- Run forward is commanded by setting control word bit 1 to 1
- Run reverse is commanded by setting control word bit 3 to 1

Preset Reference 1 500.0 rpm

Speed (RPM) 1000.00rpm Time 0.200s 0.200s

Jog Reference

The bits below can be used to trigger jog commands, once control word bit 7 is enabled:

- Jog is commanded by setting control word bit 2 to 1
- Jog direction is controlled by setting control word bit 4 to 0 (forward) or 1 (reverse)

Jog Reference 100.0 rpm

Speed (RPM) 1000.00rpm Time 0.200s 0.200s

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

- 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.

Limits (Shindrive M700)

Drive Configuration Motor & Feedback Brake References **Limits** Save Parameters Auto-Tune Motor & Load Inertia Performance Tuning Finalise

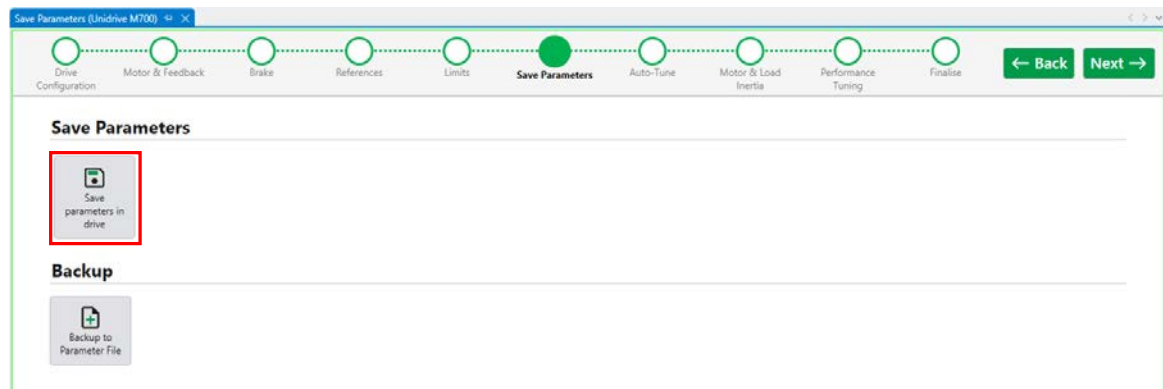
Hardware Travel Limit Configuration

Setup the 24V digital inputs used to trigger the positive and negative hardware limits. Note that when a limit is hit the axis will try to stop instantly with no profiling.

Terminal	Invert	Parameter
None	☐	Forward Limit Switch
None	☐	Reverse Limit Switch

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

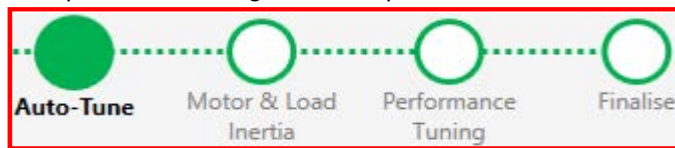
7. The save parameters page allows the parameters configured so far to be saved. It is advised to do this prior to the commissioning activities since the power might have to be removed to correct a hardware issue as a result of a failed Autotune test, such as a reversed motor or encoder wiring.



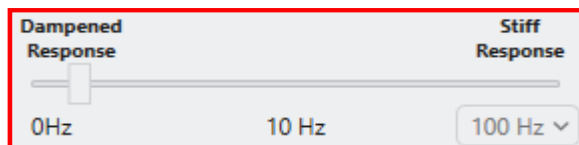
This completes the configuration section of the guided setup. The next section of the manual describes the commissioning of the drive and motor using the remaining steps in the guided setup.

4 Commission the drive and motor using Connect

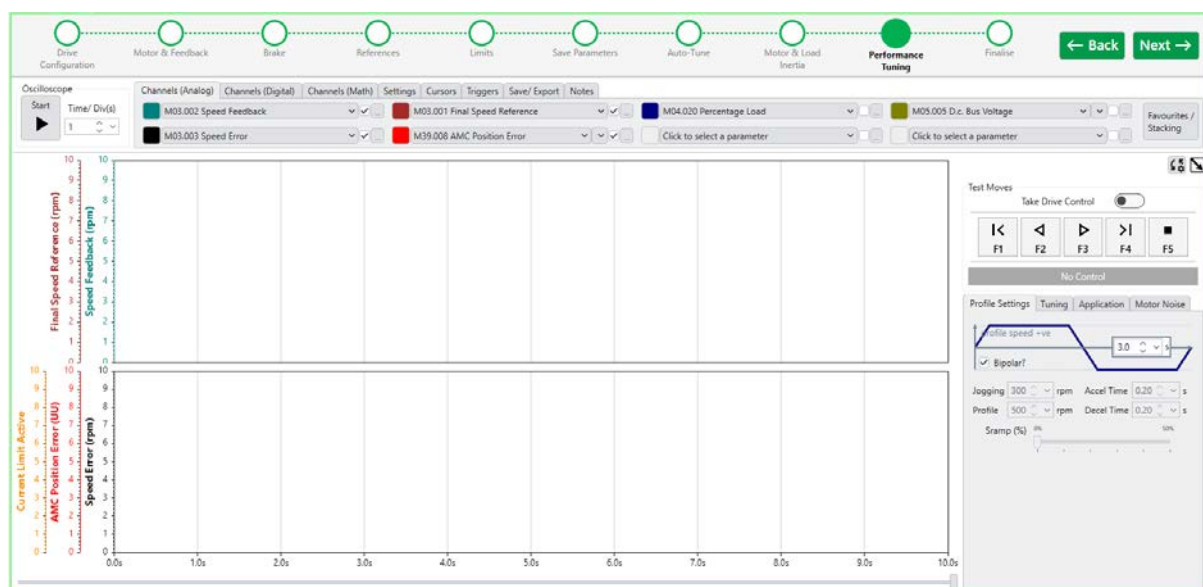
This section describes the process of commissioning the drive and motor in the application using the tools provided in the guided setup, which consist of:



- 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.

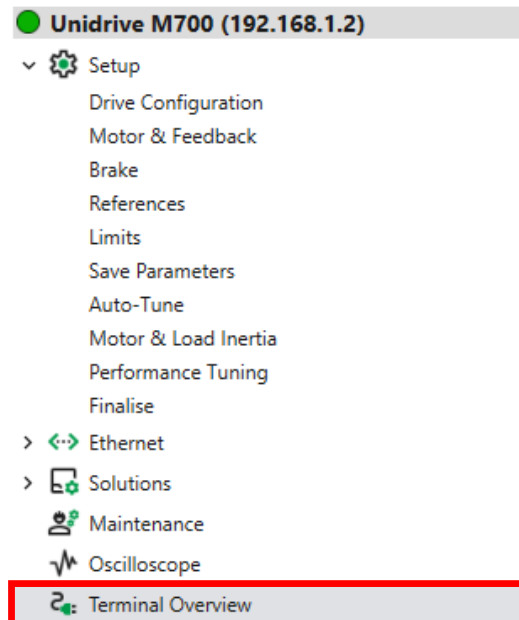


- Performance tuning and test moves. This page is a “one stop shop” with test move controls, motion profile setup, oscilloscope, and tuning controls on a single page, ideal for site commissioning using a laptop.



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.



Unidrive M700

Polarized connector: T1 - T11					
Terminal	Terminal Function	Invert	Mode	Mapped Parameter	State
T1	0V				
T2	24V Supply Input	☐		M00.000 Parameter mm.000	
T3	0V				
T4	+10V Output				
T5/T6	Analog Input 1	☐	Volt	M01.036 Analog Reference 1	
T7	Analog Input 2	☐	Volt	M01.037 Analog Reference 2	
T8	Analog Input 3	☐	Volt	M00.000 Parameter mm.000	
T9	Analog Output 1			M03.002 Speed Feedback	
T10	Analog Output 2			M04.002 Iq	
T11	0V				

Polarized connector: T21 - T31					
Terminal	Terminal Function	Invert	Mapped Parameter	State	
T21	0V				
T22	24V Supply Output	☒	M00.000 Parameter mm.000		
T23	0V				
T24	Digital IO 01	☐	M10.003 Zero Speed		
T25	Digital IO 02	☐	M10.033 Drive Reset		
T26	Digital IO 03	☐	M06.030 Run Forward		
T27	Digital Input 04	☐	M06.032 Run Reverse		
T28	Digital Input 05	☐	M01.041 Reference Select Flag 1		
T29	Digital Input 06	☐	M06.031 Jog		
T30	0V				
T31	Drive Enable (24V STO)				

Polarized connector: T41 - T42				
Terminal	Terminal Function	Invert	Mapped Parameter	State
T41/T42	Relay Output	☐	M10.001 Drive Healthy	

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 screenshot shows the 'Auto-Tune' configuration page in a software interface. At the top, a progress bar indicates the current step is 'Auto-Tune'. Below the progress bar, the 'Auto-Tune' section contains a warning and configuration options. The 'Auto-Tune Test' section has a 'Start Auto-tune' button highlighted with a red box.

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

The screenshot shows the 'Auto-Tune' configuration page. In the 'Auto-Tune Test' section, a warning message is displayed: 'Auto-Tune To start Auto-tune enable the drive by applying a 24V signal to the STO Terminal'. This message is highlighted with a red box.

The test takes approximately 30s to complete

The screenshot shows the 'Auto-Tune' configuration page. In the 'Auto-Tune Test' section, the status 'Auto-Tune in progress' is displayed, indicating the test is running. This status is highlighted with a red box.

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

Drive Configuration

Motor & Feedback

Brake

References

Limits

Save Parameters

Auto-Tune

Motor & Load Inertia

Performance Tuning

Finalise

Back

Next

Auto-Tune

An Auto-tune is used to sample the electrical properties of the motor to tune the drive operation.
WARNING! For safety reasons, even though an Auto-tune type says it is stationary, the motor should be treated as if motion may occur under full torque. Please take any appropriate safety measures in case the motor turns.

Auto-Tune Configuration

Select an Auto-tune type: Rotating * Select the motion direction: Forwards Backwards *

Auto-Tune Test

Stop Auto-tune

Auto-Tune
Complete Auto-tune by removing the 24V signal from STO terminal

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

Drive Configuration

Motor & Feedback

Brake

References

Limits

Save Parameters

Auto-Tune

Motor & Load Inertia

Performance Tuning

Finalise

Back

Next

Auto-Tune

An Auto-tune is used to sample the electrical properties of the motor to tune the drive operation.
WARNING! For safety reasons, even though an Auto-tune type says it is stationary, the motor should be treated as if motion may occur under full torque. Please take any appropriate safety measures in case the motor turns.

Auto-Tune Configuration

Select an Auto-tune type: Rotating * Select the motion direction: Forwards Backwards *

Auto-Tune Test

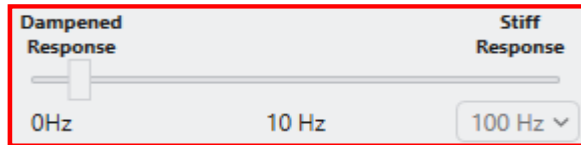
Start Auto-tune

Auto-Tune
Auto-tune completed successfully
(Parameters saved to drive)

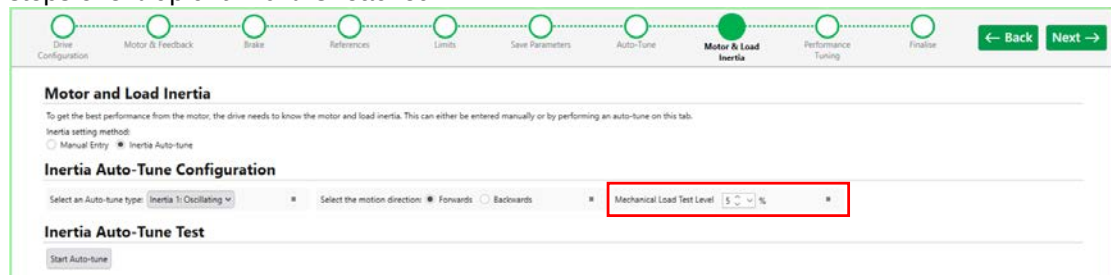
Auto-tuned values:

Parameter	Caption	Categories	Value	Source / Destination
03.025	Position Feedback Phase Angle	Autotuned Parameters	250.9 °	
04.013	Current Controller Kp Gain	Autotuned Parameters	453	
04.014	Current Controller Ki Gain	Autotuned Parameters	5271	
05.016	Minimal Movement Phasing Test Angle		0.000 °	
05.017	Stator Resistance	Autotuned Parameters	6.854452 Ω	
05.024	Ld		29.399 mH	
05.059	Maximum Deadtime Compensation	Autotuned Parameters	0.750 µs	
05.060	Current At Maximum Deadtime Compensation	Autotuned Parameters	0.63 %	

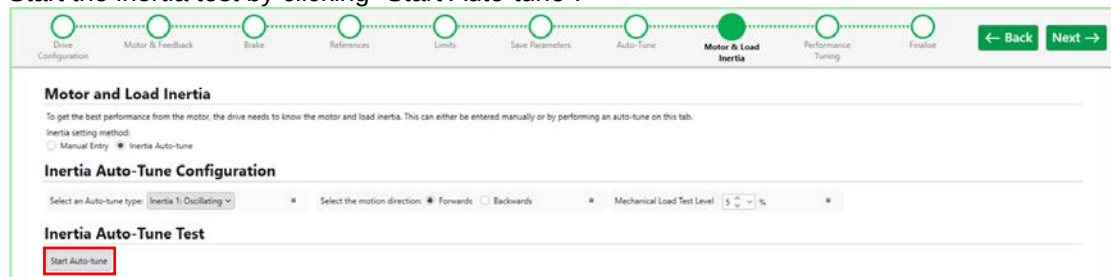
4. The “Motor and load inertia” page configures a test to measure the motor and load inertia. This test is important as it allows the speed loop gains to be configured using a single control slider:



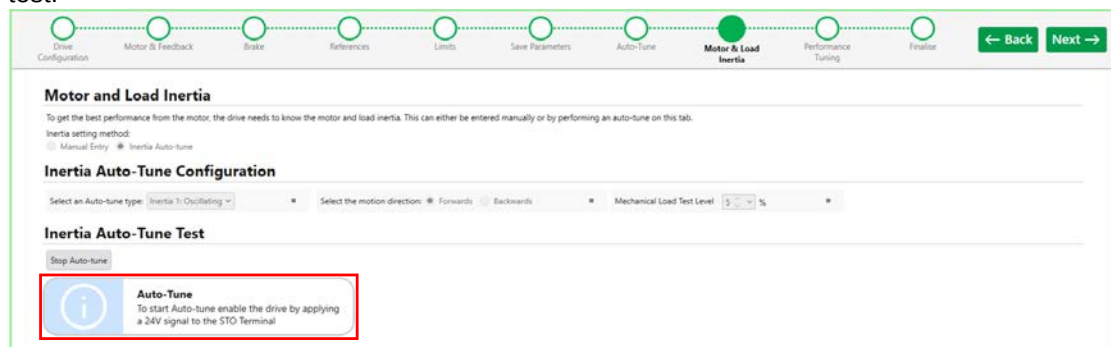
If the motor has a load connected, the default settings will be OK for most systems. Where there is no load i.e. a bare motor shaft it is recommended to increase the “Mechanical Load Test Level” to 5%. If the test fails to identify the inertia, increase the mechanical load test in steps of 5% up until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

Drive Configuration

Motor & Feedback

Brake

References

Limits

Save Parameters

Auto-Tune

Motor & Load Inertia

Performance Tuning

Finalise

← Back

Next →

Motor and Load Inertia

To get the best performance from the motor, the drive needs to know the motor and load inertia. This can either be entered manually or by performing an auto-tune on this tab.

Inertia setting method:

☐ Manual Entry ☒ Inertia Auto-tune

Inertia Auto-Tune Configuration

Select an Auto-tune type: Inertia 1: Oscillating Select the motion direction: ☒ Forwards ☐ Backwards Mechanical Load Test Level 5 %

Inertia Auto-Tune Test

Stop Auto-tune

Auto-Tune
Complete Auto-tune by removing the 24V signal from STO terminal

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

Drive Configuration

Motor & Feedback

Brake

References

Limits

Save Parameters

Auto-Tune

Motor & Load Inertia

Performance Tuning

Finalise

← Back

Next →

Motor and Load Inertia

To get the best performance from the motor, the drive needs to know the motor and load inertia. This can either be entered manually or by performing an auto-tune on this tab.

Inertia setting method:

☐ Manual Entry ☒ Inertia Auto-tune

Inertia Auto-Tune Configuration

Select an Auto-tune type: Inertia 1: Oscillating Select the motion direction: ☒ Forwards ☐ Backwards Mechanical Load Test Level 5 %

Inertia Auto-Tune Test

Start Auto-tune

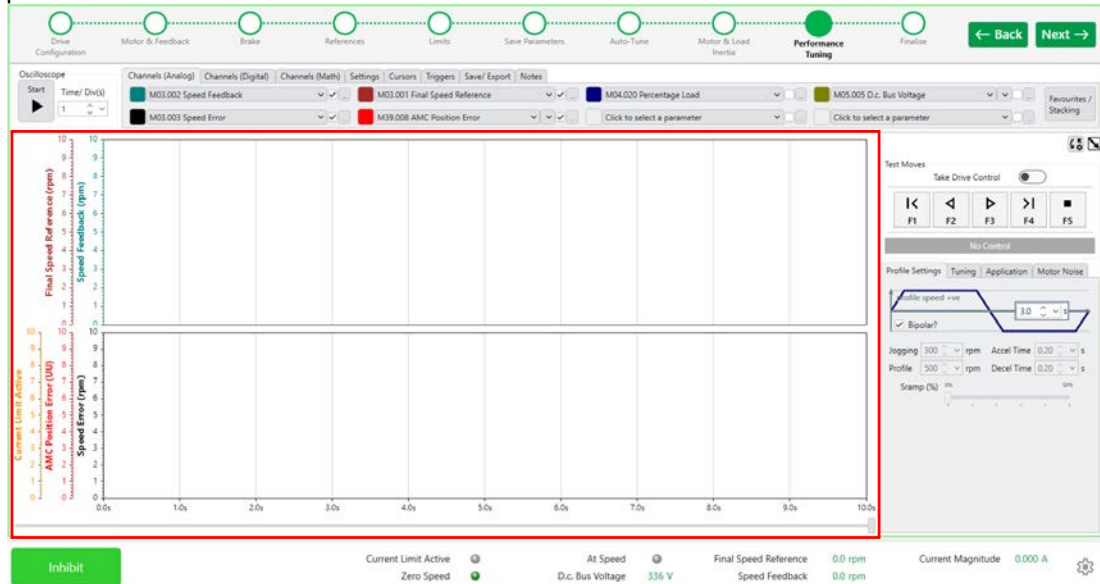
Auto-Tune
Auto-tune completed successfully
(Parameters saved to drive)

Auto-tuned values:

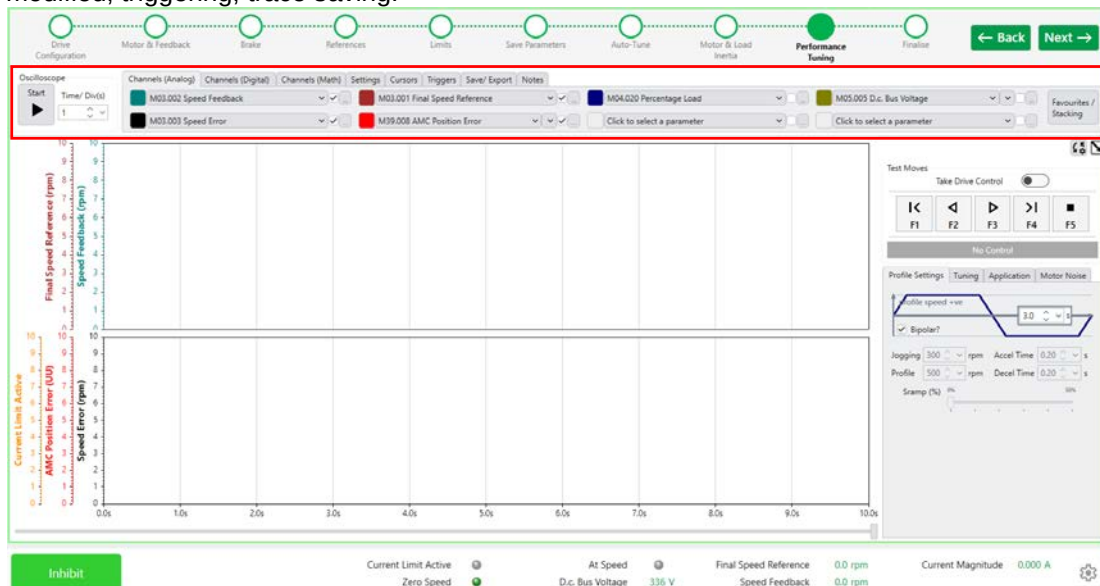
Parameter	Caption	Categories	Value	Source / Destination
03.018	Motor And Load Inertia	Autotuned Parameters	0.00101 kgm²	

- 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:



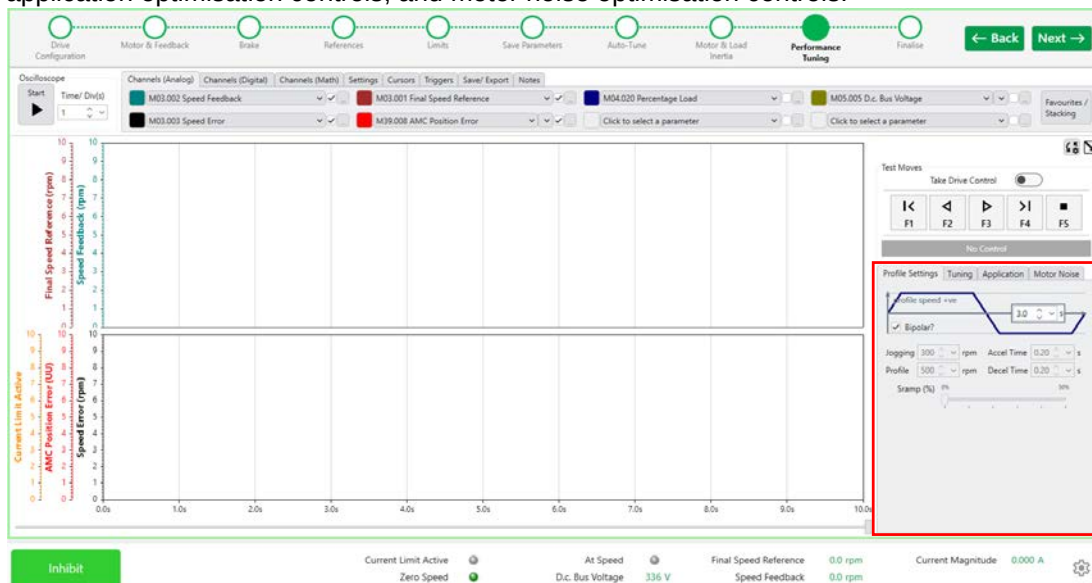
Oscilloscope controls – start and stop the trace, allow channels to be added / removed / modified, triggering, trace saving.



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



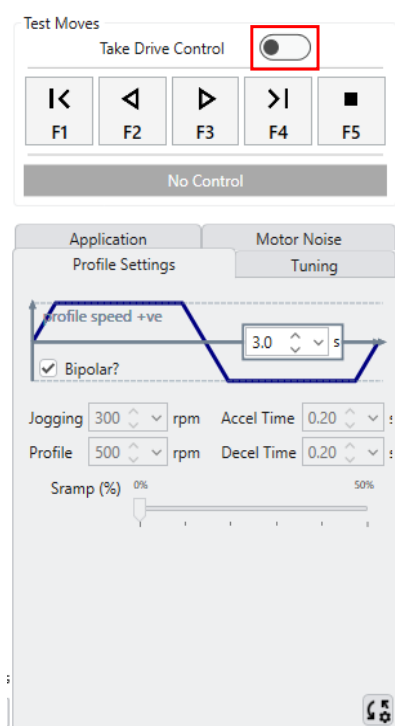
Commissioning tabs – configure the test move motion profile, speed and position loop tuning, application optimisation controls, and motor noise optimisation controls.



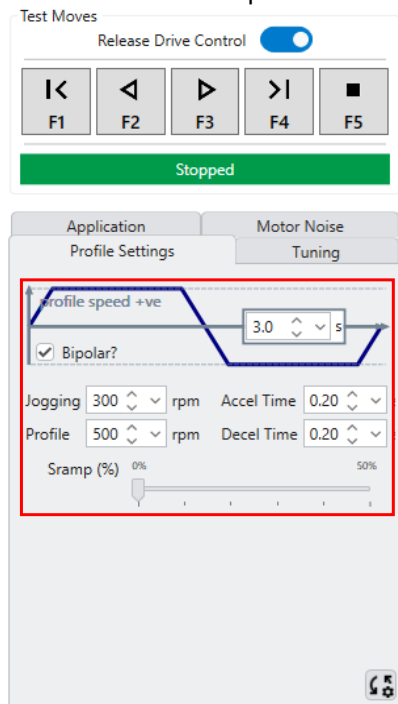
Status control – Shows key values, drive status, trip data and resetting.



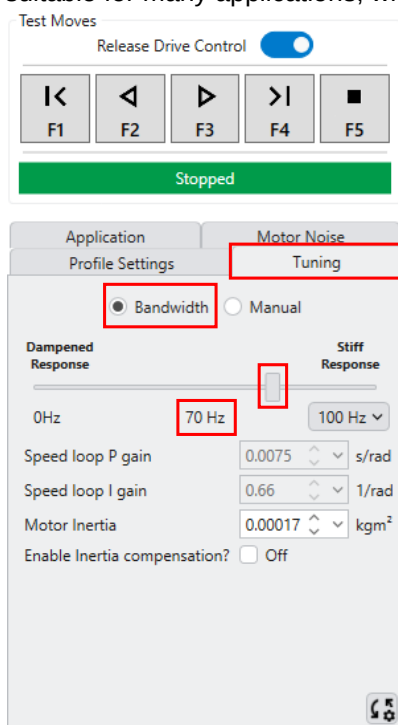
- Begin commissioning by jogging the axis (slowly) to determine if the motor direction is correct for the application. Ensure it is safe to move the motor. Click on “Take Drive Control” and then apply 24V to the STO input.



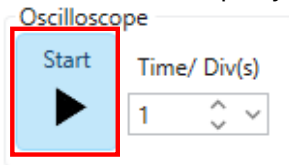
Configure the motion profile settings used when the test moves are running. This includes the jog speed, automatic running speed, acceleration and deceleration times, S ramp percentage, the overall profile time, and whether the automatic running is in one direction, or bipolar where the motor reciprocates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



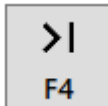
Select the Tuning tab, and then select “Bandwidth” mode. This will give moderate tuning suitable for many applications, with headroom to increase the gains further if required.



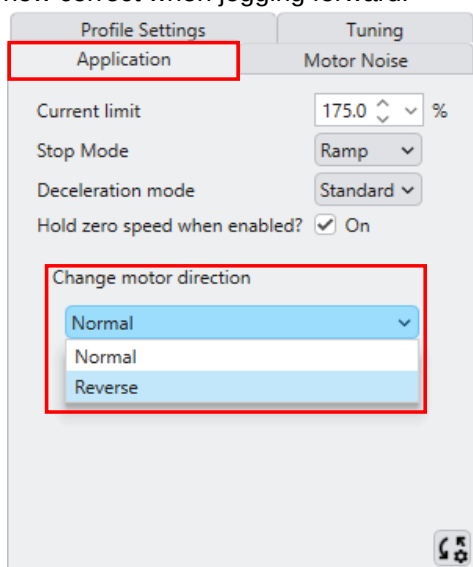
Start the oscilloscope by pressing the Oscilloscope start/stop button.



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.

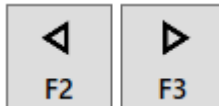


7. If the application axis has hardware limit switches connected, test them by jogging into them gently and prove that the axis stops and that the switches have been connected to the correct terminals.

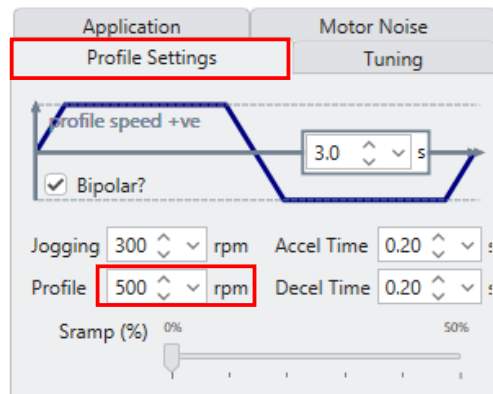
8. Verify the step response of the motor and load by enabling automatic running. Before tuning using these commands make sure that if the axis has physical limits that it is placed in the centre of these limits and that Bipolar mode is selected so that the axis moves back and forth. To stop the axis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



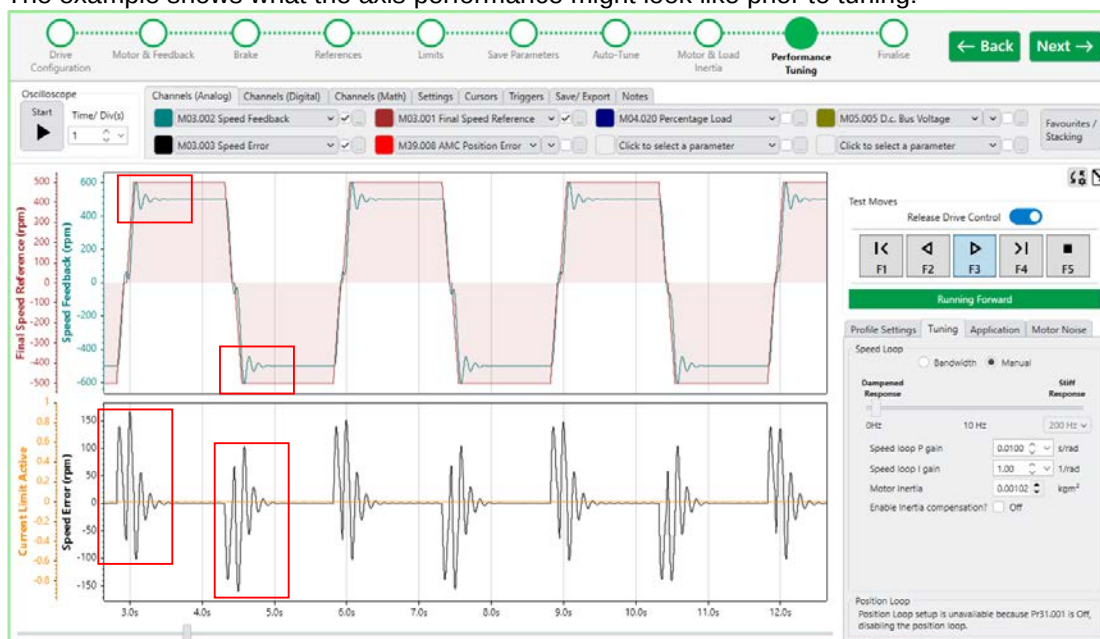
Select the initial direction of travel when automatic running using F2 (backwards) or F3 (Forwards) or by clicking the Run Forwards, Run Backwards buttons:



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.

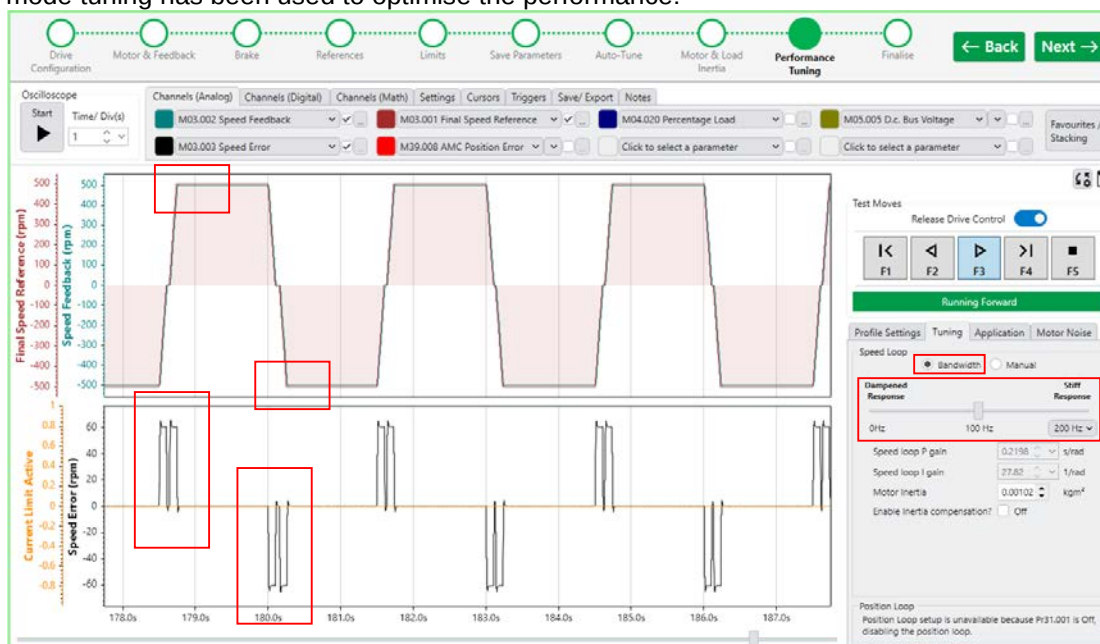


- Once the correct automatic run profile is running, the axis may be tuned further. Observe Final Speed Reference Pr3.001 and Speed Feedback Pr3.002 overlaid with each other, and the Speed Following Error Pr3.003 on a separate trace. Ensure there is no significant overshoot when stopping or when reaching 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:



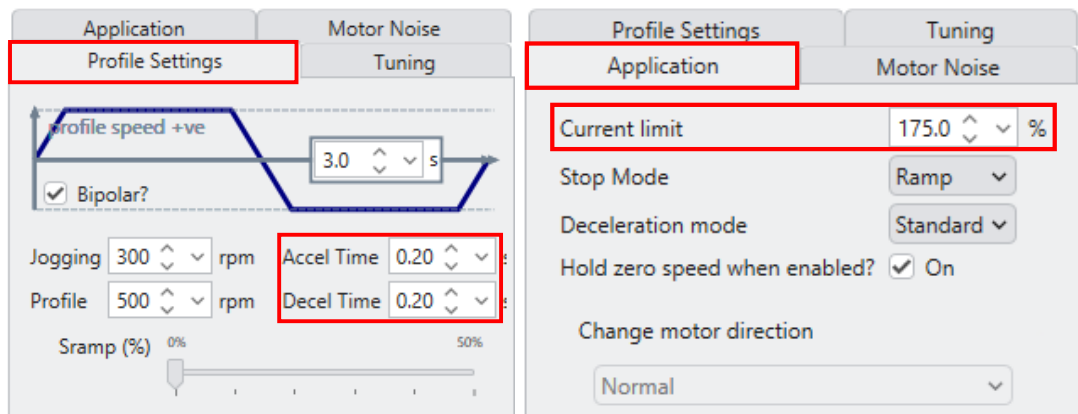
In the previous example trace it can be seen that there is significant speed overshoot caused by the load inertia and default gains. The speed following error shows oscillations when accelerating and decelerating. All of these artifacts can be tuned out easily using “Bandwidth” mode and adjusting the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

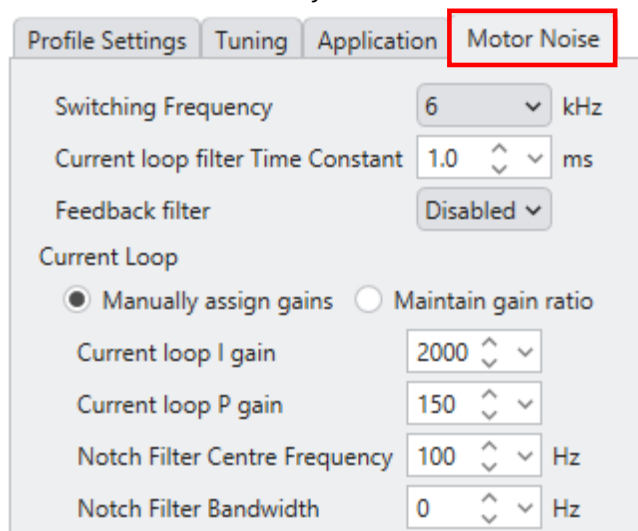


From the previous trace it can be seen that there is no significant speed overshoot, the speed following error isn't oscillating, and the drive isn't going into current limit.

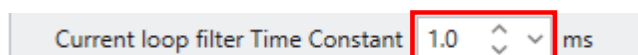
If the drive is observed going into current limit, (Current Limit Active trace goes to 1), it is an indication that the drive is going into constant torque due to hitting the current limit. This can be resolved by increasing the current limits on the Application tab or by decreasing the acceleration 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:



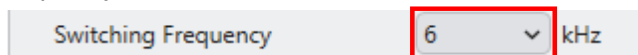
For most applications it is recommended to use a Current Loop Filter Time Constant of 1.0ms, unless the application is ultra-dynamic and needs a very fast response where a lower value is needed. A 1.0ms filter gives a 160Hz response bandwidth, where most systems will be well tuned at between 50Hz and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



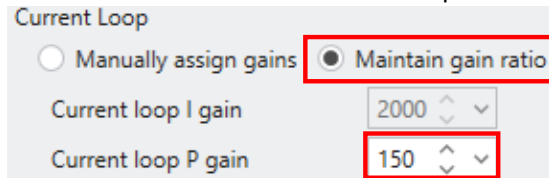
This helps in the following situations:

- o The speed reference or speed feedback contains a noise component e.g. if the feedback device is of low resolution.
- o 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.
- o The application often runs with a low motor speed where encoder quantisation noise is an issue.
- o There is mechanical resonance affecting the feedback.

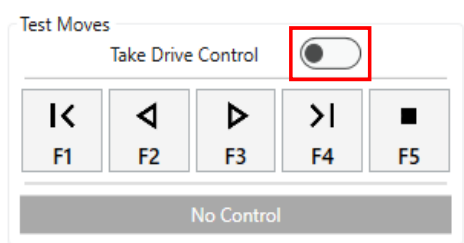
Provided the drive and motor is rated for a higher switching frequency, increasing the switching frequency can reduce audible noise from the motor.



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.



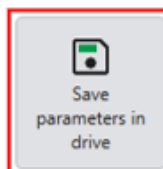
11. Disable the drive by removing 24V from the STO input, and then disable the test move control by clicking on the "Release Drive Control". When drive control has been released it looks as shown below:



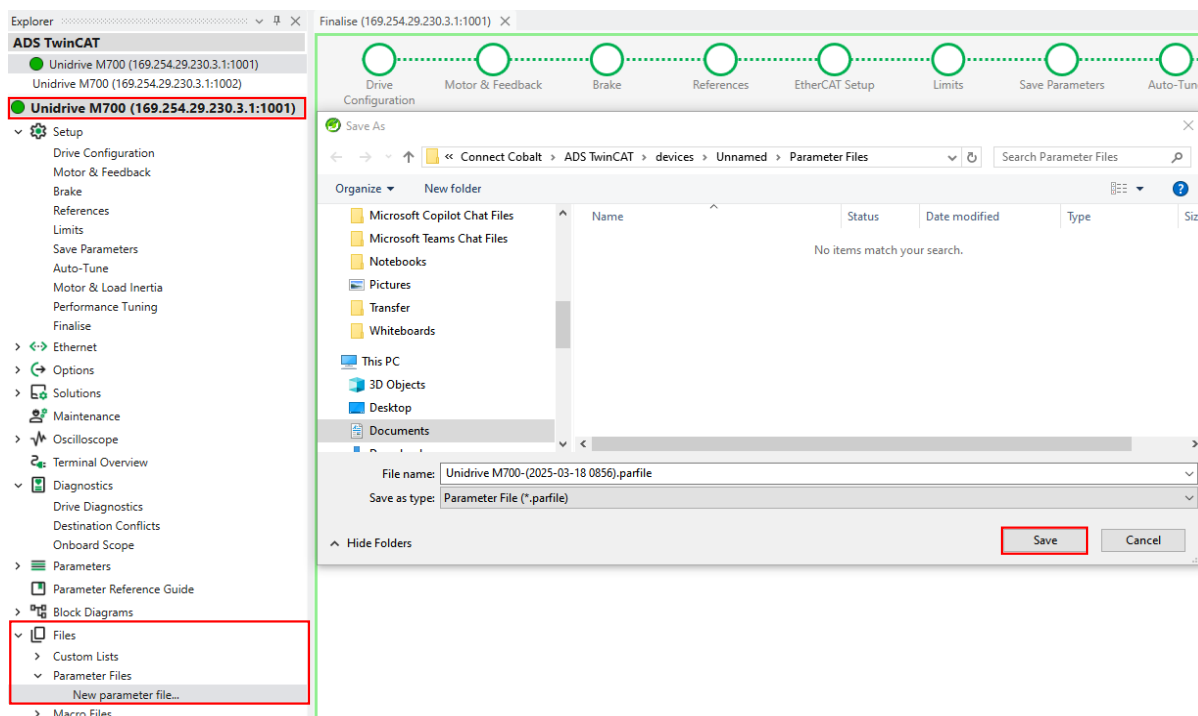
Click Next to move to the "Finalise" page.

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

Save Parameters



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”.

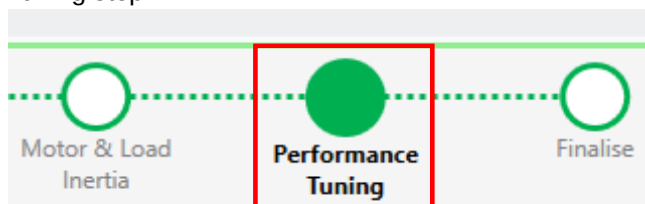


The position loop should be tuned when the application software is written, and the machine is running with the worst-case production motion profile, i.e. the most dynamic motion profile coupled with the highest load that will be experienced by the system while running.

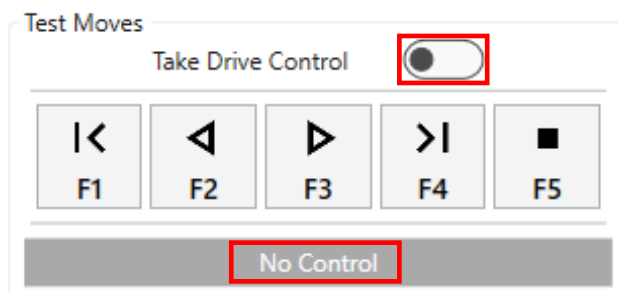
In many cases the default position loop p gain of 25.00 will give reasonable performance, but in cases where there are tight tolerances, the position loop performance can be increased to suit the requirement.

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

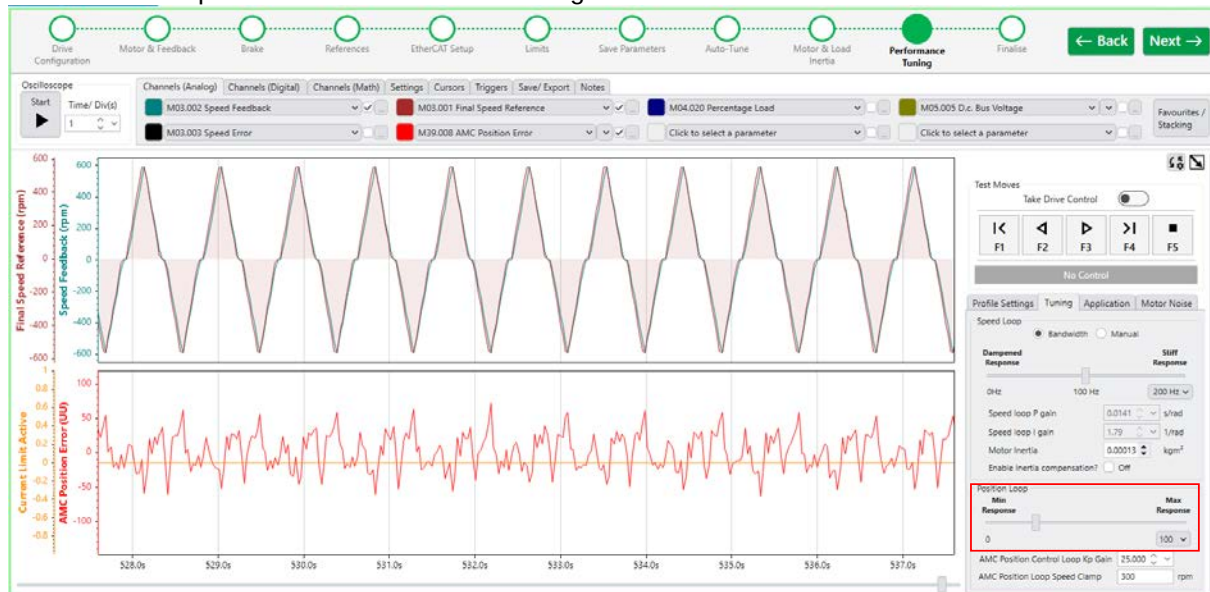


Don't enable the test move control. The test moves status must say “No Control” to leave the application software in control of the drive and therefore the drive position loop active, ready for tuning.

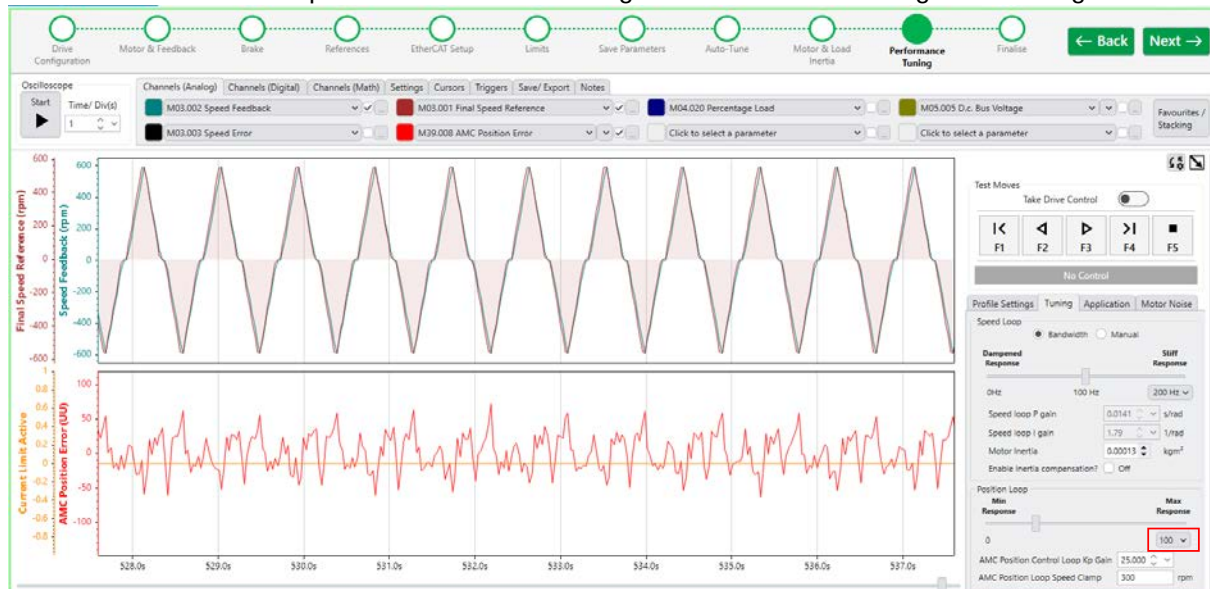


Move the position loop p gain slider to optimise the tuning and observe the red AMC Position Loop Error trace. Move the slider to the right to increase the position loop gain and increase the response.

The smaller the peak values the better the tuning is.



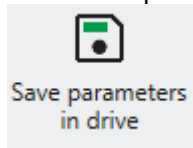
If the P Gain needs to be pushed above 100 the range can be increased using the following control:



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.

The screenshot shows the 'Performance Tuning' step of a guided setup. It has four tabs: 'Profile Settings', 'Tuning', 'Application', and 'Motor Noise'. The 'Tuning' tab is active. Under the 'Speed Loop' section, there are two radio buttons: 'Bandwidth' (selected) and 'Manual'. Below these are two sliders: 'Dampened Response' (ranging from 0 Hz to 100 Hz) and 'Stiff Response' (ranging from 100 Hz to 200 Hz). The '200 Hz' value is selected for the Stiff Response. Below the sliders are three input fields: 'Speed loop P gain' (0.0141 s/rad), 'Speed loop I gain' (1.79 1/rad), and 'Motor Inertia' (0.00013 kgm²). At the bottom of the Speed Loop section, the 'Enable Inertia compensation?' checkbox is checked and highlighted with a red box. Below the Speed Loop section is the 'Position Loop' section, which has a 'Min Response' slider (0 to 100) and a 'Max Response' dropdown (100). Below the Position Loop section are two input fields: 'AMC Position Control Loop Kp Gain' (100.000) and 'AMC Position Loop Speed Clamp' (300 rpm).

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.

The screenshot shows the 'Motor Noise' tab in a software interface. Under the 'Speed Loop' section, the 'Manual' radio button is selected and highlighted with a red box. Below this, there is a slider for 'Dampened Response' (0 Hz to 100 Hz) and a dropdown for 'Stiff Response' (200 Hz). The 'Speed loop P gain' is set to 0.0141 s/rad, and the 'Speed loop I gain' is set to 1.79 1/rad. The 'Motor Inertia' is set to 0.00032 kgm², which is also highlighted with a red box. The 'Enable Inertia compensation?' checkbox is checked and labeled 'On'. Below the 'Speed Loop' section, the 'Position Loop' section shows a slider for 'Min Response' (0 to 100) and a dropdown for 'Max Response' (100). The 'AMC Position Control Loop Kp Gain' is set to 100.000, and the 'AMC Position Loop Speed Clamp' is set to 300 rpm.

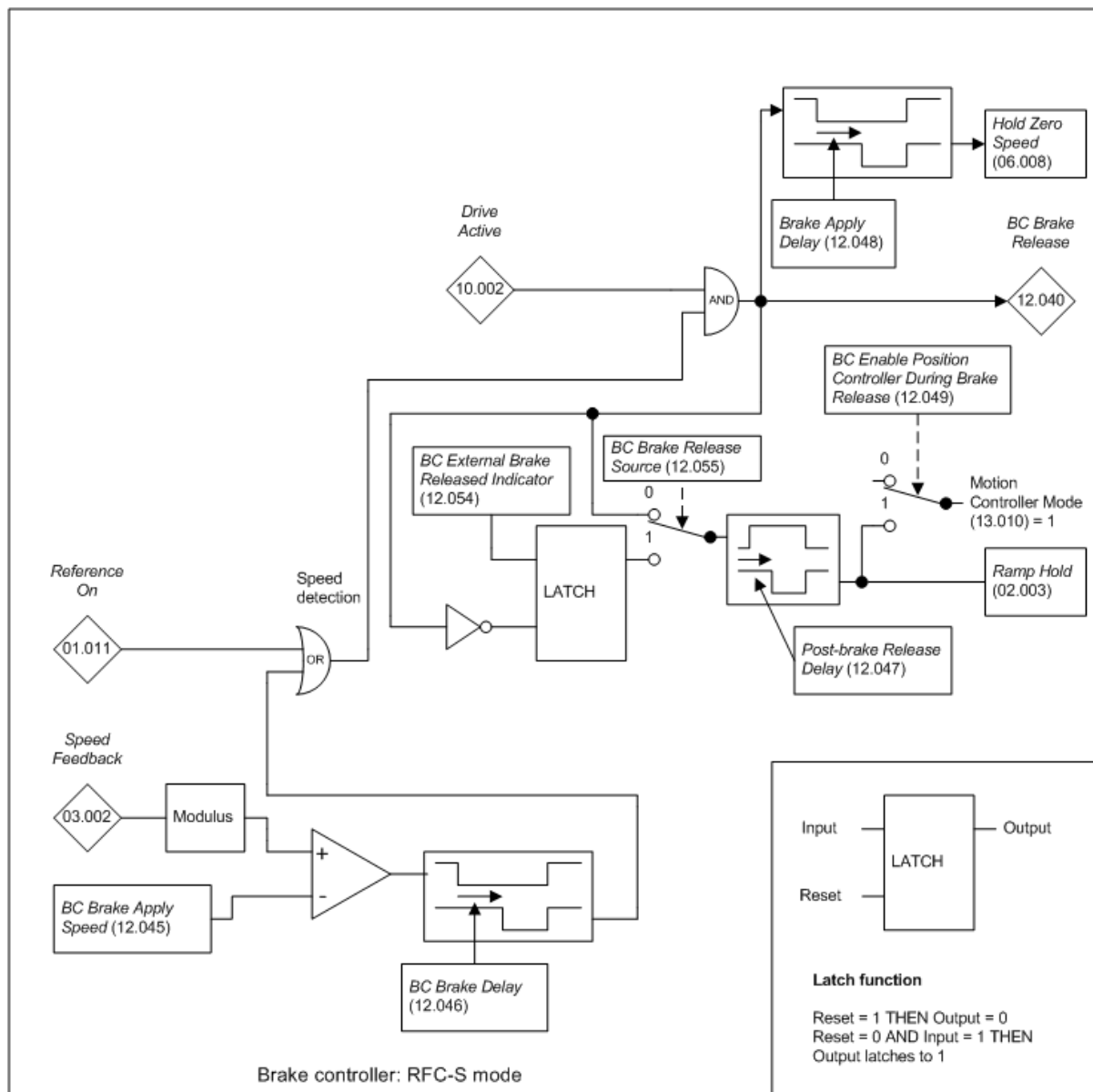
HINT: If the Inertia has been modified to tune the output of the Inertia Compensation feature, and Bandwidth mode tuning is later required, the inertia must be restored to its original value before selecting bandwidth mode, otherwise the speed loop gains may be calculated incorrectly.

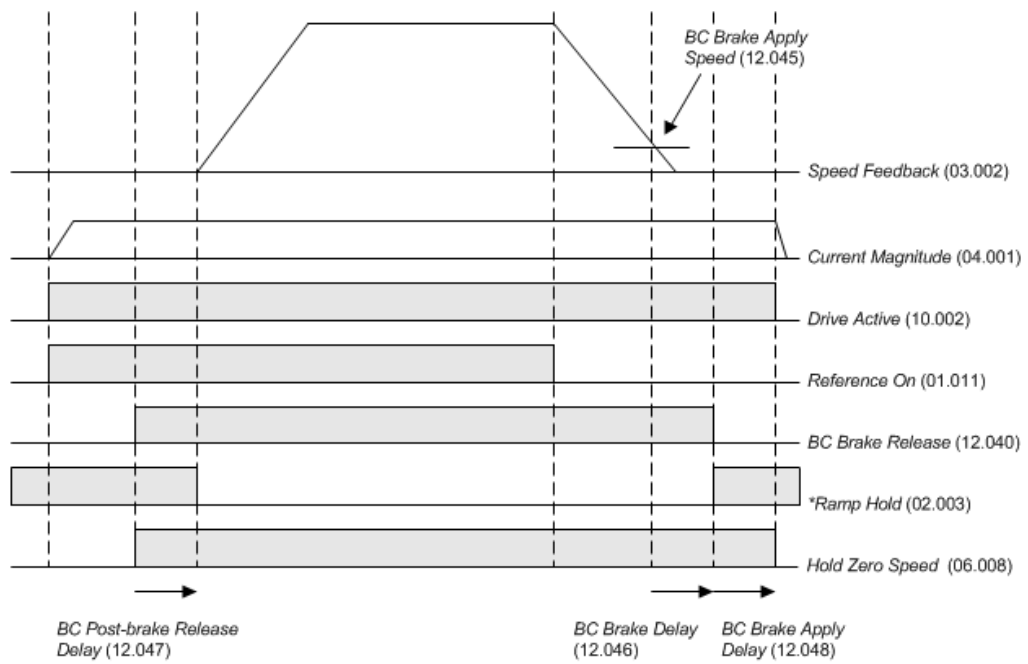
6 Additional information

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.



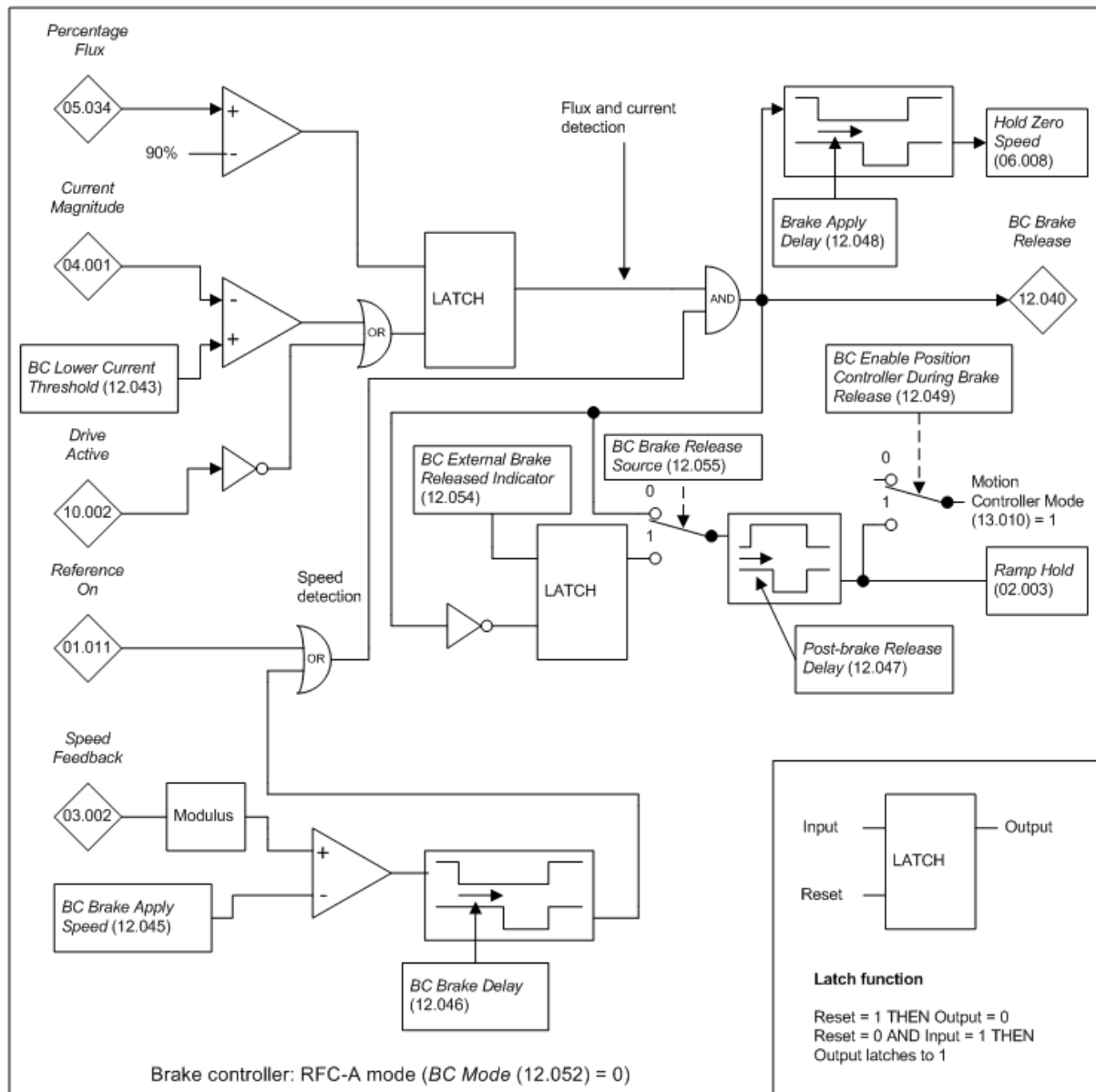


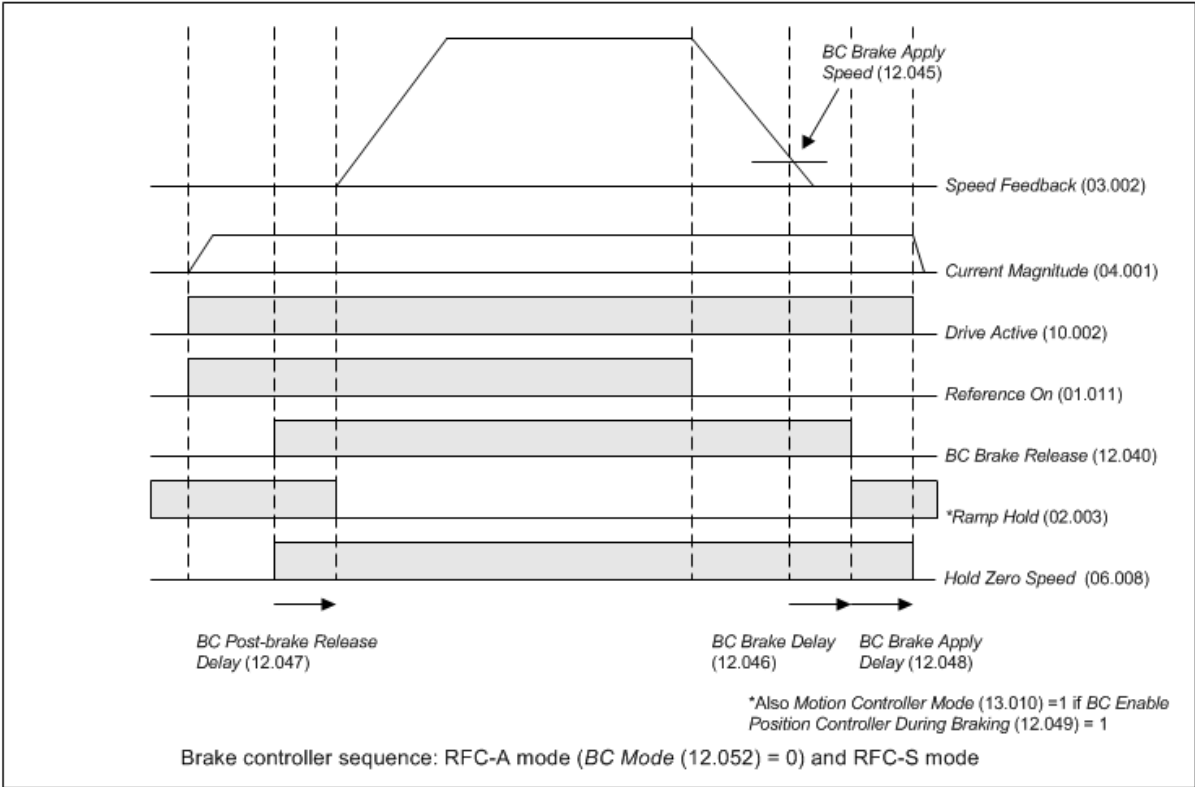
*Also Motion Controller Mode (13.010) = 1 if BC Enable Position Controller During Braking (12.049) = 1

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.







Connect with us



www.controltechniques.com

www.kbelectronics.com

©2024 Nidec Control Techniques Limited. The information contained in this brochure is for guidance only and does not form part of any contract. The accuracy cannot be guaranteed as Nidec Control Techniques Ltd have an ongoing process of development and reserve the right to change the specification of their products without notice.

Nidec Control Techniques Limited. Registered Office: The Gro, Newtown, Powys SY16 3BE.

Registered in England and Wales. Company Reg. No. 01236886.

