

TDC001 DC Servo Motor Driver User Guide



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Chapter 1 Safety

1.1 Safety Information

For the continuing safety of the operators of this equipment, and the protection of the equipment itself, the operator should take note of the **Warnings**, **Cautions** and **Notes** throughout this handbook and, where visible, on the product itself.

The following safety symbols may be used throughout the handbook and on the equipment itself.



 **Shock Warning** 
Given when there is a risk of injury from electrical shock.



 **Warning** 
Given when there is a risk of injury to users.

 **Caution** 
Given when there is a risk of damage to the product.

Note
Clarification of an instruction or additional information.

1.2 General Warnings

 **Warnings** 
If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. In particular, excessive moisture may impair operation.
Spillage of fluid, such as sample solutions, should be avoided. If spillage does occur, clean up immediately using absorbant tissue. Do not allow spilled fluid to enter the internal mechanism.

 **Caution** 
If your PC becomes unresponsive (e.g due to an operating system problem, entering a sleep state condition, or screen saver operation) for a prolonged period, this will interrupt communication between the Software and the hardware, and a communications error may be generated. To minimize the possibility of this happening it is strongly recommended that any such modes that result in prolonged unresponsiveness be disabled before the software is run. Please consult your system administrator or contact Thorlabs technical support for more details.

Chapter 2 Introduction and Overview

2.1 Introduction

The T-Cube DC Servo Controller (TDC001) is a new very compact single channel controller/driver for easy manual and automatic control of DC Servo motors. This driver has been designed to operate with a variety of lower powered DC brushed motors (up to 15V/2.5W operation) equipped with encoder feedback. The TDC001 has been optimised for 'out of the box' operation with the Thorlabs range of Z8 DC motor equipped opto-mechanical products, however highly flexible software settings and closed loop tuning also supports operation with a wide range of third party DC Servo motors and associated stages/actuators.

Although compact in footprint, this unit offers a fully featured motion control capability including velocity profile settings, limit switch handling, "on the fly" changes in motor speed and direction, control over the closed loop PID parameters and, for more advanced operation, adjustment of settings such as lead screw pitch and gearbox ratio, allowing support for many different actuator configurations.

For convenience the footprint of this unit has been kept to a minimum, measuring only 60mm x 60mm x 47mm (2.4" x 2.4" x 1.8") and with the facility to directly mount to the optical table close to the motorised device - convenient when manually adjusting motor positions using the top panel controls (jog buttons and velocity control slider). Table top operation also allows minimal drive cable lengths for easier cable management..



Fig. 2.1 T-Cube DC Servo Motor Driver

USB connectivity provides easy 'Plug and Play' PC controlled operation - multiple units can be connected to a single PC via standard USB hub technology or by using the new T-Cube Controller Hub (see over) for multi-axis motion control applications. Coupling this with the very user friendly Kinesis software (supplied) allows the user to very quickly get up and running with complex move sequences in a short space of time – for example all relevant operating parameters are set automatically by the software for Thorlabs stage/actuator products. Advanced custom motion control applications and sequences are also possible using the extensive ActiveX® programming environment also supplied. This programming library is compatible with many development tools such as LabView, Visual Basic, Visual C++, C++ Builder, LabWindows/CVI, Matlab and Delphi.

For power, a compact multi-way power supply unit (TPS008) is available from Thorlabs allowing up to 8 T-Cube Drivers to be powered from a single mains outlet. This power supply unit is also designed to take up minimal space and can be mounted to the optical table in close proximity to the driver units, connected via short power leads. A single way wall plug supply (TPS001) is also available for powering a single T-Cube Driver.

In the remainder of this handbook, operation of the unit is described for both front panel and PC operation. Tutorial sections (Chapter 4 and Chapter 5) provide a good initial understanding on using the unit and reference section (Chapter 6) covers all operating modes and parameters in detail.

2.2 T-Cube Controller Hub

As a further level of convenience when using the new T-Cube Controllers Thorlabs also offers the new T-Cube Controller Hub (TCH002). This product has been designed specifically with multiple T-Cube operation in mind in order to simplify issues such as cable management, power supply routing, multiple USB device communications and different optical table mounting scenarios.

The T-Cube Controller Hub comprises a slim base-plate type carrier (375mm x 86mm x 21.5mm, 14.75" x 3.4" x 0.85") with electrical connections located on the upper surface to accept up to six T-Cubes.

Internally the Controller Hub contains a fully compliant USB 2.0 hub circuit to provide communications for all six T-Cubes – a single USB connection to the Controller Hub is all that is required for PC control. The Controller Hub also provides power distribution for up to six T-Cubes, requiring only a single power connection (from a separate supply unit TPS006 supplied by Thorlabs).

2.3 Kinesis PC Software Overview

2.3.1 Introduction

The T-Cube range of controllers share many of the benefits. These include USB connectivity (allowing multiple units to be used together on a single PC), fully featured Graphical User Interface (GUI) panels, and extensive software function libraries for custom application development.

The Kinesis software suite provides a flexible and powerful PC based control system both for users of the equipment, and software programmers aiming to automate its operation.

The User Interface allows full control of all settings and operating modes enabling complete 'out-of-box' operation without the need to develop any further custom software. It provides all of the necessary system software services such as generation of GUI panels, communications handling for multiple USB units, and logging of all system activity to assist in hardware trouble shooting. It is this Kinesis server 'engine' that is used by software developers to allow the creation of advanced automated positioning applications very rapidly and with great ease. The Kinesis server is described in more detail in Section 2.3.2.

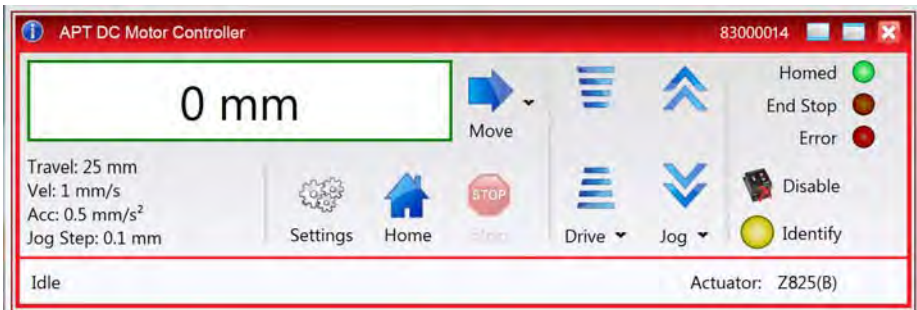
 **Caution** 
On start up, wait until the top panel POWER led is lit bright green before running the Kinesis software.

2.3.2 Kinesis Server

Kinesis controls are re-usable compiled software components that supply both a graphical user interface and a programmable interface. Many such Controls are available for Windows applications development, providing a large range of re-usable functionality. For example, there are Controls available that can be used to manipulate image files, connect to the internet or simply provide user interface components such as buttons and list boxes.

With the Kinesis system, .Net Controls are deployed to allow direct control over (and also reflect the status of) the range of electronic controller units, including the Stepper Driver T-Cube. Software applications that use .Net Controls are often referred to as 'client applications'. A .Net Control is a language independent software component. Consequently the controls can be incorporated into a wide range of software development environments for use by client application developers. Development environments supported include Visual Basic, Labview, Visual C++, C++ Builder, HPVee, Matlab, VB.NET, C#.NET and, via VBA, Microsoft Office applications such as Excel and Word.

Consider the .Net Control supplied for the T-Cube DC driver unit.



This Control provides a complete user graphical instrument panel to allow the motor unit to be manually operated, as well as a complete set of software functions (often called methods) to allow all parameters to be set and motor operations to be automated by a client application. The instrument panel reflects the current operating state of the controller unit to which it is associated (e.g. such as motor position). Updates to the panel take place automatically when a user (client) application is making software calls into the same Control. For example, if a client application instructs the associated stepper motor Control to move a motor, the progress of that move is reflected automatically by changing position readouts on the graphical interface, without the need for further programming intervention.

The Kinesis Controls collection provides a rich set of graphical user panels and programmable interfaces allowing users and client application developers to interact seamlessly with the Kinesis hardware. Each of the Kinesis controllers has an associated .Net Control and these are described fully in system online help or the handbooks associated with the controllers..

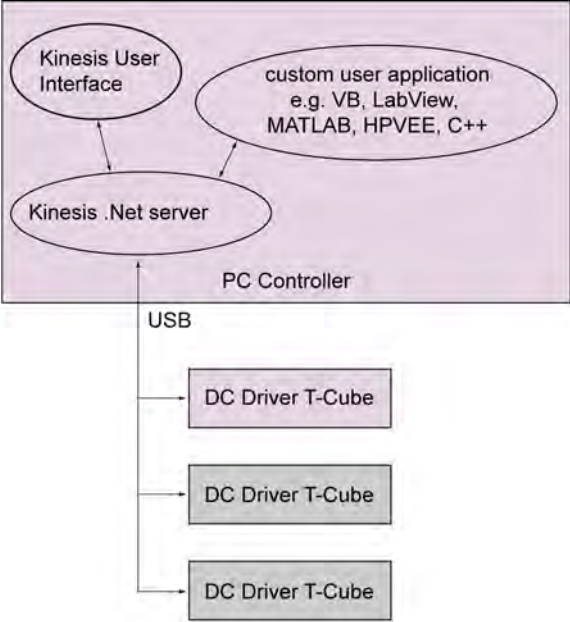


Fig. 2.2 System Architecture Diagram

Refer to the main Kinesis Software online help file, for a complete programmers guide and reference material on using the Kinesis Controls collection. This is available either by pressing the F1 key when running the Kinesis server, or via the Start menu, Start\Programs\Thorlabs\Kinesis\Kinesis Help.

2.3.3 Software Upgrades

Thorlabs operate a policy of continuous product development and may issue software upgrades as necessary.

Chapter 3 Getting Started

3.1 Install The Software



Caution



If your PC becomes unresponsive (e.g due to an operating system problem, entering a sleep state condition, or screen saver operation) for a prolonged period, this will interrupt communication between the Kinesis Software and the hardware, and a communications error may be generated. To minimize the possibility of this happening it is strongly recommended that any such modes that result in prolonged unresponsiveness be disabled before the Kinesis software is run. Please consult your system administrator or contact Thorlabs technical support for more details.



Caution



Some PCs may have been configured to restrict the users ability to load software, and on these systems the software may not install/run. If you are in any doubt about your rights to install/run software, please consult your system administrator before attempting to install. If you experience any problems when installing software, contact Thorlabs on +44 (0)1353 654440 and ask for Technical Support.

DO NOT CONNECT THE STAGE TO YOUR PC YET

- 1) Download the software from www.thorlabs.com.
- 2) Locate the downloaded setup.exe file and move to a suitable file location.
- 3) Double-click the setup.exe file and follow the on-screen instructions.

3.2 Mechanical Installation

3.2.1 Environmental Conditions



Warning



Operation outside the following environmental limits may adversely affect operator safety.

Location	Indoor use only
Maximum altitude	2000 m
Temperature range	5°C to 40°C
Maximum Humidity	Less than 80% RH (non-condensing) at 31°C

To ensure reliable operation the unit should not be exposed to corrosive agents or excessive moisture, heat or dust.

If the unit has been stored at a low temperature or in an environment of high humidity, it must be allowed to reach ambient conditions before being powered up.

3.2.2 Mounting Options

The T-Cube DC Driver is shipped with a baseplate fitted, ready to be bolted to a breadboard, optical table or similar surface.

If desired, the baseplate can be removed and the unit can be stood on rubber feet - see Section 3.2.3.

For multiple cube systems, a USB controller hub (TCH002) is available - see Section 2.2. for further details. Full instructions on the fitting and use of the controller hub are contained in handbook *ha0146 T-Cube Controller Hub*, shipped with the product.



Caution



**When siting the unit, it should be positioned so as not to impede the operation of the control panel buttons.
Ensure that proper airflow is maintained to the rear of the unit.**

3.2.3 Removing the Baseplate

The baseplate must be removed before the rubber feet (supplied) can be fitted, or the unit is connected to the USB controller hub..



Detail A
Baseplate attachment screws



Detail B
Baseplate removed and rubber feet fitted

Fig. 3.1 Removing The Baseplate

Using a hexagon key, remove the bolts securing the unit to the baseplate. Retain the bolts for future use if the baseplate is refitted.

- 4) Invert the unit.
- 5) Remove the backing paper from the rubber feet (supplied) taking care not to touch the exposed adhesive surface.
- 6) Position the feet as desired, then press and hold for a few seconds until the adhesive has bonded.
- 7) The unit may now be used freestanding, sitting on its rubber feet.

3.3 Electrical Installation

3.3.1 Connecting a Motor

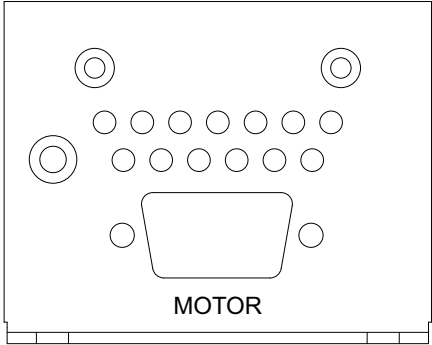


Fig. 3.2 Rear Panel Connections

The unit is supplied with a 15 pin D-type connector as shown above, which is compatible with all new Thorlabs DC servo motor actuators (refer to Appendix A for details of pin outs).

3.3.2 Using The TCH002 Controller Hub

The TCH002 USB Controller Hub provides power distribution for up to six T-Cubes, and requires only a single power connection (from a separate supply unit TPS006 supplied by Thorlabs). Further details are contained in handbook *ha0146T, T-Cube Controller Hub*, supplied with the unit.



Warning



DO NOT PLUG A POWERED UP T-CUBE INTO THE TCH002 USB CONTROLLER HUB. Always ensure that all power is disconnected from the DC Servo Driver T-Cube AND the hub before the T-Cube is plugged into the hub. Failure to observe this precaution will seriously damage the T-Cube unit and could result in personal injury.

3.3.3 Connecting To A Standalone Power Supply

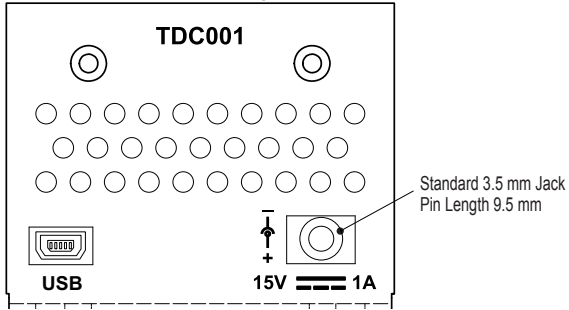


Fig. 3.3 Front Panel Power Supply Connector

- 1) Using the front panel connector as shown above, connect the unit to a regulated DC power supply of 15 V, 1A.

Thorlabs offers a compact, multi-way power supply unit (TPS008), allowing up to eight Driver T-Cubes to be powered from a single mains outlet. A single way wall plug supply (TPS001) for powering a single Driver T-Cube is also available.



Shock Warning



The unit must be connected only to a DC supply of 15V, 1A regulated. Connection to a supply of a different rating may cause damage to the unit and could result in injury to the operator.

3.4 Connect The Hardware

- 1) Perform the mechanical installation as detailed in Section 3.2.
- 2) Install the Kinesis Software.



Caution



During items (3) to (6) the instructions should be followed strictly in the order stated. Problems may occur if the process is not performed in the correct sequence.

- 3) Connect the Controller unit to your PC.
(**Note.** The USB cable should be no more than 3 metres in length. Communication lengths in excess of 3 metres can be achieved by using a powered USB hub).

**Caution**

During item (4) ensure the power supply unit is isolated from the mains before connecting to the T-Cube unit. Always power up the T-Cube unit by connecting its power supply to the mains. DO NOT connect the T-Cube unit to a 'live' external power supply. Doing so (i.e. "hot plugging") carries the risk of PERMANENT damage to the unit. Similarly, to power down the unit, disconnect the power supply from the mains before disconnecting the T-Cube unit.

- 4) Connect the DC servo motor actuator to the Controller unit - see Section 3.3.1.
- 5) Connect the Controller unit to the power supply - see Section 3.3.3.
- 6) Connect the PSU to the main supply and switch 'ON'.
(The unit takes 3 to 5 seconds from power application until warm up is finished. The green LED will light fully when the unit is ready).
- 7) Windows™ should detect the new hardware. Wait while Windows™ installs the drivers for the new hardware - see the Getting Started guide for more information.

Note

If any problems are encountered during the connection and power up process, power cycle the unit, which should clear the error.

**Caution**

Wait until the top panel POWER led is lit bright green before running the Kinesis software.

3.5 Select the Stage Type

To ensure that a particular stage is driven properly by the system, a number of parameters must first be set. These parameters relate to the physical characteristics of the stage being driven (e.g. min and max positions, leadscrew pitch, homing direction etc.).

To assist in setting these parameters correctly, you must first associate a specific stage type and axis with the motor controller. Once this association has been made,

the Kinesis server applies automatically, suitable default parameter values on boot up of the software.

Note

If the association is not used performed, the software will associate a Z806 type actuator by default.

Even if a stage type and axis has been associated with the controller, it is still possible to alter these parameters if required, (e.g. for a custom stage type not selectable using the Kinesis software) - see Section 6.3.3.

- 1) Ensure that the device is connected to the PC and powered up.
- 2) Run the Kinesis software - Start/All Programs/Thorlabs/Kinesis/Kinesis.
- 3) The 'Actuator/Startup Settings ' window is displayed.

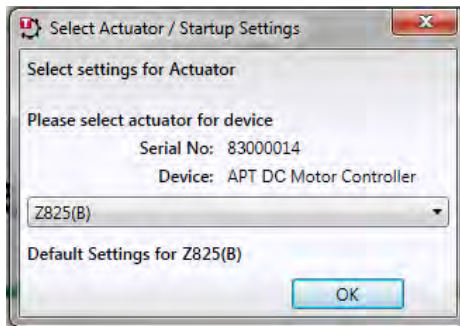


Fig. 3.4 Stage Configuration Window

- 4) Select your actuator type (e.g. Z825(B)) from the list displayed.
- 5) Click OK.
- 6) The server reads in the stage and controller information automatically. Proceed to Section 3.6. to verify the software operation.

3.6 Verifying Software Operation

3.6.1 Initial Setup

- 1) Wait until the TDC001 POWER led is lit bright green, then run the Kinesis Software and check that the Graphical User Interface (GUI) panel appears and is active.

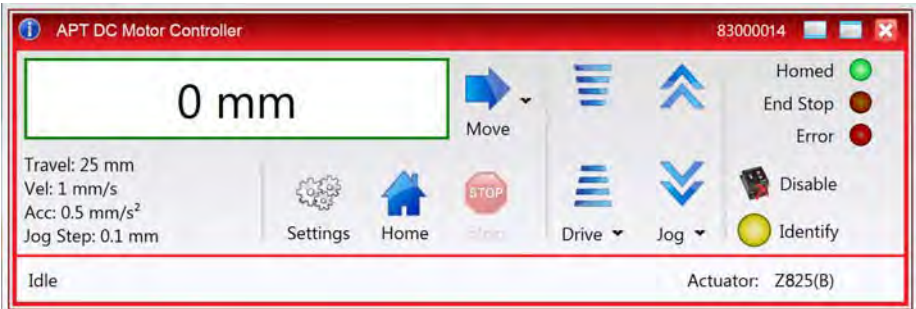


Fig. 3.5 Gui panel showing jog and ident buttons

- 2) Check that the actuator type associated at start up is displayed in the GUI panel.
- 3) Click the 'Ident' button. The Power LED and digital display on the front panel of the associated controller flashes. This is useful in multi-channel systems for identifying which channel is associated with which GUI.
- 4) Click the jog buttons on the GUI panel and check that the motor or axis connected to the DC Driver T-Cube moves. The position display for the associated GUI should increment and decrement accordingly.

Follow the tutorial steps described in Chapter 5 for further verification of operation.

Chapter 4 Standalone Operation

4.1 Introduction

The DC Driver T-Cube has been designed specifically to operate with the extensive range of Thorlabs DC motorised opto-mechanical products. The unit offers a fully featured motion control capability including velocity profile settings, limit switch handling, homing sequences and, for more advanced operation, adjustment of settings such as lead screw pitch and gearbox ratio, allowing support for many different actuator configurations. These parameters can be set via the Kinesis Server software - see Chapter 5. Furthermore, many of these parameters are automatically set to allow “out of the box” operation with no further “tuning” required.

The following brief overview explains how the front panel controls can be used to perform a typical series of motor moves. It is assumed that the unit has already been installed and configured for the particular actuator or stage to which it is associated - see Chapter 3 for more details.

In conjunction with this chapter, it also may be useful to read the background on DC servo motor operation contained in Appendix D .

4.2 Control Panel Buttons and Indicators

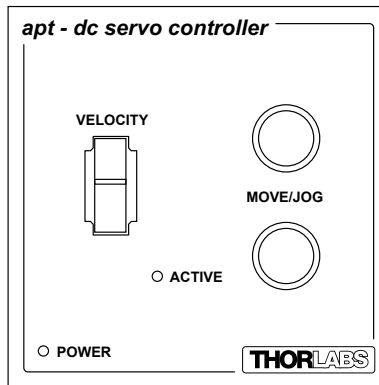


Fig. 4.1 Panel Controls and Indicators

MOVE Controls - These controls allow all motor moves to be initiated.

Move/Jog Buttons - Used to jog the motors and make discrete position increments in either direction - see Section 5.5. for more details on jogging.

Velocity Potentiometer - Used to drive the motor at a varying speed in either forward or reverse directions for full and easy motor control - see Section 4.3.

Active LED - The Active LED can be configured to flash when the motor reaches a forward or reverse limit switch, or when the Ident button is pressed in the GUI panel. It can also be configured to be lit when the motor is moving. - see Section 6.3.4. for further details.

POWER LED - Lit when power is applied to the unit. This LED can be configured to flash when the 'Ident' button is clicked on the Kinesis Software GUI panel - see Section 6.3.4. for further details.

4.3 Potentiometer Operation

The potentiometer slider is sprung such that when released it returns to its central position. In this central position the motor is stationary. As the slider is moved away from the centre, the motor begins to move. Bidirectional control of the motor is possible by moving the slider in both directions. The speed of the motor increases by discrete amounts as a function of slider deflection. These speed settings are entered in real world units (mm or degrees) in the 'Potentiometer Control Settings' parameter in the 'Advanced' settings tab - see Section 6.3.

4.4 Button Operation

The buttons on the front of the unit can be used to control the motor in a number of ways, as described below.

4.4.1 Homing

A 'Home' move is performed to establish a datum from which subsequent absolute position moves can be measured (see Section 5.3. and Section D.2.2. for further information on the home position).

To initiate a 'Home' move, press and hold both buttons for 2 seconds.

The move can be stopped at any time by pressing either of the move buttons.

4.4.2 Go to Position

In 'Go To Position' mode, each front panel button can be programmed with a different position value, such that the controller will move the motor to that position when the specific button is pressed. These 'taught' positions can be set through the software GUI - see Section 4.4.2.

In addition to entering values in the Advanced Tab as described in Section 4.4.2., when operating in 'Go To Position' mode it is possible from the front panel, to save the current position as the 'Go To Position' value.

To save the current position as the 'Go To Position' value, press and hold the required button for 2 seconds.

When the button has been programmed the 'Active' LED on the unit will flash five times. Typically you would use the pot to move the motor to the required position and then 'teach' the button by pressing and holding it.

The move can be stopped at any time by pressing either of the move buttons.

This mode of operation is enabled by setting the 'Button Mode' parameter to 'Go To Position' on the Advanced settings tab - see Section 6.3. for further information.

4.4.3 Jogging

The front panel buttons can also be configured to 'jog' the motor. This mode of operation is enabled by setting the 'Button Mode' parameter to 'Jogging' on the 'Advanced' settings tab - see Section 6.3. Once set to this mode, the jogging parameters for the buttons are taken from the 'Jog' parameters on the 'Move/Jogs' settings tab - see Section 6.3.

4.4.4 Switching between Button Modes

The two panel buttons on the unit can be set to 'Jogging' or 'Go To Position' modes via the front panel.

Press and hold one of the buttons and simultaneously deflect the pot upwards to place the unit into 'Go To Position' mode. Similarly press and hold one of the buttons and deflect the pot downwards to place the unit into 'Jogging' mode. After each mode change the 'Active' LED on the unit will flash five times.

Chapter 5 PC Operation - Tutorial

5.1 Introduction

The following brief tutorial guides the user through a typical series of moves and parameter adjustments performed using the PC based Kinesis software. It assumes that the unit is electrically connected as shown in Section 3.3.1. and that the Kinesis Software is already installed - see Section 3.1. For illustration purposes, it also assumes that a Z825B motor is connected to the 'Motor' connector on the rear panel

Caution

If your PC becomes unresponsive (e.g due to an operating system problem, entering a sleep state condition, or screen saver operation) for a prolonged period, this will interrupt communication between the Kinesis Software and the hardware, and a communications error may be generated. To minimize the possibility of this happening it is strongly recommended that any such modes that result in prolonged unresponsiveness be disabled before the Kinesis software is run. Please consult your system administrator or contact Thorlabs technical support for more details.

Caution

On start up, wait until the top panel POWER led is lit bright green before running the Kinesis software.

5.2 Using the Kinesis Software

The Kinesis software application allows the user to interact with any number of hardware control units connected to the PC USB Bus. This program allows multiple graphical instrument panels to be displayed so that multiple units can be controlled. All basic operating parameters can be set through this program, and all basic operations (such as motor moves) can be initiated.



Fig. 5.1 Typical User Screen

Caution

On start up, wait until the top panel POWER led is lit bright green before running the software.

- 1) Power up the hardware, and wait until the TDC001 POWER led is lit bright green, then run the Kinesis software - Start/All Programs/Thorlabs/Kinesis/Kinesis.
- 2) Notice how the Z825B actuator type, selected in at start up is displayed in the 'Settings' window. See Section 5.8. and Section 6.3. for further details on the parameter values shown in the 'Settings' display.

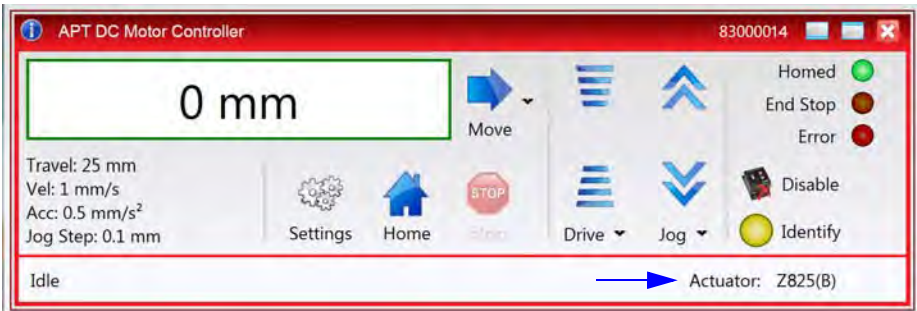


Fig. 5.2 DC Driver T-CubeSoftware GUI

5.3 Homing Motors

Homing the motor moves the actuator to the home limit switch and resets the internal position counter to zero. The limit switch provides a fixed datum that can be found after the system has been powered up.

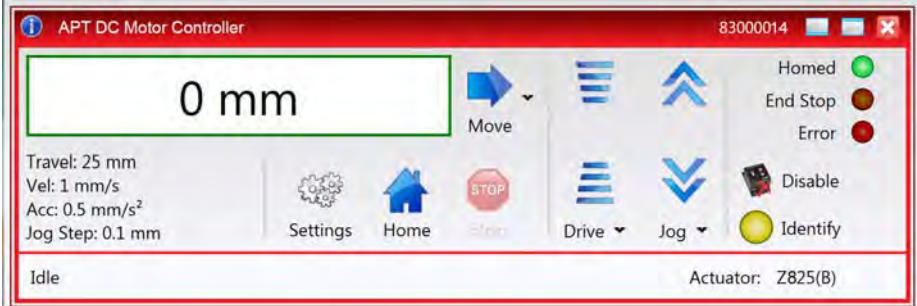


Fig. 5.3 DC Driver T-Cube Software GUI

- 1) Click the 'Home' button. Notice that the 'Not Homed' LED changes to 'Homed', and that the LED flashes to indicate that homing is in progress. The displayed position counts down to 000.000, i.e the home position.

Note

Homing can also be performed by holding down both front panel buttons for around 2 seconds.

Note


After homing, shaft relaxation may cause a small position offset to be displayed. This relates only to one or two encoder counts and is not significant in terms of 'real world' positioning.

- 2) When homing is complete, the 'Homed' LED is lit as shown above. See Appendix D Section D.2.2. for background information on the home position.

5.4 Changing Motor Parameters and Moving to an Absolute Position

Absolute moves are measured in real world units (e.g. millimetres), relative to the Home position.

Moves are performed using a trapezoidal velocity profile (see Appendix D , Section D.1.3.). The velocity settings relate to the maximum velocities at which a move is performed, and the acceleration at which the motor speeds up from zero to maximum velocity.

- 1) On the GUI panel, click the Move arrow  to show the Settings panel.

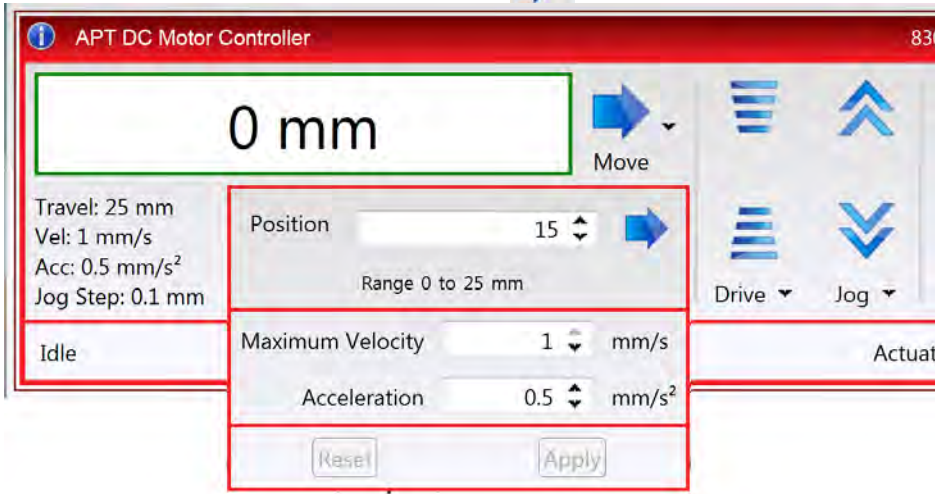



Fig. 5.4 Move Settings Panel

- 2) Enter the required absolute position and/or parameter values.
- 3) To move to the position entered click the arrow .
- 4) Click 'Apply' to save the parameter settings and close the window, click Reset to return to the previously saved values.

5.5 Jogging

During PC operation, the motor actuators are jogged using the GUI panel arrow keys. There are two jogging modes available, 'Single Step' and 'Continuous'. In 'Single Step' mode, the motor moves by the step size specified in the Step Distance parameter. If the jog key is held down, single step jogging is repeated until the button is released - see Fig. 6.3. In 'Continuous' mode, the motor actuator will accelerate and move at the jog velocity while the button is held down.

1) On the GUI panel, click the 'Settings' button to display the Settings panel.



Fig. 5.5 Settings Panel - Move/Jogs Tab

2) Make parameter changes as required.

Note
In current versions of software, the 'Min Vel' parameter is locked at zero and cannot be adjusted.

3) Click 'Apply' to save the settings and close the window, click Reset to return to the previously saved values.

5.6 Setting Move Sequences

The Kinesis software allows move sequences to be programmed, allowing several positions to be visited without user intervention. For more details and instructions on setting move sequences, please see the *Kinesis Helpfile*.

5.7 Changing and Saving Parameter Settings

During operation, certain settings (e.g. move velocity, jog step size etc) can be changed as required. Other settings (e.g. PID parameter values) cannot be changed so easily. When the Kinesis Server is run up and the stage/actuator association made, suitable default settings are loaded and these values have been chosen to provide safe performance in the majority of applications. However, for applications where these settings need to be changed, a new set of 'Device Start Up settings', must be created which can then be applied and/or uploaded on subsequent start up. See the *Kinesis Helpfile* for more details.

5.8 IStage/Axis Tab

This tab contains a number of parameters which are related to the physical characteristics of the particular stage or actuator being driven. They need to be set accordingly such that a particular stage is driven properly by the system.

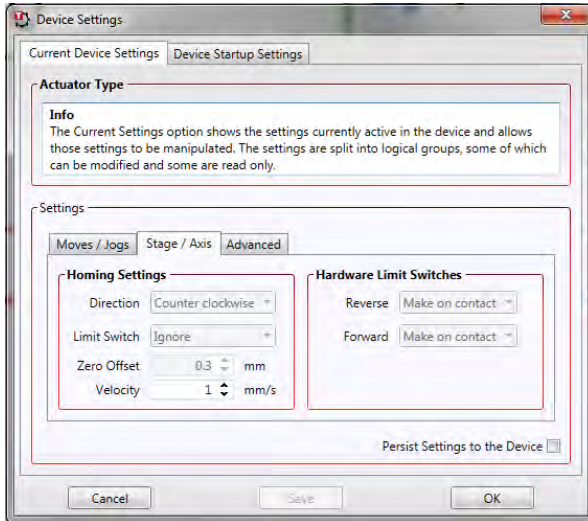


Fig. 5.6 Stage/Axis Tab

These parameters were set automatically when the actuator was selected in Section 3.5. The server automatically applied suitable defaults for the parameters on this tab during boot up. These parameters should not be altered for pre-defined Thorlabs stages and actuators, as it may adversely affect the performance of the stage.

For third party stage types not available using the software, these stage details must be entered manually.

Individual parameters are described in Section 6.3.

Chapter 6 Software Reference

6.1 Introduction

This chapter gives an explanation of the parameters and settings accessed from the Kinesis software running on a PC. For information on the methods and properties which can be called via a programming interface, see Appendix D .

6.2 GUI Panel

The following screen shot shows the graphical user interface (GUI) displayed when accessing the DC Driver T-Cube using the Kinesis software.



Fig. 6.1 DC Driver T-Cube Software GUI

Note

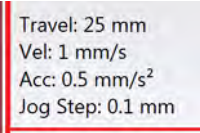
The serial number of the Stepper Driver T-Cube associated with the GUI panel is displayed in the top right hand corner. This information should always be provided when requesting customer support.

Position window - shows the position (in millimetres or degrees) of the motor. The motor must be 'Homed' before the display will show a meaningful value, (i.e. the displayed position is relative to a physical datum, the limit switch).



Move - Opens the settings window, so that position data and velocity parameters can be entered - see Section 5.4. Moves are performed using the current velocity parameters which can be changed in the same panel. The present settings are displayed below the window.

Velocity Parameters - the present setting for the move velocity parameters and the jog step size. The travel range of the associated stage/actuator is also displayed.



These settings can be adjusted as described previously, or by clicking the Settings button to display the settings window, see Section 6.3.2.

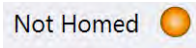
Jog Controls - used to increment or decrement the motor position. The controls comprise a bar graph and a set of jog arrows.



Each division of the bar graph represents a different velocity. The velocities are entered in the settings panel which is displayed by clicking 'Drive' or the small down arrow.

When the arrows are clicked, the motor is driven in the selected direction at the jog velocity, one step per click. The step size and jog velocity parameters can be changed by clicking 'Jog' or the small down arrow to display the settings panel.

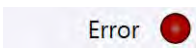
Homed/Not Homed - lit when the motor has not been 'Homed' since power up. When the home button is clicked, the caption changes to 'Homed' and the LED flashes while the home move is being performed. The LED is lit green once the move is complete.



End Stop - lit when a limit switch is activated, i.e. the motor is at its end stop.



Error - lit when a fault condition occurs.



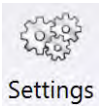
Enable/Disable - applies and removes power to the motor. With the motor enabled, only the Disable button is visible, and with the motor disabled only the Enable button is visible.

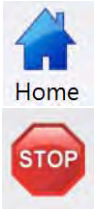


Identify - when this button is pressed, the ACTIVE LED on the front panel of the associated hardware unit will flash for a short period.



Settings - Displays the 'Settings' panel, which allows the operating parameters to be entered for the motor drive - see Section 6.3.





Home - sends the motor to its 'Home' position - see Appendix D Section D.2.2.

Stop - halts the movement of the motor.

Moving (Ext) ⚡ Actuator: Z825

Lower Display - Shows the present state of the motor, e.g. Idle, Moving, Moving EXT or Homing.

Also shows the part number of the associated actuator or stage.

6.2.1 Keyboard Shortcuts

Certain functionality can also be accessed via PC keyboard shortcuts as follows:

Jog Forwards	'Ctrl' + 'F', 'Ctrl' + '+'
Jog Backwards	'Ctrl' + 'B', 'Ctrl' + '-'
Home	'Ctrl' + 'H', 'Ctrl' + 'Home'
Stop	'Ctrl' + '0'
Jog Forward1	'LeftCtrl' + '1' (Hold to move)
Forward2	'LeftCtrl' + '2' (Hold to move)
Forward3	'LeftCtrl' + '3' (Hold to move)
Forward4	'LeftCtrl' + '4' (Hold to move)
Backward1	'RightCtrl' + '1' (Hold to move)
Backward2	'RightCtrl' + '2' (Hold to move)
Backward3	'RightCtrl' + '3' (Hold to move)
Backward4	'RightCtrl' + '4' (Hold to move)
GoTo	'Enter' (On target position box)

6.3 Settings Panel

When the 'Settings' button on the GUI panel is clicked, the 'Settings' window is displayed. This panel allows motor operation parameters such as move/jog velocities, and stage/axis information to be modified. Note that all of these parameters have programmable equivalents accessible through the functions on this Control (refer to the *Kinesis API helpfile* for further details).

6.3.1 Persisting Settings to Hardware

Many of the parameters that can be set for the Stepper Driver T-Cube can be stored (persisted) within the unit itself, such that when the unit is next powered up these settings are applied automatically. This is particularly important when the driver is being used manually in the absence of a PC and USB link. The Velocity Profile and Jogging parameters described previously are good examples of settings that can be altered and then persisted in the driver for use in absence of a PC. To save the settings to hardware, check the '*Persist Settings to the Device*' checkbox before clicking the 'OK' button.



Caution



The 'Persist Settings' functionality is provided to simplify use of the unit in the absence of a PC. When the unit is connected to a PC and is operated via the Kinesis software, the default settings will be loaded at boot up, even if the 'Persist Settings' option has been checked.

6.3.2 Moves/Jogs Tab

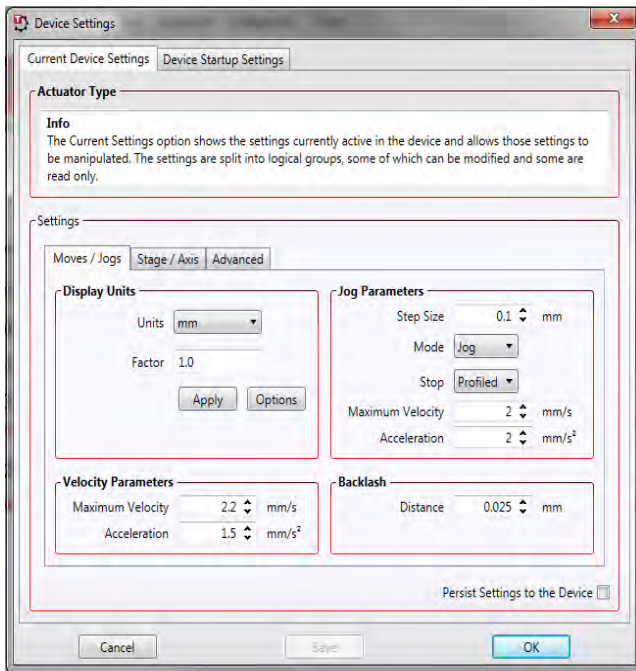


Fig. 6.2 DC Driver T-Cube - Move/Jog Settings

Display Units

By default, the unit will display position in real world units (mm or degrees). If required, the units can be changed to so that the display shows other positional units (cm, μm , μrad etc).

Units - the positioning units used on the GUI display.

Factor - the scaling factor associated with the selected units.

Jog Parameters

Jogs are initiated by using the 'Jog' keys on the GUI panel (see Section 5.5.), or the Jog Buttons on the front panel of the unit.

Step Size - The distance to move when a jog command is initiated. The step size is specified in real world units (mm or degrees dependent upon the stage).

Mode - The way in which the motor moves when a jog command is received (i.e. front panel button pressed or GUI panel button clicked).

There are two jogging modes available, 'Jog' and 'Continuous'. In 'Jog' mode, the motor moves by the distance specified in the Step Size parameter. If the jog key is

held down, single step jogging is repeated until the button is released - see Fig. 6.3. In 'Continuous' mode, the motor actuator will accelerate and move at the jog velocity while the button is held down..

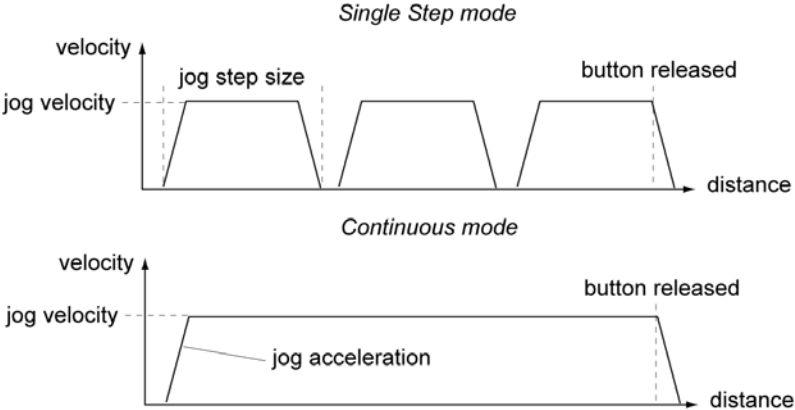


Fig. 6.3 Jog Modes

Jog - the motor moves by the distance specified in the Step Size parameter.
Continuous - the motor continues to move until the jog signal is removed (i.e. jog button is released).

Stop - the way in which the jog motion stops when the demand is removed.

Immediate - the motor stops quickly, in a non-profiled manner
Profiled - the motor stops in a profiled manner using the jog Velocity Profile parameters set above.

Maximum Velocity - the maximum velocity at which to perform a move.

Acceleration - the rate at which the velocity climbs from zero to maximum, and slows from maximum to zero.

Velocity Parameters

Moves can be initiated via the GUI panel by entering a position value after clicking on the position display box (see Section 5.4.), or by calling a software function (see the *Kinesis API helpfile*). The following settings determine the velocity profile of such moves, and are specified in real world units, millimetres or degrees.

Maximum Velocity - the maximum velocity at which to perform a move.

Acceleration - the rate at which the velocity climbs from zero to maximum, and slows from maximum to zero.

Note

Under certain velocity parameter and move distance conditions, the maximum velocity may never be reached (i.e. the move comprises an acceleration and deceleration phase only).

Backlash

Distance - The system compensates for lead screw backlash during reverse direction moves, by moving passed the demanded position by a specified amount, and then reversing. This ensures that positions are always approached in a forward direction. The Backlash Distance is specified in real world units (millimeters or degrees). To remove backlash correction, this value should be set to zero.

6.3.3 Stage/Axis Tab

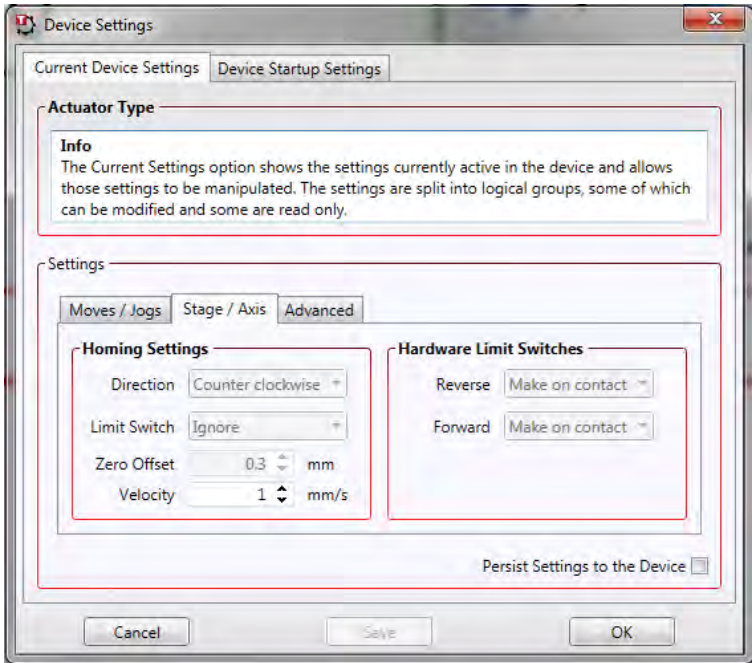


Fig. 6.4 DC Driver T-Cube - Stage/Axis Settings

Note

This tab contains a number of parameters which are related to the physical characteristics of the particular stage being driven. They need to be set accordingly such that a particular stage is driven properly by the system. For Thorlabs stages, the Kinesis software can be used to associate a specific stage and axis type with the motor channel (see Section 3.5. for further details on how to associate a stage and axis). Once this association has been made, the Kinesis server will automatically apply suitable defaults for the parameters on this tab during boot up of the software and these parameters cannot be altered subsequently as it may adversely affect the performance of the stage. Descriptions are provided for information only.

For custom stage types not available using the Kinesis software, the stage details must be entered manually - see the software overview for more details.

Homing

When homing, a stage typically moves in the reverse direction, (i.e. towards the reverse limit switch). The following settings allow support for stages with both Forward and Reverse limits.

Note

Typically, the following two parameters are set the same, i.e. both Forward or both Reverse.

Direction - the direction sense to move when homing, either *Forward* or *Reverse*.

Limit Switch - The hardware limit switch associated with the home position, either *Forward HW* or *Reverse HW*.

Zero Offset - the distance offset (in mm or degrees) from the limit switch to the Home position.

Velocity - the maximum velocity at which the motors move when Homing.

For further information on the home position, see Section D.2.2.

Hardware Limit Switches

Note

The minimum velocity and acceleration/deceleration parameters for a home move are taken from the existing move velocity profile parameters.

The operation of the limit switches is inherent in the design of the associated stage or actuator. The following parameters notify the system to the action of the switches when contact is made. Select Rev Switch or Fwd Switch as required, then select the relevant operation.

Switch Makes - The switch closes on contact

Switch Breaks - The switch opens on contact

Ignore/Absent - The switch is missing, or should be ignored.

6.3.4 Advanced Tab

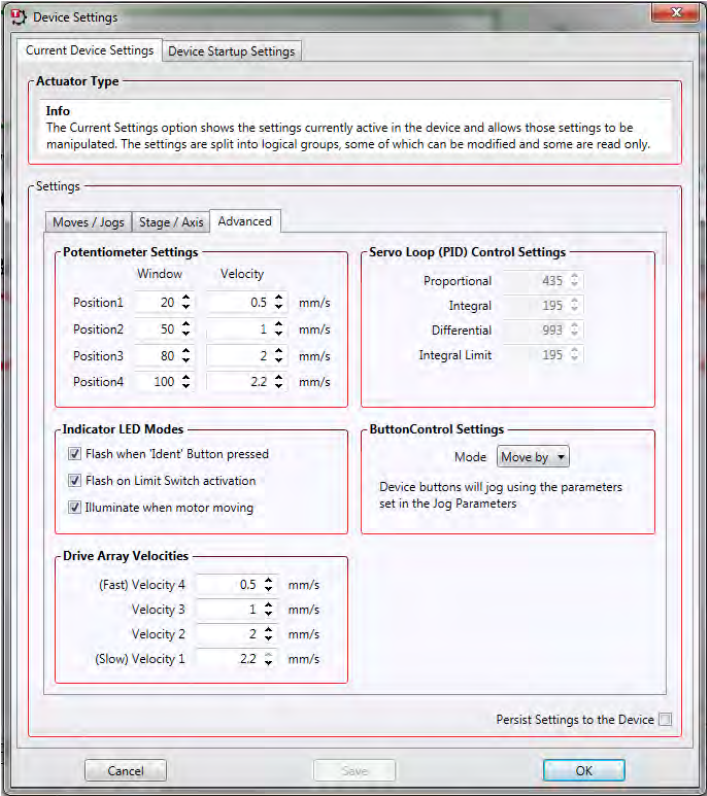


Fig. 6.5 DC Driver T-Cube - Advanced Settings

Potentiometer Control Settings

The potentiometer slider is sprung such that when released it returns to its central position. In this central position the motor is stationary. As the slider is moved away from the center, the motor begins to move; the speed of this movement increases as the slider deflection is increased. Bidirectional control of motor moves is possible by moving the slider in both directions. The speed of the motor increases by discrete amounts rather than continuously, as a function of slider deflection. These speed settings can be altered via the 'Potentiometer Control Settings' parameters.

There are 4 pairs of parameters, each pair specifies a pot deflection value (in the range 0 to 127) together with an associated velocity (set in real world units, mm or degrees) to apply at or beyond that deflection. As each successive deflection is reached by moving the pot slider, the next velocity value is applied. These settings are applicable in either direction of pot deflection, i.e. 4 possible velocity settings in the forward or reverse motion directions. The parameters displayed above indicate

that when the pot has been deflected to 20 (approx 1/6 full scale deflection) the motor will start to move at 0.1mm/sec. At a deflection of 50 (approx 2/5 full scale deflection) the motor velocity will increase to 0.2m/sec, and so on.

Note

It is acceptable to set velocities equal to each other to reduce the number of speeds, however this is not allowed for the deflection settings, e.g. the Velocity 4 Pot Deflection value must be greater than Velocity 3 Pot Deflection value.

Servo Loop (PID) Control Settings

The DC Driver T-Cube implements a full servo control loop for motor velocity and position control. The loop response to demanded position moves is determined via Proportional, Integration and Derivative settings. These settings can be altered using the 'Servo Loop (PID) Control Settings' parameters.

Proportional – This parameter makes a change to the output which is proportional to the positional error value. A high proportional gain results in a large change in the output for a given error. It accepts values in the range 0 to 32767.

Integral – This parameter accelerates the process towards the demanded position, ensuring that the positional error is eventually reduced to zero. If set too high, the output can overshoot the demand value. Under a constant torque loading, the static position error is zero. It accepts values in the range 0 to 32767.

Derivative – This term provides the 'damping' force proportional to the rate of change of the position error, thereby decreasing the overshoot which may be caused by the integral term. However, the differential term also slows down system response.

It accepts values in the range 0 to 32767.

Integral Limit – This term sets a maximum limit for the integration term to prevent an excessive build up over time of the restoring force. It accepts values in the range 0 to 32767.

Note

The default values programmed into the Kinesis software will give acceptable motor performance in most cases. These PID parameters are set according to the stage or actuator type associated with the driver.

Indicator LED Modes

The 'ACTIVE' LED fitted to the front panel of the unit can be configured to indicate certain driver states as follows:

Limit Switch Activation: When this option is selected, the Active LED will flash when the motor reaches a forward or reverse limit switch.

Ident Button Pressed: When this option is selected, the Power LED will flash when the 'Identify' button is clicked on the Software GUI panel.

Motor Moving: When this option is selected, the Active LED is lit when the motor is moving.

It is recognised that, in a light sensitive environment stray light from the LEDs could be undesirable. Therefore it is possible to disable selectively, one or all of the LED indicator modes described above by clearing the associated check boxes in the 'Indicator LED Modes' field.

Button Control Settings

The buttons on the front of the unit can be used either to jog the motor, or to perform moves to absolute positions.

Mode: This setting determines the type of move performed when the front panel buttons are pressed.

Move By: Once set to this mode, the move parameters for the buttons are taken from the 'Jog' parameters on the 'Move/Jogs' settings tab.

Move To: In this mode, each button can be programmed with a different position value, such that the controller will move the motor to that position when the specific button is pressed.

Note

The following parameters are applicable only if 'Move To' is selected in the 'Mode' field.

Left/Top Button Pos.: The position to which the motor will move when the top button is pressed.

Right/Lower Button Pos.: The position to which the motor will move when the bottom button is pressed.

Note

A 'Home' move can be performed by pressing and holding both buttons for 2 seconds. This function is irrespective of the 'Button Mode' setting.

Drive Array Velocities

These parameters relate to the velocity for moves initiated by the DRIVE bar graph. Each specifies a velocity to apply when the associated bar is clicked. These settings

are applicable in either direction of pot deflection, i.e. 4 possible velocity settings in the forward or reverse motion directions.

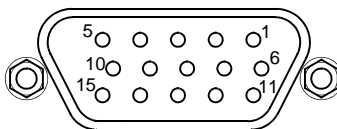
Note

It is acceptable to set velocities equal to each other to reduce the number of speeds.

Appendix A Rear Panel Connector Pinout Detail

A.1 Rear Panel Motor Control Connector

The 'Motor' connector provides connection to the DC servo motor actuator. The pin functions are detailed in Fig. A.1



Pin	Description	Pin	Description
1	Ground	9	Ident In
2	Forward Limit Switch*	10	5V Encoder Supply
3	Reverse Limit Switch*	11	Encoder Channel A
4	Not Connected	12	Not Connected
5	Motor -	13	Encoder Channel B
6	Not Connected	14	Not Connected
7	Motor +	15	Not Connected
8	Not Connected		Not Connected

* The action of the limit switch on contact (i.e. switch open or switch close) is set in the settings panel, see Section 6.3.3.

Fig. A.1 MOTOR I/O Connector Pin Identification

A 15 Pin DIN to 10 Pin IDC converter (161699) is available for use with Thorlabs legacy DC Servo Motors.

Appendix B Preventive Maintenance



Warning



The equipment contains no user servicable parts. There is a risk of electrical shock if the equipment is operated with the covers removed. Only personnel authorized by Thorlabs Ltd and trained in the maintenance of this equipment should remove its covers or attempt any repairs or adjustments. Maintenance is limited to safety testing and cleaning as described in the following sections.

B.1 Safety Testing

PAT testing in accordance with local regulations, should be performed on a regular basis, (typically annually for an instrument in daily use).

B.2 Cleaning



Warning



Disconnect the power supply before cleaning the unit.

Never allow water to get inside the case.

Do not saturate the unit.

Do not use any type of abrasive pad, scouring powder or solvent, e.g. alcohol or benzene.

The fascia may be cleaned with a soft cloth, lightly dampened with water or a mild detergent.

Appendix C Specifications and Associated Products

C.1 Specifications

Parameter	Value
Motor Output	
Motor Drive Voltage	±12 to ±15V (Depending on Supply)
Motor Drive Current	150mA (Cont) >250 mA (peak)
Motor Drive Type	8-bit Sign/Magnitude PWM
Control Algorithm	Digital PID Filter (16bit)
Position Feedback: Quadrature Encoder (QEP) Input	5V Single Ended
Encoder Feedback Bandwidth	750 kHz
Position Counter	32-bit
Operating Modes	Position, Velocity
Velocity Profile	Trapezoidal
Motor Drive Connector (15 Way D-Type)	
Motor Drive Outputs	+ve & -ve
Quadrature Encoder (QEP) Input	Single Ended
Limit Switch Inputs	Forward, Reverse (+ Common Return)
Encoder Supply	5V
Front Panel Controls	
Sprung Potentiometer Slider	4 Speed Bidirectional Velocity Control
Dual Buttons	Forward/Reverse Jogging or Position Presets
Input Power Requirements	
Voltage	15V Regulated DC
Current	500mA (peak)
General Data	
Housing Dimensions (W x D x H)	60 x 60 x 47mm (2.4" x 2.4" x 1.8")
Weight	160g (5.5 oz)

Recommended Motor Requirements	
Peak Power	2.5W
Rated Current	10mA to 200mA (Nominal)
Motor Type	Brushed DC
Coil Resistance	5 to 50Ω
Coil Inductance	250 to 1500mH
Position Control	Closed loop Encoder
Resolution	Encoder Specific
Peak Power	2.5W
Rated Current	0mA to 150mA
Motor Type	Brushed DC

C.2 Associated Products

Product Name	Part Number
6mm DC Servo Motor Actuator, 1/4"-80	Z606
6mm DC Servo Motor Actuator, 1/4"-80, Vacuum Rated	Z606V
12mm DC Servo Motor Actuator, 1/4"-80,	Z612
12mm DC Servo Motor Actuator, 3/8" Barrel Attachment	Z612B
12mm DC Servo Motor Actuator, 1/4"-80, Vacuum Rated	Z612V
12mm DC Servo Motor Actuator, Vacuum Rated, 3/8" Barrel Attachment	Z612BV
25mm DC Servo Motor Actuator, 3/8" Barrel Attachment,	Z625B
25mm DC Servo Motor Actuator, Vacuum Rated, 3/8" Barrel Attachment	Z625BV
T-Cube Controller USB Hub	TCH002
Power Supply for Controller USB Hub	TPS006
Single Way Power Supply	TPS001
8-way Power Supply	TPS008
Converter Cable for Legacy Z6 products (15 pin DIN to 10 pin IDC)	Z600-TCAB1

Appendix D DC Motor Operation - Background

D.1 How A DC Motor Works

D.1.1 General Principle

A DC motor works by converting electric power into mechanical energy (movement). This is achieved by forcing current through a coil and producing a magnetic field, which in turn, spins the motor.

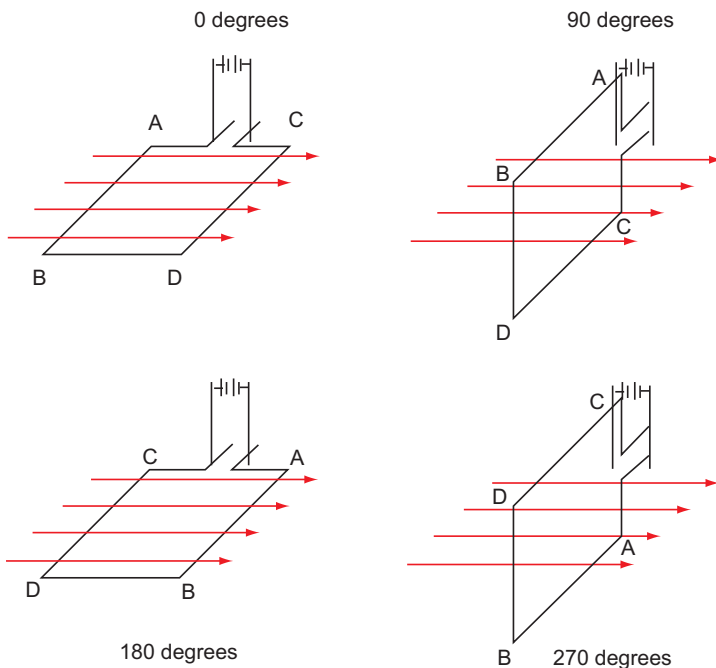


Fig. D.1 DC Motor Operation

To describe the operation of a DC motor, consider the single coil example shown above. In this diagram, current is forced through the coil via sliding contacts (brushes) that are connected to the voltage source. The brushes are located on the end of the coil wires and make a temporary electrical connection with the DC supply. When current is flowing, a magnetic field is set up as shown.

At 0° rotation, the brushes are in contact with the voltage source and current is flowing. The current that flows through the wire from A to B interacts with the magnetic field and produces an upward force. The current that flows from C to D has a similar effect, but because the flow is in the opposite direction with respect to the magnetic field, the force is in the downward direction.

Both forces are of equal magnitude. At 180° , the same phenomenon occurs, but segment A-B is forced down and C-D is forced up. In the 90° and 270° positions, the brushes are not in contact with the voltage source and no force is produced. In these two positions, the rotational kinetic energy of the motor keeps it spinning until the brushes regain contact. In reality, dc motors have several such coils, wound onto an armature, which produces a more even torque. The magnetic field is provided by an electromagnet.

D.1.2 Positive and Negative Moves

Positive and *negative* are used to describe the direction of a move. A positive move means a move from a smaller absolute position to a larger one, a negative move means the opposite.

In the case of a linear actuator, a positive move takes the platform of the stage further away from the motor.

In a rotational stage, a positive move turns the platform clockwise when viewed from above.

D.1.3 Velocity Profiles

To prevent the motor from stalling, it must be ramped up gradually to its maximum velocity. Certain limits to velocity and acceleration result from the torque and speed limits of the motor, and the inertia and friction of the parts it drives.

The motion employed is described by a trapezoidal velocity profile, reflecting the shape of the velocity vs. time graph (see Fig. D.2.), thereby driving the stage to its destination as quickly as possible, without causing it to stall or lose steps.

The stage is ramped at acceleration ' a ' to a maximum velocity ' v '. As the destination is approached, the stage is decelerated at ' a ' so that the final position is approached slowly in a controlled manner.

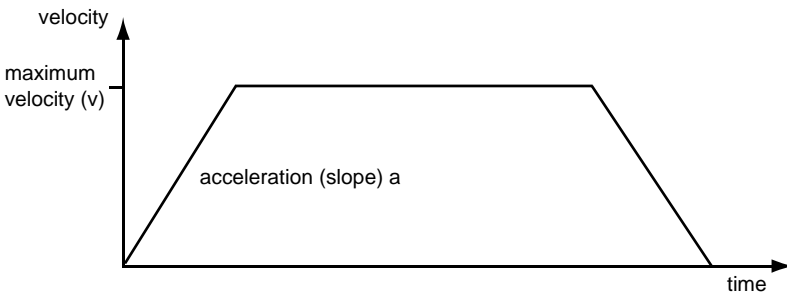


Fig. D.2 Graph of a trapezoidal velocity profile

D.2 Positioning a Stage

D.2.1 General

Whenever a command is received to move a stage, the movement is specified in motion units, (e.g. millimetres). This motion unit value is converted to encoder counts before it is sent to the stage by the software.

Each motor in the system has an associated electronic counter in the controller, which keeps a record of the net number of encoder counts moved. If a request is received to report the position, the value of this counter is converted back into motion units.

D.2.2 Home position

When the system is powered up, the position counters in the controller are all set to zero and consequently, the system has no way of knowing the position of the stage in relation to any physical datum.

A datum can be established by sending all the motors to their 'Home' positions. The 'Home' position is set during manufacture and is determined by driving the motor until the negative limit switch is reached and then driving positively a fixed distance (zero offset). When at the Home position, the counters are reset to zero thereby establishing a fixed datum that can be found even after the system has been switched off.

See Section 5.3. for details on performing a Home move.

D.2.3 Limit Switches

A linear stage moves between two stops, and movement outside these limits is physically impossible. Linear stages can include stages that control the angle of a platform within a certain range, although the movement of the platform is not really linear but angular. Rotary stages can rotate indefinitely, like a wheel.

Linear and rotary stages can contain microswitches that detect certain positions of the stage, but they differ in the way these switches are used.

All linear stages have a -ve limit switch, to prevent the stage from accidentally being moved too far in the -ve direction - see Fig. D.3. Once this switch is activated, movement stops. The switch also provides a physical datum used to find the Home position. Some linear stages and actuators also have a +ve limit switch (such as the ZST range of actuators), whereas others rely on a physical stop to halt the motion in the positive direction. A rotary stage has only one switch, used to provide a datum so that the Home position can be found. Movement is allowed right through the switch position in either direction

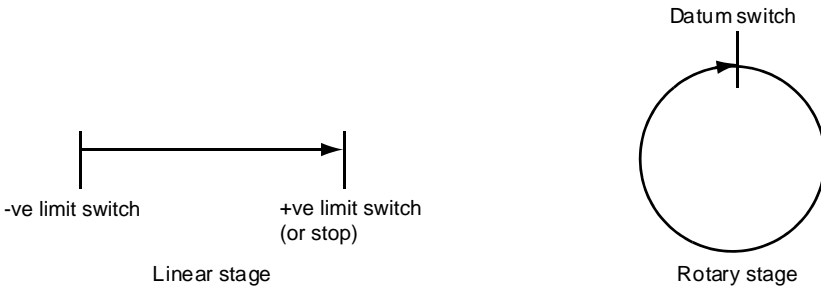


Fig. D.3 Stage limit switches

D.2.4 Minimum and Maximum Positions

These positions are dependent upon the stage or actuator to which the motors are fitted, and are defined as the minimum and maximum useful positions of the stage relative to the 'Home' position - see Fig. D.4.

The distance from the Minimum position to the Maximum position is the 'useful travel' of the stage. It is often the case that the Minimum position is zero. The Home and Minimum positions then coincide, with movement always occurring on the positive side of the Home position.

Rotary stages have effectively no limits of travel. The Minimum and Maximum positions are conventionally set to 0 and 360 degrees respectively. When the position of a rotary stage is requested, the answer will be reported as a number between 0 and 360 degrees, measured in the positive direction from the Home position.

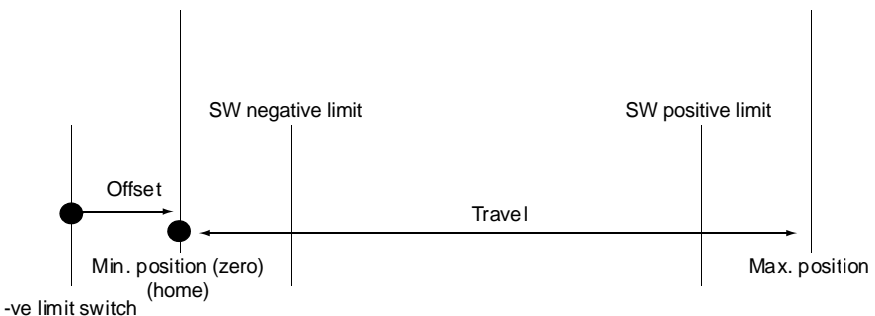


Fig. D.4 Minimum and Maximum Positions

D.3 Error Correction

D.3.1 Backlash correction

The term *backlash* refers to the tendency of the stage to reach a different position depending on the direction of approach.

Backlash can be overcome by always making the last portion of a move in the same direction, conventionally the positive direction. Consider the situation in Fig. D.5, a *positive* move, from 10 to 20 mm, is carried out as one simple move, whereas a *negative* move, from 20 to 10 mm, first causes the stage to overshoot the target position and then move positively through a small amount.

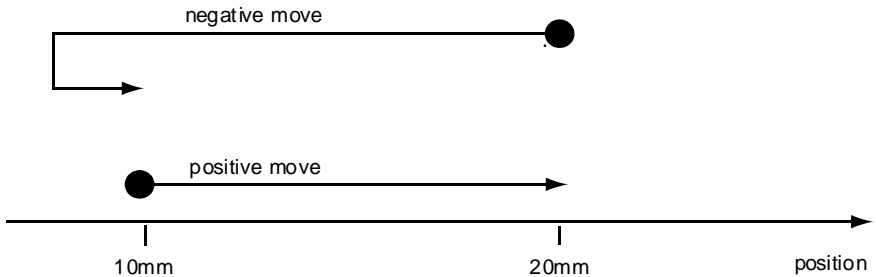


Fig. D.5 Backlash correction

The particular stage selection will usually have this type of 'backlash correction' enabled as its default mode of operation, but it can be overridden if the overshoot part of the move is unacceptable for a particular application.

See Chapter 6 Software Reference, Move/Jogs Tab for details on setting the backlash correction.

Appendix E Regulatory

E.1 Declarations Of Conformity

E.1.1 For Customers in Europe
See Section E.3.

E.1.2 For Customers In The USA

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Changes or modifications not expressly approved by the company could void the user's authority to operate the equipment.

E.2 Waste Electrical and Electronic Equipment (WEEE) Directive

E.2.1 Compliance

As required by the Waste Electrical and Electronic Equipment (WEEE) Directive of the European Community and the corresponding national laws, we offer all end users in the EC the possibility to return "end of life" units without incurring disposal charges.

This offer is valid for electrical and electronic equipment

- sold after August 13th 2005
- marked correspondingly with the crossed out "wheelie bin" logo (see Fig. 1)
- sold to a company or institute within the EC
- currently owned by a company or institute within the EC
- still complete, not disassembled and not contaminated



Fig. 5.1 Crossed out "wheelie bin" symbol

As the WEEE directive applies to self contained operational electrical and electronic products, this "end of life" take back service does not refer to other products, such as

- pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- components
- mechanics and optics
- left over parts of units disassembled by the user (PCB's, housings etc.).

If you wish to return a unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

E.2.2 Waste treatment on your own responsibility

If you do not return an "end of life" unit to the company, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

E.2.3 Ecological background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

E.3 Certificate of Conformity



EU Declaration of Conformity

In accordance with EN ISO 17050-1:2010

We Thorlabs Ltd
Of 1 Saint Thomas Place, Ely, Cambridgeshire, CB7 4EX

in accordance with the following Directive(s):

2004/108/EC Electromagnetic Compatibility (EMC)
2011/65/EU Restriction of use of certain hazardous substances (RoHS)

hereby declare that:

Equipment T-Cube DC Servo Motor Controller
Model Number TDC001

is in conformity with the applicable requirements of the following documents:

EN61326-1 Electrical Equipment for measurement, control and laboratory use - EMC requirements 2006

and which is in conformity with Directive 2011/65/EU of the European Parliament and of the Council of 8th June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, for the reasons stated below:

A does not contain substances in excess of the maximum concentration values tolerated by weight in homogenous materials as listed in Annex II of the Directive

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all applicable Essential Requirements of the Directives.

Signed:

Name: Keith Dhese
Position: General Manager
On: 05 November 2013



EDC - 2013-11-07 - T-C -TDC001



Appendix F Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.



USA, Canada, and South America

Thorlabs, Inc.
sales@thorlabs.com
techsupport@thorlabs.com

Europe

Thorlabs GmbH
europe@thorlabs.com

France

Thorlabs SAS
sales.fr@thorlabs.com

Japan

Thorlabs Japan, Inc.
sales@thorlabs.jp

UK and Ireland

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