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THORLABS

TDC001 - February 3, 2016

Item # TDC001 was discontinued on February 3, 2016. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

T-CUBE DC SERVO MOTOR CONTROLLER

- **Drives Brushed DC Servo Motors Up to 2.5 W**
- **Seamless Operation with Thorlabs Z8 Series Actuators**
- **Control via Local Panel or USB Computer Connection**
- **Optional USB Hub for Multi-Channel Applications**

TDC001
Power Supply
Sold Separately

Application Idea

TDC001
A TDC001 Controller can be Used to Drive a CR1-Z7 Rotation Stage (Sold Separately)

OVERVIEW

Features

- Compact Footprint 60 mm x 60 mm x 47 mm (2.4" x 2.4" x 1.8")
- Differential Encoder Feedback (QEP Inputs) for Closed Loop Positioning
- Auto-Configure Function for all Thorlabs Z8 Equipped Stages/Actuators
- Range of PSU Options Available Separately
- USB Plug-and-Play - Multi-axis Expansion
- Easy to Use Manual Controls with Velocity Slider and Jog Buttons
- Full Software Control Suite Supplied
- Extensive ActiveX® Programming Interfaces
- Fully Software Integrated with Other APT™ Family Controllers

T-Cube Motion Control Modules
Brushed DC Servo Motor Controller
Brushless DC Servo Motor Controller
Stepper Motor Controller
Single-Channel Piezo Controller
Single-Channel Strain Gauge Reader
Dual-Channel NanoTrak Auto-Aligner
Quadrant Detector
Solenoid Controller

Click to Enlarge
Back View of the TDC001 T-Cube (See the *Pin Diagrams* Tab for More Information)

The T-Cube APT™ USB DC Driver (TDC001) is a very compact single channel DC servo 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 15 V/2.5 W operation) equipped with encoder feedback. The TDC001 has been optimized for 'out of the box' operation with the Thorlabs range of Z8 series DC motor equipped opto-mechanical products.

Please note that older units will require a firmware upgrade before they can be used with the Z8 series motors. An upgrade is included with the latest APT software, which can be downloaded here. The highly flexible software settings and closed loop tuning also supports operation with a wide range of third party

DC Servo motors and associated stages and actuators.

The unit has a very small footprint (60 mm x 60 mm x 47 mm) [2.4" x 2.4" x 1.8"] and may be mounted directly to the optical table using the 1/4" (M6) clearance slot in the base plate. This compact size allows the controller to be positioned close to the motorized system for added convenience when manually adjusting motor positions using the top panel controls. Tabletop operation also allows minimal drive cable lengths for easier cable management.

USB connectivity provides easy 'Plug and Play' PC controlled operation. The TDC001 also includes the very user friendly APT™ software which allows the user to quickly set up complex move sequences. For example, all relevant operating parameters are set automatically by the software for Thorlabs stage and actuator products. Advanced custom motion control applications and sequences are also possible using the extensive ActiveX® programming environment described in more detail on the *Motion Control Software* and *APT Tutorials* tabs.

Furthermore, multiple units can be connected to a single PC via standard USB hub technology or by using the T-Cube Controller Hub (TCH002) for multi-axis motion control applications. By using this controller hub, up to 12 individual T-Cube controllers can be controlled on one PC.

Click to Enlarge
TCH002 USB Controller Hub (Power Supply not Shown)
with Installed T-Cube Modules

Power Supply Options
The preferred power supply (i.e., single channel, multi-channel, or hub-based) depends on the end user's application and whether you already own compatible power supplies. To that end and in keeping with Thorlabs' green initiative, we do not ship these units bundled with a power supply. This avoids the cost and inconvenience of receiving an unwanted single channel supply if a multi-channel or hub-based system would be more appropriate. The power supply options compatible with the TDC001 Motor Controller are listed below.

Quick Links to Other DC Servo Controllers	
T-Cube Single-Channel Controller	1-, 2- and 3-Channel Benchtop Controller

SPECS

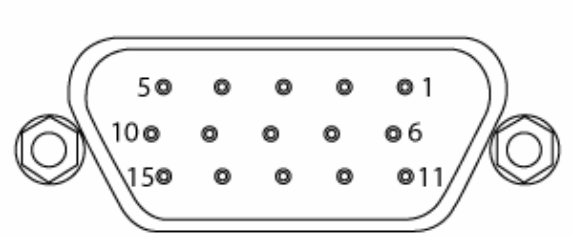
Specifications	
Motor Drive Connector (15 Way D-Type)	
Motor +15 V & -15 V Drive Outputs	
Quadrature Encoder (QEP) Input (Single Ended)	
Forward, Reverse Limit Switch Inputs (+ Common Return)	
5 V Encoder Supply	
Front Panel Controls	
Sprung Potentiometer Slider	4 Speed Bidirectional Velocity Control
Dual Buttons	Forward/Reverse Jogging or Position Presets
Motor Drive Voltage	±10 to ±12 V (Depending on Supply)
Motor Drive Current	150 mA (Cont), >250 mA (peak)
Motor Drive Type	8-bit Sign/Magnitude PWM
Control Algorithm	Digital PID Filter (16 bit)
Position Feedback	Quadrature Encoder (QEP) Input, 5 V Single Ended
Encoder Feedback Bandwidth	750 kHz
Position Counter	32-bit
Operating Modes	Position, Velocity
Velocity Profile	Trapezoidal
Input Power Requirements	
Voltage	12 - 15 V Regulated DC (15 V recommended)
Current	500 mA (peak)
General	
Housing Dimensions (W x D x H)	60.3 x 60.3 x 47.5 mm (2.37" x 2.37" x 1.87")
Weight	160 g (5.5 oz)

Compatible Motor Specifications

Motor Type	Brushed DC Servo
Peak Power	2.5 W
Rated Current	10 - 200 mA (Nominal)
Motor Type	Brushed DC
Coil Resistance (nominal)	5 to 50 Ω
Coil Inductance	250 to 1500 µH
Postition Control	Incremental Encoder
Resolution	Encoder Specific

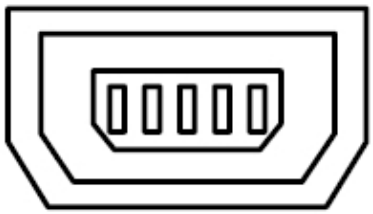
PIN DIAGRAMS

Motor Control Connector
D-type Female



Pin	Description	Pin	Description
1	Ground	9	Ident
2	Forward Limit Switch	10	5 V 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		

Computer Connection
USB Mini-B*



*USB type Mini-B to type A Included

FURTHER INFO

Introduction

The T-Cube DC Servo Controller (TDC001) is a very compact single channel USB controller/driver, designed to operate with a variety of 12-15 V DC brushed motors up to 2.5 W operation and equipped with encoder feedback - it is ideally suited for driving the Z8 motor series offered by Thorlabs (see Related Items tab). The unit contains a full embedded controller and driver circuit that can be operated with and without a PC. Although compact in footprint, the T-Cube DC Servo controller offers a fully featured motion control capability including velocity profile settings, limit switch handling, “on the fly” changes in motor speed and direction for more advanced operation, control over the closed loop PID parameters and adjustment of settings such as lead screw pitch and gearbox ratio allowing support for many different actuator configurations. When used with the extensive range of Thorlabs Z8 motorized opto-mechanical products, many of these parameters are automatically set to allow immediate “out of the box” operation with no further tuning required.

TDC001 DC Servo Driver T-Cube

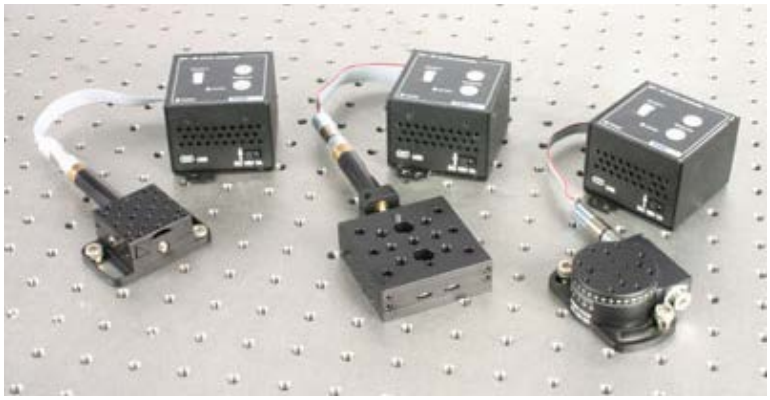
Joining the apt™ Family

Thorlabs' T-Cube controllers are members of the apt™ family of controllers which includes a range of high specification motor and piezo controllers (both in benchtop and rack-based formats) specifically aimed at high resolution positioning applications. By inheriting much of the functionality developed for these high end variants, the T-Cube drivers are built on a flexible and powerful motion control capability with full and complete software support. It is perfectly feasible to mix operation of the TDC001 T-Cube unit with any other member of the apt™ controller family through the same unified software interfaces, both graphical and programmable. For the first time, positioning and motion control applications deploying any of the complete range of Thorlabs motorized/piezo actuated nano-positioning and opto-mechanical hardware is easily achieved in minimum time via a common PC software platform.

TDC001 Rear Panel

Deployment

The TDC001 DC Servo T-Cube is contained in a very compact 60 mm x 60 mm x 47 mm (2.4" x 2.4" x 1.8") housing incorporating easily accessible local controls for manual motor control and positioning. We have taken care to keep the footprint to a minimum allowing the possibility, in many opto-mechanical applications, of locating this driver on the optical table in close proximity to the motorised apparatus being driven. A base plate option allows easy mounting to optical tables in a stacked side by side configuration for control of multiple motor channels. Use of this driver solution within the photonics R&D environment is further considered by an overall black finish and by elimination of any stray light generation associated with the front panel LEDs which can be disabled by using a software command.


Typical Applications

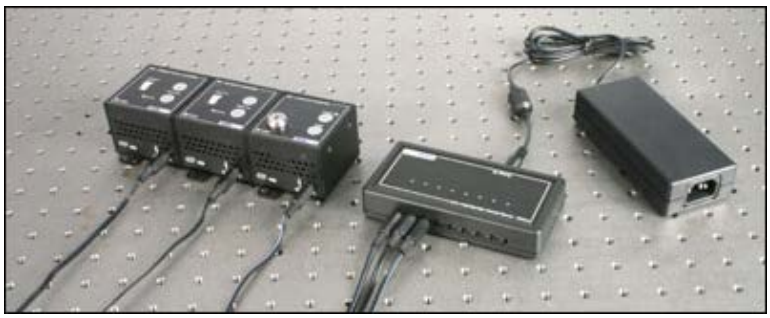
T-Cube Controller Hub

As a further level of convenience when using the T-Cube Controllers Thorlabs also offers the T-Cube Controller Hub. 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 [375 mm x 86 mm x 21.5 mm (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, and alsor outes digital and analog signals between T-Cubes allowing deterministic inter-Cube operation in certain applications.

Vertical and Horizontal Mounting Options

Standalone Power Supply Options

Note: when operating the TDC001 T-Cube standalone (in absence of the TCH002 Hub) a separate power supply is required. Compatible power supply options are listed below.



TPS008 Power Supply

Manual Operation

For quick “out of the box” manual operation, the TDC001 DC Servo controller can simply be connected to one of the range of Thorlabs Z8 DC motor actuators and powered up by connecting to one of the separate Thorlabs power supply options or by using the T-Cube Controller Hub. Motor operations are then controlled by the potentiometer slider and jog buttons located on the top face of the unit. Using the spring return slider the motor can be driven at pre-defined speeds in either forward or reverse directions for full and easy velocity control. Similarly the jog buttons can be used to make discrete position increments in either direction enabling precise and repeatable manual positioning. For full flexibility, the supplied PC software can be used to alter both the speed response of the slider and the jogging modes for the buttons - saving any changes to the memory within the driver unit allowing the PC to be disconnected once changes have been made.

Automated (PC) Control

For automated remote operation, the TDC001 is fitted with USB interfacing for connection to a host control PC. One or more drivers can be connected together easily via standard USB hubs or the T-Cube Controller Hub (TCH002) for control from a single computer. To enable easy and flexible simultaneous control of multiple units, a full software control suite (the apt™ System Software) is supplied by Thorlabs. This software suite was originally developed to provide sophisticated PC control of the full range of apt™ bench top motion controllers and has now been fully updated to provide support for the T-Cube Drivers. Using this feature rich apt™ system software the full motion control capabilities of the TDC001 controller are exposed through very intuitive graphical user

control panels, allowing motor moves to be initiated and monitored very easily. All motor operating parameters can be easily accessed and changed “on the fly” during motor moves in order to fine tune operation as required. Multiple graphical panels displayed within the software allow control of multiple T-Cube drivers simultaneously in an easy and intuitive way.

TDC001 Software GUI

Full Software GUI Conrol Suite & ActiveX® Controls Included

A full and sophisticated software suite is supplied with the TDC001. It comprises a number of 'out of the box' user utilities to allow immediate operation of the unit without any detailed pre-configuration. All operating modes can be accessed manually and all operating parameters changed and saved for next time use. For more advanced 'custom' motion control applications a fully featured ActiveX® programming environment is also included to facilitate custom application development in a wide range of programming environments. Note that all such settings and parameters described above are also accessible through these ActiveX® programmable interfaces. For further information on the apt™ software support for the T-Cube drivers refer to the Software tab. Demonstraton videos illustrating how to program the apt™ software are also available for viewing from the Video Tutorial tab.


Typical ActiveX Control View

The ActiveX® apt™ system software shipped with the TDC001 is also compatible with other apt™ family controllers including our multi-channel rack-based system, the higher power benchtop controllers and the equivalent compact stepper motor T-Cube (TST101). This single unified software offering allows seamless mixing of any apt™ benchtop, table top and rack based units in any single positioning application.


The APT Family

The key innovation of the apt™ range of controllers and associated mechanical products is the ease and speed with which complete automated alignment/positioning systems can be engineered at both the hardware and software level. All controllers in the apt™ range are equipped with USB connectivity. The 'multi-drop' USB bus allows multiple apt™ units to be connected to a single controller PC using commerical USB hubs and cables. When planning a multi-channel application, simply add up the number and type of drive channels required and connect together the associated number of APT controllers.

Software Developers Support CD

A developers’ kit is shipped with all of our apt™ series controllers. This additional software support is intended for use by software developers working on large, system integration projects that incorporate apt™ products. The kit contains an extensive selection of useful code samples as well as a library of Video Tutorials.

MOTION CONTROL SOFTWARE

Thorlabs offers two platforms to drive our wide range of motion controllers: our legacy APT™ (Advanced Positioning Technology) software package or the new Kinesis software package. Either package can be used to control devices in the APT family, which covers a wide range of motion controllers ranging from small, low-powered, single-channel drivers (such as the T-Cubes) to high-power, multi-channel, modular 19" rack nanopositioning systems (the APT Rack System).

Our legacy APT System Software platform is available by clicking on the link below. It features ActiveX-based controls which can be used by 3rd party developers working on C#, Visual Basic, LabVIEW or any Active-X compatible languages to create custom applications, and includes a simulator mode to assist in developing custom applications without requiring hardware.

The Kinesis Software features new .NET controls which can be used by 3rd party developers working in the latest C#, Visual Basic, LabVIEW or any .NET compatible languages to create custom applications. Low level DLL libraries are included for applications not expected to use the .NET framework. A Central Sequence Manager supports integration and synchronization of all Thorlabs motion control hardware.

By providing these common software platforms, Thorlabs has ensured that users can easily mix and match any of the APT controllers in a single application, while only having to learn a single set of software tools. In this way, it is perfectly feasible to combine any of the controllers from the low-powered, single-axis to the high-powered, multi-axis systems and control all from a single, PC-based unified software interface.

APT GUI Screen

The software packages allow two methods of usage: graphical user interface (GUI) utilities for direct interaction with and control of the controllers 'out of the box', and a set of programming interfaces that allow custom-integrated positioning and alignment solutions to be easily programmed in the development language of choice.

A range of video tutorials are available to help explain our APT system software. These tutorials provide an overview of the software and the APT Config utility. Additionally, a tutorial video is available to explain how to select simulator mode within the software, which allows the user to experiment with the software without a controller connected. Please select the *APT Tutorials* tab above to view these videos, which are also available on the software CD included with the controllers.

Software

APT Version 3.10.0

The APT Software Package, which includes a GUI for control of Thorlabs' APT™ system controllers.

Also Available:

- Comminications Protocol

Software

Software

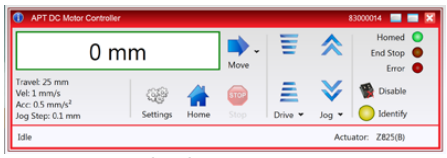
Kinesis Version 1.1.0

The Kinesis Software Package, which includes a GUI for control of Thorlabs' APT™ system controllers.

Also Available:

- Communications Protocol

Software



Kinesis GUI Screen

APT TUTORIALS

These videos illustrate some of the basics of using the APT System Software from both a non-programming and a programming point of view. There are videos that illustrate usage of the supplied APT utilities that allow immediate control of the APT controllers out of the box. There are also a number of videos that explain the basics of programming custom software applications using Visual Basic, LabView and Visual C++. Watch the videos now to see what we mean.

Click here to view the video tutorial

To further assist programmers, a guide to programming the APT software in LabView is also available.

Click here to view the LabView guide

Hide T-Cube DC Servo Motor Controller

T-Cube DC Servo Motor Controller

Power supplies sold separately, please see options below.

Part Number	Description	Price	Availability
TDC001	T-Cube DC Servo Motor Controller (Power Supply Not Included)	$613.00	Today

Hide Compatible Power Supplies

Compatible Power Supplies

The preferred power supply (i.e., single channel, multi-channel, or hub-based) for your device depends on your application and whether you already own compatible power supplies.

T-Cube Driver Operation	Power Supply
Standalone / Single Channel Operation	KPS101 Power Supply for One T-Cube TPS008 Power Supply for Up to Eight T-Cubes (Up to Four TBD001 T-Cubes)
System / Multi-channel Operation	TCH002 USB Controller Hub

Click for Details
A location-specific power adapter is shipped with the KPS101 based on your location.

The KPS101 can supply up to 2.4 A and power a single T-Cube, while the TPS008 can supply up to 8 A and can power up to eight T-Cubes, or up to four TBD001 T-Cube Brushless DC Servo Controllers. Both power supply units plug into a standard wall outlet and provide +15 VDC. The TCH002 Hub and Power Supply consists of two parts: the hub, which can support up to six standard-footprint T-cubes, and a power supply that plugs into a standard wall outlet and powers the hub, which in turn powers all the T-cubes connected to the hub.

Part Number	Description	Price	Availability
KPS101	NEW! 15 V, 2.4 A Power Supply Unit for One T-Cube	$25.71	Today
TPS008	15 V Power Supply Unit for up to Eight T-Cubes	$180.00	Today
TCH002	T-Cube Controller Hub and Power Supply Unit	$749.00	3-5 Days