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THORLABS

TST101 - February 3, 2016

Item # TST101 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 STEPPER MOTOR CONTROLLER

- **Peak Power Output up to 12 W**
- **Seamless Operation with Thorlabs' ZST and ZFS Series Actuators**
- **Operate Locally via Panel Controls or Remotely from a PC via USB**
- **Optical Table Mountable**

TST101
Power Supply
Sold Separately

Application Idea

A TST101 Controller can be Used to Drive an LNRZFS Stepper Motor Translation Stage (Sold Separately)

OVERVIEW

Features

- High Resolution Microstepping - 2048 Microsteps per Full Step
- Settings can be Saved to Allow Stand-Alone Operation via Top Panel Controls
- Trapezoidal or S-Curve Velocity Profiles
- Supports 2-Phase Bi-Polar Stepper Motors up to 15 V at 12 W (Peak)
- Range of PSU Options Available Separately
- 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
- Easy to Use Manual Controls with Velocity Slider and Jog Buttons
- Full Software Control Suite Supplied
- Intuitive Software Graphical Control Panels
- Common Software for All 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 TST101 T-Cube Controller (See the *Pin Diagrams* Tab for More Information)

This T-Cube APT™ Stepper Driver (TST101) is the next generation of enhanced controller using the familiar APT user interface. Many new features are provided, including a choice between trapezoidal and S-shaped velocity profiles, a higher theoretical microstep resolution (49,152 for a 24 full step motor, 409,600 for a 200 full step motor), and speeds more than twice that achieved by its predecessor.

This controller has been designed to operate with lower powered motors (up to 15 V at 12 W operation) such as our ZST and ZFS range of actuators. Although the unit is targeted at lower power applications, its highly flexible parameterization also supports operation with a wide range of stepper motors and associated stages and actuators such as our DRV013 1" travel and DRV014 2" travel actuators, albeit at a reduced velocity (up to 3 mm/sec) when compared to the higher power BSC series controllers. It offers full control features with a highly flexible and powerful DSP controller that provides a unique high resolution microstepping capability in a compact unit.

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. Furthermore, parameter settings can be saved (persisted) within the unit for true stand-alone operation via the top panel controls.

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

USB connectivity provides easy 'Plug and Play' PC controlled operation. The TST101 also includes the very user friendly APT software which allows the user to quickly set up 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.

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 TST101 Motor Controller are listed below and are available for purchase separately.

Other Stepper Motor Controllers		
T-Cube Single-Channel Controller	1-, 2-, and 3-Channel Benchtop Controller	Modular 2-Channel Rack System Module

SPECS

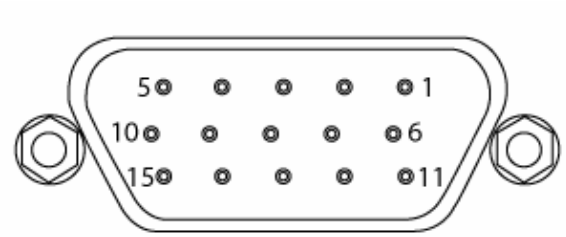
Specifications	
Motor Drive Connector (15-Way Female D-Type)	
Phase A and B Drive Outputs	
Differential Quadrature Encoder (QEP) A and B Inputs	
Forward, Reverse Limit Switch Inputs	
5V Encoder Supply	
Stepping	
High Resolution 2048 Microsteps per Full Step	
49,152 Microsteps per Revolution (for 24 Full Step Motor - e.g. ZST series)	
409,600 Microsteps per Revolution (for 200 Full Step Motor - e.g. DRV series)	
Front Panel Controls	
Sprung Potentiometer Slider	Bi-Directional Velocity Control
Dual Buttons	Forward/Reverse Jogging or Position Presets
Motor Output	
Motor Drive Voltage	12 to 15V (Depending on Supply)
Motor Drive Current	750 mA (Peak)
Motor Drive Type	12 bit PWM Control
Control Algorithm	Open Loop Microstepping (Closed Loop using PC)

Position Feedback	Quadrature Encoder (QEP) Input, 5V Differential
Encoder Feedback Bandwidth	500 kHz
Position Counter	32 bit
Operating Modes	Position, Velocity
Velocity Profile	Trapezoidal or 'S' Profile
Input Power Requirements	
Voltage	12 to 15 V Regulated DC (15 V Recommended)
Current	1 A (Peak)
General	
Housing Dimensions (W x D x H)	60 mm x 60 mm x 47 mm (2.4" x 2.4" x 1.8")
Weight	220 g (7.74 oz)

Typical Compatible Motor Specifications	
Motor Type	2 Phase Bi-polar Stepper
Peak Power	15 W
Rated Phase Current	up to 1 A Peak
Step Angles	1.8° to 20°
Motor Drive Mode	Current
Coil Resistance (Nominal)	5 to 20 Ω
Coil Inductance (Nominal)	2 to 5.5 mH
Position Control	Open Loop

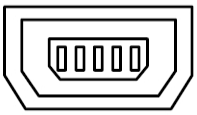
PIN DIAGRAMS

Motor Controller Connector
D-type Female



Pin	Description	Pin	Description	Pin	Description
1	Ground	6	Phase A -ve	11	Enc A +ve
2	CCW Limit Switch	7	Phase A +ve	12	Enc A -ve
3	CW Limit Switch	8	For Future Use	13	Enc B +ve
4	Phase B -ve	9	For Future Use	14	Enc B -ve
5	Phase B +ve	10	+ 5 V DC	15	For Future Use

Computer Connection
USB Mini-B*



*Type A to Mini-B cable included

FURTHER INFO

Introduction


TST101 Stepper Motor Driver T-Cube

This T-Cube APT Stepper Driver (TST101) is the next generation of enhanced controller using the familiar APT user interface. Many new features are provided, including a choice between trapezoidal and S-shaped velocity profiles, a higher theoretical microstep resolution (49,152 for a 24 full step motor), and speeds more than twice that achieved by its predecessor.

It has been designed to operate with lower powered motors (up to 15 V/7.5 W operation) such as our ZST and ZFS range of actuators. Although the unit is targeted at lower power applications, its highly flexible parameterization also supports operation with a wide range of stepper motors and associated stages and actuators such as our DRV013 1" travel and DRV014 2" travel actuators, albeit at a reduced velocity when compared to the higher power BSC series controllers. It offers full control features with a highly flexible and powerful DSP controller that provides a unique high resolution microstepping capability in a compact unit.

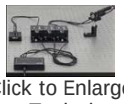

TST101 Rear Panel

Joining the APT Family

Thorlabs' T-Cube controllers are members of the APT family of controllers which includes a range of highly functional 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 TST101 stepper 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.

Deployment

Designed as a low power, yet fully featured equivalent to the BSC201/2/3 benchtop controller series, the TST101 Stepper Driver 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 motor move 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 motorized apparatus being driven. A base plate option (included with the controller) 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.


Click to Enlarge Typical Applications


Vertical and Horizontal Mounting Options for the TCH002


TPS008 Power Supply

T-Cube Controller Hub

As a further level of convenience when using the T-Cube Controllers, Thorlabs also offers the 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 [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. In addition the Hub routes digital and analog signals between T-Cubes allowing deterministic inter-Cube operation in certain applications.

Note: when operating the TST101 T-Cube standalone (in absence of the TCH002 Hub) a separate power supply is required. Compatible power supply options are listed below.

Manual Operation

For quick “out of the box” manual operation, the TST101 Stepper controller can simply be connected to one of the range of Thorlabs ZST mini stepper 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 and allowing the PC to be disconnected once changes have been made.

Automated (PC) Control

For automated remote operation, the TST101 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 TST101 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 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.

Full Software GUI Control Suite & ActiveX® Controls Included

A full and sophisticated software suite is supplied with the TST101 T-Cube. 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, please refer to the Software tab. Demonstration videos illustrating how to program the APT software are also available for viewing from the Video Tutorial tab.


TST101
Software GUI


Typical ActiveX
Control View

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

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 commercial 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.


The APT
Family

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.

APT GUI Screen

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.

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

T-Cube Stepper Motor Controller

Power supplies sold separately; please see options below.

Part Number	Description	Price	Availability
TST101	Customer Inspired!T-Cube Stepper 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