



TCH002

T-Cube USB Controller Hub  
and Power Supply

User Guide

---

---

# Contents

<b>Chapter 1 1 For Your Safety .....</b>	<b>3</b>
1.1 <i>Safety Information .....</i>	3
1.2 <i>Warnings .....</i>	4
1.3 <i>Declarations Of Conformity .....</i>	4
1.3.1 For Customers in Europe .....	4
1.3.2 For Customers In The USA .....	4
1.4 <i>Waste Electrical and Electronic Equipment (WEEE) Directive .....</i>	5
1.4.1 Compliance .....	5
1.4.2 Waste treatment on your own responsibility .....	6
1.4.3 Ecological background .....	6
<b>Chapter 2 2 Overview and Setup .....</b>	<b>7</b>
2.1 <i>Introduction .....</i>	7
2.2 <i>Mechanical Installation .....</i>	9
2.2.1 Environmental Conditions .....	9
2.2.2 Mounting Options .....	9
2.2.3 Flat Mounting .....	10
2.2.4 Edge Mounting .....	11
2.2.5 Vertical Mounting .....	12
2.2.6 Rotating a T-Cube Control Panel .....	13
2.3 <i>Electrical Installation .....</i>	14
2.3.1 Supply voltage and current requirements: .....	14
2.3.2 Connecting To A Standalone Power Supply .....	14
2.3.3 Hub IO Connections .....	15
2.3.4 Fitting a T-Cube Driver Unit .....	16
<b>Chapter 3</b>	
<b>Chapter 4 Appendices</b>	
<b>Chapter 5 A Connector Pinout Details .....</b>	<b>17</b>
5.1 <i>Power Connector .....</i>	17
<b>Chapter 6 B Preventive Maintenance .....</b>	<b>18</b>
6.1 <i>Safety Testing .....</i>	18
6.2 <i>Cleaning .....</i>	18
<b>Chapter 7 C Specifications and Associated Products .....</b>	<b>19</b>
7.1 <i>Specifications .....</i>	19
7.2 <i>Associated Products .....</i>	20
7.2.1	
7.3	

---

# Chapter 1 For Your 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 APT 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 APT software is run. Please consult your system administrator or contact Thorlabs technical support for more details.

---

## Chapter 2 Overview and Setup

### 2.1 Introduction

The T-Cube Controller Hub and power supply 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. Mix and match any combination of T-Cube Controllers to build your own custom multi-channel driver arrangement in an extremely compact footprint.

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 again requires only a single power connection (from a separate supply unit TPS006 supplied by Thorlabs). This USB and power routing capability vastly reduces the number of USB and power cables required when operating multiple T-Cubes. Furthermore, a USB output connector can be connected to the USB input on another Hub allowing multiple Controller Hubs to be connected together while still only requiring a single USB cable from the host control PC.

The Controller Hub circuitry also provides a number of internal flexible digital and analogue interconnect lines for deterministic multiple-cube synchronised operation. This is used to great effect for example when operating the new Piezo Controller and Strain Gauge Reader T-Cubes on the Controller Hub. They can be configured to operate as a coupled pair allowing 'closed loop' control of the wide number of Thorlabs piezo actuators.



Fig. 2.1 T-Cube USB Controller Hub (PSU not shown)

The Controller Hub provides a rigid mechanical mounting platform for carrying the T-Cubes. Mounting holes incorporated in the Hub allow for a variety of mounting orientations. In this way the Controller Hub can be mounted flat to the table surface (much like the individual T-Cubes), edge mounted or vertically mounted to allow vertical stacking of up to 6 T-Cube controllers thereby reducing optical table footprint to an absolute minimum.

## 2.2 Mechanical Installation

### 2.2.1 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.

### 2.2.2 Mounting Options

The T-Cube Controller Hub is shipped complete with attachment brackets for horizontal orientation, ready to be bolted to a breadboard, optical table or similar surface - see Section 2.2.3.

If desired, Thorlabs AP90 Angle Brackets can be used to mount the hub on its edge - see Section 2.2.4. or vertically - see Section 2.2.5.

 **Caution**   
**When siting the hub, it should be positioned so as not to impede the operation of the control panel buttons on the T-Cube Controllers. Ensure that proper airflow is maintained to the all T-Cube units fitted to the hub.**

### 2.2.3 Flat Mounting

- 1) Remove any T-Cube units fitted to the hub.
- 2) Turn the hub upside down and remove any attachment brackets previously fitted.
- 3) Fit the flat brackets (supplied) to the back face of the hub - see Fig. 2.2



**Fig. 2.2 Fitting the Brackets for Flat Mounting**

- 4) Position the hub in the desired position on the worksurface.
- 5) Line up the attachment holes in the bracket and the worksurface, then fit the bolts to secure the assembly in a horizontal position - see Fig. 2.3.



**Fig. 2.3 Bolting the Assembly to The Worksurface**

- 6) If the T-Cube units were previously fitted to a vertically-mounted hub, the control panel of each T-Cube must be rotated through 90° - see Section 2.2.6. for more details.
- 7) Populate the hub with T-Cubes as required.

### 2.2.4 Edge Mounting

- 1) Remove any T-Cube units fitted to the hub.
- 2) Turn the hub upside down and remove any attachment brackets previously fitted.
- 3) Fit one AP90 Angle bracket to each end of the back face of the hub - see Fig. 2.4  
Both imperial (1/4-20) and metric (M6) mounting holes are provided

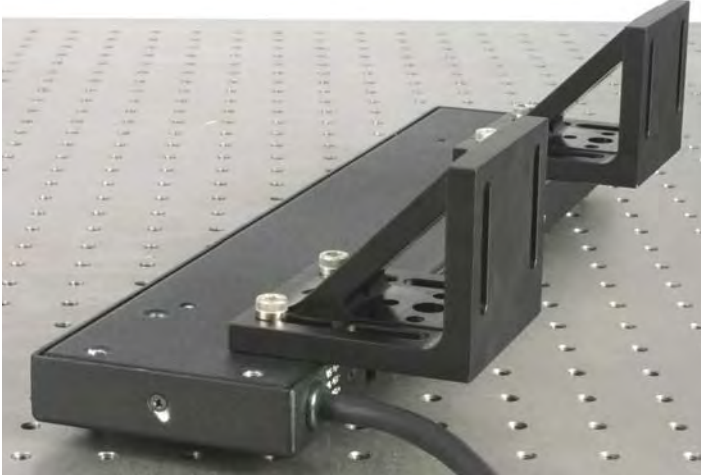


Fig. 2.4 Fitting the AP90 Brackets for Edge Mounting

- 4) Position the hub in the desired position on the worksurface.
- 5) Line up the attachment holes in the bracket and the worksurface, then fit the bolts to secure the assembly in a horizontal position - see Fig. 2.5.

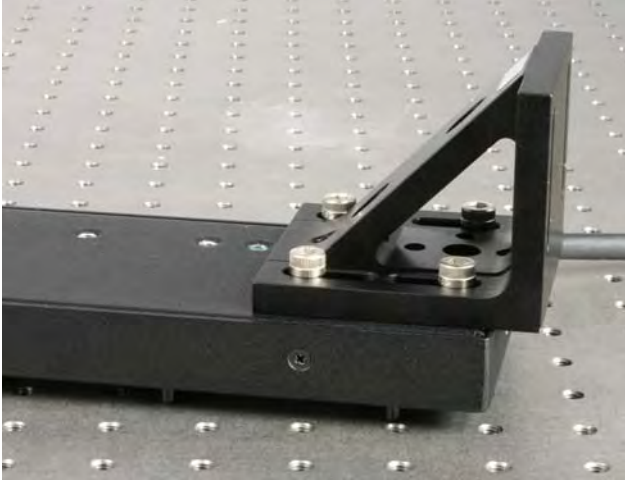


Fig. 2.5 Bolting the Assembly to The Worksurface

- 6) If the T-Cube units were previously fitted to a vertically-mounted hub, the control panel of each T-Cube must be rotated through 90° - see Section 2.2.6. for more details.
- 7) Populate the hub with T-Cubes as required.

### 2.2.5 Vertical Mounting

- 1) Remove any T-Cube units fitted to the hub.
- 2) Turn the hub upside down and remove any attachment brackets previously fitted.
- 3) Fit the AP90 Angle bracket to the back face of the hub - see Fig. 2.6



**Fig. 2.6 Fitting the AP90 Bracket for Vertical Mounting**

- 4) Position the hub in the desired position on the worksurface.
- 5) Line up the attachment holes in the bracket and the worksurface, then fit the bolts to secure the assembly in a vertical position - see Fig. 2.7.



**Fig. 2.7 Bolting the Assembly to The Worksurface**

- 6) If the T-Cube units were previously fitted to a horizontally mounted hub, the control panel of each T-Cube must be rotated through 90° - see Section 2.2.6. for more details.
- 7) Populate the hub with T-Cubes as required.



### 2.2.6 Rotating a T-Cube Control Panel

Unless specified otherwise at time of order, the T-Cubes are shipped with the control panels positioned for operation in a horizontal configuration. If the hub is to be used in its vertical configuration the control panels of the T-Cubes must be rotated anticlockwise through 90°. Similarly, if the hub has previously been used in a vertical configuration, and the orientation is changed to a horizontal mounting, then the T-Cube control panels must be rotated clockwise through 90°.



#### Caution



**Although the T-Cube units have been designed to allow rotation of the control panel, this process should be performed only when necessary. The various cables that connect the control surface to the main circuit board are delicate and can be damaged by excessive stretching or twisting stresses. As a guide, the panel should be rotated no more than 10 times.**

To rotate the control panel, proceed as follows.

- 1) Before commencing this procedure, personnel must take standard anti-static precautions. Either wear a static discharge wrist strap, or at regular intervals, touch a point electrically connected to earth.
- 2) Switch off the power to the hub, then unplug the T-Cube unit - see Section 2.3.5..
- 3) Remove the eight screws securing the control panel - see Fig. 2.8.
- 4) Carefully prise the control panel from the T-Cube unit.
- 5) Rotate the control panel to the desired orientation. Take care not to stretch or bend the membrane tail and other connecting cables. The control panel can only be fitted in two positions; either as shown in Fig. 2.8 or rotated anticlockwise 90° from this position.
- 6) Refit the control panel, taking care to ensure that no cables are trapped.
- 7) Refit the panel screws previously removed at item (3). Do not over-tighten the screws.



Fig. 2.8 Control Panel Screws

## 2.3 Electrical Installation

### 2.3.1 Hub Supply voltage and current requirements

Supply	Minimum	Maximum	Max Operating Current
+5V	+4.9V	+5.1V	5 A
+15V	+14.5V	+15.5V	6 A
-15V	-14.5V	-15.5V	1 A

### 2.3.2 Mains Power Supply Ratings

Voltage: 85-264 V AC

Power: 150 VA

### 2.3.3 Connecting To A Power Supply Unit



#### Warning



The hub must be connected only to the power supply shipped with the unit. Connection to a supply of a different rating may cause damage to the unit and could result in injury to the operator.



#### Caution



Do not connect the hub to a 'live' external power supply. Doing so (i.e. "hot plugging") carries the risk of PERMANENT damage to the unit. Always ensure the power supply unit is isolated from the mains before connecting to the hub. Always power up the hub by connecting its power supply to the mains. Similarly, to power down the unit, disconnect the power supply from the mains before disconnecting the hub.



Fig. 2.9 Power Supply Unit (Supplied)

- 1) Using the circular, 4-pin plug on the flying lead, connect the hub to the PSU supplied. (see Appendix A.1 for power supply connector pin out details).
- 2) Switch on the Power Supply unit..

### 2.3.4 Hub IO Connections

The hub is fitted with input and output connections as described below.



**Fig. 2.10 USB IN, USB OUT and AUX POWER Connections**

USB IN - provides communication to the host controller PC.

USB OUT - can be connected to the USB IN on another Hub or other USB device, allowing multiple Controller Hubs to be connected together, thereby requiring only a single USB cable from the host control PC.

AUX POWER - reserved for future use.

POWER - flying lead terminated in a circular, 4-pin plug providing connection to the power supply - see Section 2.3.3.



### Caution



#### T-Cube Hub Signal Routing.

The T-Cube Hub allows the transfer of voltage signals between T-Cubes with two available analog lines. This is used by the TPZ001 Piezo Cube and TSG001 Strain Gauge Cube to route a feedback signal via the Hub for closed loop operation. It is also used by the TNA001 NanoTrak Cube to send position demand signals to a pair of slave TPZ001 Piezo Cubes.

A clash can occur if a TSG001 Strain Gauge Cube and a TNA001 NanoTrak Cube are combined on the hub, and both attempt to drive voltage signals out via the Hub. In this instance it is recommended that the TNA001 NanoTrak Cube is configured to drive signals out via its SMA connections and the associated TPZ001 Piezo Cube pair configured to pick these signal up via SMA inputs. This will require small SMA to SMA connection cables, various lengths of which are available from Thorlabs.

### 2.3.5 Fitting a T-Cube Driver Unit



#### Warnings



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

**NEVER POWER A T-CUBE USING ITS LOCAL POWER SOCKET WHEN IT IS ALSO PLUGGED INTO THE TCH002 CONTROLLER HUB.** Dual powering a T-Cube in this way will result in severe damage to the T-Cube unit and could result in personal injury



Fig. 2.11 Fitting A T-Cube Driver Unit

- 1) Ensure that all power is disconnected from the hub AND the T-Cube unit to be fitted.
- 2) Remove the socket cover from the relevant bay.
- 3) Check for correct orientation of the ERNI connector socket on the hub and its mating plug on the T-Cube unit, then plug the T-Cube unit into the hub, ensuring that the locating pegs are correctly fitted into the lugs on the T-Cube.
- 4) Fit the securing screws, taking care not to over-tighten.



#### Caution



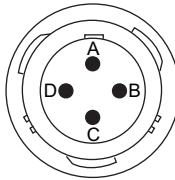
**To prevent the ingress of dust and moisture, ensure that the ERNI connector covers remain fitted to any unpopulated T-Cube bays.**

---

## Appendix A Connector Pinout Details

### A.1 Power Connector

A flying lead terminated in a circular, 4-pin plug provides connection to the power supply. The pin functions and supply requirements are detailed in Fig. A.1.



Pin	Description	Minimum	Maximum	Max Operating Current
A	0V	-	-	-
B	-15V	-14.5V	-15.5V	1 A
C	+15V	+14.5V	+15.5V	6 A
D	+5V	+4.9V	+5.1V	5 A

Fig. A.1 POWER Connector Pin Identification

## 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



### Warnings



Disconnect the power supply before cleaning the unit.

Use only a soft, dry cloth to dust the outside faces.

Do not use any water, detergents, solvents or other liquids.

Do not use any type of abrasive pad or scouring powder.

---

## Appendix C Specifications and Associated Parts

### C.1 Specifications

**USB Hub Circuit:** Fully Compliant USB 2.0 Hub

**Enclosure:** Rigid Slim Profile 'Baseplate' Construction

**Finish:** Black

**T-Cube Bays:** Six

**Table Mounting Orientation:** Horizontal, Edge or Vertical using Thorlabs AP90 Bracket

**Table Mounting Fixings:** Universal Metric (M6) or Imperial (1/4"-20) Design

**Dimensions:** 375mm x 86mm x 21.5mm (14.75" x 3.4" x 0.85")

**Power Lines:** +15V, -15V, 5V

**Mains Power:** Voltage: 85-264 V AC  
Power: 150 VA

### C.2 Associated Products

Product Name	Part Number
DC Servo Motor Driver	TDC001
Stepper Motor Driver	TST001
Piezo Driver	TPZ001
Strain Gauge Reader	TSG001
Solenoid Controller	TSC001
Auto-alignment Controller	TNA001
Quad Detector Reader	TQD001
Laser Diode Driver	TLD001
Laser Source	TLS001
TEC Controller	TTC001

---

## Appendix D Regulatory

### D.1 Declarations Of Conformity

#### D.1.1 For Customers in Europe

This equipment has been tested and found to comply with the EC Directives 89/336/EEC 'EMC Directive' and 73/23/EEC 'Low Voltage Directive' as amended by 93/68/EEC.

Compliance was demonstrated by conformance to the following specifications which have been listed in the Official Journal of the European Communities:

Safety	EN61010: 2001 Installation Category II, Pollution Degree II.
EMC	EN61326: 1997

#### D.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.

### D.2 Waste Electrical and Electronic Equipment (WEEE) Directive

#### D.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. 4.1** 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.

#### D.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.

#### D.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.

### D.3 CE Certificate



## E C Declaration of Conformity

We,

Thorlabs Ltd  
1 Saint Thomas Place,  
Cambridgeshire Business Park,  
Ely, Cambridgeshire  
CB7 4EX

declare that the TCH002 T-Cube USB controller Hub complies with the following  
Harmonized European Standards:

BS EN 61326-1:1998  
BS EN 61000-3-2: 2000  
BS EN 61000-3-3: 1995  
EN 61010-1: 2001

And is in conformity with

93/68/EEC – CE Marking Directive (1996)  
89/336/EEC – EMC Directive (1996)  
73/23/EEC – Low Voltage Directive (1997)

Signed in **Ely**  
(place)

On the 3 day of April 2012  
(day) (month) (year)

---

## Appendix E Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at [www.thorlabs.com/contact](http://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

Thorlabs Ltd.  
sales.uk@thorlabs.com  
techsupport.uk@thorlabs.com

### Scandinavia

Thorlabs Sweden AB  
scandinavia@thorlabs.com

### Brazil

Thorlabs Vendas de Fotônicos Ltda.  
brasil@thorlabs.com

### China

Thorlabs China  
chinasales@thorlabs.com



**THORLABS**  
[www.thorlabs.com](http://www.thorlabs.com)