THORLABS 43 Sparta Avenue Newton, NJ 07860 | Sales: (973) 300-3000 | www.thorlabs.com

KSG101 - February 19, 2024

Item # KSG101 was discontinued on February 19, 2024. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

KINESIS® K-CUBE™ STRAIN GAUGE READER

- **High-Resolution Strain Gauge Reader**
- **Position, Voltage, or Force Sensing Modes**
- **Operation via Local Panel Controls or Remote PC via USB**

Application Idea
KPZ101 Piezo Controller Used with a KSG101 Strain Gauge Reader for Closed-Loop Operation of One of Our 3-Axis Nanopositioning Flexure Stages

Table Mounting Plate
(Included with the KSG101)

Hide Overview

OVERVIEW

Features

- Compact Footprint: 60.0 mm x 60.0 mm x 49.2 mm
- Strain Gauge AC Bridge Signal Input
- On-Unit Controls and OLED Display
  - Select Between Position, Force, or Voltage Strain Gauge Reading
  - Calibration Mode to Set Sensor Zero Position
  - Select USB Controller Hub Feedback Signal Channels
- Nanometer-Level Position Resolution with Thorlabs Actuators
- Low-Voltage Monitor Output (Custom Closed-Loop Applications)
- Full Kinesis® or APT™ Software Control Suite (See *Motion Control Software* Tab for Details)
- Software Compatible with Other Kinesis and APT Controllers for Integrated Systems Development
- Fully Compatible with Current- and Previous-Generation T-Cube™ Controllers
- Power Supply Sold Separately
- Multi-Axis Expansion Using USB Controller Hubs (Sold Separately)
- Magnetic, Clip-On Optical Table Mounting Adapter Included

Click to Enlarge
Back and Top Views of the KSG101 K-Cube (See the *Pin Diagrams* Tab for More Information)

K-Cube™ Motion Control Modules
Brushed DC Servo Motor Controller
Brushless DC Servo Motor Controller
Fiber Alignment Controllers
Four-Channel Piezo Inertia Actuator Controller
PSD Auto Aligner
Single-Channel Piezo Controller
Single-Channel Strain Gauge Reader
Solenoid Controller
Stepper Motor Controller

Click to Enlarge
The KCH601 USB Controller Hub with installed K-Cube and T-Cube modules. One KAP101 adapter plate is used for the T-Cube on the hub.

Thorlabs' K-Cube™ Strain Gauge Reader is a part of Thorlabs' new and growing Kinesis® line of high-end, compact motion controllers. It is designed to measure, condition (rectify and filter), and display the feedback signal derived from AC bridge strain gauge systems. The KSG101 provides immediate 'out of the box' operation with the complete Thorlabs range of strain-gauge-equipped bare piezo stacks, actuators, stages, and force sensors.

This K-Cube unit can be used for position, force, or voltage strain-gauge reading. When used in isolation, it can measure the deflection/extension in a strain gauge with nanometer level resolution. Alternatively, it can be used with Thorlabs' force sensor products (Item #s FSC102 and FSC103) for high-sensitivity force sensing down to mN levels. Closed loop positioning can be achieved by using the KSG101 and KPZ101 together with the CA2906 SMA to SMA cable, which is not supplied with the KSG101 but is available separately. The strain gauge reader is also equipped with a low-voltage monitor output (0-10 V) that is proportional to the strain gauge extension, thus providing a conditioned feedback/monitoring signal for third party systems.

Embedded software allows this unit to be fully operated using the on-unit menu button, OLED display, and control wheel or using external trigger signals. The unit can switch between position, force, and voltage (feedback signal) readout displays; control force sensors; be used with our USB controller hubs; and be calibrated without being connected to a PC. In addition to these on-unit controls, USB connectivity provides simple PC-controlled operation with two available software platforms: our new Kinesis software package or our legacy APT™ (Advanced Positioning Technology) software package.

The Kinesis Software features .NET controls which can be used by 3rd party developers working in the latest C#, C++, Matlab, LabWindows/CVI, Visual Basic, LabVIEW™, or any .NET compatible languages to create custom applications. Our legacy APT software allows the user to quickly set up complex move sequences with advanced controls made possible via the ActiveX® programming environment. For example, all relevant operating parameters are set automatically by the software for Thorlabs stage and actuator products. For more details on both software packages, please see the *Motion Control Software, Kinesis Tutorials*, and *APT Tutorials* tabs.

The unit has a highly compact 60.0 mm x 60.0 mm x 49.2 mm footprint, allowing it to be positioned close to the system for added convenience when using the top panel controls. Tabletop operation also allows minimal drive cable lengths for easier cable management. Each unit contains a front-located power switch that, when turned off, saves all user-adjustable settings. Please note that this switch should always be used to power down the unit. For convenience, a 1.5 m long Type A to Type Micro B USB 3.0 cable is included with the KSG101 cube.

Optical Table Mounting Plate
Each unit comes with a mounting plate that clips onto the base of the module. The plate contains two magnets for temporary placement on an optical table and two counterbores for 1/4"-20 (M6) cap screws for a more permanent placement on the tabletop. Please see the *Specs* for a mechanical drawing of the table mounting plate and the *Mounting Options* tab for how to mount the plate.

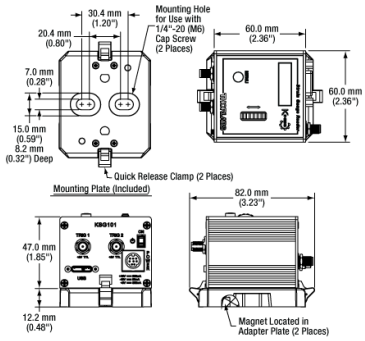
Power Supply Options
The KSG101 K-Cube, which does not ship with a power supply, can be powered using a TPS002 power supply. The TPS002 power supply plugs into a standard wall outlet and provides +15 VDC, -15 VDC, and +5 VDC for up to two K- or T-Cubes.

The KSG101 is also compatible with the KCH301 and KCH601 USB Controller Hubs, available below. Our USB Controller Hubs have a single USB connection that provides USB connectivity to all the K-Cubes and T-Cubes connected to the hub. It is especially useful when the KSG101 is used with the KPZ101 Piezo Controller since it allows for direct communication between the cubes connected on it.

Other Strain Gauge Controllers		
K-Cube Single-Channel Strain Gauge Reader	Piezo + Strain Gauge Benchtop Controller 1- and 3-Channel	Piezo + Strain Gauge Modular 2-Channel Rack System Module

Hide Specs

SPECS



Click to Enlarge
Mechanical Drawing of the KSG101 and Included Table Mounting Plate

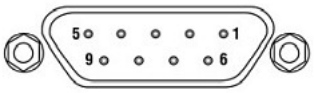
KSG101 Specifications	
General	
Bridge Type	AC
Excitation Frequency	18 kHz
Supply Voltage	±15 V, +5 V
Monitor Output	0 - 10 V (SMA Connector)
Top-Panel Display	OLED
Bandwidth	500 Hz
Housing Dimensions[a] (W x D x H)	60.0 mm x 60.0 mm x 49.2 mm (2.36" x 2.36" x 1.94")
Measurement Resolution	
Position Mode	1 nm
Force Mode	1 mN
Voltage Mode	1 mV
Ouput/Input Connectors[b]	
Strain Gauge Input	9-Pin D-Type
USB Connector Type	USB 3.0
USB Connection Speed	USB 1.1 Full Speed (12 Mbps)
K-Cube Controller Hub Connector	26-Way ERNI
Output Monitor[c]	SMA, 0 - 10 V
Bidirectional Trigger Ports	SMA, ±5 V
Input Power Requirements	
Voltage (Current)	+15 V (220 mA), -15 V (50 mA), +5 V (350 mA)

- Including Top Panel Controls
- Please see the *Pin Diagrams* tab for details.
- The monitor output is always active and cannot be turned off, thus allowing for the output of the KSG101 to always be viewed.

Hide Pin Diagrams

PIN DIAGRAMS

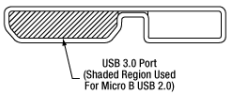
Strain Gauge I/P Connector
D-Type Female



Pin	Description	Pin	Description
1	Wheatstone Bridge Excitation	5	AC Feedback IN
2	+15 V Out [a]	6	Ground
3	-15 V Out [a]	7	Actuator ID Signal[b]
4	Ground	8 & 9	Reserved for Future Use

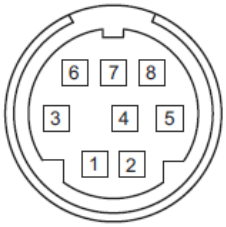
a. Power supply for the piezo actuator feedback circuit. It must not be used to drive any other circuits or devices.
b. This signal is applicable to Thorlabs piezo actuators fitted with an ID resistor. It enables the system to identify the piezo extension associated with the actuator.

Computer Connection*



*The USB 3.0 port is compatible with a USB 2.0 Micro B connector if the Micro B connector is plugged into the shaded region in the photo above. A USB 3.0 type A to type Micro B cable is included with the KSG101

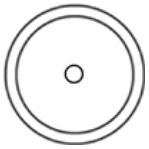
Power Connector
Mini-DIN Female



Pin	Description	Pin	Description
1	+5 V (350 mA Max)	6	Common Ground
2	+5 V (350 mA Max)	7	Common Ground
3	-15 V (50 mA Max)	8	Common Ground
4	+15 V (220 mA Max)	Shield[a]	Common Ground
5	+5 V (350 mA Max)		

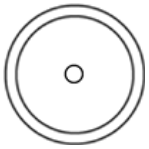
a. Outer Diameter of the Mini-DIN Connector

Monitor
SMA Female



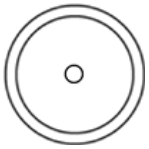
This 0 - 10 V output can be connected to an oscilloscope, allowing the strain gauge output to be monitored.

TRIG 1
SMA Female



+5 V TTL

TRIG 2
SMA Female



+5 V TTL

These connectors provide a 5 V logic level input and output that can be configured to support triggering into and out of external devices. Each port can be independently configured to control the logic level or to set the trigger as an input or output.
Impedance when Configured as Input: 100 kΩ
Impedance when Configured as Output: 620 Ω

Hide Mounting Options

MOUNTING OPTIONS

K-Cube Mounting Options

Two options are available to securely mount our K-Cube controllers onto an optical table. An optical table mounting plate, provided with every K-Cube, allows for a single controller to be attached to an optical table. Alternatively, three- and six-port USB controller hubs are offered (sold separately) that can mount and power our K-Cube controllers. These options are described in further detail below.

Optical Table Mounting Plate
Each K-Cube unit comes with a mounting plate that clips onto the base of the controller, as shown in the animation below. The plate contains two magnets for temporary placement on an optical table and two counterbores for 1/4"-20 (M6) cap screws for a more permanent placement on the tabletop. Please see the *Specs* tab for a mechanical drawing of the table mounting plate.

Kinesis USB Controller Hubs
Multiple units can be mounted and connected to a single PC by using the KCH301 or KCH601 USB Controller Hubs. They each consist of two parts: the hub, which can support up to three (KCH301) or six (KCH601) K-Cubes or T-Cubes, and a power supply that plugs into a standard wall outlet. K-Cubes simply clip into place using the provided on-unit clips, while current- and previous-generation T-Cubes require the KAP101 Adapter Plate, shown in the animation below. The hub vastly reduces the number of USB and power cables required when operating multiple controllers.

K-Cube Table Mounting Plate

Kinesis USB Controller Hubs

Hide K-Cubes vs. T-Cubes

K-CUBES VS. T-CUBES

Introducing Thorlabs' Kinesis® Motion Controllers

A major upgrade to the former-generation T-Cubes, the growing K-Cube line of high-end controllers provides increased versatility not only through the new Kinesis software, but through an overhaul and updating of their physical design and firmware.

Every K-Cube controller includes a digital display. In addition to basic input and output readouts, this display hosts a number of menu options that include zeroing, force sensor select, and unit select. The on-unit wheel and menu button are used to scroll through the available options. Each unit contains a front-located power switch that, when turned off, saves all user-adjustable settings as well as two bidirectional SMA trigger ports that accept or output a 5 V TTL logic signal.

Please see the table to the right for a full comparison of the features offered by our new KSG101 K-Cube and previous-generation TSG001 T-Cube strain gauge controllers.

K-Cube vs. T-Cube Feature Comparison		
Feature	**KSG101 K-Cube**	**TSG001 T-Cube**
Kinesis Software Compatibility	✓	✓
APT Software Compatibility	✓	✓
Kinesis USB Controller Hubs Compatibility	✓	Requires KAP101 Adapter
TCH002 T-Cube USB Controller Hubs Compatibility	N/A	✓
Power Switch	✓	N/A
Bidirectional SMA Trigger Port[a]	2	N/A
SMA Monitor Output[a]	✓	✓
Computer Connection[a]	USB 3.0 Micro B (USB 2.0 Compliant)	USB 2.0 Micro B (USB 2.0 Compliant)
Included Mounting Plate	✓	✓
Size (L x W x H)	60.0 mm x 60.0 mm x 49.2 mm (2.36" x 2.36" x 1.94")	60.0 mm x 60.0 mm x 49.2 mm (2.36" x 2.36" x 1.94")
On-Unit Digital Display Menu	✓	✓
Zeroing	✓	✓
Analog Out	✓	Only via Software
Units Select	✓	✓
Force Sensors	✓	✓
Brightness	✓	✓

a. Please see the *Pin Diagrams* tab for details.

Click to Enlarge
KSG101 K-Cube Kinesis Piezo Controller

Kinesis USB Controller Hubs

Complementing our K-Cubes are our Kinesis USB 2.0 controller hubs. With two versions available for three or six K- or T-Cubes, these USB hubs are designed specifically for communication between multiple controllers and the host control PC. These hubs are backward compatible with our T-Cubes.

K-Cubes simply clip into place using the provided on-unit clips, while current- and previous-generation T-Cubes require the KAP101 Adapter Plate, shown in the animation to the below right. The hub vastly reduces the number of USB and power cables required when operating multiple controllers.

K-Cube Table Mounting Plate

Kinesis USB Controller Hubs

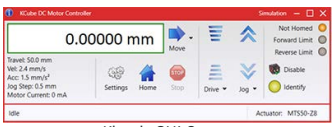
Hide Motion Control Software

MOTION CONTROL SOFTWARE

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

The Kinesis Software features .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.

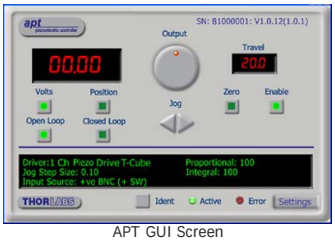
Our legacy APT System Software platform offers ActiveX-based controls which can be used by 3rd party developers working on C#, Visual Basic, LabVIEW™, or any Active-X compatible languages to create custom applications and includes a simulator mode to assist in developing custom applications without requiring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



Kinesis GUI Screen

By providing these common software platforms, Thorlabs has ensured that users can easily mix and match any of the Kinesis and 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 single-axis to 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



APT GUI Screen

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 is 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.

Software

Kinesis Version 1.14.46

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

Also Available:

- Communications Protocol Software

Software

APT Version 3.21.6

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

Also Available:

- Communications Protocol Software

Hide Kinesis Tutorials

KINESIS TUTORIALS

Thorlabs' Kinesis® software features new .NET controls which can be used by third-party developers working in the latest C#, Visual Basic, LabVIEW™, or any .NET compatible languages to create custom applications.

C#

This programming language is designed to allow multiple programming paradigms, or languages, to be used, thus allowing for complex problems to be solved in an easy or efficient manner. It encompasses typing, imperative, declarative, functional, generic, object-oriented, and component-oriented programming. By providing functionality with this common software platform, Thorlabs has ensured that users can easily mix and match any of the Kinesis 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 Kinesis System Software allows two methods of usage: graphical user interface (GUI) utilities for direct interaction 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.

For a collection of example projects that can be compiled and run to demonstrate the different ways in which developers can build on the Kinesis motion control libraries, click on the links below. Please note that a separate integrated development environment (IDE) (e.g., Microsoft Visual Studio) will be required to execute the Quick Start examples. The C# example projects can be executed using the included .NET controls in the Kinesis software package (see the Kinesis Software tab for details).

Click Here for the Kinesis with C# Quick Start Guide
Click Here for C# Example Projects
Click Here for Quick Start Device Control Examples

LabVIEW

LabVIEW can be used to communicate with any Kinesis- or APT-based controller via .NET controls. In LabVIEW, you build a user interface, known as a front panel, with a set of tools and objects and then add code using graphical representations of functions to control the front panel objects. The LabVIEW tutorial, provided below, provides some information on using the .NET controls to create control GUIs for Kinesis- and APT-driven devices within LabVIEW. It includes an overview with basic information about using controllers in LabVIEW and explains the setup procedure that needs to be completed before using a LabVIEW GUI to operate a device.

Click Here to View the LabVIEW Guide
Click Here to View the Kinesis with LabVIEW Overview Page

Hide APT Tutorials

APT TUTORIALS

The APT video tutorials available here fall into two main groups - one group covers using the supplied APT utilities and the second group covers programming the APT System using a selection of different programming environments.

Disclaimer: The videos below were originally produced in Adobe Flash. Following the discontinuation of Flash after 2020, these tutorials were re-recorded for future use. The Flash Player controls still appear in the bottom of each video, but they are not functional.

Every APT controller is supplied with the utilities APTUser and APTConfig. APTUser provides a quick and easy way of interacting with the APT control hardware using intuitive graphical control panels. APTConfig is an 'off-line' utility that allows various system wide settings to be made such as pre-selecting mechanical stage types and associating them with specific motion controllers.

APT User Utility

The first video below gives an overview of using the APTUser Utility. The OptoDriver single channel controller products can be operated via their front panel

controls in the absence of a control PC. The stored settings relating to the operation of these front panel controls can be changed using the APTUser utility. The second video illustrates this process.

APT User - Overview APT User - OptoDriver Settings

APT Config Utility

There are various APT system-wide settings that can be made using the APT Config utility, including setting up a simulated hardware configuration and associating mechanical stages with specific motor drive channels. The first video presents a brief overview of the APT Config application. More details on creating a simulated hardware configuration and making stage associations are present in the next two videos.

APT Config - Overview APT Config - Simulator Setup APT Config - Stage Association

APT Programming

The APT Software System is implemented as a collection of ActiveX Controls. ActiveX Controls are language-independant software modules that provide both a graphical user interface and a programming interface. There is an ActiveX Control type for each type of hardware unit, e.g. a Motor ActiveX Control covers operation with any type of APT motor controller (DC or stepper). Many Windows software development environments and languages directly support ActiveX Controls, and, once such a Control is embedded into a custom application, all of the functionality it contains is immediately available to the application for automated operation. The videos below illustrate the basics of using the APT ActiveX Controls with LabVIEW, Visual Basic, and Visual C++. Note that many other languages support ActiveX including LabWindows CVI, C++ Builder, VB.NET, C#.NET, Office VBA, Matlab, HPVEE etc. Although these environments are not covered specifically by the tutorial videos, many of the ideas shown will still be relevant to using these other languages.

Visual Basic

Part 1 illustrates how to get an APT ActiveX Control running within Visual Basic, and Part 2 goes on to show how to program a custom positioning sequence.

APT Programming Using Visual Basic - Part 1 APT Programming Using Visual Basic - Part 2

LabVIEW

Full Active support is provided by LabVIEW and the series of tutorial videos below illustrate the basic building blocks in creating a custom APT motion control sequence. We start by showing how to call up the Thorlabs-supplied online help during software development. Part 2 illustrates how to create an APT ActiveX Control. ActiveX Controls provide both Methods (i.e. Functions) and Properties (i.e. Value Settings). Parts 3 and 4 show how to create and wire up both the methods and properties exposed by an ActiveX Control. Finally, in Part 5, we pull everything together and show a completed LabVIEW example program that demonstrates a custom move sequence.

APT Programming Using LabVIEW - Part 1: Accessing Online Help APT Programming Using LabVIEW - Part 2: Creating an ActiveX Control APT Programming Using LabVIEW - Part 3: Create an ActiveX Method

APT Programming Using LabVIEW - Part 4: Create an ActiveX Property APT Programming Using LabVIEW - Part 5: How to Start an ActiveX Control

The following tutorial videos illustrate alternative ways of creating Method and Property nodes:

APT Programming Using LabVIEW - Create an ActiveX Method (Alternative) APT Programming Using LabVIEW - Create an ActiveX Property (Alternative)

Visual C++

Part 1 illustrates how to get an APT ActiveX Control running within Visual C++, and Part 2 goes on to show how to program a custom positioning sequence.

APT Programming with Visual C++ - Part 1 APT Programming with Visual C++ - Part 2

MATLAB

For assistance when using MATLAB and ActiveX controls with the Thorlabs APT positioners, click here.

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

Hide K-Cube™ Strain Gauge Reader

K-Cube™ Strain Gauge Reader

- Control Panel and OLED Screen for On-Unit Control and Position Readout
- Two Bidirectional Trigger Ports to Read or Control External Equipment
- Interfaces with Computer Using Included USB Cable
- Fully Compatible with Kinesis® or APT™ Software Packages
- Compact Footprint: 60.0 mm x 60.0 mm x 49.2 mm
- Power Supply Not Included (See Below)

Click to Enlarge
KCH301 USB Controller Hub (Sold Separately) with Installed K-Cube and T-Cube™ Modules (T-Cubes Require the KAP101 Adapter)

The KSG101 K-Cube Strain Gauge Reader is designed for use with our range of strain-gauge-equipped bare piezo stacks, actuators, stages, and force sensors. It features a top-mounted control panel with an OLED screen for on-unit control and position readouts. The OLED display includes a backlight that can be dimmed or turned off using the top panel menu options. The front of the unit contains two bidirectional trigger ports that can be used to read a 5 V external logic signal or output a 5 V logic signal to control external equipment. Each port can be independently configured to control the logic level or to set the trigger as an input or output.

The unit is fully compatible with our new Kinesis software package and our legacy APT control software. Please see the *Motion Control Software* tab for more information. Please note that this module does not ship with a power supply. Compatible power supplies are listed below.

Part Number	Description	Price	Availability

KSG101	**K-Cube Strain Gauge Reader (Power Supply Sold Separately)**	**$707.24**	**Lead Time**

Hide Compatible Power Supplies

Compatible Power Supplies

- Individual ±15 V/5 V Power Supply
  - TPS002: For up to Two K-Cubes™ or T-Cubes™ with Mini-DIN Input*
- USB Controller Hubs Provide Power and Communications
  - KCH301: For up to Three K-Cubes or T-Cubes
  - KCH601: For up to Six K-Cubes or T-Cubes

The TPS002 supplies power for up to two K-Cubes* or T-Cubes. The cubes still require individual computer connection via USB cable.

The KCH301 and KCH601 USB Controller Hubs each consist of two parts: the hub, which can support up to three (KCH301) or six (KCH601) K-Cubes or T-Cubes, and a power supply that plugs into a standard wall outlet. The hub draws a maximum current of 10 A; please verify that the cubes being used do not require a total current of more than 10 A. In addition, the hub provides USB connectivity to any docked K-Cube or T-Cube through a single USB connection.

For more information on the USB Controller Hubs, see the full web presentation.

*The TPS002 can only support one KNA-VIS or KNA-IR controller or one KLD101 driver and should not be used to power any additional units as that may exceed current limitations.

Part Number	Description	Price	Availability
TPS002	**±15 V/5 V Power Supply Unit with Mini-DIN Connectors for up to Two K- or T-Cubes**	**$128.29**	**Today**
KCH301	**USB Controller Hub and Power Supply for Three K-Cubes or T-Cubes**	**$598.63**	**Today**
KCH601	**USB Controller Hub and Power Supply for Six K-Cubes or T-Cubes**	**$724.52**	**Today**