ELL6K - October 17, 2025

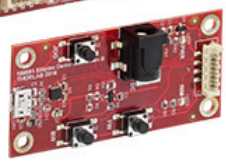
Item # ELL6K was discontinued on October 17, 2025. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

MULTI-POSITION SLIDERS WITH RESONANT PIEZOELECTRIC MOTORS

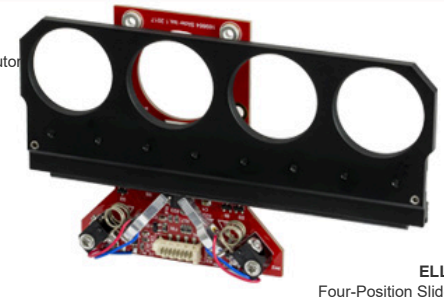
- Mount Multiple SM05- or SM1-Threaded Components
- Open Frame Design for OEM Applications
- Control via Interface Board, GUI, or ASCII Message Calls
- Fully Integrated Drive Electronics

Customization Available

ELLB
Bus Distributor



ELLC
Interface Board



ELL9
Four-Position Slider
(Also Available as a Bundle with the ELLC Interface Board)

Application Idea
ELL6K Bundle Components Shown Assembled, with Two Colored Glass Filters, and Mounted Using the ELLA1 Adapter

OVERVIEW

Features

- Ideal for OEMs and Applications Requiring Rapid Switching
- Micro-B USB and Picoflex®[1] Connectors for Control Signals
- Multi-Drop Serial Communication Protocol Supported
- SM05- or SM1-Threaded Ports for Mounted Optics or Other Components
- Photo-Interrupter Optical Sensor Technology for Precise Positioning
- Compatible with 30 mm Cage System Components
- Accessory Upgrade Kits, Additional Interface Boards and Cables, Bus Distributor, and Post Mount Adapter Available Below

Key Specs[a]			
Item #	**ELL12(K)**	**ELL6(K)**	**ELL9(K)**
Ports for Mounted Optics	Six, SM05 Threaded	Two, SM1 Threaded	Four, SM1 Threaded
Switching Time Range	No Load: 350 to 400 ms 150 g Load: <600 ms	No Load: 180 to 270 ms 100 g Load: <600 ms	No Load: 450 to 500 ms 150 g Load: <700 ms
Positioning Repeatability	<100 µm (30 µm Typical)		
Maximum Total Load[b]	150 g (5.29 oz)		
DC Voltage Input	4.5 to 5.5 V		
Minimum Lifetime[c]	3.3 Million Operations or 100 km Total Travel		
Slider Weight	78.5 g (2.77 oz)	44.0 g (1.55 oz)	70.0 g (2.47 oz)

a. See the *Specs* tab for complete specifications.
b. When vertically mounted such that the slider carriage moves from side-to-side.
c. These sliders are not designed for continuous operation. Lifetime is measured in terms of distance traveled by the optics mount. One operation is defined as a movement from one position to an adjacent position.

Thorlabs offers multi-position sliders with millisecond switching times enabled by Thorlabs' Elliptec® piezoelectric resonant motor technology. Each slider is available as a standalone unit as well as in a complete package that include an ELLC interface board. Thorlabs also offers accessory packs, which can be used to upgrade standalone units to complete kits. Our compact and lightweight multi-position sliders all use the same custom-designed PCB, with the ELL6 featuring one motor and the ELL12 and ELL9 including two. The motors are highly dynamic and have no gearing. As the motor includes no magnets, it is compatible with EM-sensitive environments. Please see *The Elliptec® Motor* tab for more information.

Thorlabs' Elliptec Technology for OEM

Video 1.1 Animation demonstrates mounting these sliders using 30 mm cage system components and operating the ELL6K via the interface board. The ELLA1 (available below) is another mounting option. For additional operating information for these sliders, see the *Operation* tab. The animation shows the carriage moving in slow motion for clarity.

The open frame format, versatility, and simplicity of these sliders make them attractive for OEM applications, as they can be customized according to customer requirements and produced in high-volume quantities. Please see our OEM and Manufacturing Capabilities page for more information.

Control

There are multiple options for powering, driving, and controlling these multi-position sliders, which are detailed in the *Slider Operation* section of the *Operation* tab. Each slider possesses a 3.3 V serial bus and is designed to be operated with or without the ELLC interface board; the *Pin Diagram* tab provides pin assignments. Thorlabs offers software for our Elliptec products capable of providing full and independent control of the slider. When the interface board is used as an accessory to change the position of the carriage on the slider, the carriage's status in the software is automatically updated. Please note that the dual-position and four-position sliders are not designed for continuous operation. We recommend operation with duty cycles of 40% or less.

Multiple Elliptec devices can be controlled using the ELLB Bus Distributor or by splicing multiple connectors onto one ribbon cable. A single bus distributor can connect up to four Elliptec devices; up to 16 devices can be connected if the buses are daisy chained. This bus can be controlled one of three ways: through an ELLC interface board (included with the bundles below; also available separately) connected to a PC running the Elliptec software, by connecting to an Arduino®[2] or Raspberry Pi®[3] board, or by wiring the connector pins to a user-supplied control board. Alternatively, up to 16 devices can be spliced onto a single ribbon cord, at which point the devices can be simultaneously controlled by the interface board or selectively controlled by the Elliptec software. See the manual for instruction on how to splice multiple devices onto a ribbon cord and the *Pin Diagrams* tab for pin assignments when making custom connections.

Application Idea

The multi-position sliders are well suited as filter changers, and the ELL6 is also recommended as shutter. Their carriages feature SM05- or SM1-threaded bores with 3.5 mm deep threads, and four 4-40 tapped holes in their structural PCBs allow the sliders to be mounted using the low-profile ELLA1 Post Mount Adapter, available below, and integrated into optical setups using Thorlabs' 30 mm Cage System components. For applications with horizontal space constraints where switching between SM05-threaded filters is needed, Thorlabs offers an SM05-threaded filter wheel ada compatible with the ELL18 rotation stage.

Elliptec Resonant Motor Products							
							
Multi-Position Sliders	28 mm Linear Stage	60 mm Linear Stage	Rotation Stage	Ø1/2" Rotation Mount	Ø1" Rotation Mount	Ø2" Rotation Mount	Motorized Iris

1. Picoflex is a registered trademark of Molex Incorporated.
2. Arduino is a registered trademark of Arduino Sa Société Anonym (SA).
3. Raspberry Pi is a registered trademark of the Raspberry Pi Foundation.

SPECS

Specifications

Performance specifications are given for the case when the multi-position slider is mounted as recommended in the *Operation* tab.

Item #		ELL12(K)	ELL6(K)	ELL9(K)
Performance				
Switching Time between Adjacent Positions	**Unloaded Carriage on Slider**	350 to 400 ms	180 to 270 ms	450 to 500 ms
	Loaded Carriage on Slider	<600 ms (150 g Load)	<600 ms (100 g Load)	<700 ms (150 g Load)
Thread Type of Ports in Carriage		Internal SM05 (0.535"-40)[a] Threads, 3.5 mm Deep	Internal SM1 (1.035"-40)[a] Threads, 3.5 mm Deep	
Number of Threaded Ports in Carriage		Six	Two	Four
Travel		95 mm (3.74")	31 mm (1.22")	93 mm (3.66")
Positioning Repeatability[b]		<100 µm (30 µm Typical)		
Maximum Total Load (Vertically Mounted)[c]		150 g (5.29 oz)		
Minimum Lifetime[d]		3.3 Million Switching Operations or 100 km Total Travel		
Electrical				
DC Voltage Input		4.5 to 5.5 V		
Typical Current Consumption	**During Movement**	<1200 mA	<600 mA	<1200 mA
	During Standby	38 mA		
	During Search for Resonant Frequencies[e]	1.2 A		
Communications				
Bus[f]		Multi-Drop 3.3 V/5 V TTL RS232		
Connector on Multi-Position Slider Board		Picoflex®		
Connectors on Interface Board		Picoflex® Micro-B USB 5 VDC Power: [For Plug with Ø5.5 mm OD (Ground) and Ø2.1 mm ID (+5 V)]		
Speed		9600 baud/s		
Data Length[g]		8 bit		
Protocol Data Format		ASCII HEX		
Module Address and Command Format		Mnemonic Character		
8-Conductor Ribbon Cable Length		Supplied: 0.250 m; Max: 3 m		
Mechanical				
Dimensions of the Slider (At End Stops)[h]		143.5 mm x 77.7 mm x 14.2 mm (5.65" x 3.06" x 0.56")	80.5 mm x 77.7 mm x 14.9 mm (3.16" x 3.06" x 0.59")	143.5 mm x 77.7 mm x 14.9 mm (5.65" x 3.06" x 0.59")

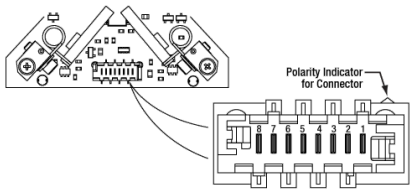
Dimensions of the Interface Board	32.0 mm x 66.0 mm x 12.5 mm (1.26" x 2.60" x 0.49")		
Weight (Slider)	78.5 g (2.77 oz)	44.0 g (1.55 oz)	70.0 g (2.47 oz)
Weight (Interface Board)	10.3 g (0.36 oz)		
Environmental Operating Conditions			
Temperature Range	15 to 40 °C		
Maximum Relative Humidity (Non-Condensing)	<80% at 31 °C		
Maximum Altitude	2000 m		

a. For more information, see the *Threading Specs* tab.
b. Low-power infrared photo-interrupter optical sensor technology aligns the carriage at each position.
c. The multi-position board is vertically mounted, with the motor beneath the optics, so that movement of the carriage is side-to-side and not up-and-down.
d. These sliders are not designed for continuous operation. Lifetime is measured in terms of distance traveled by the optics mount. One operation is defined as a movement from one position to an adjacent position.
e. Additional Power Supply May Be Required (For Details: *Operation* tab: *Supplying Power*)
f. Use two 10 kΩ pull-up resistors in multi-drop mode for RX/TX.
g. 1 Stop Bit, No Parity
h. The PCB on the bi-positional slider of the ELL6(K) has a thickness of 2.4 mm for serial numbers 2023-10600046 and above. For serial numbers lower than 2023-10600046, the thickness is 1.6 mm.

PIN DIAGRAM

ELL12 & ELL9 Connector J2 Pinout[a,b]		
Pin	**Type**	**Function**
1	PWR	Ground
2	OUT	ODTX - Open Drain, Transmit 3.3 V TTL RS232
3	IN	RX Receive 3.3 V TTL RS232
4	OUT	In Motion, Open Drain, Active Low, Max 5 mA
5	IN	JOG/Mode, Active Low, Max 5 V
6	IN	BW Backward, Active Low, Max 5 V
7	IN	FW Forward, Active Low, Max 5 V
8	PWR	VCC +5 V ± 10%; 1200 mA

a. Connector Model Number MOLEX 90814-0808;
Mating Connector Model Number MOLEX 90327-0308
b. A polarity indicator is engraved onto each PCB next to the Picoflex® connector, as shown in Figure 3.1, to assist with properly connecting the interface board to the main unit. The red wire in the ribbon cable should be adjacent to this indicator. Not doing so can harm the unit.



Click to Enlarge
Figure 3.1 Pinout diagram of the Picoflex® connector is shown referenced to a partial diagram
of the ELL12 and ELL9 slider board. The polarity indicator on the connector must be adjacent to the red wire on the supplied 8-connector cable.

ELL6 Connector J2 Pinout[a,b]		
Pin	**Type**	**Function**
1	PWR	Ground
2	OUT	ODTX - Open Drain, Transmit 3.3 V TTL RS232
3	IN	RX Receive - 3.3 V TTL RS232
4	OUT	In Motion, Open Drain, Active Low, Max 5 mA
5	IN	JOG/Mode = Normal/Test Demo, Active Low, Max 5 V
6	IN	BW Backward, Active Low, Max 5 V
7	IN	FW Forward, Active Low, Max 5 V
8	PWR	VCC +5 V ± 10%; 600 mA

a. Connector Model Number MOLEX 90814-0808;
Mating Connector Model Number MOLEX 90327-0308

b. A polarity indicator is engraved onto each PCB next to the Picoflex® connector, as shown in Figure 3.2, to assist with properly connecting the interface board to the main unit. The red wire in the ribbon cable should be adjacent to this indicator. Not doing so can harm the unit.

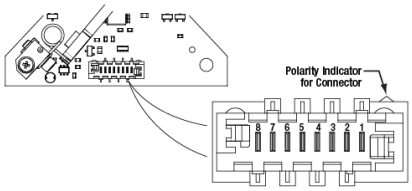


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Figure 3.2 Pinout diagram of the Picoflex® connector is shown referenced to a partial diagram of the ELL6 slider board. The polarity indicator on the connector must be adjacent to the red wire on the supplied 8-connector cable.

ELLB Connector J1, J2, J3, and J4 Pinout[a,b]		
Pin	**Type**	**Function**
1	PWR	Ground
2	OUT	ODTX - Open Drain, Transmit 3.3 V TTL RS232
3	IN	RX Receive - 3.3 V TTL RS232
4	OUT	In Motion, Open Drain, Active Low, Max 5 mA
5	IN	Not Connected
6	IN	Not Connected
7	IN	Not Connected
8	PWR	VCC +5 V ± 10%; 800 mA per Connected Device

a. Connector Model Number MOLEX 90814-0808;
Mating Connector Model Number MOLEX 90327-0308

b. A polarity indicator is engraved onto each PCB next to the Picoflex® connector, as shown in Figure 3.3, to assist with properly connecting the interface board to the main unit. The red wire in the ribbon cable should be adjacent to this indicator. Not doing so can harm the unit.

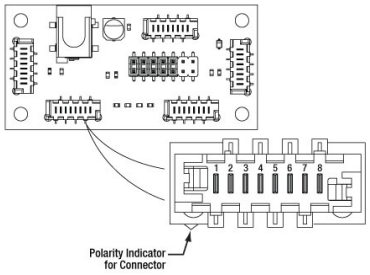

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Figure 3.3 Pinout diagram of the Picoflex® connector is shown referenced to a simplified diagram of the ELLB Bus Distributor. The polarity indicator on the connector must be adjacent to the red wire on the supplied 8-connector cables.

OPERATION

Operation Notes

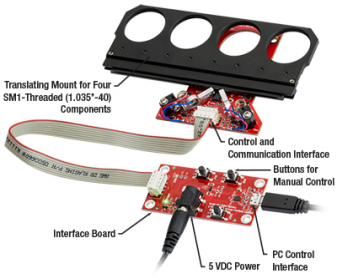
This tab contains information on handling, mounting, and operating these multi-position sliders.

Contents

Handling

Our sliders and interface boards are robust to general handling. An assembled ELL9K bundle with labels indicating key features is shown in Figure 4.1, and a picture of an interface board is in Figure 4.2. To ensure reliable operation, keep the surface contacted by the motor free of oils, dirt, and dust. It is not necessary to wear gloves while handling the dual-position or four-position slider, but avoid touching the surface contacted by the motor to avoid transferring contaminants to it. If it is necessary to clean the surface contacted by the motor, it can be wiped using KW32 or similar extra low lint sheets and isopropyl alcohol or mineral spirits (white spirit). Do not use acetone, as this solvent will damage the plastic edge of the slider's carriage.

The open frame format of these sliders can tolerate up to 8 kV of static discharge. ESD precautions should be taken, as an electrostatic discharge can produce an electrical signal that may cause an unintended movement of the carriage. Avoid subjecting the structural PCB to loads in excess of 500 g. If an excessive load is applied the PCB may bend, which will degrade the performance of the slider.



Click to Enlarge
Figure 4.1 Components of the ELL9K Bundle

Mounting

These multi-position sliders may be operated with the slider mounted vertically (upright) or horizontally (laying down), assuming certain conditions are met. When the slider is oriented vertically, ensure that the carriage translates side-to-side, rather than up-and-down, as the effects of gravity substantially reduce the maximum load that may be translated. When it is mounted vertically, the slider may be oriented with the motor(s) above or below the carriage. The recommended orientation is with the motor(s) below the carriage, as is shown in Figures 4.3 through 4.7, which minimizes the chance of any dust or particulates displaced during operation settling on the surface of the optics mounted in the carriage. When mounting the slider horizontally, ensure that the installation does not bend the PCB. In all cases, do not allow anything to interfere with moving parts of the slider and make sure that the slider and the mounted optics are secure to avoid jostling during motion.

Click to Enlarge
Figure 4.2 The ELLC Interface Board

There are several options for mounting the sliders. The ELLA1 Post Mount Adapter, which is available below, fastens directly to the back of the slider's PCB. As shown in Figure 4.3, the adapter can then be used to mount the slider to a Ø1/2" post. The compact dimensions of the ELLA1 allows sliders to be placed one behind the other while minimizing the space separating them, as shown in Figure G5.2. The adapter can also be integrated with Thorlabs' 30 mm Cage System components and/or SM1-threaded components, such as lens tubes. Alternately, 30 mm cage system components alone can be used to mount the sliders. An example of this is shown in Figure 4.4, in which a CP33 Cage Plate, four ER1 rods, a Ø1/2" post, and a post holder mount and support the assembled ELL6K.

Click to Enlarge
[APPLIST]
[APPLIST]
Figure 4.3 ELL6K with Glass Filters and Mounted using the ELLA1

Click to Enlarge
[APPLIST]
[APPLIST]
Figure 4.4 ELL6K with Glass Filters and Mounted using 30 mm Cage System Components

Loading

The maximum total load specification of 150 g refers to the weight of the load mounted to the carriage, and does not include the weight of the slider. For example, the weight of the unloaded ELL6 slider is approximately 22 g, and the maximum allowed weight of the mounted components is 150 g; the combined maximum permitted weight of the slider and mounted components is 172 g. The sliders are designed to be compatible with 30 mm cage system components.

Supplying Power

Using the Interface Board

Even though ultrasonic voltage signals are required to operate the motors, the stage is powered by applying a DC voltage signal to the interface board. The electronics on the board, which convert the applied DC signal to a sinusoidal signal oscillating at the desired resonant frequency, make this possible.

The ELL6 includes one motor and the ELL12 and ELL9 include two. Because of the lower power requirements of the ELL6's single motor, it is possible to supply power to the ELL6 through the Micro-B USB connector on the interface board. A 5 V power supply is not included in the ELL6K bundle. Operation of sliders with two motors requires a 5 V power supply, and one is included in the ELL12K and ELL9K bundles.

An advantage of powering the ELL6 using the Micro-B USB connector on the interface board is that a computer can be used to simultaneously control and power the slider. Laptops can supply the amperage necessary to enable switching between positions on the ELL6 dual-position slider; however, some laptops may not be able to supply the 1.2 A required to perform a search for optimal resonant frequencies, which is described in the following *Resonant Frequencies* section. When this is the case, and it is necessary to perform a search for optimal resonant frequencies, an alternate power source capable of delivering the needed amperage must be used to supplement the power provided by the laptop.

When the setup includes the ELL12 or ELL9 and an interface board, power is supplied through the 5 VDC power socket. As the Micro-B USB connector does not supply power sufficient to drive both motors, this connector is used only for computer control of the slider.

Without the Interface Board

When these sliders are incorporated into an application without the interface board, the connection with the power source is made using the pins on the Picoflex® connector. A pinout diagram of this connector is included in the *Pin Diagram* tab, and information on powering and addressing the slider given in its manual and the communications protocol manual respectively.

Operational Principle of the Motor

The Elliptec motors move the carriages on the sliders between positions, and the direction of the translation is determined by the ultrasonic frequency driving motor's piezoelectric elements. For each motor, there is one ultrasonic resonant frequency that will push the carriage forward, and another that will pull the carriage backward. Operating a motor at one of its resonance frequencies causes the tip of the motor to continuously cycle in a tight clockwise elliptical path. When the motor is driven at its other resonance frequency, the tip of the motor cycles through that same path in a counterclockwise direction. Both resonance frequencies are around 100 kHz. The total displacement at the tip of motor is a function of the mechanical load it is driving and the voltage supplied to the piezo element. In the case of no loading and a 5 V maximum driving voltage at a resonant frequency, the tip of the motor expands and contracts no more than a few microns while tracing the elliptical path. Please see *The Elliptec® Motor* tab for more information and an animation that illustrates the operational principle of the motor.

Resonance Frequencies

On power-up, the factory default setting instructs the slider to search for the resonance frequencies that will deliver the best performance. During this process, the slider will translate between the forward and backward positions. At the conclusion of this calibration process, the slider is in the backward position. If this movement on start-up is undesirable, it is possible to disable this calibration procedure by using the serial port to initialize the frequencies on power-up. A new search for optimal resonance frequencies may be performed at any time; to maintain optimal performance, it is recommended that new searches be performed after changes in loading and/or ambient temperature. Please see Section Section 4.4 of the manual for details.

Slider Operation

Note that our sliders are not intended for continuous operation. We recommend operation with duty cycles of less than 40% during general use, while operation with duty cycles greater than 60% should be limited to a few seconds.

The movement of the slider's carriage may be controlled by pressing buttons on the interface board, through computer control via the Elliptec® software package that may be downloaded, or by sending simple signals to digital lines on the slider board. The constant drive power results in a linear speed profile, which enables the motor to accelerate and decelerate in a few microseconds.

The interface board may be used as an accessory while interfacing with the slider through the Elliptec software; all changes in the position of the carriage that occur as a result of pressing buttons on the interface board are registered by the software, and the software may independently control the carriage while the interface board is connected. The buttons on the interface board can be seen in Figure 4.2.

Multiple Elliptec devices can be be controlled using the ELLB Bus Distributor or by splicing multiple connectors onto one ribbon cable. A single bus distributor can connect up to four Elliptec devices; up to 16 devices can be connected if the buses are daisy chained. This bus can be controlled one of three ways: through an ELLC interface board (included with the bundles below; also available separately) to connect to a PC running the Elliptec software, by connecting to an Arduino® or Raspberry Pi® board, or by wiring the connector pins to a user-supplied control board. Note that if an interface board is used, its on-unit buttons will be disabled. Alternatively, up to 16 devices can be spliced onto a single ribbon cord. The devices can then be simultaneously controlled by the interface board or selectively controlled by the Elliptec software. See the manual for instruction on how to splice multiple devices onto a ribbon cord and the *Pin Diagrams* tab for pin assignments when making custom connections. The communications protocol manual describes how to use the software to individually address each connected device. A link to download the software and accompanying documentation can be found in the *Software* tab.

Figures 4.5, 4.6, and 4.7 as well as Video 1.1 on the *Overview* tab, show the operation of the ELL6 slider using the interface board. By pressing the button on the interface board marked 'FW,' as is about to be done in Figure 4.6, the slider is sent to the forward position. The slider will return to the home position when the button on the interface board marked 'BW' is pressed.

When using the interface board to control the position of the carriage on the ELL12 or ELL9 sliders, the JOG button is also used. If the slider is facing forward and oriented vertically with motors beneath the translating mount, press and hold the JOG button then press the FW button to move the carriage one position to the observer's right. Press and hold the JOG button and press the BW button to move the carriage one position to the observer's left.

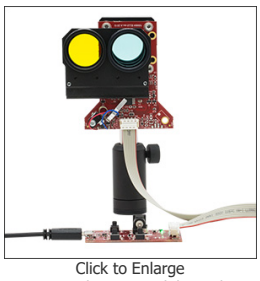


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Figure 4.5 Dual-Position Slider with Carriage in the Backward Position

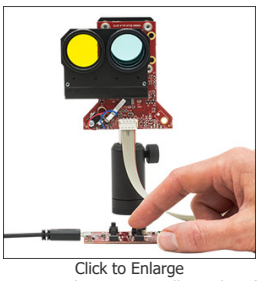

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Figure 4.6 The carriage will translate from the backward position (Figure 4.5 and above) to the forward position (Figure 4.7) in response to a press of the FW button.

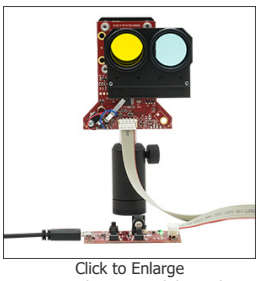

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Figure 4.7 Dual-Position Slider with Carriage in the Forward Position

SHIPPING LIST

ELL12K and ELL9K Slider Bundles

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Figure 5.1 Components of the ELL9K Bundle
One Region-Specific Power Adapter Included, All Region-Specific Plugs Shown for Reference

Each Bundle Includes the Following:

- Slider
- Interface Board
- Micro-B to A-Type USB Cable
- 8-Conductor 28 AWG Ribbon Cable
- 5 V Power Supply with Location-Specific Plug

PC-based software is also available for download, as are the manual, communications protocol manual, and other documentation.

ELL6K Slider Bundle

Click to Enlarge
Figure 5.2 Components of the ELL6K Bundle

Each Bundle Includes the Following:

- Slider
- Interface Board
- Micro-B to A-Type USB Cable
- 8-Conductor 28 AWG Ribbon Cable

PC-based software is also available for download, as are the manual, communications protocol manual, and other documentation.

SOFTWARE

Software for Devices Driven by Elliptec® Piezoelectric Resonant Motors

All devices based on the Elliptec® resonant piezo motor may be controlled by the Elliptec system software, which features an intuitive graphical user interface (GUI). The source code, in C# format, is included in software bundle available for download, and custom applications can be created in any language. Figure 6.1 shows a screen capture of the GUI, and the button that follows links to the download page.

Commands are entered in the *Sequencer command / wait order* section located at the center-left of the GUI. An example of a sequence of commands that might be sent to the device is "Afw" to move the slider at address "A" to the forward position and then "Abw" to move the slider at address "A" to the backward position. The command "As1" is used to perform the frequency search that will identify the optimal resonant frequencies, for the current operating conditions, for the motor at address "A."

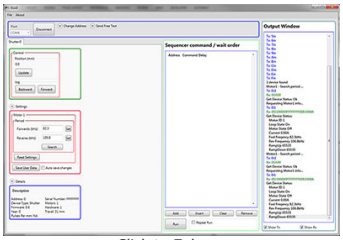

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Figure 6.1 The Elliptec Piezoelectric Resonant Motor Control Software GUI

Software

Version 1.6.5 (May 6, 2025)

Includes the Elliptec System Software, with an easy-to-use GUI. Also available for download is the Communications Protocol manual, which details the communication commands for the Elliptec software package.

Software

THREADING SPECS

Threading Specifications

The following is a general overview of screw threading. For more details regarding specifications and dimensions, please consult the *Machinery's Handbook*, available for purchase at many bookstores.

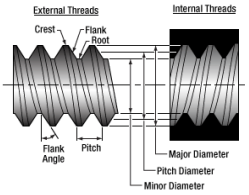

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Figure 122A Diagram of Thread Features

Features of a Thread

A thread consists of three repeating features: a crest, flank, and root (see Figure 122A). Except in special cases, threads have symmetrical sides inclined at equal angles when a vertical line is drawn through the center of a crest or root. The distance between corresponding points on adjacent threads is known as the pitch of the thread. The flank angle is defined as the angle the flank makes with a perpendicular ray drawn from the screw axis. Unless otherwise stated, threads have a flank angle of 30°, resulting in a total angle between flanks of 60°. Each feature is shown in Figure 122A.

The major diameter is taken from the crests of a thread while the minor diameter is taken from the roots. For most screws, crests and roots do not terminate at a sharp point, so crest and root truncation values are included in the definitions of major and minor diameter. The pitch diameter is approximately halfway between the major and minor diameters.

Thread Form

A thread form is a set of rules that define the features' scale relative to one another. Common thread forms include the Unified Screw Thread Form, used in the United States of America and measured in imperial units, and the ISO Metric Screw Thread Form, used in many parts of the world and measured with the International System of Units. There are many thread forms in the Unified screw thread standard designated by either UN, which defines a flat root contour, or UNR, which defines a round root contour. These can be further described by appending more letters. For example, an extremely fine thread with a flat root contour is designated UNEF. Those forms which are not standardized by the Unified screw thread system are designated UNS.

Thread Series

Most screws are identified by their thread series. Thread series are denoted by the major diameter and density of threads. Unified threads specify density in threads per inch, while Metric threads specify the thread pitch. For example, in the Unified nomenclature, a 1/4"-20 cap screw has a 1/4" diameter barrel and the pitch is 20 threads per inch (TPI). In metric nomenclature, an M4 x 0.7 cap screw has a 4 mm barrel and the pitch is 1 thread per 0.7 mm. The term M4 x 0.7 is often shortened to just M4.

Thread Class

The tolerances and allowances on a thread series are given by a thread class. Unified thread classes are alphanumeric identifiers starting with a number from 1 through 3, where 1 is the loosest tolerance and 3 is the tightest, and either A for external threading or B for internal threading.

Table 122B Unified Thread Class Tolerancing

Location	Loose	Optimal	Strict
Internal	1B	2B	3B
External	1A	2A	3A

Table 122D Metric Thread Tolerance Positions

Location	Loose	Optimal	Strict
Internal	-	G	H
External	e or f	g	h

Table 122C Metric Thread Tolerance Grades

Dimension	Location	Tolerance Grades[a]
Minor Diameter	Internal	4, 5, 6, 7, 8
Major Diameter	External	4, 6, 8
Pitch Diameter	Internal	4, 5, 6, 7, 8
	External	3, 4, 5, 6, 7, 8, 9

a. The tolerance becomes looser as the grade increases. The underlined grades are used with normal lengths of thread engagement.

Metric threads have a slightly more complex tolerancing method that uses tolerancing grades, designated by a number 3 through 9; and tolerancing positions, which use letters e through h. Grades provide a measure of the tolerance itself: the smaller the number, the tighter the tolerance. Positions denote the distance of the tolerance from the pitch diameter. Uppercase positioning letters indicate internal threads while lowercase positioning letters indicate external threads.

Quoting from the *Machinery's Handbook, 29th Edition,* p. 1885: "To designate the tolerance class, the grade and position of the pitch diameter is shown first followed by that for the major diameter in the case of the external thread or that for the minor diameter in the case of the internal thread, thus 4g6g for an external thread and 5H6H for an internal thread. If the two grades and positions are identical, it is not necessary to repeat the symbols, thus 4g, alone, stands for 4g4g and 5H, alone, stands for 5H5H."

Thorlabs' SM Series Threads

Threading specifications for our SM threads, utilized in our lens tube and cage system components, are given in Tables 122E through 122N so that you can machine

mating components to suit your application. Most SM series threads utilize a non-standard Unified thread form, indicated by the letters UNS, with a 30° flank angle and a thread class of 2A and 2B. The exception is our SM30 series thread, which is a Metric thread form with a 30° flank angle and a tolerance of 6H/6g. We also offer products with C-Mount and RMS threads, and the specifications for these threads are given in Tables 122E through 122N for reference. Please note that other manufacturers may have different tolerances for C-Mount and RMS threads. For other thread specifications that are not listed here, please contact Tech Support.

Table 122E SM05 Threading: Ø1/2" Lens Tubes, 16 mm Cage Systems			
External Thread, 0.535"-40.0 UNS-2A		**Internal Thread, 0.535"-40.0 UNS-2B**	
Max Major Diameter	0.5340"	**Min Major Diameter**	0.5350"
Min Major Diameter	0.5289"	**Min Pitch Diameter**	0.5188"
Max Pitch Diameter	0.5178"	**Max Pitch Diameter**	0.5230"
Min Pitch Diameter	0.5146"	**Min Minor Diameter (and 83.3% of Thread)**	0.508"
Max Minor Diameter	0.5069"	**Max Minor Diameter (and 64.9% of Thread)**	0.514"

Table 122F RMS Threading: Objective, Scan, and Tube Lenses			
External Thread, 0.800"-36.0 UNS-2A		**Internal Thread, 0.800"-36.0 UNS-2B**	
Max Major Diameter	0.7989"	**Min Major Diameter**	0.8000"
Min Major Diameter	0.7934"	**Min Pitch Diameter**	0.7820"
Max Pitch Diameter	0.7809"	**Max Pitch Diameter**	0.7866"
Min Pitch Diameter	0.7774"	**Min Minor Diameter (and 83.3% of Thread)**	0.770"
Max Minor Diameter	0.7688"	**Max Minor Diameter (and 64.9% of Thread)**	0.777"

Table 122G C-Mount Threading: Machine Vision Lenses, CCD/CMOS Cameras			
External Thread, 1.000"-32.0 UN-2A		**Internal Thread, 1.000"-32.0 UN-2B**	
Max Major Diameter	0.9989"	**Min Major Diameter**	1.0000"
Min Major Diameter	0.9929"	**Min Pitch Diameter**	0.9797"
Max Pitch Diameter	0.9786"	**Max Pitch Diameter**	0.9846"
Min Pitch Diameter	0.9748"	**Min Minor Diameter (and 83.3% of Thread)**	0.966"
Max Minor Diameter	0.9651"	**Max Minor Diameter (and 64.9% of Thread)**	0.974"

Table 122H SM1 Threading: Ø1" Lens Tubes, 30 mm Cage Systems			
External Thread, 1.035"-40.0 UNS-2A		**Internal Thread, 1.035"-40.0 UNS-2B**	
Max Major Diameter	1.0339"	**Min Major Diameter**	1.0350"
Min Major Diameter	1.0288"	**Min Pitch Diameter**	1.0188"
Max Pitch Diameter	1.0177"	**Max Pitch Diameter**	1.0234"
Min Pitch Diameter	1.0142"	**Min Minor Diameter (and 83.3% of Thread)**	1.008"
Max Minor Diameter	1.0068"	**Max Minor Diameter (and 64.9% of Thread)**	1.014"

Table 122J SM30 Threading: Ø30 mm Lens Tubes			
External Thread, M30.5 x 0.5 – 6H/6g		**Internal Thread, M30.5 x 0.5 – 6H/6g**	
Max Major Diameter	30.480 mm	**Min Major Diameter**	30.500 mm
Min Major Diameter	30.371 mm	**Min Pitch Diameter**	30.175 mm
Max Pitch Diameter	30.155 mm	**Max Pitch Diameter**	30.302 mm
Min Pitch Diameter	30.059 mm	**Min Minor Diameter (and 83.3% of Thread)**	29.959 mm
Max Minor Diameter	29.938 mm	**Max Minor Diameter (and 64.9% of Thread)**	30.094 mm

Table 122K SM1.5 Threading: Ø1.5" Lens Tubes			
External Thread, 1.535"-40 UNS-2A		**Internal Thread, 1.535"-40 UNS-2B**	
Max Major Diameter	1.5339"	**Min Major Diameter**	1.535"
Min Major Diameter	1.5288"	**Min Pitch Diameter**	1.5188"
Max Pitch Diameter	1.5177"	**Max Pitch Diameter**	1.5236"
Min Pitch Diameter	1.5140"	**Min Minor Diameter (and 83.3% of Thread)**	1.508"
Max Minor Diameter	1.5068"	**Max Minor Diameter (and 64.9% of Thread)**	1.514"

Table 122L SM2 Threading: Ø2" Lens Tubes, 60 mm Cage Systems			
External Thread, 2.035"-40.0 UNS-2A		**Internal Thread, 2.035"-40.0 UNS-2B**	
Max Major Diameter	2.0338"	**Min Major Diameter**	2.0350"
Min Major Diameter	2.0287"	**Min Pitch Diameter**	2.0188"
Max Pitch Diameter	2.0176"	**Max Pitch Diameter**	2.0239"
Min Pitch Diameter	2.0137"	**Min Minor Diameter (and 83.3% of Thread)**	2.008"
Max Minor Diameter	2.0067"	**Max Minor Diameter (and 64.9% of Thread)**	2.014"

Table 122M SM3 Threading: Ø3" Lens Tubes			
External Thread, 3.035"-40.0 UNS-2A		**Internal Thread, 3.035"-40.0 UNS-2B**	
Max Major Diameter	3.0337"	**Min Major Diameter**	3.0350"
Min Major Diameter	3.0286"	**Min Pitch Diameter**	3.0188"

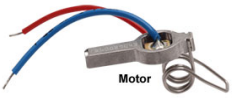
Max Pitch Diameter	3.0175"	**Max Pitch Diameter**	3.0242"
Min Pitch Diameter	3.0133"	**Min Minor Diameter (and 83.3% of Thread)**	3.008"
Max Minor Diameter	3.0066"	**Max Minor Diameter (and 64.9% of Thread)**	3.014"

Table 122N SM4 Threading: Ø4" Lens Tubes			
External Thread, 4.035"-40 UNS-2A		**Internal Thread, 4.035"-40.0 UNS-2B**	
Max Major Diameter	4.0337"	**Min Major Diameter**	4.0350"
Min Major Diameter	4.0286"	**Min Pitch Diameter**	4.0188"
Max Pitch Diameter	4.0175"	**Max Pitch Diameter**	4.0245"
Min Pitch Diameter	4.0131"	**Min Minor Diameter (and 83.3% of Thread)**	4.008"
Max Minor Diameter	4.0066"	**Max Minor Diameter (and 64.9% of Thread)**	4.014"

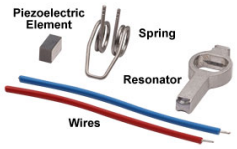
THE ELLIPTEC® MOTOR

The Elliptec® Piezoelectric Resonant Motor

Thorlabs' Elliptec® piezo resonant motor, shown in Figure 81A, is lightweight, with a mass of 1.2 g, and compact: the dimensions of the resonator housing, excluding the spring, are 8 mm x 4 mm x 20 mm.



Click to Enlarge
Figure 81A The Elliptec Piezoelectric Resonant Motor



Click to Enlarge
Figure 81B The Components of the Elliptec Motor

Components of the Motor

The components that compose the motor are shown in Figure 81B. The piezoelectric element is press fit into the aluminum resonator, which has been precisely designed and machined to produce the desired elliptical motion at the tip and to interface optimally with the driven module. The free ends of the spring are integrated with the resonator housing. The wires, which are soldered to the top and bottom of the piezoelectric element, deliver the voltage signal that induces the piezoelectric element to vibrate at ultrasonic frequencies.

When the motor is built into a system, the open loop of the spring is bolted to a sturdy surface that is stationary with respect to the item to be driven, and the tip of the resonator is placed in contact with the item. The purpose of the spring is to maintain constant contact between the tip of the resonator and the driven item, and the direction of motion is determined by the resonance frequency at which the piezo element is driven.

Elliptical Motion and Comparison with Conventional Motors

Video 81C Elliptec motors quickly and precisely position stages and mounts while never seeming to move. Their microscopic movements occur at ultrasonic frequencies and are invisible to the naked eye.

The motor is operated by driving it at one of its two resonance frequencies. A voltage signal oscillating at an ultrasonic frequency is applied to the piezoelectric chip, which responds by expanding less than a micron and then contracting back to its original dimensions at the frequency of the driving signal. This rapid-cycling change in the chip's dimensions causes a vibration in the aluminum resonator housing. When the vibration is at one of the housing's resonance frequencies, a pushing motion results at the tip of the motor. When the vibration is at the other resonance frequency a pulling motion results.

As illustrated in Video 81C, the pulling and pushing motions result from the tip of the motor tracing an elliptical path in space when the motor operates at resonance. The selected resonance frequency controls the direction of the cyclical motion. The motor's tip traces one half of the ellipse as it expands and the other half as it contracts. When the motor pushes the driven item, the motor's tip is in contact with the item while the tip expands; the two are not in contact while the tip contracts. The converse is true when the motor pulls the driven item in the opposite direction. The total displacement at the tip of the motor is a function of both the mechanical load it is driving and the voltage supplied to the piezo element. The maximum displacement can be up to a few microns when the peak driving voltage is 5 V.

The motor behaves in many ways like a DC or electromagnetic stepper motor, but it does not suffer from many of the drawbacks of these conventional motors. Unlike conventional electromagnetic motors, which must overcome inertial delays to come to a stop, the highly dynamic Elliptec motor can stop within microseconds. As it has no gears, it does not exhibit backlash. Since it possesses no magnets, it is compatible with use in environments sensitive to electromagnetic interference. The motion of the driven element is continuous and smooth. As the tip of the motor must be in contact with the driven item to induce motion, the motor possesses the safety feature of an inherent friction brake. When in contact with a plastic surface, the motor operates virtually silently.

For OEM applications, the motor can be manufactured in volume at low cost, and it can be driven by inexpensive analog electronics. It does not require microprocessors or software; however it is compatible for use with them.

Multi-Position Slider Bundles

- Bundle is Ideal for OEM Evaluation Testing

- Easy Integration into a Setup
- Operate using Manual and/or Computer Control

These multi-position slider bundles are complete kits that include the slider, also available separately, and the other components listed in Table G1.1. The ELL6, with its single motor, can be simultaneously controlled and powered via USB. As the two motors on the ELL12 and ELL9 sliders require greater power, a 5 V power supply is included with their respective kits.

Click to Enlarge

These packages facilitate quick integration of the slider into laboratory setups and other experimental applications. They also provide a convenient means to integrate this technology into OEM applications.

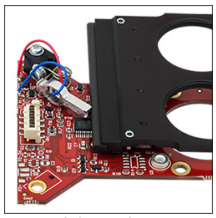


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Figure G1.2 Red and blue wires deliver power to the motor, whose aluminum tip contacts the edge of the carriage. During operation, the motor's tip cycles at ultrasonic speeds and on a microscopic scale. Its movement cannot be seen by the human eye.

Table G1.1 Kit Components

Item #	Slider	Accessories	Power Supply
ELL12K	ELL12 Slider with Six SM05-Threaded Ports	ELLC Interface Board, USB Cable, Ribbon Cable (8-Conductor, 28 AWG)	5 V Power Supply with Region-Specific Plug
ELL6K	ELL6 Slider with Two SM1-Threaded Ports		-
ELL9K	ELL9 Slider with Four SM1-Threaded Ports		5 V Power Supply with Region-Specific Plug

Part Number	Description	Price	Availability
ELL12K	**Customer Inspired! SM05-Threaded, Six-Position Slider Bundle with Interface Board and Cables**	**$460.45**	**Today**
ELL6K	**SM1-Threaded, Dual-Position Slider Bundle with Interface Board and Cables**	**$348.27**	**Today**
ELL9K	**Customer Inspired! SM1-Threaded, Four-Position Slider Bundle with Interface Board and Cables**	**$428.67**	**Today**

Multi-Position Sliders

- Standalone Multi-Position Sliders with SM05 or SM1-Threaded Ports
- Command the Slider by Connecting through an Existing Interface Board or Directly via the Multidrop TTL RS-232 Interface
- Serves Applications that do not Require an Interface Board or Cables
- Can be Used to Expand an Existing Network of Elliptec® Devices

Item #	Port Thread	# of Ports
ELL12	SM05 (0.535"-40)	6
ELL6	SM1 (1.035"-40)	2
ELL9		4

These multi-position sliders are offered as standalone products. They are frequently used to meet the needs of applications whose design requires multiple networked Elliptec® resonant motor products, or applications that do not require the other components included in the bundles above. Each position on the carriage has an SM05- or SM1-threaded bore with 3.5 mm deep threads. The four 4-40 tapped holes in the PCB, which are compatible with Thorlabs' 30 mm Cage System, can be used to mount the slider.

The PCBs of both sliders incorporate a 8-pin male Picoflex® connector (header). Each of these standalone sliders ships with the female 8-pin Picoflex® connector (receptacle) that mates with the connector (header) on the board. Please see the *Pin Diagram* tab for details.

Part Number	Description	Price	Availability
ELL12	**Customer Inspired! SM05-Threaded, Six-Position Slider**	**$361.79**	**Today**
ELL6	**SM1-Threaded, Dual-Position Slider**	**$247.88**	**Lead Time**
ELL9	**Customer Inspired! SM1-Threaded, Four-Position Slider**	**$330.23**	**Today**

Elliptec Accessory Upgrade Kits

- Convert Any Single ELL Device into a Kit by Adding the Following:
  - ELLC Interface Board
  - USB Micro-B Cable
  - Picoflex®[1] Cable
  - Item # ELLC2 Only: 5 V Power Supply with Regional Adapter (US, UK, AU, or EU)

Specifications		
DC Voltage Input to Controller		4.5 to 5.5 V
Typical Current Consumption Per Module	**Movement**	800 mA
	Standby	50 mA
Operating Temperature Range		15 to 40 °C
Maximum Supported Ribbon Cable Length		520 mm (20.5")
Dimensions (Interface Board Only)		66.0 mm x 32.0 mm x 12.5 mm (2.60" x 1.26" x 0.49")
Weight (Interface Board Only)		10.8 g (0.022 lbs)

Click for Details

Figure 749A Region-Specific Adapters for the ELLC2 Power Adapter

Thorlabs' ELLCx Accessory Upgrade Packs are designed to provide the items necessary to convert any single ELL slider, stage, or mount into an ELL kit[2]. The interface board, included in the ELLC1 and ELLC2 kits (also sold separately as Item # ELLC) features three buttons to control the position of a connected ELL stage. The USB port enables direct connection to a PC via the USB Micro-B cable. A 0.25 m Picoflex® cable with 8 loaded circuits that connects the interface board to the ELL device is included, and a 5 V power supply with a regional adapter (US, UK, AU, or EU) is included with the ELLC2 kit.

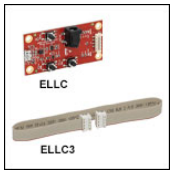
1. Picoflex® is a registered trademark of Molex Incorporated.
2. Mounting brackets for the ELL17(/M), ELL18(/M), and ELL20(/M) can be ordered by contacting Tech Support.

Table 749B Included in the ELLCx Accessory Upgrade Kits				
Item #	Interface Board	USB 2.0 Micro-B Cable[a]	Picoflex Cable[b]	5 V Power Supply[a,c]
ELLC1	✓	✓	✓	-
ELLC2	✓	✓	✓	✓

a. 1.5 m Long
b. 8-Conductor 28 AWG Ribbon Cable, 250 mm Long
c. Includes Region-Specific Power Adapter

Part Number	Description	Price	Availability
ELLC1	NEW! ELL Accessory Upgrade Pack (Interface Board, USB Cable, Ribbon Cable)	$56.00	Today
ELLC2	ELL Accessory Upgrade Pack (Interface Board, USB Cable, Ribbon Cable, Power Supply)	$113.45	Today

Interface Board and Ribbon Cables



- ELLC Interface Board Provides Local and Remote (via USB) Control of Elliptec Devices
- Additional Picoflex®1 Cables:
  - 250 mm (9.8") Long, Item # ELLC3
  - 520 mm (20.5") Long, Item # ELLC4

Click to Enlarge
Figure 813A ELLC4 Ribbon Cable

The ELLC Interface Board features three buttons to control the position of a connected Elliptec device, please see the device-specific manuals for details. The interface board also provides a USB port for direct connection to a PC via a USB Micro-B cable, and a 5 VDC power socket for supplying power to the Elliptec device. An interface board is included as part of the Elliptec device bundles and as part of the ELLC1 and ELLC2 accessory upgrade kits.

Additional Picoflex® 8-conductor, 28 AWG cables for conencting Elliptec devices, interface boards, and bus distributors are also available. These ribbon cables are offered in lengths of 250 mm (9.8") or 520 mm (20.5"), Item #s ELLC3 and ELLC4, respectively, and are sold in packs of five.

1. Picoflex® is a registered trademark of Molex Incorporated.

Part Number	Description	Price	Availability
ELLC	NEW! Interface Board for Elliptec Devices	$45.00	Today
ELLC3	NEW! Ribbon Cable, 250 mm (9.8") Long, 5 Pack	$18.00	Today
ELLC4	NEW! Ribbon Cable, 520 mm (20.5") Long, 5 Pack	$22.00	Today

Bus Distributor

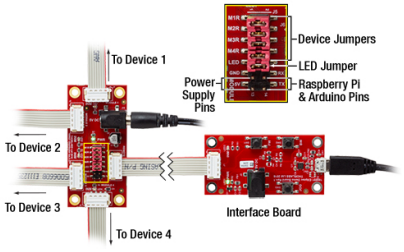
- Control and Power up to Four Elliptec® Devices with One Bus
- Daisy Chain Bus Boards to Control up to 16 Elliptec Devices
- Controlled Remotely Using Elliptec System Software (See *Software* Tab)
- Connect to PC Using USB Interface Board (Item # ELLC)
- Five Jumpers and Four 8-Conductor 28 AWG Ribbon Cables Included
- Compatible with Raspberry Pi® and Arduino® Boards

Specifications		
Item #		ELLB
Voltage Rating		4.5 to 5.5 V
Typical Current Consumption Per Module	Movement	800 mA
	Standby	50 mA
Maximum Board Current		4.0 A
Operating Temperature Range		15 to 40 °C
Ribbon Cable Length (4 Included)		250 mm
Maximum Supported Ribbon Cable Length		500 mm
Dimensions		65.0 mm x 32.0 mm x 12.5 mm (2.56" x 1.26" x 0.49")
Weight		11 g (0.02 lbs)

The ELLB Bus Distributor connects up to four Elliptec® devices. Connected devices can be controlled with or without the ELLC interface board, available as part of the above bundles or separately. When using the interface board, each connected device is controlled remotely by a PC running the Elliptec software package. The interface board connects to the bus's input port labeled *REMOTE*; once connected, the interface board's buttons are disabled. For control without using the interface board, see the *Pin Diagrams* tab for custom connections.

Multiple ELLB Bus Distributors can be daisy chained to control and power up to 16 Elliptec devices; simply connect one of the four *MODULE* outputs to the second board's *REMOTE* input. Indicator LEDs are provided to show which device is active. The communications protocol manual describes how to use the software to individually address each connected device. A link to download the software and accompanying documentation can be found in the *Software* tab.

The bus includes a Ø6.3 mm power connector that supports a 5 V supply with a maximum current of 4 A. As more devices are connected, simultaneous control of the



Click to Enlarge
Figure 683A A single bus distributor can be used to control up to four

units will require more current to be provided by the power supply; please see the *Specs* tab for the amount of current drawn by each Ellitpec device. A 5 V, 1 A power supply is included with the above ELL9 and ELL12 bundles. Depending on the current draw of the Elliptec devices connected, this supply provides enough current to power two devices simultaneously.

Elliptec devices. The bus can be connected to a PC using the interface board provided with the bundles sold above. Note that the bus is then controlled by the Elliptec software and that the buttons on the interface board are disabled.

Fourteen control pins, detailed in Figure 683A, are included for additional functionality. Four pairs of pins are each shorted with a jumper that, when in place, enables the Elliptec software to receive feedback from connected Elliptec devices. The pair of pins labeled *LED* is shorted with a jumper that, when removed, will disable the indicator LEDs. The *5V* and *GND* allow an optional, user-provided 5 V, 2 A power supply to be used in place of a source connected to the Ø6.3 mm power connector. The *RX* and *TX* pins can be used to control the bus with a Raspberry Pi® or Arduino® board, respectively, instead of the Elliptec interface board.

The board is mounted using the Ø3.5 mm through holes provided in each corner. Four 8-conductor, 28 AWG ribbon cables are included.

Elliptec Resonant Motor Products							
							
Multi-Position Sliders	28 mm Linear Stage	60 mm Linear Stage	Rotation Stage	Ø1/2" Rotation Mount	Ø1" Rotation Mount	Ø2" Rotation Mount	Motorized Iris

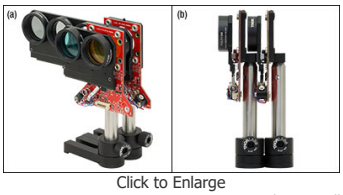
Part Number	Description	Price	Availability
ELLB	Control Bus Distributor for Elliptec Devices	$58.61	Today

Post Mount Adapter

- Mounts Directly to Slider PCB
- Front Clearance Slot Accommodates Protrusions on Back of PCB
- Four Counterbores for Use with 4-40 Threaded Screws
- One Counterbore for Use with 8-32 (M4) Threaded Screws
- SM1 (Ø1.035-40) Internal Thread

Click to Enlarge
Figure G5.1 The ELLA1 mounts to the back of the slider's PCB using the four 4-40 threaded holes, also compatible with 30 mm cage system components.

Using ELLA1 post mount adapters allow sliders to be placed one behind the



Click to Enlarge
Figure G5.2 Using ELLA1 post mount adapters allow sliders to be placed one behind the other while minimizing the space between them.
other while minimizing the space between them.

The ELLA1 Post Mount Adapter securely fastens to the back of the multi-position slider PCB using the four included 4-40 screws. The slider can then be mounted to a Ø1/2" post using the counterbore at the base of the adapter and an 8-32 (M4) screw (not included). A lens tube or other component can be mated to the adapter using the internally SM1-threaded (1.035"-40) bore. The four counterbores can also be used to connect the ELLA1 to a 30 mm cage system via Ø6 mm cage rods.

With overall dimensions of 40.0 mm x 44.0 mm x 14.0 mm and a design that positions the mounting post close to the back of the slider's PCB, the adapter is especially recommended for applications that require placing sliders one closely behind the other. The geometry of the adapter allows the optics mounted on one slider to be positioned above the post used to mount the slider directly in front. These adapters are also convenient single-component mounting solutions for general applications.

Part Number	Description	Price	Availability
ELLA1	Customer Inspired! Post Mount Adapter for ELL12, ELL6, and ELL9 Sliders	$49.85	Today