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# DDS300-E - May 1, 2021

Item # DDS300-E was discontinued on May 1, 2021. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

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# 300 mm LINEAR TRANSLATION STAGE AND CONTROLLER, DIRECT-DRIVE SERVO MOTOR

► **300 mm Travel at Speeds up to 400 mm/s**
► **Brushless DC Servo Motors**
► **Direct Drive - No Leadscrew**



**DDSA04**
Platform Height Adapter

**DDS300-E**
Kit Includes Stage
and Controller

**MJC001**
2-Axis Joystick

## OVERVIEW

### Features

- Complete Stage and Controller Package
- 300 mm (11.81") Travel
- High Speeds up to 400 mm/s
- Low Profile: 50 mm (1.97")
- Integrated, Brushless DC Linear Servo Motor Actuators
- High-Quality, Precision-Engineered Linear Bearings
- Accessories Available:
  - Height Adapter for 62.5 mm Platform Height (DDSA04)
  - 2-Axis Joystick for Precise Manual Control (MJC001)

Thorlabs' DDS300-E Low-Profile, Direct-Drive Translation Stage provides 300 mm of travel with a minimum incremental movement of 100 nm and a maximum speed of 400 mm/s. This stage is ideal for applications that require high speeds and high positioning accuracy, including automated alignment, surface inspection, mapping, and probing.

An innovative, low-profile design with integrated, brushless linear motors eliminates the external housings that create mechanical clash points and impede access to the moving platform. The direct-drive technology removes the need for a leadscrew, eliminating backlash. Internal flexible ducting ensures cables cannot become trapped as the mechanism moves. Twin, precision-grooved linear bearings provide superior rigidity and linearity with excellent on-axis accuracy (±7.5 µm). This backlash-free operation coupled with high-resolution, closed-loop optical feedback ensures a bidirectional repeatability of ±0.25 µm.

| Key DDS300-E Specifications[a] | |
|---|---|
| Travel Range | 300 mm (11.81") |
| Velocity (Max) | 400 mm/s |
| Acceleration (Max) | 10,000 mm/s$^2$ |
| Bidirectional Repeatability[b] | ±0.25 µm |
| Backlash[c] | N/A |
| Horizontal Load Capacity (Max)[d] | 10.0 kg (22.0 lbs) |
| Min. Achievable Incremental Movement[e] | 100 nm |
| Absolute On-Axis Accuracy | ±7.5 µm |
| Cable Length | 2.5 m (8.2') |
| Included Controller[a] | BBD201 |
| Stage Dimensions (L x W x H) | 500 mm x 130 mm x 50 mm (19.69" x 5.12" x 1.97") |

a. More detailed specifications are included in the *Specs* tab.
b. The average of the repeatability when a set position is approached from both directions.
c. The stage does not suffer from backlash because there is no leadscrew.
d. The default PID tuning parameters are set for loads up to 2.0 kg (4.4 lbs). For higher loads, the PID parameters must be retuned via the APT software; refer to the manual for more details.
e. The measured minimum incremental motion that the stage can achieve, also referred to as the minimum step size.

### Controller

A BBD201 single-axis Brushless DC Motor Controller is included with the stage. This controller provides a user-configurable, S-curve acceleration/deceleration profile that enables fast, smooth positioning without vibration or shock. It is ideal for motion control applications demanding operation at high speeds (hundreds of mm/s) and high encoder resolution (50 nm). The design incorporates the latest digital and analog techniques as well as high-bandwidth, high-power servo control circuitry. The controllers ship with our APT software for easy integration into an existing system. For multi-axis applications the stage can also be driven by our BBD202 and BBD203 2-Axis and 3-Axis Controllers.

| Motorized Linear Translation Stages | |
|---|---|
| 100 mm | Stepper |
| | DC Servo |
| 150 mm | Stepper |
| | Stepper with Integrated Controller |
| 220 mm | DC Servo |
| 300 mm | Stepper with Integrated Controller |
| | DC Servo with Benchtop Controller |
| 600 mm | DC Servo with Benchtop Controller |
| Optical Delay Line Kits | |
| Other Translation Stages | |

### Joystick Option

An optional 2-axis joystick console (MJC001) is also available for remote positioning applications. See the presentation below for more details. Please note that in order to control two stages simultaneously, a multi-axis BBD202 or BBD203 controller is required.

### Optical Height Adapter Plate

The DDSA04 riser plate attaches directly to the DDS300-E stage and raises the deck height of the stage to 62.5 mm, which matches that of our NanoMax, MicroBlock, and RollerBlock stages.

### Usage Notes

These stages are not suitable for operation in a vertical (Z-axis) orientation. In addition, when no power is applied, the platform of the stage has very little inertia and is virtually free running. This may make the stage unsuitable for applications where the stage's platform needs to remain in a set position when power is off.

S P E C S

| DDS300 Linear Motor Stage | |
|---|---|
| Travel Range | 300 mm (11.81") |
| Velocity (Max) | 400 mm/s |
| Acceleration (Max) | 10000 mm/s$^2$ |
| Bidirectional Repeatability[a] | ±0.25 µm |
| Backlash[b] | N/A |
| Encoder Resolution | 50 nm |
| Min. Achievable Incremental Movement[c] | 100 nm |
| Horizontal Load Capacity (Max)[d] | 10.0 kg (22.0 lb) |
| Absolute On-Axis Accuracy | ±7.5 µm |
| Straightness/Flatness | ±4.0 µm |
| Pitch | ±100 µrad |
| Yaw | ±150 µrad |
| Continuous Motor Force | 10.0 N |
| Peak Motor Force (2 sec) | 20.0 N |
| Bearing Type | High Rigidity, Recirculating, Precision Linear Bearings |
| Limit Switches | Magnetic Sensor at Each End of Stage |
| Operating Temperature Range[e] | 5 to 40 °C (41 to 104 °F) |
| Motor Type | Brushless DC Linear Motor |
| Cable Length | 2.5 m (8.2') |
| Dimensions | 500 mm x 130 mm x 50 mm (19.69" x 5.12" x 1.97") |
| Weight (Excluding Cables) | 5.9 kg (12.98 lbs) |

- The average of the repeatability when a set position is approached from both directions.
- The stage does not suffer from backlash because there is no leadscrew.
- The measured minimum incremental motion that the stage can achieve, also referred to as the minimum step size.
- The default PID tuning parameters are set for loads up to 2.0 kg (4.4 lbs). For higher loads, the PID parameters must be retuned via the APT software; see the manual for more details.
- For operation at temperatures outside normal room temerature, the PID parameters may require optimization.

| BBD201 Controller | |
|---|---|
| Drive Connector | 8-Pin DIN, Round, Female |
| Feedback Connector | 15-Pin D-Type |
| Continuous Drive Output | 2.5 A |
| PWM Frequency | 40 kHz |
| Operating Modes | Position and Velocity |
| Control Algorithm | 16-Bit Digital PID Servo Loop with Velocity and Acceleration Feedforward |
| Velocity Profile | Trapezoidal/S-Curve |
| Position Count | 32 Bit |
| Position Feedback | Incremental Encoder |
| Encoder Bandwidth | 2.5 MHz 10 M Counts/s |
| Encoder Supply | 5 V |
| AUX Control Connector | 15-Pin D-Type |

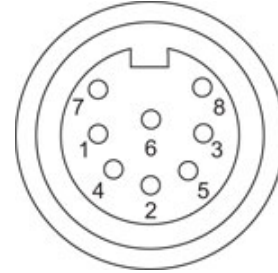| BBD201 Controller | |
|---|---|
| Power Supply Input | Power: 250 VA<br>Voltage: 100 to 240 VAC<br>Frequency: 47 to 63 Hz<br>Fuse: 3.15 A |
| Dimensions | 174 mm x 245 mm x 126 mm<br>(6.85" x 9.65" x 4.96") |
| Weight | 3.46 kg (7.60 lbs) |

## PIN DIAGRAMS

The flying leads are terminated in a male 15-pin D-Type and male 8-pin round DIN connector. Pin details are given below.

### Feedback Connector
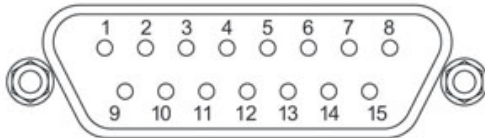


### Motor Drive Connector



| Pin | Description | Pin | Description |
|---|---|---|---|
| 1 | Not Used | 9 | Ground |
| 2 | Ground | 10 | Limit Switch + |
| 3 | Not Used | 11 | Limit Switch - |
| 4 | Enconder Index - | 12 | Encoder Index + |
| 5 | Encoder Phase B - | 13 | Encoder Phase B + |
| 6 | Encoder Phase A - | 14 | Encoder Phase A + |
| 7[a] | 5 V | 15 | Not Used |
| 8[a] | 5 V | | |

- Pins 7 and 8 are shorted together internally

| Pin | Description |
|---|---|
| 1 | Motor Phase V |
| 2 | Ground |
| 3 | Thermistor (Not Used) |
| 4 | Motor Phase U |
| 5 | Stage ID |
| 6 | Ground |
| 7 | Motor Phase W |
| 8 | Enable |

## 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.
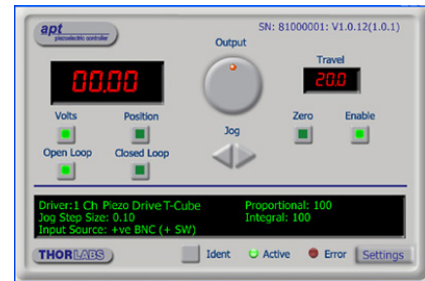

Kinesis GUI Screen

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 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.


APT GUI Screen

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.
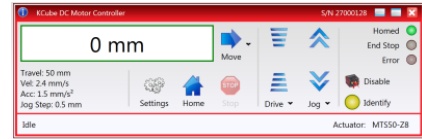
### Software

**Kinesis Version 1.14.25**

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

**Also Available:**

- Software ↓ rotocol

### Software

**APT Version 3.21.5**

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

**Also Available:**

- Software ↓ rotocol

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

APT Programming Using LabVIEW -    APT Programming Using LabVIEW -
Part 4: Create an ActiveX Property     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 -       APT Programming Using LabVIEW -
Create an ActiveX Method (Alternative)    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.

MOTORIZED LINEAR STAGES

## Motorized Linear Translation Stages

Thorlabs' motorized linear translation stages are offered in a range of maximum travel distances, from a stage with 20 µm of piezo translation to our 600 mm direct drive stage. Many of these stages can be assembled in multi-axis configurations, providing XY or XYZ translation. For fiber coupling applications, please see our multi-axis stages, which offer finer adjustment than our standard motorized translation stages. In addition to motorized linear translation stages, we offer motorized rotation stages, pitch and yaw platforms, and goniometers. We also offer manual translation stages.

## Piezo Stages

These stages incorporate piezoelectric elements in a variety of drive mechanisms. Our Nanoflex™ translation stages use standard piezo chips along with manual actuators. Our LPS710E z-axis stage features a mechanically amplified piezo design and includes a matched controller. The PD1 stage incorporates a piezo inertia drive that uses "stick-slip" friction properties to obtain an extended travel range. The Elliptec™ stages use resonant piezo motors to push and pull the moving platform through resonant elliptical motion.

| Piezoelectric Stages | | | | | | |
|---|---|---|---|---|---|---|
| **Product Family** | **Nanoflex™ 20 µm Stage with 5 mm Actuator** | **Nanoflex™ 25 µm Stage with 1.5 mm Actuator** | **LPS710E 1.1 mm Z-Axis Stage** | **PD1 20 mm Stage** | **Elliptec™ 28 mm Stage** | **Elliptec™ 60 mm Stage** |
| Click Photo to Enlarge |  |  |  |  |  |  |
| Travel | 20 µm + 5 mm Manual | 25 µm + 1.5 mm Manual | 1.1 mm | 20 mm | 28 mm | 60.0 mm |
| Maximum Velocity | - | | - | 3 mm/s | 180 mm/s | 90 mm/s |
| Drive Type | Piezo with Manual Actuator | | Amplified Piezo | Piezoelectric Inertia Drive | Resonant Piezoelectric Motor | |
| Possible Axis Configurations | X, XY, XYZ | | - | X, XY, XYZ | X | |
| Additional Details | | | | | | More [+] |

## Stepper Motor Stages

These translation stages feature removable or integrated stepper motors and long travel ranges up to 300 mm. The MLJ150 stage also offers high load capacity vertical translation. The other stages can be assembled into multi-axis configurations.

| Stepper Motor Stages | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Product Family** | **LNR Series 25 mm Stage** | **LNR Series 50 mm Stage** | **MLJ150 50 mm Vertical Stage** | **NRT Series 100 mm Stage** | **NRT Series 150 mm Stage** | **LTS Series 150 mm Stage** | **LTS Series 300 mm Stage** |
| Click Photo to Enlarge |  |  |  |  |  |  |  |
| Travel | 25 mm | 50 mm | 50 mm | 100 mm | 150 mm | 150 mm | 300 mm |
| Maximum Velocity | 2.0 mm/s | 50 mm/s | 3.0 mm/s | 30 mm/s | | 50 mm/s | |
| Possible Axis Configurations | X, XY, XYZ | X, XY, XYZ | - | X, XY, XYZ | | X, XY, XYZ | |
| Additional Details | | | | | | | More [+] |

## DC Servo Motor Stages

Thorlabs offers linear translation stages with removable or integrated DC servo motors. These stages feature low profiles and can be assembled in multi-axis configurations.

| DC Servo Motor Stages | | | | | |
|---|---|---|---|---|---|
| **Product Family** | **MT Series 12 mm Stages** | **PT Series 25 mm Stages** | **MTS Series 25 mm Stage** | **MTS Series 50 mm Stage** | **KVS30 30 mm Vertical Stage** |
| Click Photo to Enlarge | | | | | |
| Travel | 12 mm | 25 mm | 25 mm | 50 mm | 30 mm |
| Maximum Velocity | 2.6 mm/s | | 2.4 mm/s | | 8.0 mm/s |
| Possible Axis Configurations | X, XY, XYZ | | X, XY, XYZ | | - |
| **Additional Details** | | | | | More [+] |

## Direct Drive Stages

These low-profile stages feature integrated brushless DC servo motors for high speed translation with zero backlash. When no power is applied, the platforms of these stages have very little inertia and are virtually free running. Hence these stages may not be suitable for applications where the stage's platform needs to remain in a set position when the power is off. We do not recommend mounting these stages vertically.

| Direct Drive Stages | | | | | |
|---|---|---|---|---|---|
| **Product Family** | **DDS Series 50 mm Stage** | **DDS Series 100 mm Stage** | **DDS Series 220 mm Stage** | **DDS Series 300 mm Stage** | **DDS Series 600 mm Stage** |
| Click Photo to Enlarge | | | | | |
| Travel | 50 mm | 100 mm | 220 mm | 300 mm | 600 mm |
| Maximum Velocity | 500 mm/s | | 300 mm/s | 400 mm/s | 400 mm/s |
| Possible Axis Configurations | X, XY | | X, XY | X | X |
| **Additional Details** | | | | | More [+] |

## 300 mm Linear Motor Stage and Controller

Characterized by high-speed translation and high positional accuracy, the DDS300 stage is well suited for surface mapping and characterization applications where there is a need to move a camera or probe at constant velocity while simultaneously capturing data.

The BBD201 DC servo controller included in the package incorporates Thorlabs' standard apt™ control and programming interface, enabling easy integration into automated motion control applications. For greater flexibility, both a USB and RS232 (9-Pin) computer interface is provided, and automated PC control of the stage is supported with the supplied software development kit (SDK). The fully documented SDK supports all major development languages running on Windows (LabVIEW, C++, C#, etc.) and comes in the form of ActiveX libraries or a conventional dynamic link library (DLL).

USB connectivity provides easy plug-and-play PC operation. Multiple units can be connected to a single PC via standard USB hub technology for multi-axis motion control applications. Combining this feature with the user-friendly apt™ software allows the user to program and carry out complex move sequences in a short space of time. For more information, please see the full Brushless DC Servo Motor Controller presentation.

Very precise, fine positioning and control can be achieved with the associated MJC001 joystick option (described below).

### Usage Notes
These stages are not suitable for operation in a vertical (Z-axis) orientation. When no power is applied, the platform of the stage has very little inertia and is virtually free running. This may make the stage unsuitable for applications where the stage's platform needs to remain in a set position when power is off.

| Part Number | Description | Price | Availability |
|---|---|---|---|
| DDS300-E/M | 300 mm (11.81") Metric Linear Stage with BBD201 Controller | $7,141.98 | Lead Time |
| DDS300-E | 300 mm (11.81") Imperial Linear Stage with BBD201 Controller | $7,141.98 | Today |

## Optical Height Adapter

- Height Adapter to Match the 62.5 mm Deck Height on Our NanoMax300, MicroBlock, and RollerBlock Stages
- Resulting Overall Optical Height: 75.0 mm (When Used with Thorlabs' Tongue and Groove Accessories)
- Array of 48 Tapped Holes (16 of Each): 1/4"-20 (M6), 8-32 (M4), and 4-40 (M3)

The DDSA04 Optical Height Adapter is designed to raise the deck height of the DDS300 stage to 62.5 mm, which is the same as our NanoMax 300, MicroBlock, and RollerBlock stages. This allows our range of tongue and groove optical accessories to be used with the DDS300 stage and gives an optical axis height of 75.0 mm. The plate is fixed to the moving platform of the stage using four 1/4"-20 x 3/8" (M6 x 10 mm) cap screws (not supplied).

Click to Enlarge
The deck height of the DDS300 Stage is matched to the MAX311D 3-Axis Stage using the DDSA04 Riser Plate.

| Part Number | Description | Price | Availability |
|---|---|---|---|
| DDSA04/M | Optical Height Adapter for DDS600 Stage, Metric Taps | $188.28 | Today |
| DDSA04 | Optical Height Adapter for DDS600 Stage, Imperial Taps | $188.28 | Lead Time |

## 2-Axis Joystick Console

- High-Reliability Hall Effect Joystick
- Proportional Movement for Fast or High Precision Moves
- High/Low Speed Selection Button
- Speed Dial for Sensitivity Adjustment
- Ergonomic and Elegant Design
- High-Quality Machined Anodized Aluminum Casing

The MJC001 joystick console has been designed to provide intuitive, tactile, manual positioning of a stage. In most applications, the default parameter settings saved within the controller allow the joystick to be used out-of-the-box, with no need for further setup, thereby eliminating the need to be connected to a host PC and allowing true remote operation. For control of a single-axis stage, simply connect the console to the BBD201 controller. To control two stages simultaneously using the joy stick, a multi-axis BBD202 or BBD203 controller is required. This joystick is also compatible with our Rack-Mounted Brushless Controller and Stepper Motor Controllers. Please contact Tech Support for more details.

| Part Number | Description | Price | Availability |
|---|---|---|---|
| MJC001 | 2-Axis Microscopy Joystick Console | $1,098.35 | Today |

Visit the *300 mm Linear Translation Stage and Controller, Direct-Drive Servo Motor* page for pricing and availability information:
https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=7975