BPC201

## Features
- Front-Panel Controls
- Single-, Dual-, and Three-Channel Models Available
- High Power: 75V, 500mA Continuous
- Closed-Loop PID Position Via Strain Gauge Feedback Circuit
- Quiet High-Resolution Position Control (for Very Fine Positioning)
- Voltage Ramp/Waveform Generation Capability (for Scanning)
- High Bandwidth (10kHz) Piezo Positioning (Open Loop)
- Auto-Configure Function for Thorlabs' Ident-Equipped Piezo Actuators
- Full Software Control Suite Supplied
- Extensive ActiveX® Programming Interfaces
- Fully Software Integrated with Other apt™ Family Controllers
- Optional Handset Controller

The BPC apt™ high-power piezo controllers have been designed to drive the full range of open- and closed-loop piezo-equipped nanopositioning actuators and stages offered by Thorlabs (see pages 389-402). Single-, dual-, and three-channel models are available. Flexible software settings make this unit highly configurable and therefore also suitable for driving a wide range of piezo elements in third-party products. A waveform generation capability triggering outputs make this unit particularly well suited for piezo scanning applications.

See pages 380-382 for more information on the apt™ software included with the BPC Series Controllers.
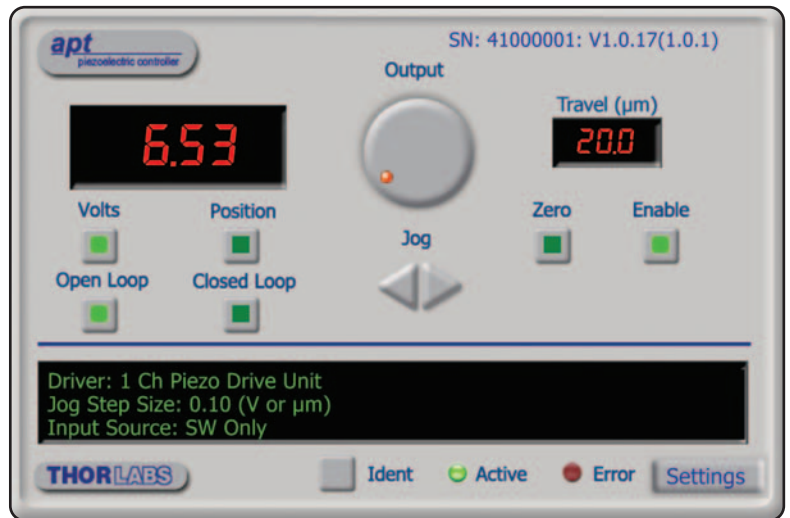
Modular High-Current Piezo Driver With Feedback

See Page 377

MPZ601

It is often convenient to make adjustments to the piezo output while closely watching the device being positioned, which can prove difficult when using the front panel keys or a remote PC.

To allow this kind of use, Thorlabs has developed the PHS101 handset, which enables the piezos to be positioned remotely from the controller and PC (i.e. without using the front panel buttons, GUI or software method calls). It is supplied with a 3m (9.75') cable.

PHS101

# Benchtop apt™ Closed-Loop Piezo Controller...Page 2 of 2

BPC203

Controls are located on the front face of the unit to allow manual adjustment of the piezo position using the digitally encoded adjustment pot. The display is easy to read and can be set to show either applied voltage or position in microns. Open- or closed-loop control and zeroing of the piezo can also be selected from the front panel.

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 applications. Coupling this with the very user-friendly apt™ software allows it to quickly get running in a short time frame. For example, all relevant operating parameters are set automatically for Thorlabs' piezo actuator products. Advanced custom motion control applications and sequences are also possible using the extensive ActiveX® programming environment. The ActiveX® programming environment is described in more detail on pages 380-382.

USER I/O
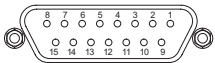
Pin	Description	Return
1	Digital O/P 1	5, 9, 10
2	Digital O/P 2	5, 9, 10
3	Digital O/P 3	5, 9, 10
4	Digital O/P 4	5, 9, 10
5	Digital Ground	
6	Digital I/P 1	5, 9, 10
7	Digital I/P 2	5, 9, 10
8	Digital I/P 2	5, 9, 10
9	Digital Ground	
10	Digital Ground	
11	For Future Use (Trigger Out)	5, 9, 10
12	For Future Use (Trigger IN)	5, 9, 10
13	Digital I/P 4	
14	5V Supply Output	5, 9, 10
15	5V Supply Output	5, 9, 10

STRAIN GAUGE
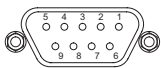
Pin	Description
1	Strain Gauge excitation
2	† +15V out
3	† -15V out
4	Ground
5	AC Feedback IN
6	Ground
7	* Actuator ID signal
8	Reserved for future use
9	Reserved for future use

Notes.
† Power supply for the piezo actuator feedback circuit. It must not be used to drive any other circuits or devices.
* This signal is applicable only to Thorlabs actuators. It enables the system to identify the piezo extension associated with the actuator.

Specifications (Per Channel)

■ **Piezoelectric Output (SMC Male)**
- **Voltage (Software Control):** 0-75VDC
- **Voltage (External Input):** -10 to 90VDC
- **Current:** 500mA Max Continuous
- **Stability:** 100ppm Over 24 Hours (After 30min Warm-Up Time)
- **Noise:** <3mV RMS
- **Typical Piezo Capacitance:** 1 – 10μF

■ **Bandwidth:** 10kHz (1μF Load, 1V p-p)

■ **Position Feedback (9-Pin D-Type Female)**
- **Feedback Transducer Type:** Strain Gauge
- **Detection Method:** AC Bridge (18kHz Excitation)
- **Typical Resolution:** 5nm (For 20μm Actuator, e.g. PAZ005)
- **Auto-Configure:** Identification Resistance in Actuator

■ **User Input/Output (15-Pin D-Type Female)**
- **4 Digital Inputs:** TTL Levels
- **4 Digital Outputs:** Open Collector
- **Trigger Input/Output:** TTL
- **Trigger Input Functionality:** Triggered Voltage Ramps/Waveforms
- **Trigger Output Functionality:** Trigger Generation During Voltage Ramp Output
- **User 5V (with Ground):** 250mA Max

■ **USB Port**
- **Version 1.1**

■ **Power Input**
- **Voltage:** 85-264VAC
- **Power:** BPC201: 100W, BPC202, BPC203: 200W
- **Fuse:** BPC201: 2A, BPC202, BPC203: 3A

■ **Housing Dimensions (W x D x H):**
BPC201: 152 x 244 x 104mm (6" x 9.6" x 4.1"),
BPC202, BPC203: 240 x 360 x 133mm (9.5" x 14.2" x 5.2")

■ **Weight:**
BPC201: 3.18kg (7lbs)
BPC202, BPC203: 6.7kg (14.75lbs)

ITEM#	$	£	€	RMB	DESCRIPTION
BPC201	$ 2,190.00	£ 1,379.70	€ 2.036,70	¥ 20,914.50	Single-Channel Closed-Loop Piezo Controller/Driver
BPC202	$ 3,485.00	£ 2,195.60	€ 3.241,10	¥ 33,281.80	2-Channel Benchtop Closed-Loop Piezo Controller/Driver
BPC203	$ 4,550.00	£ 2,866.50	€ 4.231,50	¥ 43,452.50	3-Channel Benchtop Closed-Loop Piezo Controller/Driver
PHS101	$ 270.00	£ 170.10	€ 251,10	¥ 2,578.50	Remote Handset for BPC Series Benchtop Piezo Controllers

THORLABS

apt™ Control Software Overview – Page 1 of 3

Constructing automated custom alignment and positioning solutions in a speedy and efficient manner is becoming increasingly important in today's competitive environment. Often timescales are short and yet the nature of the solutions, particularly at the software level, are becoming more complex and demanding. We have worked very closely with a large number of system engineers and research specialists in order to gain a detailed understanding of the specific requirements for sophisticated yet easy-to-use electronics and software controller products.

Out-of-the-Box Operation

When faced with an automated alignment project, the system engineer or researcher will often face a steep learning curve, and when the end requirement involves programming automative alignment sequences, learning how to operate the equipment manually is an important first step. Every apt™ controller can be manually operated using the supplied 'APTUser' utility. This utility gives access to all settings, parameters, and operating modes. In this way most automated alignment sequences can be first tested and verified without writing a single line of custom software by first using APTUser.

Time Saving Speedy Pre-Configuration

In order to further reduce the time required to configure our range of apt™ controllers, an offline pre-configuration utility, APTConfig, is supplied with all units.

As an example, this utility can be used to associate Thorlabs' stages and actuators with individual motor drive channels, thus allowing the system to set automatically a large number of system parameter defaults. This offline configuration eliminates the need to write the large amounts of initialization code often required when using other control systems, greatly reducing the time taken when developing custom applications. Many other preconfigured settings can be made by using the APTConfig utility.

apt™ Server – The Engine for Integration Software Solutions

The apt™ Server lies at the heart of the apt™ system. This software engine sits underneath the operation of both APTUser and APTConfig and makes the functionality of both utilities easily accessible. The apt™ Server actually comprises a collection of cooperating ActiveX® Controls (see aside) and associated support libraries that provide a tool kit of graphical instrument panels and associated programming interfaces. It is this set of ActiveX® Controls that allow motion control and alignment functionality to be incorporated quickly and easily into custom applications.

Evaluation version available in the download section at www.thorlabs.com

ActiveX® Controls allow apt™ motion control and alignment functionality to be incorporated quickly and easily into custom applications. ActiveX® Controls are pre-compiled software functional blocks (or components) that typically include both a graphical user interface (GUI) and programming (software function) interface. There are many such ActiveX® Controls available to the Windows software developer providing an enormous range of pre-compiled functionality for use in their own custom (or client) applications. The ActiveX® Controls supplied with the apt™ system provide all of the GUI and programmability required to operate and control the full range of apt™ controllers (T-Cube, benchtop, and rack-based variants). For example, the Motor ActiveX® Control provides a complete instrument panel allowing full manual control of our stepper motor driver units. In addition, the associated programming interface allows the software developer to automate the operation of the motor in an integration application.

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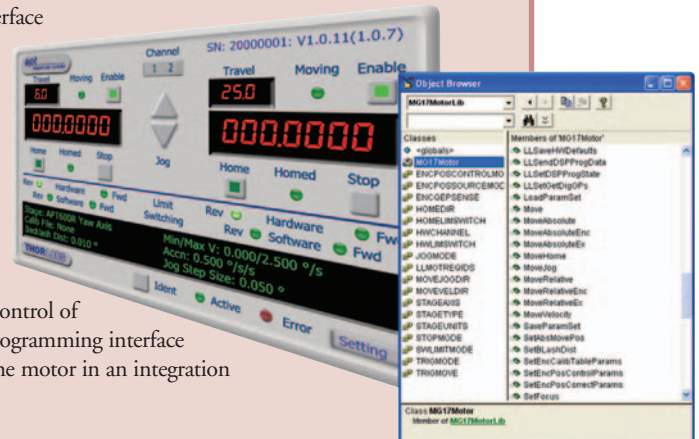
apt™ Control Software Overview – Page 2 of 3

Multiple Development Environment Support – Your Choice

One of the first questions often posed by a system developer is that of language compatibility. We accept that our customers will want to use a wide variety of software development languages and tools when architecting their solutions, and it is for this very reason that we have engineered the apt™ Server to be ActiveX® compliant. ActiveX® is a language independent interfacing technology supported by a large number of Windows-based software development environments. Using our apt™ controllers, it is possible to create custom alignment applications with environments such as LabVIEW™, Visual Basic, Visual C++, Borland C++, HP VEE, Matlab, and even Microsoft Office via VBA (Visual Basic for Applications). Certain .NET environments (e.g. VB.NET, C#.NET) will also support ActiveX® through Microsoft interop technology.

Rapid Application Development – Drag and Drop

One of the key benefits using the apt™ ActiveX® Controls is the speed with which the associated motion control functionality can be incorporated into a custom alignment application. Taking Visual Basic for example, a fully functional apt™ motor control instrument panel can be incorporated into an end application literally within a minute with a single drag-and-drop operation, a single serial number setting, and a single line of code. Unlike many other motion control software libraries available, the apt™ system provides complete prewritten GUIs for use in custom applications. Consequently, a large amount of development time is saved by eliminating the need to write code to provide essential end user interface capability. These instrument panels can also be used during software development or when commissioning and configuring the system to alter essential settings. In the finished application, it is also very easy to hide these full parameter access graphical panels from the end user in order to prevent inadvertent changes to alignment parameters.

Comprehensive Programming Interfaces

We recognize that it is crucially important that the apt™ Server makes available all required parameters and operating modes through its programming interfaces.

We have taken every available system setting and command and exposed them to support the vast range of integrated software applications that can be built around the apt™ system. Hundreds of software commands and settings exist to ensure full flexibility and adaptability when automating the operation of our controllers.
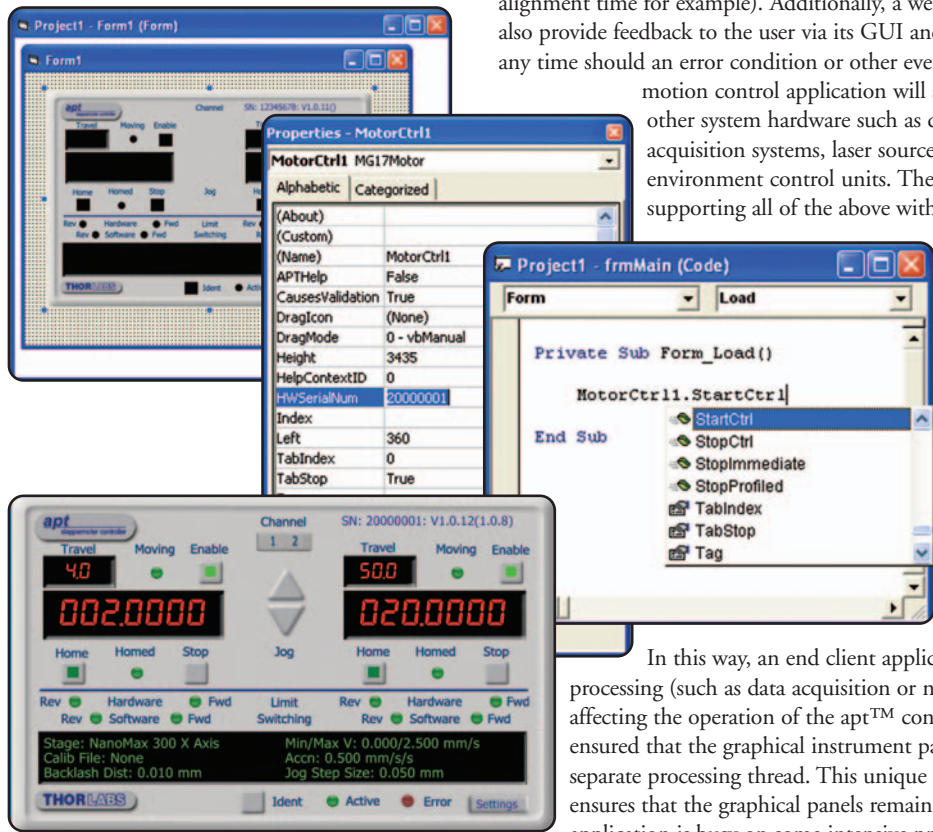
Multi-threading

When developing custom applications on a PC, it is important to ensure that the alignment process itself can execute without disruption (to maintain required alignment time for example). Additionally, a well-written client application will also provide feedback to the user via its GUI and allow operator intervention at any time should an error condition or other event occur. In many cases, a motion control application will also be required to interact with other system hardware such as device characterization and acquisition systems, laser sources, robotic units, and environment control units. The system engineer is faced with supporting all of the above within a single application while also overcoming the consequent issues of software latency from the end user's perspective (e.g. due to polling of equipment).

To address these fundamental application issues, we have built full multi-threading and event "firing" capability into the apt™ Server. Multi-threading is deployed to isolate operation of the apt™ hardware completely from that of the end application. In this way, an end client application can engage in intensive processing (such as data acquisition or number crunching) without affecting the operation of the apt™ controllers. Additionally, we have ensured that the graphical instrument panels are themselves executed in a separate processing thread. This unique approach taken in the apt™ Server ensures that the graphical panels remain fully responsive even when the end application is busy on some intensive processing activity. Always being able to access apt™ controller settings via their GUI panels is extremely useful when trying to optimise software routines, even if an alignment sequence is running. Event firing is the software mechanism by which an apt™ ActiveX® Control can inform the client application of some event or occurrence. In the apt™ system, this mechanism is effectively used to end motor movement and other lengthy operations. By responding to these events, a custom end application does not need to sit and poll for lengthy operations, which improves the overall system performance.

apt™ Control Software Overview – Page 3 of 3

apt™ Hardware Emulator – Offline Application Development

For total convenience, the apt™ Server can be placed into a full hardware emulation mode (using the APTConfig utility), giving the freedom to run the software without connecting actual physical units.

This emulation support is useful for many reasons, including learning how to use and program the apt™ software without necessarily tying up real apt™ hardware, which is useful if multiple person teams are working on the same integration project.
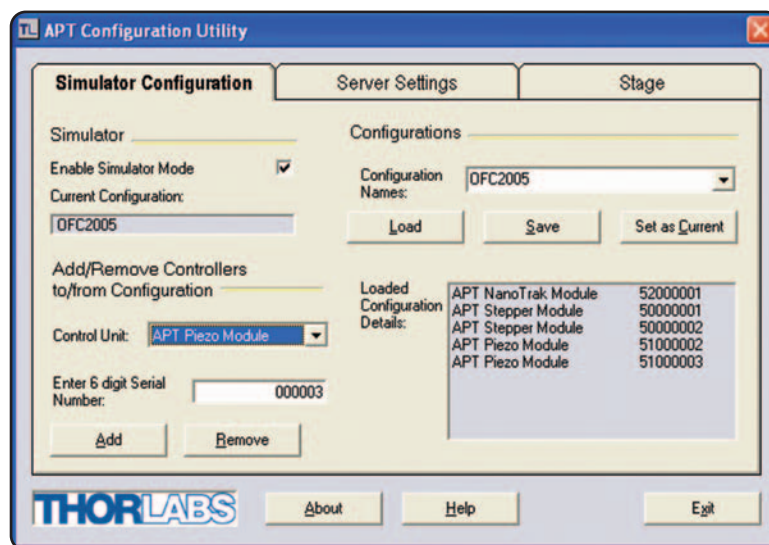
It also gives the option of developing custom applications off-line if, for example, the apt™ hardware is unavailable or already being used. Moreover, after an apt™-based custom application has been developed and released, the actual physical apt™ hardware may no longer be accessible for software support and maintenance purposes, and so a simulator mode proves invaluable.

Debugging – apt™ System Logger

Software development, particularly of complex alignment and positioning systems, is a process that inevitably involves debugging and process optimization. Often

errors that occur during actual execution of the associated software (e.g. incorrectly calculated position parameter passed to the apt™ Server) are difficult to analyze after the event (and may not even occur when interactively debugging because of the difference in execution dynamics). To solve this issue, the apt™ software has a built-in system-wide event logging capability that records all function calls (and associated parameters). This chronological record of client application activity is invaluable in monitoring the sequence of events that lead up to a process failure, thereby helping the software developer to find and debug problems.

Developer Support CD

It is inevitable, even for relatively simple applications, that software programming support will be needed. Having recognized this and the wide range of software end applications that can be built around the apt™ system, we have brought together a comprehensive collection of programmer information and reference material and burned it onto a CD. A full set of sample applications written in Visual Basic and LabVIEW™ is included, together with various hints and tips. The programming samples themselves cover a varying degree of complexity, from basic to advanced examples. The advanced examples are working programs that can be used with the apt™ motion controllers and Thorlabs' positioning stages and actuators to perform optical alignments of real world multi-axis photonics. They form an excellent starting point for the system development and in many cases will provide the functionality required with only minor coding enhancements/changes.

Try the apt™ Software for Yourself

In the end, the best way to appreciate the power and flexibility of the apt™ system software is to try it yourself. You can obtain the latest shipping version of the apt™ software from the download section of the Thorlabs' website (www.thorlabs.com). After installation, it is possible to create a simulated configuration of apt™ controllers and then go on to explore all of the software commands and features described above, as well as experiment with writing custom motion control applications.

It is also useful to view the tutorial videos included. These cover all aspects of using the software, from overviews of the supplied user utilities to programming basics in Visual Basic, LabVIEW, and C++ environments.