apt™ Modular Rack System – NanoTrak™ Auto-Alignment Module ...Page 1 of 2

MNA601

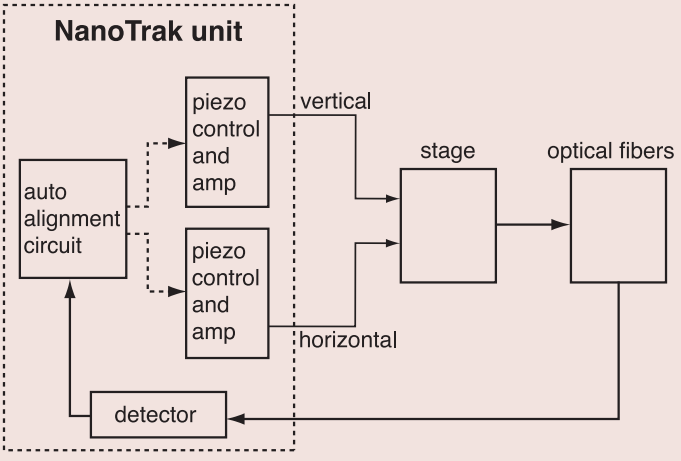
MMR601
19" Modular Rack
See Page 374

The modular NanoTrak™ auto-alignment controller combines an intelligent active-feedback alignment control system and a two-channel piezoelectric controller into a single plug-in unit. As part of the apt™ series, this auto-alignment unit represents the latest developments in automated optical alignment technologies. This system is a basic building block from which advanced alignment systems can be quickly configured. It can be fully integrated into a rack mainframe system (page 374) that is comprised of a selection of our plug-in modules – piezoelectric controllers (page 377), stepper motor controllers (page 376), and this NanoTrak™ auto-alignment module. Although used primarily for aligning optical fibers and integrated optical devices, the NanoTrak™ is ideal for automating just about any labor intensive alignment tasks.

The modular NanoTrak™ plug-in is identical in functionality and associated user software to the benchtop NanoTrak™ system presented on page 372. The principles of operation are covered in detail in the NanoTrak™ tutorial (see page 411).

Features

- Tracking Feature Maintains Optimum Throughput Indefinitely
- Advanced Dark Search Algorithms for First Light Detection with Motorized Fiber Launch
- Two Piezo Actuator Output Channels Provide Closed-Loop Feedback
- InGaAS & Si Detectors or External Inputs (FC/PC for Optical & BNC Voltage for External)
- USB Plug-and-Play Connectivity
- Full Software GUI Control Suite
- ActiveX® Graphical Panel Controls & Programming Interfaces
- Seamless Software Integration With Entire apt™ Family of Products (Electronics and Mechanics)



With one fiber fixed and the other mounted on a piezo-actuated stage capable of moving the fiber perpendicular to its end face, the NanoTrak™ controls the position of the moving fiber. The NanoTrak's auto-alignment circuit controls the position of the fiber as it optimizes the efficiency of the coupling through the two fibers. In many applications, a planar waveguide or other device replaces one of the fibers; however, the basic principles remain the same.

Auto-Alignment

When combined with a positioning stage outfitted with at least two piezoelectric actuators, the NanoTrak™ auto-alignment system is designed to optimize the coupling through an optical assembly. The NanoTrak™ module is compatible with a wide range of Thorlabs Piezo actuated stages and assemblies (see our NanoMax stages on pages 302 and 288, respectively).

In a typical automated alignment setup it is common to align for initial first light detection using motor control, and then allow the NanoTrak™ to take over and achieve optimal alignment via piezo actuation. Many of Thorlabs' piezo actuated stages can also be motorized to support this initial first alignment step (see our NanoMax™ stages on pages 303 and 288, respectively); and dual channel motor control modules (page 376) are available for use in the same rack mainframe as the NanoTrak™ module.

Once first light detection is accomplished, the NanoTrak™ system begins its alignment process using advanced phase sensitive detection and digital filtering techniques to generate correction voltages. They are then directly applied to the piezoelectric actuators in order to achieve optimal alignment performance (see NanoTrak™ tutorial page 411).

apt™ Modular Rack System – NanoTrak™ Auto-Alignment Module ...Page 2 of 2

Highly Adaptable Operation

There is an infinite variety of alignment scenarios, each with potentially different optical and physical characteristics such as half widths, coupled peak powers, misalignment power response, and mechanical phase lags.

To cope with this range of applications, the NanoTrak's operation is fully configurable with many of the parameters of the system accessible through easy-to-use graphical software panels. For example, when operating in "Tracking Mode," the system applies a small sinusoidal dither to the piezoelectric actuators as part of the alignment process (see NanoTrak™ tutorial page 411). To accommodate the specific optical characteristics of the elements in the system, the dithering amplitude and frequency can be adjusted via the "Circle Diameter" and "Circle Frequency" settings, respectively. Additionally, to deal with a potentially wide range of optical signal levels and sensitivities, the overall closed-loop gain can be adjusted via a "Gain" parameter.

All such settings and parameters are also accessible through the ActiveX® programmable interfaces for automated alignment sequences. See pages 376-378 for a full description of the apt™ system software.

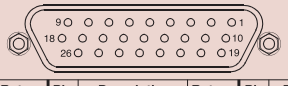
Extensive Software Support Tools

The apt™ software library contains a number of optional features, with many different graphical user interfaces, operational parameters, and programming functions. To assist in using the software, comprehensive, fully context-sensitive online help is provided.

Specifications

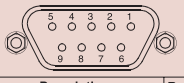
- **Optical Power Measurement:**
  - **PIN Photodiode:** FC/PC Fiber Input
  - **Si or InGaAs Detector:** 1nA to 10mA Photocurrent
  - **Ext. Power Meter Input (BNC):** Multiple Ranges
  - **Signal Phase Compensation:** -180° to 180°
- **NanoTraking:**
  - **Circle Scanning Frequency:** 1–300Hz
  - **Circle Position Range:** <1% to >99% MPE
  - **Circle Diameter Adjustment Modes:** Automatic and Manual
- **Piezoelectric Input/Output:**
  - **Two Output Connectors (SMC male):**
    - **Voltage Output:** 0-75 VDC/Channel
    - **Voltage Stability:** 100ppm over 24 Hours
    - **Noise:** <3mV RMS
    - **Output Current:** 500mA/Channel
  - **Two Output Monitors (BNC):** 0-10VDC
  - **Position Feedback** (9-Pin D-type Female)
    - **Strain Gauge Feedback**
    - **Voltage Feedback:** 0-10VDC
- **User I/O Port (26-Pin D-type Female):**
  - **Optical Power Monitors:** 0–10VDC
  - **Two Differential Analog Inputs:** 0-10VDC
  - **Trigger Input/Output:** TTL
  - **Digital I/O Lines:** Opto-Isolated
- **General:**
  - **One Slot apt™ Rack**
  - **Dimensions (W x D x H):** 190 x 270 x 50mm
  - **Weight:** 1.5kg (3.3lbs)

USER I/O



Pin	Description	Return	Pin	Description	Return	Pin	Description	Return
1	DIG IP 1	19	10	DIG OP 1	19	19	Isolated Dig Ground	
2	DIG IP 2	19	11	DIG OP 2	19			
3	DIG IP 3	19	12	DIG OP 3	19	20	Ext Trigger I/P	22
4	DIG IP 4	19	13	DIG OP 4	19	21	Ext Trigger O/P	22
5	Channel 1 RS485		14	Channel 2 RS485		22	Ground	
6	Channel 1 RS485 NOT		15	Channel 2 RS485 NOT		23	5V User O/P (Isolated)	
7	Not Used		16	Not Used		24	Not Used	
8	Ext input (+) Channel 2	25	17	Analog I/P	25	25	Ground	
						26	TIA Sig O/P	25
9	Ext input (+) Channel 1	25	18	Analog I/P	25			

PIEZO IN



Pin	Description	Return
1	Wheatstone bridge excitation	4 or 6
2	+15V	4 or 6
3	-15V	4 or 6
4	Equipment ground	
5	Feedback signal in	4 or 6
6	Equipment ground	
7	Actuator ID signal	4 or 6
8	RS485 NOT (0-5V)	9
9	RS485 (0-5V)	8

ITEM#	$	£	€	RMB	DESCRIPTION
MNA601	$ 5,601.50	£ 3,528.90	€ 5.209,40	¥ 53,494.30	apt™ NanoTrak™ Controller Module with Voltage Input Only
MNA601/IR	$ 5,916.00	£ 3,727.10	€ 5.501,90	¥ 56,497.80	apt™ NanoTrak™ Controller Module with InGaAs Detector
MNA601/VIS	$ 5,916.00	£ 3,727.10	€ 5.501,90	¥ 56,497.80	apt™ NanoTrak™ Controller Module with Silicon Detector
NTA007	$ 314.50	£ 198.10	€ 292,50	¥ 3,003.50	InGaAs Detector for NanoTrak™
NTA009	$ 314.50	£ 198.10	€ 292,50	¥ 3,003.50	Silicon Detector NanoTrak™

High-Density, Rack- Based Motion Controllers

A module version of the apt™ stepper controller is also available for use with the new apt™ rack system. The module version is functionally identical to the benchtop unit and provides a more compact implementation for multi-channel applications such as fully automated control of our range of 3-6 axis motorized stages.

Starting on Page 374

Single Axis Stages
Multi-Axis Stages
Flexure Stage Accessories
Motorized Mirror Mounts
Rotation Stages
Drive Electronics & Auto-Alignment
Actuators & Adjusters
Brief Tutorials

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.

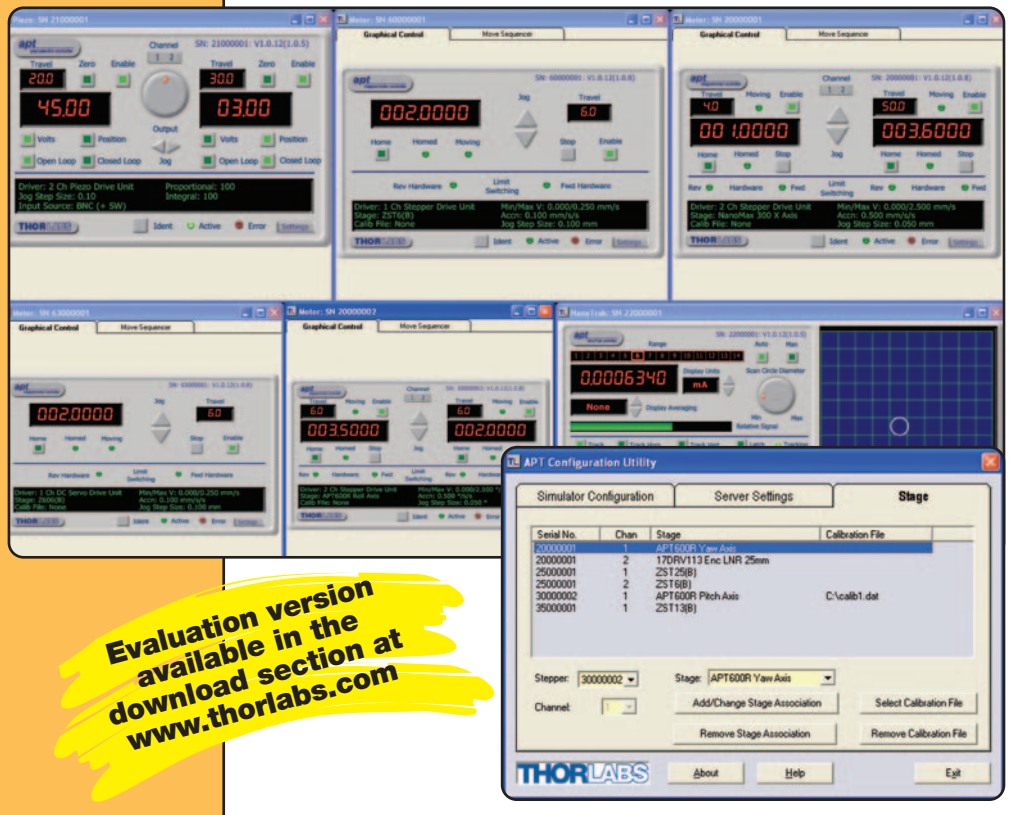
Time Saving Speedy Pre-Configuration

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.

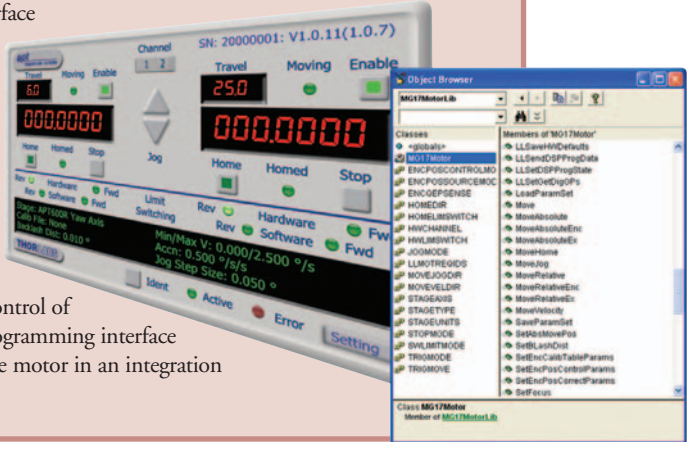
apt™ Server – The Engine for Integration Software Solutions

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

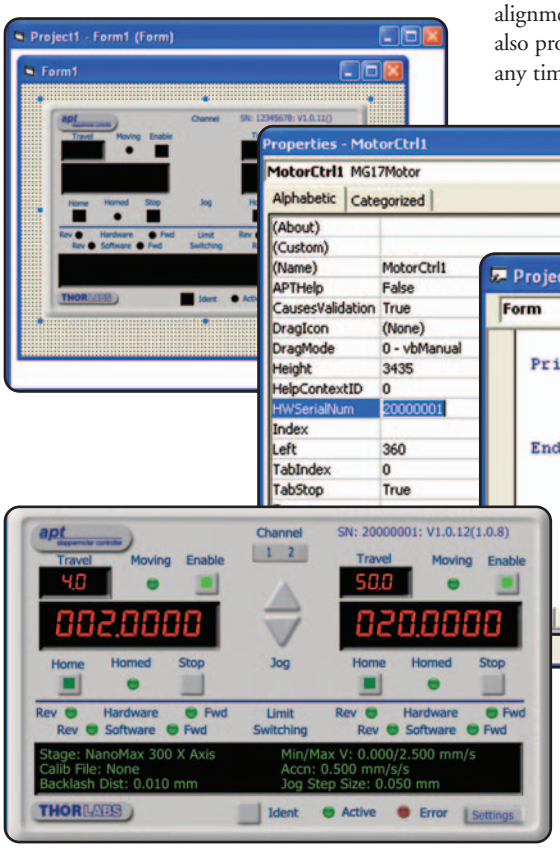
ActiveX® Controls allow apt™ motion control and alignment functionality to be incorporated quickly and easily into custom applications. ActiveX® Controls are pre-compiled software functional blocks (or components) that typically include both a graphical user interface (GUI) and programming (software 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.



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.

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Actuators & Adjusters
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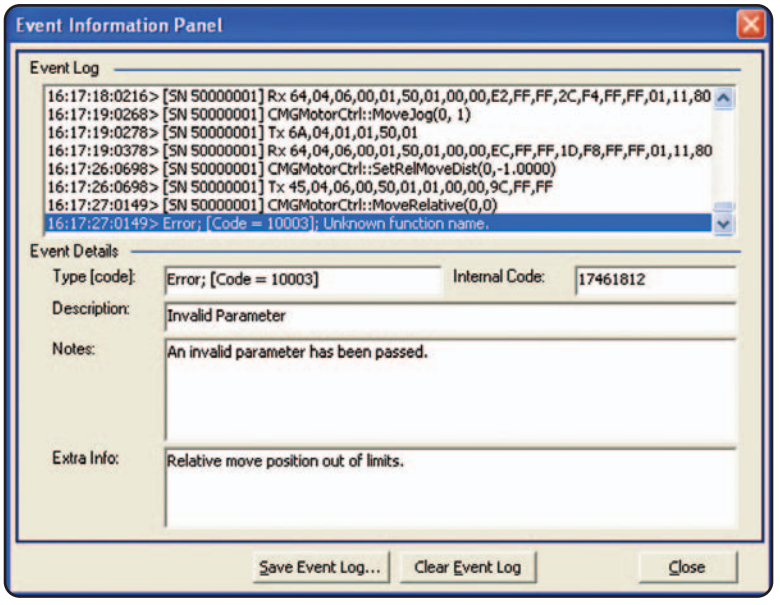
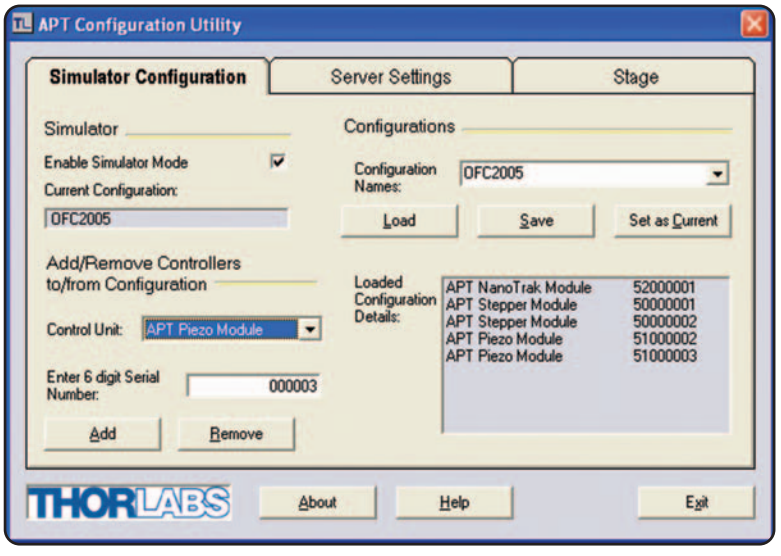


apt™ Hardware Emulator – Offline Application Development
For total convenience, the apt™ Server can be placed into a full hardware emulation mode (using the APTConfig utility), giving the freedom to run the software without connecting actual physical units.

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.