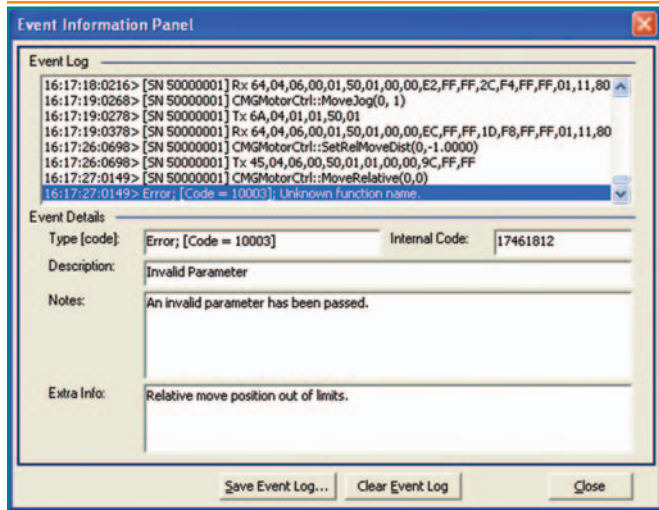
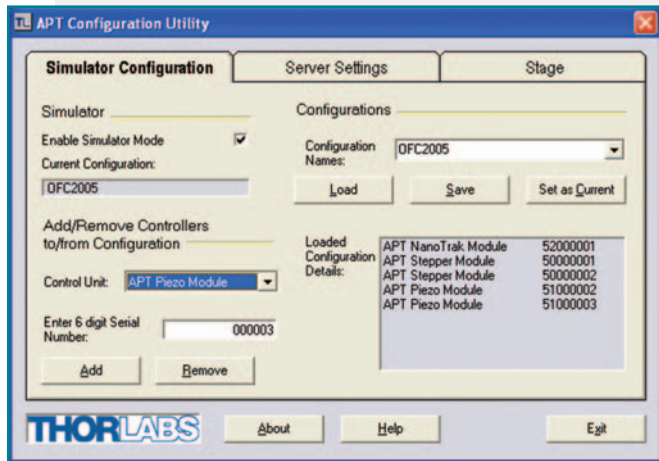




By responding to these ‘events’ a custom end application does not need to sit and ‘poll’ for lengthy operations thereby improving the overall system performance.

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 (useful in multiple person teams working on the same integration project). It also gives integration engineers the option of developing their 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.



Debugging – APT System Logger

Software development, particularly of integrated alignment and positioning systems, is a process that inevitably involves de-bugging and process optimisation. 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 analyse 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) made into the APT Server and also logs and displays any errors that occur. 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 system integrator to find and debug problems. The end application itself can add debug entries to the APT logger to easily construct a complete ‘interleaved’ chronological record of the combined APT Server and client application operation for debugging and process optimisation purposes.

Developer Support CD

It is inevitable, even for relatively simple integration applications that software programming support will be required by the system integrator/developer. 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 programmers information, and reference material onto the software CD.

This information has been included to further assist in the use of the APT products and contains an extensive range of useful content and information. In particular, a great deal of support is provided for software developers who are creating custom applications based on the APT controllers.

It is split into four broad areas:

Video Tutorials - The video tutorials provide step by step instructions on how to get your ActiveX controls up and running. There are specific instructions for Visual Basic, LabVIEW and Visual C++ . Other software platforms will be added in the future. Also featured, are overview videos showing the use of the APTUser and APTConfig utilities.

User Support - includes installation instructions for hardware and software, application software overviews and details of the APT hardware and software available.

Developer Support - includes LabVIEW and Visual Basic example programs (ranging from basic to advanced applications, (e.g. 4 axis optimization) and an overview of USB and ActiveX technologies.

These examples are provided as complete open architecture source code projects that can be 'reverse engineered' by software developers in order to learn and understand how better to use the APT programming interfaces and controllers. The software projects supplied range from very simple examples (basic APT programming steps) to fully operational multi-axis alignment routines (up to 6-axis alignment). The latter can be used 'as is' without further modification, or can be modified to fit exactly the specific end application requirements. In many cases, these open source routines will cut drastically the learning curves required by software developers when programming custom positioning and alignment applications.

Product Information - handbooks and tutorials.

Contact your local Thorlabs office to request a copy of the CD, or alternatively download from our website at www.thorlabs.com

Constructing automated custom alignment and positioning solutions in a speedy and efficient manner is becoming increasingly important to the system integrator. Often timescales are short and yet the nature of these integrated solutions, particularly at the software level, are becoming more complex and demanding. We have worked very closely with a large number of integration specialists in order to gain a detailed and fundamental understanding of the specific issues and requirements that face system integrators. The result of our extensive requirements capture and subsequent product development is the

‘APT System’ - a range of motion and alignment controllers backed up by a highly flexible and powerful software control suite. Now for the first time, system integrators and R&D researchers have tools designed by integration engineers who understand the functionality needed to achieve the end result.



The APT System includes a range of bench top and 19” rack based controllers that, together with the Thorlabs range of precision stages and actuators, support motion control from the 10’s of cm to the nm regime. As well as steppermotor and piezo controllers the range features a sophisticated feedback controller (NanoTrak™) that fully optimises coupled optical powers in a wide range of alignment scenarios. All of our controllers are supported by unified PC based user and programming utilities (the APT software suite) that enable higher level custom applications to be constructed extremely effectively and quickly. Thanks to the USB connectivity implemented on all of our controller units, it is extremely easy to link multiple units together to realise a multi-axis motion control solution for many positioning and alignment needs.



apt System

making it easy for system integrators

Scalable Processing Power

Each APT bench top controller is designed around leading edge and powerful embedded DSP processing. In alignment applications, it is often crucial that timing of motion control is guaranteed e.g. in scan and acquisition operations. The embedded DSP intelligence is responsible for ensuring this ‘deterministic’ operation on a per channel basis. Each channel of operation is driven by a dedicated processor, so that when the number of channels is scaled up by adding controllers, the processing power to ‘drive’ those channels is also scaled up.

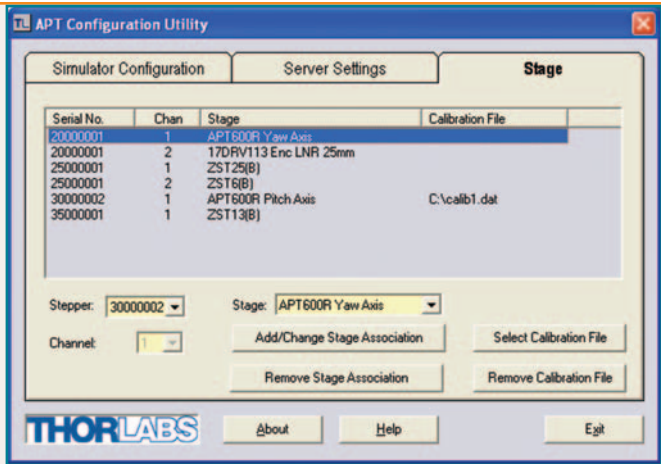
'Out of the Box' Operation

When faced with an automated alignment project, the integration engineer or researcher will often face many learning curves, and when the end requirement involves programming from automotive 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 and, thanks to USB connectivity and the multithreaded nature of the APT software (more later), multiple hardware units (including our rack systems) can be controlled simultaneously from APTUser. In this way most automated alignment sequences can be first trialled and verified without writing a single line of custom software by first using APTUser.



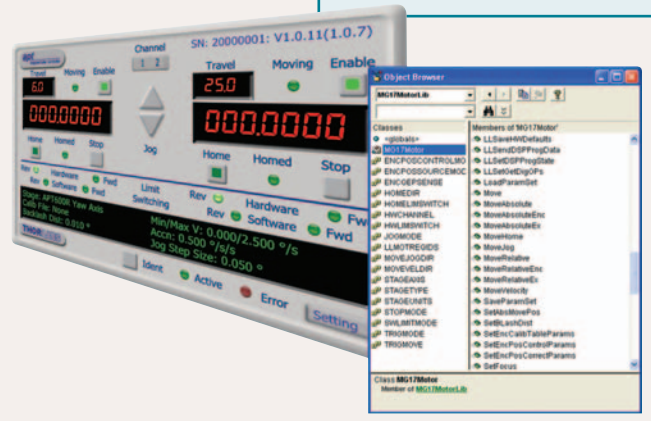
'Speedy Pre-Configuration' – Time Saving

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 a wide range of Thorlabs stages and actuators with individual motor drive channels allowing the system to automatically set a large number of system parameter defaults. This offline configuration eliminates the need to write the large amounts of initialisation code often required when using other control systems, greatly reducing the time taken when developing custom integrated applications. Many other preconfigured settings can be made similarly using the APTConfig utility.



APT Server – The ‘Engine’ For Integration Software Solutions

The PC based motion control '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 accessible to the system integrator. The APT Server actually comprises a collection of cooperating ActiveX Controls (see aside) and associated support libraries that provide a 'toolkit' of 'feature rich' graphical instrument panels and associated programming interfaces. It is this set of ActiveX Controls that the integration engineer or programmer can deploy quickly and easily to incorporate APT motion control and alignment functionality into their custom application.



Aside: ActiveX Controls

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 naturally provide all of the GUI and programmability required to operate and control the full range of APT electronics controllers (both 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 fully automate operation of the motor driver in an integration application.

Multiple Development Environment Support – Your Choice

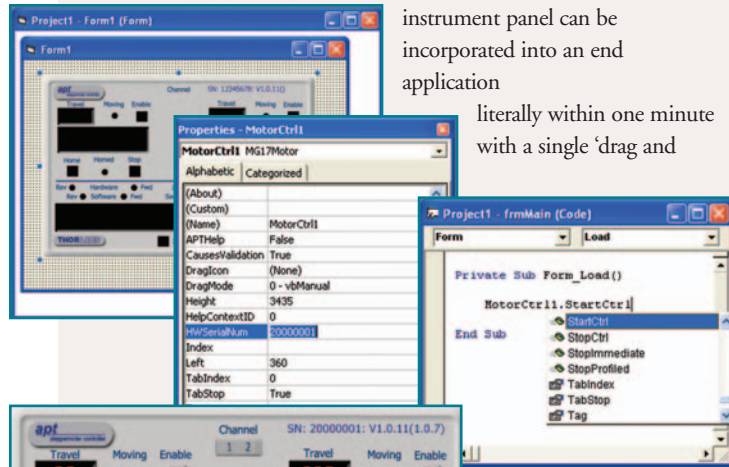
One of the first questions often posed by an integration system developer is that of language compatibility. We accept that our customers will want to use a wide variety of software development languages and tools when architecting their solutions, and it is for this very reason we have engineered the APT Server to be ActiveX compliant (in the form of a collection of ActiveX Controls). ActiveX is a language independent interfacing technology supported by a large number of Windows based software development environments. As a system integrator using our APT controllers it is possible to create custom alignment applications with environments such as LabView, Visual Basic, Visual C++, Borland C++, HPVEE, 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 Microsofts 'interop' technology.

Rapid Integration 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 'user ready' APT motor control

instrument panel can be incorporated into an end application

literally within one 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 GUI's for use in

your 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. In many cases the system integrator will also use the provided instrument panels, both during software development and when commissioning or 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 recognise it is crucially important to the system integrator that the

APT Server makes available all required parameters and operating modes through its programming interfaces. We have taken every available system setting and control command (both high level and low level in nature) 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.



In many cases, when a more ‘intuitive’ high level command is not available, the lower level APT functions can be ‘glued’ together to create new ‘higher level’ functions without suffering project delays through missing functionality.

Multi-Threading Events – 'Oiling The Alignment Process'

When developing integrated 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 however, 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 an end application will also be required to interact with other system hardware such as device characterisation and acquisition systems, laser sources, robotic units and environment control units. The system integrator 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. Multithreading is deployed to completely isolate operation of the APT hardware from that of the custom integrated application. In this way, an end client application can engage in intensive processing (such as data acquisition or number crunching) without affecting the simultaneous 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 'alive' and 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 in this way is extremely useful for system integrators trying to optimise their software routines even when 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 is used to good effect to 'signal' end of motor moves and other lengthy operations.