

OASIS
blue

**OASIS-blue CONTROLLER
USER GUIDE**

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INTRODUCTION

Thank you for purchasing the OASIS-blue four axis stepper controller for the PCI bus! The OASIS-blue is the latest generation in compact, advanced, high-performance controller designed for the most demanding imaging and microscopy applications. The half length PCI form factor of the OASIS-blue ensures a highly integrated solution for automation control.

This guide provides an overview of how to physically install the OASIS-blue card into your system, install the required driver software, and configure the controller for your particular setup. Various hardware options for the OASIS-blue card, such as joystick units and plug-in daughter modules, are also described.

Note that your OASIS-blue controller may have been provided as part of an integrated automation system. There may be aspects of your system configuration that are specialized for your application. In these situations, please contact your system vendor for details regarding your configuration before proceeding.

OASIS-blue Applications

The OASIS-blue controller is intended to address a wide range of automated applications in microscopy. The four-axis design of the controller makes it ideally suited for use with automated microscopes with a combination of the following components:

- Motorized XY stage, for fast and precise translation of the specimen
- Motorized Z focus drive, for autofocus and Z-stack acquisition
- Motorized filter changer(s), for wavelength selection, e.g., fluorescence

The OASIS-blue can be configured to support automated components from a variety of 3rd party vendors, and Objective Imaging supplies a range of cabling options that ensure simple connection of the OASIS-blue to a particular configuration.

Optional components

The OASIS-blue controller has two on-board expansion connectors for optional daughter modules.

- BLUE-EXPIO module for TTL and RS-422 encoder support, as well as digital camera trigger synchronization I/O signals, for digital autofocus and fast mosaic imaging applications
- Two- and three-axis joystick control, as well as specialized support for Leica Microsystems input devices

Figure 1 gives a schematic overview of the OASIS-blue controller family of products.

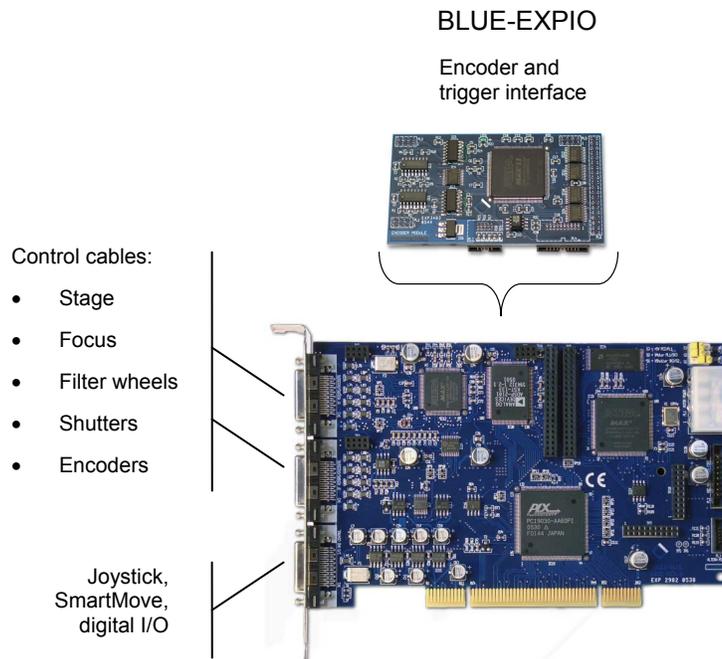


Figure 1. OASIS-blue controller and options.

Details regarding installation and use of the various hardware options are given below in the section *Options and Accessories*.

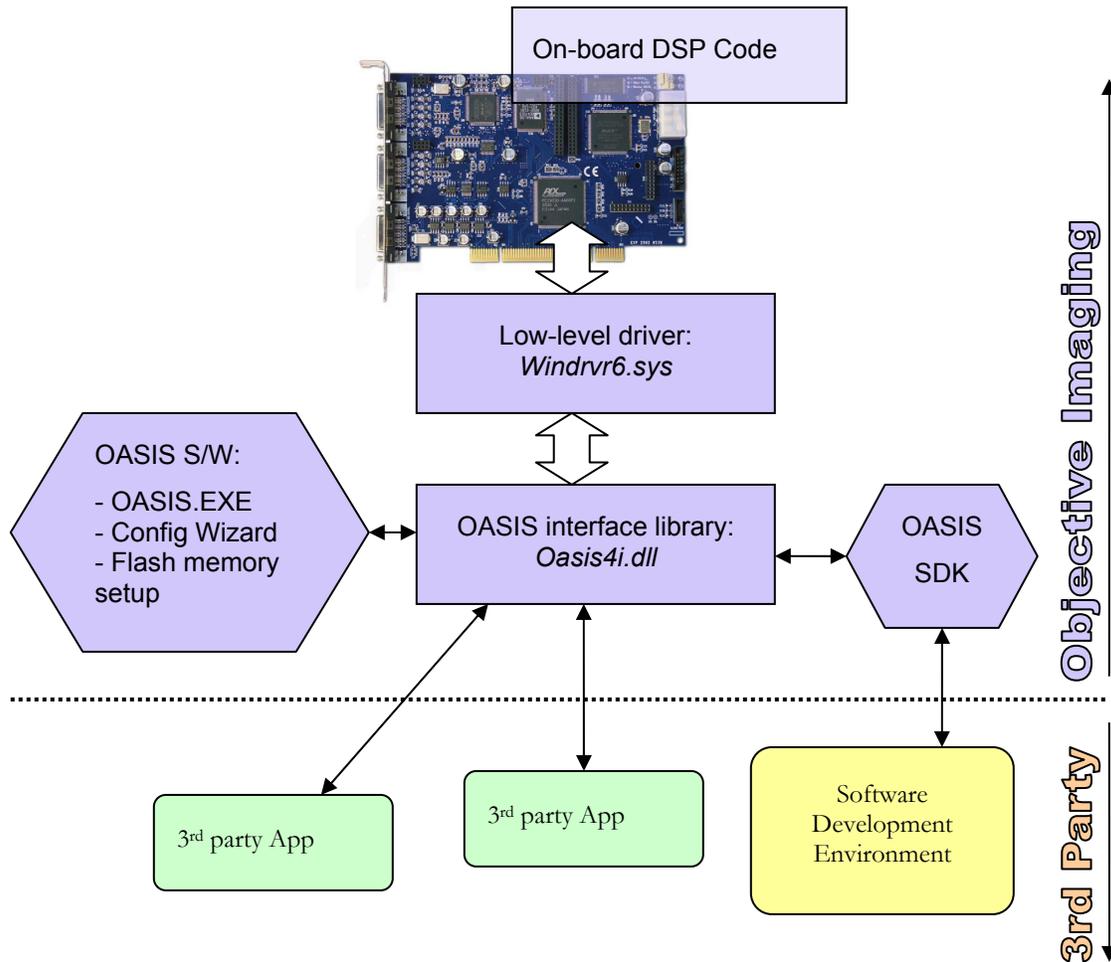
Software Structure

The OASIS software architecture corresponds to the physical hardware items associated with the OASIS-blue controller. How you relate to the specific aspects of the OASIS software depends on what type of user you are:

- **End User of 3rd Party Software/System.** In this scenario, you will be using the OASIS hardware in conjunction with a 3rd party application that includes support for the OASIS-blue card. Examples of these applications include Leica Microsystems' Workstation platforms for imaging, Media Cybernetics' Image-Pro® with the Scope-Pro™ plug in, Olympus MicroSuite™, and Soft Imaging System's analySIS®, among others.

- **Software Application Developer.** In this scenario, you will be developing your own custom or flagship application based on the library of functions available for the OASIS-blue controller.

The figure below illustrates the OASIS software architecture:



You can see there are three critical software components that are used by the OASIS-blue controller:

1. On-board DSP code that provides the fundamental controller functionality.
2. A low-level driver called *Windrvr6.sys* that provides PCI communication support between your computer and the OASIS-blue card.
3. The *Oasis4i.dll* dynamic link library (DLL) file that exposes the functionality of the OASIS-blue controller to software applications on your computer.

All three of these components—one on the OASIS-blue card itself and two on the associated Windows PC—make up the necessary foundation for your use of the OASIS-blue controller. The installation procedure described in the next section explains how to ensure these items are present and working properly on your system.

In addition to these three critical components, several additional software utilities are provided with the OASIS-blue controller. These include:

- **OASIS Configuration Wizard.** This utility guides you through the fundamental steps of configuring the OASIS-blue controller for your particular hardware setup.
- **OASIS Flash Memory Setup application.** This utility gives you access to the full settings available in the OASIS-blue's flash memory, allowing you to customize aspects the controller such as maximum and standby motor currents, acceleration ramps, sine-cosine drive tables, and other settings, as needed.
- **OASIS Controller application.** This application offers basic functionality for stage, focus, and filter changer control. It is useful for verifying that your system is working properly, as well as for defining various software settings such as the target cruise speeds for movements.
- **OASIS SDK.** This software developer's kit provides the headers, import libraries, and documentation needed to integrate the OASIS-blue controller into your own applications.

Some aspects of these software utilities are described later in the relevant section on installation and configuration of the OASIS-blue controller. The OASIS SDK is documented in detail in the *OASIS Library Reference Manual* ("OASIS_DLL_Manual.pdf") included on the OASIS installation CD.

INSTALLATION

Warning!

This board contains static sensitive components. Please take the necessary precautions when handling and installing the board, to prevent damage or malfunction.

Installation Requirements

In order to install the OASIS-blue card into your system, you will need the following:

- PC with a half-length PCI or PCI-X slot available
- Windows® XP or Windows® 2000 operating system
- CD-ROM drive
- One free (hard disk style), power connector, with 2A at 12V available
- Cross-head screwdriver
- OASIS Installation CD

Installation Process

The OASIS-blue installation process consists of three distinct steps:

1. **Hardware Installation.** In this step, you will physically place the OASIS-blue card inside your computer.

2. **Driver Installation.** After installing the hardware, you need to install the driver software so that Windows recognizes the card and application software can use it.
3. **Configuration.** You will need to configure the OASIS-blue card to match your particular system setup.

Once these steps are complete, the OASIS-blue card is generally ready for use. However, if you are using a 3rd party application, you may need to install additional software so that your application package can use the OASIS-blue controller to drive the motorized components of your system. Refer to your application / system documentation for further details on how to configure the application for use with OASIS-blue.

Connector Identification

Refer to the following diagram for information regarding the various connectors available on the OASIS-blue card.

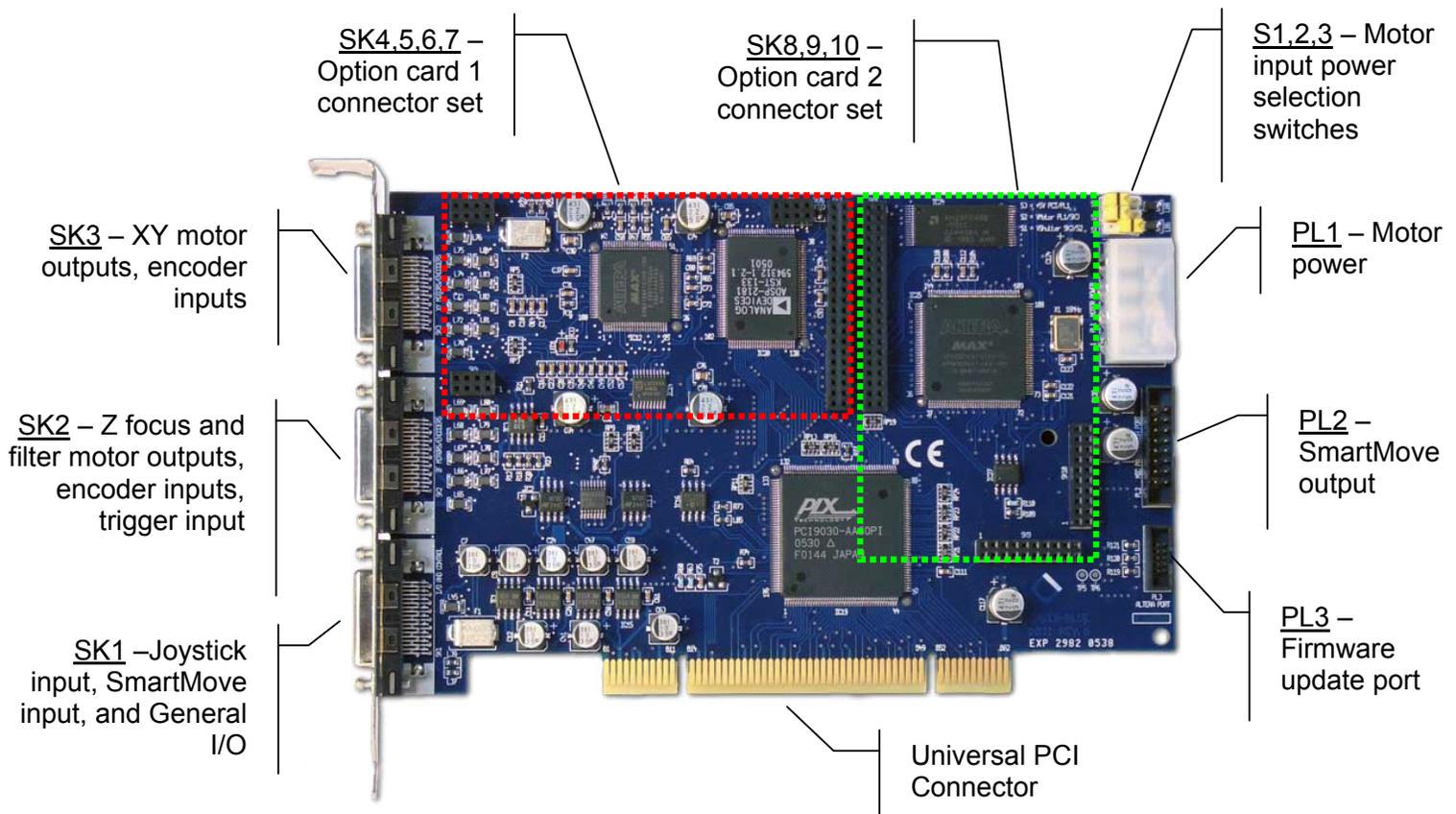


Figure 2. OASIS-blue Connectors.

Hardware Installation Procedure

Preparing the PC case

- 1) Switch off the PC and unplug it from the mains to disable any standby power.
- 2) Remove the system unit cover or side panel.
- 3) Select a suitable PCI or PCI-X slot with no obstructions (preferably one with adequate air-flow from the auxiliary fan), and remove blanking panel as necessary.

Fitting the card

- 4) Ground yourself to an antistatic mat or other grounded source to discharge static electricity before handling the board.
- 5) Pick up the board (still in its anti-static sleeve), by grasping the metal edge bracket with one hand, and remove the sleeve.
- 6) Taking care to hold the edges of the board, avoiding contact with the electronic components, position it over the PCI slot and locate the tip of the metal bracket in the slot of the PC chassis, before pushing the board firmly but gently home with a slight rocking action.
- 7) Secure the bracket with a retaining screw.

Connecting power and options

- 8) If necessary, fit any daughter modules and their external connections.
- 9) Connect a spare power connector from the PC power supply to PL5 at the rear of the board. Preferably the OASIS-blue should be the only device drawing power from this lead. The on board motor drive components get their power via the +12V from this connector, in addition attached shutters may also use the +12V and +5V from this connector. There is an extension cable provided with the OASIS-blue in case the PC cable is too short.

Making external connections

- 10) Replace PC system cover or side panel.
- 11) Connect a joystick or other compatible control device to SK1 (marked I/O on front panel) as required.
- 12) Connect the XY stage cable to SK3 (marked X/Y on front panel), and the Focus and Filterwheel cable to SK2 (marked Z/F on front panel) as required.

NOTE:

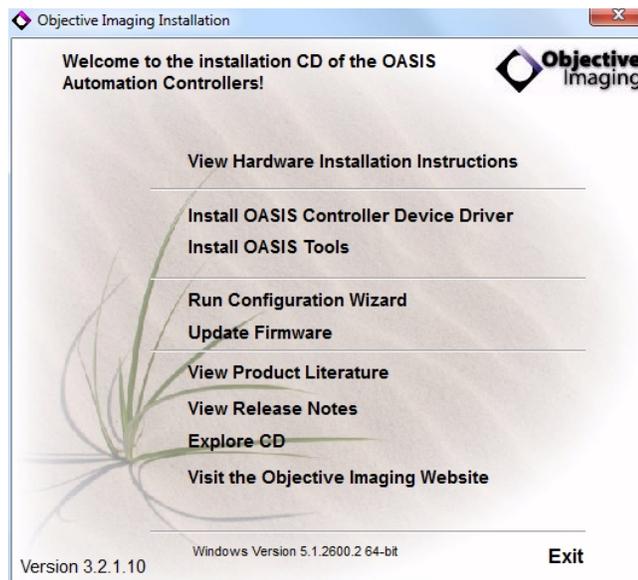
All three front-panel connectors are identical and are not keyed, so take care to fit the cables correctly. If you do not, the OASIS-blue will sense that they are fitted incorrectly and disable functionality for those connectors.

- 13) You are now ready to switch on the PC and proceed with the driver installation for your operating system.

Warning: Do not connect or disconnect motor cables while the PC is powered on. The OASIS-blue card may be applying power to the motors, in which case a connection or disconnection could damage the OASIS-blue card.

Driver Installation

- 1) Switch on PC and boot into Windows.
- 2) If the 'Add New Hardware Wizard' appears, choose Cancel.
- 3) Insert the OASIS Installation CD or navigate to the folder where you downloaded and unzipped the installation download.
- 4) Run the Setup.exe from the main installation disk.



- 5) Click on the 'Install OASIS Controller Device Driver' option. A message will indicate the drivers were installed and registered correctly.
- 6) Click on the 'Install OASIS Tools' option to install the Configuration Wizard, the Flash Configuration program and the OASIS Application utility. These utilities will be useful in configuring the OASIS-blue controller for your particular hardware situation.

CONFIGURING THE OASIS- blue CONTROLLER

The OASIS-blue controller is designed to work with a wide range of different types of automation hardware. For instance, there are a number of manufacturers of XY motorized stages for microscopes, and each manufacturer uses different styles of connectors, wirings for limit switch logic, and other features specific to their make and model of stage.

In order to drive these different types of hardware, the OASIS-blue controller must be configured accordingly. Most of these configuration settings are stored in the onboard flash memory of the OASIS-blue card, permitting the correct start-up conditions when the card is powered up and initialised.

OASIS Configuration Wizard

The easiest way to configure the card is to run the OASIS Configuration Wizard (Figure 3). The wizard provides step-by-step instructions for defining the settings most appropriate for your particular system, and actually consists of three wizards:

1. **System Configuration Wizard.** This wizard performs the basic tasks of defining the hardware you have connected to the OASIS-blue controller.
2. **Encoder Setup Wizard.** This wizard is used to enable the use of encoders and specify their resolution and polarity.
3. **Joystick Setup Wizard.** This wizard allows you define what input control device(s) you have connected to the OASIS-blue controller, and set the details of their operation, including sensitivity and direction.

Also displayed in the main screen of the OASIS Configuration Wizard are:

- **Serial Number.** This is the serial number assigned to your particular OASIS-blue controller.
- **DSP.** This reports the current DSP code revision running on your OASIS-blue controller.

- **DLL.** This displays the current version of the OASIS-blue DLL installed on your computer.
- **Option Card.** If an option card is installed on your OASIS-blue controller, the type of card will be displayed, as well as additional information relevant to the type.

When installing an OASIS-blue card, you would typically run each wizard in turn to ensure proper configuration for your setup.

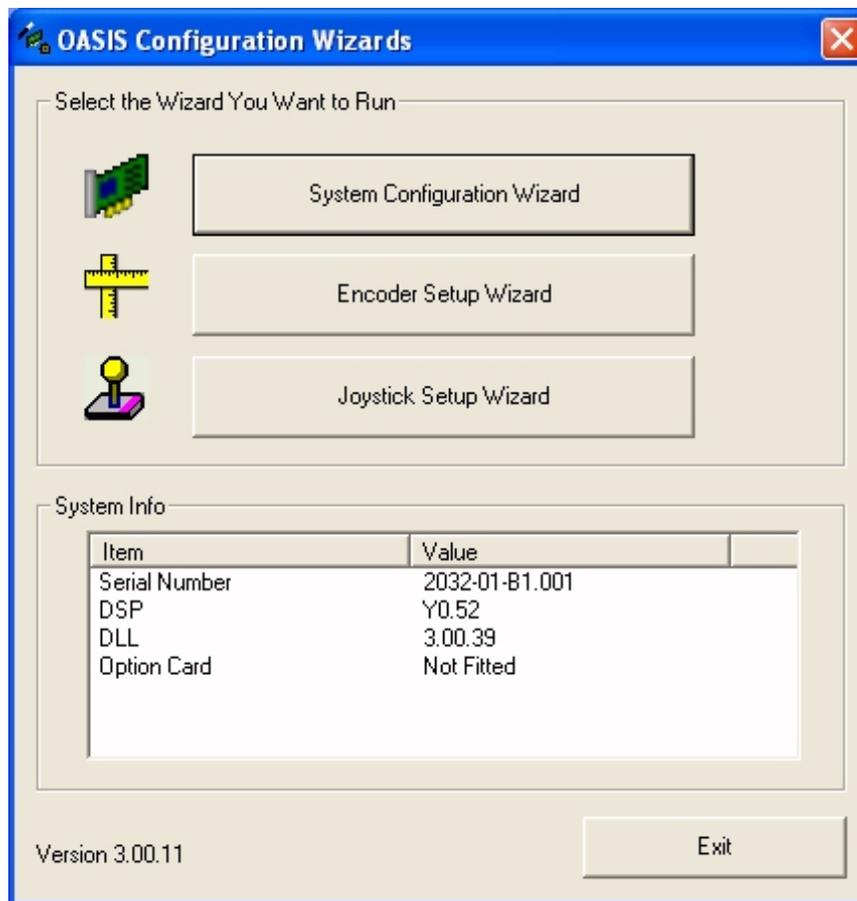


Figure 3. OASIS Configuration Wizards

Each of the wizards is described in the following sections.

System Configuration Wizard

The System Configuration Wizard performs the primary tasks of ensuring the motor and limit settings of the OASIS-blue card match the make and model of automation hardware connected to it.

The wizard includes a listing of the various makes and models of XY stage, focus drives, and filter wheels, and can setup the card based on known default values for the particular device. The wizard can also auto-detect the settings of your particular systems—such as limit switch polarity, axis and limit directions, and encoder settings (if fitted)—by performing various movements to test and measure your system’s characteristics.

After displaying the start page (Figure 4), the wizard displays the configuration page (Figure 5), allowing you to indicate the make and model for your XY stage, Z focus, and F-axis connection, if necessary.

Green LED icons in the configuration page indicate whether a motor has been detected for the given axes.



Figure 4. OASIS System Configuration Wizard.

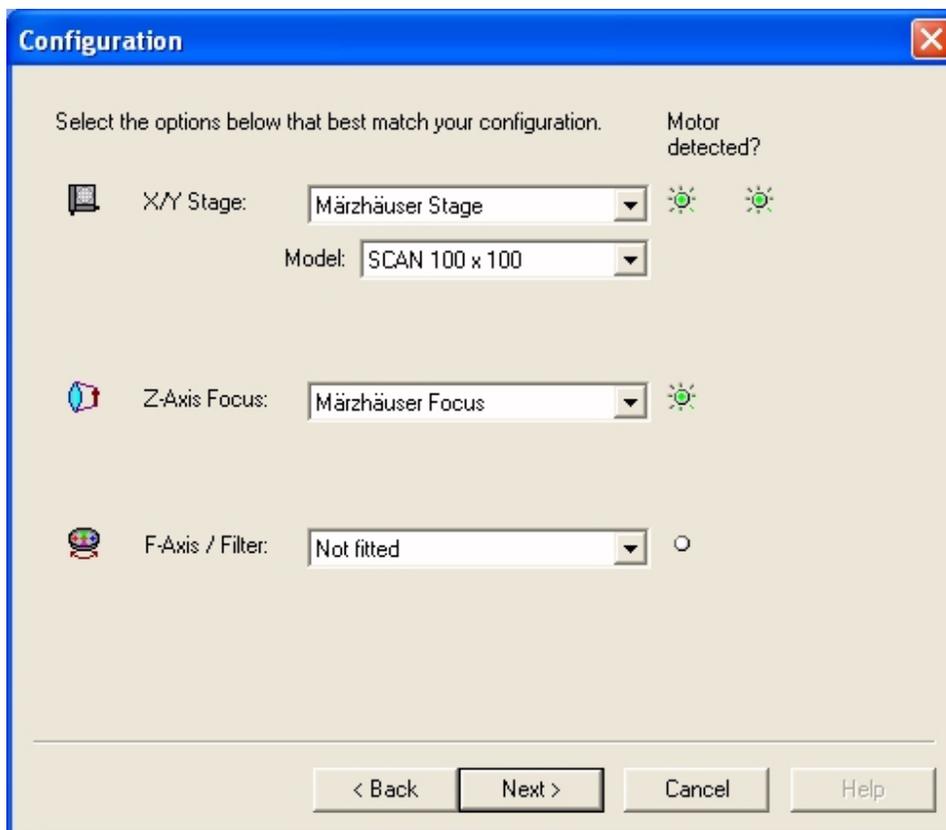


Figure 5. Overall system configuration.

The next step in the wizard is to define whether any of the axes drive directions are to be reversed. Reversing the drive direction will change the “sense” of positive vs. negative on that axis. For instance, if a clockwise turn of the motor is producing a positive motion on the axis, then reversing the drive direction will result in a negative motion when the motor is turned clockwise. Setting the drive direction may be useful in ensuring the desired direction of stage travel relative to the view in the eyepieces or camera mounted on the microscope.

The drive direction setting also can accommodate for the side of the microscope onto which a motorized focus drive is mounted. A given direction of turning of the motor will result in opposing fine focus movement depending on whether the motor is mounted on the left or right side of the microscope, so reversal of the motor drive direction may ensure the expected result of positive and negative movements of the focus for your setup.

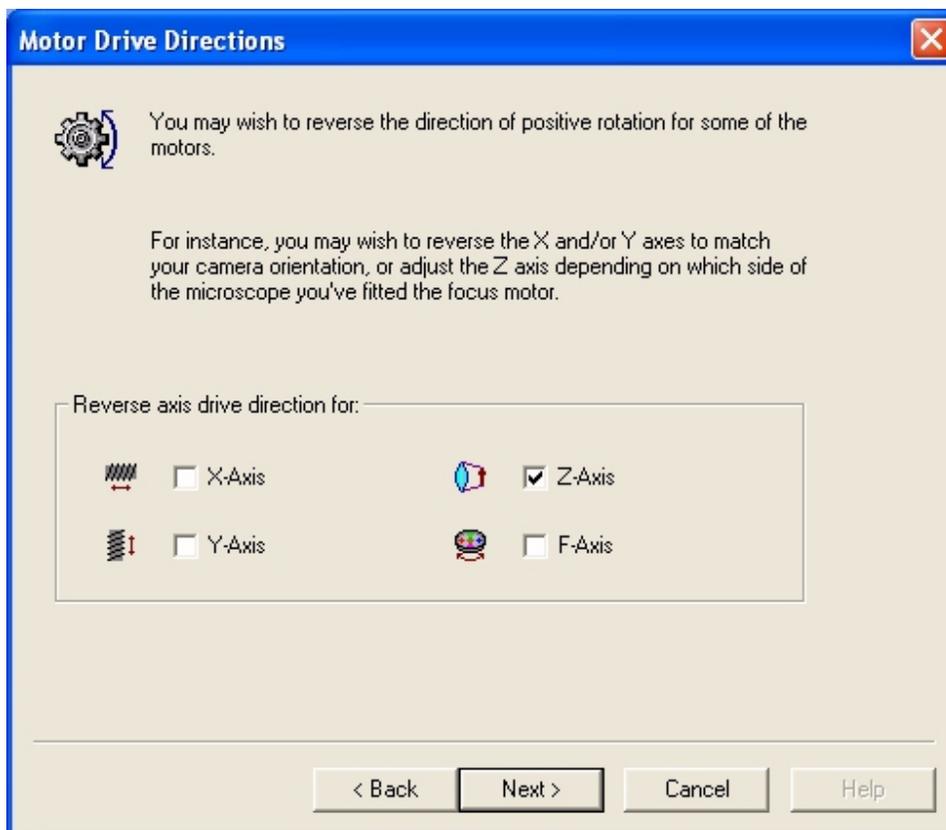


Figure 6. Setting the drive direction.

Following the drive direction page is the automatic ramp calculation page (Figure 7). Selecting to have the wizard automatically optimize your ramp tables will result in default tables that have been adjusted to match the microstepping currently defined for the OASIS-blue controller.

Note that the Encoder Wizard will also present the option to optimize the acceleration ramps, since the microstepping resolution may be adjusted by that wizard based on the encoder resolutions.

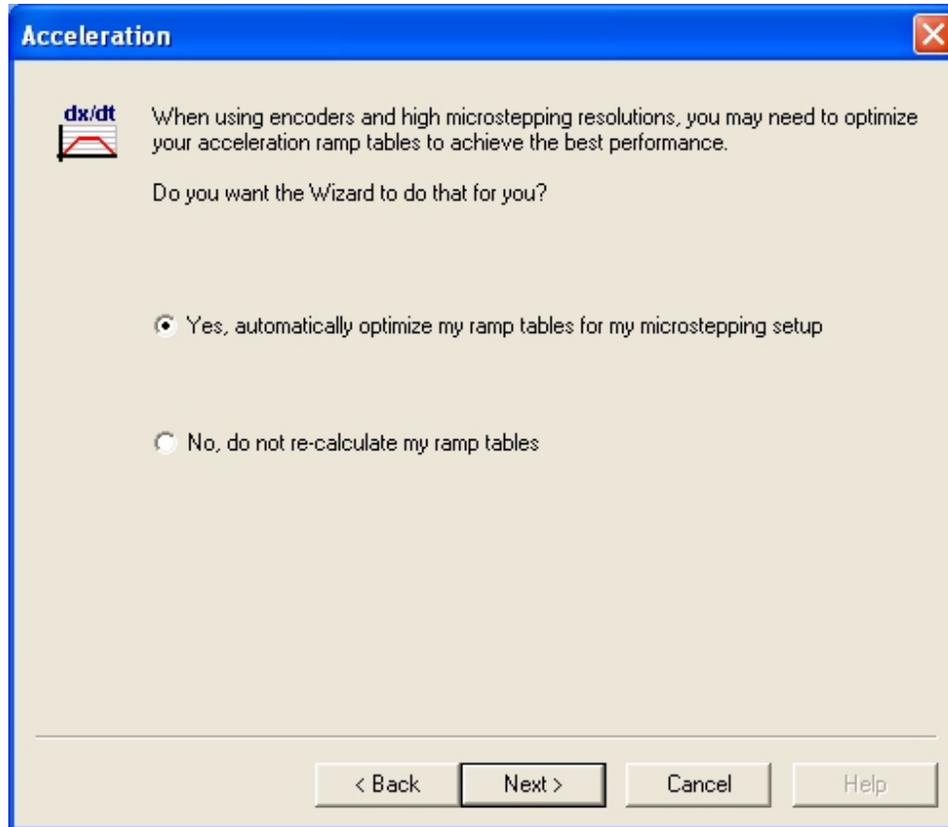


Figure 7. Automatic ramp calculation.

Following the acceleration page, you will be presented with the option to have the configuration wizard automatically determine your setup (Figure 8).

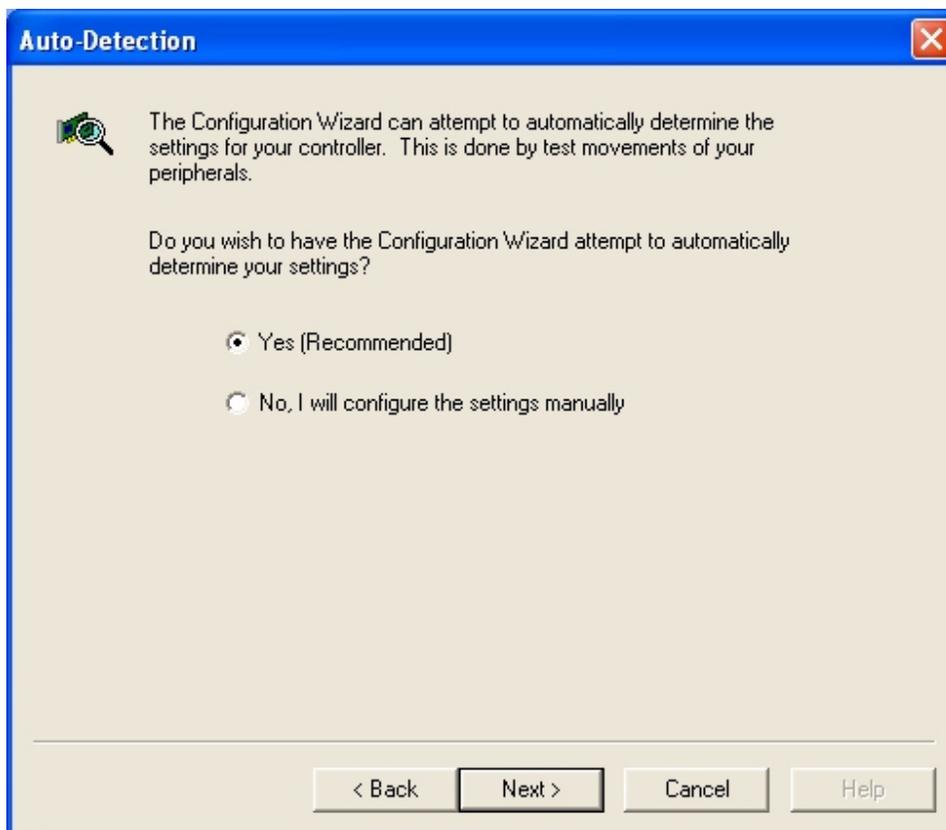


Figure 8. Auto-Detection selection.

During auto-detection, the wizard verifies the limit switch polarity (which may be either open or closed logic) for each axis where a motor has been detected. The wizard then drives each axis of the XY stage to the limits in turn (Figure 9), verifying that the expected limit is sensed for the direction of travel. The range of travel is measured between the limits and is compared to the expected value for the make and model of stage selected in the configuration page in order to estimate the pitch of each axis.

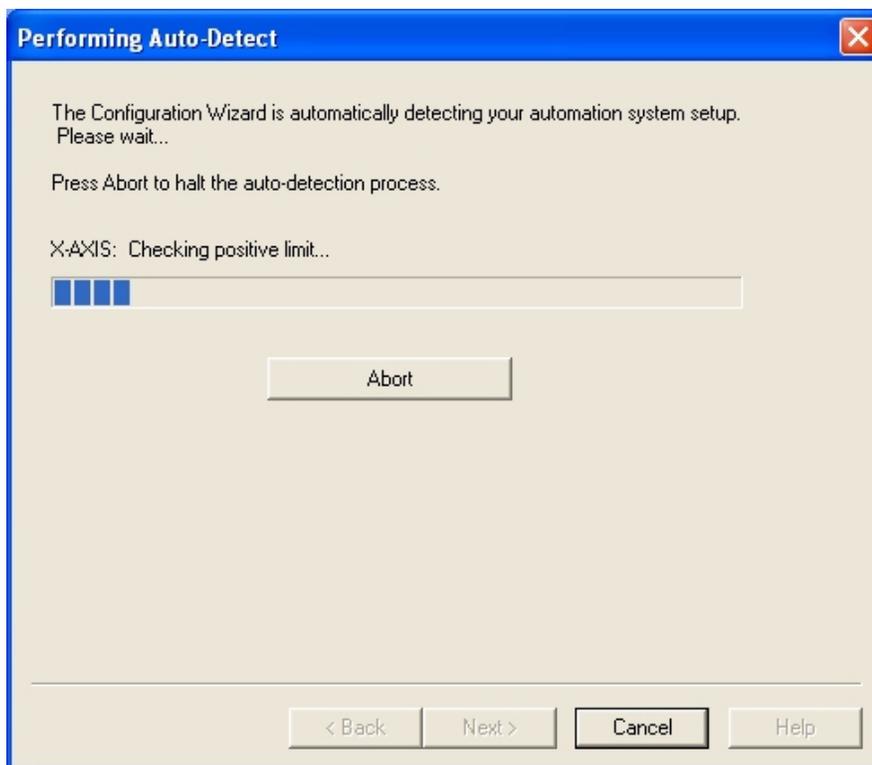


Figure 9. Auto-detection in progress.

Once the auto-detection is complete, the wizard displays the settings page for each component for verification of the settings.

For the XY stage, the limit switch polarity is displayed, as well as the limit direction indicating whether it was reversed to match the axis drive direction (Figure 10). Next, the stage's estimated pitch values are shown, along with the expected and actual travel measured between the limits for each axis (Figure 11).

For the focus drive, the current pitch value is displayed, corresponding to the amount of travel of the focus drive for one revolution of the motor. For many microscopes the fine focus travels 100 microns (0.1 mm) per turn, though other variations also exist. Please check with your microscope manufacturer for the amount of travel expected per turn on your fine focus drive.

The focus page also shows a setting allowing selection of physical limits fitted, with polarity and direction options. The wizard does not attempt to automatically detect physical limits on the focus drive since most external focus drive systems are not fitted with limits and thus unrestrained travel of the focus could lead to collisions with the objective or condenser.

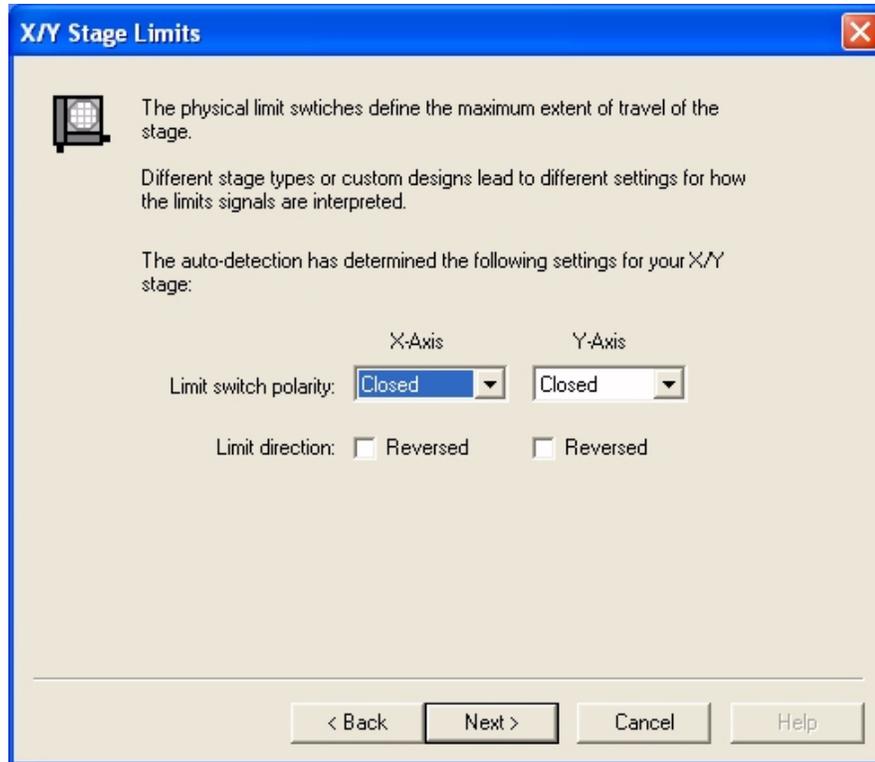


Figure 10. Stage settings showing limit switch definition.

X/Y Stage Settings

The pitch of the stage's lead screw determines the calibration used to accurately move the stage.

	X-Axis	Y-Axis	
Lead screw pitch (mm):	2.00	2.00	
Stage dimensions:	4.72	3.54	in
Actual available travel:	4.72	3.54	in

Use actual travel values to perform initialization using only one corner

< Back Next > Cancel Help

Figure 11. Stage settings show estimated lead screw pitch and available travel.

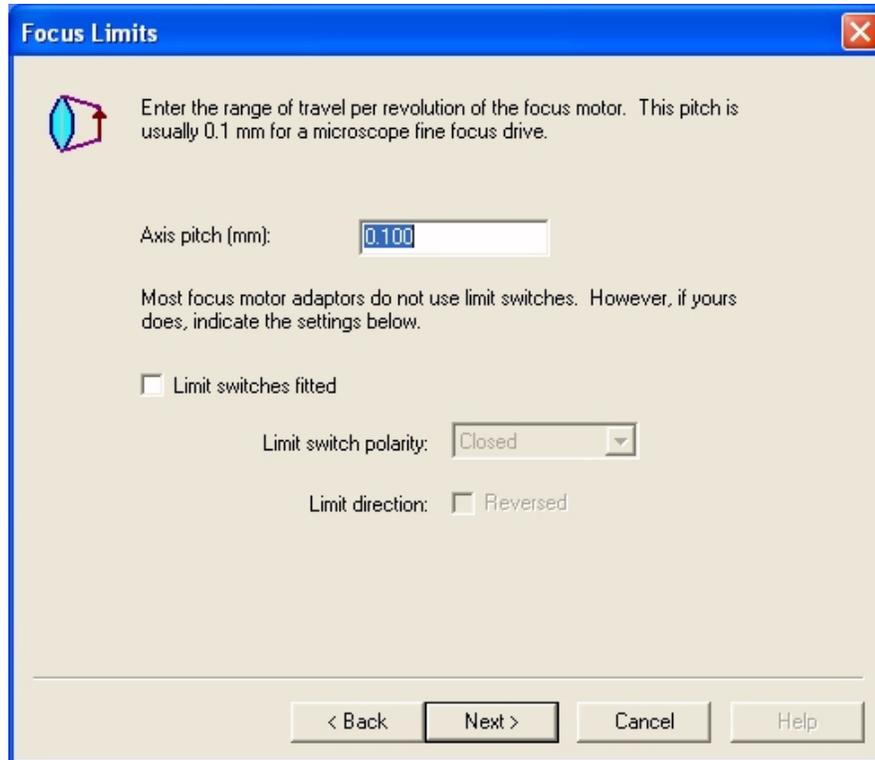


Figure 12. Focus settings, including pitch and limit settings.

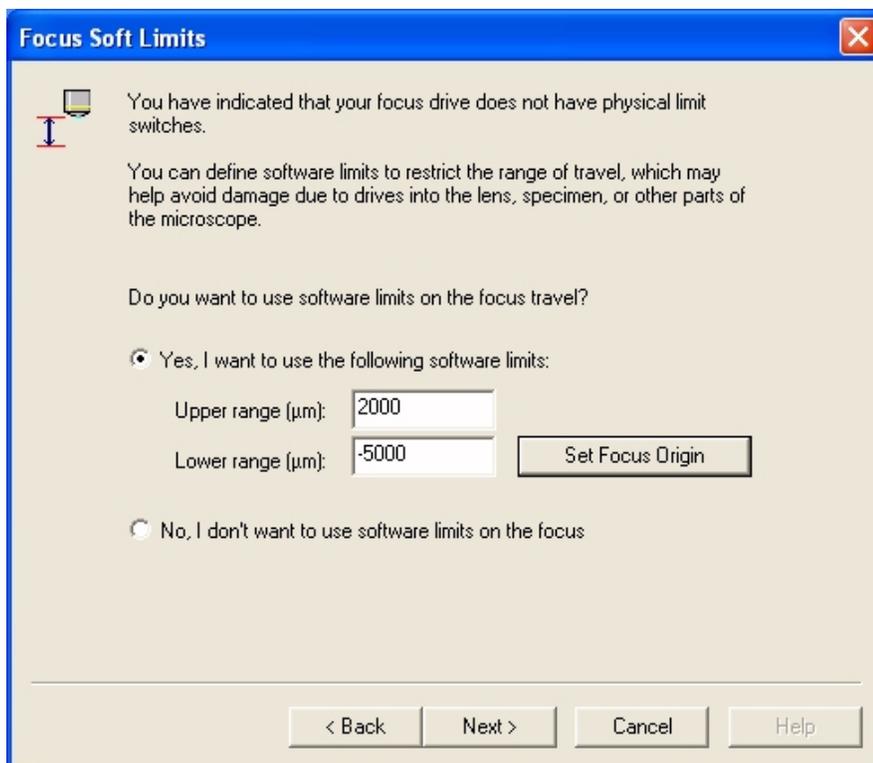


Figure 13. Focus soft limit definition.

To accommodate focus drive systems with no limit protection, the wizard displays a page allowing you to initialize the focus drive by setting the origin position and defining software limits above and below the current position.

Note that if you elect not to use software limits on focus drives without physical limits, collisions between the specimen and the objective lens, or between the sub-stage optics and the stand are possible. It is recommended that you use software limits to avoid damage to your microscope and specimen.

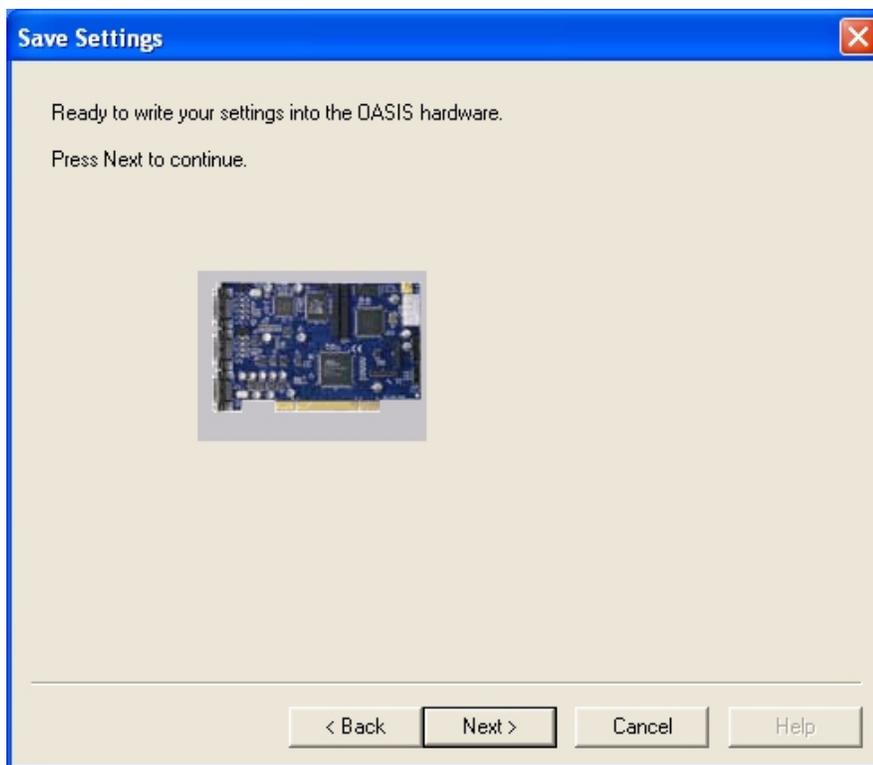


Figure 14. Writing the changes to flash memory.

The final step of the wizard writes the changes made to your configuration into the flash memory of the OASIS-blue controller (Figure 14). Once the flash is updated, you may quit the wizard and start using your OASIS-blue controller, or you may elect to run the Encoder Setup Wizard and/or the Joystick Setup Wizard.

Encoder Setup Wizard

The Encoder Setup Wizard automatically detects the presence, resolution, and polarity of encoders on the X, Y, and Z axes. The wizard also verifies that your microstepping resolution and acceleration ramps are optimized for the resolution of encoders that are connected to the OASIS-blue controller.

The Encoder Wizard starts by asking how you would like to proceed in defining the encoders (Figure 15). For the XY stage and Z focus you can select to:

- Indicate the pitch settings and have the wizard determine the encoder resolutions
- Indicate the encoder resolutions and have the wizard determine the axis lead screw pitch
- Enter the values manually

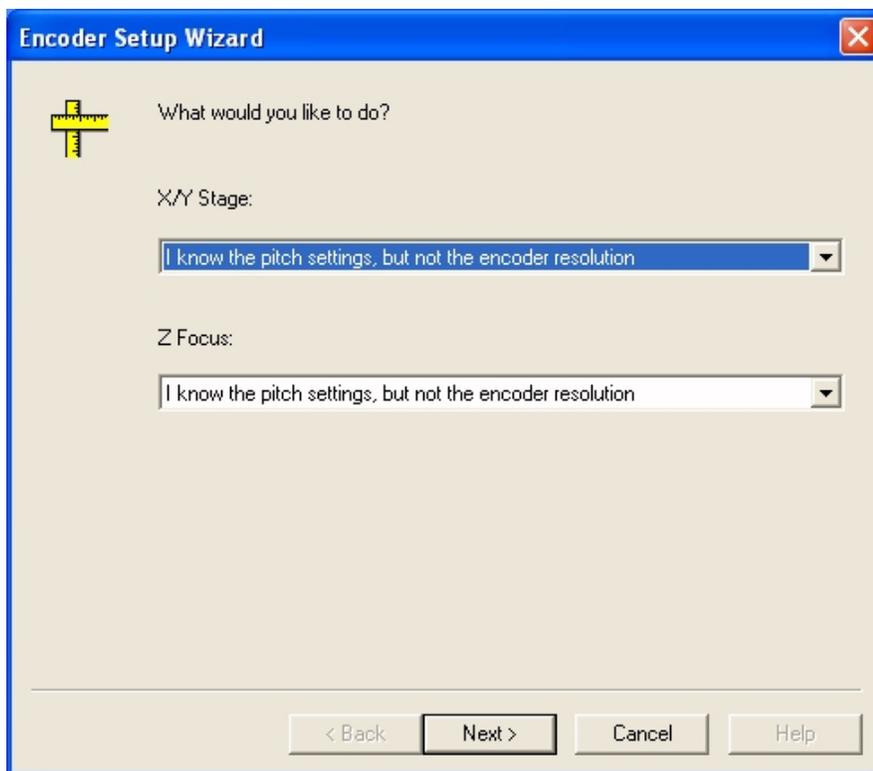


Figure 15. Encoder setup method selection.

The wizard then displays the information page where either the pitch value or encoder resolution is entered, depending on the method you chose for the XY stage and Z focus (Figure 16).

For instance, if you know that your XY stage has a 2 mm lead screw, but are uncertain of the encoder resolution, you would choose the option “I know the pitch settings, but not the encoder resolution” in the method selection page. You will then be prompted to verify the pitch value in the information page, i.e., 2 mm for the X and Y axes of the stage.

Alternatively, if you know the encoder resolution but wish the wizard to determine the pitch, choose the option “I know the encoder resolution, but not the pitch” in the method selection page. You will then be prompted to enter the encoder resolution, e.g., 0.1 micron.

Once the information has been entered and you select “Next”, the wizard will perform moves on the X, Y, and Z axes. The distance moved is compared to the encoder feedback to determine if encoders are fitted. If so, the relative values of motor to encoder counters are used to calculate either the encoder resolution (based on your input of pitch) or the pitch value (based on your input of encoder resolution).

The direction of travel is also compared to the encoder polarity to ensure positive motion of the motor also results in positive changes in the encoders.

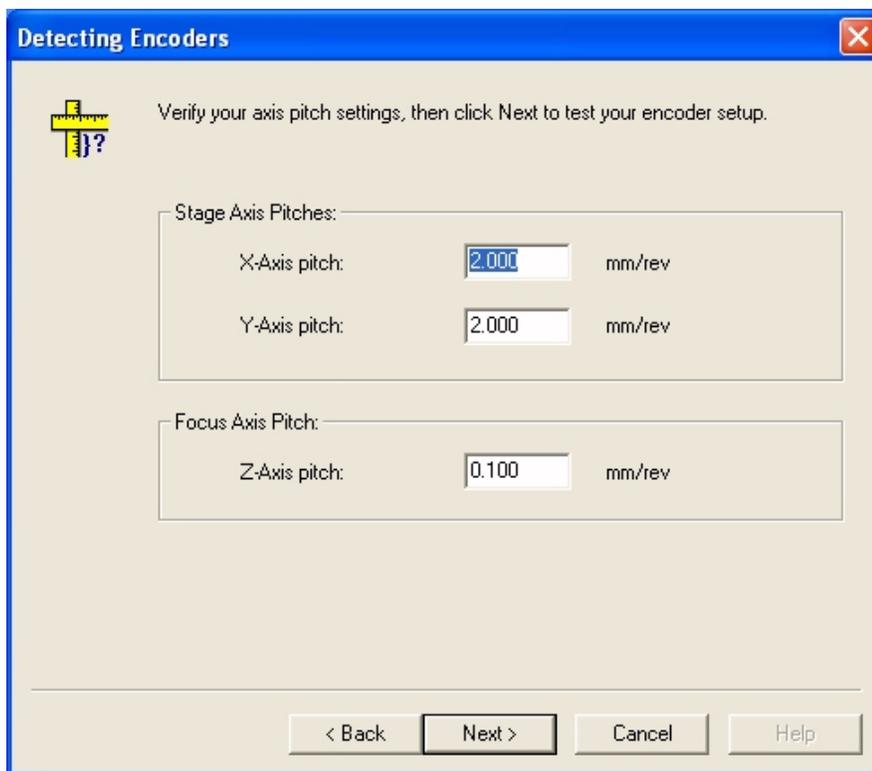


Figure 16. Encoder wizard information page.

The results are displayed in the encoder settings page (Figure 17). This page indicates whether encoders were detected, as indicated by the “fitted” options. The results from the axis pitch and encoder resolution measurements are also shown, as well as the encoder polarity. You may manually make changes to the values displayed, if needed.

Based on these values, the wizard verifies that the microstepping resolution of the OASIS-blue controller is sufficient to support the encoder resolution. Ideally the microstepping of the motor should be greater than the encoder resolution to ensure full benefit of the encoder feedback.

For instance, with a 2 mm lead screw and 0.1 micron encoders, an ideal microstepping is 40,000 steps per rev, since this leads to a step size of 0.05 microns (2,000 microns divided by 40,000 steps). Thus there will be two microsteps available per encoder count, allow more precise positioning in closed-loop situations.

Once the microstepping has been automatically determined by the wizard, you are given the option to re-calculate the acceleration ramp tables (Figure 18). This may be required since the acceleration ramp tables are based on microstep values. When the microstepping resolution is changed, the ramp table should be matched to the new microstepping in order to achieve the same actual speed on the axis. See the section on *Speed and Acceleration* in the *Chapter*

5

Principles of Operation chapter for further details on acceleration ramps.

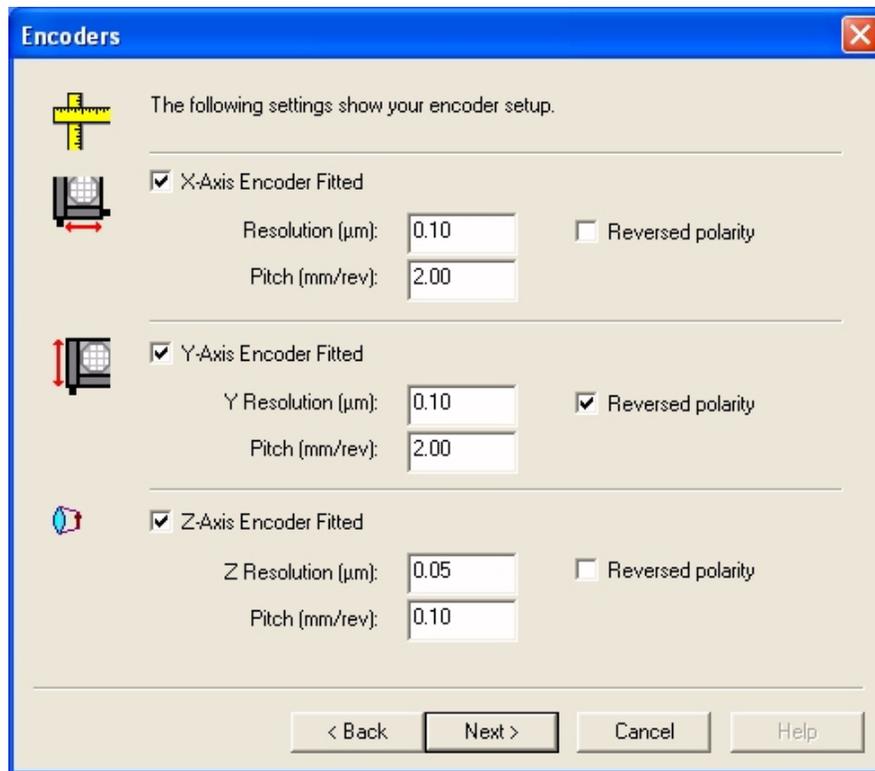


Figure 17. Encoder settings.

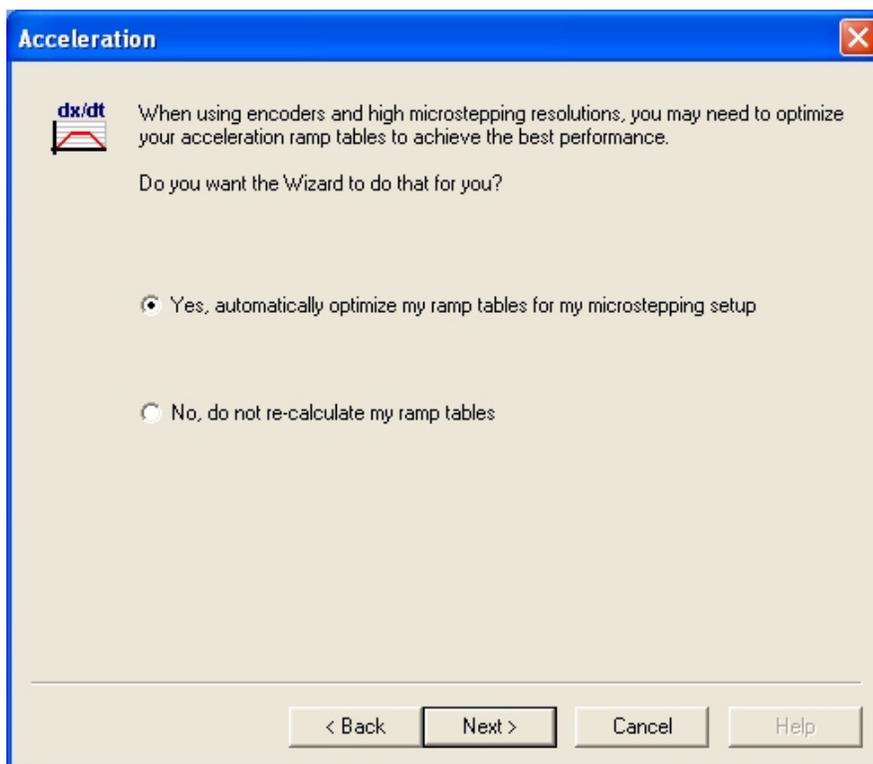


Figure 18. Automatic ramp calculation.

The final step in the encoder wizard before the settings are actually written into the OASIS-blue flash memory is to initialize the XY stage to verify the range of travel. This is necessary to ensure the settings are set correctly and to account for effects the changes in microstepping and encoder resolution may have had on the known range of travel of the stage.

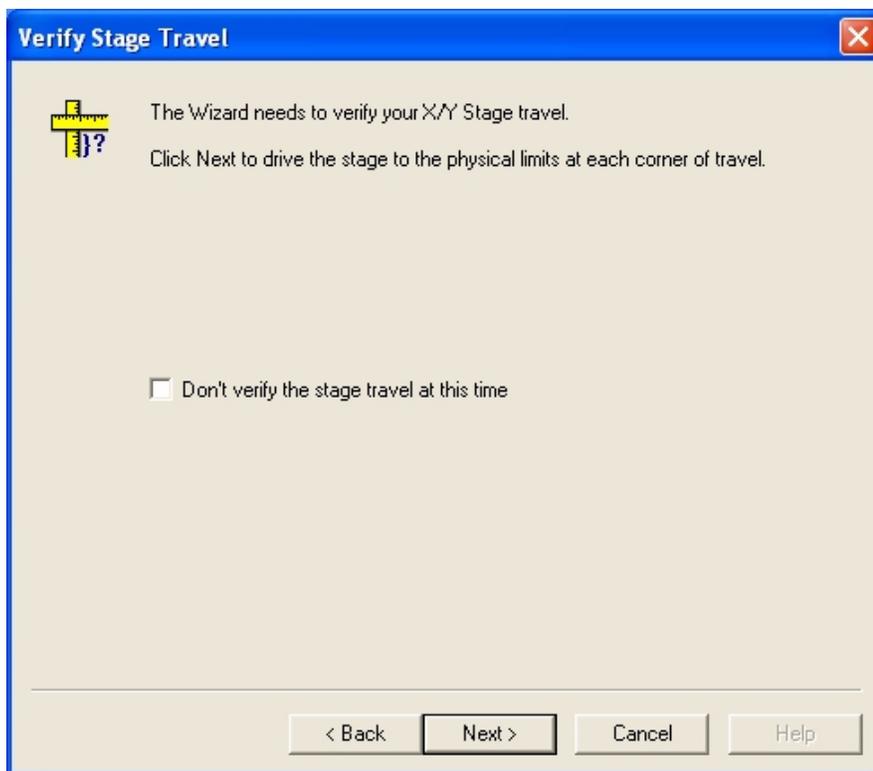


Figure 19. Stage initialization after encoder setup.

Note that you have the option to skip the stage travel verification, but you should only do this if you intend to initialize the stage in another application before attempting to use it. For instance, if you are using Surveyor to perform mosaic imaging acquisition, you should first initialize the stage in Surveyor before attempting any scans.

Joystick Setup Wizard

The Joystick Setup Wizard simplifies configuration of the type of input controller present on the system.

The main page of the Joystick Wizard (Figure 20) prompts you for the type of joystick fitted, as well as selections for indicating whether you have fitted a trackball or Leica Microsystems SmartMove input device interface (See the section in the *Options and Accessories* chapter for further details on this interface).

Note that it is possible to have more than one device connected to the OASIS-blue card at a time. For instance, it is possible to have the BLUE-SNP interface for the Leica SmartMove, an OI joystick unit, and a trackball all fitted. However, in most cases only one type of input controller is used.

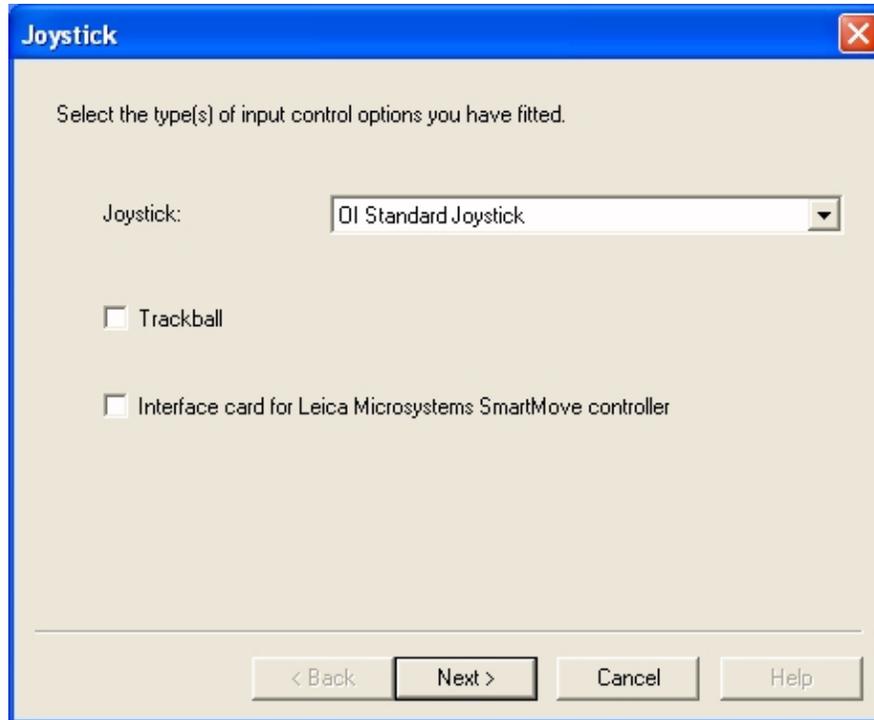


Figure 20. Joystick main page.

If a joystick is fitted, you are given the option of defining the desired action for the button. Two options are available:

- **Turbo mode.** In this mode the joystick will use the fastest sensitivity setting when the button is pressed and held.
- **Autofocus.** In this mode, the button press initiates a video autofocus. Note that this option will have no effect for systems not fitted with the OASIS-AF video autofocus module.

Next the wizard presents the joystick settings page (Figure 22). This page allows you to set the XY and Z joystick sensitivities, providing more coarse or fine movements for deflections of the XY joystick and turns of the Z joystick digiknob.

You may also reverse the sense of travel of the XY joystick deflection and Z digiknob turns in this page.

Note that changes to the joystick direction values do not affect the axis direction of travel, i.e., the sense of positive and negative direction of the axis. The joystick settings only affect the relative direction of travel for joystick operations.

Once the settings for the joystick are complete, the changes are written into the OASIS-blue flash memory, and you are returned to the main wizard screen.

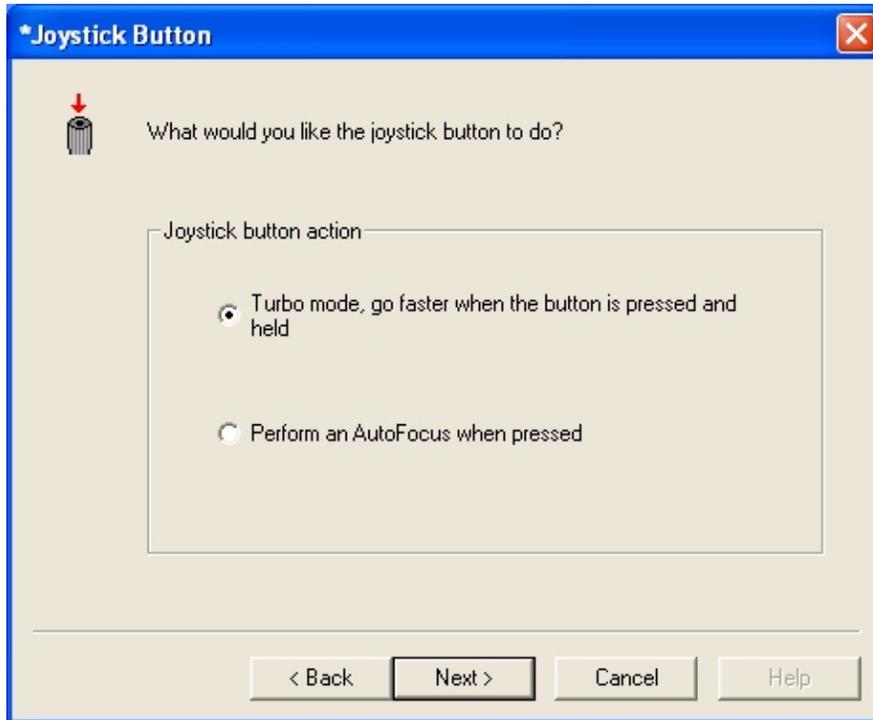


Figure 21. Joystick button definition.

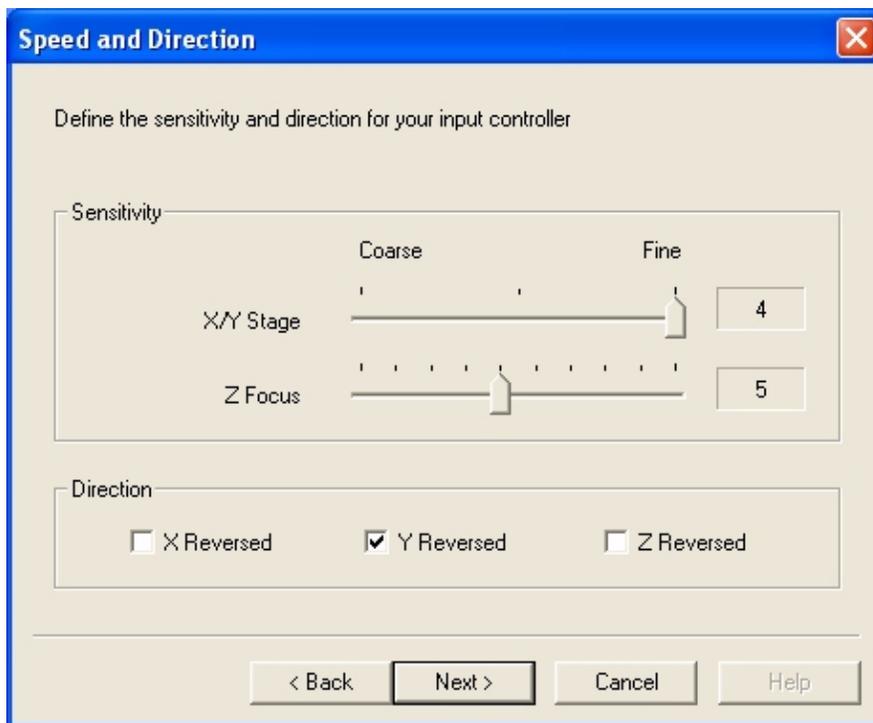


Figure 22. Joystick speed and direction settings.

OASIS Flash Memory Configuration Utility

Individual flash memory settings may be modified using the OASIS Flash Memory Setup utility (Figure 23).

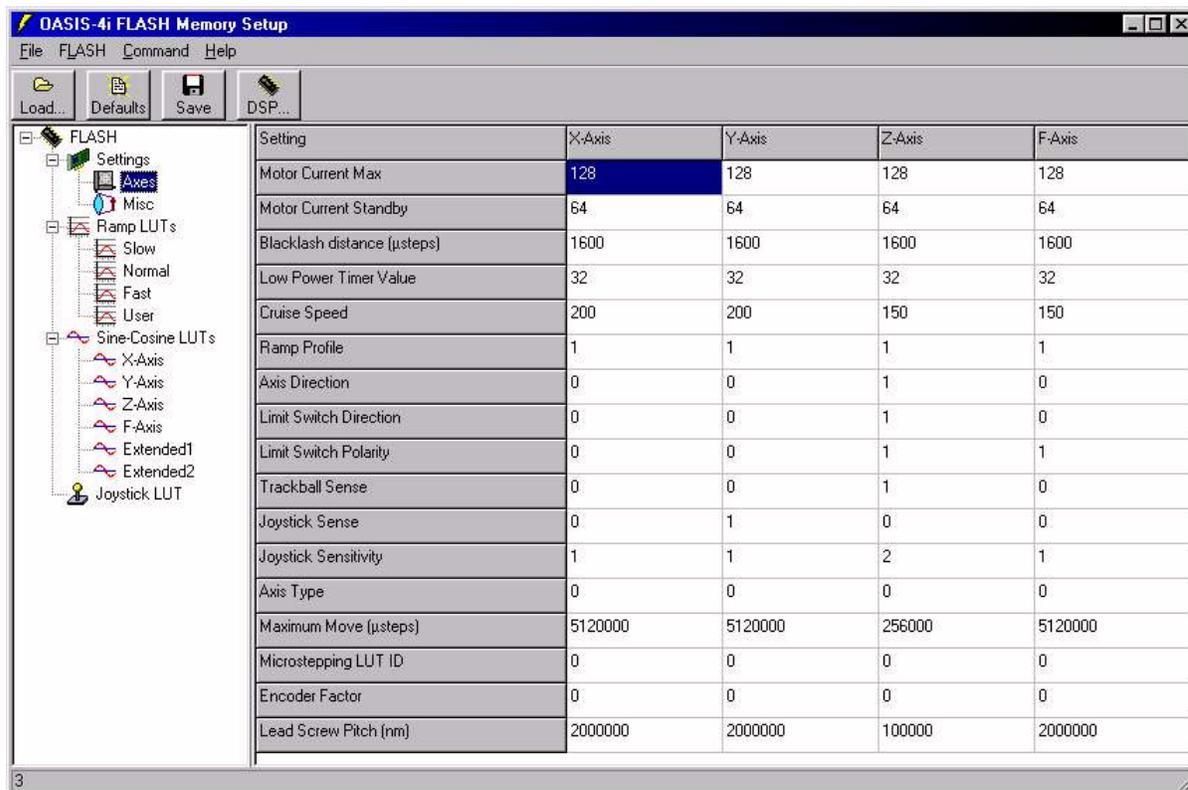


Figure 23. OASIS Flash Memory Setup application.

The flash configuration utility provides a means to adjust the following settings for each axis:

- Maximum motor current
- Standby motor current
- Backlash correction distance
- Standby power timer interval
- Power-on cruise speed
- Power-on ramp profile
- Axis direction (clockwise or counter clockwise)
- Limit switch direction
- Limit switch polarity
- Trackball sense (direction)
- Joystick sense (direction)
- Joystick sensitivity
- Axis Type

- Maximum acceptable move command distance
- Microstepping setup
- Encoder setup
- Calibration lead screw pitch

Also, advanced settings such as autofocus settings, acceleration ramp tables, motor drive tables, and joystick deflection tables are defined in the OASIS-blue flash memory.

What Next?

Once the OASIS-blue card has been installed and configured, the next step depends on your situation.

If you are the user of a 3rd party imaging application, you would next need to perform any further installation required to support the OASIS-blue card within your application. Please refer to your imaging application's documentation for further instructions.

If you are a developer of applications that will use the OASIS-blue controller, you should next install the OASIS-blue Tools from the OASIS CD. This will copy the full OASIS software utilities, SDK libraries and include files, and support documentation to your development system. Please refer to the OASIS-blue SDK DLL manual for further details regarding integration of the OASIS-blue into your system software.

OPTIONS AND ACCESSORIES

Joystick Units

The BLUE-JOY1, BLUE-JOY2, and BLUE-JOY3 joystick units provide manual control of focus and/or stage movement. These units are connected via socket SK1 for joystick and general I/O on the OASIS-blue controller.

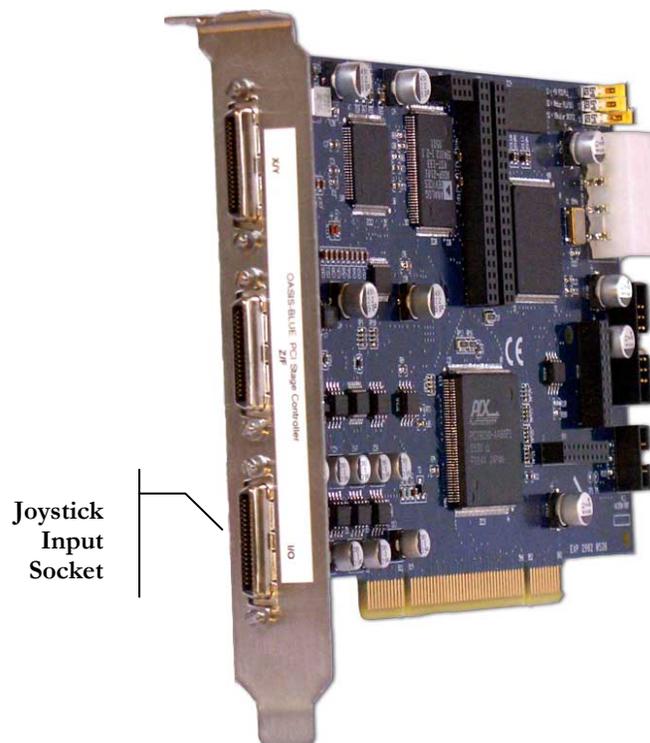


Figure 24. Connection of joystick to OASIS-blue controller.

Operation

There are three primary controls on the BLUE-JOY3 three axis joystick unit: the XY joystick, the Z focus digiknob and three push buttons.

The joystick controls X and Y movement of the stage, and speed of movement is proportional to the deflection via a cubic law, which means that small deflections should equate to a slow enough speed for high magnification work, whilst full deflection will drive the stage at full speed.

The digiknob controls the Z (focus) axis and here the speed of Z movement is proportional to the rate of change of rotation of the digiknob, so at slow rotational speed the Z motor appears to be 'locked' to the digiknob, but if turned faster then the Z motor will turn proportionally faster still, to ease the amount of turning necessary to adjust the focus over a long range.

The pushbutton on the top of the joystick handle acts as a sensitivity action for XY movements. When pressed, the joystick will automatically use the maximum available speed in the joystick deflection LUT (stored in flash), bypassing the sensitivity setting (see below). Therefore, an ideal configuration is to adjust the sensitivity for slower movements, allowing precise control for small movements since the XY sensitivity pushbutton provides convenient full-speed operation.

The pushbutton on the side of the unit near the focus digiknob is used to cycle through four pre-set focus sensitivities. At each press of the pushbutton, an LED on the top plate below the XY joystick handle will flash momentarily to indicate the current setting, i.e., the LED will flash once for sensitivity 1, twice for sensitivity 2, etc.

The third pushbutton on the top plate of the joystick unit, above the XY joystick handle is used to toggle shutter control line 1. Pressing once opens the shutter, while pressing a second time closes the shutter.

Power for the joystick unit is provided via the OASIS-blue board.

Software Control

By default, all three axes are enabled at power-up, and the direction of movement fixed. However, it is possible to enable or disable the axes individually, and change the direction of movement, using DLL function calls. Please refer to the DLL documentation on the installation CD for more information.

It is also possible to change the power-up conditions by altering the appropriate settings in the Flash memory. This may be achieved using either the OASIS Joystick Setup Wizard or the Flash Memory Setup application, both of which can be found in the \UTILS folder on the installation CD.

Adjusting Joystick Sensitivity using the Configuration Wizard

The joystick sensitivity may be adjusted using the Joystick Setup Wizard. See the section *Joystick Setup Wizard* in the *Configuring the OASIS-blue Controller* chapter for further details.

BLUE-EXPIO

The BLUE-EXPIO module is a plug-in daughter card providing a set of enhanced capabilities for the OASIS-blue controller.

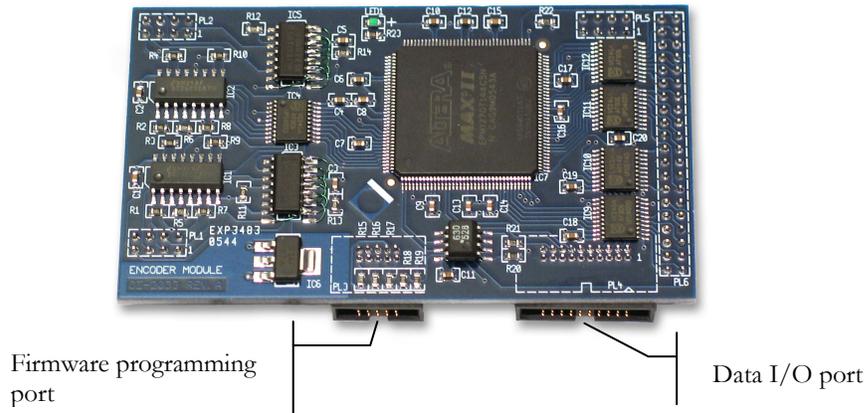


Figure 25. BLUE-EXPIO Encoder and Digital Trigger Module.

The BLUE-EXPIO offers:

- **Encoder Support.** The BLUE-EXPIO's 32-bit counters enable the use of encoder signals for all four axes of the OASIS-blue controller. Either RS-422 or straight TTL phase-quadrature encoder signals enter the OASIS-blue via the main axis connectors on the OASIS-blue and are then routed to the BLUE-EXPIO's 32-bit counters for use when reading position and performing closed-loop movements.
- **Digital Trigger I/O.** The BLUE-EXPIO enables the use of digital trigger I/O capabilities for the OASIS-blue controller. When used with encoded stage and focus drives, the BLUE-EXPIO offers encoder-based trigger output capabilities for highly accurate trigger synchronization.

To utilize the BLUE-EXPIO module, fit the module to the OASIS-blue control using sockets SK4, SK5, SK6 and SK7, as shown in Figure 26.

Configuration

The BLUE-EXPIO module's encoder settings may be configured either using the OASIS Configuration Wizard or the OASIS FLASH Memory Utility.

Please see the *Encoder Setup Wizard* above for instructions on configuring encoders using the wizard.

To configure the encoders using the OASIS FLASH Memory Utility, select the "Configure Microstepping and Encoders" option under utilities Edit menu.

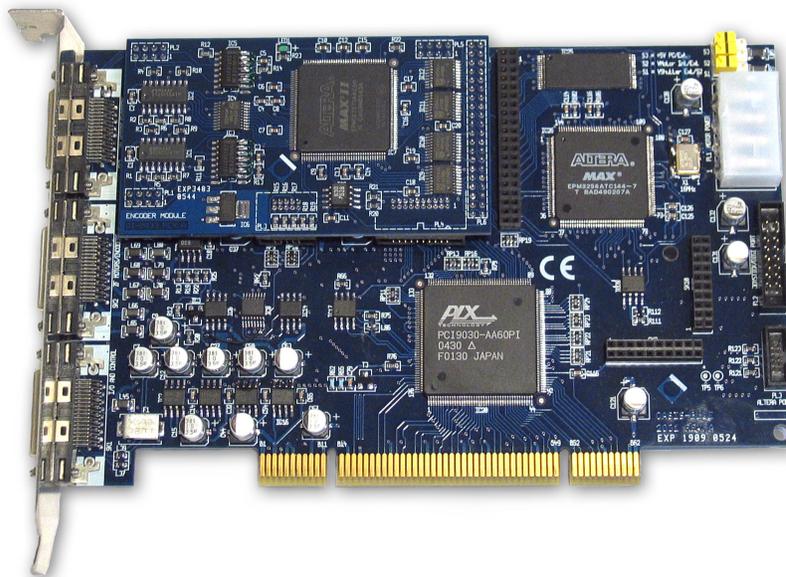


Figure 26. BLUE-EXPIO Module fitted to OASIS-blue controller.

PRINCIPLES OF OPERATION

This section reviews the basic principles of operation for the OASIS-blue controller. Topics covered include calibration of movements, microstepping resolution, speed and acceleration settings, physical vs. soft limits, and encoder support.

Calibration of Movements

The basis for motion operations performed by the OASIS-blue is control of the two phases of the stepper motor. By applying current to the phases in sequence, rotation of the motor is achieved. Using a technique called *microstepping*, the full rotation of the stepper motor can be divided into a number of discreet small steps. For instance, many stepper motors used in microscopy provide 200 steps per revolution. Using half-stepping, a controller can achieve 400 steps per revolution, or a resolution of 0.9 degrees per step.

The OASIS-blue controller by default is set to a resolution of 12,800 microsteps per revolution and can be configured with up to 51,200 microsteps per revolution.

For XY stages and Z focus drives, the revolution of the motor is translated to linear motion using a gearing device such as a lead screw. The OASIS software permits calibration of movement by indicating the pitch of the lead screw. When a 2 mm lead screw is used, for instance, the 12,800 microstepping gives 0.15625 microns per step (2000 microns per revolution, subdivided into 12,800 discrete microsteps). If 20,000 microsteps are used with a 2 mm lead screw, the smallest controller step size would be 0.1 micron.

Note that the controller resolution is independent from the mechanical accuracy and precision of the actual stage and focus drive hardware.

Speed and Acceleration

A commanded movement is performed by accelerating an axis to a top speed, cruising at that speed for a required length of time, then decelerating as the destination position is approached so that the axis is stopped at the target position.

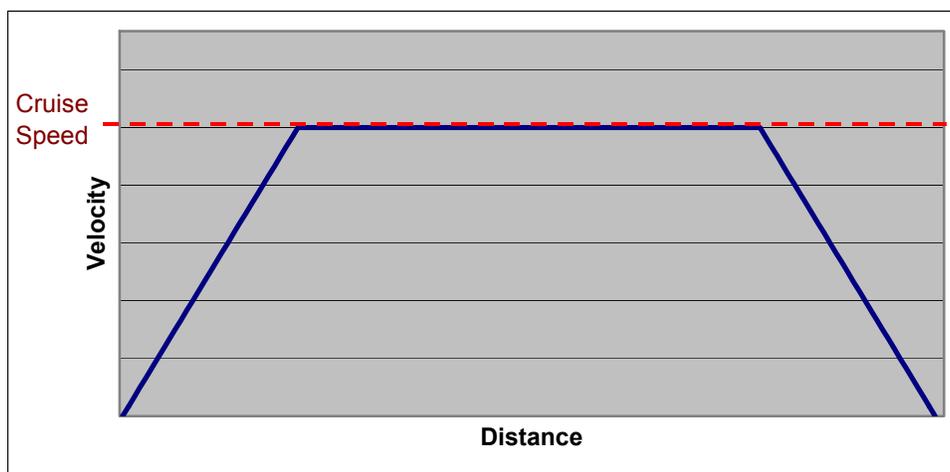


Figure 27. Speed vs. time for a typical move using linear acceleration.

Figure 27 shows a linear acceleration profile. The velocity increases linearly until a given cruising speed is reached. Once the target destination approaches, the axis is decelerated in a similar fashion in order to stop at the desired location. The job of the OASIS-blue controller is to determine the precise nature of this move to ensure accurate positioning.

Table 1. The first 7 entries in a linear ramp table.

Index	Timer Interval (microseconds)	Step Size (microsteps)
0	244	1
1	227	1
2	212	1
3	397	2
4	374	2
5	354	2
6	335	2

The OASIS-blue uses four pre-defined ramp profile lookup tables to define acceleration and deceleration. Each table consists of 512 values indicating a timer value and step size. By default, these tables are configured for Slow, Normal, Fast, and User-defined acceleration profiles and are normally referred to using these names.

Table 1 shows an example ramp table, showing a sequence of microsecond timer intervals and step sizes. The acceleration is performed by running through successive indices in the table after stepping the indicated steps size and waiting the corresponding timer interval.

In the example, note the transition from 1 microstep to 2 microsteps that occurs at index 3 and the corresponding increase in the timer interval to compensate. This is required in order to keep the timer interval above a 200 microsecond value, which allows for simultaneous servicing of up to five axes by the DSP.

Selecting the Table

Each axis independently uses one of the four pre-defined tables for its acceleration profile.

The default ramp table for each axis is stored in the Flash memory, and may be modified using the Flash Memory Setup application. The table may also be selected under software control, such as with the OASIS application or a 3rd party application that supports this feature of the OASIS-blue controller.

Defining the Table

Each of the four ramp tables is stored in the Flash memory of the OASIS-blue controller. The Flash Memory Setup application allows you to calculate new linear and S-curve tables, or specify your own individual table values, and save them to any of these locations. See the documentation for the Flash Memory Setup application later in this chapter for more information on defining your own ramp tables.

Cruising Speed

The cruising speed defines the maximum speed at which a given axis will be driven. The OASIS-blue controller allows you to specify the desired cruise speed separately for each axis. The cruise speed is a value between 0 and 511, which corresponds to the desired maximum index to use in the acceleration ramp table associated with that axis.

For example, a cruise speed of 300 means that the controller will ramp up to index 300 in the acceleration ramp table, and then continue to drive at the rate found at index 300 until deceleration is required near the final destination.

The default cruise speed for each axis is stored in the Flash memory, and may be modified using the Flash Memory Setup application.

Physical and Soft Limits

As mentioned above, the coordinate system for each axis is defined in units of microns. Each axis has a range of travel, which is defined by both negative and positive software limit values. In cases where hard limit switches are fitted, as with a motorised XY stage, an automatic initialisation may be performed to search for these limit switches in X and Y.

Figure 28 gives a graphical example of the physical situation. A motor is connected to a lead screw that is used to convert the rotational motion of the motor into a translation of a device such as a XY stage. The physical, hard limit switches are found near the end of the physical limits of travel. Within that range are the software limits, defining the range in which the controller allows movement. An axis origin defines the 0 position value, to which all other positions are referenced. In reality, the range of travel is broken down into a larger number of very fine steps, corresponding to the microstepping resolution of the motor controller.

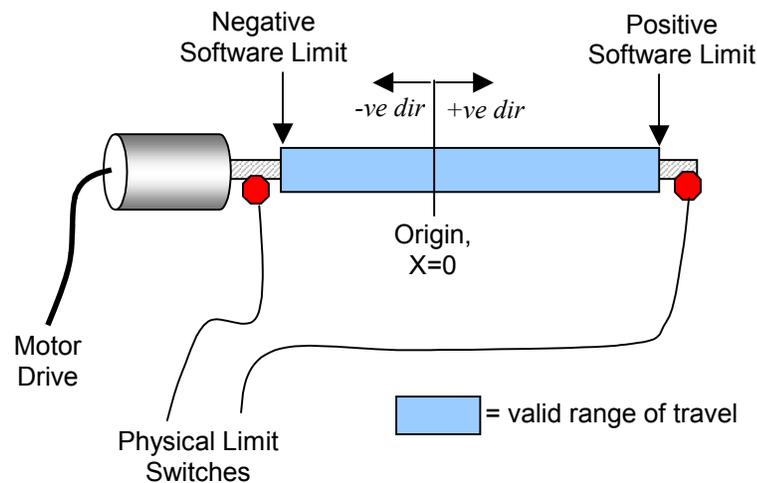


Figure 28. Physical and software limits, with range of travel.

Stage Initialization and Soft Limits

Most XY stages are fitted with physical limit switches at the positive and negative ends of travel for each axis. The available range of travel for each axis therefore can be determined by driving towards the physical limits and measuring the travel available between the limits at each end. This *initializes* the stage travel, after which the position of the stage relative to the range of travel is known.

The stage initialization provided by the OASIS software also automatically sets the software limits just inside the physical limit positions. The size of this margin between the software and hardware limits is based on the current cruise and ramp to ensure there is enough time to decelerate without hitting the physical limits once the software limit is encountered.

Focus Initialization and Soft Limits

In many cases, retrofit focus motors do not have hard limits, but instead simply wind the fine focus mechanism clockwise and counter-clockwise without the protection of end of travel limit switches. This can be problematic as eventually a hard stop will be encountered, possibly with damaging results, for instance, if the specimen is driven into the objective lens.

The OASIS-blue software supports focus initialization for setting the focus origin and soft limits for travel to help prevent out-of-range movements.

1. Sets the current position to the origin ($Z=0$);
2. Sets the positive software limit a given micron distance above the current position;
3. Sets the negative software limit a given micron distance below the current position.

The physical situation is illustrated in Figure 29.

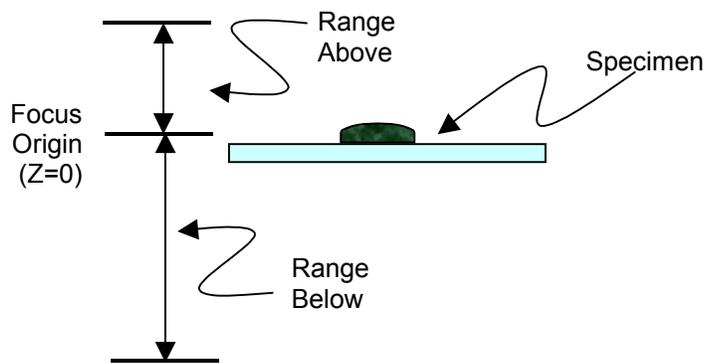


Figure 29. Focus initialization.

This configuration, where the focus origin is considered the nominal in-focus position and specific ranges of travel are defined above and below that, works well for microscopy applications, where consideration must be given to prevent large movements that may damage the specimen or the optical system.

Maximum allowed move protection

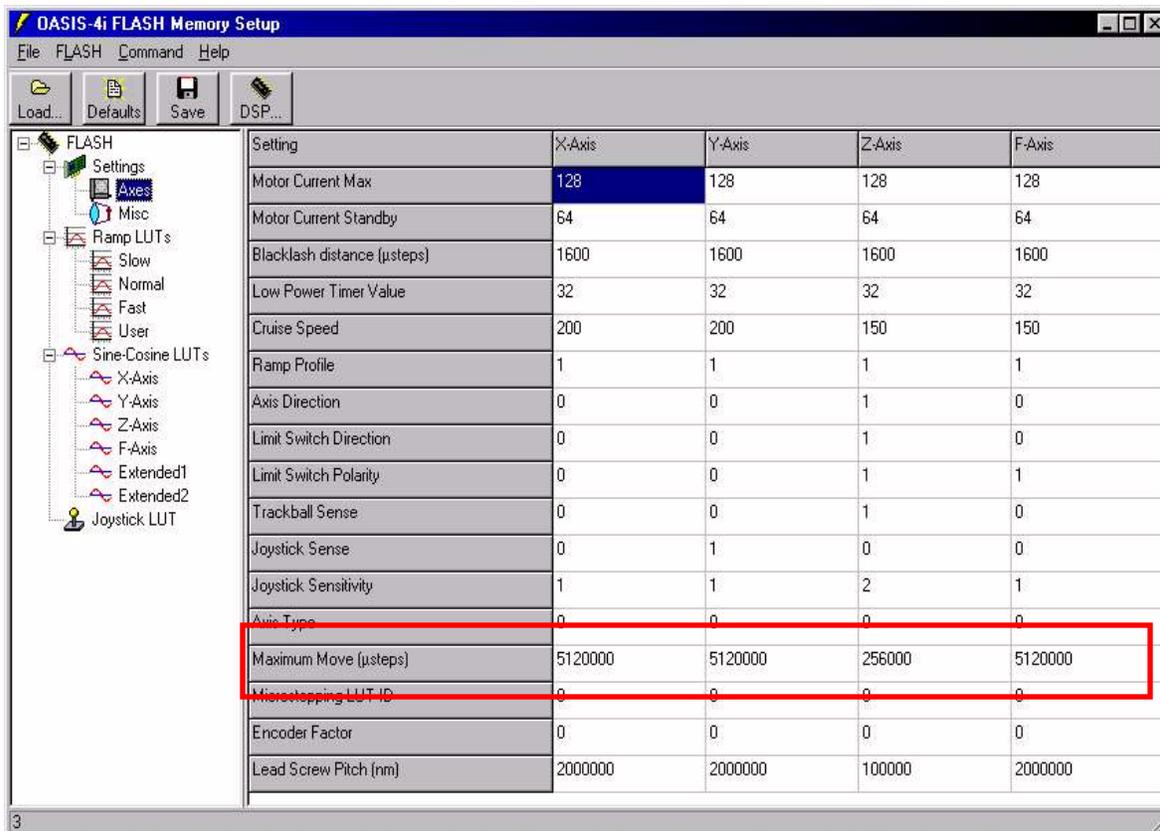
In order to further protect against large movements that may damage the specimen or optical components of a microscope, the OASIS-blue controller also uses a 'Maximum Move' value, which is a microstep value the DSP uses to reject large move requests. The actual Maximum Move value is set in the Flash memory.

This method helps prevent physical collisions when for instance in a situation where the software limits have not been properly set and a very large move has been called, for example, in cases where the Z axis has not been initialised and is in an unknown state. A call to move to an absolute position may in such a case result in a very large movement, potentially causing damage to the specimen or the optical system. If such a move is beyond the Maximum Move value, the DSP refuses the move, i.e., the axis is not driven at all.

Changing the maximum move value

The Maximum Move value is stored in the OASIS-blue flash memory. To change the value for the maximum allowed move on a given axis:

1. Close all applications that access the OASIS-blue controller.
2. Start the OASIS-blue Flash Memory Setup application.
3. Select the FLASH->Settings->Axes option in the left pane to reveal the settings for each axis.
4. Select the value under Maximum Move for the axis that you wish to change, and enter the new value, in microsteps.
5. Click Save on the main toolbar to write the settings to flash memory then shut down the OASIS-blue Flash Memory setup application.



Encoders

Encoders are position-sensing devices that provide feedback indicating movement of a sensor relative to a scale. Encoders may be fitted to a given axis in order to provide an independent feedback mechanism to sense manual movements of the axis (for instance if the stage hardware permits turning by hand) and also may be used during movements to ensure accuracy of positioning.

The OASIS-blue controller accepts TTL and, using optional interfaces such as the Interface Kit for Ludl Systems, RS-422 encoder inputs and may be configured to use these to perform closed-loop operations. The setup of the encoder parameters is accomplished in either the OASIS Encoder Wizard or the Flash Memory Setup application. Please refer to these applications' documentation for further details on properly configuring the controller for using encoders.

For accurate stepping, it is important to ensure the microstepping resolution is some multiple of the encoder resolution, and the Flash Memory Setup application allows you to select from various microstepping resolutions in order to achieve the appropriate ratio for a given encoder. The OASIS Encoder Wizard will automatically select the appropriate microstepping resolution for your encoder situation.

For instance, if an encoder with 0.1 micron resolution is fitted to an axis with a 2 millimetre pitch lead screw, then the microstepping resolution should be set to 40,000 steps per revolution to ensure a 2:1 ratio of microsteps to encoder inputs.

Enabling Encoder Inputs

A secondary counter in the OASIS-blue controller, maintained in addition to the normal microstepping position counter, manages encoder inputs. Closed-loop operation is achieved when the OASIS-blue controller uses the encoder input counter to correct the position information maintained by the microstepping counter.

If an encoder has been configured for an axis, the use of the encoder input signals may be enabled or disabled via software.

When encoder inputs are enabled, all position readouts are given based on the encoder input counter. Therefore the position information is given by the encoder resolution rather than the microstepping resolution. For instance, if a 2 mm pitch axis is configured for 40,000 microsteps per rev and a 0.1 micron encoder is also fitted and enabled, the position values will be provided to the nearest 0.1 micron, rather than the 0.05 micron resolution of the microstepping.

For the X, Y, and Z axes, you can specify via application software whether the encoders are used to perform closed-loop position maintenance. In closed-loop mode, the OASIS-blue controller uses the encoder feedback to ensure that movements are made to within a specified tolerance. Also, the controller will 'servo' the current position, using the encoder signals to ensure that the current position is not changed by any external forces (other than controller movement commands or joystick-type of inputs).

In some high resolution applications where the accuracy and precision of motion is a high priority, such as with the Objective Imaging Surveyor software for fast mosaic imaging, the use of linear encoders on each axis of stage travel is highly desirable.



TROUBLESHOOTING GUIDE

<i>Problem</i>	<i>Possible Causes</i>	<i>Solution</i>
OASIS-blue card not detected by Windows; Plug-and-Play does not find OASIS-blue card	<ul style="list-style-type: none"> • Card not fully seated into PCI slot • Conflict with another card on PCI bus 	<p>Ensure card is fully seated into PCI slot along entire length</p> <p>Move OASIS-blue card to another free PCI slot</p>
OASIS-blue card is listed as an unknown PCI device in Windows Device Manager	<ul style="list-style-type: none"> • OASIS-blue driver not installed 	<p>Perform driver installation procedure</p>
My 3 rd party application software cannot recognize OASIS-blue card	<ul style="list-style-type: none"> • OASIS-blue driver not installed • Application's support library for OASIS-blue card not installed 	<p>Perform driver installation procedure</p> <p>Run application's motorized controller installation procedure; refer to the application documentation for further details</p>
My 3 rd party application recognizes the OASIS-blue card, but the motors are not working	<ul style="list-style-type: none"> • Motor power not connected • Motor cable connectors disengaged or faulty 	<p>Ensure OASIS-blue motor power connector is fitted with a power supply plug</p> <p>Ensure motors are connected fully fitted at OASIS-blue connector SK3 for stage and SK2 for focus, and at motor end of cables</p>

<i>Problem</i>	<i>Possible Causes</i>	<i>Solution</i>
	<ul style="list-style-type: none"> OASIS-blue is not properly configured for the type of automation hardware fitted 	Run OASIS configuration wizard to setup the card for your system
	<ul style="list-style-type: none"> Axis positions are outside the limits of travel 	Run OASIS configuration wizard or 3 rd party application options to initialize the axis coordinate system
The system is stalling when making movements	<ul style="list-style-type: none"> Insufficient power to motor drives Insufficient power to motor drives Insufficient power to motor drives The drive lead screw is damaged 	<p>Adjust maximum motor current using the OASIS Flash Memory Configuration utility</p> <p>Use parallel motor windings to increase current in motor phases</p> <p>Increase motor drive voltage using external 24V power supply</p> <p>Contact automation mechanics manufacturer for service details</p>
The XY stage does not halt when a physical limit is reached	<ul style="list-style-type: none"> Limit switch direction is incorrect for stage type 	Run OASIS configuration wizard to auto-detect limit switch direction and polarity
An axis is not moving the correct distance when attempting to step a known amount	<ul style="list-style-type: none"> Axis calibration incorrect The axis is stalling Encoder, if fitted, is configured incorrectly 	<p>Set axis pitch or step size using OASIS or 3rd party application software</p> <p>See troubleshooting section for stalling during movement</p> <p>Run OASIS configuration wizard for encoders or define encoder settings using OASIS Flash Memory Configuration utility</p>

<i>Problem</i>	<i>Possible Causes</i>	<i>Solution</i>
The Joystick is not working	<ul style="list-style-type: none"> Joystick not enabled 	Run the OASIS application and ensure that joystick control is enabled in the Stage, Settings tab and/or the Focus Settings tab.

If You Need Help

If your OASIS-blue controller was provided as part of an integrated solution, your first contact should be to your system vendor. They will be most familiar with your overall system and any specialized configuration details.

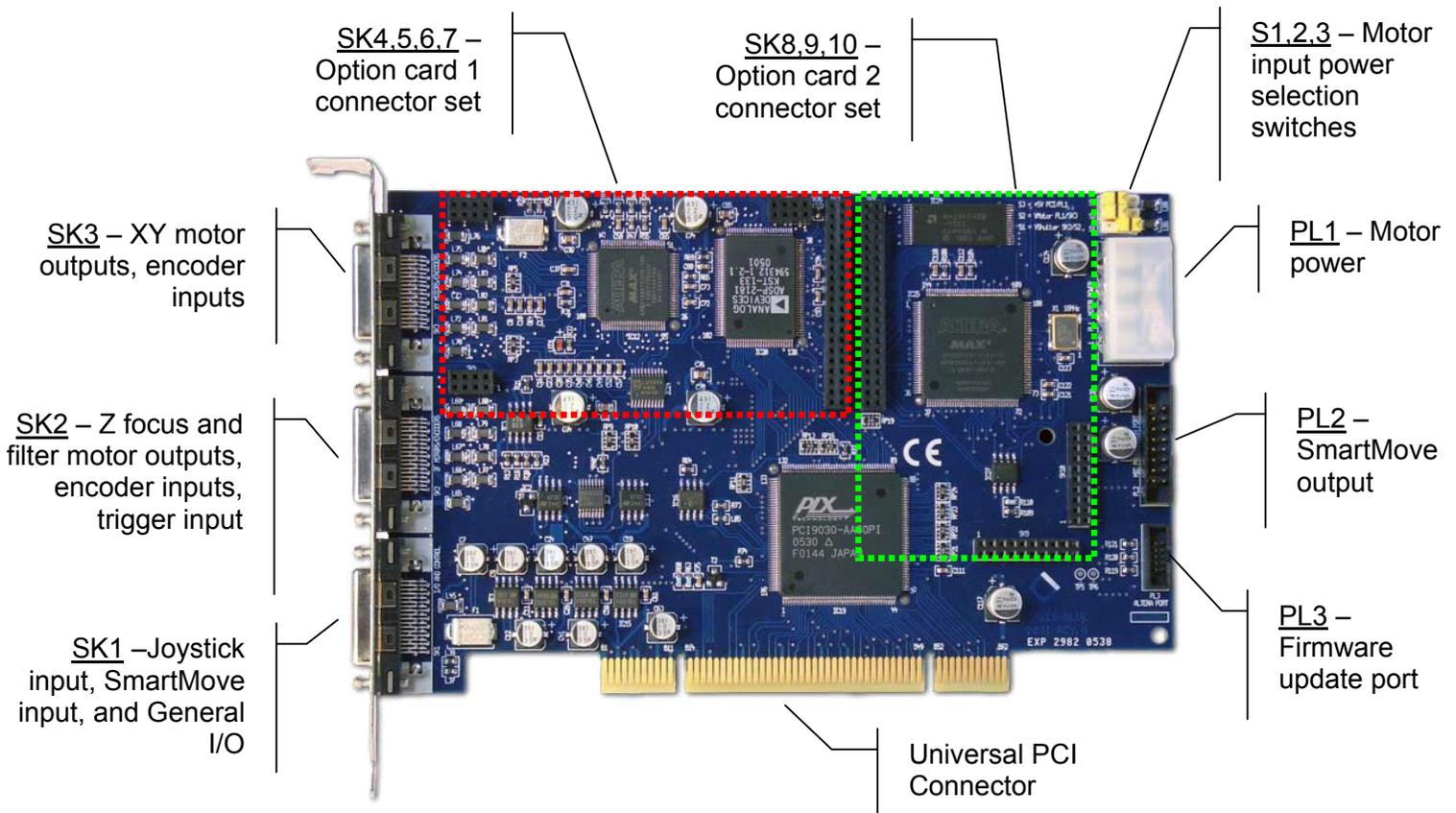
To contact Objective Imaging directly, please visit www.objectiveimaging.com for contact details for your area.

Appendix

B

CONNECTOR INFORMATION

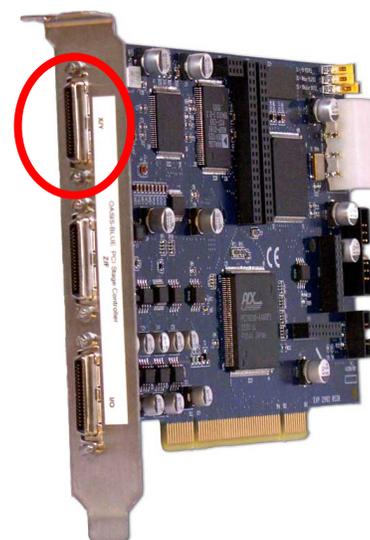
Refer to the following schematic for connector placement on the OASIS-blue card.



SK3: XY - 36W AMP

Socket SK3 on the OASIS-blue provides input and output signals for the XY stage. This includes:

- motor phase power outputs
- axis limit and home switch inputs
- RS-422 encoder signal inputs
- opto signal inputs
- general purpose outputs
- external motor power inputs
- general +5V and +1.8V power outputs



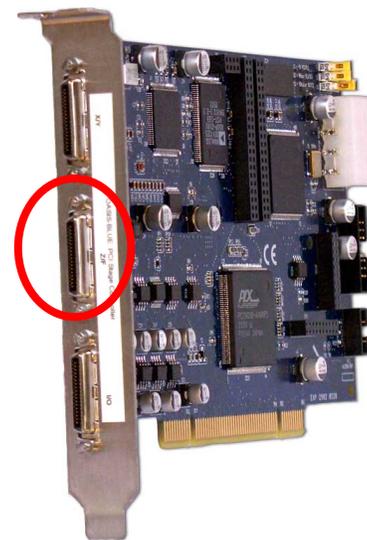
Socket SK3 pinouts are as follows:

Pin	Signal	Pin	Signal
1	0V	19	VMotor_In
2	X_PH2_Out	20	VMotor_In
3	X_PH1_Out	21	0V
4	X_PH1_In	22	Opto_Input1+
5	X_PH2_In	23	Opto_Input1-
6	Y_PH2_Out	24	GP_Output1
7	Y_PH1_Out	25	GP_Output2
8	Y_PH1_In	26	0V
9	Y_PH2_In	27	+1.8V
10	X_Limit+	28	X_Enc_A+
11	X_Limit-	29	X_Enc_A-
12	X_Home+	30	X_Enc_B+
13	X_Home-	31	X_Enc_B-
14	+5V	32	+5V
15	Y_Limit+	33	Y_Enc_A+
16	Y_Limit-	34	Y_Enc_A-
17	Y_Home+	35	Y_Enc_B+
18	Y_Home-	36	Y_Enc_B-

SK2: ZF - 36W AMP

Socket SK2 on the OASIS-blue provides input and output signals for the Z focus and a fourth axis (e.g., filter wheel). This includes:

- motor phase power outputs
- axis limit and home switch inputs
- RS-422 encoder signal inputs
- opto signal inputs (e.g., camera trigger inputs)
- shutter power outputs
- external shutter power inputs
- general +5V and +1.8V power outputs



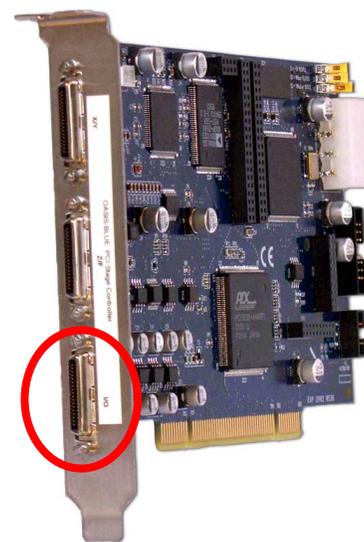
Socket SK2 pinouts are as follows:

Pin	Signal	Pin	Signal
1	0V	19	VShutter_In
2	Z_PH2_Out	20	VShutter_In
3	Z_PH1_Out	21	0V
4	Z_PH1_In	22	Opto_Input2+
5	Z_PH2_In	23	Opto_Input2-
6	F_PH2_Out	24	Shutter_Output1
7	F_PH1_Out	25	Shutter_Output2
8	F_PH1_In	26	0V
9	F_PH2_In	27	+1.8V
10	Z_Limit+	28	Z_Enc_A+
11	Z_Limit-	29	Z_Enc_A-
12	Z_Home+	30	Z_Enc_B+
13	Z_Home-	31	Z_Enc_B-
14	+5V	32	+5V
15	F_Limit+	33	F_Enc_A+
16	F_Limit-	34	F_Enc_A-
17	F_Home+	35	F_Enc_B+
18	F_Home-	36	F_Enc_B-

SK1: I/O - 36W AMP

Socket SK1 on the OASIS-blue provides input and output signals for the XY stage. This includes:

- joystick and button input signals
- general purpose I/O
- Leica SmartMove input / XYZ digiknob control inputs
- general +12V and +5V power outputs



Socket SK1 pinouts are as follows:

Pin	Signal	Pin	Signal
1	0V	19	Joy_Button_1
2	Video_In	20	Joy_Button_2
3	Video_Out	21	0V
4	X_Digi_A	22	Joy_Button_3
5	X_Digi_B	23	SnP_Button_4
6	Y_Digi_A	24	IDIO_In_1
7	Y_Digi_B	25	ID_Out
8	Z_Digi_A	26	IDIO_In_2
9	Z_Digi_B	27	+5VRef
10	SnP_Button_1	28	X_Joy_In
11	SnP_Button_2	29	Y_Joy_In
12	SnP_Button_3	30	IRQ
13	0V	31	DR0
14	+12V	32	+5V
15	SCLK0	33	I/O_1
16	TFS0	34	I/O_2
17	RFS0	35	I/O_3
18	DT0	36	I/O_4

OASIS-BLUE SPECIFICATIONS



Stepper Performance	
Axes	4 stepper, independently controlled with on-board drivers
Microstep resolution	Software selectable from 400 steps/rev to 51,200 steps/rev with 1.8° motor
Maximum speed	960 kHz (microsteps/s), 7.5 kHz (half-steps/s)
Minimum speed	32 Hz (microsteps/s), 0.0078125 Hz (half-steps/s)
Maximum peak motor current	0.5A to 1.50 A/phase in 6mA steps
Standby motor current	0.5A to 1.50 A/phase in 6mA steps
Standby motor current switchover time	0 to 2097 seconds in 32mS steps
Maximum motor supply voltage	+40V (typically +12V)
Minimum motor supply voltage	+10V
Command overhead (Move XYZ)	<10 µs
Controller Response time (Move XYZ)	<20 µs
Acceleration/deceleration profiles	4 preset user-definable tables (512 values per table), including linear and S-curve
Position counter resolution	32 bits
General	
Processor (DSP)	ADSP-2181
Processor clock frequency	32 MHz
Non-volatile memory	4-Mbit Flash for program and user configuration storage
Reset method	Hardware watchdog or software command (PC reset selectable as required)
Switch-on time	<1 s - fully functional
Bus Interface	
Type	Universal PCI 2.2 Compliant, 3.3V or 5V
Bus-type	Slave
Operating Frequency	to 33 MHz
System Safety	
Watchdog timer function	Resets board on processor fail or dip in +5V
Watchdog timeout period	1.6 seconds
Drive current limit	4A maximum per motor
Drive current limit response time	4 ms (typical)
Thermal shutdown	Yes - motor driver IC's in hardware or in software at user-definable temperature
Temperature monitor	Yes - monitors driver IC's heatsink plane
Drive voltage monitor	Yes - 0 - 50V
Hardware limit switch inputs	2 per axis, user definable N/O or N/C
Software limits	User-definable, any range within 2 ³¹ microsteps
Software	Stop individual or all axes command
Hardware	Opto-isolated input may be used to shutdown motor drive current
Maximum move size	User-defined from 1 to 2 ³¹ microsteps
I/O	
Encoder inputs	4 total (1 per axis) using optional Encoder Module
Encoder signals	Phase-quadrature TTL or RS422 using optional Encoder Module
Home inputs	4 total (1 per axis), TTL compatible with 1K pull-up to 5V
General Purpose I/O	4 TTL compatible input/output lines
General Purpose Inputs	2 Opto-isolated inputs, supporting interrupts to DSP
General Purpose Outputs	2 TTL compatible output lines
Dedicated Inputs	7 TTL compatible with 10K pull-ups to 5V, for input device buttons and switches, supporting interrupts to DSP
Synchronous serial port	Direct to DSP for further I/O expansion
+12V Output	Via 36-way I/O connector (resettable fuse protected 1.1A)
+5V Output	Via 36-way X/Y, Z/F and I/O connectors (resettable fuse protected 1.1A)
Analog port	2 x 8-bit A/D (joystick interface)

Phase-quadrature inputs	3 (for X, Y and Z axis control, digi-knob or trackball etc.)
Composite video input	1, with 75R termination (provides autofocus capability with optional Expansion Module)
Composite video output	1 buffered video 75R drive using optional Expansion Module
10-40V Motor power input	Input on XY 36-way Champ connector (SK3)
12-24V Shutter power input	Input on ZF 36-way Champ connector (SK2)
Shutter Control	
Outputs	2 Shutter outputs for Uniblitz(r) 25mm-35mm shutters
Minimum opening time	25 mS
Maximum opening time	Infinite
Programmable	Yes, software programmable timed opening periods from 25mS to 65535mS in 1mS steps
Power Requirements (Max)	
+5V (±5%)	1.75 A (via PCI connector)
+12 V (±5%)	100 mA (via PCI connector)
-12 V. (±5%)	50 mA (via PCI connector)
10-40V (motor supply)	PSU 1.0 x motor current x number of axes driven simultaneously. From PC or external
12-24 V (shutter supply)	2.0A x number of shutters driven simultaneously (current required only during 20mS pulse operation)
Connectors	
X/Y Drives and encoders	36-way Champ connector (SK3) with spring latch on front plate
Z/F Drives and encoders	36-way Champ connector (SK2) with spring latch on front plate
I/O Joystick, digi-knobs, TTL I/O etc	36-way Champ connector (SK1) with spring latch on front plate.
PL1 - Motor power	4-way male disk-drive power connector (normally connected to PC power supply)
PL2 - I/O Pass-through	16-way 2mm pitch IDS connector for pass through of I/O signals
SK4, 5, 6 and 7	2mm pitch connectors for mating with the Encoder Module
SK8, 9 and 10	2mm pitch connectors for mating with the Expansion Module
Physical Dimensions (not including front plate connectors)	
152mm x 97mm (6" x 3.8")	Smaller than a standard height short PCI card - 174mm x 106mm (6.875" x 4.2")
Environment	
Operating temperature	0 to 35° C (ambient)
Storage temperature	0 to 70° C
Relative humidity range	10 to 90% (non-condensing)

OASIS

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Objective Imaging Ltd.
The Bury, Newmarket Road
Stow cum Quy
Cambridge CB5 9AQ
Great Britain
www.objectiveimaging.com