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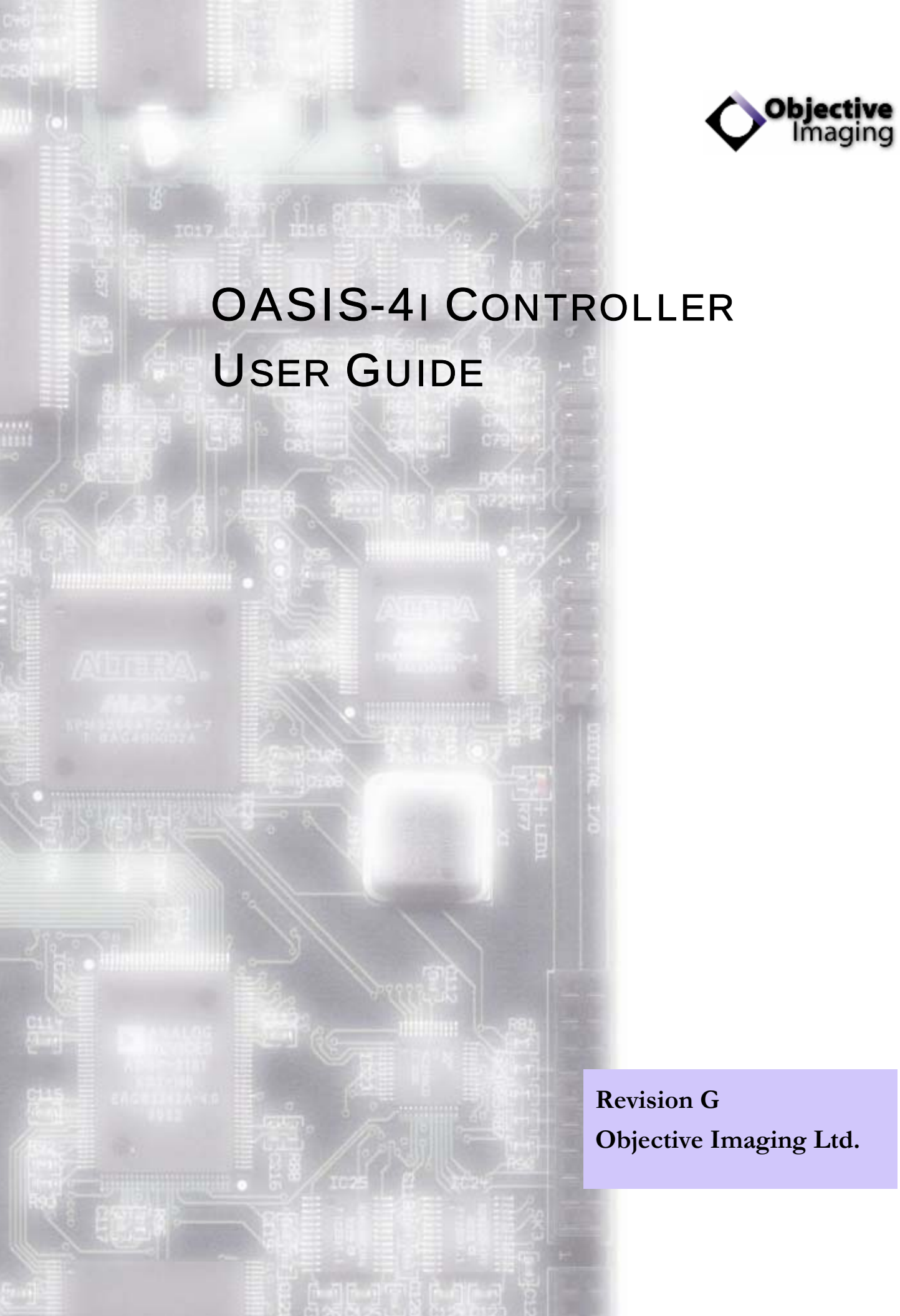
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OASIS-4i Controller User Guide

Revision G

Objective Imaging Ltd.

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Chapter

1

INTRODUCTION

Thank you for purchasing the OASIS-4i four axis stepper controller for the PCI bus! The OASIS-4i is an advanced, high-performance controller designed for the most demanding imaging and microscopy applications. The ¾ length PCI form factor of the OASIS-4i ensures a highly integrated solution for automation control.

This guide provides an overview of how to physically install the OASIS-4i card into your system, install the required driver software, and configure the controller for your particular setup. Various hardware options for the OASIS-4i card, such as joystick units and plug-in daughter modules, are also described.

Note that your OASIS-4i 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-4i Applications

The OASIS-4i 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., fluoresence

The OASIS-4i 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-4i to a particular configuration.

Optional components

Various hardware options are available to provide additional functionality, such as:

- Video autofocus, using the OASIS-AF plug-in daughter module
- Digital camera trigger synchronization, using the OASIS-DC1 module, for digital autofocus and fast mosaic imaging

- A 5th axis option, using the OASIS-XA1 module, providing for instance a second filter wheel control axis
- RS-422 encoder input interfaces
- Four axis shutter control, using the OI-SC4 external controller
- 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 controller family of products.

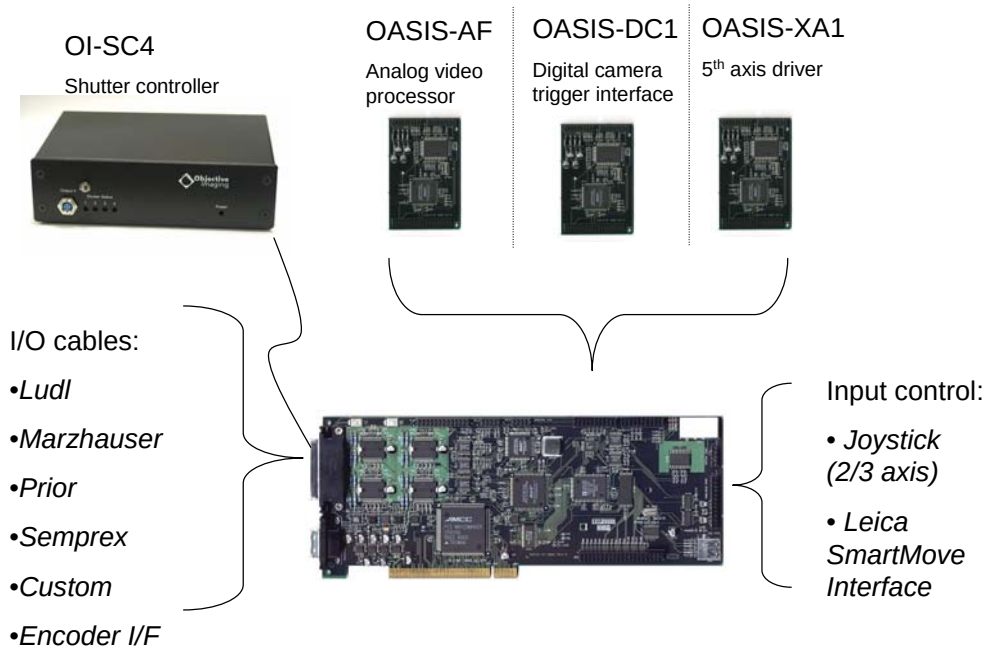


Figure 1. OASIS-4i controller and options.

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

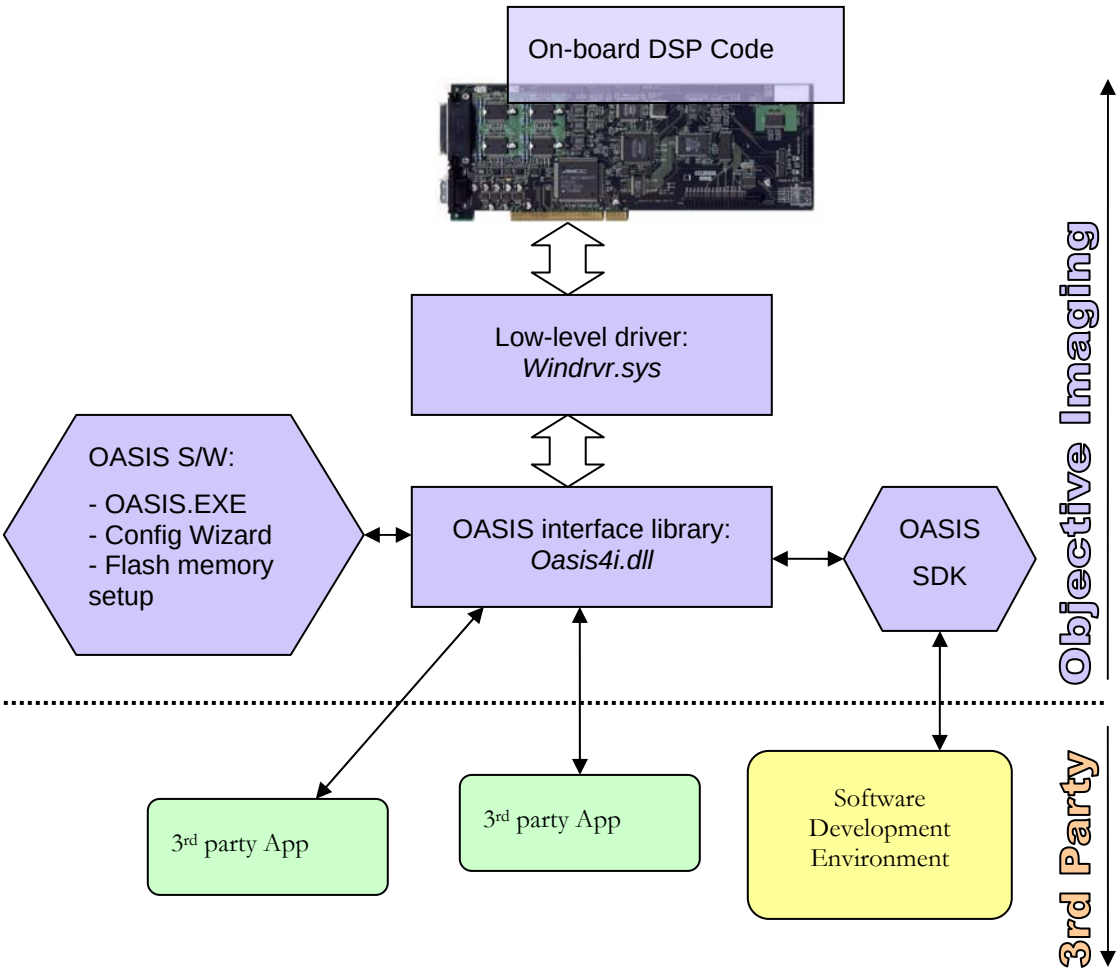
Software Structure

In addition to the physical hardware items associated with the OASIS-4i controller, there is also a corresponding software architecture. 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-4i 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-4i controller.

The figure below illustrates the OASIS software architecture:



You can see there are three critical software components that are used by the OASIS-4i controller:

1. On-board DSP code that provides the fundamental controller functionality.
2. A low-level driver called *Windrvr.sys* that provides PCI communication support between your computer and the OASIS-4i card.
3. The *Oasis4i.dll* dynamic link library (DLL) file that exposes the functionality of the OASIS-4i controller to software applications on your computer.

All three of these components—one on the OASIS-4i card itself and two on the associated Windows PC—make up the necessary foundation for your use of the OASIS-4i 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-4i controller. These include:

- **OASIS Configuration Wizard**. This utility guides you through the fundamental steps of configuring the OASIS-4i controller for your particular hardware setup.
- **OASIS Flash Memory Setup application**. This utility gives you access to the full settings available in the OASIS-4i'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 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-4i 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-4i controller. The OASIS SDK is documented in detail in the *OASIS-4i Automation Controller Software Library Reference Manual* ('OASIS4I_DLL_Manual.pdf') included on the OASIS-4i installation CD.

Chapter

2

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-4i card into your system, you will need the following:

- PC with one three-quarter length PCI slot available
- Windows® XP, Windows® 2000, Windows® 95/98/Me, or Windows® NT4.0 operating system
- CD-ROM drive
- One free (hard disk style), power connector, with 2A at 12V available
- Cross-head screwdriver
- OASIS-4i Installation CD

Installation Process

The OASIS-4i installation process consists of three distinct steps:

1. **Hardware Installation**. In this step, you will physically place the OASIS-4i 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-4i card to match your particular system setup.

Once these steps are complete, the OASIS-4i 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-4i 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-4i.

Connector Identification

Refer to the following diagram for information regarding the various connectors available on the OASIS-4i card.

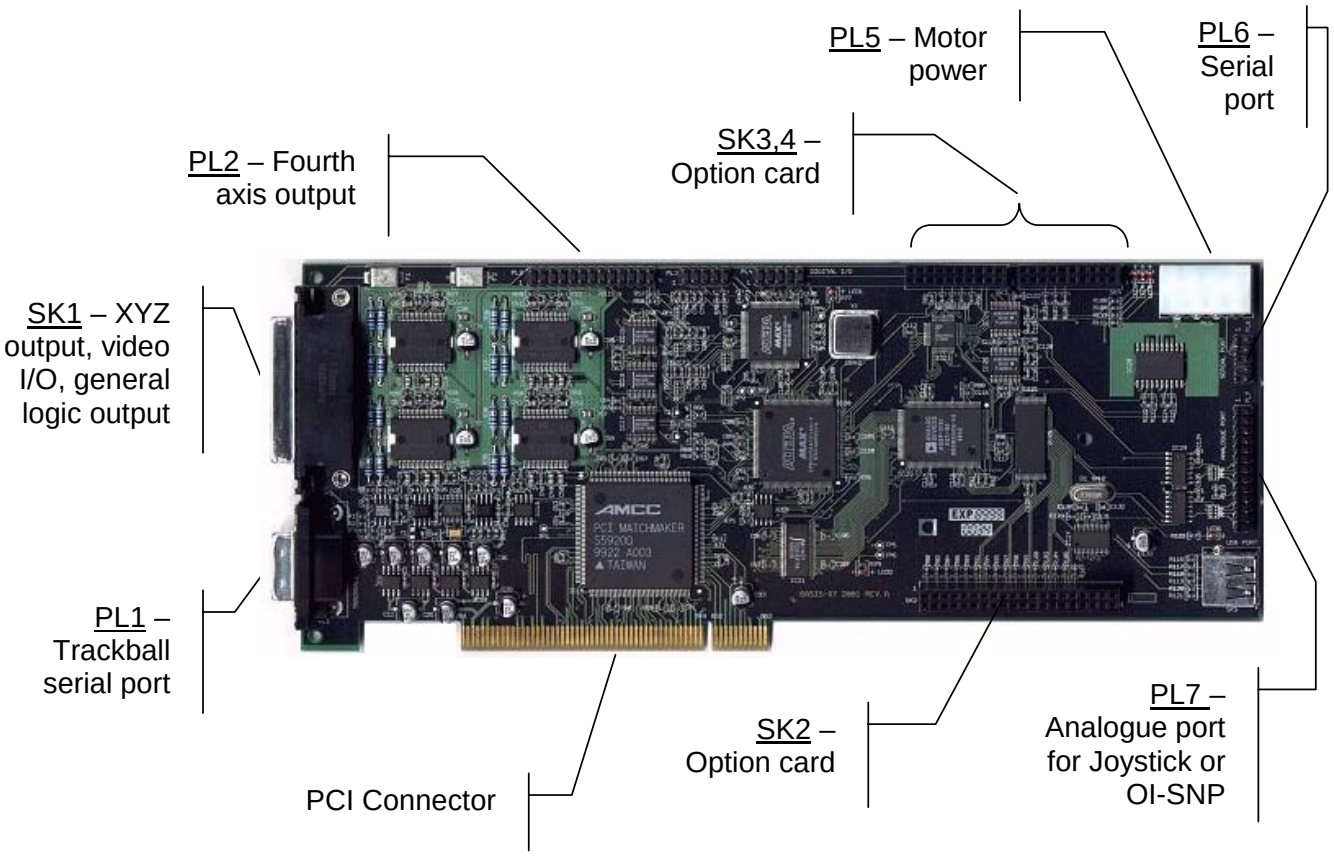


Figure 2. OASIS-4i Connectors.

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 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

8a) If intending to use the 4th axis, you will need to fit an adapter plate to another spare slot and the interconnecting cable to PL2 the 4th axis output. Be careful to attach pin 1 of the ribbon cable (with the red stripe), to pin 1 of PL2, which is marked on the board (towards metal bracket).

8b) If fitting a joystick or OI-SNP (Leica SmartMove interface), you will need to fit an adapter plate to another spare slot and the interconnection cable to PL7, the Analogue Port. Be careful to attach pin 1 of the ribbon cable (with the red stripe), to pin 1 of PL7, which is marked on the board (towards the power connector).

8c) If intending to use the OASIS-XA1 5th axis module, please refer to the OASIS-XA1 documentation for connection details.

8d) If intending to use the OASIS-DC1 module, please refer to the OASIS-DC1 documentation for connection details.

9) Connect a spare power connector from the PC power supply to PL5 at the rear of the board. Preferably the OASIS-4i 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.

Making external connections

10) Replace PC system cover or side panel.
11) If using a Kensington Expert Mouse 5.0 serial trackball or other serial control device, connect it to PL1, the 9-pin trackball serial port below the 44-way main connector.
12) Connect the appropriate cable from SK1, the 44-way XYZ and video in/out connector, to your desired XY stage, focus adapter (Z) and video source as required. Notice that this 44 way connector is keyed to prevent insertion of an incorrect cable.
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-4i card may be applying power to the motors, in which case a connection or disconnection could damage the OASIS-4i card.

Driver Installation Procedure for Windows2000/XP

1) Switch on PC and boot into Window.
2) The 'Add New Hardware Wizard' should appear.
3) Select 'Search for best driver for your device' and press next.
4) Insert OASIS-4i installation CD into your CD-Rom drive and select 'Specify a Location' with 'D:' as the source for the driver. (Where D: is the CD-Rom drive letter).
5) Windows should find 'OASIS-4i : 4-axis PCI Stage Controller'. Press next.
6) After the driver and DLL have been copied to the relevant directories, press 'Finish'.
7) Re-boot the PC before operation of the board and/or installation of the SDK or other software.
8) A 'WinDriver Virtual Device' may be found after a re-boot. If so, a suitable driver is included in the 'Drivers' folder of the OASIS-4i installation CD.

Driver Installation Procedure for Windows 98/Me

1) Switch on PC and boot into Window.
2) The 'Add New Hardware Wizard' should appear.
3) Select 'Search for best driver for your device' and press next.
4) Insert OASIS-4i installation CD into your CD-Rom drive and select 'Specify a Location' with 'D:' as the source for the driver. (Where D: is the CD-Rom drive letter).
5) Windows 98 should find 'OASIS-4i : 4-axis PCI Stage Controller'. Press next.
6) After the driver and DLL have been copied to the relevant directories, press 'Finish'.
7) Re-boot the PC before operation of the board and/or installation of the SDK or other software.

Driver Installation Procedure for Windows NT

1) Boot into Windows.
2) Run the program called 'Oasis4i_Setup.exe', which is located in the root directory of the CD. This will install, register and start the driver.
3) It will be necessary to re-boot before using the board or installing the SDK or other software.

Chapter

3

CONFIGURING THE OASIS-4I CONTROLLER

The OASIS-4i 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-4i controller must be configured accordingly. Most of these configuration settings are stored in the onboard flash memory of the OASIS-4i 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-4i 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-4i 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-4i controller.
- **DSP**. This reports the current DSP code revision running on your OASIS-4i controller.
- **DLL**. This displays the current version of the OASIS-4i DLL installed on your computer.

- **Option Card**. If an option card is installed on your OASIS-4i controller, the type of card will be displayed, as well as additional information relevant to the type.

When installing an OASIS-4i card, you would typically run each wizard in turn to ensure proper configuration for your setup.

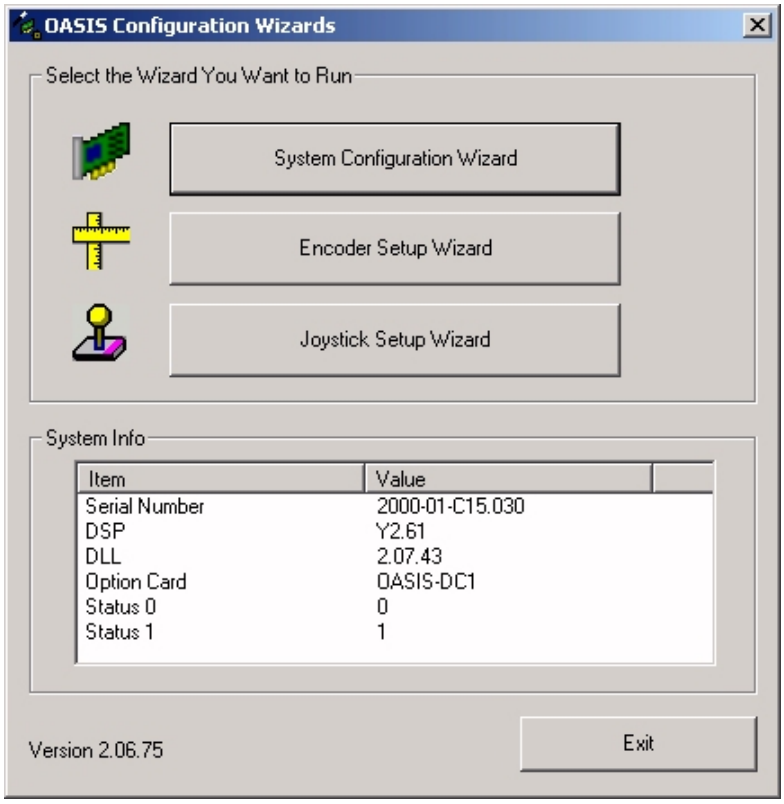


Figure 3. OASIS Configuration Wizards

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-4i 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.

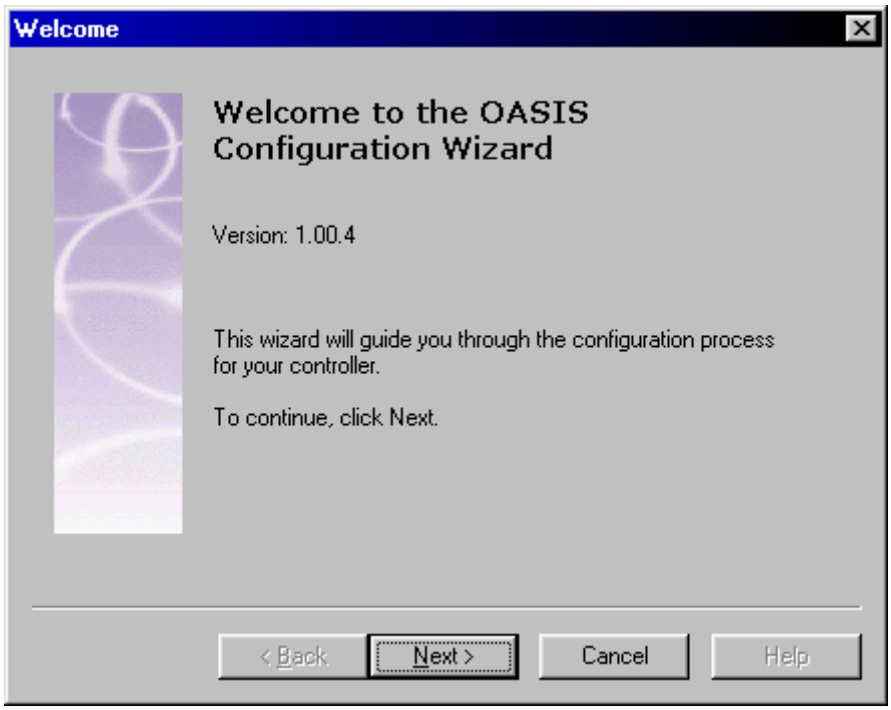


Figure 4. OASIS System Configuration Wizard.

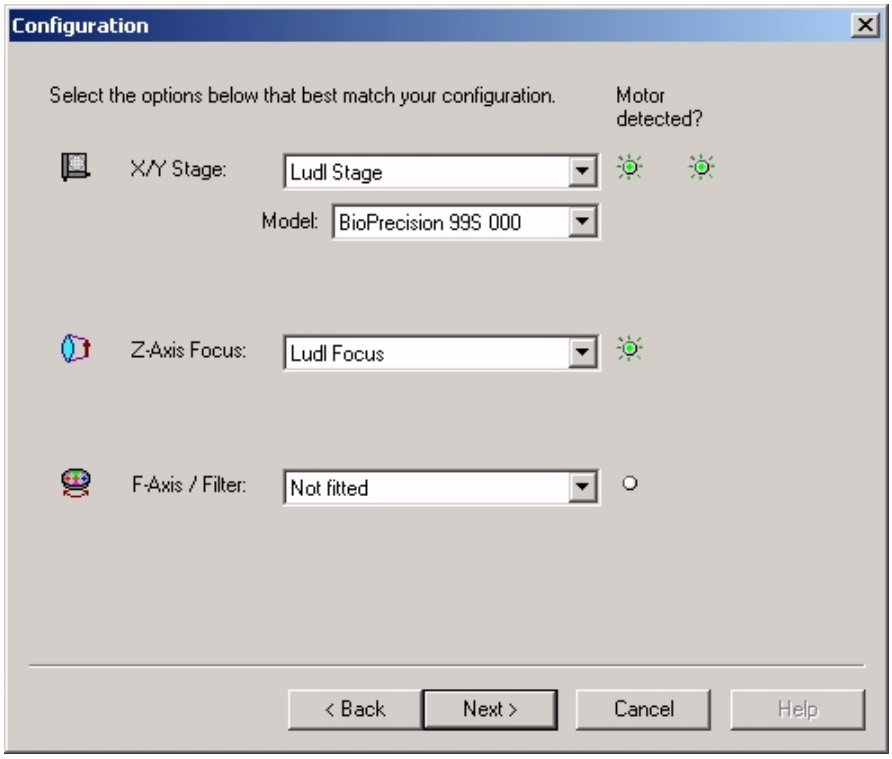


Figure 5. Overall system configuration.

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.

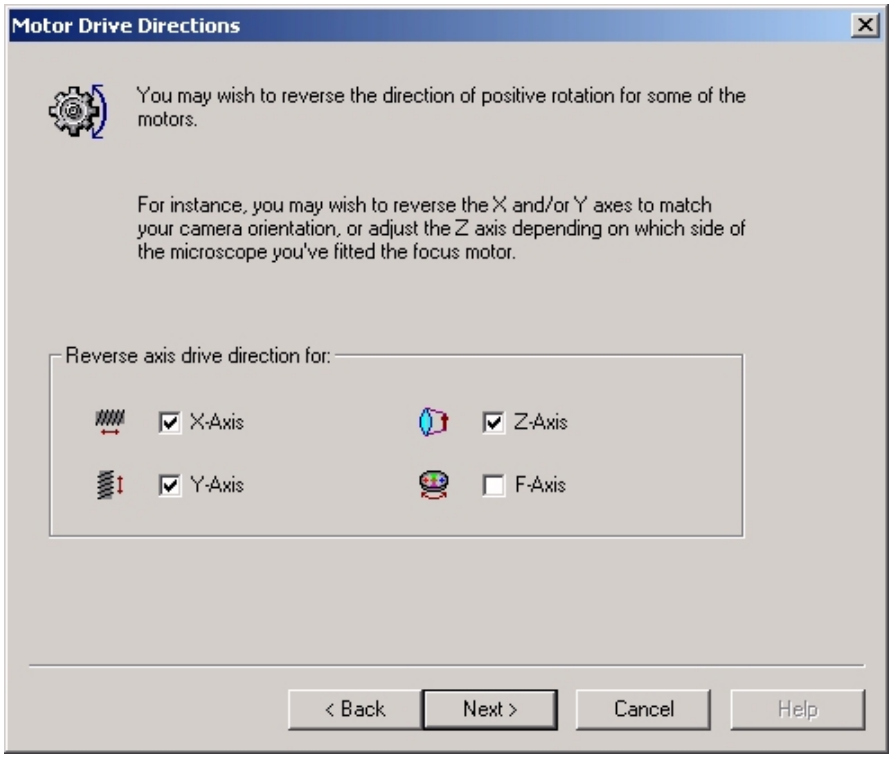


Figure 6. Setting the drive direction.

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-4i controller. See the section below, *Speed and Acceleration* in the *Principles of Operation* chapter for further information regarding acceleration ramp tables.

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.

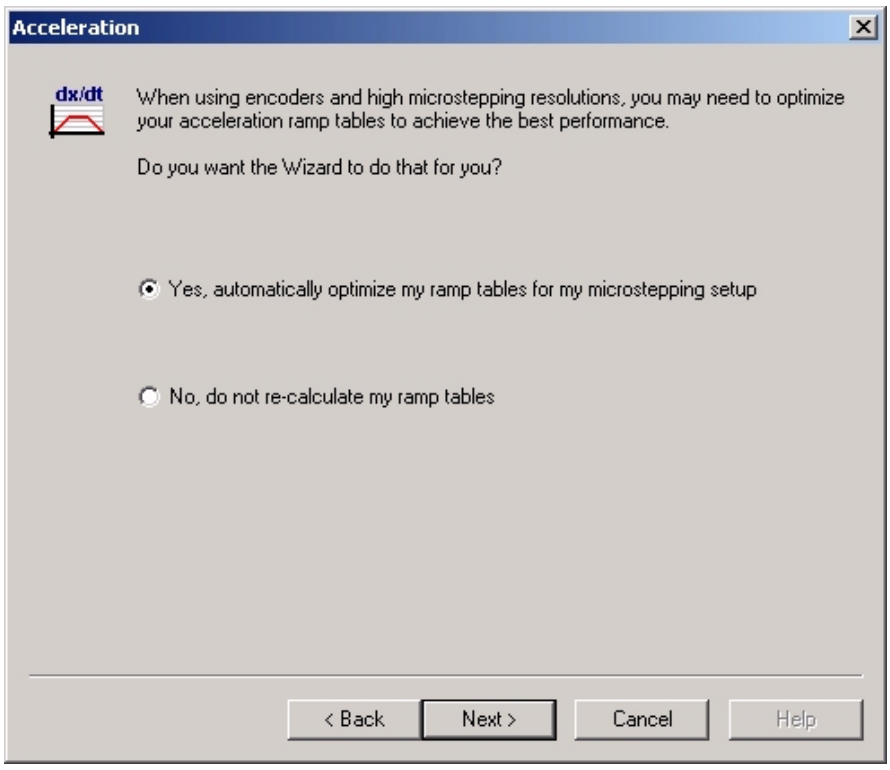


Figure 7. Automatic ramp calculation.

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

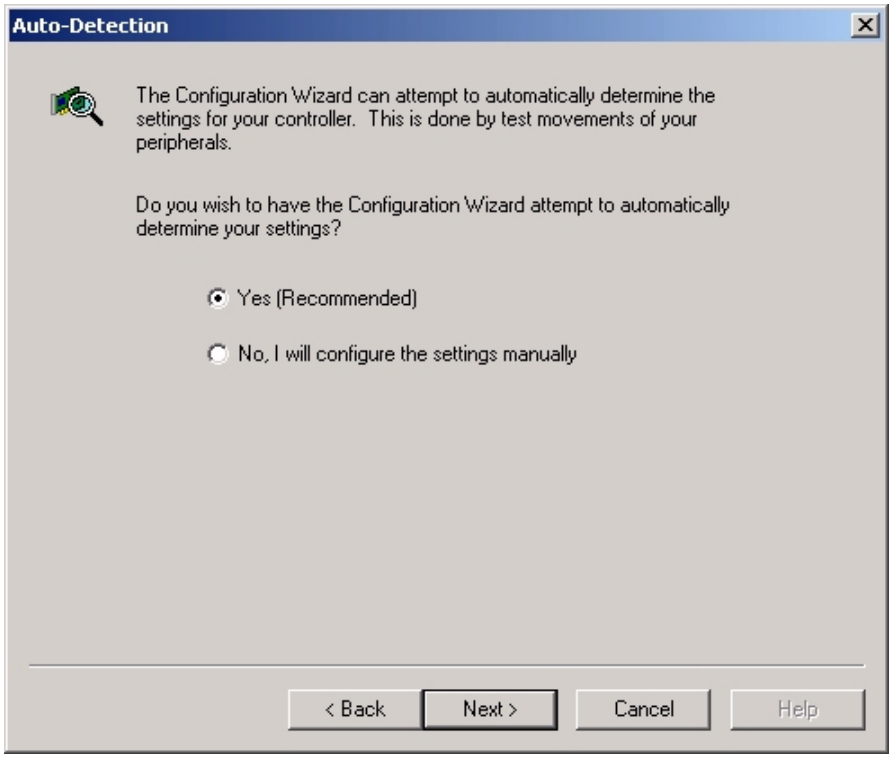


Figure 8. Auto-Detection selection.

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.

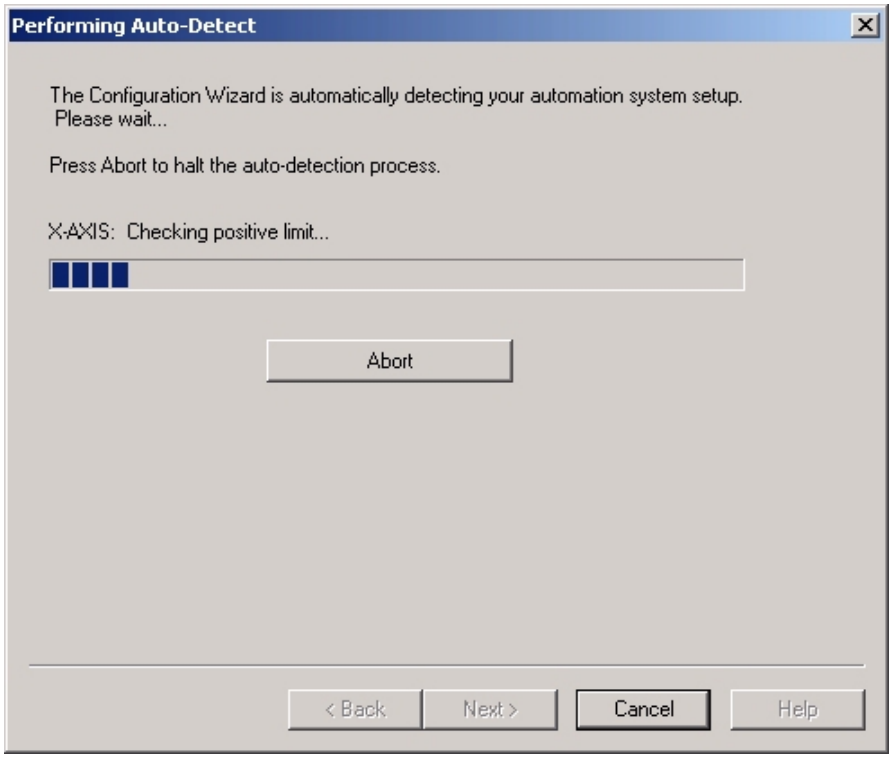


Figure 9. Auto-detection in progress.

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.

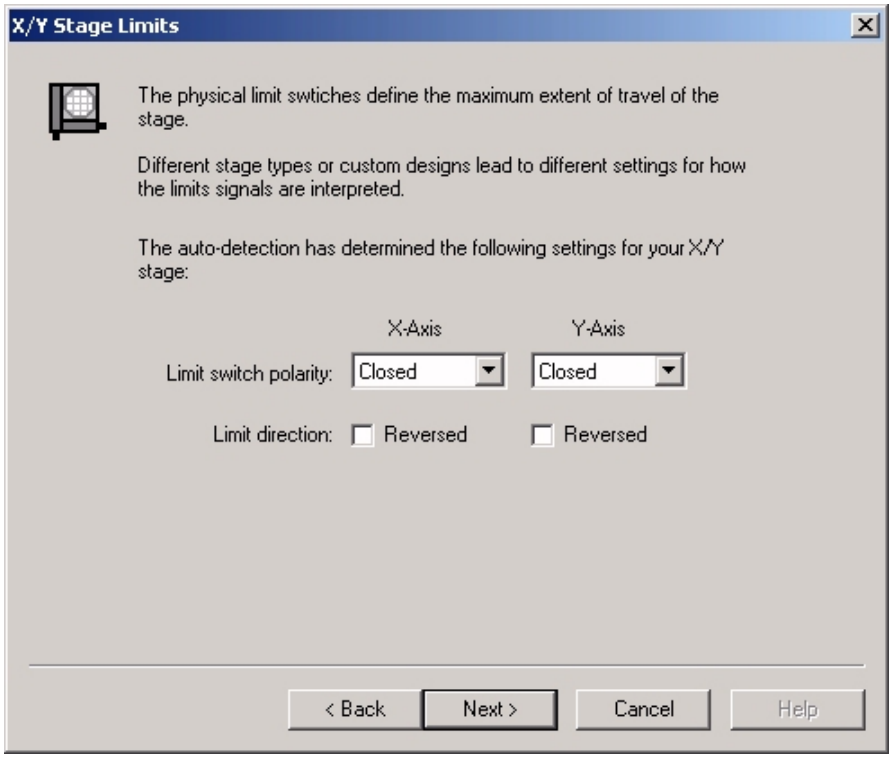


Figure 10. Stage settings showing limit switch definition.

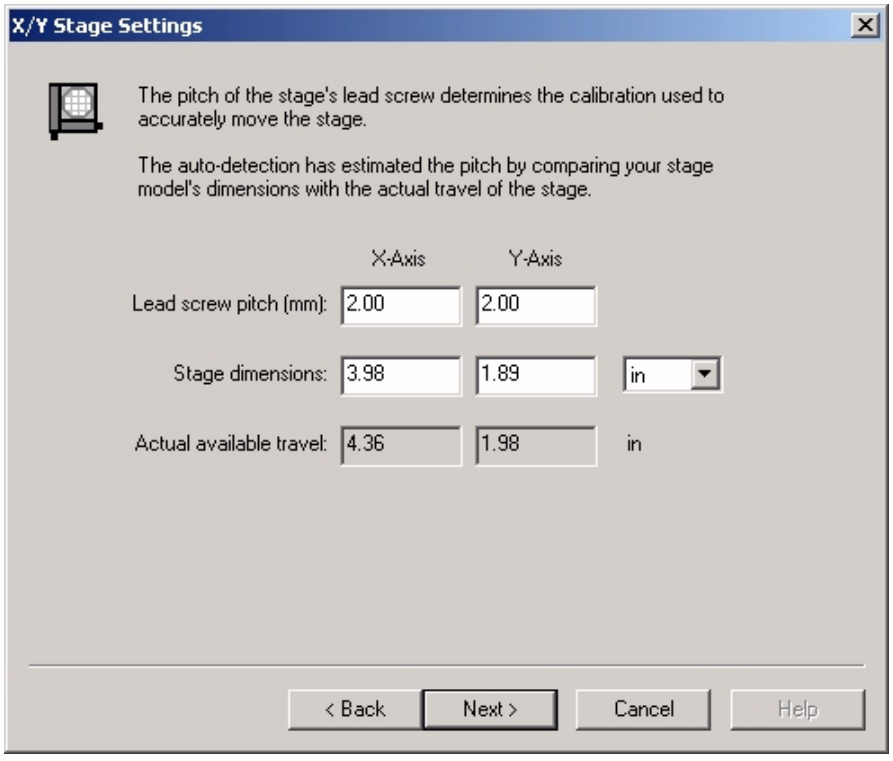


Figure 11. Stage settings show estimated lead screw pitch and available travel.

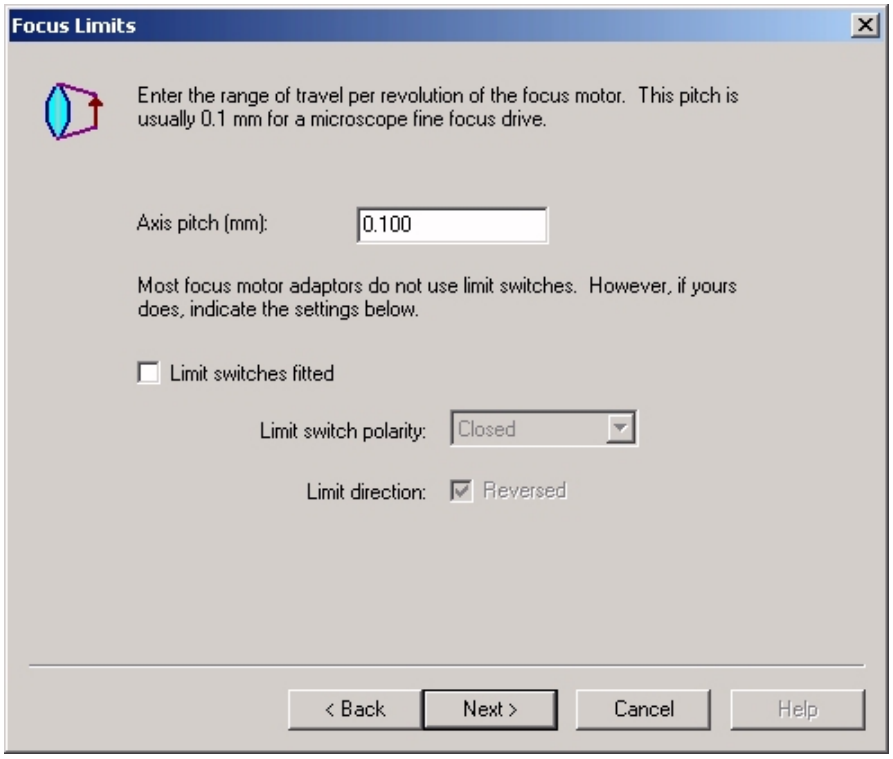


Figure 12. Focus settings, including pitch and limit settings.

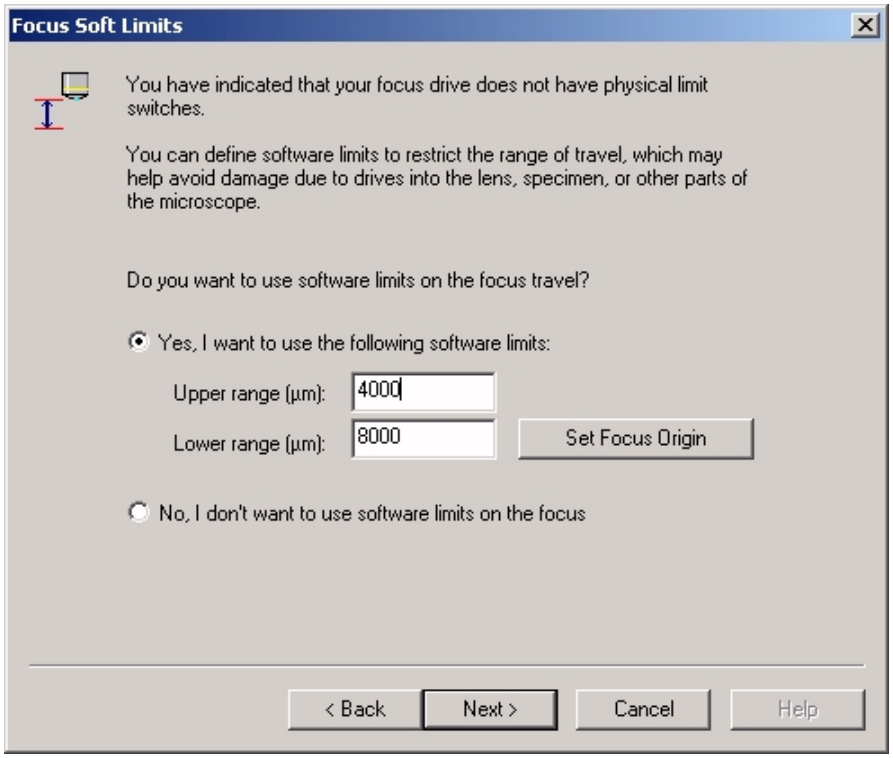


Figure 13. Focus soft limit definition.

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.

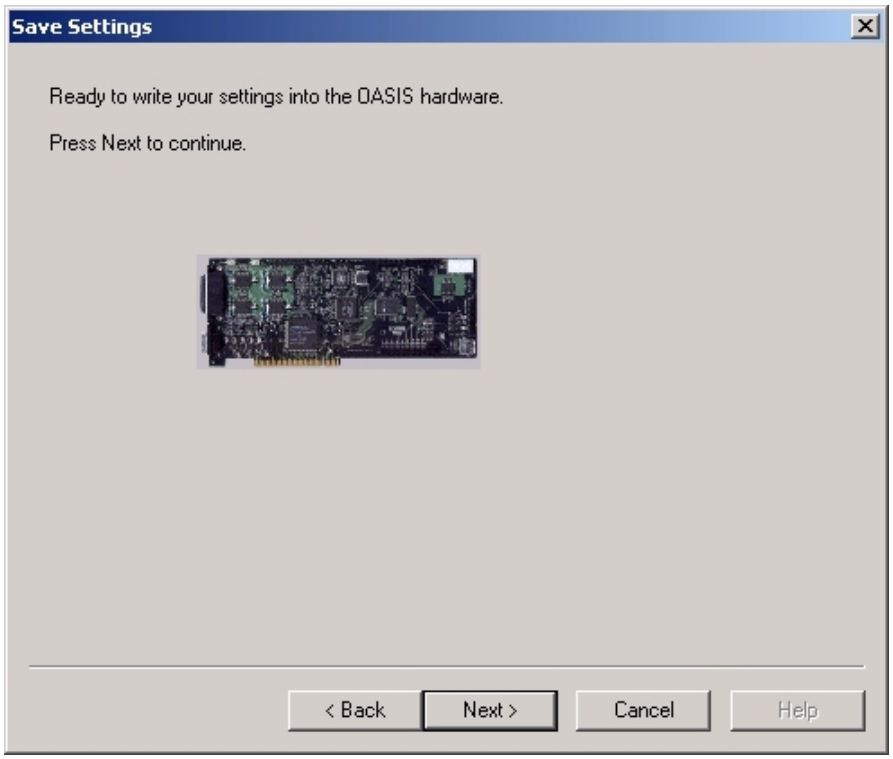


Figure 14. Writing the changes to flash memory.

The final step of the wizard writes the changes made to your configuration into the flash memory of the OASIS-4i controller (Figure 14). Once the flash is updated, you may quit the wizard and start using your OASIS-4i 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-4i 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

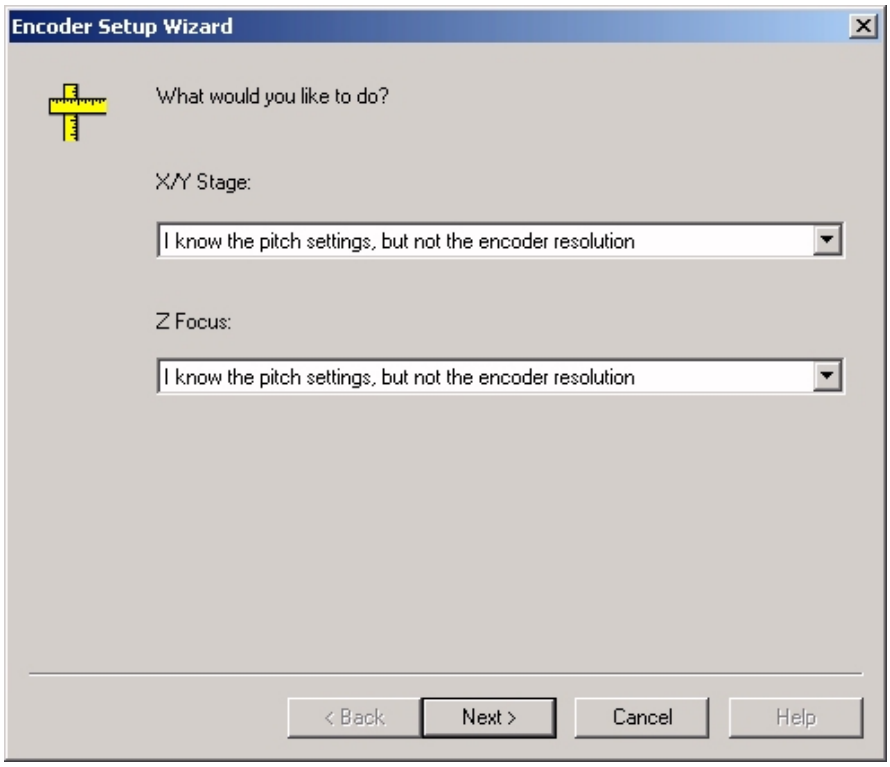


Figure 15. Encoder setup method selection.

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.

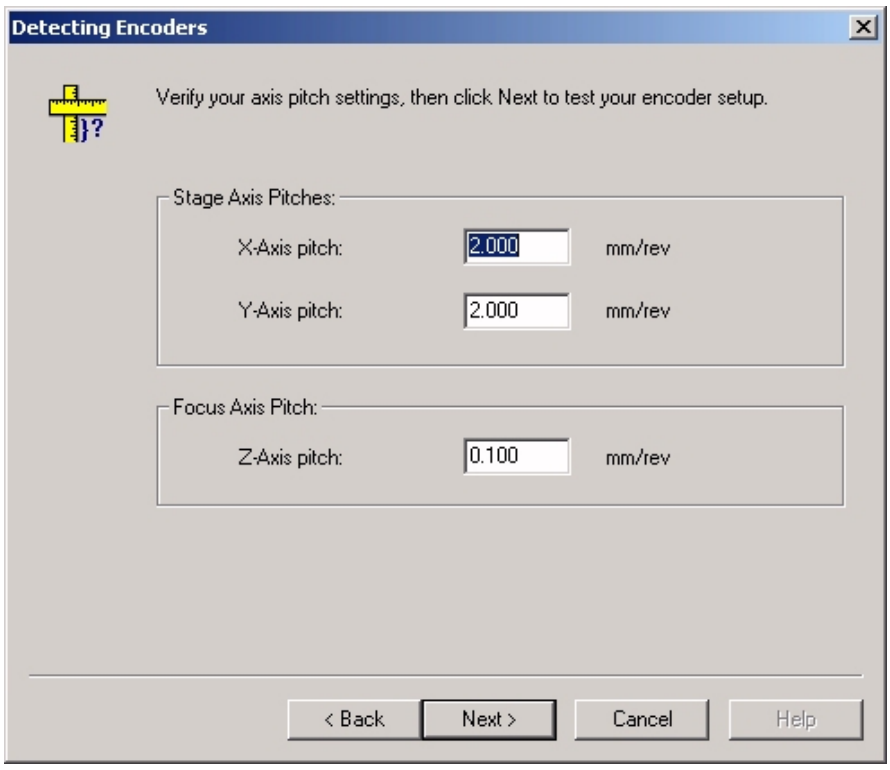


Figure 16. Encoder wizard information page.

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-4i 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 *Principles of Operation* chapter for further details on acceleration ramps.

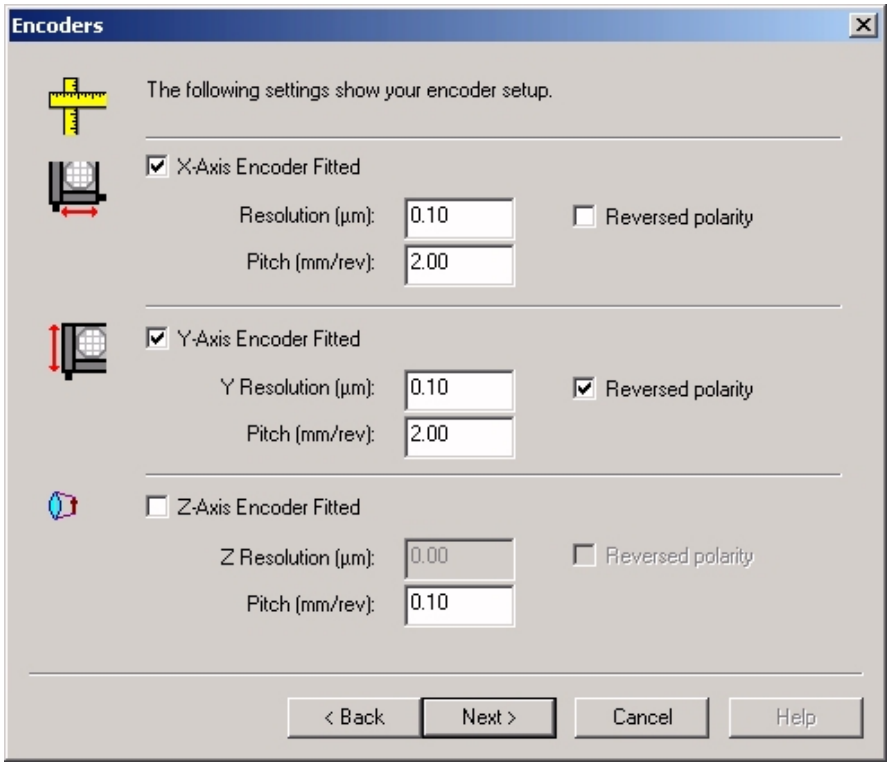


Figure 17. Encoder settings.

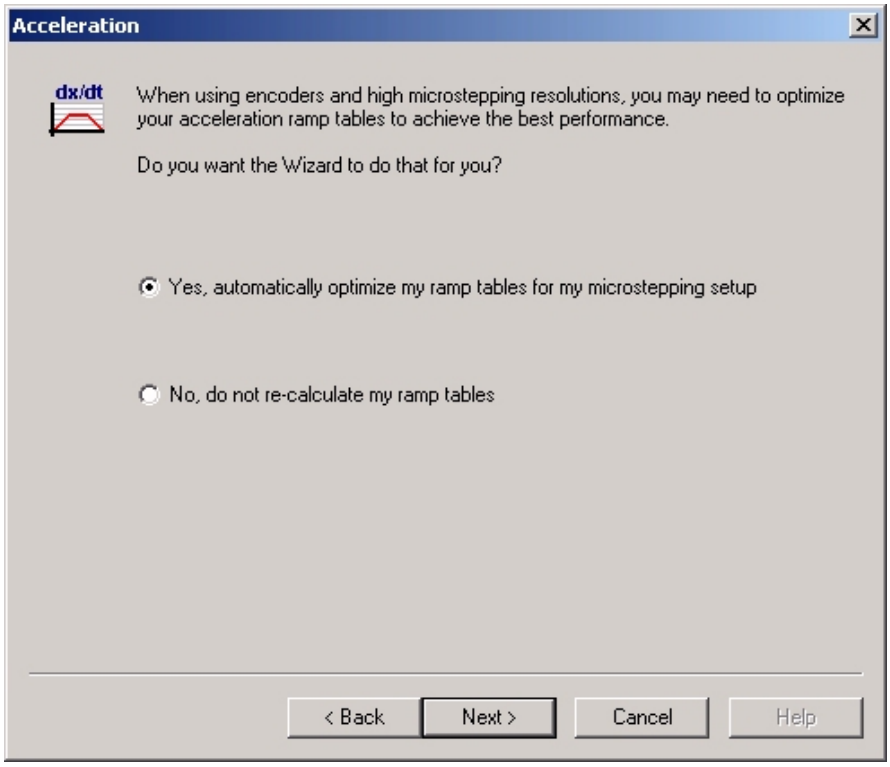


Figure 18. Automatic ramp calculation.

The final step in the encoder wizard before the settings are actually written into the OASIS-4i 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.

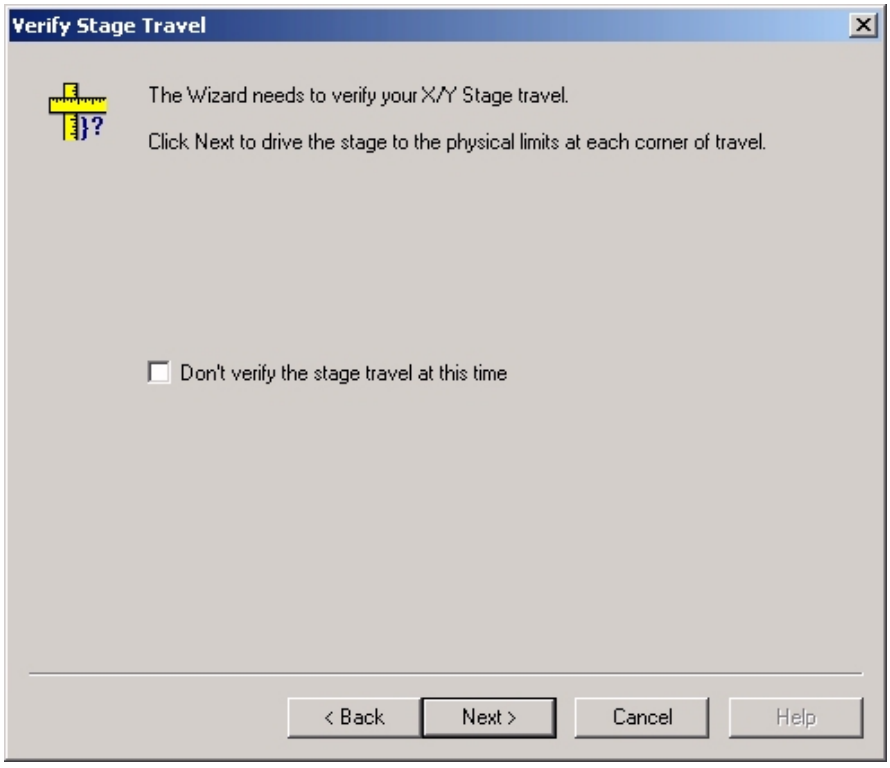


Figure 19. Stage initialization after encoder setup.

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 *OI-SNP* 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-4i card at a time. For instance, it is possible to have the OI-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.

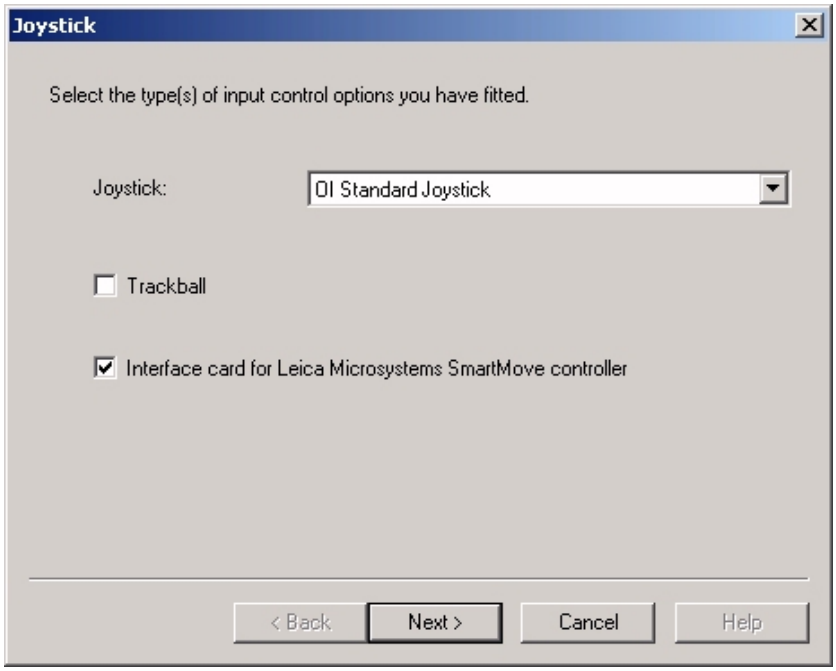


Figure 20. Joystick main page.

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-4i flash memory, and you are returned to the main wizard screen.

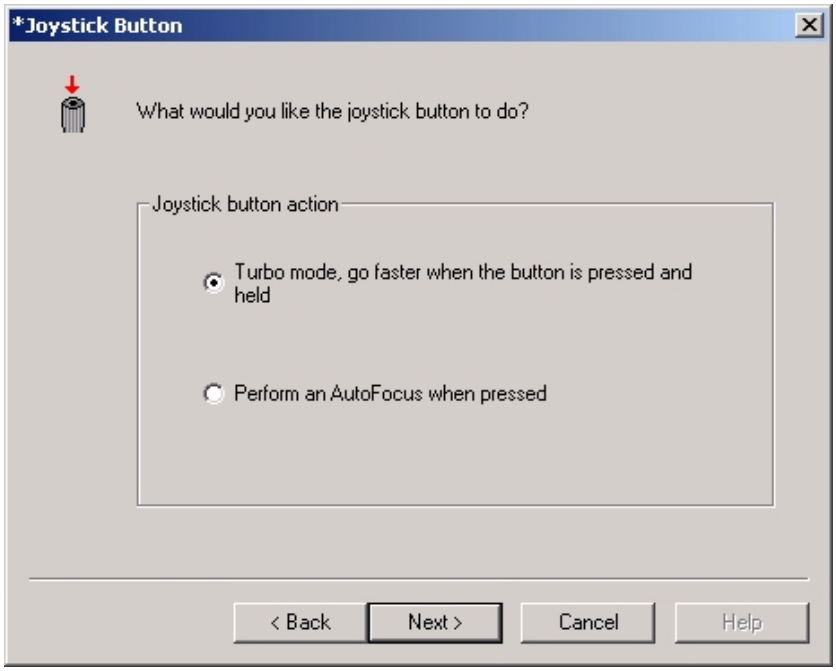


Figure 21. Joystick button definition.

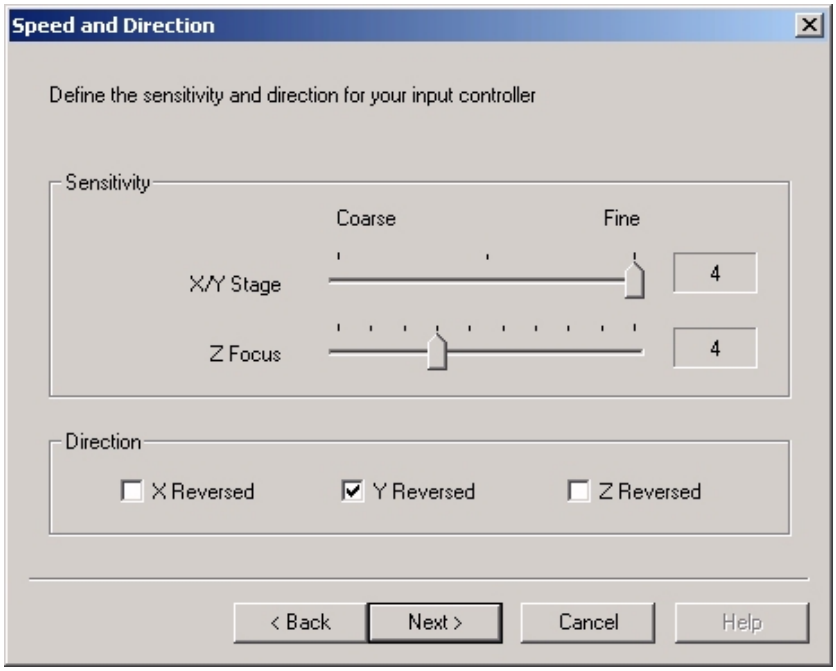
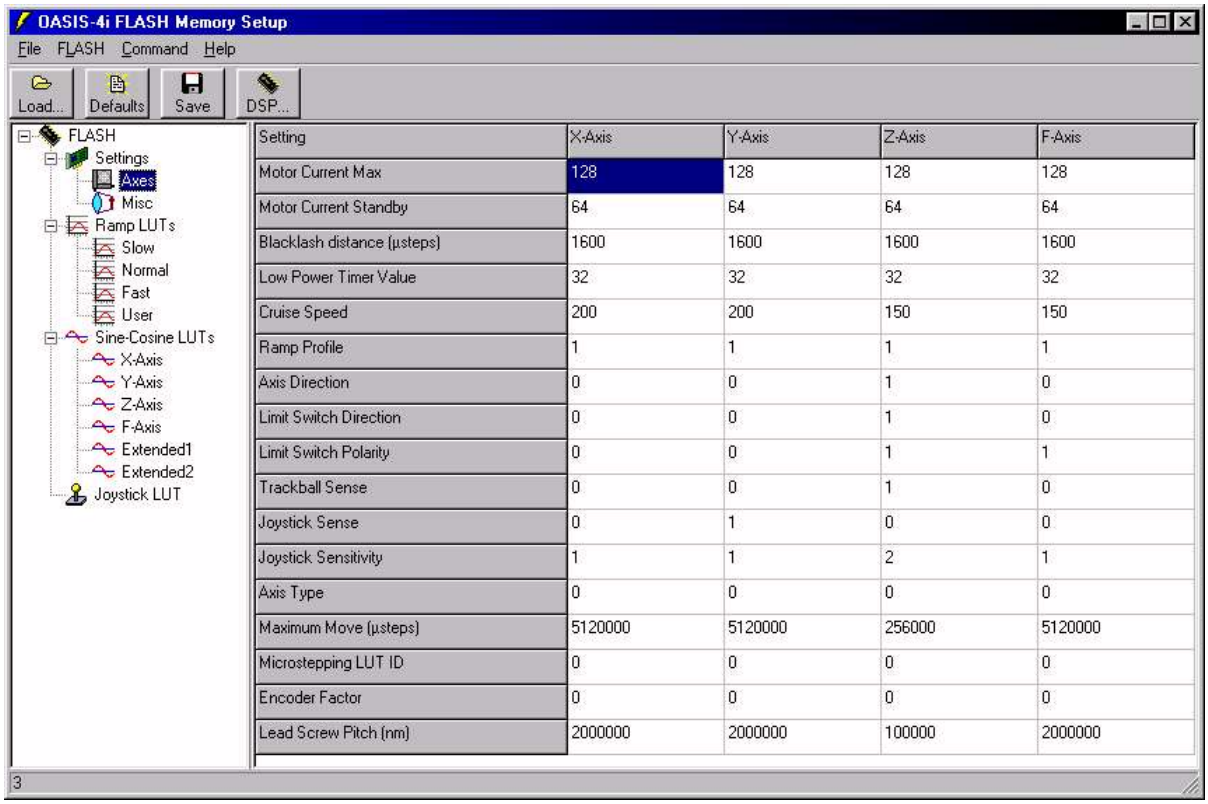


Figure 22. Joystick speed and direction settings.

OASIS Flash Memory Configuration Utility

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



Setting	X-Axis	Y-Axis	Z-Axis	F-Axis
Motor Current Max	128	128	128	128
Motor Current Standby	64	64	64	64
Blacklash distance (µsteps)	1600	1600	1600	1600
Low Power Timer Value	32	32	32	32
Cruise Speed	200	200	150	150
Ramp Profile	1	1	1	1
Axis Direction	0	0	1	0
Limit Switch Direction	0	0	1	0
Limit Switch Polarity	0	0	1	1
Trackball Sense	0	0	1	0
Joystick Sense	0	1	0	0
Joystick Sensitivity	1	1	2	1
Axis Type	0	0	0	0
Maximum Move (µsteps)	5120000	5120000	256000	5120000
Microstepping LUT ID	0	0	0	0
Encoder Factor	0	0	0	0
Lead Screw Pitch (nm)	2000000	2000000	100000	2000000

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-4i flash memory.

See section *Using the Flash Memory Setup Application* in the *Principles of Operation* chapter for further details on using the Flash Memory setup application.

What Next?

Once the OASIS-4i 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-4i card within you application. Please refer to your imaging application's documentation for further instructions.

If you are a developer of applications that will use the OASIS-4i controller, you should next install the OASIS-4i 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-4i SDK DLL manual for further details regarding integration of the OASIS-4i into your system software.

Chapter

4

OPTIONS AND ACCESSORIES

Joystick Units

The OI-JOY2 and OI-JOY3 joystick units are designed to plug into the analogue port of the OASIS-4i controller board. The 26-pin analogue port is PL7, which can be found at the rear edge of the board, and is attached to the joystick unit via a ribbon cable attached to a PC expansion slot mounting plate. Pin 1 of PL7 is marked on the OASIS-4i board (refer to diagram below) and should line up with the red wire on the ribbon cable. The mounting plate can then be fitted to a spare PC slot, or if none are available, the 25-way D connector can be unscrewed from the plate, and mounted directly to a 25-way D cut-out on the back of the PC.

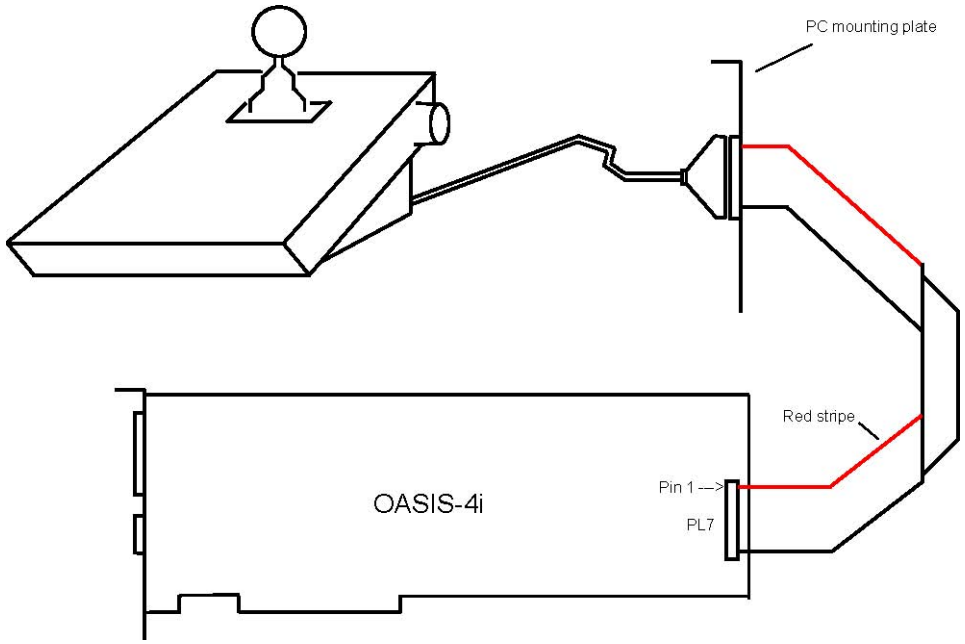


Figure 24. Connection of joystick to OASIS-4i controller.

Operation

There are three controls on the OI-JOY3, the joystick, the digiknob and the pushbutton.

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 can be configured to perform either an automatic focus or as a sensitivity action for XY movements.

Power for the joystick unit is provided via the OASIS-4i 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 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.

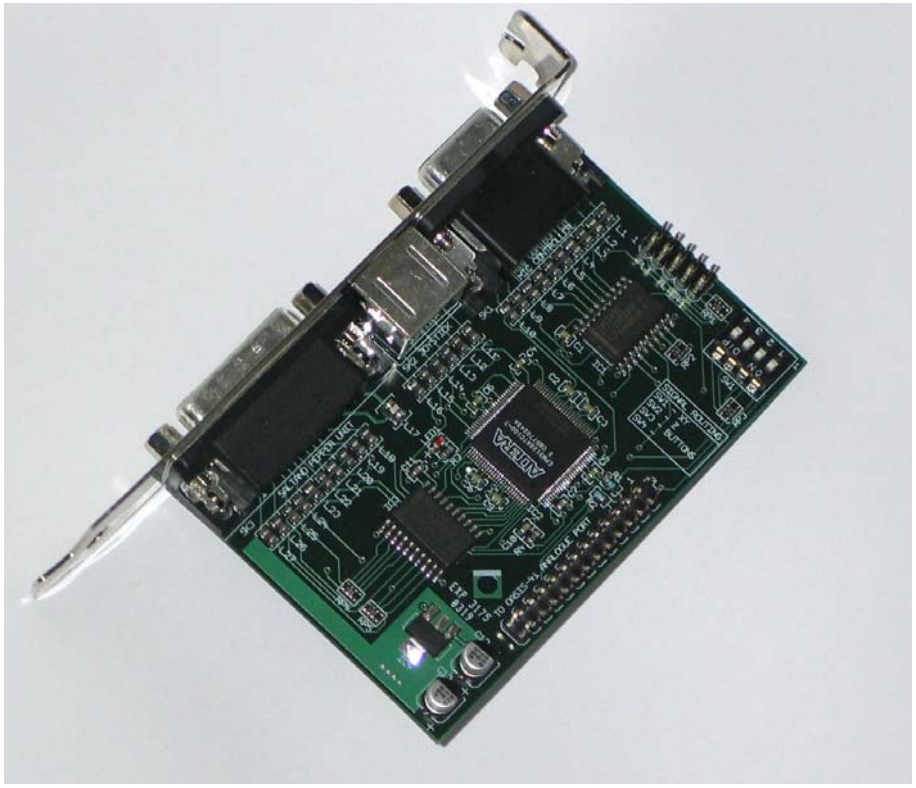
Adjusting Joystick Sensitivity using the Configuration Wizard

The joystick sensitivity may be adjusted using the Joystick Setup Wizard. See the section *Joystick Setup Wizard* in the *Configuring the OASIS-4i Controller* chapter for further details.

Adjusting Joystick Sensitivity using the Flash Memory Setup Application

You may also directly enter the joystick sensitivity in the Flash Memory Setup application. See the section *Joystick Sensitivity* in the *Principles of Operation* chapter for further details.

OI-SNP



The OI-SNP interface card is designed to allow the OASIS-4i PCI Controller Card to use the Leica Microsystems SmartMove input device as a control for manual positioning of X, Y and Z axes.

The Leica Microsystems SmartMove device provides an ergonomic manual input controller for automated XY stage and Z focus movement, used with the Leica Microsystems range of automated microscope stands. Objective Imaging's OI-SNP interface card allows the SmartMove to be used with standard 3rd party stages and focus adaptors that are controlled via the OASIS-4i controller. The OI-SNP allows each axis of the SmartMove to be independently configured for use with either built-in microscope control or OASIS-4i control.

Installation

NOTE: Please observe anti-static precautions when handling any electronic components.

1. Switch off and unplug the PC from the mains supply before starting the installation procedure.
2. The OI-SNP is mounted to a PC back-plate for easy mounting in a PC slot near to the OASIS-4i card. Fix the OI-SNP to the PC chassis with the usual locking screw, unless the PC has a different method for holding cards in place.

3. Attach the supplied 26 way ribbon cable between PL2 on the OI-SNP and PL7 on the OASIS-4i card, taking care to align pin 1 on each connector with the red stripe on the ribbon cable, as shown below. Pin 1 is marked on the silk-screen of both cards.

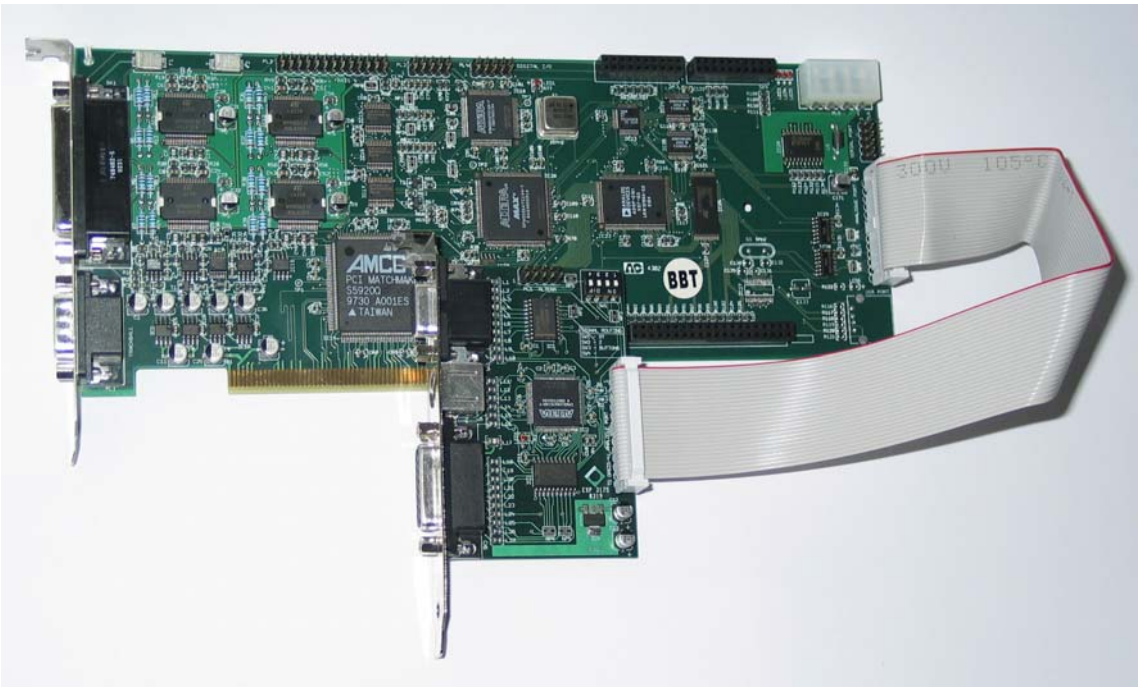


Figure 25. OI-SNP connected to OASIS-4i controller.

Connectors

The bottom connector on the PC bracket is a 15 way female D-type socket which connects the Leica SmartMove controller.

The 8 way mini-DIN socket in the middle of the bracket is for attaching an OI-JOY2 or OI-JOY3 joystick unit (via an adapter cable or with a modified joystick cable connector).

The top connector on the PC bracket is a 15 way High-Density D-type socket which connects to the Leica CTRMIC controller 'XYZ Control' input. This is to allow pass-through of some or all of the SmartMove controller signals to the CTRMIC Controller.

Configuration

On the top right hand corner of the OI-SNP PCB is a 4 way DIP-switch that controls the following functions:

Table 1. OI-SNP DIP switch settings

Switch	ON	OFF
1	XY controlled by Leica CTRMIC	XY controlled by OASIS-4i
2	Z controlled by Leica CTRMIC	Z controlled by OASIS-4i
3	Buttons controlled by CTRMIC	Buttons controlled by OASIS-4i
4	Z control input is Leica SmartMove	Z control input is OI-JOY3 joystick digiknob

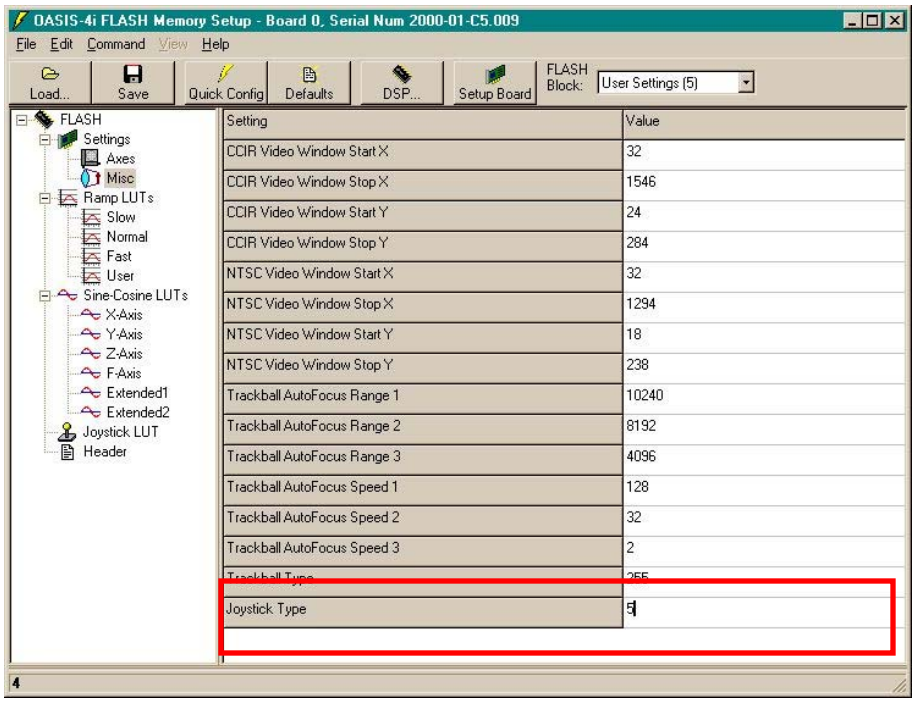
For example if the OASIS-4i is being used to control the XY stage, and the CTRMIC controller is being used to control Z, the lamps and the turret, then set switch 1 to OFF, and switches 2 and 3 to ON. The CTRMIC controller's XYZ-Control input must be connected to the OI-SNP module's top connector (SK1), for the signals to be passed through to it.

Operation

The DSP code stored in the OASIS-4i may need updating before the OI-SNP module can be used. Contact Objective Imaging if in doubt as to which version of DSP code is compatible.

Once the OASIS-4i DSP code has been updated, it will also be necessary to change a Flash memory setting to select the Smart Move Controller as the input device. Normally this is done using the OASIS Joystick Setup Wizard (see the section *Joystick Setup Wizard* in the *Configuring the OASIS-4i Controller* chapter for further details).

The OASIS-4i Flash Memory Setup application may also be used to configure the OI-SNP. If you run this program and go to the 'Settings -> Misc' page, you will see a 'Joystick Type' value near the foot of the page, as shown.



This value can be set to the following options:

Table 2. Joystick Type settings.

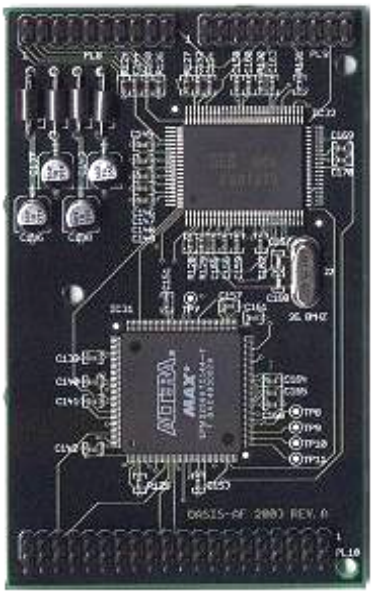
Value	Input type
1	OI Standard 2 or 3 Axis Joystick, joystick button is autofocus
2	OI Standard 2 or 3 Axis Joystick, joystick button is turbo-mode
3	Leica Lamp Controller
4	Leica Joystick Unit
5	Leica SmartMove + OI Joystick, joystick button is autofocus
6	Leica SmartMove + OI Joystick, joystick button is turbo-mode

It is not necessary to have a joystick fitted as well as the SmartMove device, but it is possible to have both. The normal value for use of the OI-SNP with the Leica SmartMove would be 5.

After changing the value, press the 'Save' button on the toolbar to store it in the Flash memory.

OASIS-AF

The OASIS-AF Module is an optional plug-in daughter board that can be fitted to the OASIS-4i Four Axis Controller to automate microscope focus adjustment dependent on image content and user defined parameters. The OASIS-AF Autofocus module extends the capability of the OASIS-4i Four Axis Controller by providing real time video image processing hardware.



By continuously measuring the characteristics of each video frame to produce a goodness-of-focus score, the OASIS-AF module enables rapid, automatic selection of the best point of focus.

Video-rate measurements of total area and chord length data for detected image details are also performed by the OASIS-AF hardware for applications such as blank field and rare event identification.

For a detailed explanation of the autofocus and video processing capabilities of the OASIS-AF module, see the sections *Autofocus* and *OASIS Video Page* in the *Principles of Operation* chapter.

OASIS-DC1

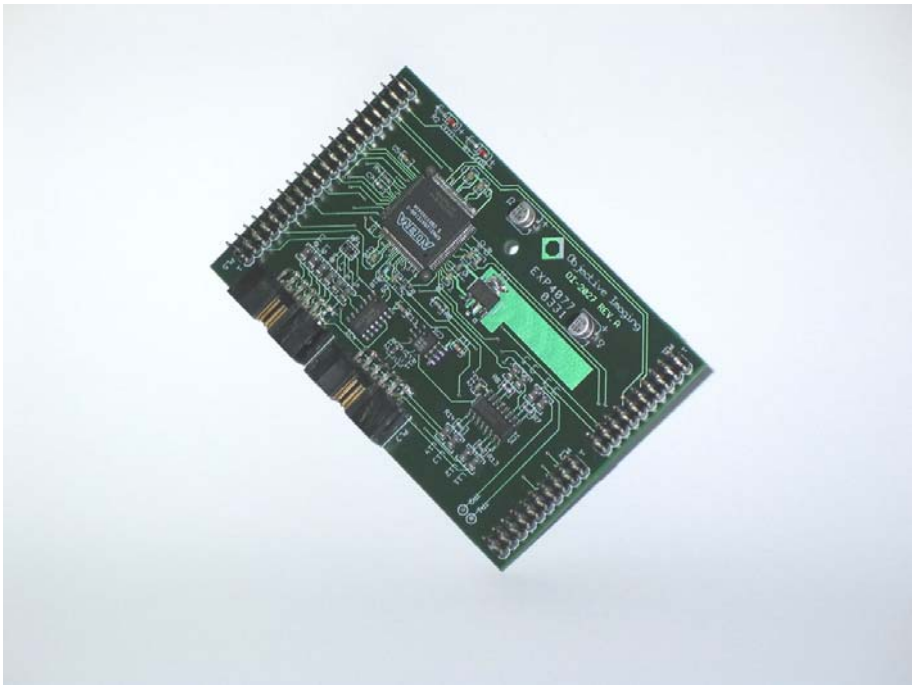


Figure 26. OASIS-DC1 module.

The OASIS-DC1 module is designed to allow the interface of timing signals from certain digital cameras to the OASIS-4i PCI Controller Card. This allows the use of the rapid scanning and mosaic imaging feature of the Surveyor application called Turboscan and also the possibility of providing autofocus capability with these cameras. A list of suitable cameras is supplied in below in the section *Supported digital cameras*.

Installation

NOTE: Please observe anti-static precautions when handling any electronic components.

The OASIS-DC1 is fitted as a 'daughter' card to the OASIS-4i PCI Controller Card. To fit the OASIS-DC1 you will need to remove the OASIS-4i from the host PC if already installed, and carefully press fit the OASIS-DC1 on to the three connectors SK2, SK3 and SK4 as shown in Figure 27.

Make sure that the connector pins on the OASIS-DC1 module line up exactly with the mating sockets on the OASIS-4i card. There should be no pins visible when the module is correctly installed.

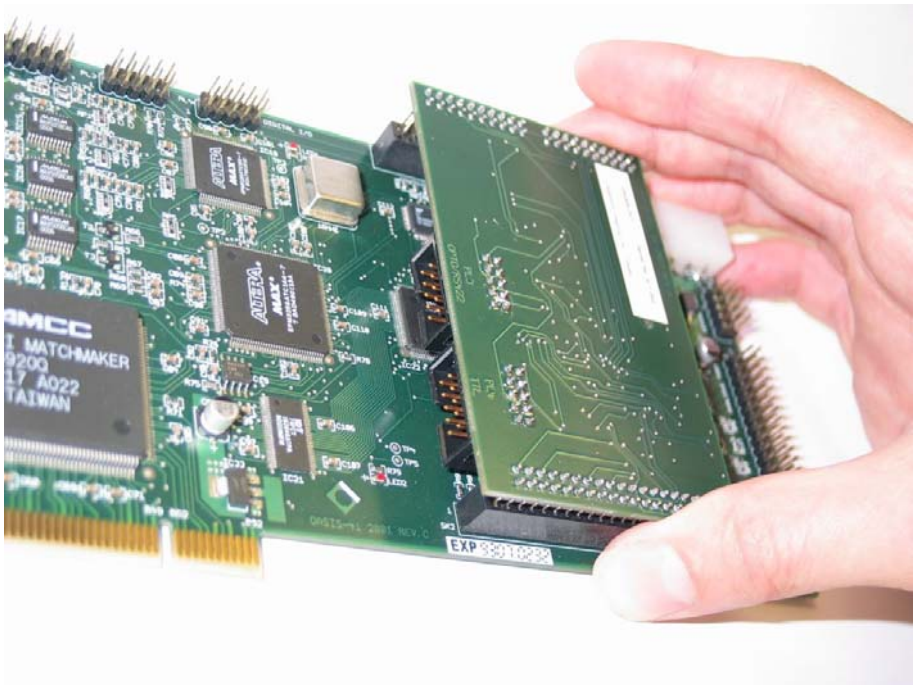


Figure 27. Placing the OASIS-DC1 onto the OASIS-4i controller.

Attach the supplied 9-way ribbon cable to the appropriate connector on the OASIS-DC1 module, either PL3 for opto-isolated or RS422 signals, or PL4 for TTL compatible signals (see Figure 28). If you have ordered this product to suit a particular camera, then the ribbon cable should be marked with the correct connector name. Re-install the OASIS-4i and DC1 in the PC and fix the other end of the ribbon cable to a spare PC cover-slot or chassis cut-out, as necessary. Reconnect any cables associated with the OASIS-4i and finally connect the timing signals from the camera to the OASIS-DC1 via the cable supplied. This cable should be clearly marked to indicate where on the camera it should be attached.



Figure 28. Ribbon cable connected to OASIS-DC1 module.

Configuration

The OASIS-4i controller's on-board DSP code must be of version Y2.37b or later in order to control the OASIS-DC1.

Contact Objective Imaging if in doubt as to which version of DSP code is compatible.

Operation

The OASIS-DC1 is controlled via the application software. Please refer to the relevant application guide for any necessary setting information.

Supported digital cameras

The following digital cameras have been tested for use with the OASIS-DC1 module. If a camera of interest is not listed, please contact Objective Imaging for compatibility information.

Table 3. Digital cameras supported by OASIS-DC1 module.

Manufacturer	Models	OASIS-DC1 Connector	Comments
QImaging Corp.	QICAM, Retiga	PL4	Requires additional +5V power supply for trigger signal. This can be achieved using the appropriate OASIS-4i main connector "-5V" option.
Leica Microsystems	DFC300FX, DFC350FX, DFC320, DFC480, DC500	PL4	Only revision 2 models or later with appropriate trigger output.
Sensovation	EZ-45	PL3	
JVC	KY-F1030	PL3	

Connector pin-out information

Table 4. OASIS-DC1 PL3, Opto/RS-422 ribbon cable to 9-way D-type

Pin on OASIS-DC1 PL3	Signal	Pin at 9-way D-type
1	RS-422 A+	1
2	RS-422 A-	6
3	RS-422 C+	2
4	RS-422 C-	7
5	Opto input 1+	3
6	Opto input 1-	9
7	Opto input 2+	4
8	Opto input 2-	9
9	GND	5

Table 5. OASIS-DC1 PL4, TTL/RS-422 ribbon cable to 9-way D-type

Pin on OASIS-DC1 PL4	Signal	Pin at 9-way D-type
1	TTL input 1	1
2	TTL input 2	6
3	TTL input 3	2
4	TTL input 4	7
5	RS-422 B+	3
6	TTL output 1	8
7	RS-422 B-	4
8	TTL output 2	9
9	GND	5

OASIS-XA1

The OASIS-XA1 module is designed to increase the drive capability of the OASIS-4i board from four motors up to five. Software control of this 5th axis is very similar to that used for controlling the F-axis, typically used for driving filter-wheels, although it should be noticed that there are a few differences which will be described later. The XA1 module fits to the OASIS-4i board in place of the Video Processor (Autofocus) module, therefore it is not possible to have both the OASIS-XA1 and OASIS-AF or OASIS-DC1 modules fitted at the same time.



Installation

NOTE: Please observe anti-static precautions when handling any electronic components.

With the OASIS-4i board removed from its host PC and on the workbench, remove the existing OASIS-AF or OASIS-DC1 module (if fitted), which attaches to connectors SK2, SK3 and SK4, and fit the XA1 module firmly in its place. Take care to line up the pins of the XA1 connectors with the holes of the mating connectors on the OASIS-4i. The OASIS-4i and XA1 module may now be replaced in the PC.

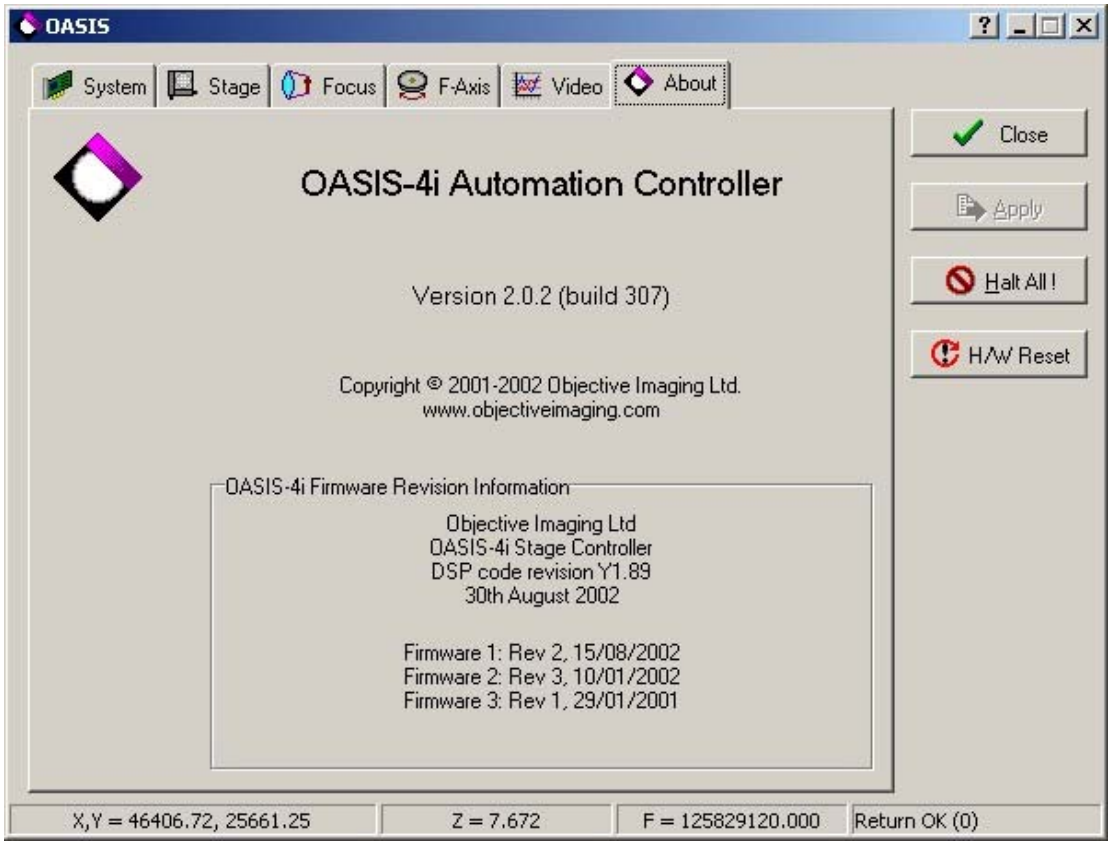
(Please refer to the OASIS-4i hardware installation instructions earlier in this document if needed.)

Power for the 5th axis motor is provided via a separate connector than that used for the other 4 axes. Usually a spare lead from the PC power supply is available which has two of the appropriate four pin connectors in series. These connectors should be plugged in to PL5 on the OASIS-4i and PL2 on the XA1 module, respectively.

The motor itself plugs into PL4 on the XA1 module, usually via a 9-pin female D-type to 10-pin IDC female header cable (OI part no. OIC-9002). This connector is polarised so it should not be possible to fit it the wrong way round or out of line.

Configuration

In order for the software to be able to use the XA1 hardware, the OASIS-4i firmware and DSP code need to be of a certain revision. You can check the appropriate revision codes by looking at the 'About' tab of the OASIS application utility.



In the OASIS-4i Firmware Revision Information section, the DSP code revision should be Y1.89 or later, and Firmware 1 should be Revision 2 or later.

With the other four axes it is possible to configure some operational parameters in non-volatile Flash memory, using the OASIS-4i Flash Memory Setup application. At this time there are no equivalent settings for the 5th axis. The main difference between the 5th axis and the other four is

that the micro-step resolution is fixed at 3200/rev. In practice this should be more than adequate for controlling filter-wheels, etc. The ramp profile is also fixed at the equivalent of a 'normal' ramp profile for the other axes. Otherwise the functionality is the same as for the F-axis, with a 'home' switch input available for the initialisation of filter-wheels, along with positive and negative limit switch inputs.

Wiring Information

When using the 10-pin IDC to 9-pin female D-type internal cable (OIC-9002), use the following pin information for connection to external devices.

Table 6. OASIS-XA1 9-way D-type connector information

Pin	Signal
1	Motor phase A+
2	Motor phase B+
3	GND
4	Not connected
5	+5V
6	Motor phase A-
7	Motor phase B-
8	Not connected
9	Home switch

OASIS-XA1 Specifications

- Optional 5th axis stepper motor driver module.
- Max. output current 1.25 A/phase.
- Max. Input voltage +28V.
- Microstepping resolution 3,200 /rev.
- Acceleration/deceleration ramps and speed software programmable.
- Inputs - 1 x home-switch (TTL with 4K7 pull-up) for filter-wheel initialization
- 2 x limit switch (TTL with 4K7 pull-up)
- Outputs - Bipolar stepper-motor drive (PWM switching)

- +5V @ 0.25A max.

Interface Kit for Ludl Systems

This unit is designed to provide an easy connection route between the OASIS-4i PCI controller card and Ludl BioPrecision stages and focus adapters. In addition the unit provides buffering and interpolation for Ludl rotary encoders and Heidenhain (or similar) linear encoders.

Connectors

Referring to the picture above, the top three 15 way male D-type connectors are for X, Y and Z encoders which work on the complementary TTL or RS422 format, such as Heidenhain and Renishaw linear types.



Figure 29. Motor and Encoder interface kit for Ludl devices.

Please use the short adapter cables with a revision A unit (which can be determined by looking at the first letter of the serial number) to ensure compatibility with these models of encoders. The pin-out information for these connectors (when using the adapter cable) is as follows:

Table 7. Encoder connector details.

Pin	Signal
1	Encoder A+
2,10	0V
3	Encoder B+

4,12	+5V
9	Encoder A-
11	Encoder B-

The lower three female 15 way D-type connectors are for direct connection to Ludl X, Y and Z axes. They each provide power and signal connection for Ludl rotary encoders (TTL).

The pin-out information for these connectors is as follows:

Table 8. Motor connector details.

Pin	**Signal**
1	Encoder channel A
2	Encoder channel B
3,4	0V
7	+5V
8	Limit, negative direction of travel
9	Limit, positive direction of travel
10	Motor phase 1 out
12	Motor phase 1 in
13	Motor phase 2 out
15	Motor phase 2 in

The two BNC connectors on the right of the unit provide a means of inputting standard video to the OASIS-4i, for video processing or autofocusing, and a buffered video output signal.



Figure 30. Location of DIP switches on bottom of unit.

On the underside of the unit (see Figure 30) there are 8 DIP-switches which allow the selection of either rotary (via the motor connector), or linear (via the separate encoder connector) encoder type, for each axis, and also whether or not the encoder signals should be used directly or interpolated by a factor of 4, before being fed to the OASIS-4i.

The switches, reading from left to right, have the following functions:

Table 9. Interface DIP switch settings.

Switch	OFF	ON
1 (left bank)	X encoder direct	X encoder with 4x interpolation
2 (left bank)	Y encoder direct	Y encoder with 4x interpolation
3 (left bank)	Z encoder direct	Z encoder with 4x interpolation
4 (left bank)	Test use only	
1 (right bank)	X encoder (RS-422) via separate connector	X encoder via motor cable
2 (right bank)	Y encoder (RS-422) via separate connector	Y encoder via motor cable
3 (right bank)	Z encoder (RS-422) via separate connector	Z encoder via motor cable
4 (right bank)	Test use only	

Note:

If the two test switches (both labelled 4) are left in the ON position, then the green LED of the opposite side of the box from the connectors will be permanently on whilst the unit is powered up.

When interpolation is enabled on an axis, then both edges of both encoder phases A and B are used to update the counters. This is normally necessary to achieve the resolution as stated on the encoder.

General Notes

The captive main cable to the OASIS-4i board has been kept purposely short to minimize the noise induced on the encoder inputs from the switching motor currents. It is not recommended that this cable be extended.

Chapter

5

PRINCIPLES OF OPERATION

This section reviews the basic principles of operation for the OASIS-4i 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-4i 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-4i 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.

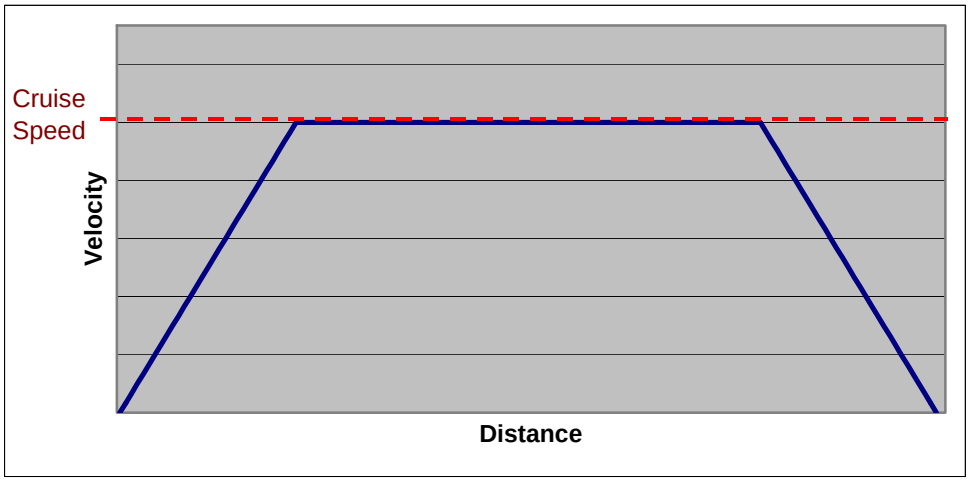


Figure 31. Speed vs. time for a typical move using linear acceleration.

Figure 31 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-4i controller is to determine the precise nature of this move to ensure accurate positioning.

Table 10. The first 7 entries in a linear ramp table.

Index	Timer Interval (microsections)	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-4i 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 10 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-4i controller.

Defining the Table

Each of the four ramp tables is stored in the Flash memory of the OASIS-4i controller. The Flash Memory Setup application allows you to calculate new linear and S-curve tables, or specify you 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-4i 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 32 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.

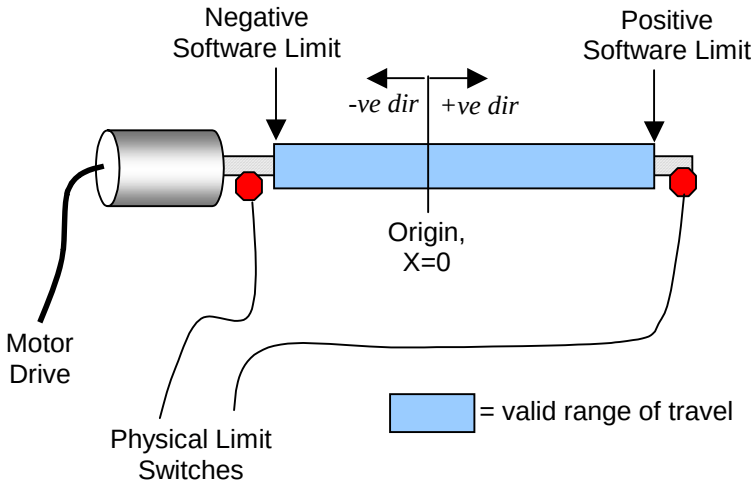


Figure 32. Physical and software limits, with range of travel.

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-4i 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 33.

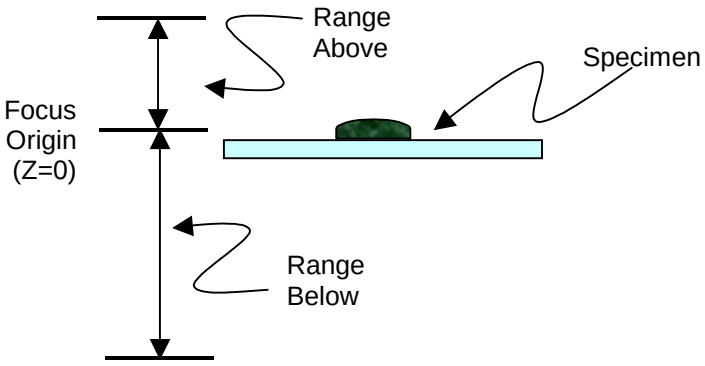


Figure 33. Focus initialization.

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

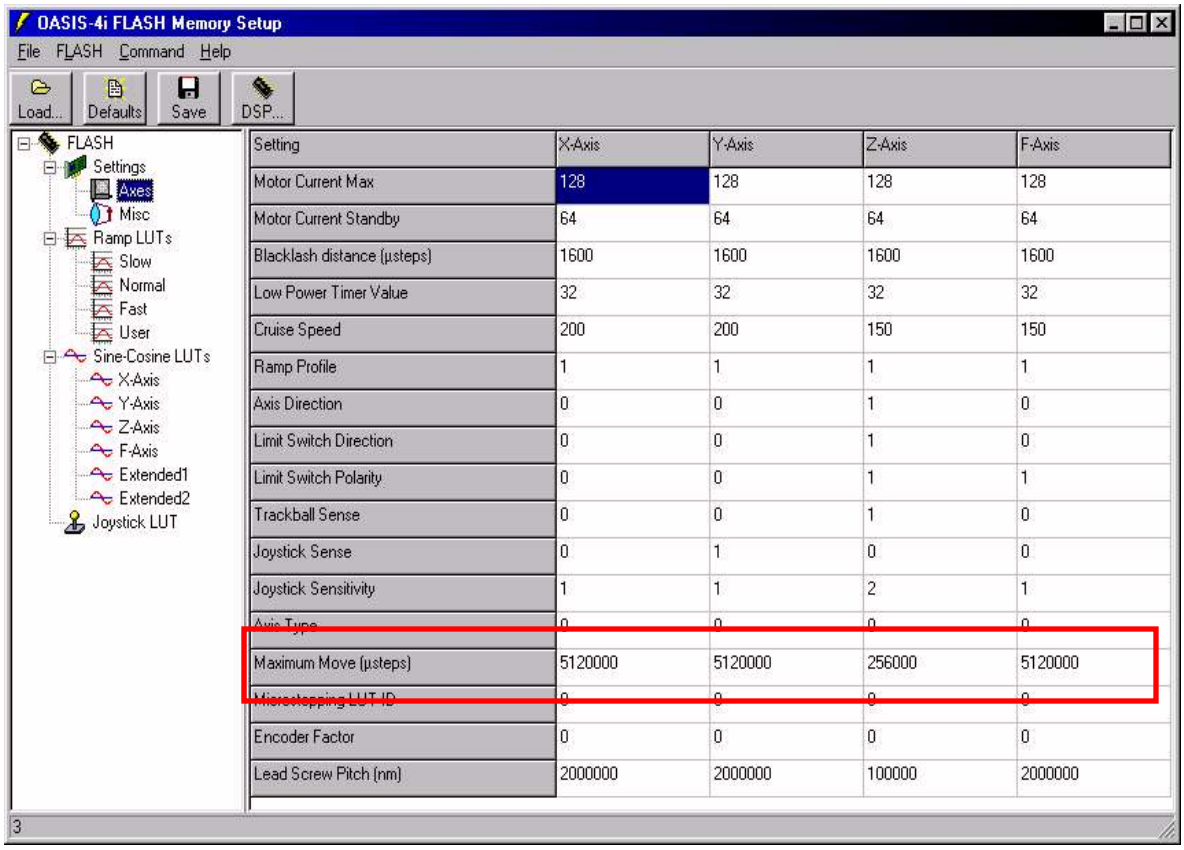
In order to further protect against large movements that may damage the specimen or optical components of a microscope, the OASIS-4i controller also uses a 'Maximum Move' value, which is a microstep value the DSP uses to reject large move requests. The actual Maximum Move value is set in the Flash memory.

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-4i flash memory. To change the value for the maximum allows move on a given axis:

1. Close all applications that access the OASIS-4i controller.
2. Start the OASIS-4i 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-4i Flash Memory setup application.



Setting	X-Axis	Y-Axis	Z-Axis	F-Axis
Motor Current Max	128	128	128	128
Motor Current Standby	64	64	64	64
Blacklash distance (µsteps)	1600	1600	1600	1600
Low Power Timer Value	32	32	32	32
Cruise Speed	200	200	150	150
Ramp Profile	1	1	1	1
Axis Direction	0	0	1	0
Limit Switch Direction	0	0	1	0
Limit Switch Polarity	0	0	1	1
Trackball Sense	0	0	1	0
Joystick Sense	0	1	0	0
Joystick Sensitivity	1	1	2	1
Axis Type	0	0	0	0
Maximum Move (µsteps)	5120000	5120000	256000	5120000
Microstepping LUT ID	0	0	0	0
Encoder Factor	0	0	0	0
Lead Screw Pitch (nm)	2000000	2000000	100000	2000000

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-4i 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-4i controller, maintained in addition to the normal microstepping position counter, manages encoder inputs. Closed-loop operation is achieved when the OASIS-4i 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-4i 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.

The OASIS Application

One of the utilities included with the OASIS-4i controller is the *OASIS Controller Application*. If you have chosen to install the OASIS Tools (or SDK) from the OASIS installation CD, you will have been given the option to install a shortcut to the OASIS Controller Application on your desktop. The shortcut will show the Objective Imaging logo along with the description 'OASIS Controller.'

If you haven't installed the OASIS Tools, you can run the OASIS application from the CD. The application executable is called *Oasis.exe*, and you can find it in the *Utils* folder of the CD.

The OASIS application is useful for verifying that your OASIS-4i installation and configuration are working properly on your system, as well as for familiarizing yourself with the capabilities and principles of operation of the controller.

OASIS System Information Page

The main screen of the OASIS application is show in Figure 34. You will see the OASIS application includes a number of tabs associated with information on the System, Stage, Focus, F-Axis (fourth or filter axis), Video, and About. At the bottom of the OASIS application you will find a status bar indicating the current position values for the XY Stage, Z focus, and F-axis. Also included in the status bar is a panel indicating the condition returned from the last action, e.g., whether the function command returned OK as opposed to some error.

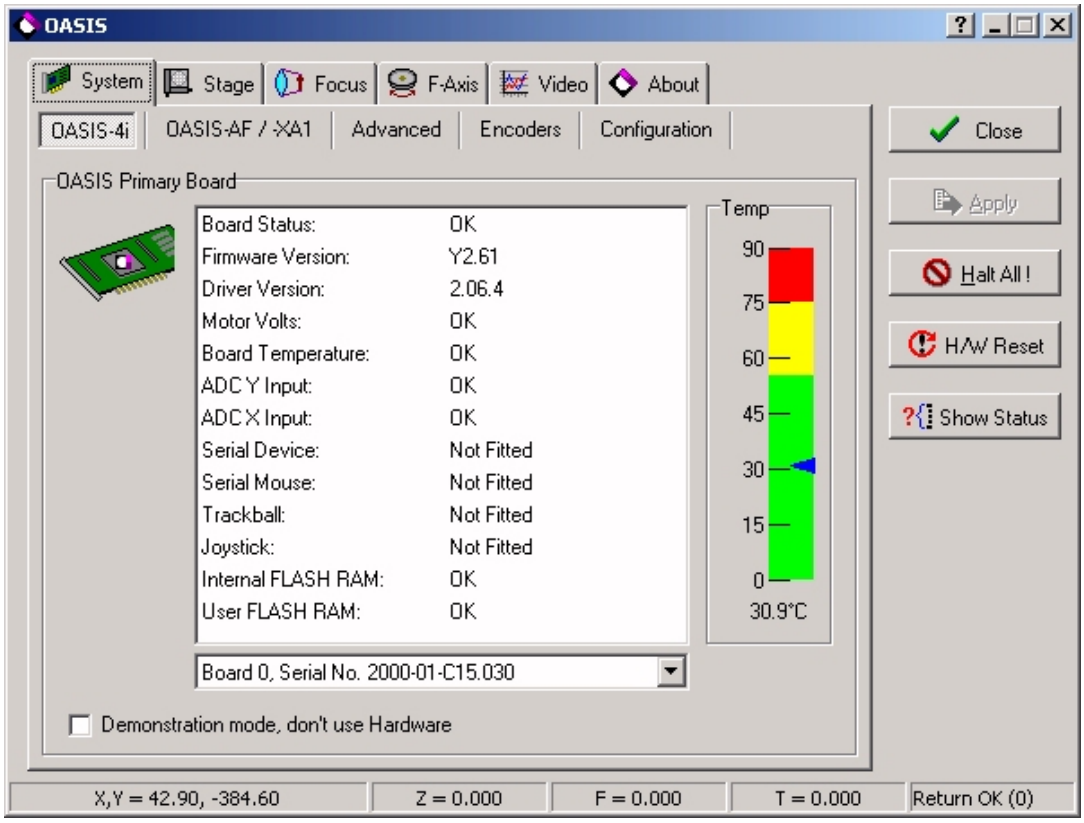


Figure 34. The OASIS application main screen.

Note: To retrieve extended error information on the last command, click on the command return status panel in the status bar at the bottom of the OASIS application.

Main Buttons

Item	Description
OK	Closes the OASIS application.
Apply	Applies changes you have made to settings such as cruise speed, ramp table, etc.
Halt All	Issues a halt command on axes to stop any motion that may be occurring.
H/W Reset	Issues a reset command to the OASIS-4i DSP. This is similar to the effect of re-booting the PC in that the OASIS-4i will go though its start-up sequence as if you had reset the PC.
Show Status	Displays the status window indicating the status of each of the axes, such as whether it is on a physical or software limit, motor detection, etc.

Board Status

This readout gives you information on the overall status of the OASIS-4i controller. This readout will display either of the following values:

Table 11. Board status values.

Value	Meaning
"OK"	The OASIS-4i card has been detected and is communicating with your computer properly.
"Simulated"	The OASIS-4i card was not found. If a card is indeed present, this reading indicates that attempts to open the card for communication failed; the system has gone into simulation mode since no card was detected.

Finding the DSP and DLL Version Information

In some circumstance you may need to verify the version information of the on-board DSP code or the OASIS DLL that is running on your system. For instance, if you are installing new hardware options onto the OASIS-4i card, you will need to verify that the OASIS-4i DSP code is at a sufficient revision level to support the new hardware. Also, certainly 3rd party applications may use facilities found in later versions of the OASIS DLL, so you may need to verify the version currently installed to ensure compatibility.

The System page of the OASIS application lists these versions as follows:

Table 12. DSP and DLL version information.

Setting	Meaning
Firmware version	Indicates the DSP code version currently running on the OASIS-4i card.
Driver version	Indicates the DLL version currently running on your PC.

Motor Volts

The Motor volts display indicates whether the OASIS-4i card has sensed sufficient input power on connector PL5 for driving the motors. The following displays may occur:

Table 13. Motor volts display indication.

Value	Meaning
"OK"	Motor power has been detected.

"FAIL"	Motor power has not been detected. Recheck power connection at PL5 or your power supply for sufficient voltage (+12V to +30V).

Board Temperature Readout

The OASIS-4i includes circuitry to monitor the board temperature and a safety feature to automatically limit motor drive current if the board temperature begins rising above acceptable levels.

The System page of the OASIS application displays the current board temperature on a thermometer-style gauge, as well as the actual temperature value. Also, the Board Temperature status flag indicates either 'OK' or 'FAIL' depending on whether the temperature is sensed to be within acceptable limits.

ADC Inputs

The ADC Y and ADC X display the status of the analogue-to-digital converters used for the XY joystick input. If either of these values appears out of normal position on start up, the display will read 'FAIL.'

Serial Devices

If a serial device has been connected to the primary serial input port PL1 on the main connector plate, the Serial Device and Serial Mouse displays indicate that the device has been detected, and whether it appears to be a mouse.

Trackball and Joystick

If the serial device is detected to be a trackball, the Trackball flag will show it has been detected. If the analogue joystick is detected, the Joystick flag will indicate it has been detected.

FLASH RAM Status

The OASIS-4i flash RAM is used to store various user settings, factory defaults, as well as the current DSP code. Whenever the flash is modified, a checksum is calculated on the source data and written into the header of the flash block. When the OASIS-4i reads the flash memory to configure itself based on the settings found there, it also calculates the checksum from the data in the flash block.

If the DSP's calculated checksum does not match the checksum from the source data, the FLASH RAM display will indicate 'FAIL'; if they do match, the FLASH RAM display will indicate 'OK.'

The FLASH RAM status displays indicate the checksum integrity of given flash RAM blocks, as follows:

Table 14. FLASH RAM settings.

Setting	Meaning
Internal FLASH RAM	Indicates whether the checksum is correct in the factory FLASH block.

User FLASH RAM	Indicates whether the checksum is correct in the user FLASH block, where most current settings are being held.

OASIS Stage Page

The Stage page of the OASIS application allows you to perform actions and define settings for the XY stage.

Stage Control

The Control area of the Stage page allows you to execute actions related to movement and initialization of the stage (Figure 35).

The Position items include movements to a given XY location, movement followed by autofocus to an XY location (OASIS-AF video autofocus module required), as well as readout and definition of the current XY position.

The Step items permit relative moves in +/- X and +/- Y directions, as well as along the diagonals. The step size is indicated in microns for each axis. A central button with a bull's eye icon returns the stage to the origin location.

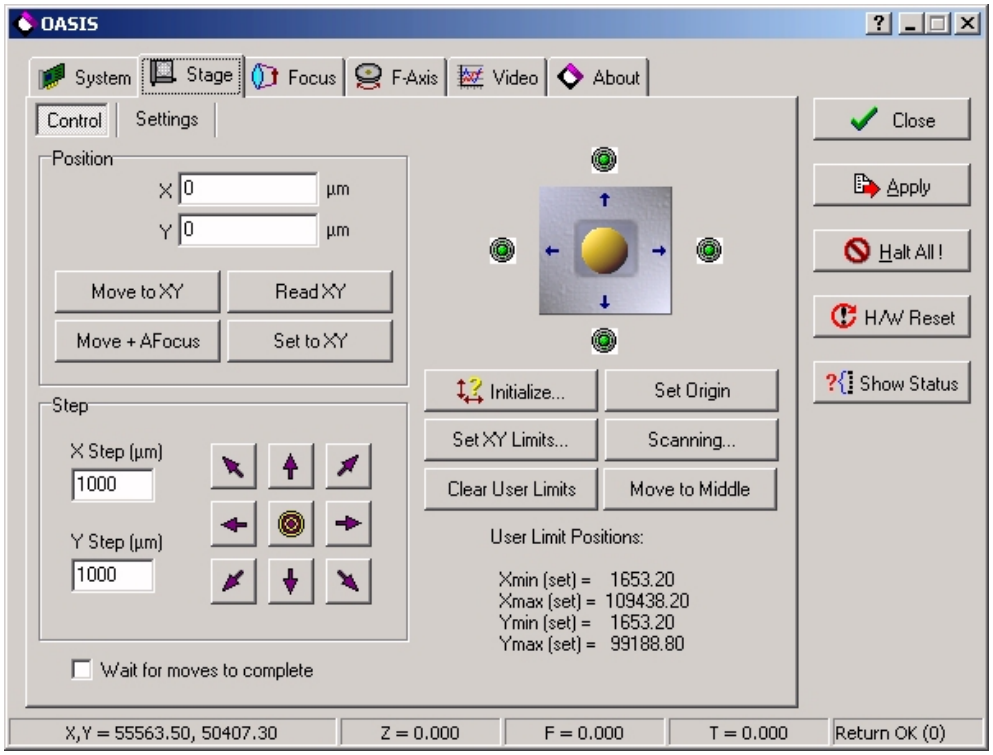


Figure 35. OASIS stage control.

Item	Description
XY position readout	The X and Y coordinate values used for Move to XY, Move + Autofocus, Read XY, and Set to XY.
Move to XY	Moves to the specified XY position.
Move + AFocus	Moves to the specified XY position and performs and automatic focus (OASIS-AF video autofocus hardware required).
Read XY	Reads the current XY positions and displays the result in Position readouts, in microns.
Set to XY	Sets the current XY positions to the values as specified by Position, in microns.
Step Size	Indicates the step distance for relative moves using the up/down arrow buttons, in microns.
Up/down/left/right arrow buttons	Moves the X and/or Y axels in the positive and negative directions by a relative amount given by the Step Size, in microns
Bull's eye	Moves the X and Y axes to the origin (zero) position.
Initialize	Prompts to determine the stage travel and set software limits based on driving the stage to opposite corners to search for the physical limit switches.
Set Origin	Sets the current position to zero, while maintaining the relative position of the soft limits.
Clear User Limits	Disables the soft limits on X and Y.

Note that the current XY stage position readout is found in the status bar at the bottom of the OASIS application window.

The Settings area of the Stage page (Figure 36) allows you to define the movement speed and acceleration, calibrate the stage using the lead screw pitch value, and define and view various other options and settings, as described below.

Stage Settings

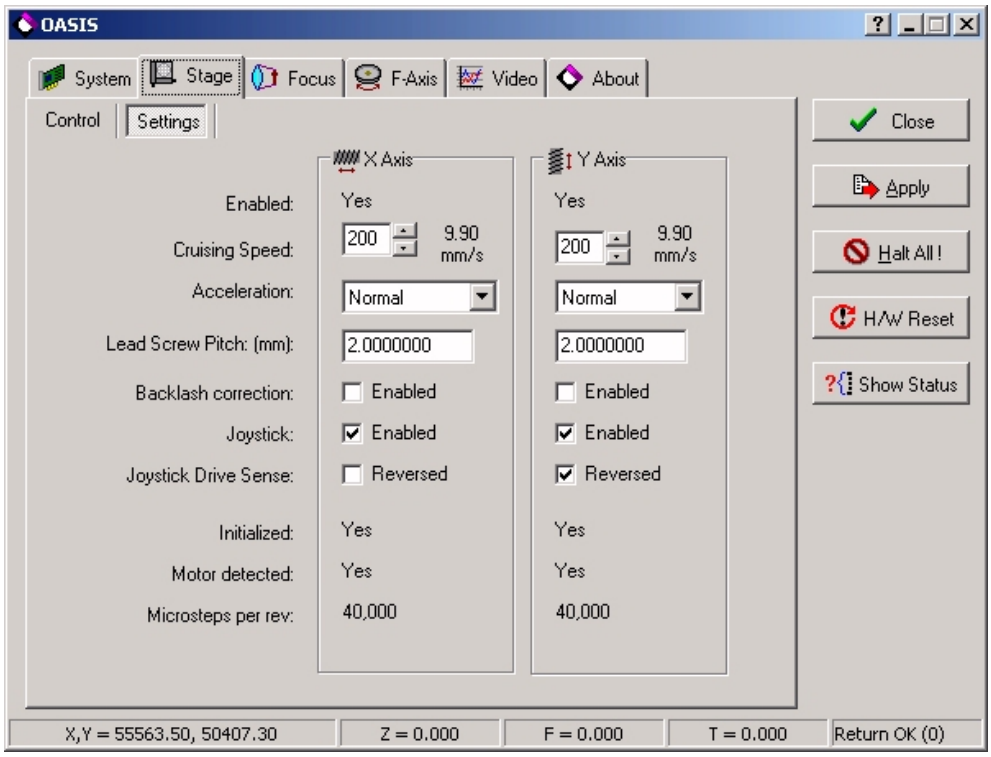


Figure 36. OASIS stage settings.

Use the Apply button in the OASIS application right-hand button group to apply your changes.

Setting	Description
Enabled	The axis is present and available for use.
Cruising speed	The index in the current acceleration ramp table to be used as the target speed. The actual speed in mm/sec is also displayed.
Acceleration	The currently selected acceleration ramp table. Four tables are available: Slow, Normal, Fast, and User
Lead screw pitch	The displacement per revolution of the axis, in mm.
Backlash correction	Enables backlash correction, ensuring the end point of each movement is approached from the same direction. This is achieved by slightly overshooting the desired position when moving in one direction, then returning to the position from the opposite direction. Movements from the opposite direction are unaffected. The amount of overshoot is specified in the flash memory and can be set using the OASIS Flash Memory

Setting	Description
	Setup application.
Joystick	Enables control of the axis via joystick inputs.
Joystick drive sense	Reverses the direction of movement for joystick deflections.
Initialized	Indicates whether the coordinate system of the axis has been defined.
Motor detected	Indicates whether a motor has been detected on the axis.
Microsteps per rev	Indicates the current microstepping resolution for the axis.

OASIS Focus Page

Z-axis control and settings are available in the Focus page.

Focus Control

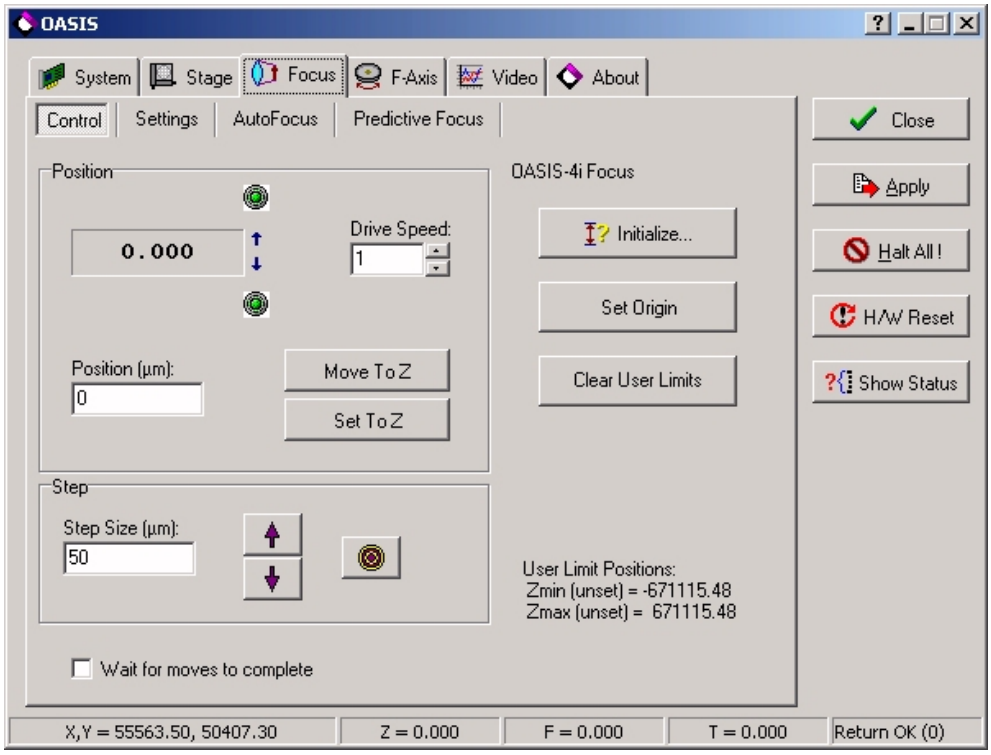


Figure 37. Focus control.

Item	Description
Z-position readout	Readout of the current focus position, with LED indication of proximity to limit (yellow is close, red means at limit). Small arrows permit continuous drive using Drive Speed setting when pressed.
Drive speed	The continuous Z-axis drive speed when using small arrows on position display.
Position	Indicates value to use for Move to Z and Set to Z commands.
Move to Z	Moves to the Z position as specified by Position, in microns.
Set to Z	Sets the current Z position to the value as specified by Position, in microns.
Step Size	Indicates the step distance for relative moves using the up/down arrow buttons, in microns.
Up/down arrow buttons	Moves the Z in the positive and negative directions by a relative amount given by the Step Size, in microns.
Bull's eye	Moves the Z axis to the origin (zero) position.
Initialize	Prompts to initialize the Z axis by defining the current position as zero and setting soft limits to provide a limited range of travel above and below the current position.
Set Origin	Sets the current position to zero, while maintaining the relative position of the soft limits.
Clear User Limits	Disables the soft limits on the focus drive. Note that without appropriate soft limits, it may be possible to damage your equipment when driving the focus too far up or down.
Wait for moves to complete	When checked, the application will wait until the move is finished before permitting further action in the Focus page.

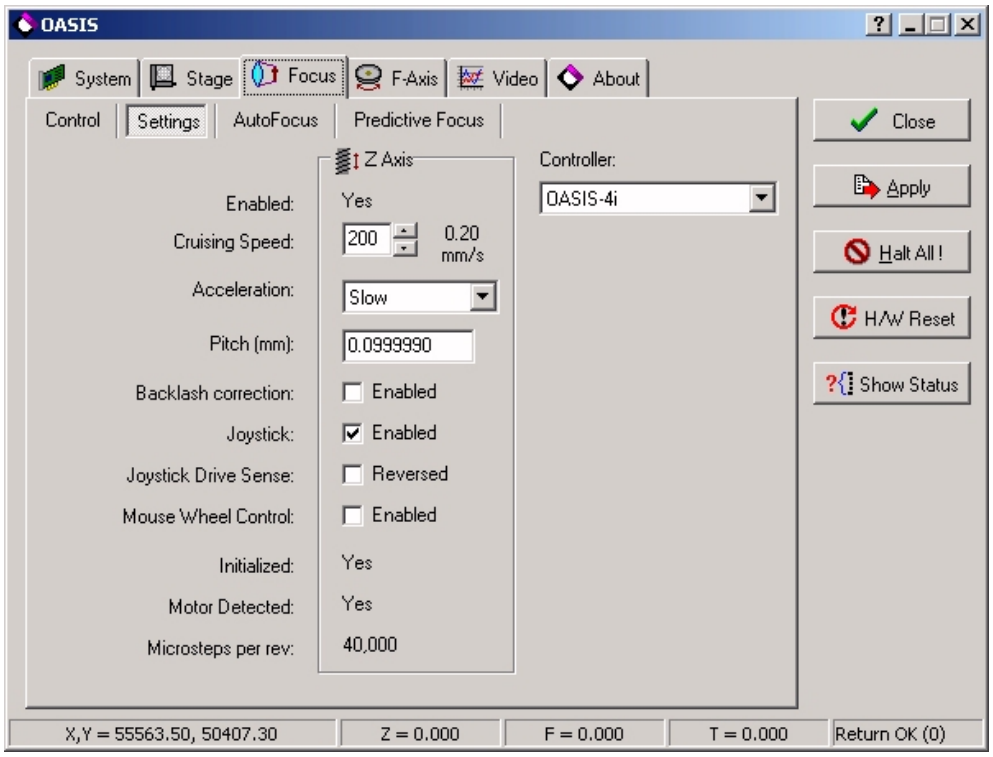


Figure 38. Focus settings.

Setting	Description
Enabled	The axis is present and available for use.
Cruising speed	The index in the current acceleration ramp table to be used as the target speed. The actual speed in mm/sec is also displayed.
Acceleration	The currently selected acceleration ramp table. Four tables are available: Slow, Normal, Fast, and User
Lead screw pitch	The displacement per revolution of the axis, in mm.
Backlash correction	Enables backlash correction, ensuring the end point of each movement is approached from the same direction. This is achieved by slightly overshooting the desired position when moving in one direction, then returning to the position from the opposite direction. Movements from the opposite direction are unaffected. The amount of overshoot is specified in the flash memory and can be set using the OASIS Flash Memory Setup application.
Joystick	Enables control of the axis via joystick inputs.

Setting	Description
Joystick drive sense	Reverses the direction of movement for joystick deflections.
Mouse wheel control	Allows the wheel on your computer's mouse to be used to move the focus drive.
Initialized	Indicates whether the coordinate system of the axis has been defined.
Motor detected	Indicates whether a motor has been detected on the axis.
Microsteps per rev	Indicates the current microstepping resolution for the axis.
Controller	Allows selection for the type of focus drive controller. The OASIS software supports other focus controllers besides the OASIS-4i, including microscopes using the Leica DM SDK and the Olympus BX-61.

Autofocus

If the OASIS-AF video processing module is fitted, then the Autofocus page will be available, allowing setup and execution of automatic focus operations.

The principle of automatic focus using the OASIS-AF is based on the video-rate *focus score* produced by the OASIS-AF module. The focus score is based on the sharpness of edges in the image present in the video signal. As detail in the image becomes sharper, the focus score increases. As the detail loses sharpness, the focus score decreases. Automatic focus involves maximizing the focus score as a function of the focus position.

The actual autofocus operation may operate by continuously driving the focus over a range, by making discrete steps over a range, or by using a "hunting" operation where the focus is stepped towards the maximum to find the local peak.

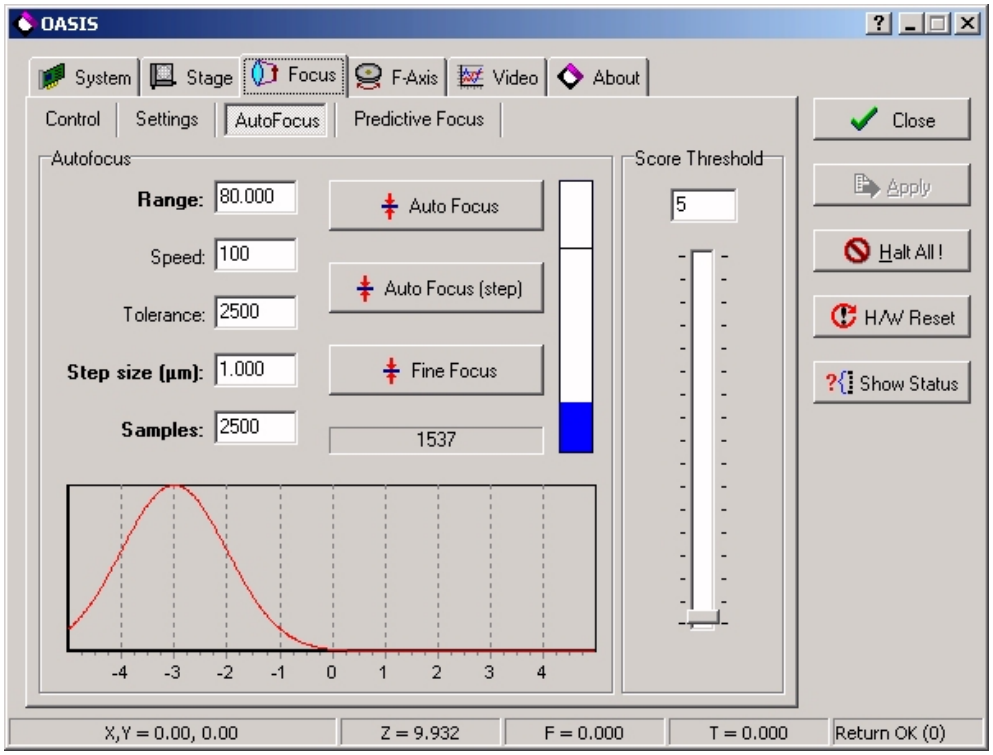


Figure 39. OASIS-AF video autofocus.

Item	Description
Auto Focus	Performs a focus operation by continuously driving the focus through a given range using the specified speed and tolerance values.
Auto focus (step)	Performs a focus operation by making discrete steps through the given range using the specified speed and tolerance values.
Fine Focus	Performs a focus operation by hunting of the local focus. The focus is stepped by a given step size, and the focus score is measured. This process is repeated until the local peak of the focus score is identified.
Range	Specifies the range of travel over which the focus is to travel when performing the autofocus.
Speed	Specifies the cruise speed to be used during the autofocus operation. Since the video input uses a fixed frame rate, faster speed settings result in fewer samples and less precision. Slow speeds result in more samples and more precision.
Tolerance	A tolerance that guides the autofocus operation in what to consider a valid peak. Lower values make the algorithm more sensitive to small variations in the focus score. For example, to work out an appropriate value for the

Item	Description
	autofocus *Tolerance*, set up your range, speed and *Threshold* parameters on a typical sample until you are happy with the speed, accuracy and reliability. Then compare the difference between the focus score value at the best focus position with that at one end of your focus range (i.e., the minimum focus score value). If you have a reasonable amount of detail in your image you will probably find that this difference is quite a large number. A good suggestion for the starting *Threshold* value would be about 1/10th of the difference in focus scores. This means that if the difference between maximum and minimum focus score values falls below this *Tolerance* value, then the focus position will return to its starting point. This is useful for preventing focus 'creep' on blank fields of view.
Step size	Specifies the step size to use for the *Auto Focus (step)* and *Fine Focus* methods.
Samples	Specifies the number of focus score samples that are to be take at each location during the *Fine Focus*. The samples are averaged to produce the score at each location. The higher the samples, the less noise in the video signal will affect the result.
Score Threshold	The focus score threshold reduces the effect of noise on the focus score value. As the threshold is increased, the score is scaled such that the actual score is decreased. The helps ensure only strong peaks in the focus score profile are considered.
Score Plot	Displays the measured focus score vs. position profile from the last auto focus operation.

Predictive Focus

Predictive focus is a feature available in the OASIS-4i controller whereby the plane of focus relative to the XY movement is used to continuously maintain proper focus.

The plane is set up by measuring three sets of X, Y, and Z values indicating the in-focus Z position at each XY location. The OASIS-4i controller uses these nine values to solve the plane of focus. Thereafter the predictive focus may be enabled, providing continuous maintenance of the predicted focus position for the current XY location, including throughout movements made via software or during joystick operations.

A commanded move of the focus, by software or joystick action, will disable the continuous predictive focus. However, the plane of focus is still stored so that predictive focus can be re-enabled when needed without re-measuring the three sets of XYZ locations.

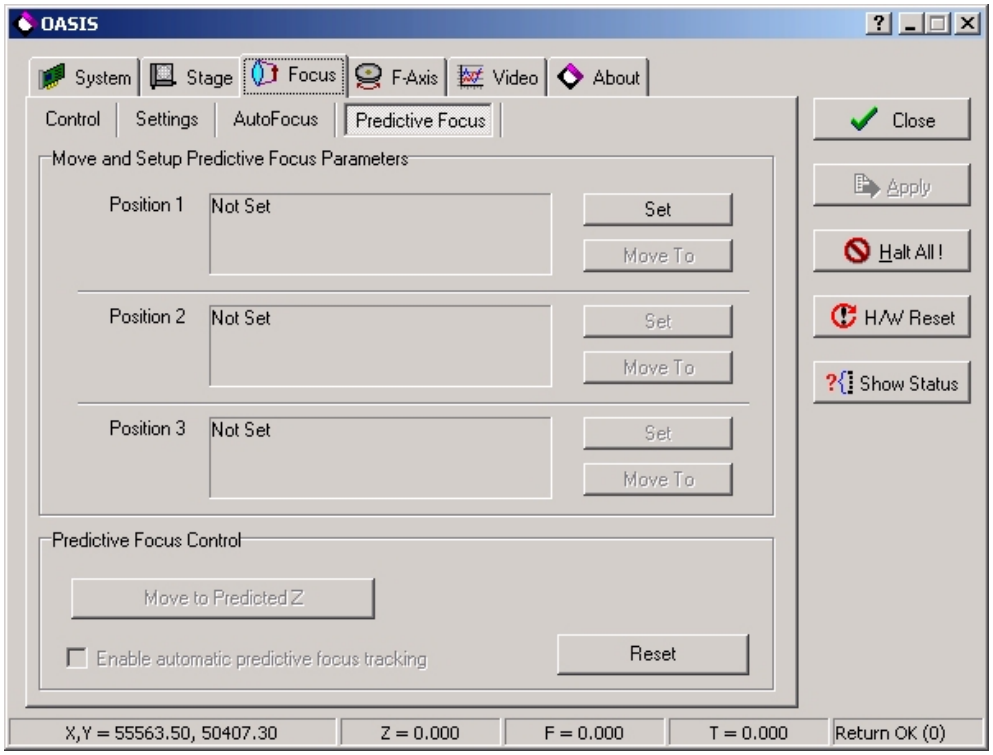


Figure 40. Predictive Focus setup and control.

Item	Description
Position 1	Sets the first set of XYZ locations to be used for predictive focus. Use the associated Set button to read and store the current XYZ position as Position 1. Use the Move To button to return to this position after it has been set.
Position 2	Sets the second set of XYZ locations to be used for predictive focus. Use the associated Set button to read and store the current XYZ position as Position 2. Use the Move To button to return to this position after it has been set.
Position 3	Sets the third set of XYZ locations to be used for predictive focus. Use the associated Set button to read and store the current XYZ position as Position 3. Use the Move To button to return to this position after it has been set.
Move to Predicted Z	Moves to the predicted Z position for the current XY location.
Enable automatic predictive focus tracking	When enabled, the focus will continuously track the predicted Z position.
Reset	Clears the predictive focus setup.

OASIS F-Axis Page

The F-Axis of the OASIS-4i is often used for filter wheels, but can be used in other applications such as for the control of zoom lenses that use stepper motors. The F-Axis pages in the OASIS application provide control and settings for the F-Axis. Also, a Filter page permits setup, initialization, and control of a typical motorized filter wheel.

F-Axis Control

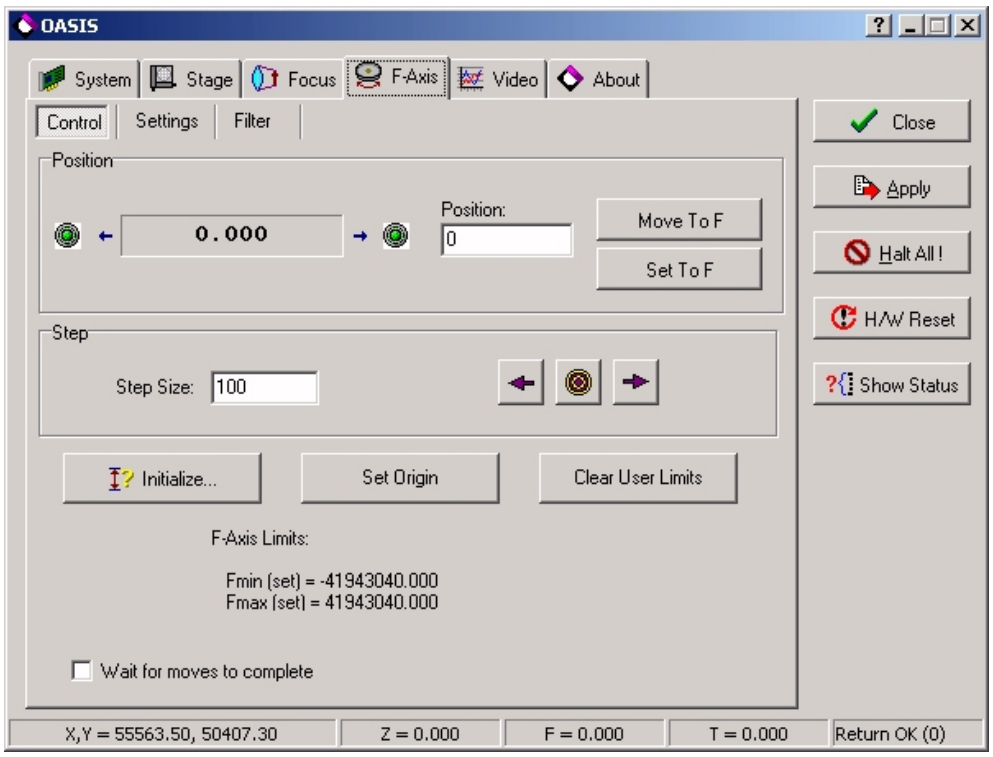


Figure 41. F-Axis control.

Item	Description
F-position readout	Readout of the current F-Axis position, with LED indication of proximity to limit (yellow is close, red means at limit). Small arrows permit continuous drive using Drive Speed setting when pressed.
Position	Indicates value to use for Move to F and Set to F commands.
Move to F	Moves to the F position as specified by Position, in calibrated units.
Set to F	Sets the current F position to the value as specified by Position, in calibrated units.
Step Size	Indicates the step distance for relative moves using the

Item	Description
	up/down arrow buttons, in calibrated units.
Up/down arrow buttons	Moves the F in the positive and negative directions by a relative amount given by the Step Size, in calibrated units.
Bull's eye	Moves the F axis to the origin (zero) position.
Initialize	Prompts to initialize the F axis by defining the current position as zero and setting soft limits to provide a limited range of travel above and below the current position.
Set Origin	Set's the current position to zero, while maintaining the relative position of the soft limits.
Clear User Limits	Disables the soft limits on the focus drive. Note that without appropriate soft limits, it may be possible to damage your equipment when driving the focus too far up or down.
Wait for moves to complete	When checked, the application will wait until the move is finished before permitting further action in the F-Axis page.

F-Axis Settings

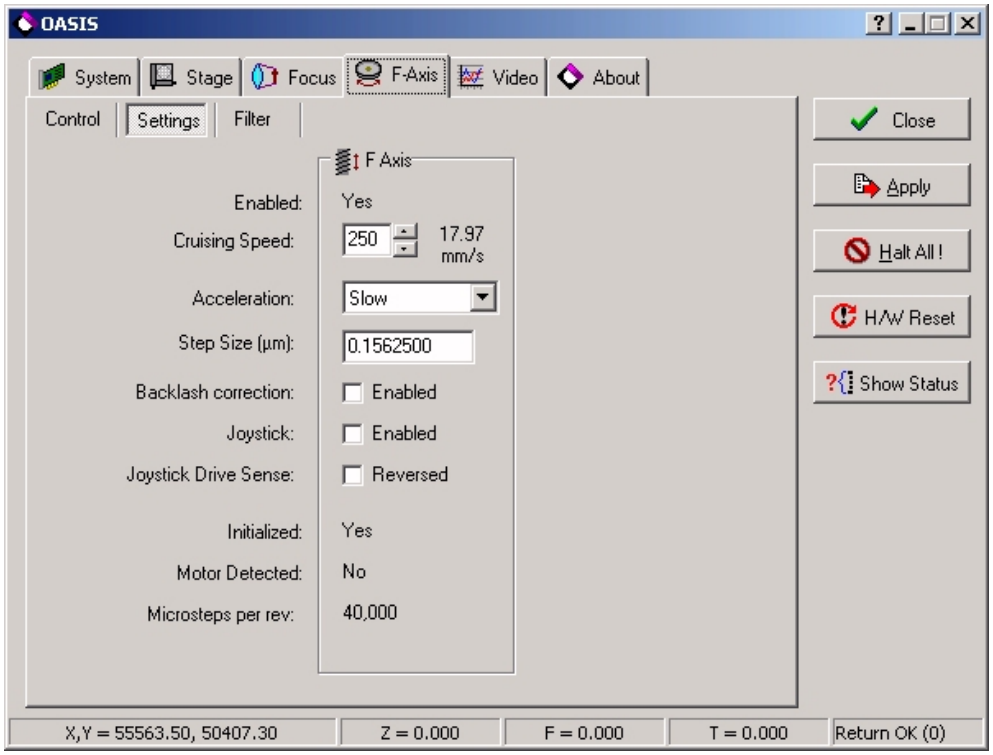


Figure 42. F-Axis settings.

Setting	Description
Enabled	The axis is present and available for use.
Cruising speed	The index in the current acceleration ramp table to be used as the target speed. The actual speed in mm/sec is also displayed.
Acceleration	The currently selected acceleration ramp table. Four tables are available: Slow, Normal, Fast, and User
Step Size	Specifies the size of each microstep for the F-Axis.
Backlash correction	Enables backlash correction, ensuring the end point of each movement is approached from the same direction. This is achieved by slightly overshooting the desired position when moving in one direction, then returning to the position from the opposite direction. Movements from the opposite direction are unaffected. The amount of overshoot is specified in the flash memory and can be set using the OASIS Flash Memory Setup application.
Joystick	Enables control of the axis via joystick inputs (if available).
Joystick drive sense	Reverses the direction of movement for joystick deflections for F-Axis control (if available).
Initialized	Indicates whether the coordinate system of the axis has been defined.
Motor detected	Indicates whether a motor has been detected on the axis.
Microsteps per rev	Indicates the current microstepping resolution for the axis.

Filter Control

The F-Axis is often used for filter wheel control, and the OASIS application provides an implementation of a filter changer on the F-Axis (as well as an implementation of a second changer on the OASIS-XA1 5th axis module, if fitted).

Typically a filter wheel is free to move through 360 degrees, but contains a home switch allowing the current position to be determined after an initialization where the home switch position is identified.

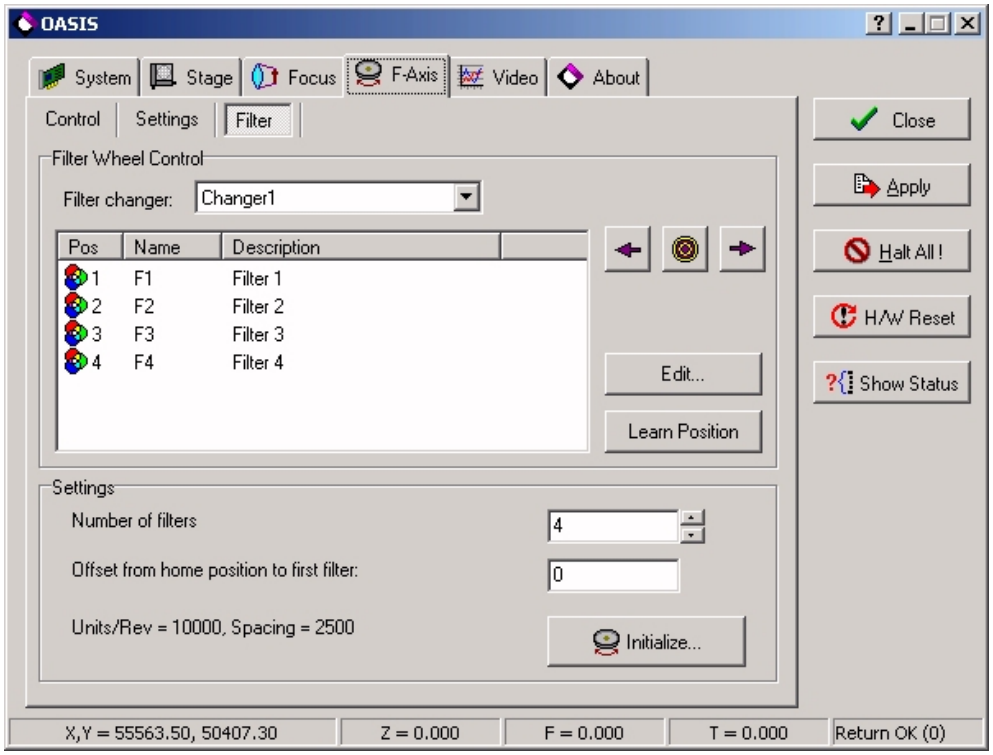


Figure 43. Filter control.

Item	Description
Filter changer	Selects which filter changer is active. For the OASIS-4i, the F-Axis is Changer 1. If the OASIS-XA1 module is fitted, then a second filter changer will be available.
Filter list	Lists the name and description of each filter in the filter wheel.
Left/Right arrows	Moves the filter changer to the previous and next filter position.
Edit	Allows the name and description of the current filter to be set.
Learn Position	Sets the currently selected filter's position to the current value for the F-Axis.
Number of filters	Specifies the number of filter positions in the filter wheel.
Offset from home position to first filter	Specifies the distance, in calibrated units, between the position and the home switch. This value is often either zero or half the filter spacing.
Units/rev	Indicates the number of calibrated units per revolution, based on the filter initialization.

Item	Description
Spacing	Indicates the spacing between filters, in calibrated units.
Initialize	Homes the filter wheel. The *Units/rev* value will be updated based on the home position data.

OASIS Video Page

If the OASIS-AF video processing module is fitted, the Video page of the OASIS application will display advanced features available for video measurement and settings.

In addition to focus score calculation used for automatic focus, the OASIS-AF module performs basic image analysis functions on the video image. These include: dual thresholding of light and/or dark features, total detected area, maximum chord length, and maximum gradient values.

Applications for the video-rate measurements of the OASIS-AF include blank field detection for pre-screening of fields during high throughput screening.

Video Control

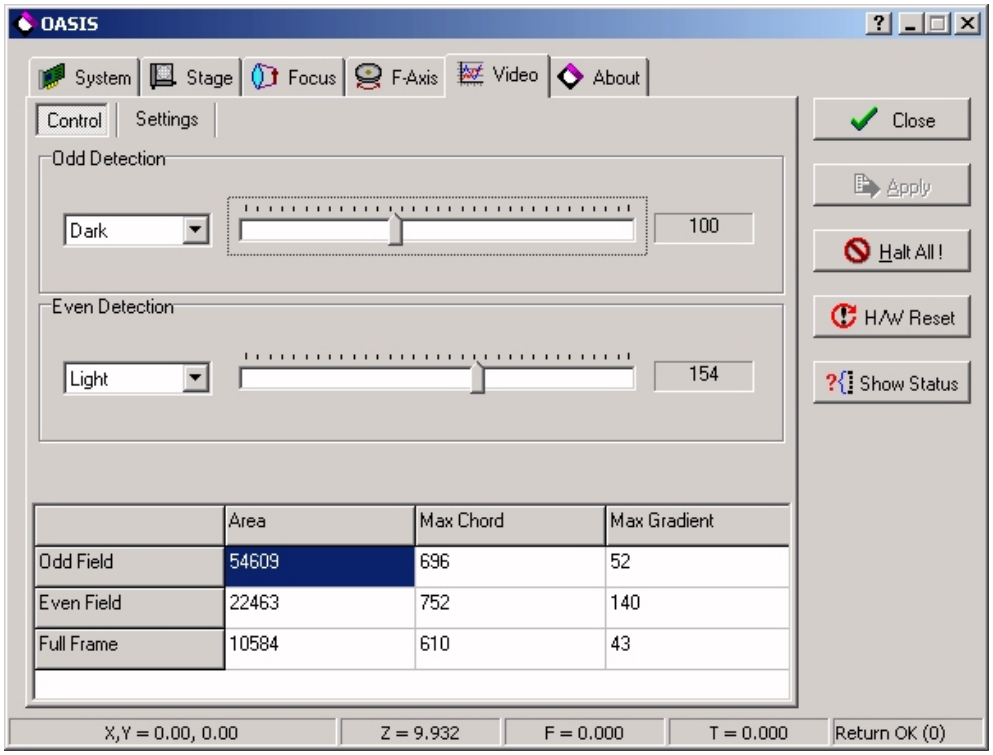


Figure 44. OASIS-AF video processing.

Item	Description
Odd Detection	Specifies the phase (light or dark) and threshold value for the odd video lines. Light thresholding occurs from the specified threshold to maximum white (255). Dark thresholding occurs from minimum dark (0) to the specified threshold.
Even Detection	Specifies the phase (light or dark) and threshold value for the even video lines. Light thresholding occurs from the specified threshold to maximum white (255). Dark thresholding occurs from minimum dark (0) to the specified threshold.
Odd Field	Displays the odd field video measurement results for the Area (pixel count), Mac Chord (pixel length), and Mac Gradient (8-bit grey value).
Even Field	Displays the even field video measurement results for the Area (pixel count), Mac Chord (pixel length), and Mac Gradient (8-bit grey value).
Full Frame	Displays the combined even and odd field video measurement results for the Area (pixel count), Mac Chord (pixel length), and Mac Gradient (8-bit grey value).

Video Settings

The OASIS-AF module supports a moveable rectangular region of interest. This window selects the area where focus score and video measurements are to take place.

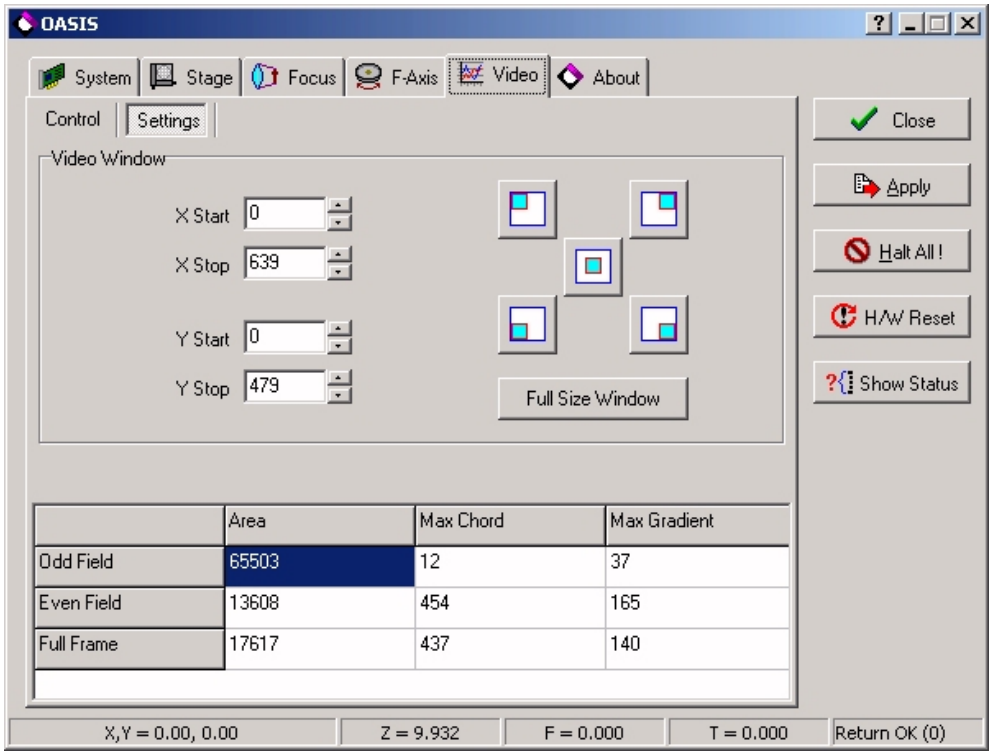


Figure 45. OASIS-AF video window settings.

Item	Description
X Start	Specifies the left edge of the video window, in pixels.
X Stop	Specifies the right edge of the video window, in pixels.
Y Start	Specifies the top edge of the video window, in pixels. Note that this value must be less than the mid-point of the vertical dimension of the image.
Y Stop	Specifies the bottom edge of the video window, in pixels.
Frame quadrant buttons	Moves the video window to quadrants upper-left, upper-right, lower-left, lower-right, and centred.
Full Size Window	Sets the video window to the full size of the video image.

OASIS About Page

The OASIS application About page displays version information for the OASIS application, as well as the onboard firmware for the OASIS-4i controller, including DSP and EPROM revision data.

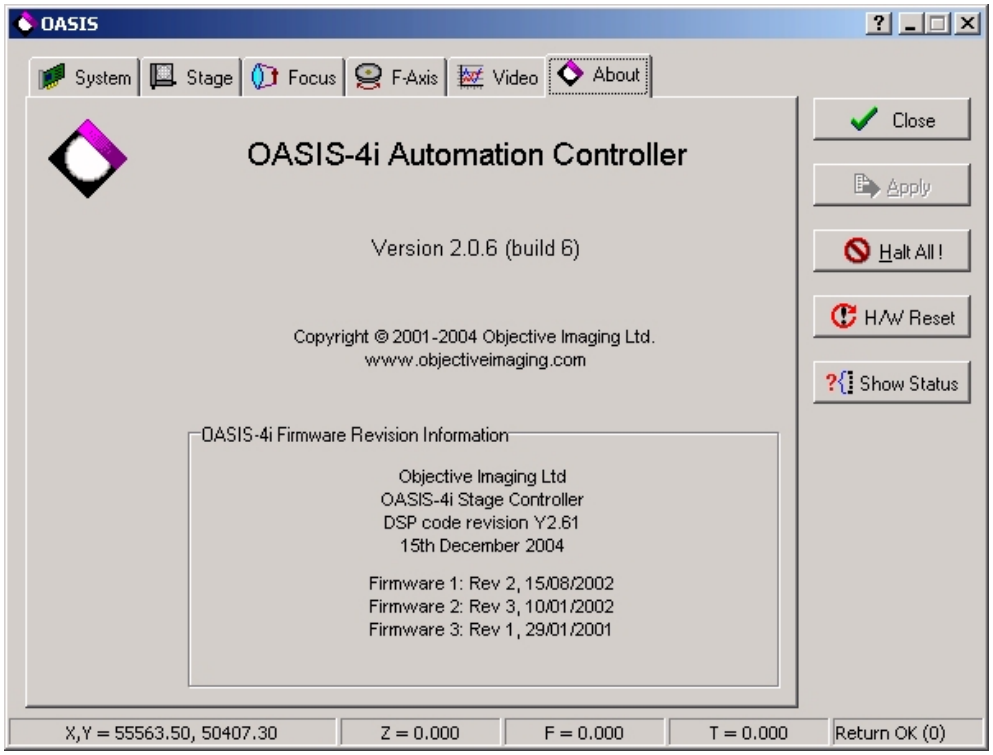


Figure 46. OASIS version information.

Flash Memory

The on-board flash memory of the OASIS-4i controller stores information in a permanent format and is used to customise the configuration of the controller to particular situations. The settings stored in flash represent fundamental parameters that are infrequently altered except when optimising the controller for the various hardware options that have been connected to it.

The executable code that runs the DSP on the OASIS-4i is also stored in flash memory, allowing for simple upgrades from time to time as new versions are released.

The OASIS Configuration Wizards write many of the settings used in the flash based on automatic detection and user input of hardware configuration settings. As various settings are actually interdependent (such as axis and limit directions, microstepping resolution and ramp tables, etc.), it is recommended that you use the OASIS Configuration Wizards where possible to setup the OASIS-4i controller for your particular system.

For advanced configuration, the Flash Memory Setup application is used.

Flash Memory Organization

The Flash memory is divided up into several blocks, three of which are dedicated to configuration settings. The upper-most block (block 7), contains the factory pre-set default settings, much like the default settings of a PC BIOS, which are thought to be the most general purpose and safe settings. Block 7 may not be changed by the user. Block 5 (the user block) is

initially programmed with the same settings as found in block 7, the factory presets. However, some of the settings in this block are usually altered by the user to suit their needs. Block 6 is used as temporary storage whilst programming is underway, so that a copy of the user block is available in the event of failure whilst programming (for example, due to power failure).

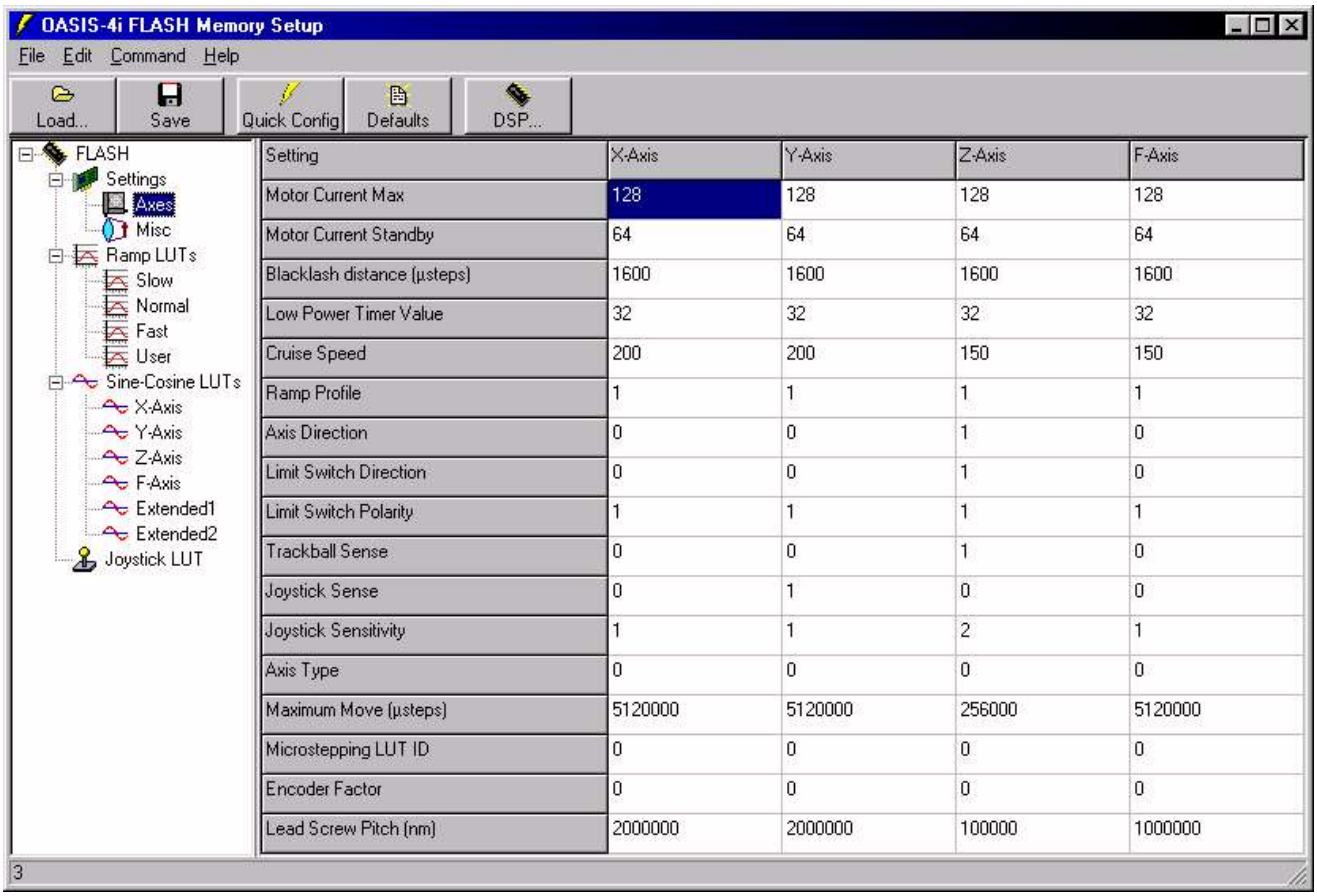
The lower blocks of flash memory store the DSP code, and are accessible only during updates of the DSP software from the DSP update utility or via the Flash Memory Setup application.

Using the Flash Memory Setup Application

The OASIS-4i Flash Memory Setup application is used to view and modify the settings stored in the user block of flash settings (Figure 47).

On the left is a panel that groups the settings into categories:

- General settings for each axis and miscellaneous items such as joystick type.
- Ramp LUTs list the details of each acceleration ramp.
- Sine-Cosine LUTs defining the actual motor drive microstepping tables.
- Joystick LUT specifying joystick ADC input-to-speed values.



Setting	X-Axis	Y-Axis	Z-Axis	F-Axis
Motor Current Max	128	128	128	128
Motor Current Standby	64	64	64	64
Blacklash distance (µsteps)	1600	1600	1600	1600
Low Power Timer Value	32	32	32	32
Cruise Speed	200	200	150	150
Ramp Profile	1	1	1	1
Axis Direction	0	0	1	0
Limit Switch Direction	0	0	1	0
Limit Switch Polarity	1	1	1	1
Trackball Sense	0	0	1	0
Joystick Sense	0	1	0	0
Joystick Sensitivity	1	1	2	1
Axis Type	0	0	0	0
Maximum Move (µsteps)	5120000	5120000	256000	5120000
Microstepping LUT ID	0	0	0	0
Encoder Factor	0	0	0	0
Lead Screw Pitch (nm)	2000000	2000000	100000	1000000

Figure 47. OASIS-4i Flash memory setup application.

Axis Settings

The flash settings for each axis may be set independently by selecting the axis value and entering the desired new value.

Motor Current Max

For each motor (X, Y, Z, and F), you may define the maximum permissible peak current per phase. The maximum value allowed for these settings is 255, which corresponds to a current of 1.25 Amps. The minimum is 0, which corresponds to 0.00 Amps. The relationship is linear such that if a peak current of 0.625 Amps was required, the setting for that axis would be: 0.625/1.25 * 255 = 128.

We recommend this median value for most small stages. If stalling occurs at high speeds, try a *lower* current setting, if stalling occurs at slow speeds, try increasing the current a little (and possibly a slower acceleration profile).

Motor Current Standby

The motor current standby values follow the same rules as for Motor Current Max. These settings will be used when an axis has been left idle for a defined length of time. Usually these settings are lower than the corresponding 'Motor Current Max.' setting as it is not necessary to keep this current flowing through the motor phases whilst the motor is stationary. This can prevent excessive heat build-up in the motors and the board's output drivers.

Low Power Timer Value

The Low Power Timer settings determine how long it will be, from a motor becoming idle, until the 'Motor Current Standby' settings come into play. A value of 1 corresponds to approximately 32 msec. The maximum value is 65,535 or just over 2000 seconds. The default value is 32 or approximately 1 second.

Backlash Distance (Micro-steps)

For each motor (X, Y, Z, and F), you may define the backlash correction distance. Backlash is enabled or disabled using an application software function. These settings allow you to adjust the amount of correction applied. The maximum value for each setting is 65,535 micro-steps. (There are typically 12,800 micro-steps for every revolution of a 200 step motor.)

Cruise Speed

For each motor (X, Y, Z, and F), you may define the cruising speed (maximum speed). Permissible settings range between 1 and 511. These values correspond to an entry in the 512 location 'Ramp Profile' currently loaded for each axis. Choose settings which give fast, smooth and low noise stage movements. A value of 200 with the normal 'Ramp Profile' is a good starting point for a 2mm/rev lead screw pitch stage.

Ramp Profile

For each motor (X, Y, Z, and F), you may choose from one of four acceleration/deceleration profiles. Permissible settings for each axis are:

0	-	Slow Ramp Profile
1	-	Normal Ramp Profile

2 - Fast Ramp Profile

3 - User Defined Ramp Profile (Currently the same as Normal)

We recommend a setting of 1 for most applications.

Note: These settings may also be changed under software control.

Axis Direction

For each motor (X, Y, Z, and F), you may choose the direction of rotation that will be regarded as a positive rotation by the software. A value of 0, means a motor shaft will turn clockwise (looking at it from the rear of the motor), for a positive move, and a value of 1, anti-clockwise. This can be useful when trying to match a scan pattern on the screen with what physically happens to the stage, or to accommodate the focus motor being mounted on either side of a microscope.

Please note that it will probably be necessary to change the appropriate 'Limit Switch Direction' setting, described below, if the axis direction setting is altered, as the axis will now drive to the opposite limit switch (if fitted).

Limit Switch Direction

When an axis is moving in the positive direction, only the positive limit switch is checked at every step. Likewise for a move in the negative direction, only the negative limit switch is checked. These settings allow the limit switches for any axis to be swapped over. This is likely to be necessary if the 'Axis Direction' settings are altered, or possibly if some special hardware is being driven.

The usual value is 0. To swap over the limit switches for a given axis, use a value of 1.

Trackball Sense

For the X, Y and Z axes, you may change the direction of movement whilst using the trackball. This is to allow for personal preference and possible 'flipping' of the image in one axis as is the case with some microscopes.

Permissible values for each axis are 0 and 1.

Note: These settings may be changed under software control too.

Joystick Sense

For the X, Y and Z axes, you may change the direction of movement whilst using the joystick. This is to allow for personal preference and possible 'flipping' of the image in one axis as is the case with some microscopes.

Permissible values for each axis are 0 and 1.

Note: These settings may be changed under software control too.

Joystick Sensitivity

For the X, Y and Z axes, you may change the sensitivity of movement whilst using the joystick. This is to suit various lead-screw pitches and magnifications.

Permissible settings for each axis are:

0 - High speed movement

1 - Medium speed movement

2 - Slow speed movement

3 - Very slow speed movement

Axis Type

These are intended for reference only and are not currently used.

Maximum Move (Micro-steps)

For each motor (X, Y, Z, and F), you may define the maximum move distance in micro-steps. There are typically 12,800 microsteps for every revolution of a 200 step motor, though other microstepping resolutions are supported.

This is an important safety measure when an axis has no physical limit switches, like several of the available focus adapters. If the controlling software asks the OASIS-4i to move an axis a distance which is greater than the value defined in these settings, then it will refuse to move.

Valid numbers for each axis are from 1 to 2,147,483,648 (2^{31}).

The default settings are 5,120,000 (400 turns), for the X, Y and F axes, and 256,000 (20 turns) for the Z axis.

Miscellaneous Settings

The following video window settings are to allow as much of the cameras field of view as possible, to be used for generating the focus score values and the video data. These may need modifying slightly to suit different camera types.

CCIR Video Window Start X

Horizontal start position offset for CCIR type camera. Default = 32 (2x desired pixel number).

CCIR Video Window Stop X

Horizontal stop position offset for CCIR type camera. Default = 1546 (2x desired pixel number).

CCIR Video Window Start Y

Vertical start position offset for CCIR type camera. Default = 24 (field based).

CCIR Video Window Stop Y

Vertical stop position offset for CCIR type camera. Default = 284 (field based).

RS170 Video Window Start X

Horizontal start position offset for RS170 type camera. Default = 32 (2x desired pixel number).

RS170 Video Window Stop X

Horizontal stop position offset for RS170 type camera. Default = 1546 (2x desired pixel number).

RS170 Video Window Start Y

Vertical start position offset for RS170 type camera. Default = 24 (field based).

RS170 Video Window Stop Y

Vertical stop position offset for RS170 type camera. Default = 284 (field based).

Trackball Autofocus Range 1

When using the Kensington Expert Mouse 5.0 trackball (Part no. 64215), the lower left button repeats the last autofocus command issued, or, one of three predefined autofocus commands, selected by repeated pressing of the lower right button. The autofocus range of the first in the sequence may be adjusted by changing this value. (Values are in micro-steps.)

Permissible values for this setting are between 1000 and 65,535; the default setting is 10,240.

Trackball Autofocus Range 2

The autofocus range of the second in the sequence may be adjusted by changing this value. Permissible values for this setting are between 1000 and 65,535; the default setting is 8,192.

Trackball Autofocus Range 3

The autofocus range of the third in the sequence may be adjusted by changing this value. Permissible values for this setting are between 1000 and 65,535; the default setting is 4,096.

Trackball Autofocus Speed 1

The autofocus speed of the first in the sequence may be adjusted by changing this value. The value is the speed that relates to that position in the currently selected Ramp LUT. Permissible values for this setting are between 1 and 255; the default setting is 128.

Trackball Autofocus Speed 2

The autofocus speed of the second in the sequence may be adjusted by changing this value. The value is the speed that relates to that position in the currently selected Ramp LUT. Permissible values for this setting are between 1 and 255; the default setting is 32.

Trackball Autofocus Speed 3

The autofocus speed of the third in the sequence may be adjusted by changing this value. The value is the speed that relates to that position in the currently selected Ramp LUT. Permissible values for this setting are between 1 and 255; the default setting is 2.

Ramp Profile LUTs

The acceleration ramps used for Slow, Normal, Fast, and User profiles are stored as lookup tables in the OASIS-4i flash memory. See the section *Speed and Acceleration* in the *Principles of Operation* chapter for more information regarding acceleration ramps.

Although individual values may be edited using the Ramp LUTs section in the Flash Memory Setup application, the Flash Memory Setup also provides a tool for generating ramps, found under the Edit menu.

Using the Acceleration Ramp Generator, you can select one of the four ramp tables. The table details and a graphic display are shown. To calculate a new acceleration profile:

1. Select the type of ramp, either linear or S-curve.
2. Define the starting point in the table by entering a start time in microseconds and move distance in microsteps.
3. Define the end target speed in the table by entering a time and microstep distance.
4. Indicate the target cruise index associated with the final point. For instance, a target cruise of 511 indicates the profile should use the last entry of the table as the end-point for the curve. A value of 256 would indicate that the curve should reach the final point at the 256th entry in the table, with the remaining entries taken on the final speed value.
5. To general the ramp, click the Calculate button.
6. To save the ramp into the flash, click on OK to dismiss the dialog and click the Save button on the main Flash Memory Setup toolbar.

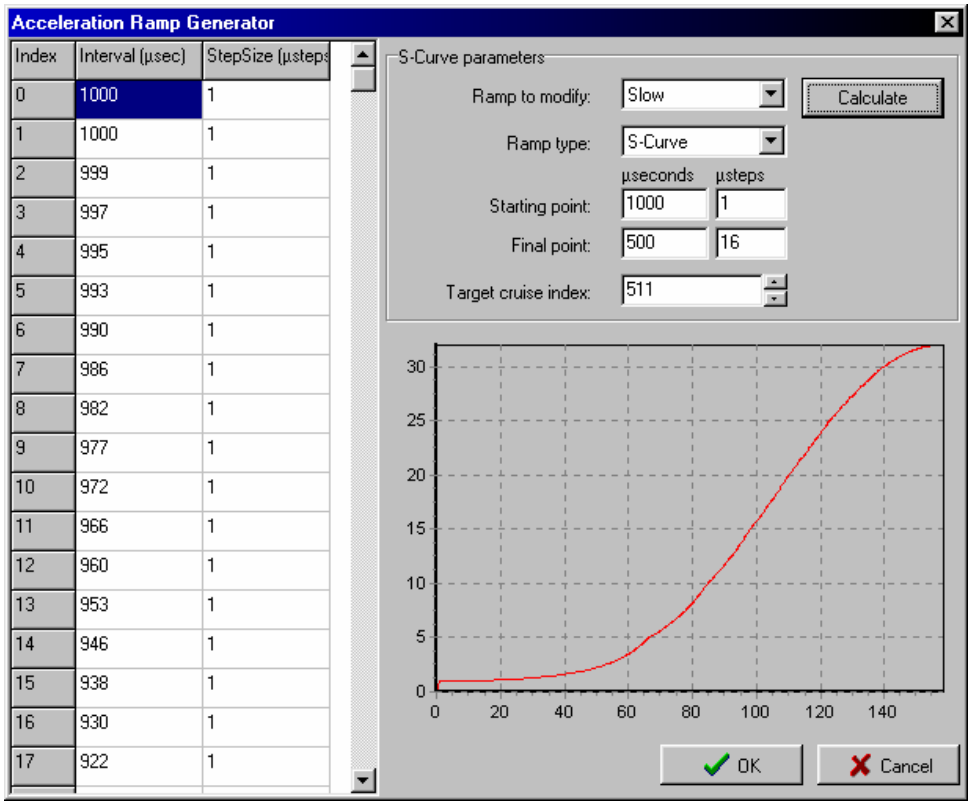


Figure 48. Acceleration ramp generation in the Flash Memory Setup application.

Sine Cosine LUTs

The Sine-Cosine LUTs specify how the microstepping is to take place for each axis. A LUT is available for each axis, as well as two extended tables supporting custom microstepping resolutions.

Note: incorrect setting of the Sine-Cosine LUTs can lead to motor drive problems. Only advanced users should modify these tables.

Joystick LUT

The joystick lookup table specifies how the 8-bit ADC inputs from the joystick unit are translated into speed.

Updating the DSP Code

The code that the DSP on the OASIS-4i board loads on power-up is also stored in other areas of the Flash memory. The Flash Memory Setup application allows the DSP code to be updated in the field, as necessary.

To upgrade it to a later (or earlier) version, first make sure you have a copy of the desired DSP data file, then press the button labelled 'DSP' on the toolbar. Select the data file and the update will proceed. The new code will actually be loaded by the DSP when it is either next reset or powered off and on again.

Appendix

A

TROUBLESHOOTING GUIDE

Problem	***Possible Causes***	***Solution***
OASIS-4i card not detected by Windows; Plug-and-Play does not find OASIS-4i card	• Card not fully seated into PCI slot	Ensure card is fully seated into PCI slot along entire length
	• Conflict with another card on PCI bus	Move OASIS-4i card to another free PCI slot
OASIS-4i card is listed as an unknown PCI device in Windows Device Manager	• OASIS-4i driver not installed	Perform driver installation procedure
My 3rd party application software cannot recognize OASIS-4i card	• OASIS-4i driver not installed	Perform driver installation procedure
	• Application's support library for OASIS-4i card not installed	Run application's motorized controller installation procedure; refer to the application documentation for further details
My 3rd party application recognizes the OASIS-4i card, but the motors are not working	• Motor power not connected	Ensure OASIS-4i motor power connector (PL5) is fitted with a power supply plug
	• Motor cable connectors disengaged or faulty	Ensure motors are connected fully fitted at OASIS-4i connector SK1 and at motor end of cables

Problem	*Possible Causes*	*Solution*
	• OASIS-4i is not properly configured for the type of automation hardware fitted	Run OASIS configuration wizard to setup the card for your system
	• Axis positions are outside the limits of travel	Run OASIS configuration wizard or 3rd party application options to initialize the axis coordinate system
The system is stalling when making movements	• Insufficient power to motor drives	Adjust maximum motor current using the OASIS Flash Memory Configuration utility
	• Insufficient power to motor drives	Use parallel motor windings to increase current in motor phases
	• Insufficient power to motor drives	Increase motor drive voltage using external 24V power supply
	• The drive lead screw is damaged	Contact automation mechanics manufacturer for service details
The XY stage does not halt when a physical limit is reached	• 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	• Axis calibration incorrect	Set axis pitch or step size using OASIS or 3rd party application software
	• The axis is stalling	See troubleshooting section for stalling during movement
	• Encoder, if fitted, is configured incorrectly	Run OASIS configuration wizard for encoders or define encoder settings using OASIS Flash Memory Configuration utility
The Joystick is not working	• Internal cable connection	Verify internal connection from joystick cable connector

Problem	*Possible Causes*	*Solution*
	error	plate to PL7 on back end of OASIS-4i card; ensure red stripe on ribbon cable is aligned to Pin 1 on connector PL7

If You Need Help

If your OASIS-4i controller was provided as part of an integrated solution, your first contact should by to your system vendor. They will be most familiar with your overall system and any specialized configuration details.

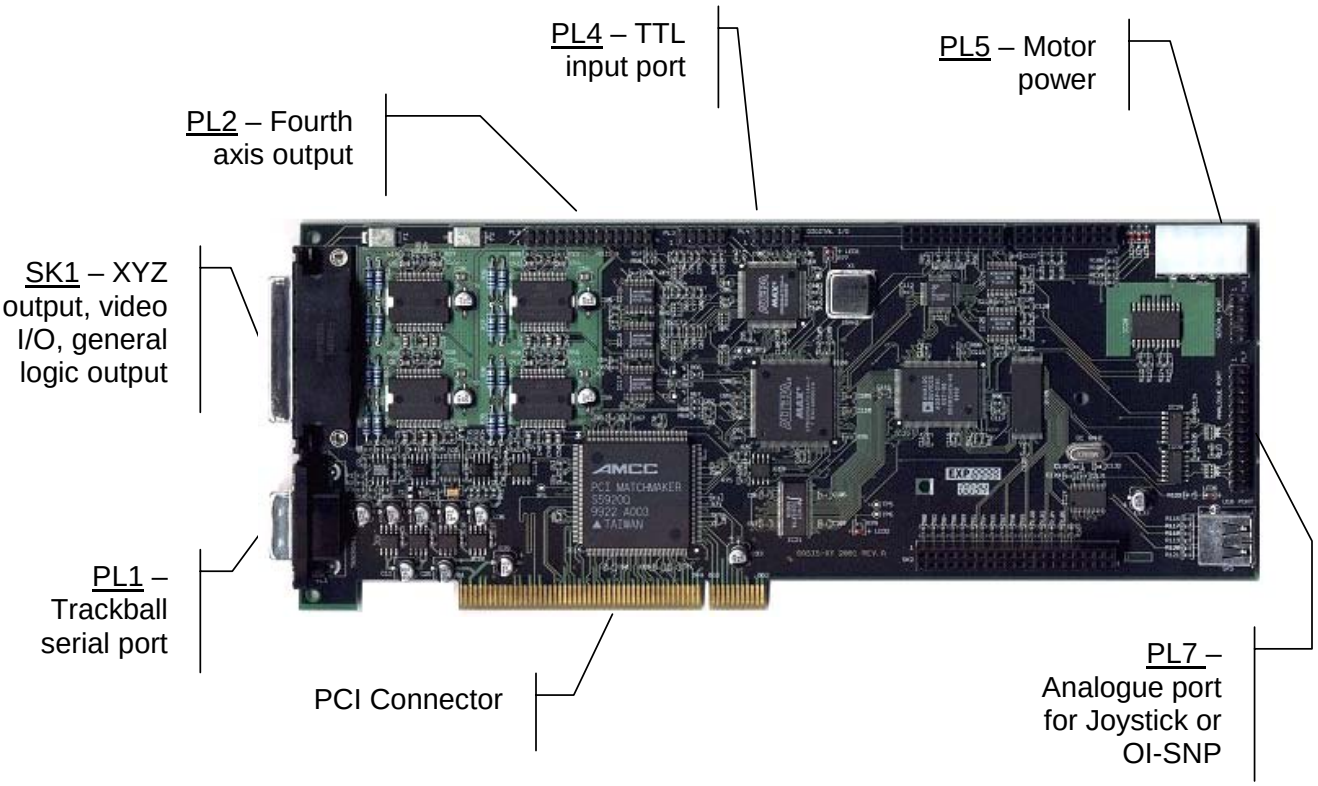
To contact Objective Imaging directly, please visit *www.objectiveimaging.com* for contact details for your area.

Appendix

B

CONNECTOR INFORMATION

Refer to the following schematic for connector placement on the OASIS-4i card.



SK1 - 44-way HD-type female - XYZ, video, and digital outputs on front panel.

The main connector for XY stage, Z focus, video I/O, XYZ encoder input, and digital output signalling.

Pin	Signal	Pin	Signal
1	Video in (Y)	23	I/O Control 2
2	Ground (Video in Y)	24	Y Encoder B
3	Z-axis Cosine Out	25	Y Encoder A
4	Z-axis Sine Out	26	Ground
5	Z-axis Sine Return	27	No Connect
6	Z-axis Cosine Return	28	X Encoder B
7	Y-axis Cosine Out	29	X Encoder A
8	Y-axis Sine Out	30	Ground
9	Y-axis Sine Return	31	Video out (Y)
10	Y-axis Cosine Return	32	Ground (Video out Y)
11	X-axis Cosine Out	33	Video out (C)
12	X-axis Sine Out	34	Ground (Video out C)
13	X-axis Sine Return	35	Z Limit -ve
14	X-axis Cosine Return	36	Z Limit +ve
15	Key (No connect)	37	Open Collector Output 1 (100R current limit resistor)
16	Key (No connect)	38	+ 5V (Fused - 1A)
17	Video in (C)	39	Y Limit -ve
18	Ground (Video in C)	40	Y Limit +ve
19	I/O Control 1	41	Open Collector Output 2 (No current limit resistor)
20	Z Encoder B	42	+12 V (Fused - 1A)
21	Z Encoder A	43	X Limit -ve
22	Ground	44	X Limit +ve

PL2 - 25-way D-type female - F-axis connector

Fourth axis connector designed to be connected to filter wheels, motorized zoom, and general-purpose motor drive. Connected to PL2 via ribbon cable.

Pin	Signal	Pin	Signal
1	F-axis Sine Out	9	F Limit +
2	F-axis Sine Return	10	F Limit
3	F-axis Cosine Out	11	N/C
4	F-axis Cosine Return	12	N/C
5	F Encoder A	13	Home Input
6	F Encoder B	14	+5V
7	N/C	15	+5V
8	N/C	16 - 25	0V

PL1 – 9-way D-type male - Trackball/Mouse port on front panel

RS232 port designed to connect to a serial mouse or trackball.

Pin	Signal
1	N/C
2	data receive
3	data transmit
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	N/C

PL7 – 26-way header male – Analogue/Joystick port

Pin	Signal	Pin	Signal
1	VRef	14	GND
2	GND	15	DSP Serial Port Data transmit
3	Joystick X Input	16	GND
4	GND	17	DSP Serial Port gated SCLK
5	Joystick Y Input	18	GND
6	GND	19	DSP Serial Port Receive Frame Sync (RFS)
7	GND	20	N/C
8	N/C	21	DSP Serial Port Data Receive
9	+5V	22	N/C
10	N/C	23	DSP IRQE (Focus Digi-knob A signal)
11	DSP Serial Port gated SCLK	24	N/C
12	GND	25	TTL Input (Focus Digi-knob B signal)
13	DSP Serial Port Transmit Frame Sync (TFS)	26	N/C

PL4 – 10-way header male - TTL input port

TTL/3.3V compatible input port.

Pin	Signal
1	Input 0
2	GND
3	Input 1
4	GND
5	Input 2
6	GND
7	Input 3
8	GND
9	+3.3V
10	GND

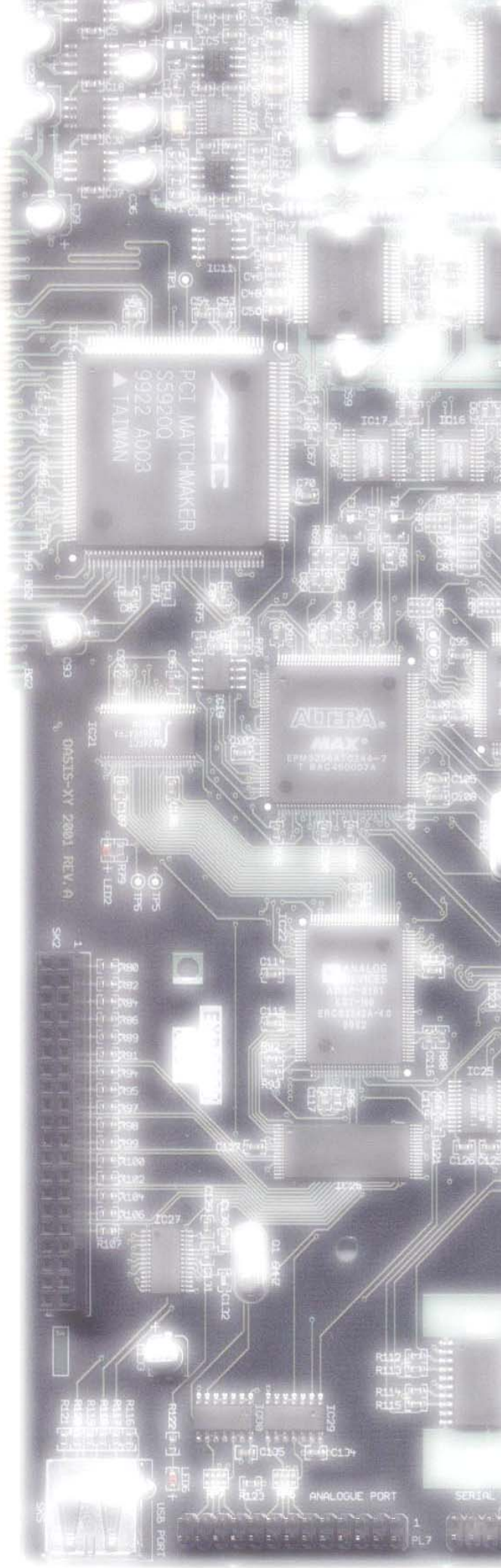
Appendix

C

OASIS-4i SPECIFICATIONS

Stepper Performance	Axes	4 (Independently controlled)
	Micro-step resolution	1/64 Full-step (0.028 degrees with 200 step/rev motor)
	Maximum speed	512 KHz (micro-steps/sec), 8 KHz (half-steps/sec)
	Minimum speed	32 Hz (micro-steps/sec), 1 Hz (half-steps/sec)
	Maximum motor current	0.5A to 1.25A/phase in 5mA steps
	Maximum motor supply voltage	+30V (typically +12V)
	Minimum motor supply voltage	+10V
	Command overhead (Move XYZ)	<10 µs
	Controller Response time (Move XYZ)	<20 µs
	Acceleration/deceleration profiles	Preset slow/normal/fast or user definable
	Position counter accuracy	32 bits
General	Processor (DSP)	ADSP-2181
	Processor clock frequency	32 MHz
	Non-volatile memory	1-Mbit Flash for program and user configuration storage
	Reset method	Hardware watchdog, software, (PC reset selectable as required)
	Switch-on time	<1 s - fully functional
Bus Interface	Type	PCI 2.2 Compliant
	Bus-master	No
	Operating Frequency	to 33 MHz
System Safety	Watchdog timer function	Resets board on processor fail
	Watchdog timeout	1.6 s
	Drive current limit	4 A max per motor
	Drive current limit response time	4 ms (typical)
	Thermal shutdown	Yes
	Temperature monitor	Yes
	Drive voltage monitor	Yes
	Hardware limit switch inputs	Definable N/O or N/C
	Software limits	User defined
	Software	Stop individual or all axes command
I/O	Encoder inputs	Phase-quadrature, +5V, each axis
	Maximum count rate	512 KHz
	O/C output - current limited	1 (100 Ohm in series)
	O/C output - unprotected	1 (100 mA max)
	Home input (filter-wheel)	1 (10k pull-up to +5V)
	General Purpose I/O	4 (3.3V)
	+12V	Via 44-way connector (resettable fuse protected 1.1A)
	+5V	Via 44-way connector (resettable fuse protected 1.1A)
	S232 ports	2 (1 used for Trackball/mouse control of XYZ axes)
	Analogue port	1 (joystick interface)
	Phase-quadrature I/P	1 (for Z axis control)
	SVHS video I/P	1 (75R terminated for use with optional Autofocus module)
	SVHS video O/P	1 (buffered video in, 75R drive)

Power Reqm't (Max)	+5 V (±5%)	1.75A
	+12 V (±5%)	100 mA
	–12 V (±5%)	50 mA
	10-28V (motor supply)	1.4 x motor phase current x number of axes driven simultaneously
	PC Power Supply	PC power of 250W or higher is required (in some models the fitting of an additional cooling fan is recommended)
Connectors	Drive / Encoder / Limit I/O connector	44-way female high-density d-type with screw fixings
	Trackball / Mouse connector	9-way male d-type (standard serial port)
	4th axis	25-way female d-type with screw fixings (optional)
	RS232	9-way male d-type (standard serial port) (optional)
	Motor power	4-way male disk-drive power connector (normally connected to PC power supply)
Physical Dimensions	Length / Height (excluding connectors)	248 mm x 102 mm (9-3/4" x 4")
Environment	Operating temperature	0 to 35 °C (ambient)
	Storage temperature	0 to 70 °C



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