

# MAC 6000 Configuration Manual



Ludl Electronic Products, Ltd.  
p/n: 90M039

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# Preface

## Summary

This user guide introduces you to the LEP MAC6000 Modular Automation Controller. It will orient you to the many features and how to configure your system.

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## Ludl on the internet

For further information on LEP products, please visit [www.ludl.com](http://www.ludl.com)

## Safety Information

This manual contains sections on setting up the controller and installing mechanical systems. Where applicable throughout this manual, cautions and warnings are used to draw your attention to safety precautions that should be taken.

## Customer Service

If service should be required, contact your equipment dealer or Ludl Electronic Products, 171 Brady Avenue, Hawthorne, NY 10532-2201 (888) 769-6111.

By email or through our website: [www.ludl.com](http://www.ludl.com), [sales@ludl.com](mailto:sales@ludl.com) or [support@ludl.com](mailto:support@ludl.com)

## Responsibilities

Users and service personnel should be aware of possible hazards associated with any mechanical system. Safety awareness and training should be provided.

# Product Compliance

## **Listings and Conformance Data**

The MAC 6000 system is ETL listed #3153061NYM and tested to the following standards:

EU Low Voltage Directive – Safety

CENELEC EN 61010-1

*Issued:2001/03/01 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use Part 1: General Requirements -Construction Review, Testing and Report Issuance*

\* ETL listing - if performed concurrently with EN 61010-1

\* cETL - Canada - if performed concurrently with UL 61010-1

CE EMC Directive:

BSI BS EN 61326-1 (RF Emissions and Immunity),

BSI BS EN 61000-4-2 *Issue:1995/09/15 Electromagnetic Compatibility (EMC) Part 4: Testing and Measurement Techniques Section 4.2: Electrostatic Discharge Immunity Test - Basic EMC Publication IEC 1000-4-2: 1995 -*

CENELEC EN61000-4-3

*Issued:2002/04/01 Electromagnetic Compatibility (EMC) Part 4-3:Testing and Measurement Techniques - Radiated, Radio-Frequency, Electromagnetic Field Immunity Test IEC 61000-4-3: 2002 -*

CENELEC EN61000-4-4

*Issue:1995/01/01 Electromagnetic Compatibility (EMC) Part 4: Testing and Measurement Techniques Section 4: Elec. Fast Transient/Burs Immunity Test Basic EMC Publication (IEC 1000-4-4 : 1995) -*

CENELEC EN61000-4-5

*Issue:1995/01/01 Electromagnetic Compatibility (EMC) Part 4: Testing and Measurement Techniques Section 5: Surge Immunity Test (IEC1000-4-5 : 1995) -*

CENELEC EN61000-4-6

*Issue:1996/07/01 Electromagnetic Compatibility (EMC) Part 4: Testing and Measurement Techniques Section 6: Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields IEC 1000-4-6: 1996 –*

CENELEC EN61000-4-8

*Issue:1993/01/01 Electromagnetic Compatibility (EMC) Part 4: Testing and Measurement Techniques Section 8: Power Frequency Magnetic Field Immunity Test - Basic EMC Publication (IEC 1000-4-8 :1993) –*

CENELEC EN61000-4-11

*Issue:1994/01/01 Electromagnetic Compatibility (EMC) Part 4: Testing and Measurement Techniques Section 11: Voltage Dips, Short Interruptions and Voltage Variations Immunity Tests (IEC1000-4-11:1994) -*

CENELEC EN61000-3-3

*Issue:1995/01/01 A1(2001) (EMC) Part 3: Limits Section 3: Limitation of Voltage Fluctuations and Flicker in Low-Voltage Supply Systems for Equipment with Rated Current Less Than or Equal to 16 A -*

\* Flicker - applicable only if rated below 16amps per phase

The system is also CE compliant and has been tested extensively for compliance with international standards for mechanical and electrical safety as well as emission and susceptibility to EMI (electro-magnetic interference). To maintain compliance with these standards use only LEP supplied components.

# MAC 6000 System

The purpose of this manual is to describe the system and outline the configuration options. It should be used in conjunction with the LEP Interface BASIC Interpreter manual and the LEP MAC6000 Command Manual

## Introduction

The MAC 6000 system is the sixth generation automation controller from LEP. Intended for use in microscope automation systems, the system has flexible communication ports and supports a wide variety of motor drives and I/O control devices. System configuration is simplified and more flexible than previously possible with the earlier versions of LEP controllers. By eliminating the limitations imposed by a fixed chassis design, the MAC 6000 controller can easily be configured with different combinations of modules to suit various application requirements. Up to twenty interlocking stackable MAC 6000 modules can be used with only a small sacrifice in workspace due to the MAC6000's compact footprint. The modular nature of the system facilitates troubleshooting and minimizes down time since a malfunctioning module may be easily swapped with a replacement module by the user. The system uses flash memory, which enables the firmware to be field upgradeable.

## Architecture

Each MAC 6000 controller incorporates the main power supply base module and a RS-232/USB/Ethernet interface module. Additional MAC 6000 modules are stacked above this base system interlocking both electrically and mechanically to the prior module. This unique architecture allows for greater system flexibility and provides a simple user serviceable upgrade path as application requirements vary.

## Explanation of Symbols used in this Manual:



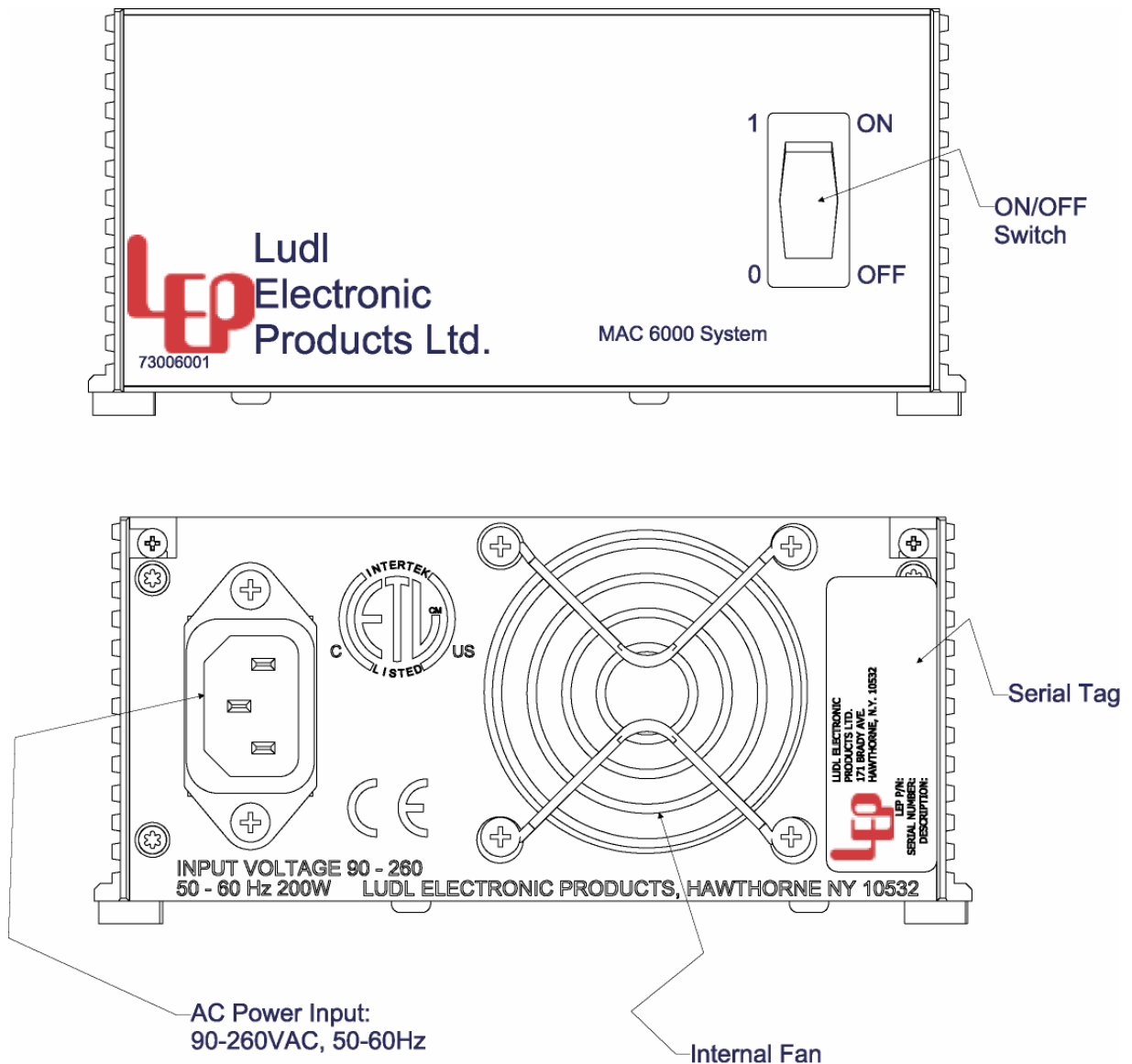
**WARNING:** - Refers to a hazardous condition explained later in this manual.



**PINCH POINT:** - Refers to locations where user should use caution to avoid personal injury

## System Power Supply

The system power supply, P/N: 73006001, provides the power to the MAC 6000 bus. The MAC 6000 system uses +24V main system power supply. Regulators on the system interface P/N: 73006042 generate +7V, +5v,  $\pm 15v$  and +3.3v.



The following table is a reference for which supplies are most commonly used internally and for what function:

VOLTAGE	WHERE USED
+5v	Microprocessors, TTL logic
+3.3v	Microprocessors and support devices
+7v	Stepper motor standby (at rest) power
$\pm 15v$	Analog electronics
+24v	Motor drive power & System Power

The front panel of the system interface module has green indicating LEDs showing the presence of the 24v and 5v. These LEDs provide a trouble-shooting aid as there is no normal condition where any of the LEDs should not be lit.

## Fuses

***There are no user serviceable components in the 73006001. Refer all service to LEP if a fault is determined.***



**WARNING: Main voltage is present inside this module.**

The MAC 6000 has a single fuse integrated into the switching power supply within the base module. This is not a user serviceable component. In the unlikely event of a switching power supply failure, the base module would need to be serviced by LEP.

### Fuses used in application modules

Warning – All replaceable fuses must be replaced with same type as given in following table. Individual modules are safety fused as follows:

Module #	Module Name	Fuse qty	Fuse type	Location	Fuse Mfr.	Function
73006050	Stepper Motor Drive	1	452 003.MRL	F2	Littlefuse Nano series 3 Amp	Motor drive protection
73006054	Dual Microstepping Motor Drive	2	452 003.MRL	F2,3	Littlefuse Nano series 3 Amp	Motor drive protection
73006055	Dual DC Motor Drive	2	452 005.MRL	F2,3	Littlefuse Nano series 5 Amp	Motor drive protection
73006056	Focus Motor Drive	1	452 003.MRL	F2	Littlefuse Nano series 3 Amp	Motor drive protection
73006057	Absolute Focus Motor Drive	1	452 003.MRL	F2	Littlefuse Nano series 3 Amp	Motor drive protection
73006068	Shutter Drive	4	452 001.MRL	F1,2,3,4	Littlefuse Nano series 1 Amp	Shutter drive protection
73006080	Stepper Filter wheel Drive	2	452 003.MRL	F2,3	Littlefuse Nano series 3 Amp	Motor drive protection
73006080	Stepper Filter wheel Drive	3	452 001.MRL	F4,5,6	Littlefuse Nano series 1 Amp	Shutter drive protection
73006081	DC Filter wheel Drive	2	452 005.MRL	F2,3	Littlefuse Nano series 5 Amp	Motor drive protection
73006081	DC Filter wheel Drive	3	452 001.MRL	F4,5,6	Littlefuse Nano series 1 Amp	Shutter drive protection

### Input Power Requirement and Ratings

The MAC 6000 controller automatically switches to accommodate any of the international supply voltages. Simply connect the proper line cord to the rear-panel receptacle and switch it on. Allowable range is 90-260 Volts AC, 50-60 Hz. Internal fusing is 3.15 Amp, time delay. Rated input power is 200Watts maximum.

### Mounting considerations:

This system is intended for indoor/laboratory use in a dry environment.

The controller, as provided, is for tabletop use. It must be placed such that there is at least 2" of clearance on sides and rear for unrestricted cooling airflow. If mounted within a cabinet, ambient air available for cooling controller should be below 25C.



If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.



## Installing and Removing Modules

**Note:** *An anti-static work surface is recommended. Uninstalled modules should be kept in anti-static bags until mounted.*

The modular nature of the MAC6000 controller makes it easy to add or remove modules to configure for a particular task. Only the Philips screws should be used for this operation. The Torx screws are part of the module assembly and should not be touched.

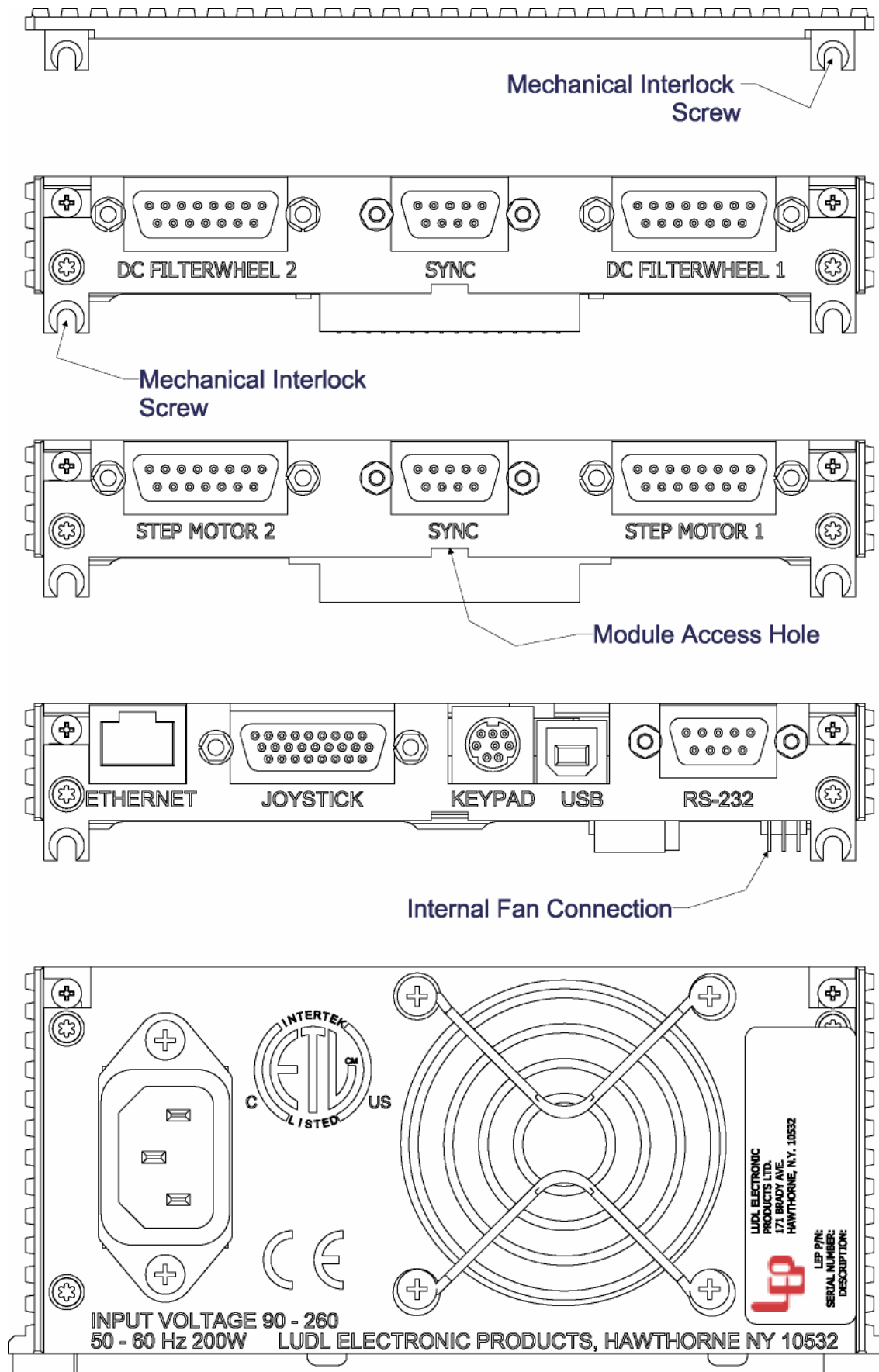
**To Remove a Module-** Make sure that main power switch is OFF. Loosen the two Philips head screws on the rear panel immediately below the module to be removed. Lift the rear of the module away from the module below it (a slot is provided for a pry tool if needed). The module should now be able to be removed.



**WARNING:** If removing the system interface PN:73006042 from the power base previously described, note the two cables between the '6042 and '6001. The fan connector on the underside of the '6042 is keyed and the +24V power connector is offset 2 pins from the end of the switching power supply. Note positions and re-install in similar manner. Ensure that wires stay clear of cooling fan and are not pinched between modules when modules are locked back into place.

**To Install a Module-** Make sure that the main power switch is OFF & power cable is disconnected. Ensure that the Philips locking screws are loosened to allow for insertion. Place module to be inserted on top of existing modules. Keep the rear of the new module slightly elevated and slide the front side forward (starting from about ½" behind front panel of bottom module. This will engage the dovetail joint that holds the front panels locked against one another. Next, firmly push down the rear panel to engage the bus connector. Verify the module is seated properly. Tighten the rear panel Philips screws and verify that there is no vertical movement if the front panels are pulled.

**Note:** The system will not meet RF and ESD standards if the locking screws are not tightened.



## System Setup

As this is a modular system, setup varies with purchased options. In general though, the system includes the MAC6000 controller, joystick, microscope stage and/or filter wheel.

Cable connections are made to the rear of the controller unit. 'Quick-lock' connector latches are used on all of the 15 circuit D-subminiature connectors. In order to mate a Quick-lock connector, press firmly into place. You should hear clicks as they snap into place. A tug on the connector shell will confirm that the locks are snapped into place. To remove connector, squeeze the two releases on the sides of the shell and pull.

Mount stage and/or filter wheel to user system as required.



Users and/or service personnel must be properly trained in safe installation of motorized devices.



**PINCH POINT:** - Please note any locations where user should use caution to avoid. Most commonly these are between the stage and microscope column. Users and service personnel should be advised of these locations.

Attach joystick, stage and filter wheel cables as marked

Attach one or more communication interface cables as required [RS-232, USB or Ethernet]  
Default RS-232 communication is 9600, N, 8, 2

Attach power cord to mains power and turn on power switch on front panel.

Front panel LEDs for 24v and 5v should come on and airflow should be felt from the rear mounted cooling fan.

Any stepper motors attached should attempt to calibrate. Stages will first make a small jog to determine whether an encoder is present or not and if so, determine a ratio. Filter wheels will rotate to the #1 position.

When system is idle, all BUSY LEDs will be off.

Basic operation can be verified with joystick to move the stage. A button on top of the joystick stalk is normally released for fine control and pressed for high speed movement. Limit switches at the ends of travel will light corresponding LEDs on the Motor Drive module.

Operation of the filter wheel can be confirmed by pressing the front panel toggle switches on the filter wheel control module in the controller. Movement of one position up or down is done with the 'wheel' toggle (momentary up/down). Shutters, if installed in a filter wheel or external can be activated by 'shutter' switches. A corresponding RED LED will show that the shutter is activated (open).

The LEP IDE software tool (or any suitable terminal emulator) can be used to verify communications. Once started, it will try to open the default serial port. If no communication is detected, communication setup from the pull-down menu should be run. Once communication is established, type VER\*<enter> and a list of installed modules with their firmware version is listed to screen.

## Rear Panel Connectors

All connections to the MAC 6000 are made at the rear of each module. Each connector is clearly labeled as to its designated function. Cable connections should be completed prior to power-up of the controller. To ensure proper connections, always tighten screw lock connectors and snap the Quick-lock connectors into locked position.

## Line Cord

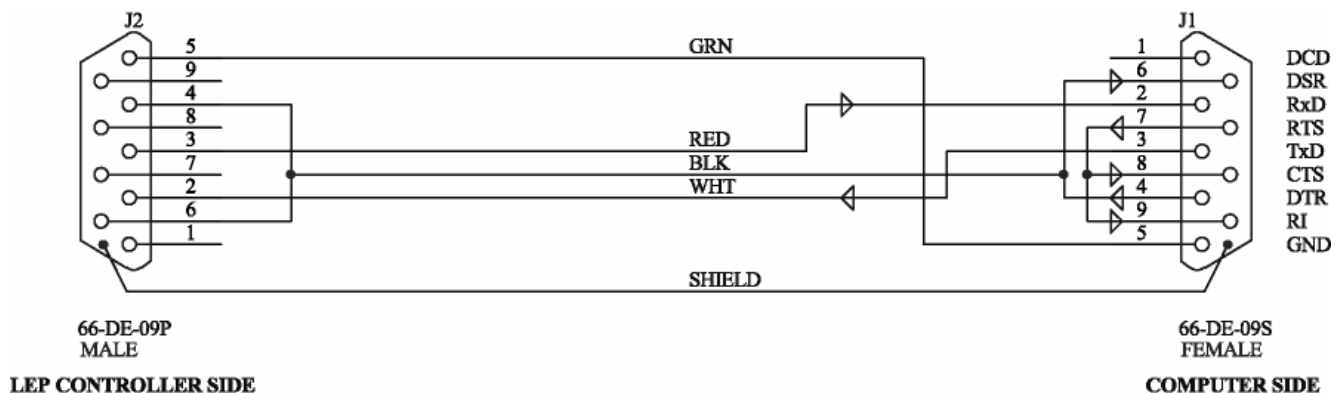
The line cord connection is a standard IEC receptacle. The MAC 6000 switches automatically to accommodate any standard international line voltage and frequency.

## Host Computer Interface Cables

Every MAC 6000 system is supplied with a standard RS232, USB and Ethernet cable, which interconnects from the rear panel of the controller to an available host computer.

## RS232

The RS232 cable (p/n: 73A00031) is can be connected from the 9-pin female connector, labeled RS232, to the host serial port. No hardware handshaking is provided.



## USB

A USB 2.0 Type A/B cable (p/n: 73A00056) can be connected from the USB port, labeled USB, on the rear of the controller to the host computer USB port. Provided on the MAC6000 Application CD (p/n: 99P015) are the necessary USB drivers.

## ETHERNET

A crossover Ethernet cable (p/n: 73A00067) can be connected from the Ethernet port, labeled ETHERNET, on the rear of the controller to the host computer Ethernet port. Connect to the controller via a web browser from the address, <http://192.168.100.1>

The following screen will be displayed.

LEP MAC6000 Controller - Windows Internet Explorer provided by Yahoo!

http://192.168.100.1/default.asp

File Edit View Favorites Tools Help

Suggested Sites eBay Repair Reports Free Hotmail Web Slice Gallery Yahoo! Mail

LEP MAC6000 Controller

**LEP** Ludl Electronic Products Ltd.

**LEP MAC6000 Controller**

**Web Page Version 2.8 - 02-25-2011**

**HOME** **DEVICE CONFIGURE** **SIMPLE CONSOLE** **CONFIGURATION REPORT** **CONFIGURATION ANALYSIS** **?**

**Version Information:**

Version no. : 12.2/10.9 01/27/2010 MAC6000 Interface with USB/ETH SN=167978  
 Version no. : 8.7/0.4 08/06/2009 EMOT Id=X ( 1) SN=162134.0 Status=0x84  
 Version no. : 8.7/0.4 08/06/2009 EMOT Id=Y ( 2) SN=162134.1 Status=0x84  
 Version no. : 8.7/0.4 08/06/2009 EMOT Id=B ( 3) SN=121212.0 Status=0x4  
 Version no. : 4.9/3.2 08/30/2010 EFILS Id=S1 (17) SN=163773.0 Status=0xF  
 Version no. : 4.9/3.2 08/30/2010 EFILS Id= (27) SN=163773.1 Status=0xF

**Device Information:**

DevNum	DevID	Node	Family	Name	Type	ReqID	SerNum	Version	Date
32	-	1	6042	INT	20	0	167978.0	12.2	01/27/2010
1	X	3	6054	EMOT	1	1	162134.0	8.7	8/ 6/2009
2	Y	4	6054	EMOT	1	2	162134.1	8.7	8/ 6/2009
3	B	2	6056	EMOT	1	3	121212.0	8.7	8/ 6/2009
17	S	5	6081	EFILS	10	17	163773.0	4.9	8/30/2010
27		6	6081	EFILS	10	27	163773.1	4.9	8/30/2010

Done Internet 100%

## MAC6000 Device Configuration

Each module can be configured via the Ethernet port for user specific configuration, by simply clicking the **DEVICE CONFIGURE** or **CFG** button.

See specific modules for device configuration.

The screenshot shows a web browser window titled "LEP MAC6000 Controller - Windows Internet Explorer provided by Yahoo!". The address bar shows the URL "http://192.168.100.1/devdisp.asp". The browser's menu bar includes File, Edit, View, Favorites, Tools, and Help. The toolbar shows various icons for navigation and actions. The main content area displays the LEP logo and the text "Ludl Electronic Products Ltd." on the left, and "LEP MAC6000 Controller" in green on the right. Below this, it says "Web Page Version 2.8 - 02-25-2011". A navigation bar contains buttons for HOME, DEVICE CONFIGURE (highlighted in red), SIMPLE CONSOLE, CONFIGURATION REPORT, and a question mark. Below the navigation bar, the "Device Status" section contains a table with the following data:

Dev Num	Dev ID	Version	Date	Module	Type	
32	-	12.2	1/27/2010	6042	INT	<a href="#">CFG</a>
1	X	8.7	8/6/2009	6054	EMOT	<a href="#">CFG</a>
2	Y	8.7	8/6/2009	6054	EMOT	<a href="#">CFG</a>
3	B	8.7	8/6/2009	6056	EMOT	<a href="#">CFG</a>
17	S1	4.9	8/30/2010	6081	EFILS	<a href="#">CFG</a>
27	-	4.9	8/30/2010	6081	EFILS	<a href="#">CFG</a>

The browser's status bar at the bottom shows "Done" and "Internet" with a 100% zoom level.

## MAC6000 Joysticks

The joystick provides manual control of a motor for either an XY stage or focus control. The standard LEP joystick, p/n 73006362, features an XY analog joystick with a rotary digipot on the side for digital control of a third axis. There are several other joysticks that may be specified with your system. The following table describes the joysticks available for the MAC 6000 system.

### Part Number Description

73006360 XY joystick

73006361 XYZ joystick

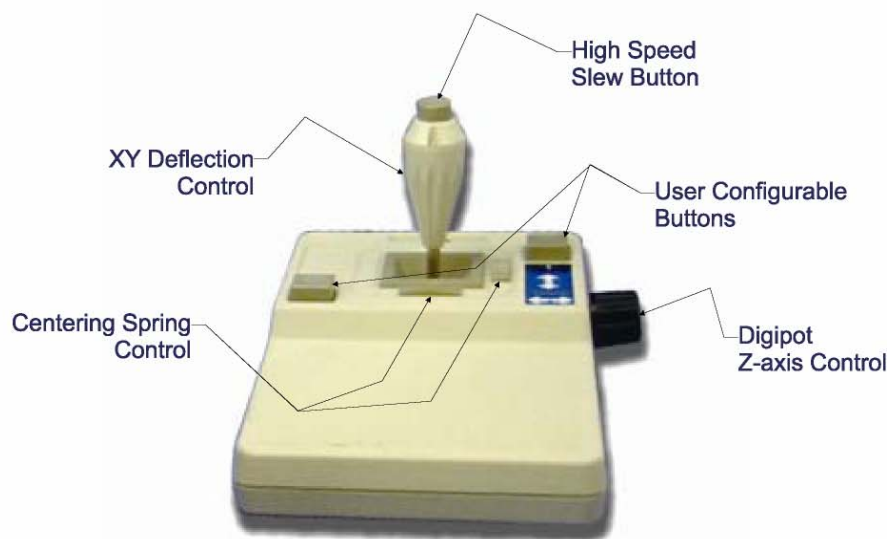
73006362 XY with integrated digipot

73006365 Digipot only

73006366 XYZ joystick with integrated digipot

73006367 XY joystick with 4 user configurable buttons

73006369 XYZ joystick with 4 user configurable buttons



73006362 - XY joystick with Z-axis digipot



73006365 - Z-Axis Digipot

Upon power-up, the MAC 6000 system performs an automatic calibration. of the joystick. First the system checks for the presence of the joystick. If a joystick is connected, it reads the current position and assigns it the zero position, any deflection from this angle will cause an axis to move. A common problem is that the joystick is slightly deflected on power-up and then released. This makes the stage drift slowly on its own and may cause asymmetrical speed response based on equal deflection of the joystick.

Pushing the XY stick will cause the stage to move in the desired direction. The stage movement velocity is exponential with deflection angle of the joystick. This gives very fine accurate control with small deflections, but also provides for higher speeds during larger movements. The actual direction of movement can be configured on the motor controller module. Default joystick speeds are set to be usable in all configurations of resolution; however, the joystick speed can be changed by host software if desired.

### **High Speed Slew Button**

Pressing the button located on the top of the XY stick forces a higher speed and allows quicker long distance moves.

### **Digipot**

The digipot is a digital input device that is similar to a single axis trackball or mouse. The input is incremental. This means that the movement is directly coupled to the input. For example, if one turn of the knob turns the motor a half turn, then the motor will always turn in this ratio whenever the knob is turned regardless of the speed at which the knob is turned.

### **Digipot Gain**

The digipot gain is set by the three position toggle switch mounted on the back of the joystick housing. This is used for fine, medium or coarse type movements of the focus drive.

### **User Buttons**

There are two (four on the 73006367 or 73006369) user defined buttons available on the LEP joystick. The buttons have no direct function on the MAC6000 system other than the fact that host software can read them via the interface port. A typical application would be the host software executing some type of subroutine based on the switch status.

### **Centering Spring Control**

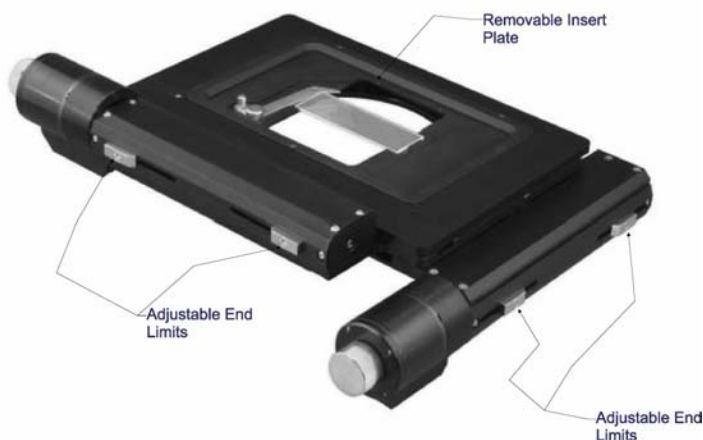
The two sliders arranged in line with the X and Y axis of the joystick control the self-centering function of the joystick. Normally these sliders should be left in the engaged position. If they become loose, the stage may creep along slowly and it may appear that there is something wrong.



## BioPrecision 2 XY Stage

BioPrecision 2 stages utilize zero-backlash ballscrews and ground crossed-roller bearing ways to meet the demanding requirements of high precision microscopy. The resolution of each stage is dependent on two factors: the pitch of the ballscrew divided by the microstepping resolution or encoder resolution. Unless otherwise specified, upright BioPrecision 2(4x3 and 4x4.) stages have a default resolution equal to .1 microns/step whereas inverted BioPrecision stages have a default resolution of .2 microns/step. The BioPrecision 2 linear encoded stage resolution is dependent on the type of scale installed. The suffix on the p/n: denotes the scales resolution (-LE is 100nm; -LE2 is 50nm). The X and Y axis on the stage are electrically equivalent which makes a valuable troubleshooting aid since the user may swap cables from one axis to the other to discern

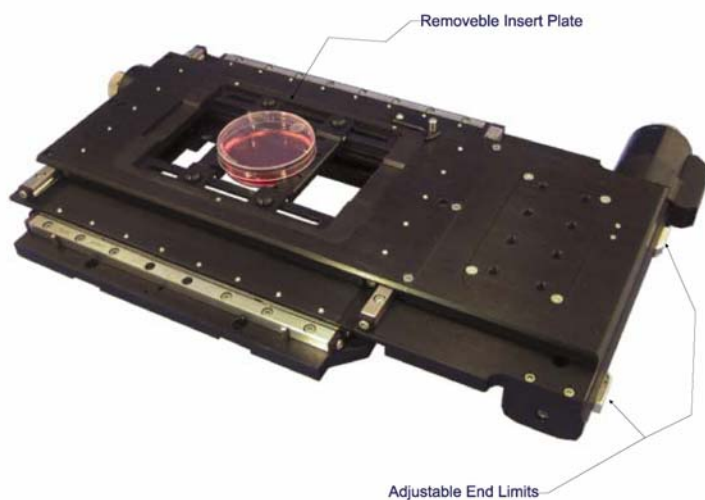
if a malfunction is specific to the stage axis or the controller. This simple test can point one in the right direction in the event of problems. The universal design of the BioPrecision 2 stage allows simple integration with most microscopes using interchangeable stage adapters; however, some microscope configurations cause interference with the full travel of the stage. One of the most critical steps during installation of the stage is adjustment of the stage travel limits.



Depending on the microscope model, adjustment of the limits is required to avoid interference from either the microscope stand or expensive optics. The technique to accomplish this is summarized in this simple procedure:

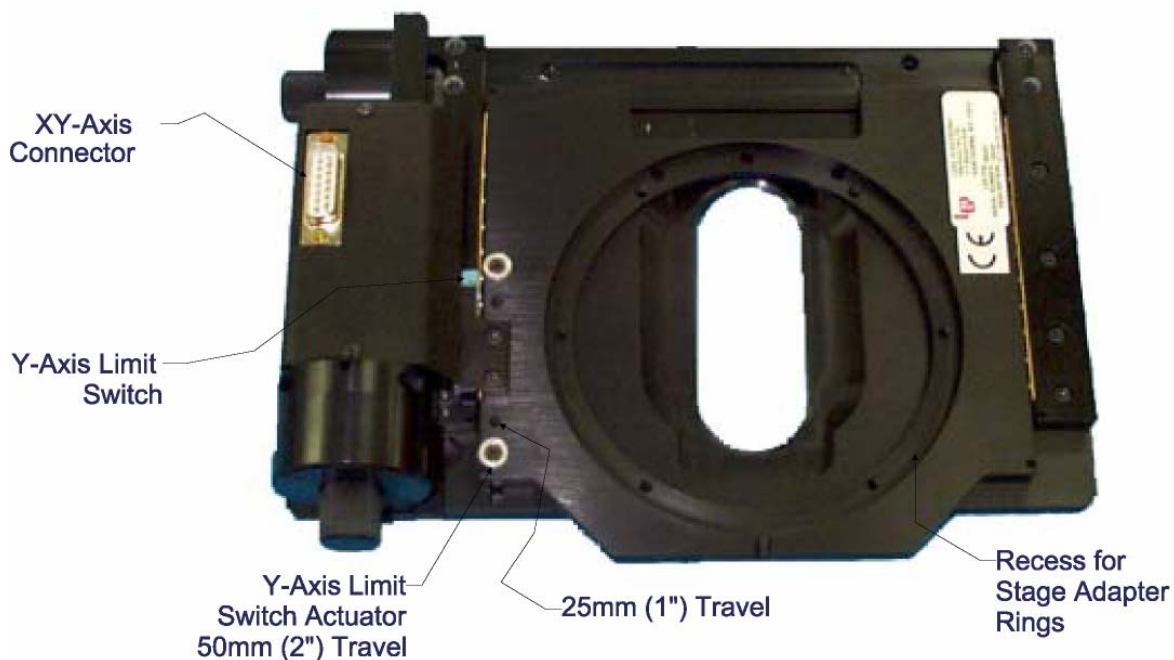
- Mount the specimen to the stage and focus the optics near the center of stage travel.
- Slowly move the stage with the joystick to a point where interference occurs, either with the optics or the microscope stand.
- Adjust the stage limits for the direction of travel.
- Repeat for the other axes and directions of travel.

Once the limits are properly set, the stage insert plate should be leveled to maintain focus over the travel range. The leveling is accomplished using the set screws located at the edge of the insert plate. It is nearly impossible to maintain perfect focus over the entire travel (particularly with high power objectives), however, a good rule of thumb is there should be no need for more adjustment than a quarter turn of the fine focus knob.



## BioPoint 2 XY Stage

All LEP BioPoint 2 motorized XY stages consist of an X and Y axis stepper motor driving a Teflon coated leadscrew drive system (default resolution is .05 microns/step). The BioPoint 2 stage is controlled with a dual axis drive module and interconnected to the XY stage with a single 15-pin cable. All stages have electronic and mechanical limits on travel. The limit switches are an electronic protection to prevent the system from encountering the mechanical limits which would cause the stage to stall, lose position and perhaps cause damage to expensive optics. The limit switches can also be used for location of the home position of the stage provided the software does not allow the stage to strike the switches at a high rate of speed. The universal design of the BioPoint 2 stage allows simple integration with most microscopes using interchangeable adapters; however, some microscope configurations cause interference with the full travel of the stage.



Therefore, the Y axis of the BioPoint 2 upright stage is shipped with removable travel limiters. To enable the full 50mm Y axis travel it is necessary to remove the limiters using a #1 Phillips head screwdriver. Figure 6 shows the two locations for the 25mm and 50mm travel limiters. Remove the two travel limiter and relocate them to the two outer locations.



**PINCH POINT:** - Please note any locations where user should use caution to avoid. Most commonly these are between the stage and microscope column. Users and service personnel should be advised of these locations.

## Focus Control

LEP's standard motorized focus control adds another added layer of automation to a microscope by simply attaching a supplied adapter ring (adapter ring microscope make and model dependant) to the course knob of the microscope. The microscope fine focus is then coupled to the LEP focus motor shaft. Default resolution is equal to the distance traveled by 1 revolution of the fine focus divided by the microstepping resolution (default is 10,000 microsteps).

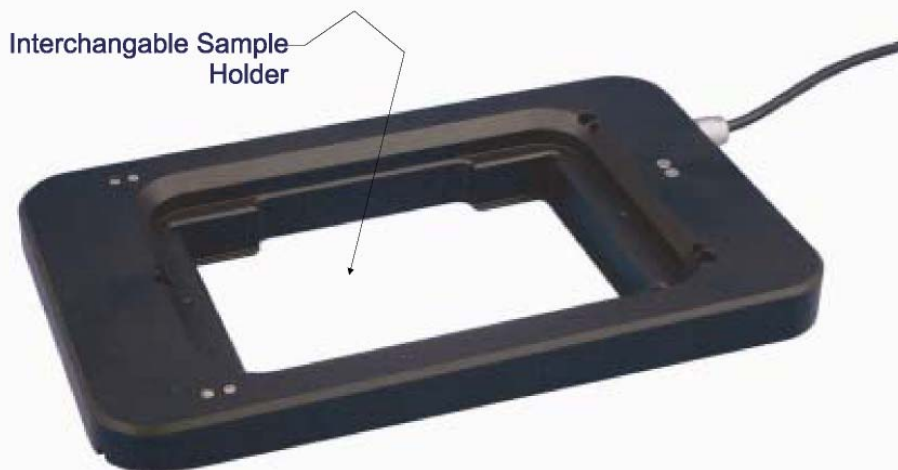


A red button on the focus motor also allows the user to disable the focus motor power, which allows for manual movement.

For added resolution and repeatability a 50nm linear encoder can be added to the system to provide an even higher resolution feedback.

A LEP Piezo Z-Stage Insert can also added to inverted stages. The Piezo insert allow rapid, precise focus control. The MAC6000 provides full 16-bit resolution with digital positional feedback.

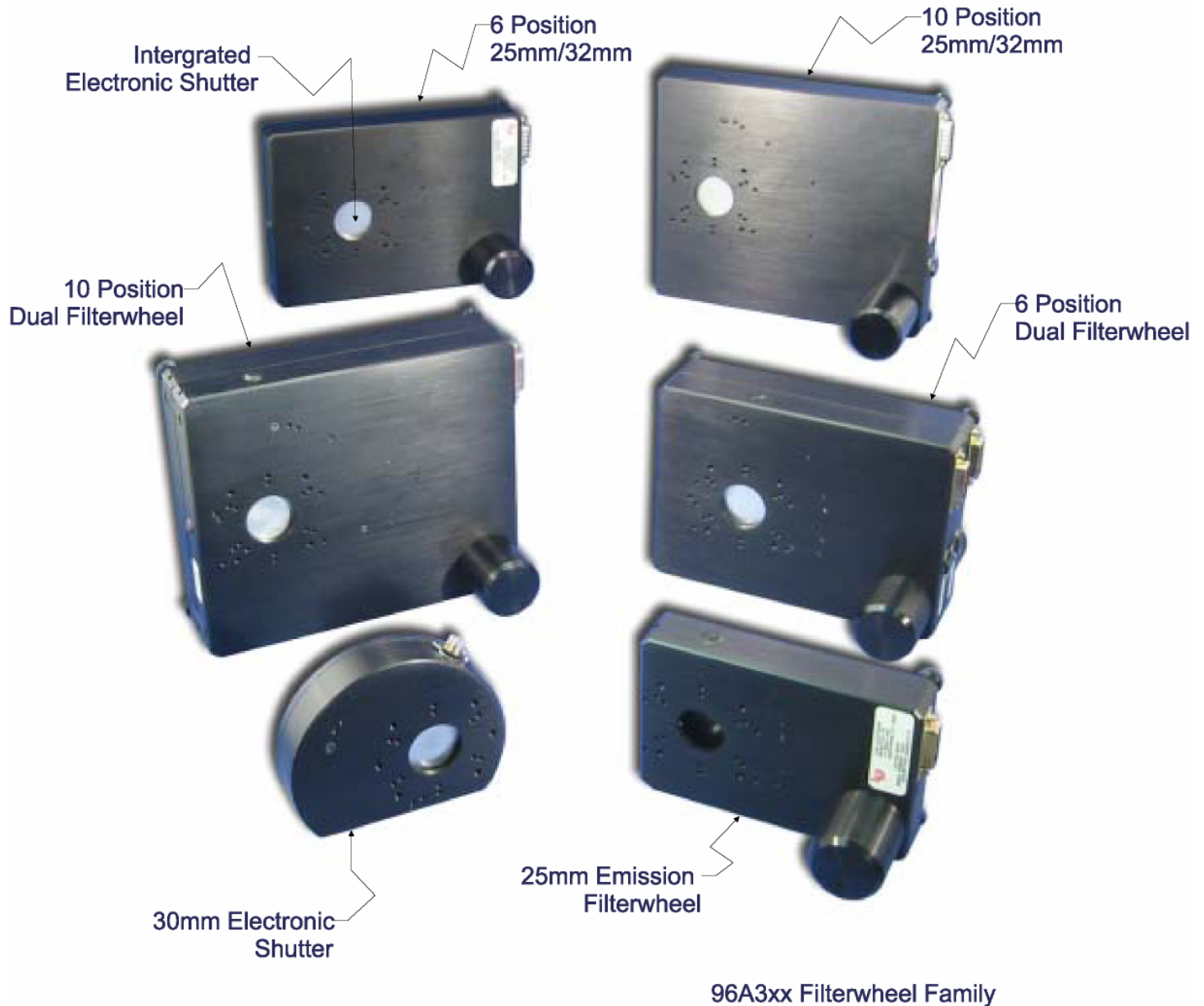
The piezo insert can controller via software, external sync input or through a manual input device.



## Filter wheels

LEP's filter wheels are DC motor driven with encoder feedback. The excitation filter wheels have the versatility to use either 25mm or 32mm filters, 6 or 10 position options, single or dual format and an integrated electronic shutter. Emission filter wheels come with a 6 position 25mm straight or at a 5° tilt. All filter wheels have the same mounting patterns, so wheels can be moved from microscope to microscope with the simple change of a mounting flange.

The MAC6000 controller can control up to two filter wheel and three shutters. A shutter controller module is also available to control up to four 30mm electronic shutters.



## MAC 6000 Module Configuration

Each MAC 6000 module requires a unique address (1-32) and may be configured to meet specific application requirements. **This is accomplished using the LEP MAC6000 Configuration setup program.**

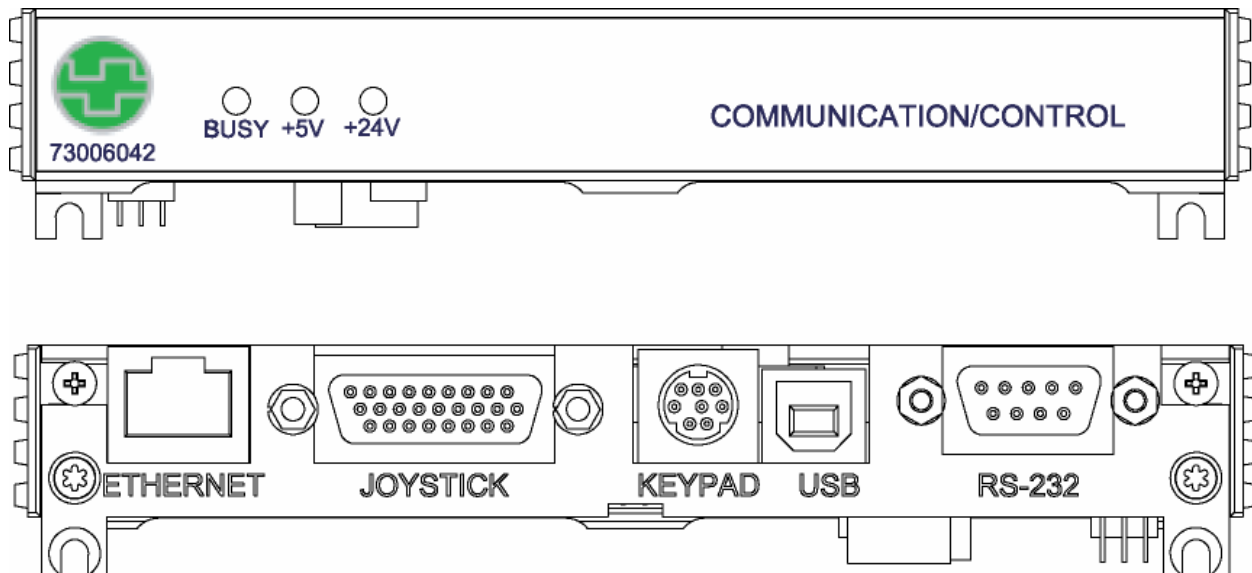
### High Level Module IDs:

Address	High Level ID	Description
1	X	Stage X axis
2	Y	Stage Y axis
3	B	Microscope Z-axis
4	R	Robot Radius 1 axis
5	C	Robot Radius 2 axis
6	Z	Robot Lift axis
7	T	Robot Theta axis
8/9	I/O	Digital I/O ports
10	A	Flat/Notch aligner
11	F	Video autofocus
12	P(1)	Spare
13	P2	Spare
14	P3	Spare
15	P4	Spare
16	P5	Spare
17	S(1)	Filter wheel 1
18	S2	Filter wheel 2
19	S3	Filter wheel 3
20	S4	Filter wheel 4
21	S5	Filter wheel 5



# 73006042

## RS-232/USB/ETH Interface



### General Description

The MAC 6000 interface serves a dual role. First the RS-232 / USB / Ethernet interfaces provide a means for the host computer to communicate with the MAC 6000 system. Second, the secondary power supplies are integrated into this module. The interface supports several modes of communication: ASCII and binary modes (backward compatible for with MAC 5000 and earlier systems) plus new CAN format (both in ASCII and Binary formats). The ASCII mode processes recognizable commands such as MOVE X=1000. The binary mode provides a lower level of communication providing higher throughput and universal adaptability. The CAN commands are the native command formats used in MAC6000 and should be used when writing new applications. All other formats are interpreted to CAN commands internally.

Joystick input is by the HD-26 connector. The input is compatible with any LEP joysticks supporting up to three axes with digipot. It is recommended that the user refrain from use of the joystick or RS-232 serial communication until completion of interface initialization routine which is approximately 5 seconds after power up.

The standard RS-232 port supports baud rates up to 115.2k, the USB interface complies with the USB standard 2.0 and the Ethernet port supports 10base-T. A separate mini-din connector is available for RS-232 communication with the optional 73006047 MAC6000 filter wheel keypad.

## Module Configuration

COM, USB and ETHERNET settings can be customized to the user's software preference. A USB Virtual Com Port can also be utilized, which enables older serial software to communicate at USB speeds. See Virtual Com Install File on the MAC6000 Application CD (p/n: 99P015).

After settings have been selected, click the **Set Device Settings** button for the changes to take affect then cycle the power on the controller.

LEP MAC6000 Controller - Windows Internet Explorer provided by Yahoo!

http://192.168.100.1/cfgint.asp?Q1=208&Q2=328&Q3=328

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LEP MAC6000 Controller

**LEP** Ludl Electronic Products Ltd. **LEP MAC6000 Controller**  
Web Page Version 2.8 - 02-25-2011

HOME DEVICE CONFIGURE SIMPLE CONSOLE CONFIGURATION REPORT ? **INTERFACE**

TYPE: 20 DEVICE: 32 Interface: 6042

**CAUTION:** Incorrect settings may cause the MAC6000 Interface to loose network connectivity.

Get Device Settings Set Device Settings

**TCP/IP Parameters**

Net Address	192.168.100.1	SET
Net Mask	255.255.255.0	SET
Net Gateway	0.0.0.0	SET
Net DNS1	0.0.0.0	SET
Net DNS2	0.0.0.0	SET
<input checked="" type="checkbox"/> DHCP Client		
<input checked="" type="checkbox"/> DHCP Server		
MAC Address	0.24.3A.FF.FF.FF	SET

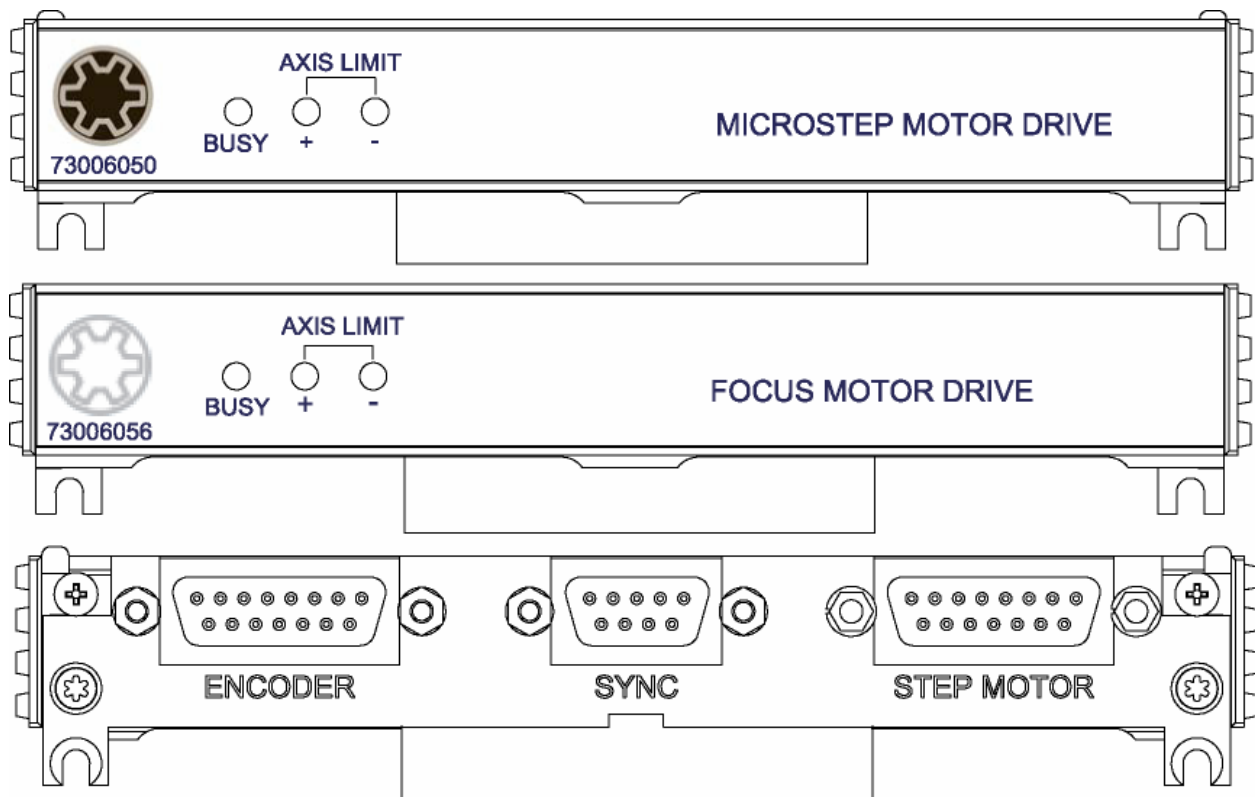
**COM Port Paramaters**

COM1 Baud	9600	
COM1 Parity	N	
COM2 Baud	9600	
COM2 Parity	N	
<input type="checkbox"/> USB Virtual Com Port		

Done Internet 100%

## 73006050 & 73006056

### Single MicroStep Motor Module



### General Description

The 73006050 & 73006056 modules are self-contained microprocessor motor controllers with a high performance regulated linear microstepping driver. The linear driver provides the highest accuracy without excessive motor heating or EMI radiation that can sometimes be a problem with conventional chopper type drives. All functions are built-in to the module: analog joystick control, digital joystick control, limit switches, pre-limit input, open or closed loop stepper motor control, configurable microstepping resolution and motor current selection.

This module's step-motor connector supports two phase stepper motors with CW and CCW limits, home position signaling, encoder inputs and a single pre-limit. A SYNC-OUT connector has step pulse output as well as inputs/outputs for move triggering. The separate encoder connection is utilized when an external encoder input is supplied to the system. The 73006056 module is primarily used with a connection of a 50nm linear encoder for focus applications.



## Module Configuration

Just like with the previous MAC controllers, the user has the ability to change settings on the motor drive module for different functionality.

When changing a parameter, always click on the associated **Set** button. After the desired settings have been adjusted and set, click the **Apply/Save** button. The changes will take effect on the next power restart.

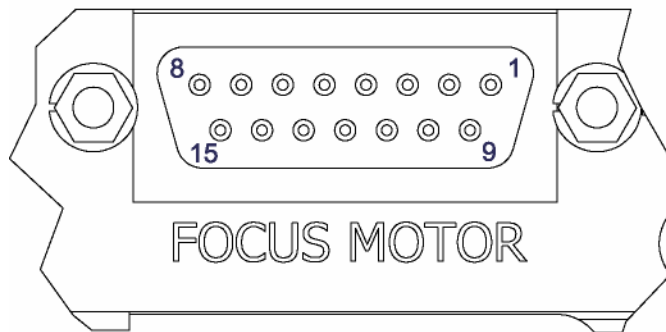
The screenshot shows a web browser window titled "LEP MAC6000 Controller - Windows Internet Explorer provided by Yahoo!". The address bar shows "http://192...". The page header includes the LEP logo, "Ludl Electronic Products Ltd.", and "LEP MAC6000 Controller". Below the header is a navigation bar with links: HOME, DEVICE CONFIGURE, SIMPLE CONSOLE, CONFIGURATION REPORT, and a help icon. A red bar highlights the "6056" motor ID.

The main content area displays the following configuration options:

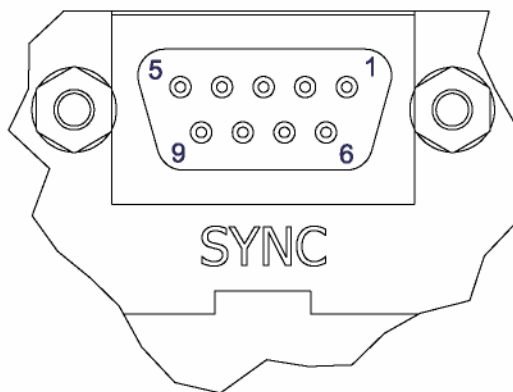
- TYPE: 1    DEVICE: 3    MOTOR: 6056**
- POS:     CWLim: ☐    CCWLim: ☐    BUSY: ☐
- Move To...
- Factory Defaults    Apply/Save
- ☐ Advanced Mode
- Joystick Direction:     ☐ Enable Encoder
- Set Digipot Speed:     (slow)  (fast)
- Motor Direction:
- End Limit Signal:
- Set Resolution:
- Set Power Level:
- ☐ Enable Servo Checking

The status bar at the bottom shows "Done" and "Internet" with a 100% zoom level.

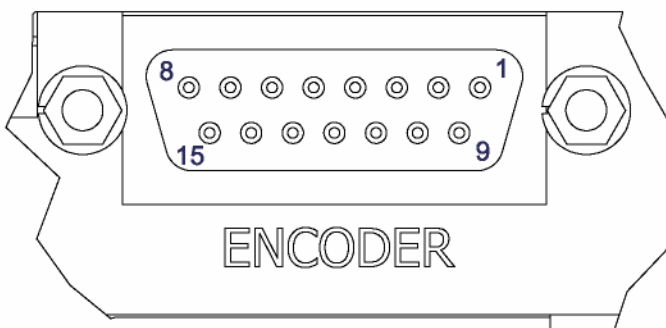
## Rear Panel Pin Out



DB15 STEPPER MOTOR PINOUT		
PIN	FUNCTION	
1	ENCODER	A
2	ENCODER	B
3	GROUND	
4	GROUND	
5	HOME	
6		
7	+5V	
8	LIMIT SWITCH CCW	
9	LIMIT SWITCH CW	
10	MOTOR PHASE 1	
11		
12	MOTOR PHASE 1	
13	MOTOR PHASE 2	
14	RESERVED	
15	MOTOR PHASE 2	



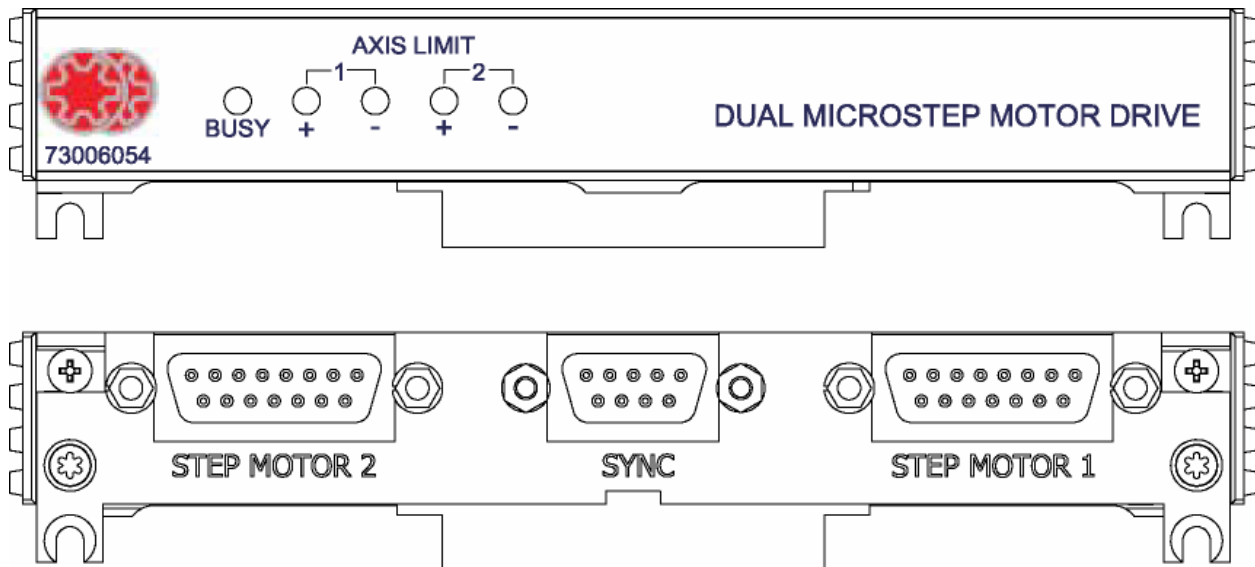
DB9 STEPPER SYNC PINOUT	
PIN	FUNCTION
1	GROUND
2	SYNC-IN1
3	SYNC-OUT1
4	END OF MOVE 2
5	+5V
6	STEP PULSE
7	END OF MOVE 1
8	SYNC-IN2
9	SYNC-OUT2



DB15 EXT ENCODER PINOUT	
PIN	FUNCTION
1	ENCODER A
2	GROUND
3	ENCODER B
4	+5V
5	
6	
7	INDEX/
8	
9	ENCODER A/
10	GROUND
11	ENCODER B/
12	+5V
13	
14	INDEX
15	

# 73006054

## Dual MicroStep Motor Module



### General Description

The 73006054 module is microprocessor controlled microstepping motor driver which controls up to two individual stepper motors. This module features user configurable end limit inputs and configurable relative motor direction for both the primary and secondary motor. Since this module supports two motion axes it is addressable as two separate modules with independently selectable addresses. All module parameters are software configurable. Microstep resolutions of up to 200x are available which yields 40,000 microsteps with a standard 1.8 degree stepper motor. Please contact LEP for information regarding motor compatibility for custom system integrations.

## Module Configuration

Just like with the 7300605x single motor drive module, the same configuration options are available for the user.

When changing a parameter, always click on the associated **Set** button. After the desired settings have been adjusted and set, click the **Apply/Save** button. The changes will take effect on the next power restart.

The screenshot shows a web browser window titled "LEP MAC6000 Controller - Windows Internet Explorer provided by Yahoo!". The address bar shows "http://192....". The page header includes the LEP logo, "Ludl Electronic Products Ltd.", and "LEP MAC6000 Controller". Below the header is a navigation bar with links: HOME, DEVICE CONFIGURE, SIMPLE CONSOLE, CONFIGURATION REPORT, and a question mark. A red bar highlights the "6054" motor ID. The main content area displays "TYPE: 1 DEVICE: 1 MOTOR: 6054". Below this, there are input fields for "POS:" (set to 0) and status indicators for "CWlim:", "CCWLim:", and "BUSY:". A "Move To..." button is also present. Two buttons, "Factory Defaults" and "Apply/Save", are shown. A red horizontal line separates the top section from the "Advanced Mode" section, which is currently unchecked. In the "Advanced Mode" section, there are several configuration options: "Joystick Direction" (Normal), "Set Joystick Factor" (60), "Set Joystick Speed" (10000), "Set Joystick Top Speed" (70000), and "Set Joystick Acceleration" (300000). To the right of these are three sliders for speed control, each with "Enable Encoder" and "Enable Servo Checking" checkboxes. The bottom section includes "Motor Direction" (Normal), "End Limit Signal" (Active Low), "Set Resolution" (10000), and "Set Power Level" (80). The browser's status bar at the bottom shows "Done" and "Internet".

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http://192....

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LEP MAC6000 Controller

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HOME DEVICE CONFIGURE SIMPLE CONSOLE CONFIGURATION REPORT ?

6054

**TYPE: 1 DEVICE: 1 MOTOR: 6054**

POS: 0 CWlim: ■ CCWLim: ■ BUSY: ■

Move To...

Factory Defaults Apply/Save

☐ Advanced Mode

Joystick Direction: Normal

Set Joystick Factor 60

Set Joystick Speed 10000

Set Joystick Top Speed 70000

Set Joystick Acceleration 300000

Motor Direction: Normal

End Limit Signal Active Low

Set Resolution 10000

Set Power Level 80

☐ Enable Encoder

(const speed) (very smooth)

(slow) (fast)

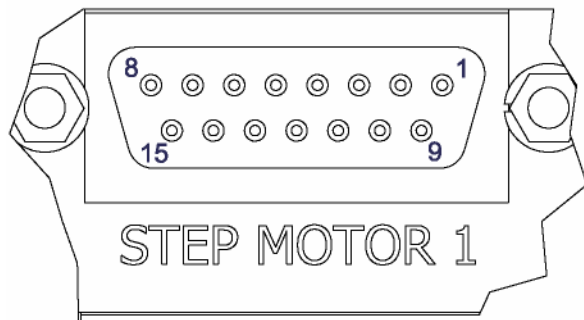
(slow) (fast)

(slow) (fast)

☐ Enable Servo Checking

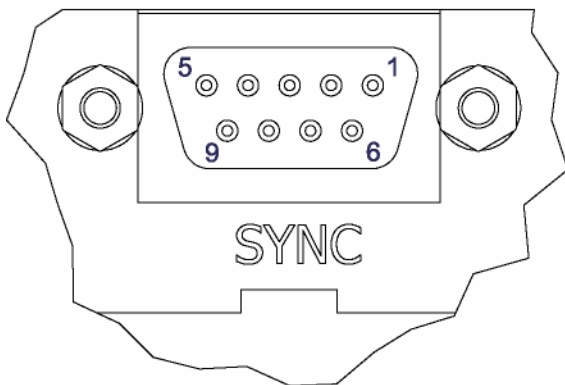
Done Internet 100%

## Rear Panel Pin Out



\* Both MOTOR 1 and MOTOR 2 ports are wired the same.

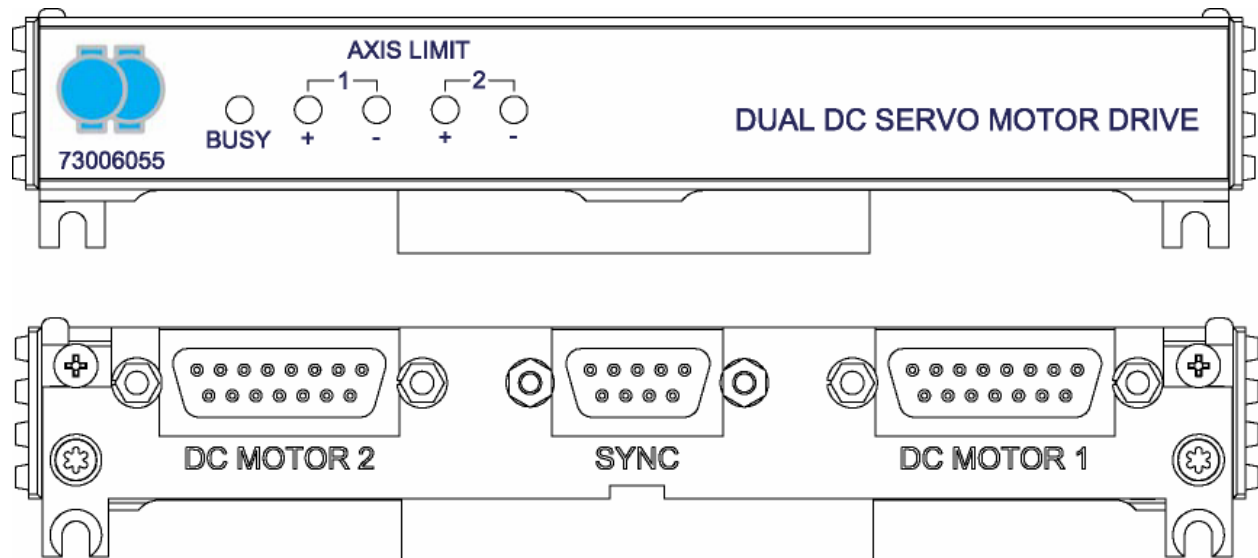
DB15 STEPPER MOTOR PINOUT	
PIN	FUNCTION
1	ENCODER A
2	ENCODER B
3	GROUND
4	GROUND
5	HOME
6	
7	+5V
8	LIMIT SWITCH CCW
9	LIMIT SWITCH CW
10	MOTOR PHASE 1
11	
12	MOTOR PHASE 1
13	MOTOR PHASE 2
14	RESERVED
15	MOTOR PHASE 2



DB9 STEPPER SYNC PINOUT	
PIN	FUNCTION
1	GROUND
2	SYNC-IN1
3	SYNC-OUT1
4	END OF MOVE 2
5	+5V
6	LIMIT SWITCH CW/CCW
7	END OF MOVE 1
8	SYNC-IN2
9	SYNC-OUT2

# 73006055

## Dual DC Servo Motor Module



### General Description

The 73006055 module is complete microprocessor-based dual motor controller and servo amplifier system in a single MAC6000 module. The module employs a dedicated DSP processor for both axes to provide high performance motion control for DC servo motors.

Presets for 7 common applications are embedded to make implementations quick and easy. A full featured command set for “state based” servo parameters are available for no compromise servo turning.

### High Level Module IDs:

DC Device	Description
0	Last Record Stored
1	Stage 1
2	Stage 2
3	Robot Arm
4	Robot Rotation
5	Robot Lift
6	Focus Drive
7	DC Gearhead Motor

The parameter profiles define the DSP control loop parameters such as gain, acceleration, velocity, resolution, etc....

## Module Configuration

Much like the 73006054 module, the same configuration options are available for the user.

When changing a parameter, always click on the associated **Set** button. After the desired settings have been adjusted and set, click the **Apply/Save** button. The changes will take effect on the next power restart.

The screenshot shows the LEP MAC6000 Controller web interface in a Windows Internet Explorer browser window. The browser title is "LEP MAC6000 Controller - Windows Internet Explorer provided by Yahoo!". The address bar shows "http://192....". The page header includes the LEP logo, "Ludl Electronic Products Ltd.", and "LEP MAC6000 Controller". Below the header is a navigation bar with links: HOME, DEVICE CONFIGURE, SIMPLE CONSOLE, CONFIGURATION REPORT, and a question mark. A red bar highlights the "6055" model number. The main content area displays "TYPE: 5 DEVICE: 1 MOTOR: 6055". Below this, there are input fields for "POS:" (set to 0) and "CWlim:", "CCWLim:", and "BUSY:". A "Move To..." button is also present. Two buttons, "Factory Defaults" and "Apply/Save", are located below the input fields. A red horizontal line separates the top section from the "Advanced Mode" section, which is currently unchecked. In the "Advanced Mode" section, there are several configuration options: "Joystick Direction" (set to Normal), "Set Joystick Factor" (60), "Set Joystick Speed" (10000), "Set Joystick Top Speed" (50000), and "Set Joystick Acceleration" (1200000). To the right of these are three sliders for speed control, each with "Enable Encoder" checked. The sliders are labeled "(const speed)", "(slow)", and "(fast)", with a "very smooth" label for the first. Below these are "Motor Direction" (set to Normal), "End Limit Signal" (set to Active Low), "Set Resolution" (10000), and "Set Power Level" (20). The "Enable Servo Checking" checkbox is also present. The browser's status bar at the bottom shows "Done" and "Internet".

LEP MAC6000 Controller - Windows Internet Explorer provided by Yahoo!

http://192....

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LEP MAC6000 Controller

**LEP** Ludl Electronic Products Ltd. **LEP MAC6000 Controller**  
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HOME DEVICE CONFIGURE SIMPLE CONSOLE CONFIGURATION REPORT ?

6055

**TYPE: 5 DEVICE: 1 MOTOR: 6055**

POS: 0 CWlim: ■ CCWLim: ■ BUSY: ■

Move To...

Factory Defaults Apply/Save

☐ Advanced Mode

Joystick Direction: Normal

Set Joystick Factor 60

Set Joystick Speed 10000

Set Joystick Top Speed 50000

Set Joystick Acceleration 1200000

☒ Enable Encoder

(const speed) (very smooth)

(slow) (fast)

(slow) (fast)

(slow) (fast)

Motor Direction: Normal

End Limit Signal Active Low

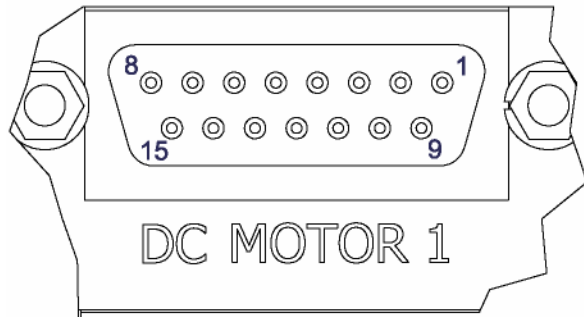
Set Resolution 10000

Set Power Level 20

☐ Enable Servo Checking

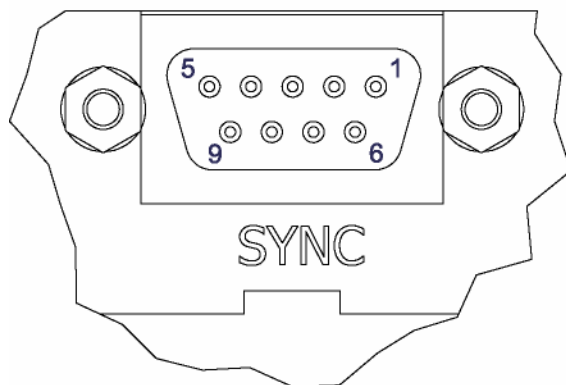
Done Internet 100%

## Rear Panel Pin Out



\* Both MOTOR 1 and MOTOR 2 ports are wired the same.

DB15 DC MOTOR PINOUT	
PIN	FUNCTION
1	ENCODER A
2	ENCODER B
3	GROUND
4	GROUND
5	HOME
6	
7	+5V
8	LIMIT SWITCH CCW
9	LIMIT SWITCH CW
10	
11	
12	MOTOR -
13	MOTOR +
14	RESERVED
15	

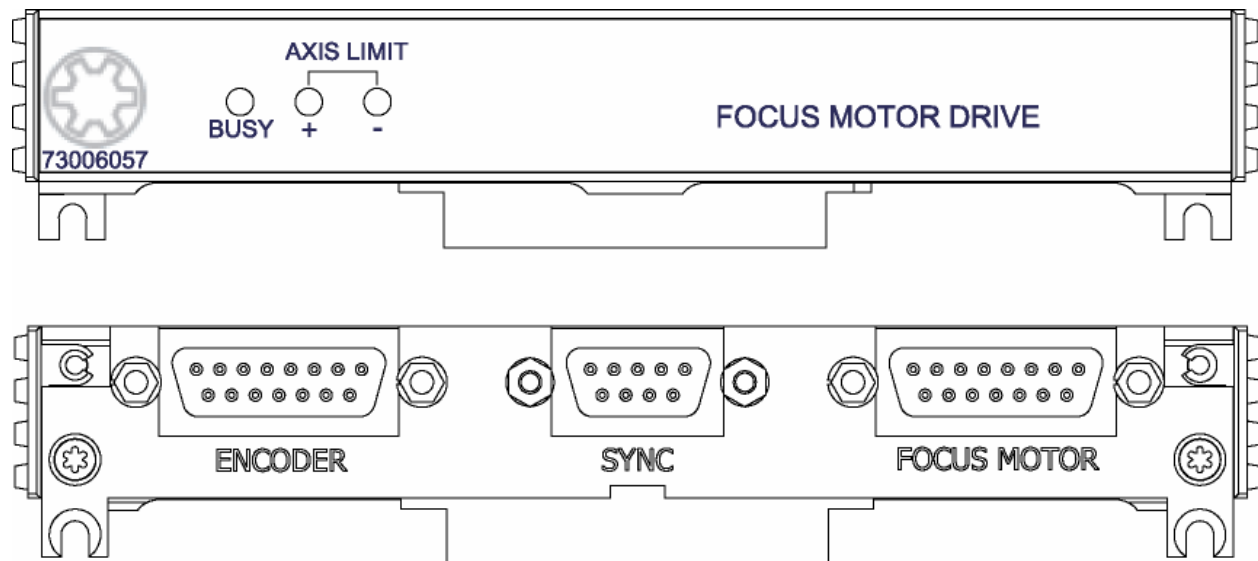


DB9 DC SYNC PINOUT	
PIN	FUNCTION
1	GROUND
2	SYNC-IN1
3	SYNC-OUT1
4	END OF MOVE 2
5	+5V
6	LIMIT SWITCH CW/CCW
7	END OF MOVE 1
8	SYNC-IN2
9	SYNC-OUT2



## 73006057

### Focus Motor Module



### General Description

The 73006057 module is much like the 73006056 module, but has the circuitry built in to read absolute encoders. The module is a self-contained microprocessor motor controller with a high performance regulated linear microstepping driver. The linear driver provides the highest accuracy without excessive motor heating or EMI radiation. All functions are built-in to the module: analog joystick control, digital joystick control, limit switches, pre-limit input, open or closed loop stepper motor control, configurable microstepping resolution and motor current selection.

This module's step-motor connector supports a two phase stepper motor with CW and CCW limits, home position signaling, encoder inputs and a single pre-limit. A SYNC-OUT connector has step pulse output as well as inputs/outputs for move triggering. The separate encoder connection is utilized when an external encoder input is supplied to the system. This module can not only read standard incremental encoders, but can also process absolute encoders using the EnDat2.2 protocol.

The absolute encoder uses a proprietary digital interface to report current position in absolute terms. This eliminates the need to initialize position or calibrate the encoder. Cycle power, re-boot software, change specimens, switch objectives, and the encoder will always report the correct position. Since the encoder knows it's position at all times, software upper and lower limits can be set to protect expensive objectives. This can easily be done with step by step instructions in the MAC6000 module configuration web page.

## Module Configuration

Just like with the 73006056 focus motor drive module, the same configuration options are available with an added absolute **Setup** box. Clicking on the **Setup** box will guide you through a step by step process for the absolute encoder.

When changing a parameter, always click on the associated **Set** button. After the desired settings have been adjusted and set, click the **Apply/Save** button. The changes will take effect on the next power restart.

LEP MAC6000 Controller - Windows Internet Explorer provided by Yahoo!

http://192.168.100.1./cfg6057.asp?Q1=1&Q2=3&Q

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LEP MAC6000 Controller

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HOME DEVICE CONFIGURE SIMPLE CONSOLE CONFIGURATION REPORT ? 6057

TYPE: 1 DEVICE: 3 MOTOR: 6057

POS: -72086 LIM +: ■ LIM -: ■ BUSY: ■

Move To... Soft LIM +: ■ Soft LIM -: ■ ENCODER: ABSOLUTE

STOP Soft LIM + Enabled: ■ Soft LIM - Enabled: ■

Factory Defaults Apply/Save Advanced Mode Setup

Encoder Resolution 23 nM Pos Soft Lim 80944

Motor Steps 1 Neg Soft Lim -267301

Encoder Steps 1

Joystick Direction: Normal

Set Digipot Speed 1250

Motor Direction: Normal

End Limit Signal Active Low

Set Resolution 10000

Set Power Level 20

Enable Encoder

(slow) (fast)

Enable Servo Checking

Done Internet 100%

## Absolute Encoder Setup

After clicking on the **Setup** box, the following step by step windows will guide you through the absolute encoder setup.



At this time the focus motor, encoder bracket and p/n: 96A422 absolute encoder need to be installed onto the microscope.

---

### Step 1:

Move so that encoder is in valid range and can move in either direction safely. Press NEXT when ready

This is to ensure the encoder can get a steady reading without any physical disruptions on the microscope. The mid travel point of the microscope z is a good place to start.

---

### Step 2:

Wait for Encoder Jog to finish

The MAC6000 will momentarily pulse the focus motor. This is to determine the encoder/motor ratio and encoder orientation as mounted onto the microscope.

---

### Step 3:

Verify Ratio and modify if needed, then Press SET

After the encoder jog, the encoder and motor steps will be calculated. The **Encoder Resolution**, **Motor Steps**, and **Encoder Steps** fields will be populated with the calculated values, click the **SET** button when completed.

---

### Step 4:

Verify motor Direction. Use settings below to change direction. Press SET when satisfied

Use the **+INC** & **-INC** buttons to rotate the focus motor. If the direction is not as desired, the motor direction can be reversed by changing parameter **Motor Direction** from **Normal** to **Reversed**. Once the desired direction as been achieved, click on the **SET** button.

---

### Step 5:

Move To Zero Position. Press SET to set zero position.



Using the joystick, move the sample into focus. This should be considered your zero position.

**Note:** For quick movement, the red button on the focus motor can be clicked to disable the motor power. Clicking on the red button again or using the joystick will re-enable the motor power.

---

### Step 6:

Move To Positive Limit Position. Press SET to set upper limit

With the joystick, move the sample just before it's about crash into the objective. This will be your upper limit. After the setup has been completed, the + Axis Limit LED on the front of the controller will blink when the upper limit has been reached.

---

### Step 7:

Move To Negative Limit Position. Press SET to set lower limit

Drive the stage to a safe lower limit. Do not move lower than the encoder plunger. After the setup has been completed, the - Axis Limit LED on the front of the controller will blink when the lower limit has been reached.

---

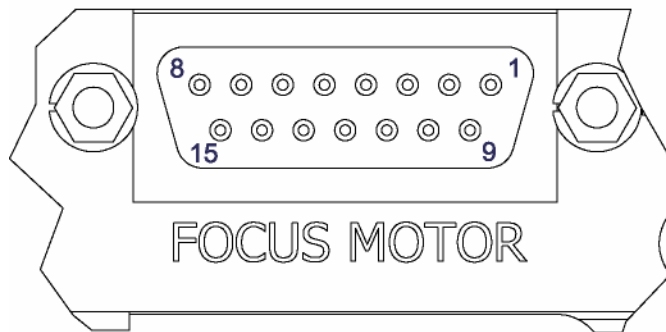
### Finished!!!

Encoder has been successfully setup.

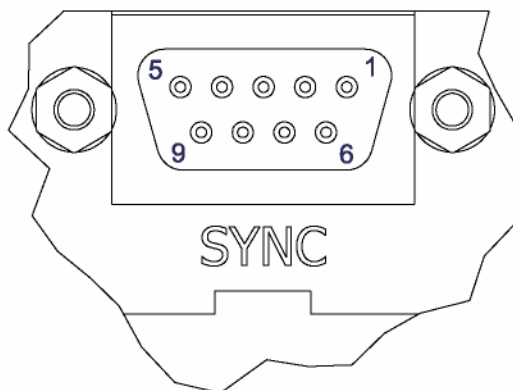
---

Setup completed, uncheck the **Setup** box to exit out of setup mode. Click the **Apply/Save** button and cycle the power on the controller for the changes to take affect.

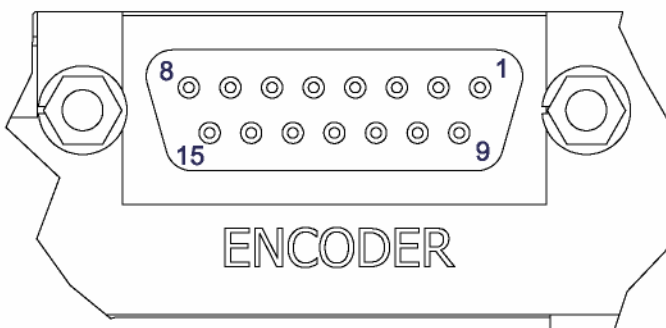
## Rear Panel Pin Out



DB15 STEPPER MOTOR PINOUT	
PIN	FUNCTION
1	ENCODER A
2	ENCODER B
3	GROUND
4	GROUND
5	HOME
6	
7	+5V
8	LIMIT SWITCH CCW
9	LIMIT SWITCH CW
10	MOTOR PHASE 1
11	
12	MOTOR PHASE 1
13	MOTOR PHASE 2
14	RESERVED
15	MOTOR PHASE 2



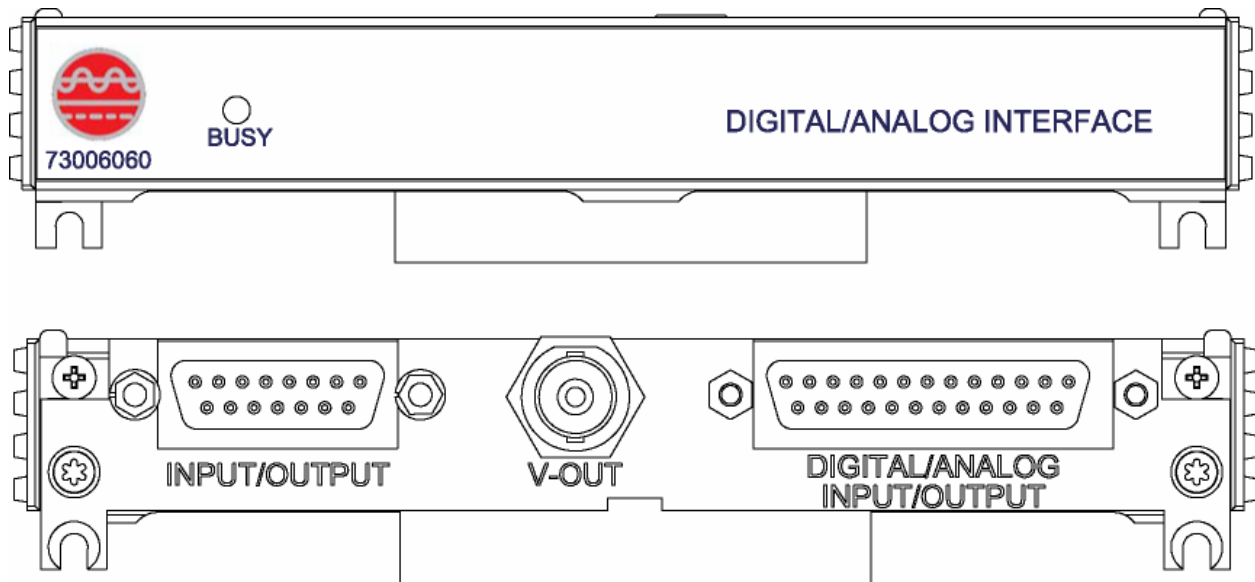
DB9 STEPPER SYNC PINOUT	
PIN	FUNCTION
1	GROUND
2	SYNC-IN1
3	SYNC-OUT1
4	END OF MOVE 2
5	+5V
6	STEP PULSE
7	END OF MOVE 1
8	SYNC-IN2
9	SYNC-OUT2



DB15 EXT ENCODER PINOUT	
PIN	FUNCTION
1	ENCODER A
2	GROUND
3	ENCODER B
4	+5V
5	
6	
7	INDEX/
8	
9	ENCODER A/
10	GROUND
11	ENCODER B/
12	+5V
13	
14	INDEX
15	

# 73006060

## Digital/Analog Module



### General Description

The 73006060 module is a general purpose I/O module that supports 8 open collector outputs (two of which can source drive outputs (24V DC), 16 TTL inputs, (4) 8-bit analog (0-5V) inputs and either 2,3, and 4 analog outputs. The standard 73006060 is configured for 4 analog outputs, 0-10V 8 bits per channel.

Common applications of the DAIO module would be remote control of an illumination source, detecting the status of an interlock switches, and vacuum control/sense in different types of specimen handling.

## Module Configuration

The 73006060 ADIO can be configured in various different manners.

When changing a parameter, always click on the associated **Set** button. After the desired settings have been adjusted and set, click the **Apply/Save** button. The changes will take effect on the next power restart

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http://192.168.100.1./cfg

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LEP MAC6000 Controller

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HOME DEVICE CONFIGURE SIMPLE CONSOLE CONFIGURATION REPORT ? DAIO

TYPE: 17 DEVICE: 9 MOTOR: 6060

Bits: 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

INPUT: ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Output: ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

DIRECTION: ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒

SWITCH: ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

BUSY: ☐

AD0: 174 AD1: 174

AD2: 218 AD3: 216

DA0: 0 set

DA1: 0 set

DA2: 0 set

DA3: 0 set

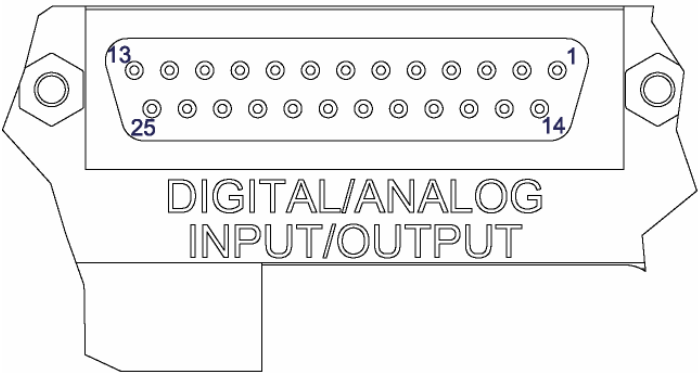
DA4: 0 set

DA5: 0 set

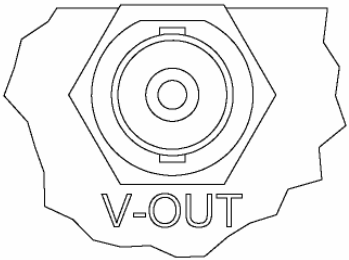
DA6: 0 set

DA7: 0 set

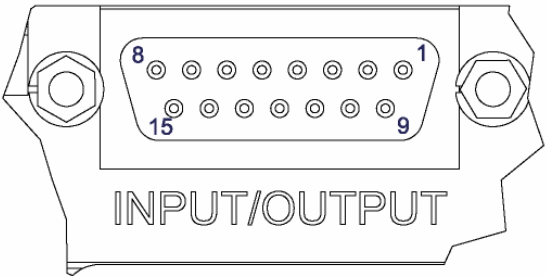
Rear Panel Pin Out



DB25 DAIO PINOUT	
PIN	FUNCTION
1	DIGITAL IN 0
2	DIGITAL IN 2
3	DIGITAL IN 4
4	DIGITAL IN 6
5	POWER OUT 0
6	POWER OUT 2
7	POWER OUT 4
8	POWER OUT 6
9	POWER ANALOG 3
10	POWER ANALOG 4
11	
12	+24V
13	DIGITAL GND
14	DIGITAL IN 1
15	DIGITAL IN 3
16	DIGITAL IN 5
17	DIGITAL IN 7
18	POWER OUT 1
19	POWER OUT 3
20	POWER OUT 5
21	POWER OUT 7
22	ANALOG IN 7
23	ANALOG IN 6
24	ANALOG 4 OUT
25	+5V



BNC OUTPUT	
PIN	FUNCTION
CENTER	ANALOG 3 OUT
SHELL	GND

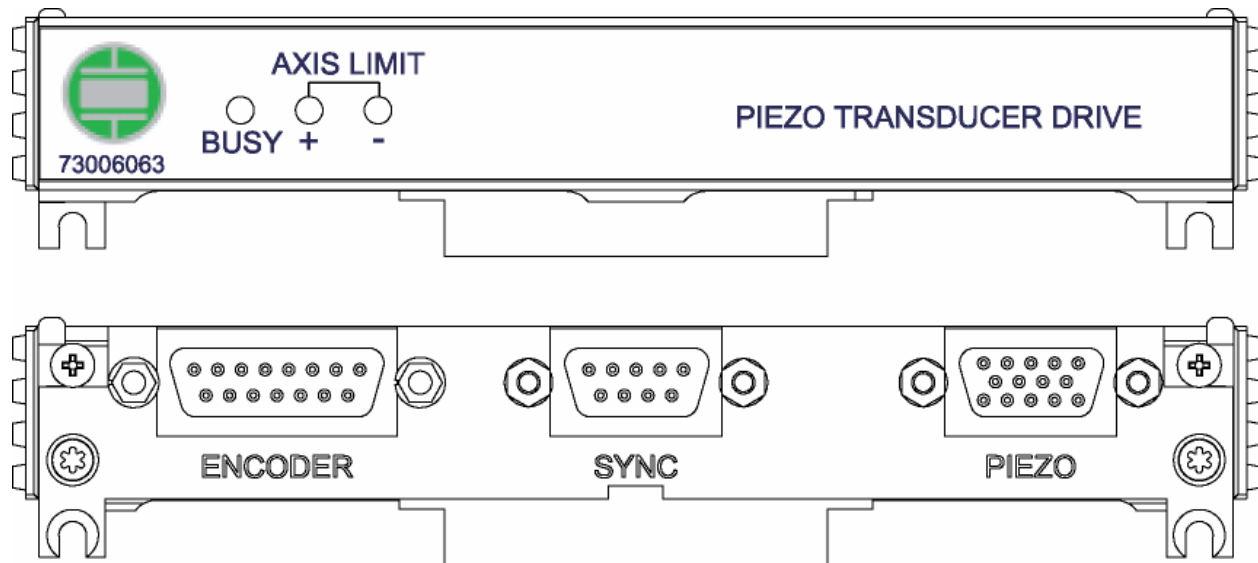


DB15 IO PINOUT	
PIN	FUNCTION
1	ANALOG IN 3
2	DIGITAL OUT 9
3	DIGITAL GND
4	POSITION C
5	POSITION B
6	POSITION A
7	+5V
8	IN POSITION
9	
10	ANALOG OUT 2
11	ANALOG OUT 1
12	MOTOR -
13	MOTOR +
14	DIGITAL IN 9
15	ANALOG IN 4



# 73006063

## Piezo Module



### General Description

The 73006063 module is used to drive LEP's piezo stage inserts. The piezo system provides rapid and precise focus control for image acquisition.

The module uses a dedicated 16 bit resolution, digital position feedback system and offers a sophisticated electronic triggering option. LEP offers two different piezo inserts, 200um and 500um travel range. With the SGS (Strain Gage Sensor) to track position, the 200um piezo insert is capable of 3nm per step and the 500um is 7.6nm per step.

The piezo insert can be controlled in four manners.

- LEP standard motor commands.
- External DAQ for high speed acquisition.
- Manual control via an LEP input device, such as a digipot p/n: 73006365.
- External triggering.

## Module Configuration

The 73006063 piezo drive module offers some limited configuration options to the user.

When changing a parameter, always click on the associated **Set** button. After the desired settings have been adjusted and set, click the **Apply/Save** button. The changes will take effect on the next power restart

The screenshot shows a web browser window titled "LEP MAC6000 Controller - Windows Internet Explorer provided by Yahoo!". The address bar shows "http://192.168.100.1/cfgpi". The page features the LEP logo and "Ludl Electronic Products Ltd." on the left, and "LEP MAC6000 Controller" and "Web Page Version 2.8 - 02-25-2011" on the right. A navigation bar includes links for HOME, DEVICE CONFIGURE, SIMPLE CONSOLE, CONFIGURATION REPORT, and a highlighted PIEZO button. The main content area displays configuration parameters: TYPE: 11, DEVICE: 3, MOTOR: 6063. Below these are input fields for POS: -191, DA0: 2, DA1: 0, CWLim: (checkbox), AD0: 7306629, AD1: 1834, CCWLim: (checkbox), and BUSY: (checkbox). Buttons for "Set Position", "Factory Defaults", and "Apply/Save" are present. An "Advanced Mode" section is expanded, showing "Joystick Direction: Normal", "Control Source: Interface", "Enable Encoder" (checked), and "Enable Servo Checking" (unchecked). At the bottom, there are sliders for "Set Digipot Speed" (1250) and "Set Power Level" (On), with a speed indicator ranging from (slow) to (fast). The browser's status bar at the bottom shows "Done" and "Internet".

LEP MAC6000 Controller - Windows Internet Explorer provided by Yahoo!

http://192.168.100.1/cfgpi

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LEP MAC6000 Controller

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HOME DEVICE CONFIGURE SIMPLE CONSOLE CONFIGURATION REPORT ? **PIEZO**

**TYPE: 11 DEVICE: 3 MOTOR: 6063**

POS: -191 CWLim: ■ CCWLim: ■ BUSY: ■

DA0: 2 AD0: 7306629

DA1: 0 AD1: 1834

Set Position

Factory Defaults Apply/Save

☐ Advanced Mode

Joystick Direction: Normal ☐ Enable Encoder

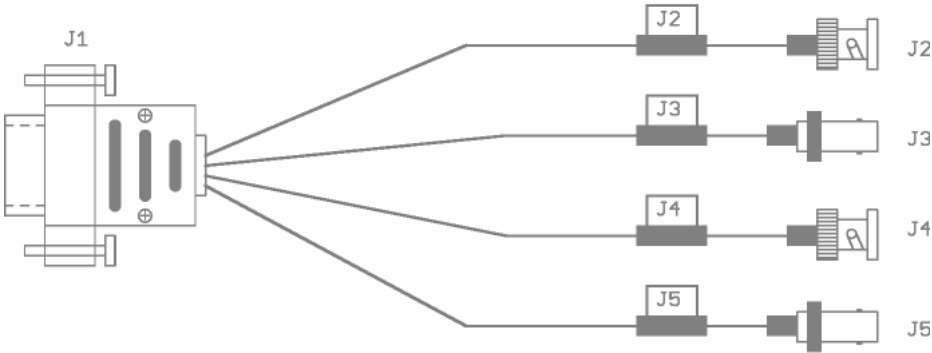
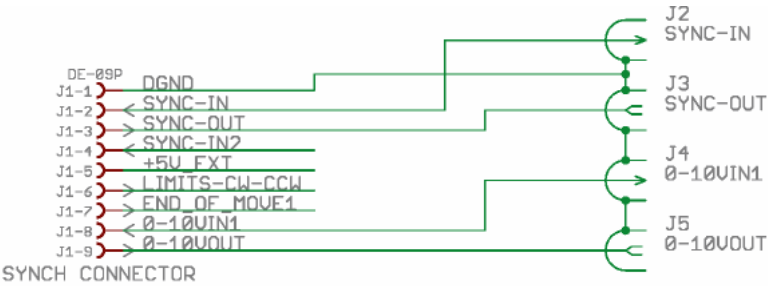
Control Source: Interface ☐ Enable Servo Checking

Set Digipot Speed 1250 (slow) (fast)

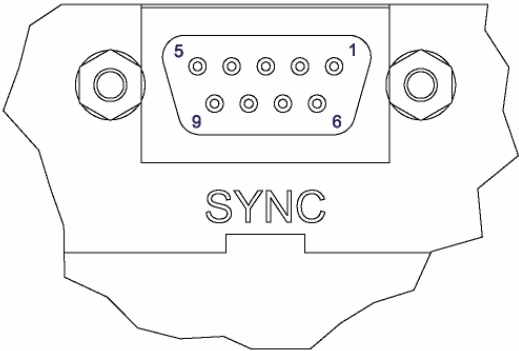
Set Power Level On

Done Internet 100%

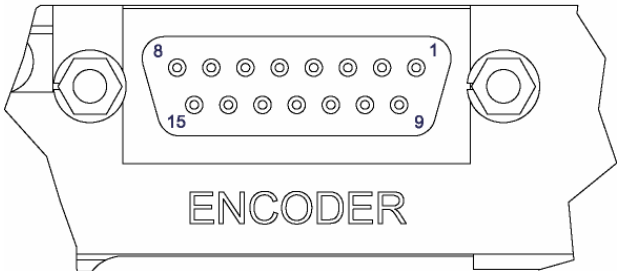
# Rear Panel Pin Out



73A00165 - Z-AXIS CABLE FOR ANLG IN/OUT SYNC



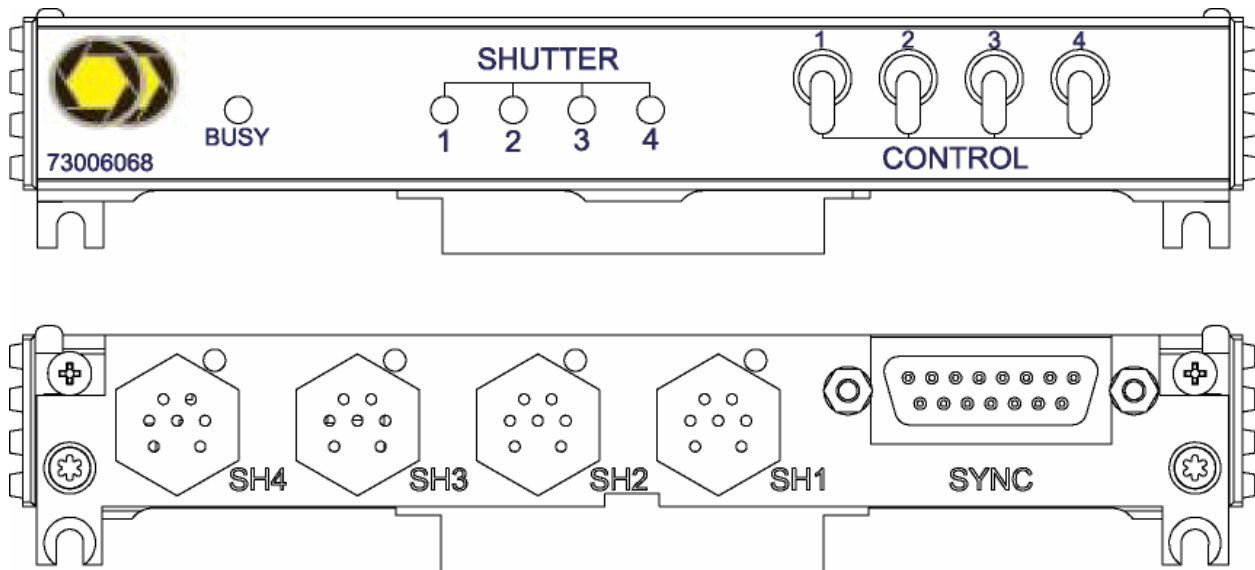
DB9 PIEZO SYNC PINOUT	
PIN	FUNCTION
1	DIGITAL GND
2	SYNC IN1
3	SYNC OUT
4	
5	+5V EXT
6	
7	END OF MOVE
8	10V IN
9	10V OUT



DB15 PIEZO ENCODER PINOUT	
PIN	FUNCTION
1	ENCODER PHASE A
2	DIGITAL GND
3	ENCODER PHASE B
4	+5V EXT
5	
6	
7	
8	
9	
10	DIGITAL GRD
11	
12	+5V EXT
13	
14	HOME
15	

# 73006068

## 4-Shutter Controller Module



### General Description

The 73006068 module allows control over four different shutters. The shutters can be controlled in the three manners, front panel switches, software control, and SYNC connector option.

Located on the front of the controller are four toggle switches used to open/close each corresponding shutter. Each shutter port has a corresponding LED indicator light denoting when the shutter is open (light on) or closed (light off).

Utilizing LEP's unique shutter design a life expectancy of 50 million cycles is expected. The shutter open/close characteristics can also be programmed, but are factory set for optimal performance at 18ms for an open and close.

## Module Configuration

The 73006068 only offers some advanced options, which pertain to the synch settings.

After settings have been selected, click the **Apply/Save** button for the changes to take affect after a power restart.

The screenshot shows a web browser window titled "LEP MAC6000 Controller - Windows Internet Explorer provided by Yahoo!". The address bar shows "http://192.168.100.1/". The browser's menu bar includes File, Edit, View, Favorites, Tools, and Help. The toolbar shows various icons including a star, a green arrow, a magnifying glass, and a printer. The main content area displays the LEP logo and the text "Ludl Electronic Products Ltd." on the left, and "LEP MAC6000 Controller" in green on the right. Below this, it says "Web Page Version 2.8 - 02-25-2011". A navigation bar contains links: HOME, DEVICE CONFIGURE, SIMPLE CONSOLE, CONFIGURATION REPORT, and a red button labeled "6068". The main configuration area shows "TYPE: 10 DEVICE: 17 MOTOR: 6068". There are input fields for "POS:" (value 0) and "BUSY:" (checkbox). Below these are buttons for "Move To...", "Factory Defaults", and "Apply/Save". A section titled "Advanced Mode" is expanded, showing a "Sync Pulse" input field (value 10) and a list of checkboxes: "Enable Encoder", "External Synch Pulse Out", "External Synch In Active Low" (checked), "External Synch Out Active Low" (checked), "Enable External Synchs as Limits", and "Flip Synch Limits (sync1=CCW)". The status bar at the bottom shows "Done", "Internet", and "100%".

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http://192.168.100.1/

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LEP MAC6000 Controller

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HOME DEVICE CONFIGURE SIMPLE CONSOLE CONFIGURATION REPORT ? 6068

TYPE: 10 DEVICE: 17 MOTOR: 6068

POS: 0 BUSY: ☐

Move To... SH1: ☐ SH2: ☐ SH3: ☐ EXP1: ☐ EXP2: ☐

Factory Defaults Apply/Save

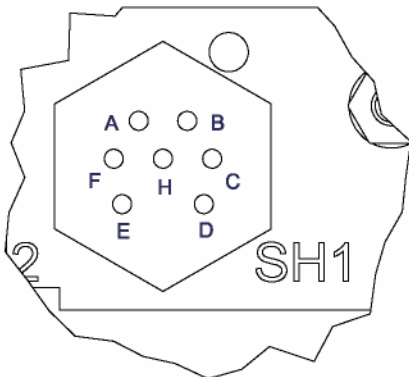
☒ Advanced Mode

Sync Pulse 10

☐ Enable Encoder  
☐ External Synch Pulse Out  
☒ External Synch In Active Low  
☒ External Synch Out Active Low  
☐ Enable External Synchs as Limits  
☐ Flip Synch Limits (sync1=CCW)

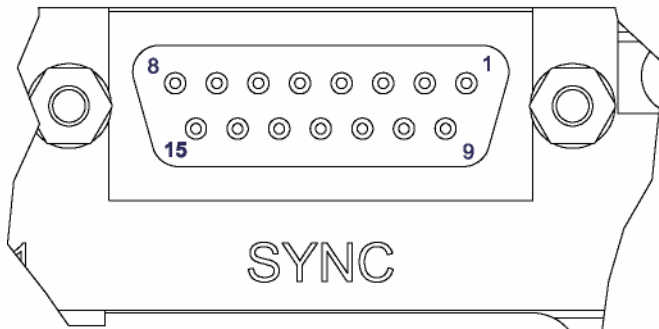
Done Internet 100%

## Rear Panel Pin Out



SHUTTER CONNECTOR PINOUT	
PIN	FUNCTION
A	DIGITAL GND
B	SH1 OUT
C	
D	
E	POWER GND
F	RESERVED
H	

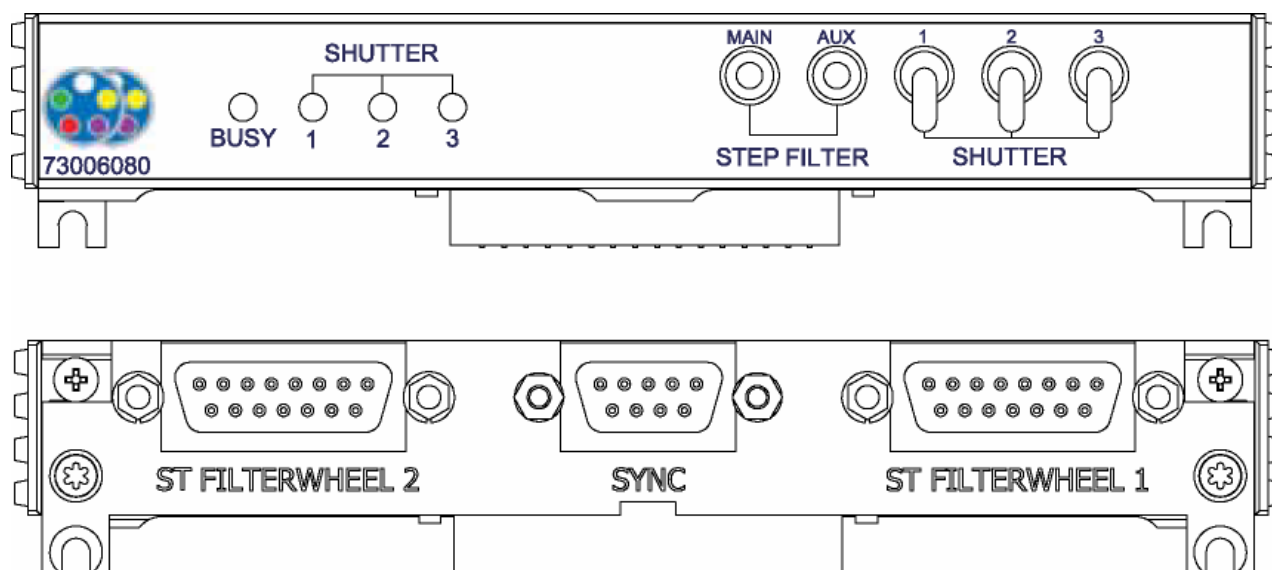
\* All four shutter ports are wired the same.



DB15 SYNC PINOUT	
PIN	FUNCTION
1	SYNC OUT 1
2	SYNC OUT 2
3	DIGITAL
4	SYNC OUT 3
5	SYNC OUT 4
6	SH1 IN
7	+5V EXT
8	SH1 IN/
9	SH2 IN
10	SH2 IN/
11	SH3 IN
12	SH3 IN/
13	SH4 IN
14	SH4 IN/
15	CLOSE ALL

# 73006080

## Stepper Motor Filter/Shutter Module



### General Description

The stepper motor filter wheel/shutter is a microprocessor half step motor driver capable of operating up to two six position filter wheels and three high speed shutters.

The LEP stepper filter wheels are driven by stepper motors via a timing belt. An integral home position (Hall Effect) sensor is utilized for automatic initialization. The maximum speed is 100ms between adjacent filter positions.

Microscope specific mounting flanges are available which simplify mechanical integration of LEP filter wheels with most microscopes offered by Leica, Olympus, Nikon and Zeiss. A filter wheel can have either a 25mm or 32mm filter. Filters can be easily inserted and removed from the filter wheel while the entire assembly is mounted on the microscope due to the hinged construction of the filter wheel.

Up to three high speed shutters may be controlled using the same module. The drive electronics utilize a bi-level drive, supplying an initial high opening voltage for high-speed action (<15ms to open or close) followed by a lower holding voltage which allows shutters to be held open indefinitely without damage. Manufactured specifically for high temperature applications, these shutters have proven to be extremely durable under heavy usage due to their simple design.

## Module Configuration

There are limited options for configuration settings for the filter wheel module, but in Advance Mode you have the ability to customize the stepper motor characteristics and the SYNC connector on the rear of the controller.

After settings have been selected and changes, click the **Apply/Save** button for the changes to take affect after a power restart.

The screenshot shows a web browser window titled "LEP MAC6000 Controller - Windows Internet Explorer provided by Yahoo!". The address bar shows "http://192.168.100.1/ci". The browser's menu bar includes File, Edit, View, Favorites, Tools, and Help. The toolbar shows various icons including a home button, RSS feed, and printer. The main content area displays the LEP logo and "Ludl Electronic Products Ltd." on the left, and "LEP MAC6000 Controller" in green text on the right, with "Web Page Version 2.8 - 02-25-2011" below it. A navigation bar contains buttons for HOME, DEVICE CONFIGURE, SIMPLE CONSOLE, CONFIGURATION REPORT, and a red button labeled "6080". Below this, the text "TYPE: 9 DEVICE: 17 MOTOR: 6080" is shown. The "POS:" field contains the value "0". To the right, "BUSY:" is followed by a black square icon. Below these are fields for "SH1:", "SH2:", "SH3:", "EXP1:", and "EXP2:", each followed by a black square icon. There is a "Move To..." button and a text input field. At the bottom of this section are "Factory Defaults" and "Apply/Save" buttons. A red horizontal line separates this from the "Advanced Mode" section, which is indicated by a checked checkbox. In the "Advanced Mode" section, there is a "Sync Pulse" button and a text input field containing the value "2". To the right are several checkboxes: "Enable Encoder" (unchecked), "External Synch Pulse Out" (checked), "External Synch In Active Low" (unchecked), "External Synch Out Active Low" (unchecked), "Enable External Synchs as Limits" (checked), and "Flip Synch Limits (sync1=CCW)" (unchecked). The browser's status bar at the bottom shows "Done" and "Internet" with a 100% zoom level.

LEP MAC6000 Controller - Windows Internet Explorer provided by Yahoo!

http://192.168.100.1/ci

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LEP MAC6000 Controller

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HOME DEVICE CONFIGURE SIMPLE CONSOLE CONFIGURATION REPORT ? 6080

TYPE: 9 DEVICE: 17 MOTOR: 6080

POS: 0 BUSY: ■

Move To... SH1: ■ SH2: ■ SH3: ■ EXP1: ■ EXP2: ■

Factory Defaults Apply/Save

☒ Advanced Mode

Sync Pulse 2

☐ Enable Encoder  
☒ External Synch Pulse Out  
☐ External Synch In Active Low  
☐ External Synch Out Active Low  
☒ Enable External Synchs as Limits  
☐ Flip Synch Limits (sync1=CCW)

Done Internet 100%



## Triggering Options

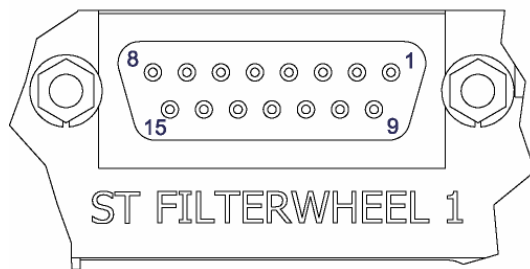
- High speed synch mode where a TTL output signal may trigger an image capture after a filter position change.
- Sequencer macro function to simplify repetitive filter movements.
- External TTL signals may be used for shutter synchronization.

## Front Panel Control Functions

The filter wheel module allows manual control of key filter wheel/shutter functions using five switches located on the front panel. A user may control the state (i.e. open or closed) of three shutters simply by using the toggle switches which are labeled SH1, SH2 and SH3. **Note:** Software control overrides the front panel switch setting. Indicator LED's on the front panel illuminate to signify that a shutter is open and darken when the shutter is closed. The filter position of filter wheel 1 and filter wheel 2 may be changed using the toggle switches labeled MAIN and AUX; the wheel will respond with a sequential movement dependent on the direction which the switch was toggled. Both wheels may be re-initialized to the "HOME" position by depressing the move switch down and holding for 4 secs.

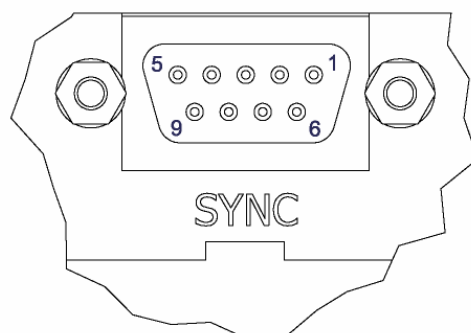
## Rear Panel Connections

Connections are made at the rear panel of the MAC 6000 module via a DB-15 female connector labeled Filter wheel 1 and Filter wheel 2. Each filter wheel/shutter combination requires a separate 15 pin cable. Most filter wheels are manufactured with a single internal shutter and auxiliary shutter. The auxiliary shutter may be added to the system by connecting to the 7 pin AUX port on the filter wheel housing. If not available, one of the DB-15 filter wheel connectors can be also be used.



\* Both FILTERWHEEL 1 and FILTERWHEEL 2 ports are the same, except for pin 5. On FILTERWHEEL 2, pin 5 becomes SHUTTER 2 OUT.

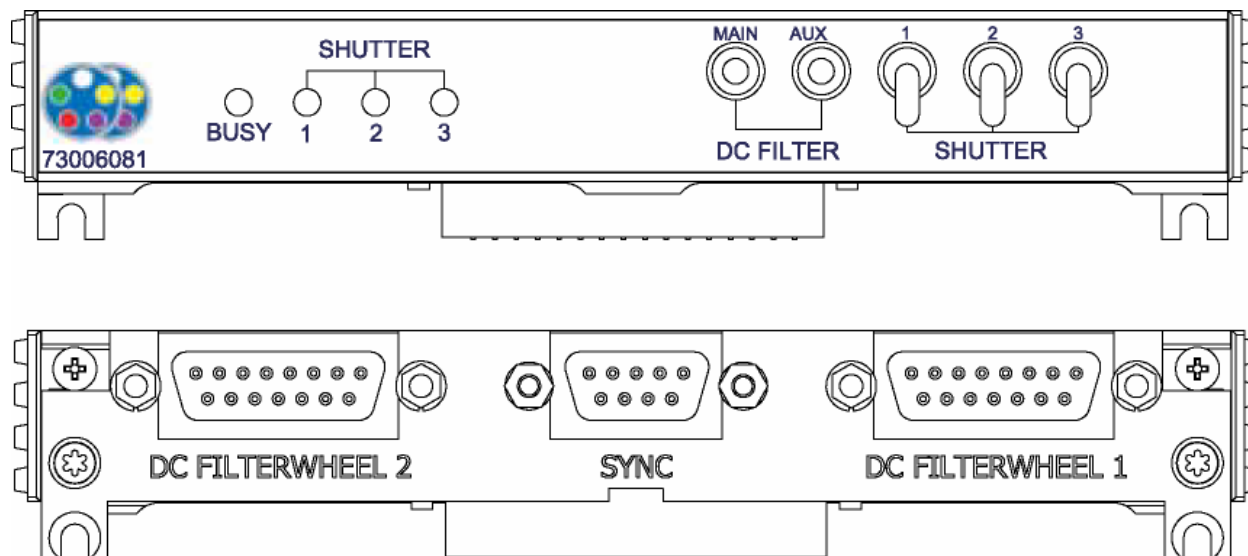
PIN	FUNCTION
1	ENCODER A
2	ENCODER B
3	GROUND
4	HOME
5	SHUTTER 1 OUT
6	SHUTTER 3 OUT
7	+5V
8	
9	RATIO
10	MTR PH2
11	RESERVED
12	MTR PH1
13	MTR PH3
14	RESERVED
15	MTR PH4



PIN	FUNCTION
1	GROUND
2	SYNC-IN1
3	SYNC-OUT1
4	END OF MOVE 2
5	+5V
6	RESERVED
7	END OF MOVE 1
8	SYNC-IN2
9	SYNC-OUT2

## 73006081

### DC Motor Filter/Shutter Module



### General Description

The 7306081 is a complete microprocessor motor controller and servo amplifier system in a single MAC 6000 module. The module employs a dedicated DSP processor to provide high performance motion control for the DC servo motors used in LEP high speed filter wheels. This module is capable of operating up to two 10 position filter wheels and three high speed shutters. The major advantage to the DC filter wheel system is speed; 50ms between adjacent filter positions as opposed to 100ms with the stepper filter wheel systems. Also, the DC filter wheel system operates as a closed loop system. This means the filter position is controlled with reference to feedback from an encoder input. The closed loop mode performance is improved over the open loop mode used by the stepper filter wheel by correcting for the possibility of misalignment due to missed steps, stalling or physical disturbance.

Microscope specific mounting flanges are available which simplify mechanical integration of LEP filter wheels with most microscopes offered by Leica, Olympus, Nikon and Zeiss. Each wheel can have a mixed combination of 25mm and 32mm filters, with easy interchangeable filter cups. Filters can be easily inserted and removed from the filter wheel while the entire assembly is mounted on the microscope due to the hinged construction of the filter wheel.

Up to three high speed shutters may be controlled using the same module. The drive electronics utilize a bi-level drive, supplying an initial high opening voltage for high-speed action (<15ms to open or close) followed by a lower holding voltage which allows shutters to be held open indefinitely without damage. Manufactured specifically for high temperature applications, these shutters have proven to be extremely durable under heavy usage due to their simple design.

## Module Configuration

There are limited options for configuration settings for the filter wheel module, but in Advance Mode you have the ability to customize the SYNC connector on the rear of the controller.

After settings have been selected and changes, click the **Apply/Save** button for the changes to take affect after a power restart.

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http://192.168.100.1./cl

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LEP MAC6000 Controller

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HOME DEVICE CONFIGURE SIMPLE CONSOLE CONFIGURATION REPORT ? **6081**

**TYPE: 10 DEVICE: 17 MOTOR: 6081**

POS: 0 BUSY: ■

Move To... SH1: ■ SH2: ■ SH3: ■ EXP1: ■ EXP2: ■

Factory Defaults Apply/Save

☒ Advanced Mode

Sync Pulse 2

- ☒ Enable Encoder
- ☒ External Synch Pulse Out
- ☐ External Synch In Active Low
- ☐ External Synch Out Active Low
- ☐ Enable External Synchs as Limits
- ☐ Flip Synch Limits (sync1=CCW)

Done Internet 100%

## Triggering Options

- High speed synch mode where a TTL output signal may trigger an image capture after a filter position change.
- Sequencer macro function to simplify repetitive filter movements.
- External TTL signals may be used for shutter synchronization.

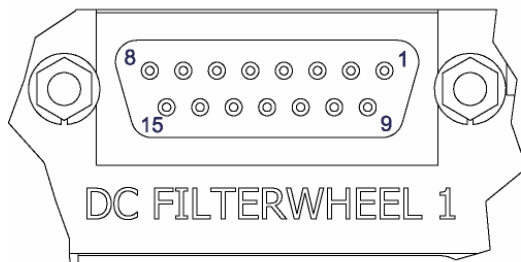
## Front Panel Control Functions

The filter wheel module allows manual control of key filter wheel/shutter functions using five switches located on the front panel. A user may control the state (i.e. open or closed) of three shutters simply by using the toggle switches which are labeled SH1, SH2 and SH3. **Note:** that software control overrides the front panel switch setting. Indicator LED's on the front panel illuminate to signify that a shutter is open and darken when the shutter is closed. The filter position of filter wheel 1 and filter wheel 2 may be changed using the toggle switches labeled MAIN and AUX; the wheel will respond with a sequential movement dependent on the direction which the switch was toggled. Both wheels may be re-initialized to the "HOME" position by depressing the move switch down and holding for 4 secs.

## Rear Panel Connections

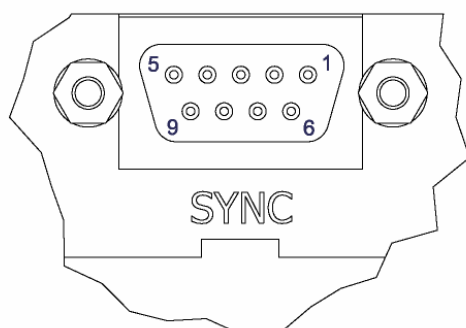
Connections are made at the rear panel of the MAC 6000 module via a DB-15 female connector labeled Filter wheel 1 and Filter wheel 2. Each filter wheel/shutter combination requires a separate 15 pin cable. Most filter wheels are manufactured with a single internal shutter and auxiliary shutter. The auxiliary shutter may be added to the system by connecting to the 7 pin AUX port on the filter wheel housing. If not available, one of the DB-15 filter wheel connectors can be also be used.

## Rear Panel Pin Out



\* Both FILTERWHEEL 1 and FILTERWHEEL 2 ports are the same, except for pin 5. On FILTERWHEEL 2, pin 5 becomes SHUTTER 2 OUT.

DB15 FILTERWHEEL PINOUT	
PIN	FUNCTION
1	ENCODER A
2	ENCODER B
3	GROUND
4	HOME
5	SHUTTER 1 OUT
6	SHUTTER 3 OUT
7	+5V
8	
9	RATIO
10	
11	RESERVED
12	MOTOR +
13	MOTOR -
14	RESERVED
15	



DB9 FILTERWHEEL SYNC PINOUT	
PIN	FUNCTION
1	GROUND
2	SYNC-IN1
3	SYNC-OUT1
4	END OF MOVE 2
5	+5V
6	RESERVED
7	END OF MOVE 1
8	SYNC-IN2
9	SYNC-OUT2

# Warranty Information

## Warranty Time Period and Limitations

Ludl Electronic Products Ltd., hereafter referred to as **LEP**, warrants its products to be free from malfunctions and defects in both materials and workmanship for a period of one year from the date of original purchase.

Units returned to **LEP** that have been subject to abuse, misuse, damage or accident; have been connected, installed or adjusted contrary to the instructions furnished by **LEP** or repaired by unauthorized persons will not be covered by this warranty.

This warranty becomes null and void if you fail to pack equipment in a manner consistent with the original product packaging and damage occurs during product shipment.

**LEP** reserves the right to discontinue models; change specifications, price or design of this device at any time without notice and without incurring any obligation whatsoever.

The purchaser agrees to assume all liabilities for any damages and/or bodily injury which may result from the use or misuse of this device by the purchaser, his employees or agents.

**LEP** shall not be liable in any way for consequential damages resulting from use of this device.

This warranty is in lieu of all other representations or warranties expressed or implied and no agent or representative of **LEP** is authorized to assume any other obligation in connection with the sale and purchase of this device.

All instruments are delivered with serial tags located on the rear panel or bottom of the unit. These serial numbers are used to track the manufacturing date and the revision level. If this serial number is removed for any reason, the warranty is void.

## Warranty Repair Coverage

**LEP** under this warranty is limited to repairing or replacing the defective device when returned to the factory, shipping charges prepaid, within one (1) year from date of original purchase. Such repair service will include all labor as well as any necessary adjustments and/or replacement parts. If replacement parts are used in making repairs, these parts may be remanufactured, and/or may contain remanufactured materials. If it is necessary to replace the entire system, it may be replaced with a remanufactured system.

## Application Support

For application specific support, please contact your reseller, systems integrator, software manufacturer, or dealer directly. If additional technical support is required, your service provider should contact **LEP** with a detailed description of the problem, system configuration, and any available troubleshooting information.

## How to Obtain Service

You may visit our web site at <http://www.ludl.com>; simply choose the appropriate contact group and we will promptly respond to your inquiry.

When returning any **LEP** equipment for repair you must first obtain an RMA (Return Merchandise Authorization) number from one of our Customer Service Representatives. The unit should be packed in its original packing materials and a detailed problem report should be enclosed. The accompanying paperwork should reference the RMA# and all items which were shipped to **LEP**.

#### Disclaimer

LEP Ltd. assumes no responsibility for damage of equipment or loss of information as a result of misuse of the contents in this manual. All information contained within is accurate at the time of printing.

## NOTES

Ludl Electronic Products designs and manufactures a wide range of automation accessories for microscopes and instrumentation.

*[www.ludl.com](http://www.ludl.com)*

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