



Piezo Aperture Operating Manual



Quantum Composers, Inc.
212 Discovery Drive
Bozeman, MT 59718
Phone: (406)582-0227
Fax: (406)582-0237

www.quantumcomposers.com

Contents

Introduction	3
Setup	3
Electrical Connections.....	3
USB Connection	4
USB Driver Installation (If Necessary)	4
Driver Installation (Windows XP)	4
Driver Installation (Windows 7 and Greater).....	4
Software Operation.....	5
Command Set.....	5
Device Command Format	5
Device Addresses	6
Command Types.....	6
Command Set.....	6
Specifications	8
Input:.....	8
Output:.....	8
Controller:.....	8
Package:	8
Mechanical Drawings.....	9

Introduction

The Quantum Composers motorized rectangular aperture module for use in imaging systems for precise patterning. The module allows independent control of X, Y aperture size. The optional Theta configuration also rotates the aperture +/- 45°. Direct drive aperture edges and rotation all feature closed loop control for backlash free, precise size and angle control. The module is controlled via a RS232 serial interface that can be daisy chained to other Quantum Composers laser modules or communicated with directly via USB.

Setup

The Aperture must be placed in the beam path such that the laser beam is orthogonal to and centered on the input aperture of the module. The aperture should be placed such that the imaging plane matches the aperture blade plane. See the mechanical drawings for details on the location of this plane. Connect the power and communications cable(s) to start using the module (see the electrical connections section for more information on this).

Electrical Connections

The Piezo Aperture module requires 5VDC @ 750mA (Max) to operate. The module can be operated and powered from a standard Micro-USB connection. For use in an integrated system, the module also has a second set of connectors for power and communications. For more information on these connections see the tables below. An image of the location of these connections can be seen in the mechanical drawings section.

USB Micro-B Connector

Pin Number	Name	Description
1	+5VDC	VBus.
2	D-	Data -
3	D+	Data +
4	ID	Identification. Not used.
5	Ground	Power return.

Input Connector (Connector: Molex 0874390400, Contacts: Molex 0874210000)

Pin Number	Name	Description
1	+5VDC	Default Power Source for the Module
2	Ground	Power Source and Communications Return
3	RS-232 Rx	UART Communications into the Module from a Personal Computer/next Module
4	RS-232 Tx	UART Communications out from the Module to a Personal Computer/next Module

Output Connector (Connector: Molex 0874390500, Contacts Molex 0874210000)

Pin Number	Name	Description
1	+5VDC	Default Power Source for the Module
2	Ground	Power Source and Communications Return
3	RS-232 Tx	UART Communications out from the Module to a Personal Computer/next Module
4	RS-232 Rx	UART Communications into the Module from a Personal Computer/next Module
5	NC	This pin is not used

USB Connection

Normally the device drivers for the module will be factory installed on many Windows based computers and there will be no need to install additional drivers. If drivers are already installed with Windows, then the module will show up as a USB Serial Port under device manager with a port number assigned. If the driver is not installed properly or Windows indicates an unknown device, proceed with the USB Driver Installation Instructions that follow. In order to communicate with the module via USB the driver must first be installed.

USB Driver Installation (If Necessary)

Driver Installation (Windows XP)

1. Plug the module into the computer using a micro USB cable.
2. The computer will display a message indicating it has found new hardware: “unrecognized device”.
3. The new hardware wizard will launch. Check the “Install from a list or specific location” option and click next.
4. Select “Search for the best driver in these locations” and check the option to “Include this location in the search”. Click the browse button and locate the folder on the CD where the module drivers are located. Click next.
5. A message window will launch asking if you want to continue installing this driver. Select the “Continue Anyway” button.
6. It should now indicate that it is installing a driver for a “USB Serial Port”.
7. Once the process is finished, a message will indicate that the drivers have been successfully installed.
8. You can now communicate with the module using either the included GUI application or by using any generic communication terminal program. You can view the Com Port number assigned to the module in your computers’ device manager under Ports.

Driver Installation (Windows 7 and Greater)

1. Plug the module into the computer using a USB cable. Make sure the unit is powered on.
2. A message will pop up on the computer indicating it has found new hardware and is installing device driver software.
3. A message will indicate that the device drivers have not been successfully installed. The Action Center may then launch with a list of options. Close the Action Center and do not launch any of the actions.
4. Go to your computers Device Manager. This can be done by one of two ways. a) Right click on the desktop “Computer” icon and select properties. Select Device Manager on the left toolbar. b) Navigate to Control Panel and then Device Manager.
5. In Device Manager you should see a device under the Other Devices called the unrecognized device. There will be a yellow exclamation point next to it.
6. Right click on the unrecognized device and select update driver software.
7. Select “Browse My Computer” for driver software and browse to the location of the USB drivers for the module. The location is typically found on the software CD. It will contain a file called “QCDevicecdc.inf” and “QCDevicecdc.cat”. Select the folder in which the file resides, not the file itself. Click next.
8. Windows will then indicate a warning window that the drivers are not verified. Select “Install this driver software anyway”.
9. A message will then indicate that the drivers have been successfully updated and the unrecognized device USB Communication Port is now available.

10. You can now communicate with the module using either the included GUI application or by using any generic communication terminal program. You can view the Com Port number assigned to the module in your computers device manager under Ports.

Software Operation

Quantum Composers provides a simplified software interface (GUI) to allow for quick setup and operation of the module. The software will run on any Windows based computer. Before running the software make sure the module is powered on and communications are attached. If communicating via USB first ensure the driver is installed. Once the module has power and communications run the software by double clicking the executable file. If for any reason the software cannot detect the module an error message will appear. If this should occur recheck the power and communications connections then try again. The software allows for control of all the module functions. It also shows the status of the module at all times. The command terminal section allows for command entry and for the user to view the commands sent.

Command Set

The Piezo Aperture communicates via a standard RS-232 or USB connection. The default communication settings are: **57,600** baud, **8** data bits, **Even** parity, and **1** stop bit. A typical DB9 serial port pin out is shown below. Only the Tx, Rx, and Ground pins are used to communicate with the Piezo Aperture module.

Typical PC Serial Port (DB9)

Pin	Name	Description
1	DCD	Line Signal Detect
2	Rx	Received Data*
3	Tx	Transmitted Data*
4	DTR	Data Terminal Ready
5	GND	Ground*
6	DSR	Data Set Ready
7	RTS	Request to Send
8	CTS	Clear to Send
9	RI	Ring Indicator

Device Command Format

All Commands use ASCII characters and are composed of the following fields:

<Prefix><Address><Deliminitor><Command String and Parameters><Terminator>

Field	Description
Prefix	A single semicolon character (;) must precede all commands. All Quantum Composers devices will reset their command input buffers when the prefix is received.
Address	Each Quantum Composers device has a unique address which consists of 2 ASCII characters that are pre-programed into its firmware. See below for the specific address of each module.
Deliminitor	A single colon character (:) must follow the device address.
Command String	Commands are specific to each Quantum Composers device, see sections below for specific instructions for the Piezo Aperture module.
Parameters	(Optional Field) Some commands may have parameters which immediately follow the command string. Multiple parameters are separated by commas.
Terminator	To finish a command string attach an ASCII carriage return (decimal 13) at the end of the string.

	The receiving device will not process any commands until the terminator is received. <CR> or carriage return = ASCII carriage return = decimal value 13
--	------------------------------------------------------------------------------------------------------------------------------------------------------------

Device Addresses

SL – XY and XY Theta apertures will have this address

Command Types

There are two types of commands, those that initiate an action (control commands), and those that request information (query commands). Each device will respond according to the command type and parameters supplied as follows.

Control Commands – A Quantum Composers device will always parse a control command and return a response immediately. If a control command is received while the module is in the midst of executing a previous command, and the commands are mutually exclusive, then the previous command is aborted and the new one is executed. Some exceptions exist and can be found below in the specific command detail. It is up to the host controller (the PC) to poll the device and make sure the previous command is finished, if that is needed.

1. “OK<CR>” – If the command is recognized and the parameter is valid the device will return and OK.
2. “?1<CR>” – If the command is not recognized by the device it will return a ?1.
3. “?2<CR>” – If the command is recognized, but the parameter is invalid or missing the device will return a ?2.
4. “?3<CR>” – If the command is recognized, but the parameter is out of range the device will return a ?3.

Query Command – Query commands return a value to the PC as soon as the command is parsed and executed. The value returned will depend on the command. The response is always terminated with a <CR>. If a query command is not recognized by the device, then a “?0<CR>” is returned.

Command Set

Command	Detail						
EC? EC 0 or 1	Echo – When set to echo=1 the characters received by the module will be repeated back to the host. The default setting is 0. A query will return the current status.						
HM	Home – Sending the home command will move the motor to its limit then return it to the default position. The module automatically homes on power up.						
ID?	Identification – This query will return the identification string for the module. For example: QC, PiezoSlit, SN, VN. SN is the serial number and VN is the firmware version.						
SA? SA #	Slit Angle - Sets the current slit rotation angle. Units are in degrees. Values range from -450 to +450. Degrees are x10. NOTE: Only available on rotating theta version.						
SP? SP #	Slit Position – Sets the X and Y aperture size. A query returns the current position of both. Units are in mm x 1000						
RS	Reset – The reset command will return the controller to its default settings.						
SS?	System Status – This query will return a integer value that represents the current status of the module.						
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Motor X2 Homing	Motor X1 Homing	Motor Theta Active	Motor Y2 Active	Motor Y1 Active	Motor X2 Active	Motor X1 Active	Reserved
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8

Motor Y2 Calibrated	Motor Y1 Calibrated	Motor X2 Calibrated	Motor X1 Calibrated	System Homing	Motor Theta Homing	Motor Y2 Homing	Motor Y1 Homing
Bit 21		Bit 20		Bit 19		Bit 18	Bit 17
		Theta In Position	Motor Y2 In Position	Motor Y1 In Position	Motor X2 In Position	Motor X1 In Position	Motor Theta Calibrated
ST	Stop – Sending this command will stop any motor movement.						
SZ?	Size – Returns the size of the maximum aperture opening.						
VN?	Version Number – This query will return a two digit decimal value reporting the currently installed version of Firmware						

Examples:

To send the aperture to a size of 1000um x 2500um, send the command:

;SL:SP 1000,2500<CR>

Response: OK

To send the theta to an angle of +45 degrees, send the command:

;SL:SA 450>CR>

Response: OK

To query the status, send the query:

;SL:SS?

Response: 4190208 (All motors calibrated and in position)

Specifications

Input:

Beam Height	20 mm (0.8") from base
Direction	Collinear
Aperture Size	2.5mmx2.5mm (3.6mm diagonal)
Max Fluence	5 J/cm ² max

Gaussian beam fluence calculation:

$$f_{max} = \frac{E_{peak}}{\pi r^2 / 2}$$

where r is the radius of the beam in cm E_{peak} (energy in J) = P_{peak} (peak power in W) *
t (pulse width in sec)

$$P_{avg} \text{ (average power in W) } = E \text{ (energy in J) } * f \text{ (frequency in Hz)}$$

$$P_{avg} = P_{peak} * dc \text{ (duty cycle in \%)}$$

Output:

Direction	Collinear, 180° to input
X/Y Slit	
Range	0 to 2.5mm (4mm optional)
Accuracy	± (20µm + 0.004 * size)
Resolution	2µm
Linearity	R2 ≥ 0.995
Theta Slit	
Range	-45 to +45 degrees
Accuracy	± 1.0 degrees
Resolution	≤ 0.5 degrees

Controller:

Communication	USB, RS-232 w/ passthru(1)
Range	0 to 2500µm
Tact Time	X/Y ≤ 400ms, full range of motion, Theta ≤ 800ms, 0 to ± 45°
Initialization	≤ 5.0s
Power	5VDC ± 250mV, 750mA max

Package:

Size, w/o theta	40.6 mm x 40.6 mm x 30 mm (W x H x L) (1.60" x 1.60" x 1.2")
Size, w/ theta	56 mm x 42 mm x 62 mm (W x H x L) (2.2" x 1.65" x 2.5")

1. PASSTHRU allows units to be Daisy Chained.

Mechanical Drawings

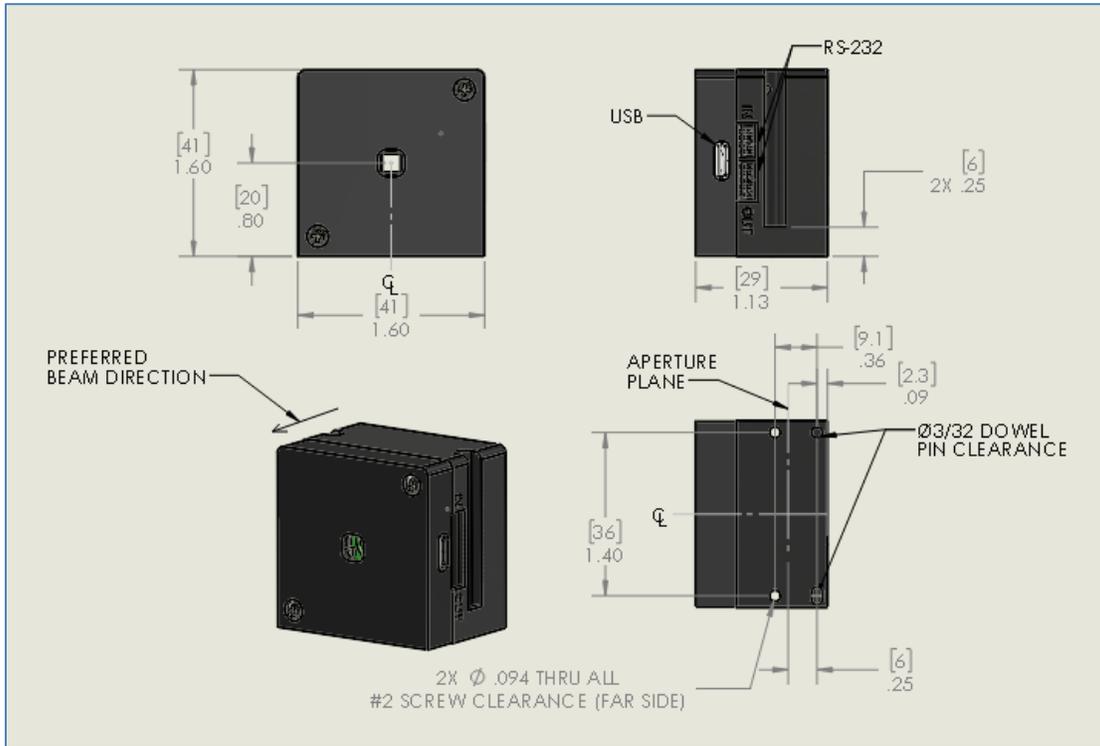


Figure 1 XY Mechanical Interface

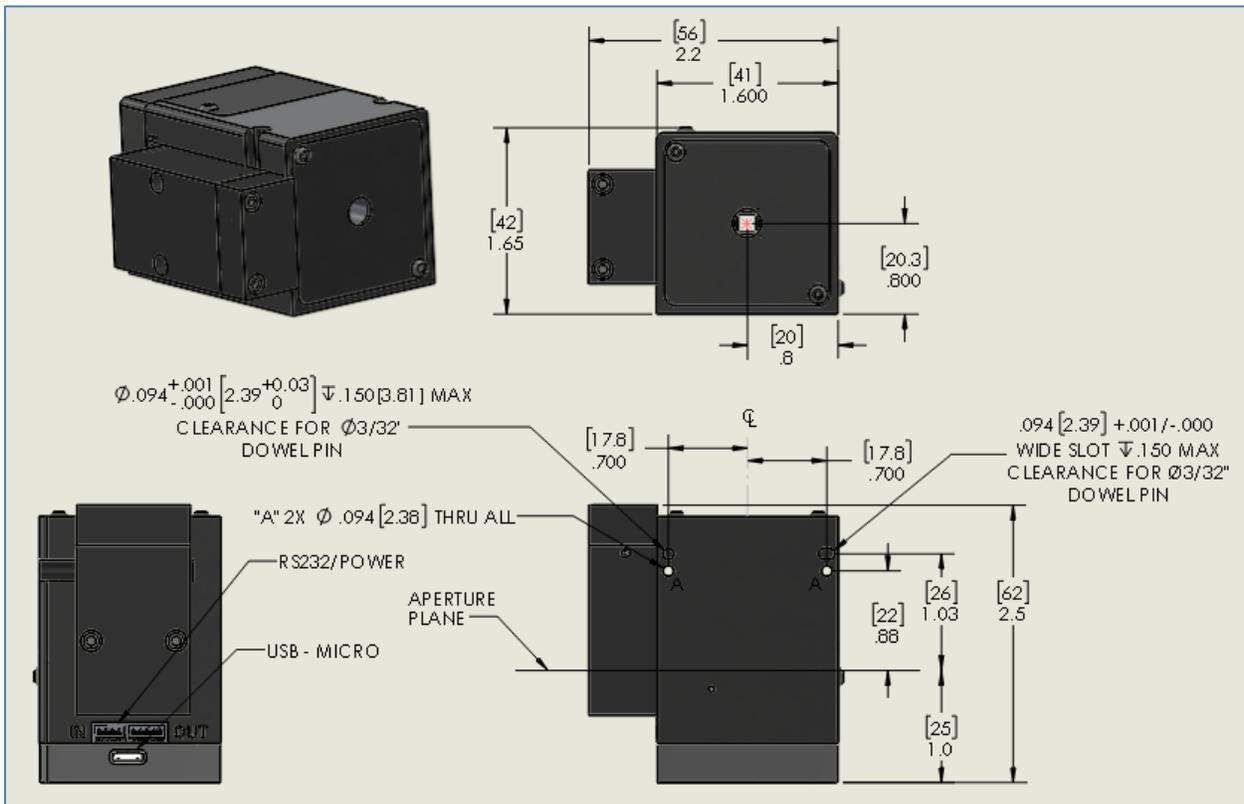


Figure 2 XY Theta Mechanical Interface