

Agilis™ Series

Piezo Motor Driven Components



Warranty

Newport Corporation warrants this product to be free from defects in material and workmanship for a period of 1 year from the date of shipment. If found to be defective during the warranty period, the product will either be repaired or replaced at Newport's discretion.

To exercise this warranty, write or call your local Newport representative, or contact Newport headquarters in Irvine, California. You will be given prompt assistance and return instructions. Send the instrument, transportation prepaid, to the indicated service facility. Repairs will be made and the instrument returned, transportation prepaid. Repaired products are warranted for the balance of the original warranty period, or at least 90 days.

Limitation of Warranty

This warranty does not apply to defects resulting from modification or misuse of any product or part. This warranty also does not apply to fuses.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular use. Newport Corporation shall not be liable for any indirect, special, or consequential damages.

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EU Declaration of Conformity



2 Tech Drive
Andover, MA 01810
www.mksinst.com

EU27 Declaration of Conformity

Application of Council Directive(s):

- Electromagnetic Compatibility Directive (EMCD) – 2014/30/EU
- Machinery Directive – 2006/42/EC
- Restriction of Hazardous Substances Directive (RoHS3) – (EU) 2015/863⁽⁷⁾
- Waste Electrical and Electronic Equipment – Directive 2012/19/EU



Standard(s) to which conformity is declared:

- EN 61326-1:2013 – (EMC)
- EN ISO 12100:2010 Safety of Machinery – General Principles of Design – Risk Assessment and Risk Reduction

Emissions:

- EN 55011: 2016 +A1:2017 ⁽⁴⁾ Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement

Immunity:

- EN 61000-4-2:2009 EMC/Electrostatic Discharge Immunity Test
- EN 61000-4-3:2006+A2:2010 EMC/Radiated Radio Frequency Electromagnetic Field Immunity Test
- EN 61000-4-4:2012 EMC/Electrical Fast Transient/Burst Immunity Test
- EN 61000-4-5:2014+A1:2017 EMC/Surge Immunity Test
- EN 61000-4-6:2014 EMC/Conducted Disturbances induced by Radio Frequency Fields Immunity Test
- IEC EN 61000-4-11:2020 EMC/Voltage Dips, Short Interruptions and Variations Immunity Test

Manufacturers Name: MKS Instruments, Inc., 2 Tech Drive, Andover, MA 01810 USA

Authorized Representatives Name & Location: _____

Equipment Type/Description: AGILIS Series

Model Number(s) ⁽⁶⁾: AG-UC2 ; AG-UC8 ; AG-UC8PC ; AG-MxxL/..V6 ; AG-LS25/..V6 ; AG-LS25-27; AG-MxxN/..V6 ; AG-PR100/..V6 ; AG-MD4-1.2 ; USB-CH

The object of the declaration described above is in conformity with the relevant Community harmonization legislation. MKS product conforms to the above Directive(s) and Standard(s) only when installed in accordance with manufacturer's specifications. This declaration has been issued under the sole responsibility of the manufacturer.

Date: 12/27/2021

Le Cointe Hervé – Quality Director

4) Class A, Group 2

6) Compliance of the above model numbers requires the use of a braided shielded cable properly terminated at both ends – if so noted in the MKS Instruction Manual.

7) RoHS Directive has to be checked for in scope products; cannot CE mark without compliance to RoHS. RoHS Directive can be unchecked only for systems which MKS sells which qualify for "Large Scale Industrial Tool" exclusion.

UK Declaration of Conformity



2 Tech Drive
Andover, MA 01810
www.mksinst.com

UK Declaration of Conformity

Application of Council Directive(s):

- Electromagnetic Compatibility Directive (EMCD) – 2014/30/EU
- Machinery Directive – 2006/42/EC
- Restriction of Hazardous Substances Directive (RoHS3) – (EU) 2015/863⁽⁷⁾
- Waste Electrical and Electronic Equipment – Directive 2012/19/EU



Standard(s) to which conformity is declared:

- BS EN 61326-1:2013 – (EMC)
- BS EN ISO 12100:2010 Safety of Machinery – General Principles of Design – Risk Assessment and Risk Reduction

Emissions:

- EN 55011: 2016 +A1:2017 ⁽⁴⁾ Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement

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- BS EN 61000-4-5:2014+A1:2017 EMC/Surge Immunity Test
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Date: 12/27/2021

Le Cointe Hervé – Quality Director

4) Class A, Group 2

5) Applicable to AC powered product only.

6) Compliance of the above model numbers requires the use of a braided shielded cable properly terminated at both ends – if so noted in the MKS Instruction Manual.

7) RoHS Directive has to be checked for in scope products; cannot CE mark without compliance to RoHS. RoHS Directive can be unchecked only for systems which MKS sells which qualify for "Large Scale Industrial Tool" exclusion.

Safety Precautions

Definitions and Symbols

The following terms and symbols are used in this documentation.

European Union CE Mark



CE Mark.

The CE mark indicates that the equipment has been designed and tested to comply with all applicable European Union (CE) regulations.

C-US CSA Mark



CSA Mark.

The presence of the C-US CSA mark indicates that the equipment has been designed, tested and certified as complying with all applicable US and Canadian safety standards.

Direct Current (DC)



Direct Current Symbol.

This symbol indicates that the equipment is suitable for DC power only. The Agilis system is DC power only.

Warnings and Cautions

The following are definitions of the Warnings, Cautions and Notes that may be used in this manual to call attention to important information regarding personal safety, safety and preservation of the equipment, or important tips.



WARNING

Situation has the potential to cause bodily harm or death.



CAUTION

Situation has the potential to cause damage to property or equipment.

NOTE

Additional information the user or operator should consider.

General Warnings

Observe these general warnings when operating or servicing this equipment:

- Read all warnings on the unit and in the operating instructions.
- Do not use this equipment in or near water.
- Route cables so they are not likely to be damaged.
- Do not use liquid or aerosol cleaners; use only a damp lint-free cloth.
- To avoid explosion, do not operate this equipment in an explosive atmosphere.

General Cautions

Observe these cautions when operating or servicing this equipment:

- Use only specified replacement parts.
- Follow precautions for static sensitive devices when handling this equipment.
- This product should only be powered as described in this manual.
- There are no user-serviceable parts inside the Agilis system components.
- If this equipment is used in a manner not specified within this manual, the protection provided by the equipment may be impaired.

Manual Conventions

The following conventions are used in this manual:

- Acronyms appear on the first occurrence enclosed in parentheses following their definition. An acronym is a word formed from the initial letters of a string of words. Example: Read Only Memory (ROM).
- Italics or boldface text are used as an alternative to quotation marks to highlight special text, such as keyboard keys, onscreen buttons, or text entries. Examples: Press **Enter**. **AU** command.

Warnings and Cautions

PLEASE READ THE FOLLOWING RECOMMENDATIONS CAREFULLY BEFORE USING YOUR AG-UC2 CONTROLLER FOR THE FIRST TIME:

CAUTION

Do not place any Agilis component in a hostile environment such as X-Rays, hard UV or in a vacuum environment.

Do not place a vacuum compatible Agilis component (V6) in a hostile environment or in a vacuum environment less than 10^{-6} hPa.

CAUTION

Do not leave this actuator in places subject to extremely high temperatures or low temperatures. This may cause an electric shock.

- Operating temperature: +10 to +35 °C.
- Storage temperature: -10 to +40 °C (in its original packaging).

WARNING

Do not introduce anything in the holes of AG-UC2 or AG-UC8 controllers, or spill any liquid on the product.

WARNING

Do not switch-on AG-UC2 or AG-UC8 controllers before connecting all the cables.



WARNING

Do not connect anything to AG-UC2 or AG-UC8 controllers except the cables provided by Newport for this specific product.

CAUTION

Our vacuum compatible Agilis components (V6) are delivered equipped with a vacuum compatible cable but a not vacuum compatible connector.

So, the customer has to cut the cable, to use one part in vacuum environment and the other part to go from his feed-through to the controller.

Customer has in charge to connect both part of this cut cable on its feed-through.

WARNING

Do not use AG-UC2 or AG-UC8 controllers after the unit experiences abnormal conditions that may compromise safety and functionality.

Newport cannot be held liable if the above recommendations are not followed.

CAUTION



AG-UC8PC boards are very likely to be damaged by electrostatic discharge (ESD). Please use ESD protective measures when unpacking and handling these devices.

Piezo Motor Driven Components

Agilis



Newport's new piezo motor driven components take a completely new design approach to the adjustments needed for many laser setups. Agilis components provide the ultra-high adjustment sensitivity and convenient remote operation of a motorized component at the price and size of a manual mount!

Why Agilis?

Mechanical friction and the effects of human operation limit the precision of many optical adjustments. In theory, it is possible to achieve sub- μm adjustment sensitivity with very fine mechanics and differential screws. However, in practice, the lateral forces applied to a component during an adjustment often have an excessive effect, making alignments lengthy and frustrating. Also, many optical experiments are extremely sensitive to environmental factors and provide consistent results only when shielded well against external influences.

Motorized mounts overcome the limits of manual components, but are typically costly and bulky, restricting their use for systems integration or simple remote operation in tight spaces. Agilis components provide a lower cost solution in a miniature size, without compromising adjustment sensitivity, speed, or position stability.

Agilis components feature Newport's new, proprietary, non-resonant piezo step direct motors. The motor is directly coupled to the moving platen. When idle, spring forces lock the position for true set and forget long-term stability. Agilis components have a faster adjustment speed than alternative screw driven designs and are free of the problems associated with backlash or hysteresis. In contrast to ultrasonic motors, the Agilis non-resonant motor concept makes small adjustments more predictable with its 50 nm incremental motion capability, ideal for ultra-sensitive optical alignments.

Agilis components must be driven by the AG-UC2, AG-UC8 or AG-UC8PC controllers.

1.0 AG-M050 and AG-M100 Optical Mounts



1.1 Specifications

	AG-M050	AG-M100
Optics diameter	0.5 in (12.7 mm)	1.0 in (25.4 mm)
Allowable thickness of optics	0.16 to 0.24 in. (4 to 6 mm)	0.16 to 0.24 in. (4 to 6 mm)
Angular range	±2°	±2°
Adjustment sensitivity	2 μrad	1 μrad
Absolute positioning Accuracy/Repeatability ^{(1) (2)}	0.05°	0.05°
Weight	25 g	85 g
Cable length	1.2 m length, 4-wire mini-DIN connector. Can extend cable length using AG-MD4-1.5 extension cable.	

NOTE

The V6 versions are vacuum compatible up to 10⁻⁶ hPa.

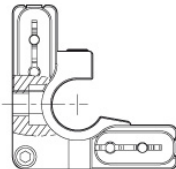
¹⁾ Max. position deviation before an MA command (measure absolute current position) and after a PA command (move to absolute position).

²⁾ Available with models AG-M050L(V6) and AG-M100L(V6) only.

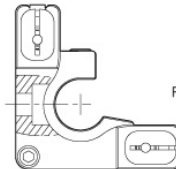
1.2 Dimensions



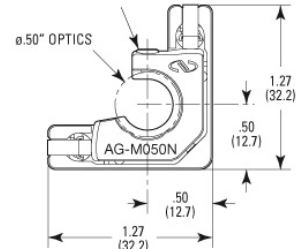
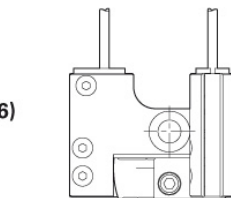
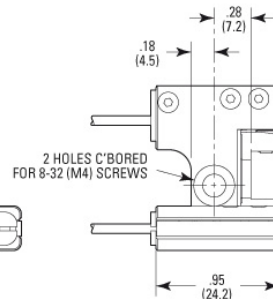
Rear View
AG-M050L(V6)
(2 x 2-cable)



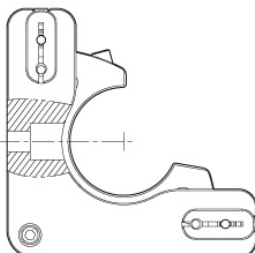
Rear View
AG-M050N
(2 x 1-cable)



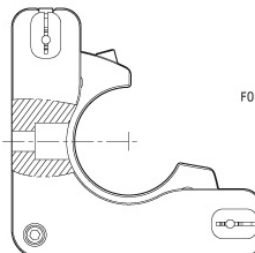
Models AG-M050N(V6)



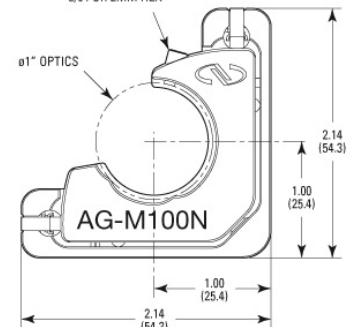
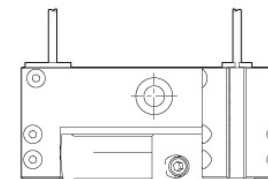
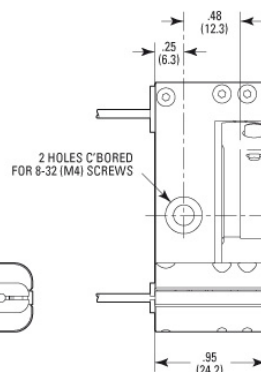
Rear View
AG-M100L(V6)
(2 x 2-cable)



Rear View
AG-M100N
(2 x 1-cable)



Models AG-M100N(V6)



2.0 AG-LS25-xx Linear Stages

2.1 Specifications



	AG-LS25	AG-LS25-27
Travel range	0.47 in (12 mm)	1.06 in (27 mm)
Minimum incremental motion (µm) ⁽¹⁾	0.05	0.1
Absolute positioning accuracy (µm) ⁽²⁾	100	250
Maximum speed (mm/s)	>0.5 with no axial load >0.2 with 1.7 N axial load	0.4 with no axial load 0.15 with 1.7 N axial load
Max. normal load capacity (N)	3 (max. 40 mm cantilever)	2.5 (max. 40 mm cantilever)
Holding force (N)	3	3
Axial load capacity (N)	2	1.5
Pitch, Yaw (µrad)	200	200
Material	Stainless steel	
Limits	Mechanical hard stops and precision electrical limits switch	
Weight [oz (g)]	without cable: 2.5 (70) with cable: 3.4 (95)	without cable: 4.4 (125) with cable: 5.3 (150)
Cable	1.2 m length, 4-wire mini-Din connector. Can extend cable length using AG-MD4-1.5 extension cable.	
Life time	>1000 m (>500,000 cycles of ±1 mm motion).	

¹⁾ The step size for forward and backward direction is adjustable. With default settings, the step size for the forward direction varies from the step size for the backward direction and may be larger than 50 nm. Individual steps are not 100% repeatable.

²⁾ For absolute positioning, the stage determines the average step size by counting the number of steps between the limits. The execution of an absolute positioning command may take up to 80 s.

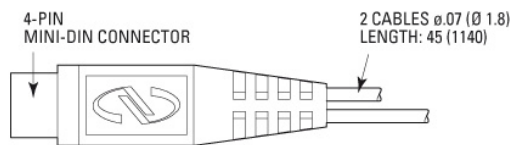
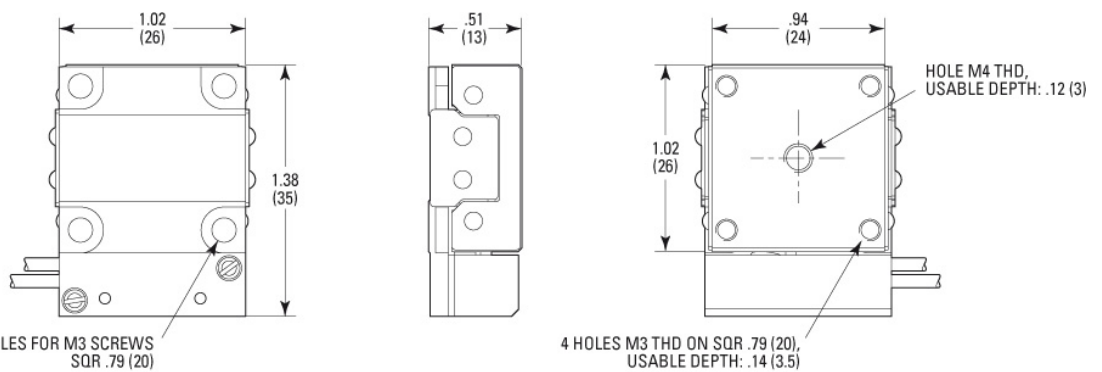
2.2 Dimensions



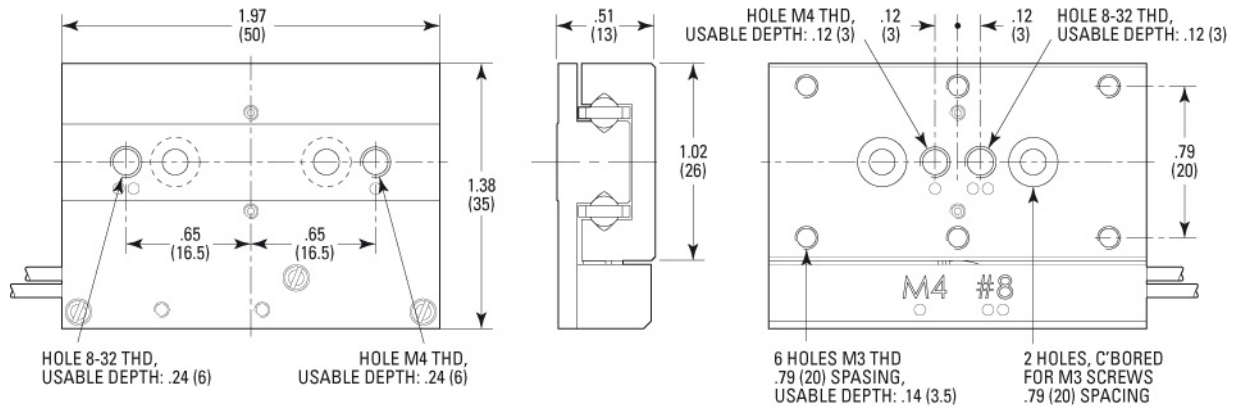
NOTE

For XY assemblies of AG-LS25, use 4 x TC M3x4 screws supplied with each stage.
For mounting AG-LS25 stages to B-Series adapter plates, M-SDS25 or M-DS25, use 4 x TC M2x4 screws plus washers supplied with each stage.

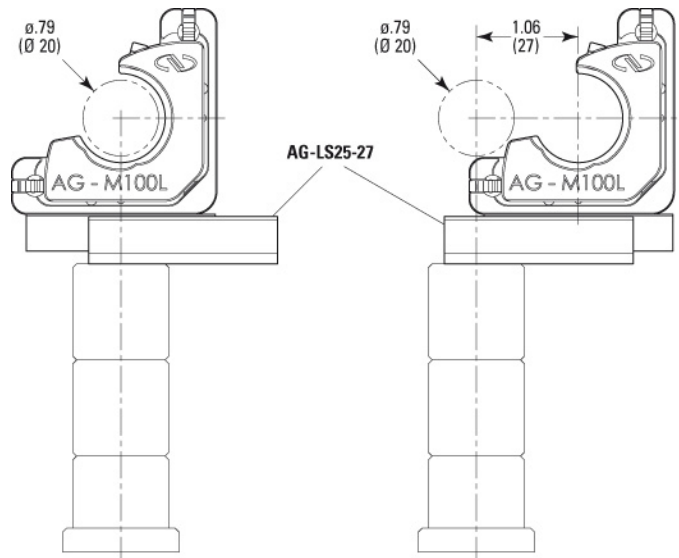
2.2.1 AG-LS25



2.2.2 AG-LS25-27

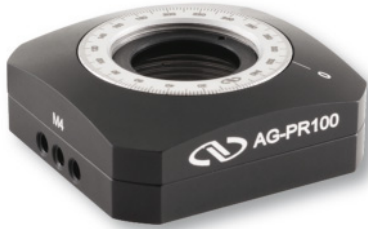


2.2.3 AG-LS25-27 Inserter for 1" Diameter Optics



3.0 AG-PR100 Rotation Stage

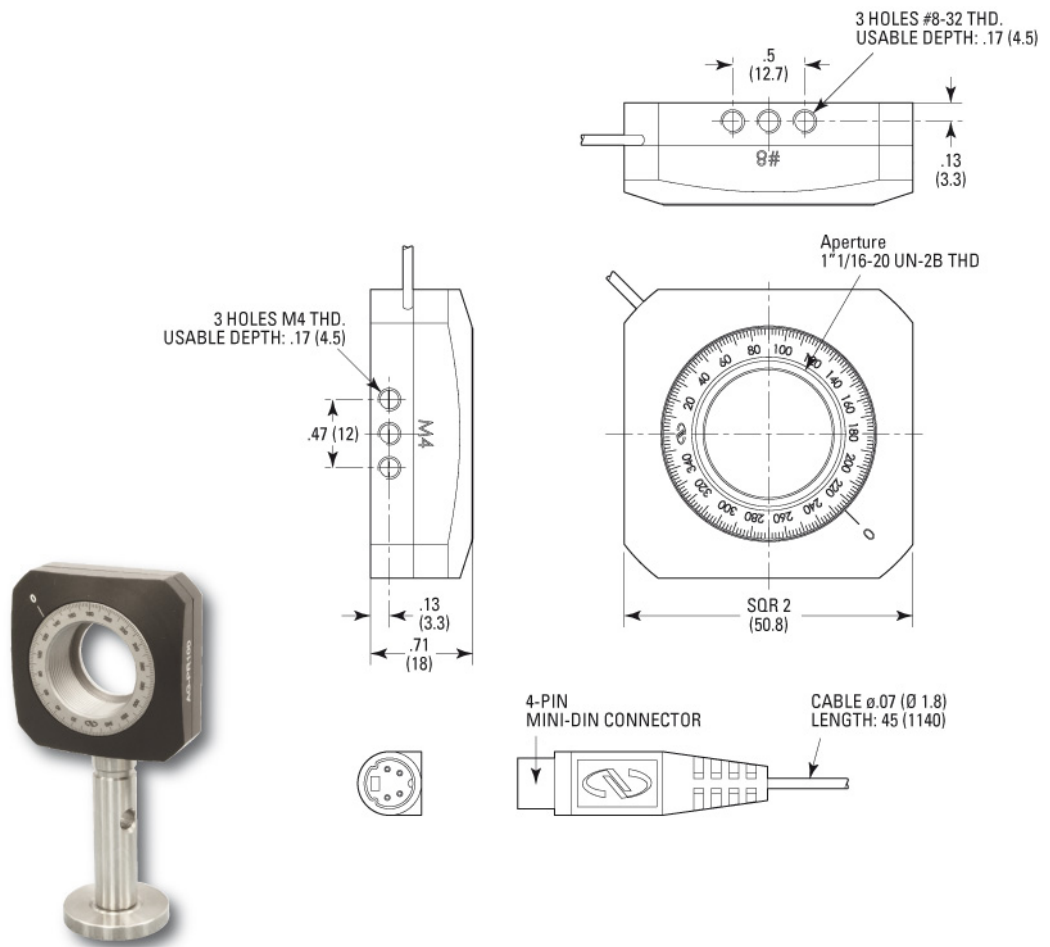
3.1 Specifications



Optics diameter	1.0 in (25.4 mm)
Max. optics thickness	0.40 in. (10 mm)
Travel range	360° continuous
Minimum incremental motion ⁽¹⁾	5 μrad (1 arcsec)
Maximum speed	2 °/s
Wobble	100 μrad
Limits	None
Weigh	135 g
Graduation	2°
Cable	1.2 m length, 4-wire mini-Din connector. Can extend cable length using AG-MD4-1.5 extension cable.

¹⁾ The step size for forward and backward direction is adjustable. With default settings, the step size for the forward direction varies from the step size for the backward direction and may be larger than 5 μrad. Individual steps are not 100% repeatable.

3.2 Dimensions



4.0 AG-UC2 Piezo Controller



AG-UC2 Agilis controller.

4.1 Description

The Agilis AG-UC2 controller provides convenient push button remote control and USB computer control of Agilis components. For each axis, two rows of push buttons are available for step size settings, precise low speed adjustments and fast coarse motion. Power is supplied through the USB port, either directly from the computer or from an independent USB power supply such as the USB-CH. A software utility allows mimicking remotely the operation of the controller buttons through the computer and selecting and operating a specific Agilis mount, as needed. A set of ASCII-commands and LabViewVI's for all functions are provided as well.

4.2 Modes of Operation

The Agilis AG-UC2 provides two modes of operation. In local mode, default setting at power up, the push buttons are enabled and most computer functions are disabled (see table page 13). The local operation is described in detail in section 4.4.

In remote mode all push buttons are disabled, and the controller can be fully operated from a PC, either from the supplied AG-UC2-UC8 Applet software (see section 5.6 for details) or by sending ASCII commands (see section 4.6 for details).

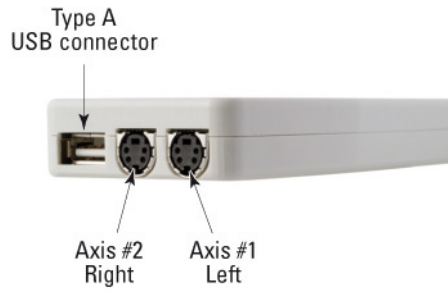
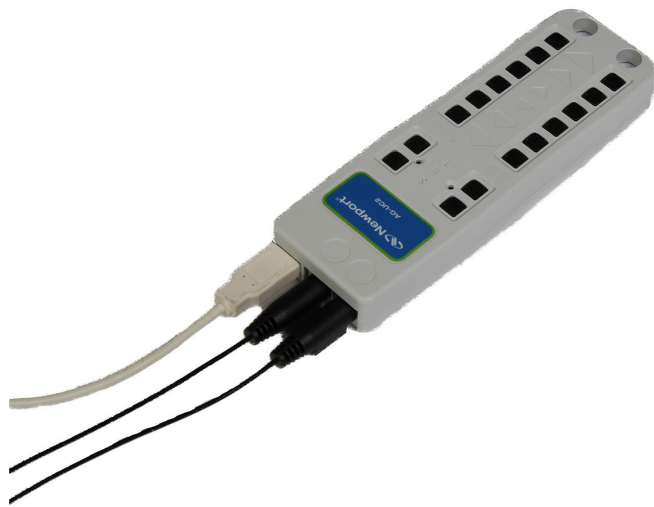
To switch from local to remote mode, use the AG-UC2-UC8 Applet (see section 5.6 for details) or send the command MR.

To switch from remote to local mode, either close the AG-UC2-UC8 Applet, or connect to another controller through the software and send the ML command or disconnect and reconnect the controller to power.

4.3 Getting Started

Connect the two cables from the Agilis optical mount to the AG-UC2 controller.

Connect the Agilis controller to a powered USB port or to the USB power supply, Newport part number USB-CH.

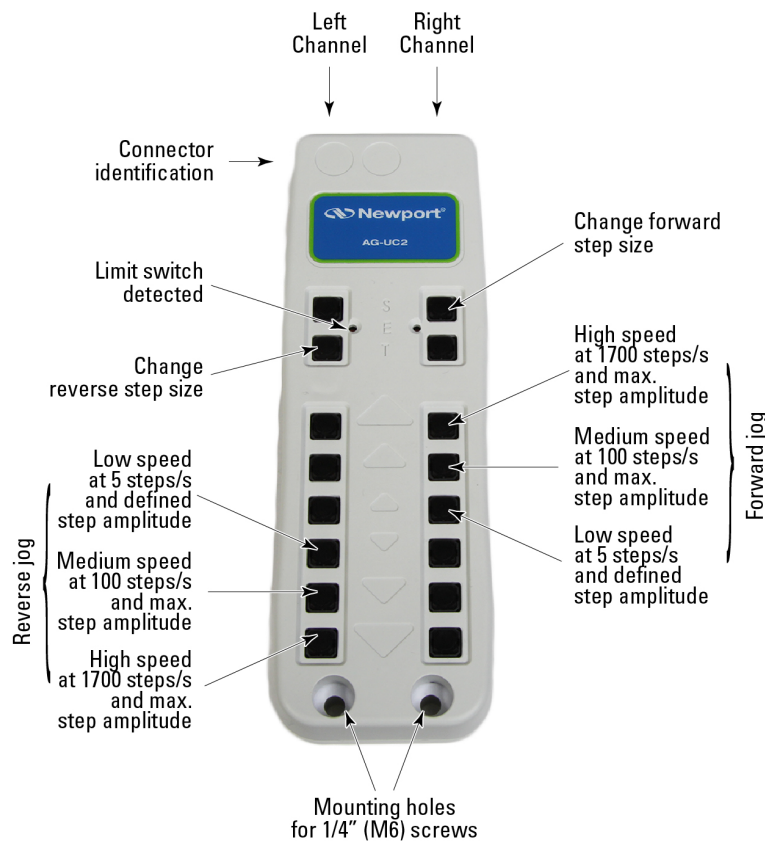


AG-UC2 controller connectors.



USB-CH USB power supply with changeable international power outlet adapters.

4.4 Local Operation

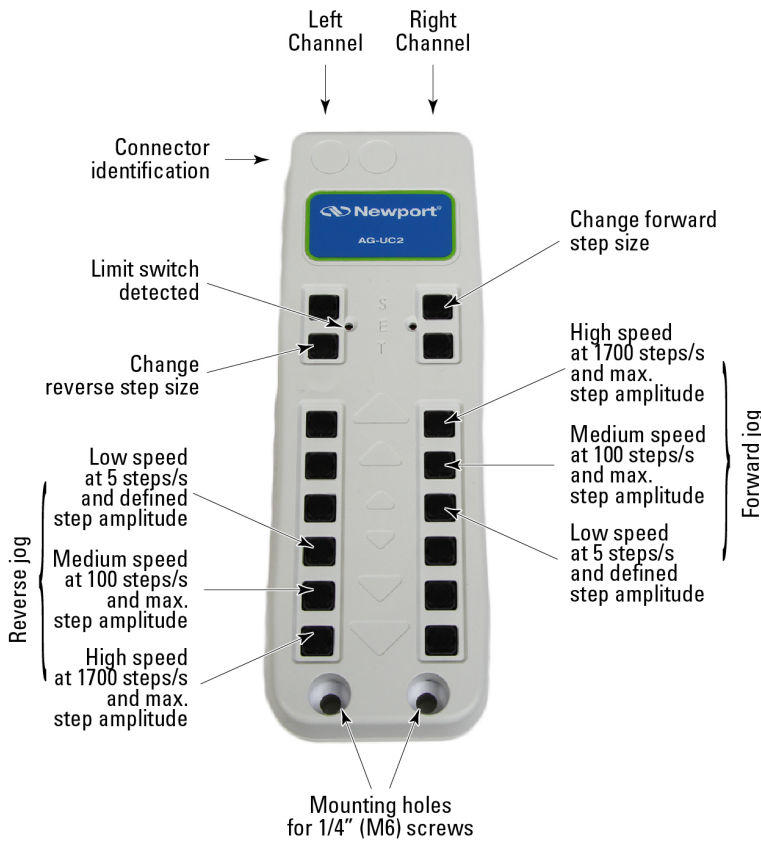


1 Jog buttons.

There are 6 jog buttons for each channel. Holding down any of the 6 buttons for less than one second results in a single step motion at the defined step amplitude. Otherwise holding a button for more than a second results in continuous motion at the designated button speed.

- ① On each row of buttons, the upper three buttons are assigned to the forward motion. When the lowest of the three button positions is pressed and held for more than one second, the motor moves at 5 steps/s. The medium button moves the piezo at 100 steps/s. The fastest forward motion at 1700 steps/s is performed with the top button position.
- ② The remaining three lower buttons on each row are assigned to the reverse motion direction. The third highest button position, enables 5 steps/s speed when pressed and held. The lowest button position provides the fastest motion at 1700 steps/s. The middle button provides 100 steps/s motion.

② Step amplitude (size) adjustment buttons.



NOTE

When using the step amplitude buttons, you must be able to sense the motion. Hence, you either must be in the high sensitivity range of your application or you need to use an external feedback sensor like a quad cell or an autocollimator to sense the motion of the mirror mount.

There are 2 step size adjustment buttons for each channel.

- ① Forward (upper button) and reverse (lower button) buttons control the step amplitude adjustment. The default step size at power on is a medium step size.
- ② Pressing and holding a button initiates the amplitude selection beginning with a very low step amplitude. With every next step a slightly large step amplitude is used. When the button is released, the last step amplitude is saved until power up or the next adjustment is made.
- ③ During the first couple of steps you may not sense any motion as the step amplitude might be too low to result in consistent motion. Hence, release the button only when sensing a real motion. Test the new step amplitude at different positions. When results are inconsistent, repeat the step amplitude adjustment and select a larger step amplitude. To restore the default step amplitude, power down the controller and then power it up.

NOTE

As in any open loop system, the step size is not always consistent. Agilis technology can provide the required sensitivity, but not necessarily repeatable steps in an open loop condition. However, a feedback sensor is recommended to fully utilize the functionality and sensitivity of the Agilis mirror mount system.

- ③ A red LED indicates a detected limit switch.

4.5 USB Communication

Using a Type A-A USB Cable.

Install the software downloaded from Newport website on your PC.

Apply the following settings to the COM port of your PC:

- Baud Rate = 921600
- Data Bits = 8
- Parity = None
- Stop Bits = 1
- Flow Control = None
- Termination Character = CR/LF

4.6 ASCII Command Set

This section describes the two-letter ASCII commands that may be used to configure and operate the AG-UC2 controller when the controller is connected to a computer. These commands work with LabView, Visual Basic, C++ or any other computer application that can issue ASCII commands via a computer COM port. AG-UC2-UC8 Applet application, described in section 5.6 of this manual, uses these commands.

4.6.1 Syntax

The AG-UC2 is a command driven controller. The general format of a command is a two letter ASCII character preceded axis parameters and followed by parameters specific to the command:

Command format

nn	AA	xx
-----------	-----------	-----------

nn — Axis number (1 or 2).

AA — Command name.

xx — Optional or required value or “?” to query current value.

Both, upper and lower case characters are accepted. Depending on the command, it can have an optional or required prefix (**nn**) for the axis number (1 or 2) and/or a suffix (**xx**) value or a “?”.

Blank spaces

Blanks are allowed and ignored in any position, including inside a numerical value. The following two commands are equivalent, but the first example might be confusing:

2 PR1 000

2PR1000

Command terminator

Commands are executed as the command terminator CRLF (carriage-return line-feed, ASCII 13 and ASCII 10) is received. The controller will analyze the received string. If the command is valid and its parameters are in the specified range, it will be executed. Otherwise it will memorize an error. After the execution of the command, all remaining characters in the input string, if any, will be ignored. In particular, it is not possible to concatenate several commands on a single string from the PC. Each command will properly handle the memorization of related errors that can be accessed with the TE command.

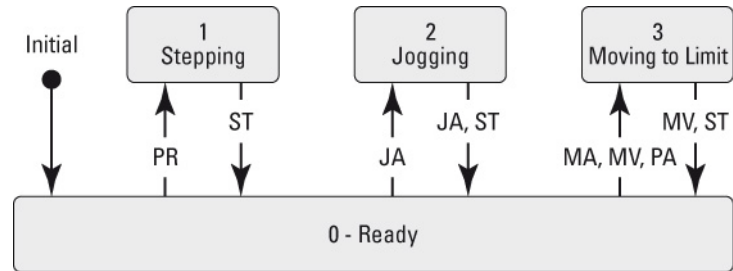
4.6.2 Operating Modes

The Agilis AG-UC2 provides two modes of operation. In local mode, default mode after powering up the controller, the push buttons are enabled and all commands that configure or operate the controller are disabled. Only commands that are used to monitor or diagnose the controller are enabled. In remote mode all push buttons are disabled, and all ASCII commands are enabled.

To go from local mode to remote mode, use the command MR. To go from remote mode to local mode, use the command ML.

4.6.3 State Diagram

The AG-UC2 uses different states for each axis. Not all commands are accepted in all states; see sections Command Set Summary for details.



The numbers represent the values of the status that can be queried with the TS command.
 Shown are only transitions made by command. Internal transitions like from STEPPING to READY at the end of a PR command are not shown.

State diagram.

4.6.4 Command Set Summary

Name	Short Description	State				Type		Modes	
		0	1	2	3	Set	Query	Local	Remote
JA	Jog	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
MA	Measure position	<input type="checkbox"/>				<input type="checkbox"/>			<input type="checkbox"/>
ML	Local mode	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
MR	Remote mode	<input type="checkbox"/>				<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
MV	Move to limit	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
PA	Absolute move	<input type="checkbox"/>				<input type="checkbox"/>			<input type="checkbox"/>
PH	Tell limit status	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>		<input type="checkbox"/>
PR	Relative move	<input type="checkbox"/>				<input type="checkbox"/>			<input type="checkbox"/>
RS	Reset	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
ST	Stop motion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>
SU	Set step amplitude	<input type="checkbox"/>				<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
TE	Get error	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TP	Tell number of steps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>		<input type="checkbox"/>
TS	Get status	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
VE	Firmware version	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ZP	Zero position	<input type="checkbox"/>				<input type="checkbox"/>			<input type="checkbox"/>

NOTE

Commands MA, MV and PA require that the device has an electrical limit switch (e.g. model AG-LS25, AG-M050L, and AG-M100L).

JA — Start jog motion or get jog mode

Syntax	xxJAnn , or xxJA?
Parameters	
Description	<p>xx — Axis number.</p> <p>nn — Jog mode or “?”</p>
Range	<p>xx — 1 to 2</p> <p>nn — -4, -3, -2, -1, 0, 1, 2, 3, 4, “?”</p>
Input tests	<ul style="list-style-type: none"> – Check controller is in remote mode. – Check the axis (1 or 2). – Check the current state of the axis. – Check jog mode (integer ranging between -4 and 4).
Description	<p>Starts a jog motion at a defined speed or returns jog mode. Defined steps are steps with step amplitude defined by the SU command (default 16). Max. amplitude steps are equivalent to step amplitude 50:</p> <ul style="list-style-type: none"> -4 — Negative direction, 666 steps/s at defined step amplitude. -3 — Negative direction, 1700 steps/s at max. step amplitude. -2 — Negative direction, 100 step/s at max. step amplitude. -1 — Negative direction, 5 steps/s at defined step amplitude. 0 — No move, go to READY state. 1 — Positive direction, 5 steps/s at defined step amplitude. 2 — Positive direction, 100 steps/s at max. step amplitude. 3 — Positive direction, 1700 steps/s at max. step amplitude. 4 — Positive direction, 666 steps/s at defined step amplitude..
Returns	No return if jog mode is specified. If the sign “?” takes place of nn, this command returns the current jog mode.
Errors	<ul style="list-style-type: none"> 0 — No error. -2 — Axis out of range (must be 1 or 2). -3 — Wrong format for nn (must be integer). -4 — Wrong value for nn (must be -4, -3, -2, -1, 0, 1, 2, 3 or 4). -5 — Not allowed in local mode (controller must be in remote mode). -6 — Not allowed state (controller must be in state 0 or 2).

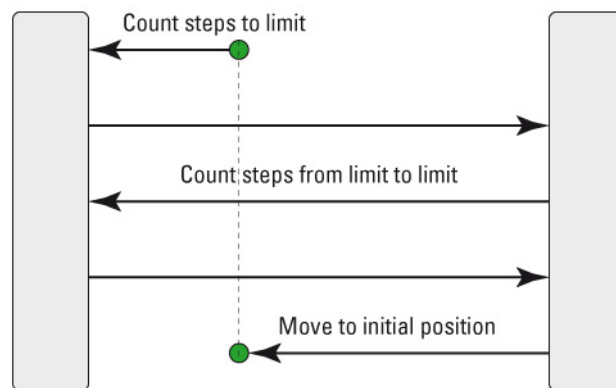
MA — Measure current position

Syntax	xxMA
Parameters	
Description	xx — Axis number.
Range	xx — 1 or 2
Input tests	<ul style="list-style-type: none"> – Check controller is in remote mode. – Check the current state of the axis. – Check the axis (1 or 2).
Description	Starts a process to measure the current position (see below). During the execution of the command, the USB communication is interrupted. After completion, the communication is opened again. The execution of the command can last up to 2 minutes.

NOTE

The MA command functions properly only with devices that feature a limit switch like models AG-LS25, AG-M050L and AG-M100L.

Returns	Returns the distance of the current position to the limit in 1/1000th of the total travel.
Errors	<ul style="list-style-type: none"> 0 — No error. -2 — Axis out of range (must be 1 or 2). -3 — Wrong format for nn (must be integer). -5 — Not allowed in local mode (controller must be in remote mode). -6 — Not allowed state (controller must be in state 0).



Process of position measurement

ML — Set to local mode

Syntax	ML
Parameters	None.
Input tests	<ul style="list-style-type: none"> – Check that axis is not specified. – Check that parameter is not specified.
Description	<p>Sets the controller to local mode. In local mode the pushbuttons on the controller are enabled and all commands that configure or operate the controller are disabled. To go to remote mode, use the MR command.</p> <p>At power-up the controller is always in local mode.</p>
Returns	None
Errors	<ul style="list-style-type: none"> 0 — No error. -2 — Axis must not be specified. -3 — Parameter must not be specified.

MR — Set to remote mode

Syntax	MR
Parameters	None.
Input tests	<ul style="list-style-type: none"> – Check that axis is not specified. – Check that parameter is not specified. – Check the current state of the two axes (need to be 0).
Description	<p>Sets the controller to remote mode. In remote mode all commands are enabled and the pushbuttons on the controller are disabled. To go to local mode, use the ML command.</p>
Returns	None.
Errors	<ul style="list-style-type: none"> 0 — No error. -2 — Axis must not be specified. -3 — Parameter must not be specified. -6 — The two axis must be in state 0.

MV — Move to limit

Syntax	xxMVnn, or xxMV?
Parameters	
Description	<p>xx — Axis number.</p> <p>nn — Jog mode or “?”</p>
Range	<p>xx — 1 or 2</p> <p>nn — -4, -3, -2, -1, 0, 1, 2, 3, 4, “?”</p>
Input tests	<ul style="list-style-type: none"> – Check controller is in remote mode. – Check the axis (1 or 2). – Check the current state of the axis (must be 0 or 3). – Check jog mode (integer ranging between -4 and 4 or ?).
Description	Starts a jog motion at a defined speed to the limit and stops automatically when the limit is activated. See JA command for details.

NOTE

The MA command functions properly only with devices that feature a limit switch like models AG-LS25, AG-M050L and AG-M100L.

NOTE

No motion will be executed when the limit switch is active.

NOTE

The MV-4 and MV4 commands are useful to calibrate the average step size at a certain step amplitude by counting the number of steps between the limits in forward and reverse direction. They are used as part of the MA and PA commands. In order to measure the number of steps between the limits, you can use the following sequence of commands:

1MV-3 Move to the negative limit.

1PH? If reply is 1PH1 or 1PH3, then:

1SUnn nn = value of step amplitude you want to use.

1ZP Reset step counter to zero.

1PR100 Move 100 steps. Needed to move out of the limit.

MV4 Move to positive limit and stop.

1PH? If reply is PH1 or PH3, then:

1TP? Tell number of steps. The average step size in forward direction at the defined step amplitude is equal to the total available travel range (see data sheet) divided by the return of the TP command.

NOTE

Individual steps may not be 100% repeatable.

NOTE

When using a too low value for the step amplitude, the sequence may take a very long time and may not be very repeatable.

Returns	No return if jog mode is defined. If the sign “?” takes place of nn, this command returns the current jog mode.
----------------	-----------------------------------------------------------------------------------------------------------------

- Errors**
- 0 — No error.
 - 2 — Axis out of range (must be 1 or 2).
 - 3 — Wrong format for nn (must be integer).
 - 4 — Wrong value for nn (must be -4, -3, -2, -1, 0, 1, 2, 3 or 4).
 - 5 — Not allowed in local mode (controller must be in remote mode).
 - 6 — Not allowed state (controller must be in state 0 or 3).

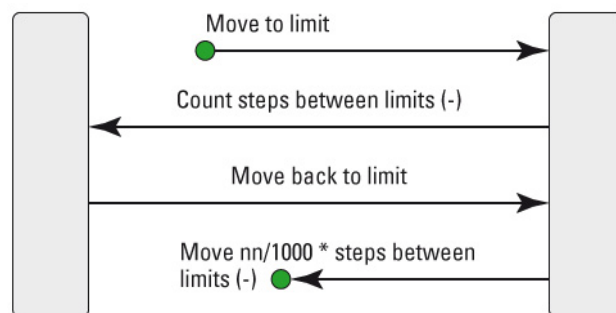
PA — Absolute move

Syntax	xxPAnn, or xxPA?
Parameters	
Description	<p>xx — Axis number.</p> <p>nn — Target position in 1/1000th of the total travel.</p>
Range	xx — 1 or 2
Input tests	<ul style="list-style-type: none"> – Check controller is in remote mode. – Check the axis (1 or 2). – Check the current state of the axis (must be ready). – Check target position (must be integer between 0 and 1000 included).
Description	Starts a process to move to an absolute position (see below). During the execution of the command, the USB communication is interrupted. After completion, the communication is opened again. The execution of the command can last up to 2 minutes.

NOTE

The PA command functions properly only with devices that feature a limit switch like models AG-LS25, AG-M050L and AG-M100L.

- | | |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Returns | xxPAnn at the end of motion. If the sign “?” takes place of nn, this command returns the current target position. |
| Errors | <ul style="list-style-type: none"> 0 — No error. -2 — Axis out of range (must be 1 or 2). -3 — Wrong format for nn (must be integer). -4 — Wrong value for nn (must be between 0 and 1000 included). -5 — Not allowed in local mode (controller must be in remote mode). -6 — Not allowed state (controller must be in state 0). |



PH — Tell limit status

Syntax	PH
Parameters	None.
Input tests	<ul style="list-style-type: none"> — Check controller is in remote mode. — Check that axis is not specified. — Check that parameter is not specified.
Description	Returns the limits switch status of the controller.
Returns	Possible returns are:

	Description
PH0	No limit switch is active
PH1	Limit switch of channel #1 is active, limit switch of channel #2 is not active
PH2	Limit switch of channel #2 is active, limit switch of channel #1 is not active
PH3	Limit switch of channel #1 and channel #2 are active

NOTE

If the device has no limit switch, the return is always PH0.

Errors	0	—	No error.
	-2	—	Axis must not be specified.
	-3	—	Parameter must not be specified.
	-5	—	Not allowed in local mode (controller must be in remote mode).

PR — Relative move

Syntax	xxPRnn
Parameters	
Description	<p>xx — Axis number.</p> <p>nn — Number of steps.</p>
Range	<p>xx — 1 or 2</p> <p>nn — Signed integer, between -2,147,483,648 and 2,147,483,647 (equivalent to long integer in C : $[-2^{-31}, 2^{-31} - 1]$).</p>
Input tests	<ul style="list-style-type: none"> – Check controller is in remote mode. – Check the axis (1 or 2). – Check the current state of the axis. – Check the number of steps (has to be integer, can be negative).
Description	Starts a relative move of nn steps with step amplitude defined by the SU command (default 16).
Returns	None
Errors	<p>0 — No error.</p> <p>-2 — Axis out of range (must be 1 or 2).</p> <p>-3 — Wrong format for nn (must be integer).</p> <p>-5 — Not allowed in local mode (controller must be in remote mode).</p> <p>-6 — Not allowed state (controller must be in state 0).</p>

RS — Reset controller

Syntax	RS
Parameters	None.
Input tests	<ul style="list-style-type: none"> – Check that axis is not specified. – Check that parameter is not specified.
Description	Resets the controller. All temporary settings are reset to default and the controller is in local mode.
Returns	None.
Errors	<p>0 — No error.</p> <p>-2 — Axis must not be specified.</p> <p>-3 — Parameter must not be specified.</p>

ST — Stop motion

Syntax	xxST
Parameters	
Description	xx — Axis number.
Range	xx — 1 or 2
Input tests	<ul style="list-style-type: none">– Check controller is in remote mode.– Check the axis (1 or 2).– Check that parameter is not specified.
Description	Stops the motion on the defined axis. Sets the state to ready.
Returns	None.
Errors	<ul style="list-style-type: none">0 — No error.-2 — Axis out of range (must be 1 or 2).-3 — Parameter must not be specified.-5 — Not allowed in local mode (controller must be in remote mode).

SU — Set step amplitude or get step amplitude setting

Syntax	xxSUnn, or xxSU+? or xxSU-?
Parameters	
Description	<p>xx — Axis number.</p> <p>nn — Signed step amplitude or “+?” or “-?”.</p>
Range	<p>xx — 1 or 2</p> <p>nn — Integer between -50 and 50 included, except zero.</p>
Input tests	<ul style="list-style-type: none"> – Check controller is in remote mode. – Check the axis (1 or 2). – Check the current state of the axis (must be 0). – Check the format of the step amplitude (has to be an integer between -50 and 50 included, except zero).
Description	Sets the step amplitude (step size) in positive or negative direction. If the parameter is positive, it will set the step amplitude in the forward direction. If the parameter is negative, it will set the step amplitude in the backward direction.

NOTE

The step amplitude is a relative measure. The step amplitude corresponds to the amplitude of the electrical signal sent to the Agilis motor. There is no linear correlation between the step amplitude and the effective motion size. In particular, too low a setting for the step amplitude may result in no output motion. Also, the same step amplitude setting for forward and backward direction may result in different size motion steps. Also, the motion step size corresponding to a step amplitude setting may vary by position, load, and throughout the life time of the product. The step amplitude setting is not stored after power down. The default value after power-up is 16.

This step size is used with the commands PR, JA1, JA4, MV1, and MV4, but not with JA2, JA3, MV2, and MV3. JA2, JA3, MV2, MV3 use the maximum step amplitude, equivalent to xxSU50 setting.

Returns	No return if step amplitude is specified. If ‘+?’ takes place of nn, this command returns the step amplitude setting in forward direction. If ‘-?’ takes place of nn, this command returns the step amplitude setting in backward direction.
Errors	<ul style="list-style-type: none"> 0 — No error. -2 — Axis out of range (must be 1 or 2). -3 — Wrong format for nn (must be integer). -4 — Wrong value for nn (must be an integer between -50 and 50, not zero). -5 — Not allowed in local mode (controller must be in remote mode) -6 — Not allowed state (controller must be in state 0)

TE — Get error of previous command

Syntax TE

Parameters None.

- Input tests**
- Check that axis is not specified.
 - Check that parameter is not specified.

Description Returns the error code of the previous command. Each command generates an error code including “0” for NO ERROR. This error code can be queried with the TE command. For a safe program flow it is recommended to always query the command error after each command execution. The following error codes are defined:

Returns Error code of the previous command. The following error codes are defined:

Error code	Description
0	No error
-1	Unknown command
-2	Axis out of range (must be 1 or 2, or must not be specified)
-3	Wrong format for parameter nn (or must not be specified)
-4	Parameter nn out of range
-5	Not allowed in local mode
-6	Not allowed in current state

- Errors**
- 0 — No error.
 - 2 — Axis must not be specified.
 - 3 — Parameter must not be specified.

TP — Tell number of steps

Syntax	xxTP
Parameters	
Description	xx — Axis number.
Range	xx — 1 or 2
Input tests	<ul style="list-style-type: none"> – Check controller is in remote mode. – Check the axis (1 or 2). – Check the status of the axis (must not be 3). – Check that parameter is not specified.
Description	Returns the number of accumulated steps in forward direction minus the number of steps in backward direction since powering the controller or since the last ZP (zero position) command, whatever was last.

NOTE

The step size of the Agilis devices are not 100% repeatable and vary between forward and backward direction. Furthermore, the step size can be modified using the SU command. Consequently, the TP command provides only limited information about the actual position of the device. In particular, an Agilis device can be at very different positions even though a TP command may return the same result.

Returns	TPnn, where nn is the number of accumulated steps in forward direction minus the number of steps in backward direction as Integer.
Errors	<ul style="list-style-type: none"> 0 — No error. -2 — Axis out of range (must be 1 or 2). -3 — Parameter must not be specified. -5 — Not allowed in local mode (controller must be in remote mode). -6 — Not allowed state (axis must not be in state 3).

TS — Get axis status

Syntax	xxTS
Parameters	
Description	xx — Axis number.
Range	xx — 1 or 2
Input tests	<ul style="list-style-type: none"> – Check the axis (1 or 2). – Check that parameter is not specified.
Description	Returns the status of the axis.

NOTE

Entering anything other than 1 or 2 in the axis number field is equivalent to entering 0 or nothing.

Returns Possible returns are:

Error code	Description
0	Ready (not moving)
1	Stepping (currently executing a PR command)
2	Jogging (currently executing a JA command with command parameter different than 0).
3	Moving to limit (currently executing MV, MA, PA commands)

Errors	0 — No error.
	-3 — Parameter must not be specified.

VE — Get controller firmware version

Syntax	VE
Parameters	None.
Input tests	<ul style="list-style-type: none"> – Check that axis is not specified. – Check that parameter is not specified.
Description	Returns the firmware version of the controller.
Returns	Returns the firmware version of the controller.
Errors	<ul style="list-style-type: none"> 0 — No error. -2 — Axis must not be specified. -3 — Parameter must not be specified.

ZP — Zero position

Syntax	xxZP
Parameters	
Description	xx — Axis number.
Range	xx — 1 or 2
Input tests	<ul style="list-style-type: none">– Check controller is in remote mode.– Check the axis (1 or 2).– Check the status of the axis (must be 0).– Check that parameter is not specified.
Description	Resets the step counter to zero. See TP command for further details.
Returns	None.
Errors	<ul style="list-style-type: none">0 — No error.-2 — Axis out of range (must be 1 or 2).-3 — Parameter must not be specified.-5 — Not allowed in local mode (controller must be in remote mode).-6 — Not allowed state (axis must not be in state 3).

5.0 AG-UC8 & AG-UC8PC Multi-Axis Piezo Controllers



CAUTION

AG-UC8PC boards are very likely to be damaged by electrostatic discharge (ESD). Please use ESD protective measures when unpacking and handling these devices.

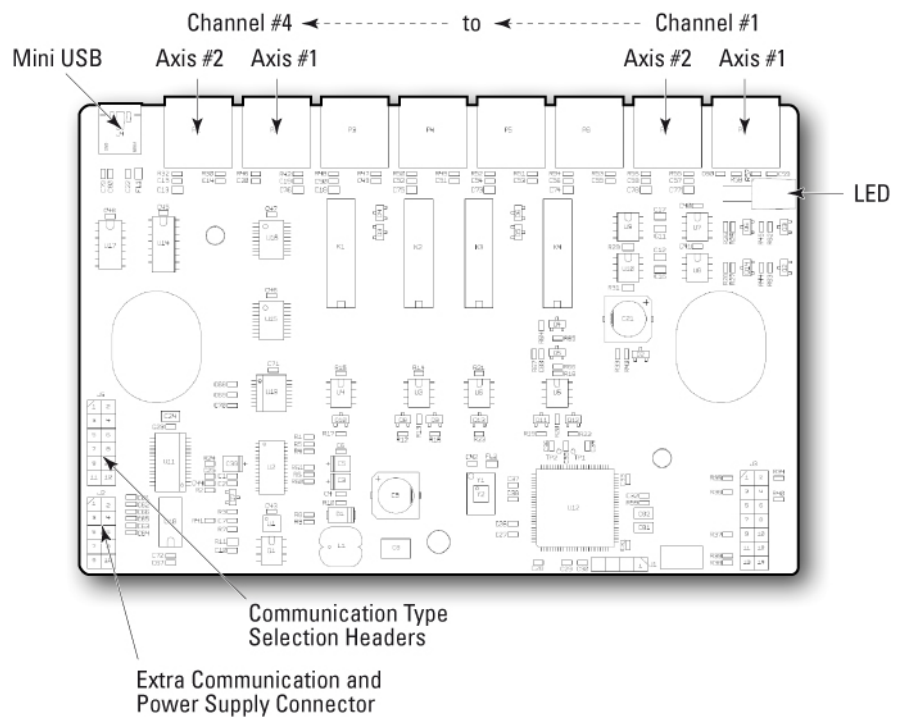
5.1 Description

Both Agilis AG-UC8 and AG-UC8PC controllers provide the capability to drive up to 8 piezoelectric motors. They can be powered through the USB port directly from the computer while the AG-UC8PC version can also be powered from an external power supply. A software utility allows driving the two selected motors at a time and switching from pair to pair. A set of ASCII-commands and LabViewVI's for all functions are provided.

5.2 Modes of Operation

Both controllers can be fully operated from a PC, either from the supplied Agilis Applet Software (see section 5.6 for details) or by sending ASCII commands (see section 5.7 for details).

5.3 Motor Selection



AG-UC8PC Controller Board.



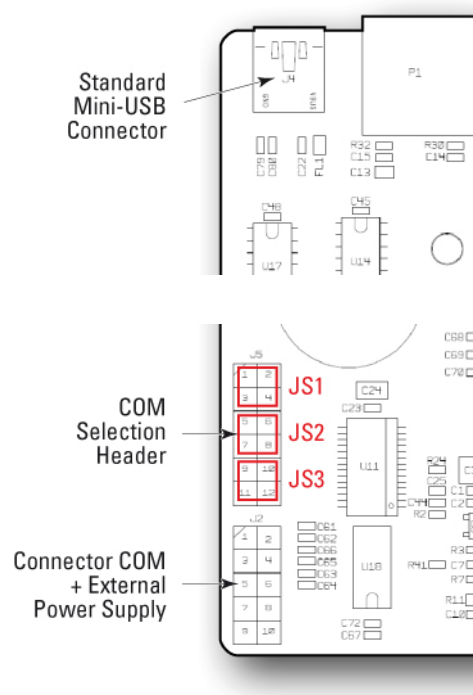
AG-UC8 Controller.

Both Multi-Axes Agilis Controller versions are able to control up to 8 piezoelectric motors.

Multi-Axes Agilis controllers drive piezoelectric motors by pairs. The “CC” command allows selecting the desired motor. For example, to control motor number 8 (Axis 2 on channel 4), one has to select pair number 4 with the command “CC4” and then use the index of the second motor of the pair, for example, “2PR500” to execute a relative move of 500 steps.

5.4 Communication Type Selection (Available on AG-UC8PC Only)

The AG-UC8PC controller is able to communicate through 3 different protocols: USB, RS232, or RS485. The board has a dedicated USB connector and a HE10 connector where the two RS protocols are available (see below table for connector pins assignment).



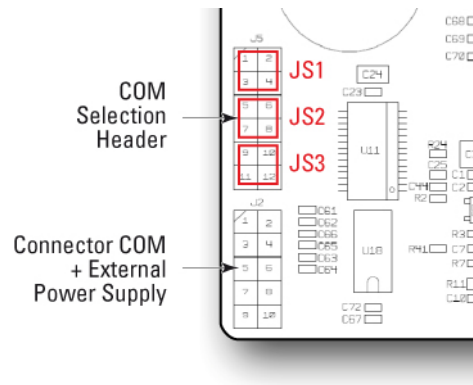
On the AG-UC8PC version, jumpers on the electronic board do the communication type selection. For each communication type, only one set of jumpers should be placed at a time.

Jumper Set	COM
JS1 (1&2, 3&4)	RS232
JS2 (5&6, 7&8)	RS485
JS3 (9&10, 11&12)	USB

The required connections schemes depending on the jumper location is indicated on the figure below.

Communication parameters are indicated in the table below.

Protocol	Speed	Jumper
RS232	115200	JS1
RS485	115200	JS2
USB	921600	JS3



Pin #	Description
1	RS232 - Rx
2	RS232 - Tx
3	RS485 - Tx+
4	RS485 - Tx-
5	RS485 - Rx+
6	RS485 - Rx-
7	GND
8	GND
9	Power supply +5 V
10	Power supply +5 V



WARNING

Never plug anything on the USB cable when power is supplied through the external J2 connector.

5.4.1 USB Communication

Using a Type A-mini USB Cable

Install the software downloaded from Newport website on your PC and check that JS3 jumpers are set on pins 9&10 and 11&12.

Apply the following settings to the COM port of your PC:

- Baud Rate = 921600
- Data Bits = 8
- Parity = None
- Stop Bits = 1
- Flow Control = None
- Termination Character = CR/LF

5.4.2 RS232 Communication

Install the software downloaded from Newport website on your PC and check that JS1 jumpers are set on pins 1&2 and 3&4.

Apply the following settings to the COM port of your PC:

- Baud Rate = 115200
- Data Bits = 8
- Parity = None
- Stop Bits = 1
- Flow Control = None
- Termination Character = CR/LF

5.4.3 RS485 Communication

Install the software downloaded from Newport website on your PC and check that JS2 jumpers are set on pins 5&6 and 7&8.

Apply the following settings to the COM port of your PC:

- Baud Rate = 115200
- Data Bits = 8
- Parity = None
- Stop Bits = 1
- Flow Control = None
- Termination Character = CR/LF



CAUTION

In order to communicate through the RS232 or RS485 protocols, provide the power supply through the J2 connector and configure the selection jumpers accordingly.

CAUTION

Mating connectors or equivalent can be used.

5.5 LED Indication

The LED can display green or orange to show states:

	Green	Orange
Solid	No axis in the limit / No axis moving	1 or 2 axes in the limit / No axis moving
Blinking	No axis in the limit / 1 or 2 axes moving	1 or 2 axes in the limit / 1 or 2 axes moving



CAUTION

If there is no communication, please check the led status and check if the jumpers are correctly configured.

5.6 Newport AG-UC2-UC8 Applet (Software)

The Newport AG-UC2-UC8 Applet is a software that has a graphical user interface (GUI) which allows the user to interact with the AG-UC2 or AG-UC8 controller.

The AG-UC2-UC8 software provides access to all functions of the Agilis controller. It is compatible with PC's with a minimum of 64 MB of RAM and Windows 98 or higher operating system.

To install the AG-UC2-UC8 software, download it from Newport website on AG-UC2 or AG-UC8 page. The program gives you the option of where to load the files, or you can use the default directory *C:\Program Files\Newport\Piezo Motion Control\Newport AG-UC2-UC8 Applet*.

After installation is complete, reboot your PC and open Newport AG-UC2-UC8 Applet by double-clicking on the newly created icon.

Once installed, refer to the "AG-UC2-UC8 Applet Manual" available on Newport website.

5.7 ASCII Command Set

NOTE

Both AG-UC8 and UC8PC controllers feature the same set of commands as the AG-UC2 controller, so please refer to chapter 4.7.4 for details on available commands.

The “CC” command is the only command specific to the AG-UC8/UC8PC multi-axes controllers (see details of this command below).

CC — Change channel

Syntax	CCnn, or CC?
Parameters	
Description	nn — Channel number.
Range	nn — 1 to 4
Input tests	<ul style="list-style-type: none"> – Check the controller is AG-UC8. – Check controller is in remote mode. – Check there is no background task (MA, PA). – Check the current state of both axes (must be 0). – Check channel number (must be integer).
Description	This command is specific to AG-UC8. The piezo actuators are selected by pairs which are grouped in four channels. This command changes the selected channel.
Returns	None.
Errors	<ul style="list-style-type: none"> 0 — No error. -1 — Unknown command (only available on AG-UC8). -2 — Must not specify any channel. -3 — Wrong format for nn (must be integer). -4 — Wrong value for nn (must be between 0 and 4 included). -5 — Not allowed in local mode (controller must be in remote). -6 — Not allowed state (both axes must be in state 0).

NOTE

For a particular actuator selection (1 to 8), the range nn (1 to 4) specifies a channel number in CC commands. The axis number xx (1 or 2) is specified in other commands. For example, to control actuator number 8 (Axis 2 on channel 4), one has to select the channel number 4 with the command “CC4” and then use the index of the second actuator of the channel, for example, “2PR500” to execute a relative move of 500 steps.

- Channel 1: Actuators 1 and 2 (xx = 1, 2)
 - Channel 2: Actuators 3 and 4 (xx = 1, 2)
 - Channel 3: Actuators 5 and 6 (xx = 1, 2)
 - Channel 4: Actuators 7 and 8 (xx = 1, 2)
-

5.8 LabVIEW

LabVIEW users can find all necessary files in "C:\Program Files\Newport\Piezo Motion Control\Newport AG-UC2-UC8 Applet\Samples" folder.



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