

axiom 660 with mpc28

User Manual



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Customer Support

Should the laser fall below acceptable specification performance, please contact our service and support team on +44 161 975 5306 or email: support@laserquantum.com. They will provide initial assistance to rectify the problem remotely. If this is not possible, they will provide you with a Return Material Authorisation (RMA) Form and instruction on how to package and return the laser safely to us for assessment.

For our commitment to the ‘Waste Electrical’ compliance requirements we recommend you to return your systems back to the manufacturing site at end of life.

This take-back service will enable us to put the systems beyond use and disseminate the parts into recycling waste streams.

PLEASE DO NOT RETURN THE LASER WITHOUT PRIOR CONTACT WITH AND AGREEMENT FROM OUR SUPPORT TEAM.

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Warranty Information

Laser Quantum provides a return to base warranty across all our product ranges. See contact details in the Support section.

Warranty cover for the laser is subject to proper use, care and protection from mistreatment. Examples of mistreatment include but are not limited to any of the following:

- Any deviation from the instructions laid out in the Operating Manual
- Opening the product or breaking the warranty seals
- Operation in any hostile environment as outlined in the Operating Manual
- Any damage due to operation in unclean environments
- Any substantial mechanical shock
- Any damage through static discharge (this will not occur under normal operation)

The definition of mistreatment and its applicability to the warranty is at the reasonable discretion of Laser Quantum.

Laser Quantum's obligation under this warranty is limited to the replacement or repair of the product which having been returned to the factory is found to be defective, and where the defect was not caused by factors external to the product. Any replacement part/product is under warranty for the remainder of the initial product warranty period.

Summary of EU compliance

Reference	DOCEU-AXI-1/2/3/4
Manufacturer Details	Laser Quantum Ltd, Stockport, UK
Product name and description	axiom 532nm laser + mpc32 (smd32); axiom 660nm laser + mpc28 (smd28)

The declaration is issued under the sole responsibility of the manufacturer and relates to following regulations and technical standards.

Directive 2014/35/EU Low Voltage Directive (LVD)

- EN 60825-1:2014: Safety of Laser Products.
- EN 61010-1:2010+A1:2019: Safety requirements for electrical equipment for measurement and laboratory use. General requirements.

Directive 2014/30/EU Electromagnetic Compatibility (EMC) Directive:

- EN 61326-1:2013: Electrical equipment for measurement, control and laboratory use -EMC requirements. General requirements for immunity and emissions.
- Meeting the requirements for the electromagnetic environment.

Directive 2011/65/EU Restriction of the use of certain hazardous substances (RoHS)

- Restriction of the use of certain hazardous substances in electrical and electronic equipment and the amended Annex II – **Directive 2015/863/EU**

Further information on Declaration of EU Conformity and product compliance available on request.



Warning: Serious Personal Injury

Failure to read this manual carefully before operating the laser may result in catastrophic damage to the system which may void the warranty.

Introduction

The **axiom 660** is a Diode-Pumped Solid-State (DPSS) laser system emitting light in the visible region of the spectrum 660 nm. It is a Class 4 laser product. This manual describes the set up requirements and operational procedures to ensure the systems safe operation.



Warning: Serious Personal Injury

Use of controls or procedures or performance of procedures other than those specified herein may result in hazardous radiation exposure. **Use laser ONLY for the originally intended requirement such as for scientific research, industrial application or for oem integration.**

Operational Requirement: Electrical Specification

The **mpc28** Power Supply Unit (PSU) requires:

Input Voltage: **24 V** DC

Input Current: **11 A**

A minimum of 11 A must be available from the external source.



Important Note: The centre pin of the input connector is positive and the external DC source must not have a ground connection. If the system experiences significant power interruption (surges or dips) it will restart and revert to a safe standby mode.

Operational Requirement: Environment

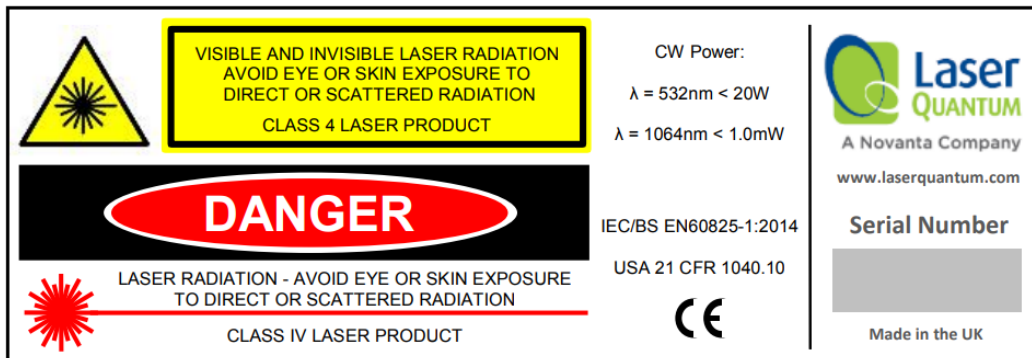
Optimal Operating Temperature Range – Laser Head	20°C to 29°C
Maximum Operating Temperature – Laser Head	35°C
Maximum Operating Temperature – PSU	50°C

For optimal performance, the laser head should be connected to a closed loop cooling system set to around 25°C and have a flow rate of at least 1.6 L/min. The laser head itself should be mounted securely to an appropriate flat surface such as an optical bench.

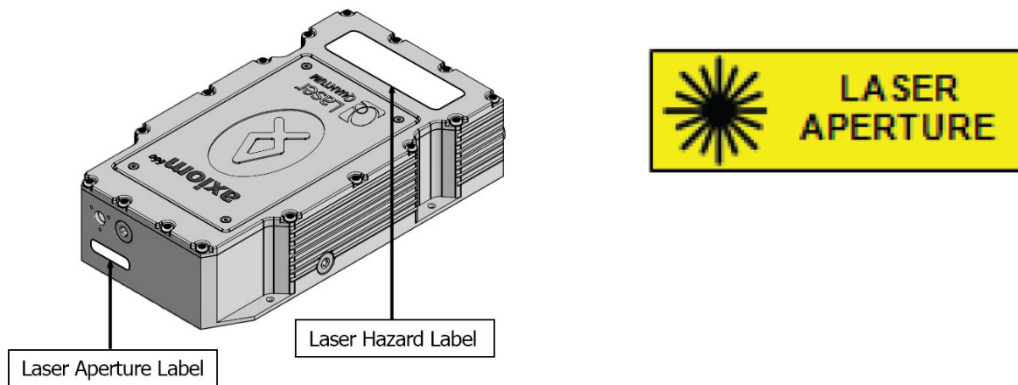
If the maximum temperature is reached in either case, then the laser system will shut down. The system can only be restarted once it has been cooled to a safe temperature and is powered off/on.

Laser Safety

The **axiom 660** is a Class 4 laser product, and this is denoted by the laser warning label affixed to the laser head. A further label also appears adjacent to the laser aperture.



A further label also appears adjacent to the laser aperture:



When operating the laser, those in the environment must adhere to the following instructions to avoid eye damage and prevent the risk of fire:

- Laser safety goggles must be worn at all times when the laser is in operation.
- Always ensure the beam is safely collected in a suitable beam stop or that the laser is disabled when not in use.
- Choice of laser safety goggles and other PPE should be based upon the maximum power the laser is capable of - which should not exceed 15 W

For a full description of laser safety procedures, the user is referred to:

- FDA "Regulations for the administration and enforcement of the radiation control for health and safety act of 1968" 21 CFR Ch.1 section 1040.1
- American National Standards for Safe Use of Lasers – ANSI Z136
- IEC/BS EN60825-1:2014 "Safety of Laser Products – Part 14: A user's guide"

System Specifications

A full list of parts supplied with the laser systems appear in Section 3 along with the dimensions (mm) and weights (kg). These measurements should be referred to whilst integrating the system.

Parts List

The **axiom 660** laser system comes complete with:

- **axiom 660** laser head
- **mpc28** Microprocessor Controlled Power Supply Unit (PSU)
- **Umbilical Cable** – to connect the laser head and PSU



Important Note: Laser head and PSU are **NOT** interchangeable and must remain paired to meet specification.

Pairing with another Laser Quantum PSU should not be attempted as this may damage the laser.

Depending on the purchase specification, some or all of the following items may also be included:

- RS232 Serial Cable – for communication with the **mpc28** via computer
- External Power Supply Source (AC to 24 V DC Switchmode)
- EC Mains Lead
- PSU Key Set – to operate the interlock key on the PSU control panel
- Interlock dongle – to enable the laser system (green spot on casing and red LED)*
- RemoteApp™ software suite & Operating Manual – delivered on a USB flash drive



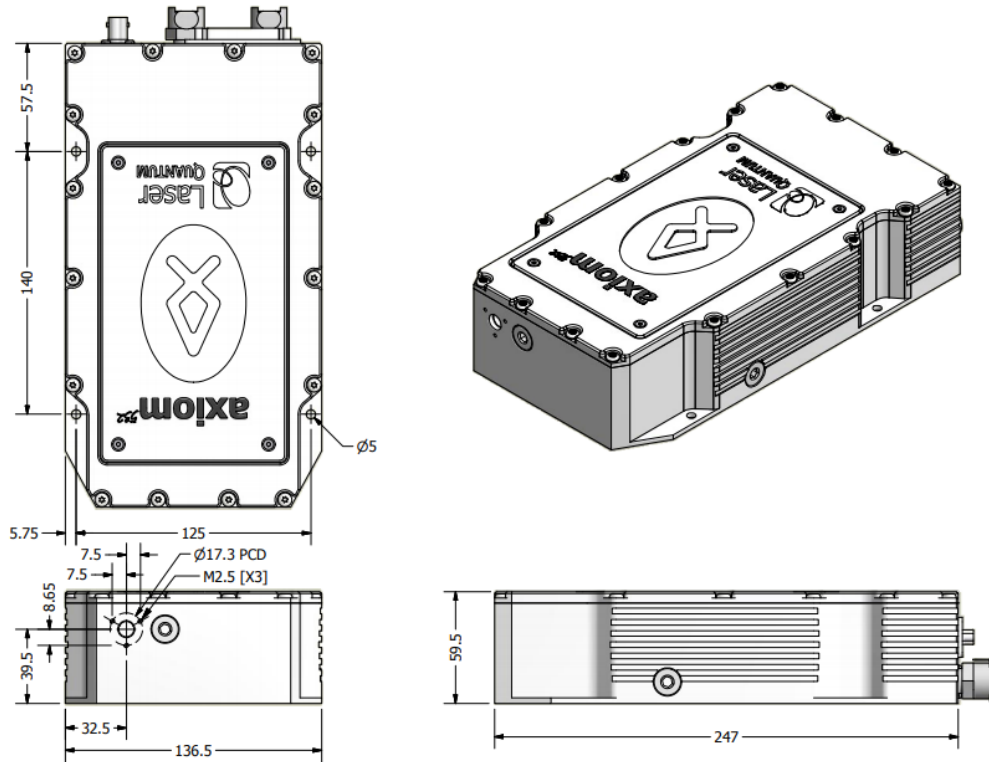
Important Note: If a red spot interlock dongle has been supplied, Section 5.1 is amended to include an additional safety warning which must be taken into consideration before operating the laser.

System parts and accessories that meet manufacturer's specification **MUST** only be used. **DO NOT** replace the IEC Mains Lead with alternative inadequately rated leads.

Weights and Dimensions

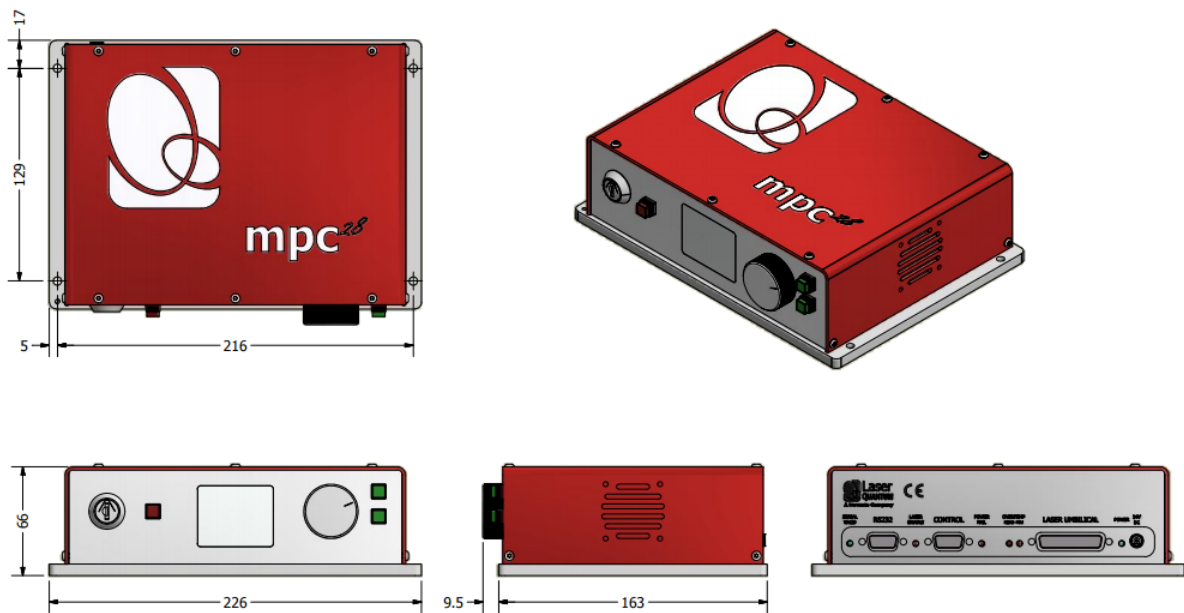
axiom 660 laser head

Weight: 3.9 kg



mpc28 PSU

Weight: 1.7 kg



PSU Configuration Drawings

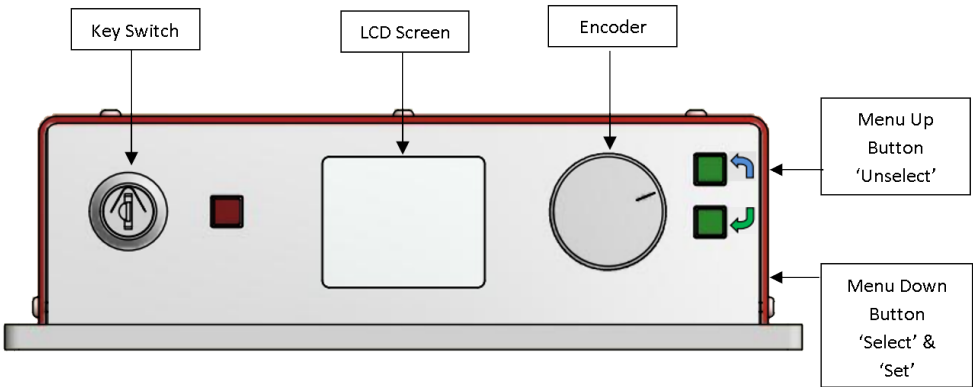


Figure 4-1

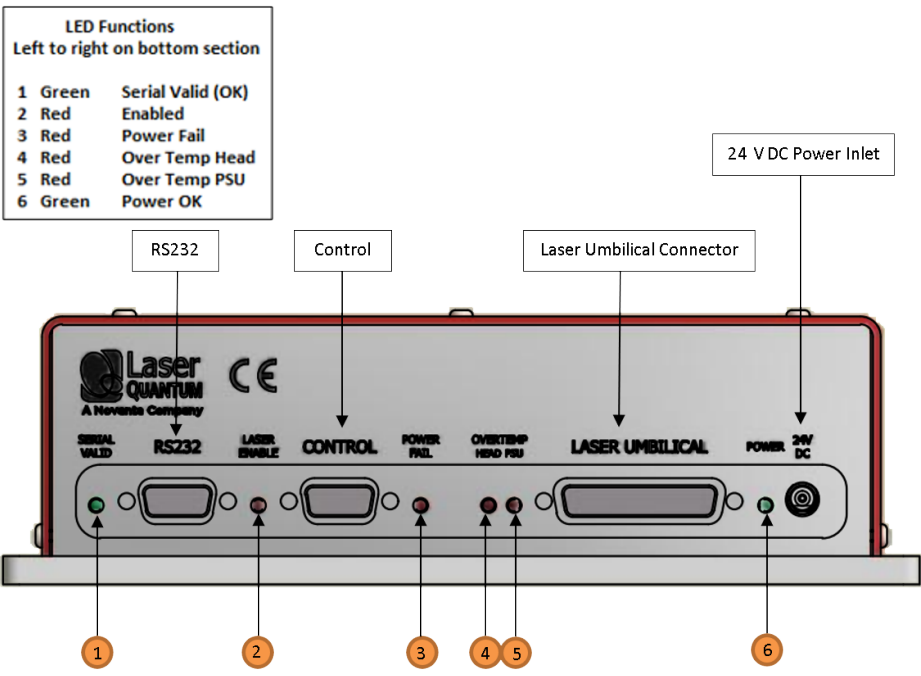


Figure 4-2



Warning: Serious Personal Injury

The **axiom 660** laser contains components which can be damaged if exposed to an electro-static discharge. Ensure the connector pins on the back of the laser head are never exposed to an electro-static discharge.

Laser Operation

Switching the laser “on”

- 1 Ensure the **mpc28** is not powered (i.e. 24 V DC source is switched off).
- 2 Connect the Laser Umbilical Cable to the port marked ‘Laser Umbilical’ on the **mpc28** before connecting the other end to the laser head. Tighten the locking posts on the screws at both ends so they are finger tight.
- 3 Switch on the 24 V DC source, this should illuminate the **mpc28** green power LED. At this stage the thermal control circuitry is activated but no laser emission should occur.
- 4 The analogue Control port (see Figure 4.2) is multi-functional as it has connections for Interlock, Enable Switch and Laser Power Control/Modulation. The Interlock must be closed to allow the laser to operate, and this can be achieved using the supplied red-spot Interlock Dongle.
- 5 With the Key Switch turned to the ‘on’ position, a momentary press of the Enable button will start the laser.



Warning: Serious Personal Injury

If a red spot Interlock Dongle has been supplied with the laser system this will over-ride the need to press the Enable button. Turning the Key Switch to the ‘on’ position will start the laser.

- 6 Using the Encoder and Menu Up/Down buttons (see Figure 4.1) the operation current or power can be adjusted (see Section 5: Front Panel Controls).
- 7 The laser can be operated in either Power mode or Current mode, the selection of either mode is described in Section 5.

Power Mode

The laser power is constant and a feedback control loop maintains the power at the level requested by the operator via the Front Panel LCD.

Current Mode

The pump diode current as selected by the operator is a percentage of the total pump diode current available. The requested current remains constant, however the power may drift due to environmental changes.

Switching the laser “off”

The laser is switched off by turning the Key Switch to the ‘off’ position or disabling the interlock connection.

Front Panel controls

On the front panel of the PSU:

‘Up’ button is marked



‘Down’ button is marked



In order to adjust the laser output, the user must first select the parameter mode displayed on the LCD screen by pressing the menu down button. This action changes the text with the navigation marker (). Depressing the menu down button again will change the text with the selection marker ><. The rotary encoder allows the selection of the required parameter (power or current). Once selected, depressing the menu up button once will return the parameter back to the navigation marker (). The laser is now operating in the selected mode.

Using the rotary encoder select the parameter (power or current) depending on selected mode. Depressing the menu down again will change the selection marker to ><. The value can then be changed using the rotary encoder. The value will change faster if the rotary encoder is de- pressed whilst rotated.

Once the desired value is reached, depressing the menu up button twice will store the parameter in long-term memory.

The selected parameter – depending upon the operating mode (power or current) – is represented on a horizontal bar in the centre of the LCD screen. The set value is depicted by a blue bar and the output value is depicted by a red bar.

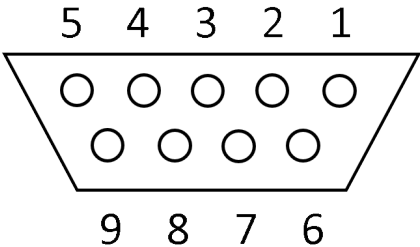
Both the laser head and power supply temperatures are displayed on the screen, as well as the number of hours of PSU operation and a status display. The status messages are tabulated below:

Status Message	Description
KEYSWITCH : OFF	Kesyswitch/ Interlock disabled
ENABLE TO START	Laser ready, awaiting Enable button
LASER DISABLED	Laser disabled via RS232 command
LASER EMISSION	Danger! Laser Emission!

Control Port - Functionality

The **MPC32** can be operated directly via the control port (see Figure 4.2) by applying 0 to 5 V in accordance with the diagrams in this section.

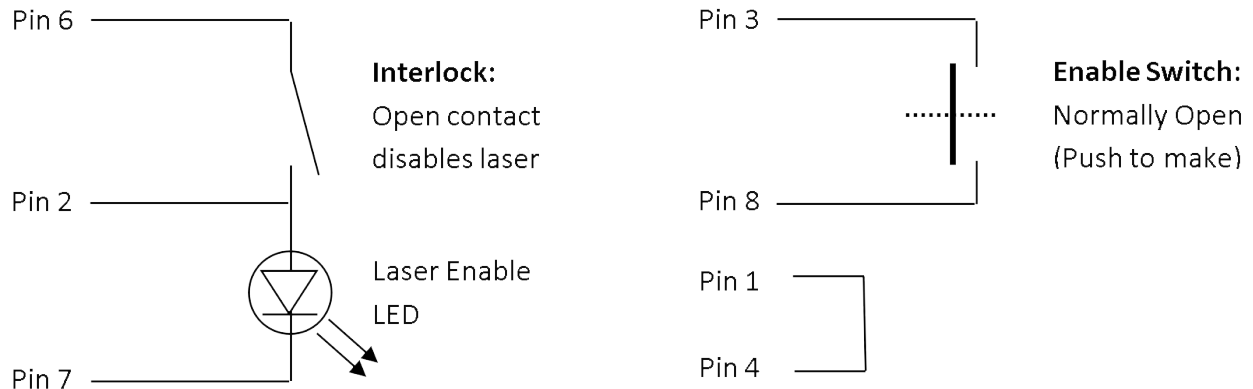
Alternatively, use of the supplied dongle will allow the system to be operated without external interlock connections – although it is recommended to use an external interlock where possible for laser safety reasons.



Pin	Function
1	+5 V rail (source)
2	Interlock (connection 2) and Enable LED anode
3	Enable switch (connection 1)
4	Diode current enable (connect to pin 1)

5	Ground (GND)
6	Interlock (connection 1)
7	Enable LED cathode
8	Enable switch (connection 2)
9	Ground (GND)

The remote Interlock, Enable and Enable LED can be wired in accordance with the diagrams below, to be used as part of a laboratory interlock safety circuit.



If the Interlock connection is broken or if the laser head or controller overheats, the laser will shut down. The Interlock connection must be re-made or the temperature restored to normal before the laser can be re-started.

RS232 Port – Functionality

Control of the laser can be achieved via the RS232 port using a terminal emulator such as HyperTerminal or PUTTY. This allows the operator to:

- Turn the laser on/off
- Control the laser power
- Prompt the processor for information such as laser head/PSU temperature
- Check the laser status

It is necessary to have the Interlock and Enable switches closed via the Control port in order to enable the laser, prior to controlling the laser through the RS232 port. Pins 1 and 4 of the Control port must be shorted together to allow maximum current to be set by the RS232 commands.

The RS232 port uses the standard 9-way connector pin configuration:

Pin 2 TXD: RS232 – Transmit

Pin 3 RXD: RS232 – Receive

Pin 5 GND – Ground

Port settings are:

Baud Rate: 57,600

Parity: None

Stop Bit: 1

Hand Shaking: None

The operator must wait for a response from the PSU before sending the next command. A response is any text string (including null) followed by a carriage return.

RS232 Port – Serial Commands

Serial Command	Function
OFF	Disables the laser, regardless of the interlock status
ON	Enables the laser subject to Interlocks and Enable Switch status
POWER=###	This sets the output power of the laser. For example, to set a power of 2800 mW, send the string POWER=2800, followed by striking the RETURN key.
POWER?	Returns the power of the laser (read from the internal photodiode)
STPOW=###	### is the optical power in mW. Sets the default start-up power. This serial command must be followed by WRITE
ACTP=###	### is in mW, Recalibrates the APC mode (See section 5)
WRITE	Stores APC calibration, STEN and STPOW in memory
LASTEMP?	Returns the temperature of the laser head in degrees centigrade
PSUTEMP?	Returns the temperature of the PSU in degrees centigrade
STATUS?	Returns the status of the Interlock
TIMERS?	Returns the timers of the laser and PSU: Time=#####.# - Total time the system has been powered. Laser Time=#####.# - Total time the diodes have been powered. Laser > 1 A Time=#####.# - Total time the diodes have been powered >1 A

*A minimum % current threshold level is required to achieve laser emission. This threshold varies from laser to laser and is also dependent on the laser power.

The system has been tested for compliance using a 3m serial cable. If a serial cable >3m is used, compliance of the system may be compromised unless optical isolation is used.

RemoteApp™

Using Laser Quantum's unique RemoteApp™ software suite the laser can be controlled via the RS232 port. The application is supplied on a USB Flash Drive and should install automatically. Alternatively, it can be downloaded from

www.laserquantum.com. Follow the on-screen prompts to install the software onto the computer. RemoteApp™ includes a comprehensive instruction manual which can be accessed via the 'Help' and 'Contents' tabs.

The RemoteApp™ can also be used if a remote connection is required by our Service & Support Centre and is a powerful tool if performance optimisation is required.

Re-calibrating the laser power

The laser can be recalibrated at any time during its use to ensure the APC mode is in good agreement with any external power meter device. Recalibration is a simple process that takes place via the RS232 port. The procedure for recalibration requires the RS232 port to be configured for use with a terminal emulator (Section 5). The following procedure must be followed:

- 1 Select an intermediate power that the laser is capable of reaching. Set the laser to this power by typing the command `POWER=###`. "###" represents this intermediate or characteristic operating power level in mW.
- 2 After a period of 5 minutes, measure the actual power using a trusted, external power meter.
- 3 Type the command `ACTP= [external power meter reading in mW]`.
- 4 Confirm that the laser has adjusted its power such that the external power meter now reads ###mW within a few mW.
- 5 If necessary, repeat steps 3 and 4 until the calibration agrees.
- 6 Once accepted, type the command `WRITE` to store the new calibration.



Important Note: The power is calibrated during manufacture and may be subject to an error of up to 5% as a result of power meter variation.

Take extra care to remove back-reflections to the laser. Any magnitude of back reflection may disturb the resonant cavity and will affect the APC feedback control loop.

Cooling Requirements and Power Consumption

Cooling Requirements

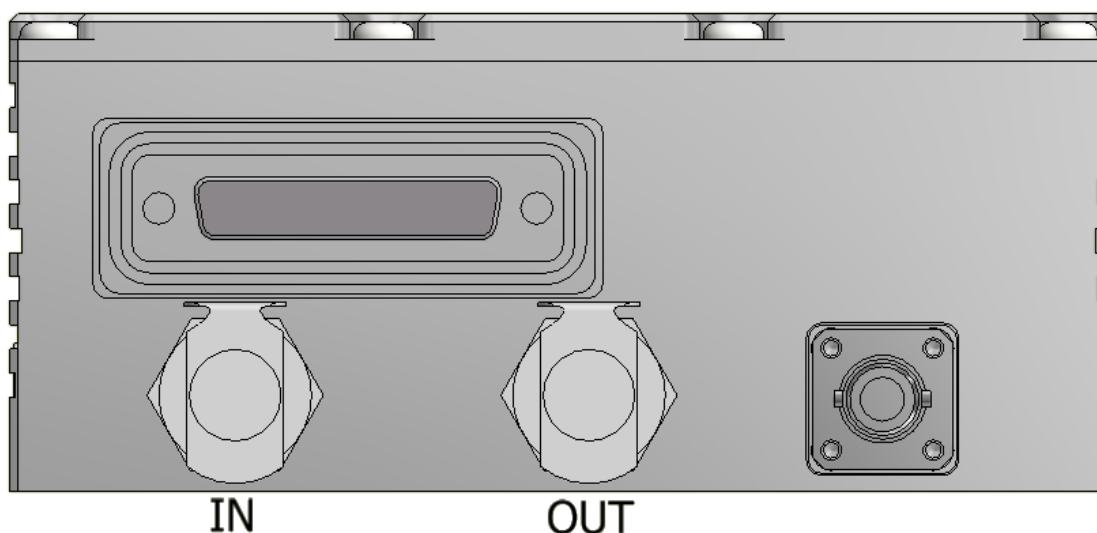
The laser has a characteristic warm-up period before it reaches specification; this time depends partly on the heat sink to which it is attached. However, the typical warm-up time is 10 minutes from switch on.

In order for the laser to perform to specification and in particular to have a minimum variation of beam size, the laser head should be operated between around 24-28°C. Ideally it would be supplied with water from a closed loop cooling solution set to around 25°C and have a flow rate of at least 1.6 L/min. This can be achieved by directly attaching the coolant pipes into the base of the laser using the fixtures attached.

The water should have a suitable inhibitor added in order the long term use will not cause undue oxidation of aluminum. Laser Quantum recommends the use of 20% "COOLFLOW DTX" mixed with 80% distilled water.

The cooling system should be capable of removing up to 100 W of heat load. This may be higher if the laser is operated at a higher temperature.

To ensure the correct cooling arrangement the flow direction should be as follows:



The required water connectors are standard CPC coupling inserts and a tubing size of approximately 1/4" or 3/8" is suitable.

If the **axiom 660** or the **mpc28** are each not attached to an adequate cooling solution, the component will gradually increase in temperature. During this increase, the OVERTEMP LEDs on the rear of the **mpc28** will begin to flash slowly as a warning – there is an LED dedicated to each component. Once either LED begins to flash, the current to the laser diode begins to reduce in an attempt to reduce the effects of overheating.

The tables below show the temperatures of the laser head and the response of the OVERTEMP LEDs:

axiom 660 laser head

Temperature of head	Current to laser	Head OVERTEMP LED
<=35	Normal	off
>35	Reduced to zero	on

mpc28 PSU

Temperature of head	Current to laser	Head OVERTEMP LED
<50	Normal	off
>50	Reduced to zero	on

To restart the system after an over temperature condition, the power supply must be power cycled.

Power Consumption

The power consumption shown is that which is drawn at the plug from the mains supply in both the Maximum and Typical states. The Maximum power will usually be drawn at start up and the typical power is when all temperatures are stabilized, and the system is operating at the specified power. Peak values are shown in all cases and efficiencies will vary between systems of different wavelengths.

Maximum at 240 V/120 V supply – using the supplied Switched-mode external power unit:
- 300 W

At the 24 V input the PSU must be able to draw a maximum of 11 A

Laser System: Maximum power draw (laser system power shown in blue)
6000 mW 250 W

Laser System: Typical power draw (laser system power shown in blue)
6000 mW 160 W

The heat dissipation of the laser head is approximately 60% of the total power consumption.

Laser Maintenance

If the **axiom 660** is operated in a smoky or dirty environment, occasional cleaning of the laser window may be necessary. To perform this procedure, the laser must be turned off and, using optical cloth dampened with research grade methanol, the laser window must be gently wiped.

- Always follow the instructions given in this Operating Manual
- Always use the PSU which was delivered with the laser and do not attempt to control the laser with any other PSU
- Ensure laser is firmly fixed to an appropriate heatsink to allow efficient heat dissipation from the laser head and ensure a thermal equilibrium is achieved. The laser should be held in an environment with temperature stability $\pm 0.1^{\circ}\text{C}$ to achieve the marketed specifications. Use the laser head power consumption figures to help determine what heat-sink dissipation is needed or speak with your sales representative
- Never touch the connector on the laser head with anything other than the Umbilical cable provided and always follow the connection instructions in this Operating Manual
- Do not open the laser head or PSU; this will immediately invalidate the warranty
- Do not subject the laser head to mechanical shock; if severe this can cause mis-alignment of the laser cavity
- Do not allow the output window of the laser to be touched as this may damage the precision optical coatings used. Avoid very dirty atmospheres where dirt may settle on the window
- Do not operate or store this laser system in very humid or damp environments

Guaranteed specification will only be achieved at the ordered power level. Laser calibration may not always be accurate at very low powers – for alignment purposes seek external attenuation.

Liability

Laser Quantum accepts no liability for damage to persons or property caused by incorrect or unsafe use of any of its products; this is the sole responsibility of the user. Proper safety regulations for the use of these products must be observed at all times.



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