

# axiom 660 with smd28

User Manual



## Table of Contents

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Table of Contents .....	2
Warranty Information .....	3
Summary of EU compliance .....	4
Introduction .....	5
Laser Safety .....	6
System Specifications.....	7
PSU Configuration Drawings .....	9
Laser Operation.....	9
Cooling Requirements and Power Consumption .....	13
Power Consumption.....	15
Laser Maintenance.....	15
Liability .....	16

## 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](mailto: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	<b>Laser Quantum Ltd, Stockport, UK</b>
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 **smd28** 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.

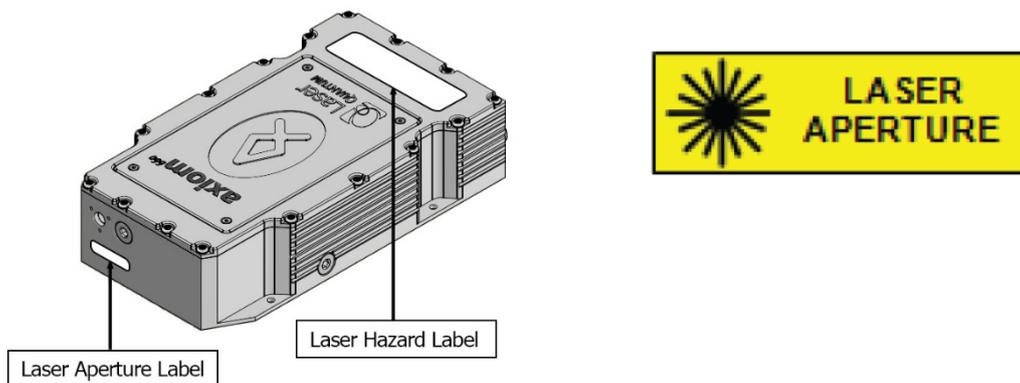
If the maximum temperature is reached in either case, then the laser system will shut down. The system can only be restarted once it has been cooled to a safe temperature and is powered off/on.

## 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
- **smd28** 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:

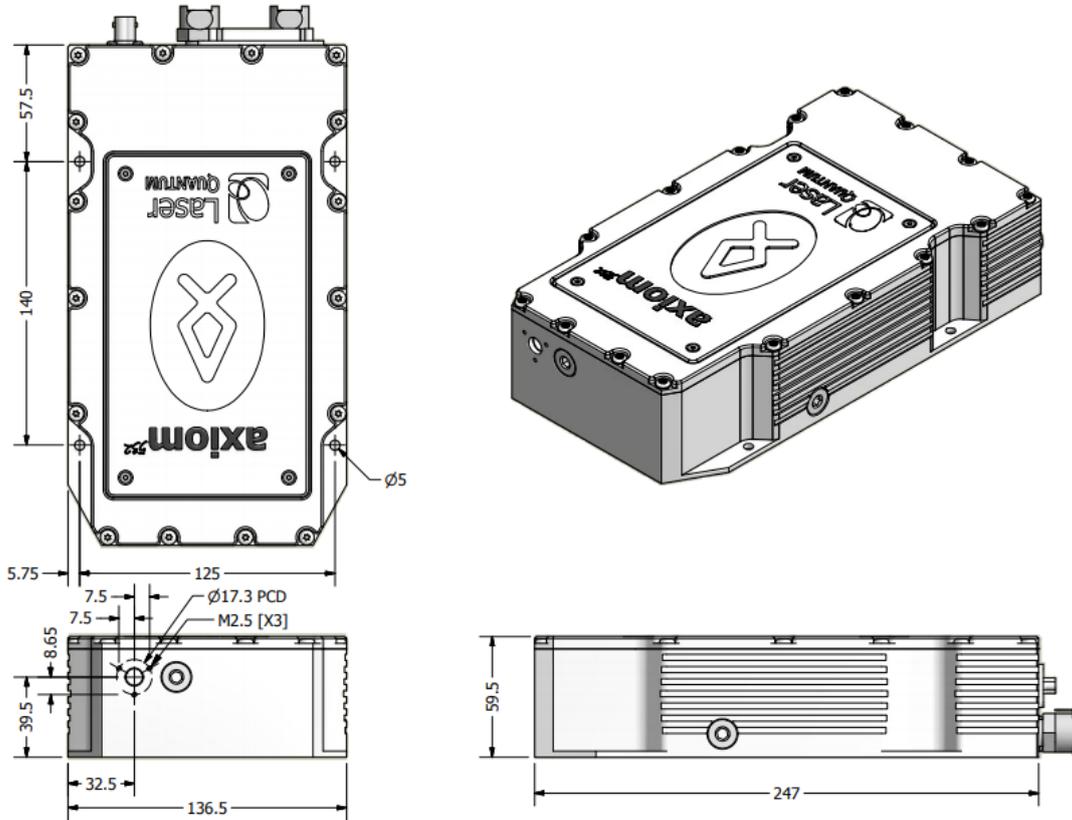
- RS232 Serial Cable – for communication with the **smd28** via computer
- External Power Supply Source (AC to 24 V DC Switchmode)
- EC Mains Lead
- PSU Key Set – to operate the interlock key on the PSU control panel
- Interlock dongle – to enable the laser system (red spot on casing and red LED)\*
- RemoteApp software suite & Operating Manual – delivered on a USB flash drive



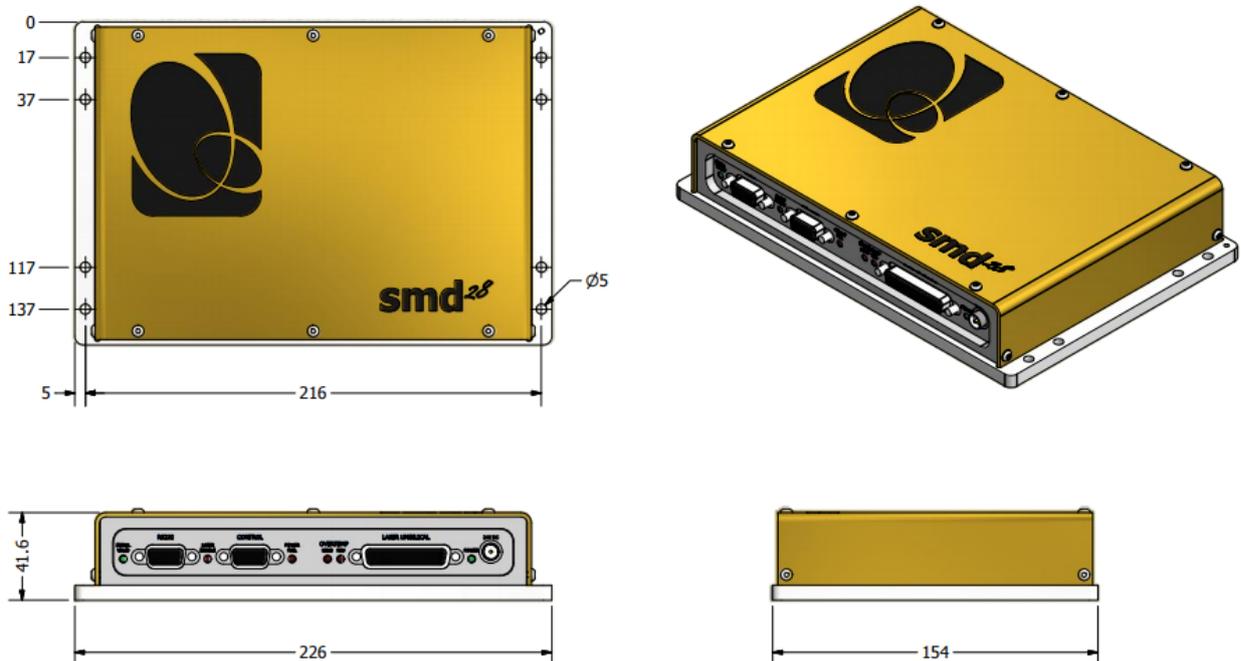
**Important Note:** Use **ONLY** system parts and accessories meeting manufacturer's specification.

Weights and Dimensions

**axiom 660 laser head**      **Weight: 3.9 kg**



**smd28 PSU**      **Weight: 1.7 kg**



## PSU Configuration Drawings

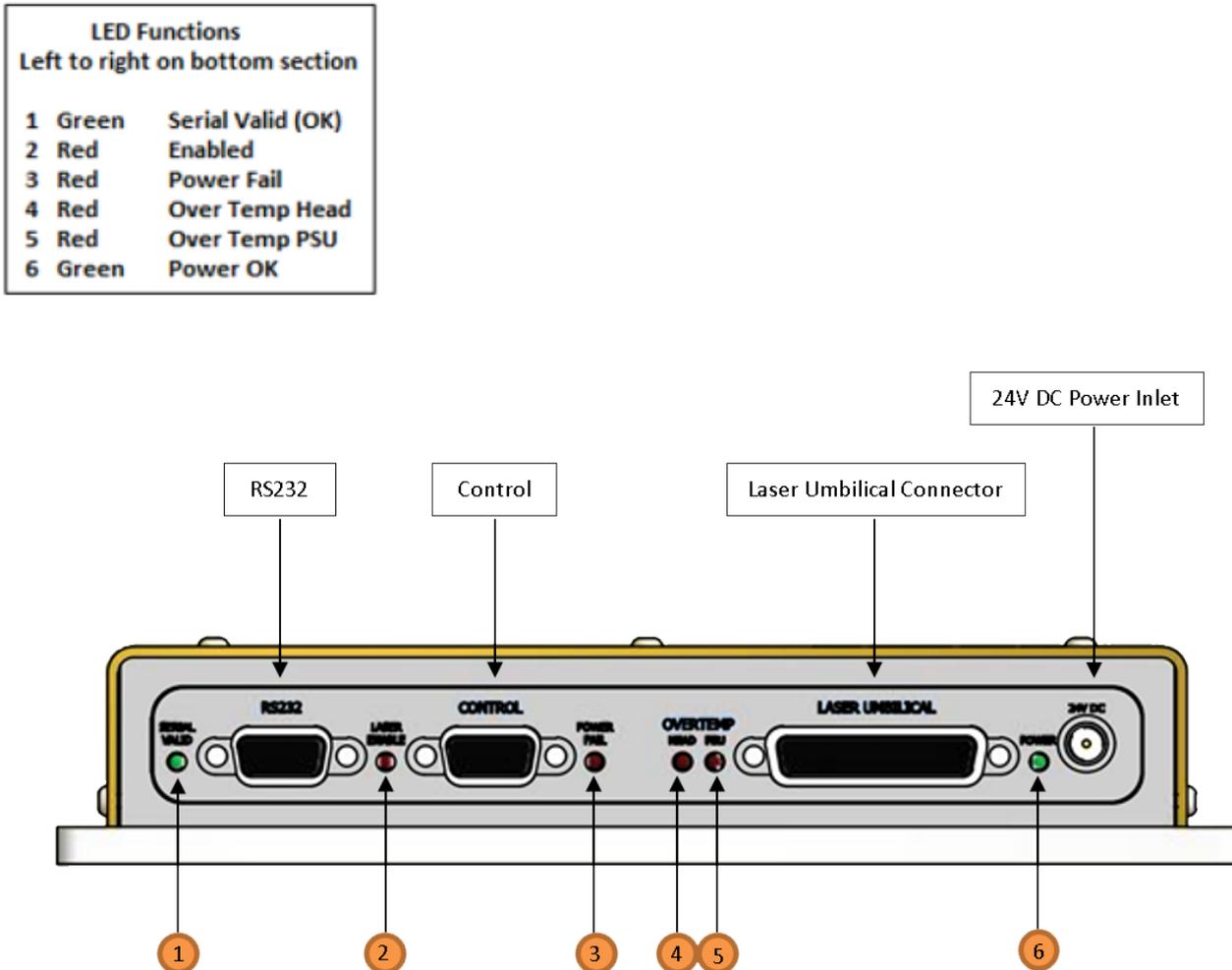


Figure 4-1

## Laser Operation

### Switching the laser “on”

- 1 Ensure the **smd28** 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 **smd28** 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 **smd28** 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 4-1) 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 Depending on the start-up conditions set for the system the laser may now start to emit laser light.
- 6 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. This is achieved by automatic adjustment of an integrated Variable Optical Attenuator within the laser head.

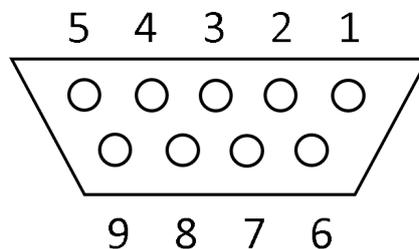
## Switching the laser “off”

The laser is switched off by: Removing the interlock dongle (or opening the interlock circuit if used) or sending the serial command ‘OFF’. The **axiom** system MUST NOT be positioned so that it is difficult to operate the disconnecting devices.

## Control Port - Functionality

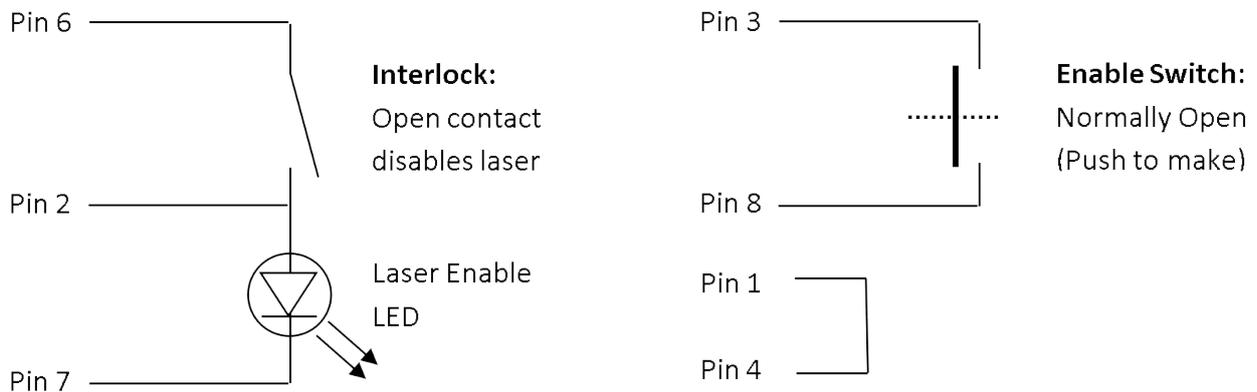
The **MPC32** can be operated directly via the control port (see Figure 4-1) by applying 0 to 5 V in accordance with the diagrams in this section.

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 Interlock 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)
STEN=YES / NO	Enable (YES) or disables (NO) laser as default at start-up. This serial command must be followed by WRITE
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 > 1A Time=#####.# Total time the diodes have been powered >1 A

## 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](http://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 optimization 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.
- 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

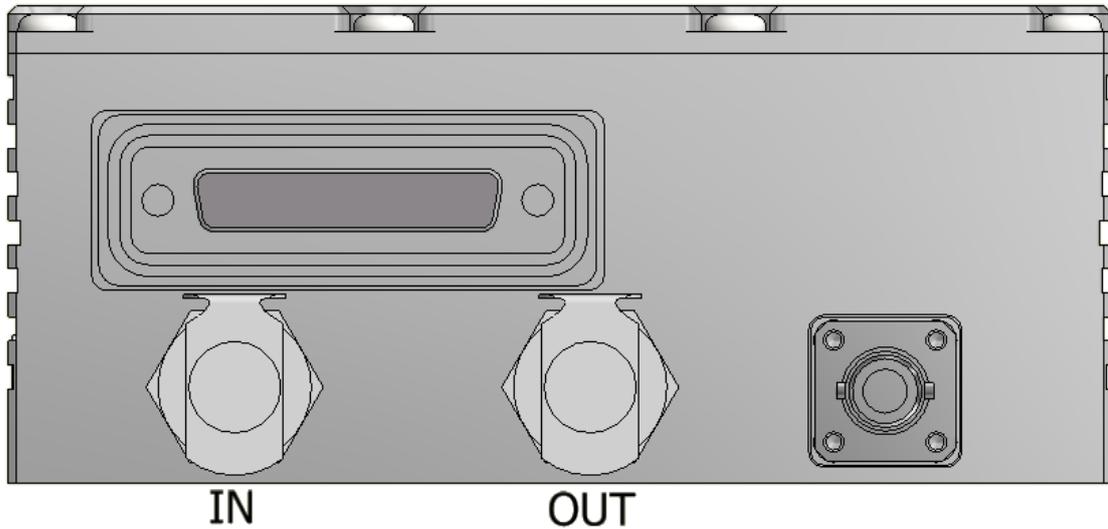
The laser has a characteristic warm-up period before it reaches specification; this time depends partly on the heat sink to which it is attached. However, the typical warm-up time is 10 minutes from switch on.

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. Depending upon environmental conditions and power of the laser, additional cooling might be required for the SMD28 PSU (e.g. Heatsink, TEC, forced air cooling, water cooling). For further information on heatsinking your laser system, please consult your sales representative who may be able to provide a heatsink solution.

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 **smd28** 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 **smd28** 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	<b>Normal</b>	<b>off</b>
>35	<b>Reduced to zero</b>	<b>on</b>

#### smd28 PSU

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

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.



# Novanta

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