

finesse with fpu60

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-FIN-1
Manufacturer Details	Laser Quantum – A Novanta company, Stockport, UK
Product name and description	finesse 532mn laser +fpu60 (ulc16) power supply

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 basic 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.



Caution: Possible Equipment Damage

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 **finesse** is a Diode-Pumped Solid-State (DPSS) laser system emitting light in the visible region of the spectrum at 532 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 OE**

Operational Requirement: Electrical Specification

The **fpu60** Power Supply Unit (PSU) requires

Mains input: 90 to 264 V AC, 47-63 Hz, 300 W max

Fuse Rating: 4 A (anti-surge type)



Important Note: The Earth pin of the mains IEC lead (supplied) must be connected to ground at all times. If the system experiences significant power interruption (surges or dips) it will restart and revert to a safe standby safe mode.

Operational Requirement: Environment

Optimal Operating Temperature Range – Laser Head 20°C to 38°C

Optimal Operating Temperature Range – Environment 15°C to 32°C

Maximum Operating Temperature – Laser Head 40°C

Maximum Operating Temperature – PSU 40°C

For optimal performance, the laser head should be mounted onto an appropriate heatsink in a stable environmental temperature. The heatsink requirements will depend on the ambient temperature of the operating environment and the operating power of the laser (section 6).

In the event of the laser head or PSU over-heating, a controlled shut down of the system will occur (Section 6). The system can only be restarted once it has been cooled to a safe temperature.

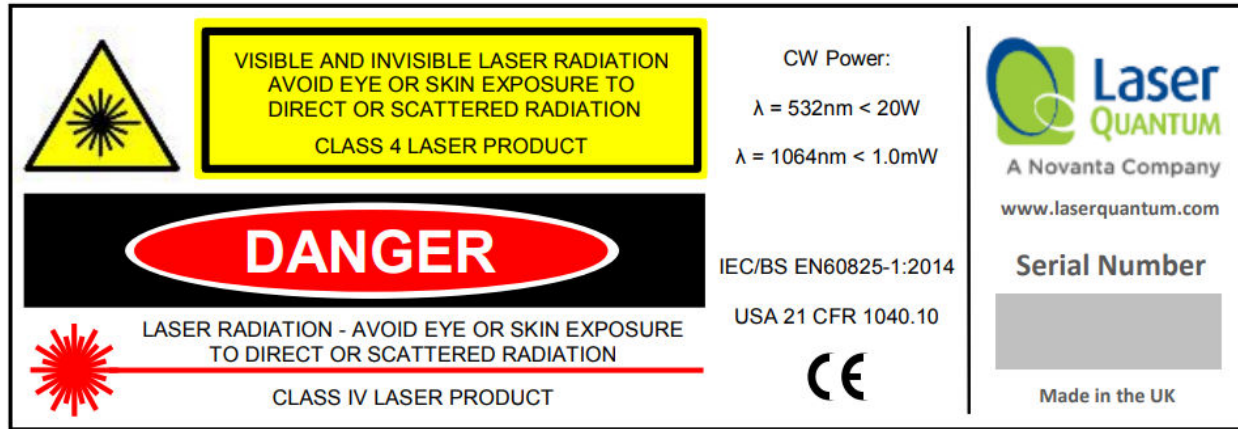
Storage Requirements

Temperature Range: **5°C to 45°C**

Humidity: **Non-Condensing**

Laser Safety

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

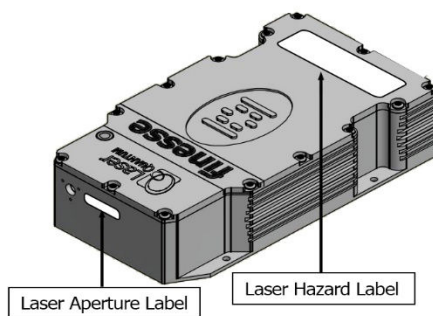


A further label also appears adjacent to the laser aperture:



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.



For a full description of laser safety procedures, the user is referred to Declaration of Conformity standards plus:

- FDA Code of Federal Regulations (CFR) Title 21 Subchapter J section 1040.10 Laser products
- American National Standards for Safe Use of Lasers – ANSI Z136

System Specifications

A full list of parts supplied with the laser systems appears in Section 3.

The dimensions (mm) and weights (kg) are shown in Section 3. These measurements should be referred to whilst integrating the system.

Parts List

The **finesse** laser system comes complete with:

- **finesse** laser head
- **fpu60** 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:

- IEC 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

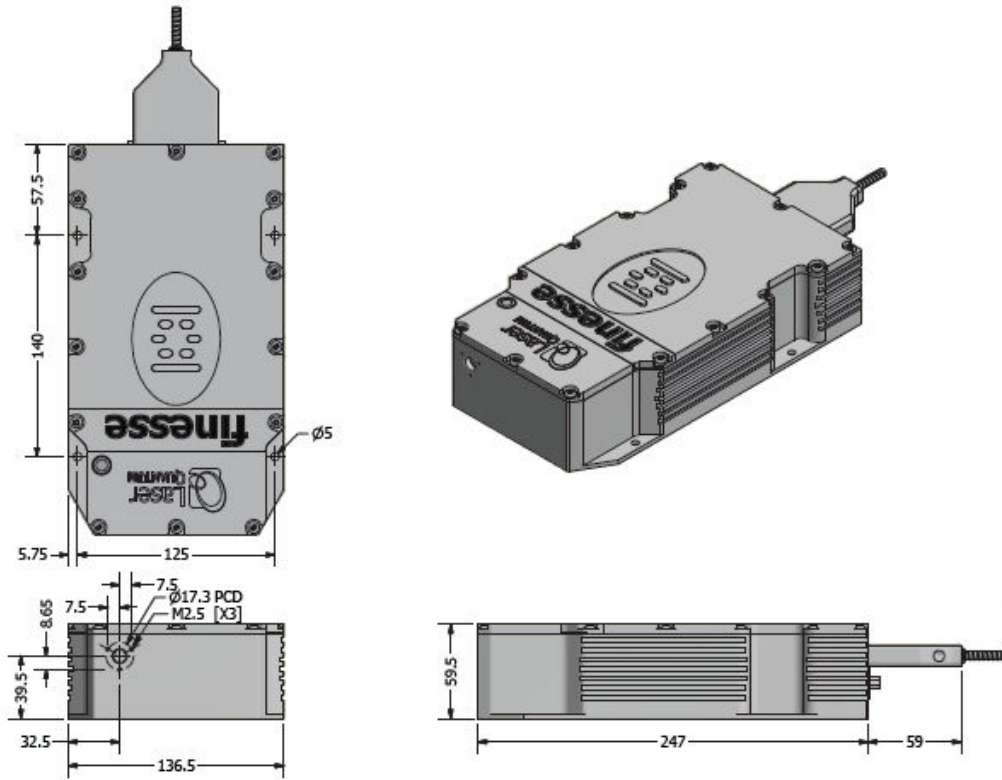


Important Note: System parts and accessories that meet manufacturer's specification **MUST** only be used. **DO NOT** replace the IEC Mains Lead with alternative inadequately rated leads.

Weights and Dimensions

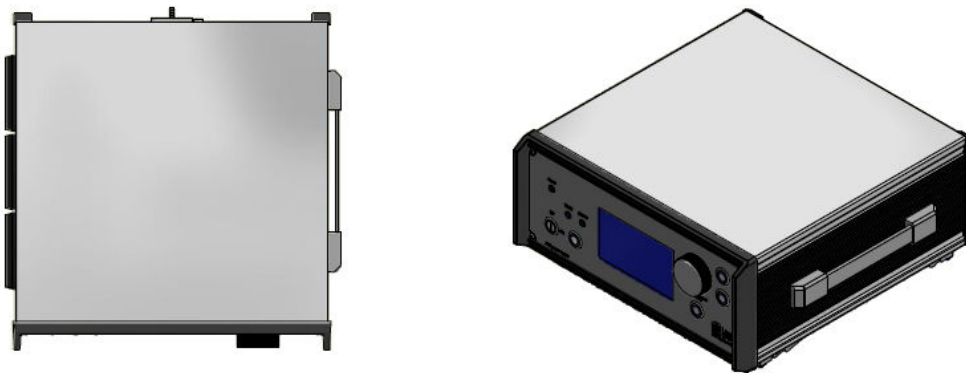
finesse laser head

Weight: 3.6 kg

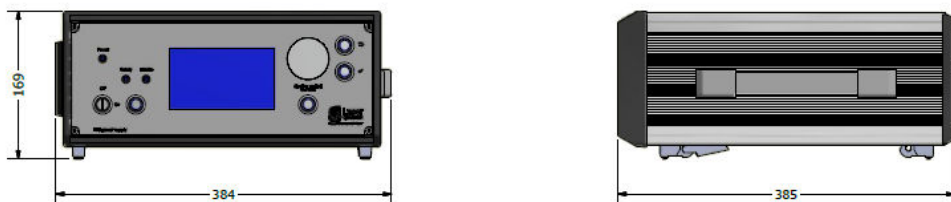


fpu60 PSU

Weight: 11 kg



PSU (



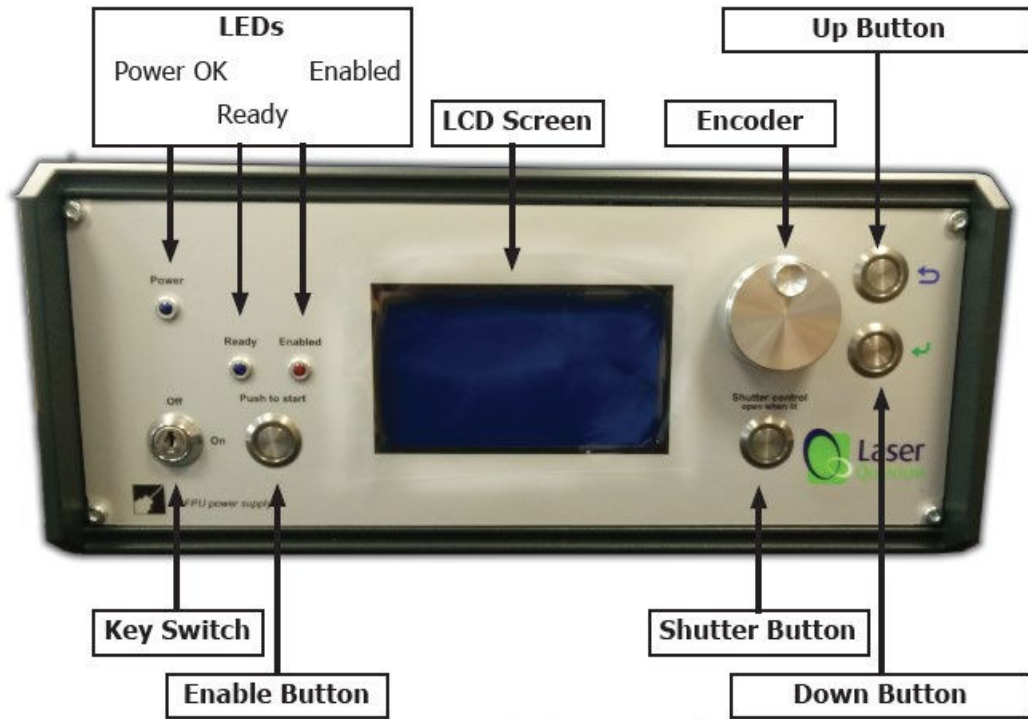


Figure 4-1

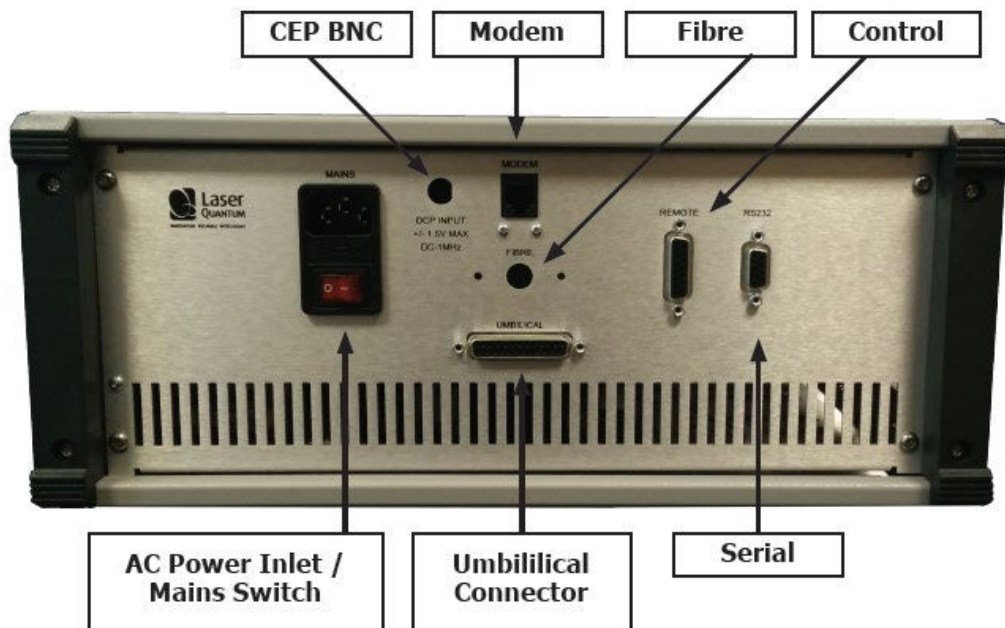


Figure 4-2

Laser Operation

Optical Fibre Cable

The manner in which the optical fibre is handled can have a significant impact on the functionality and reliability of the **finesse** system. Ensure there are no sharp bends in the fibre and that it is not forced or trapped under any heavy equipment. The cost of a rework or replacement due to improper handling can be significant.

Do NOT disconnect to the fibre at any time. The finesse system MUST NOT be positioned so that it is difficult to operate the disconnecting devices.

Switching the laser “on”

- 1 Ensure the FPU60 is not powered (i.e. Main source is switched off).
- 2 Connect the Umbilical Cable to the port marked ‘Umbilical’ on the **fpu60** 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 mains switch at the rear of the PSU (the ‘I’ position), this should illuminate the front panel ‘POWER’ LED. At this stage the thermal control circuitry is activated but no laser emission should occur. During this process the LCD will initially display a screen containing information describing the type of laser system followed by the model and serial number details.
- 4 The Interlock must be closed to allow the laser to operate, and this can be achieved using the supplied red spot interlock dongle.



Caution: Possible Equipment Damage

Safety features within the PSU will ensure the system does not operate if the connections at both ends of the umbilical are not good and well secured.

- 5 With the Key Switch turned to the ‘on’ position, a momentary press of the Enable button will start the laser, the system will sound an audible warning at this point.
- 6 Opening the Shutter in the laser head is achieved by pressing the ‘SHUTTER’ button, the status LED will glow red to indicate the shutter is open.
- 7 Using the Encoder and Menu Up/Down buttons the operation current or power can be adjusted (see Section 5: Front Panel Controls).

Switching the laser “off”

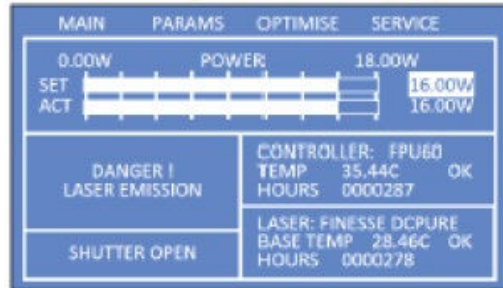
The laser is switched off by turning the Key Switch to the ‘off’ position or disabling the interlock connection.

Front Panel LCD MAIN Menu

The operator can interact with the ‘MAIN’ and ‘OPTIMISE’ menus (the other menus can be viewed but are locked). Within the ‘MAIN’ menu the screen is split into two sections:

The top half of the LCD screen displays the system settings that control the laser. It is from this window that the operator can set the output power needed.

The bottom half of the LCD screen displays information regarding the system temperatures, PSU controller type, timers and the status of the shutter and laser emission.



Front Panel controls- Functions

On the front panel of the **fpu60**:

'Up' button is marked



'Down' button is marked



To adjust the laser configuration the operator must select a parameter in the 'MAIN' menu.

- 1 The function to be changed must be selected using the selection cursor (a bar of inverted text). Under normal operation the selector cursor is not displayed. To make it appear rotate the jog wheel to 'MAIN' and press the 'down' button.
- 2 Once the cursor has appeared rotate the jog wheel to select the parameter to be adjusted. When the parameter is highlighted press the 'down' button to select it, this will change the select cursor in to the modify cursor.
- 3 The value of the chosen parameter can now be changed by rotating the jog wheel. Depressing the jog wheel increases the rate at which the value changes.
- 4 Once the value has been adjusted the modify cursor should be changed back to the select cursor by pressing the 'up' button.
- 5 Finally pressing the 'up' button once more will store the chosen value in the PSU memory and remove the select cursor from the LCD.

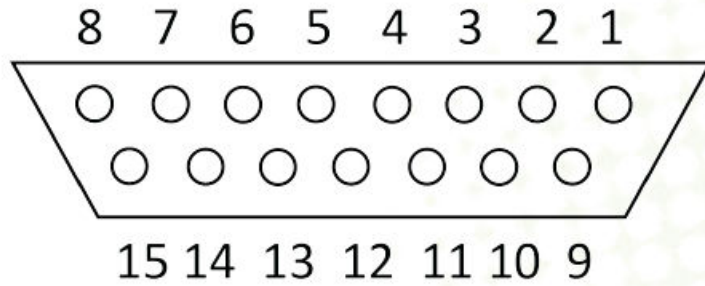
Front Panel Controls- Power Feedback

With the 'SET' power highlighted by the modify cursor, adjusting the jog wheel will change the set output power (0 to maximum in 0.01 W steps). The top bar displays the SET power value and the bottom bar the actual (ACT) power output. To store the new 'SET' power value press the up button twice.

Modifications to the SET output power can be made with the laser either enabled or disabled. If the laser is enabled the power will immediately change as the chosen output power changes. With the laser disabled the SET output power will be achieved upon enabling the system.

Control Port - Functionality

An external interlock system is fitted to the **fpu60**. The connector for it is the 15-pin D type on the rear panel. The pins are numbered as shown below when viewed from the panel side:

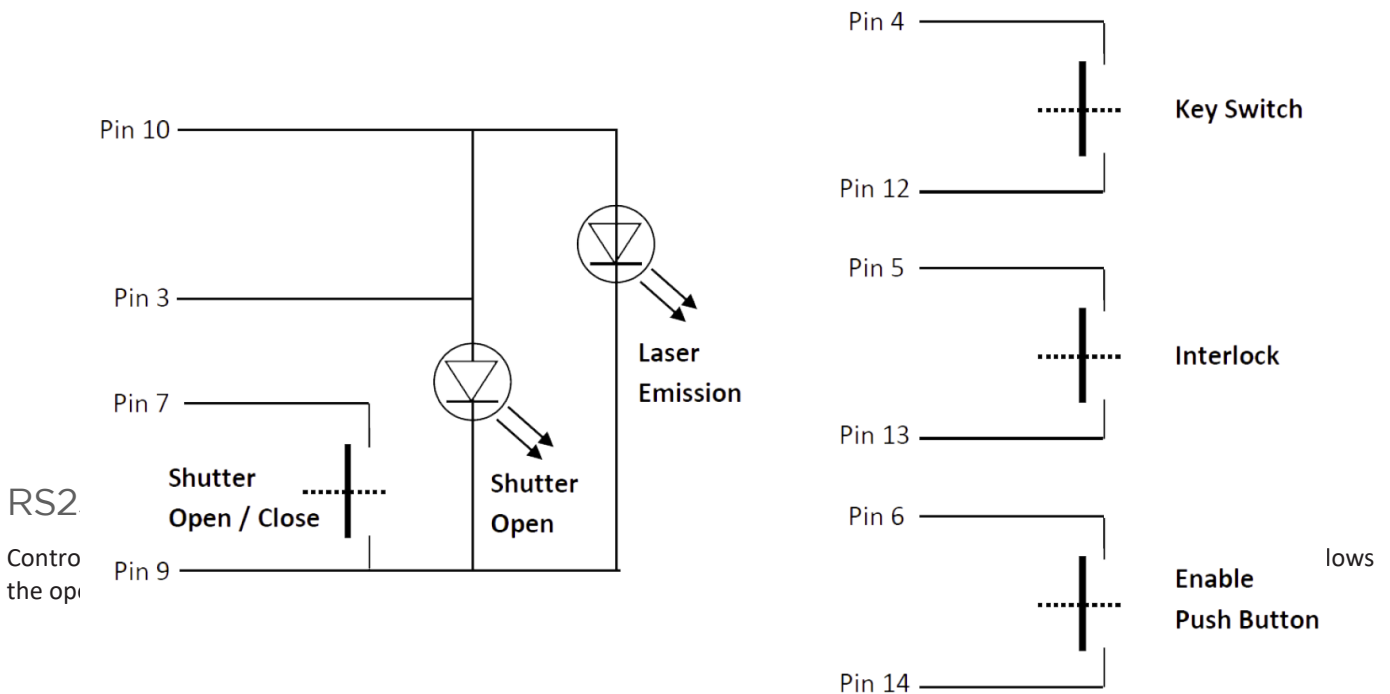


The external Interlock will disable the system (laser emission will cease) whenever the circuit is open. The status window on the LCD screen will read 'DISABLED: KEYSWITCH/INTLK'. To re-enable the laser the Interlock circuit must be closed and then the "Switching On" instructions followed (Section 5.).

If the laser is to be used:

- Within an enclosed cabinet: It is suggested that the Interlock connector be wired to an Interlock switch that changes from closed to open circuit with the removal of an access lid or panel.
- In an open environment: It is suggested that the Interlock connector be wired to an Interlock switch that changes from closed to open circuit if the laboratory door is opened.

If the Interlock connection is broken or if the laser head or **fpu60** overheats, the laser will shut down. The Enable button must be pressed again to operate the laser once the Interlock connection is restored or the temperature has cooled.



- Control the laser power
- Query information such as laser head/PSU temperature
- Check the laser status

It is necessary to have the Interlock, external keyswitch/interlock 2 and Enable switches closed via the Control port in order to enable the laser, prior to controlling the laser through the RS232 port.

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: 19,200

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, new line.

RS232 Port – Serial Commands

Serial Command	Function
OFF	Disables the laser, and “Push to Start” button regardless of the interlock status

ON	Enables the “Push to Start” button subject to Interlocks and Enable Switch status
POWER=###	This sets the output power of the laser in Watts. For example, to set a power of 5W, send the string POWER=5
POWER?	Returns the power of the laser (read from the internal photodiode)
SHUTTER OPEN	Opens laser shutter
SHUTTER CLOSE	Closes laser shutter
BACKLIGHT=###	LCD Backlight brightness (%)
INTERLOCK	Returns the status of the Interlock
SERIAL?	Returns the laser serial number
SHUTTER?	Returns the status of the Shutter
STATUS?	Returns whether the laser is enabled or disabled
HTEMP?	Returns the temperature of the laser head base in degrees centigrade
PSUTEMP?	Returns the temperature of the PSU in degrees centigrade
TIMERS?	Returns the timers of the laser and PSU: PSU Time = ##### Mins Total time the system has been powered. Laser Enabled Time = ##### Mins Total time the laser has been enabled. Laser Threshold Time = ##### Mins Total time the laser has been enabled and running above threshold.
CALDATE?	Reports the calibration date of the system
DATE?	Reports the date stored in the FPU60 controller
SOFTVER?	Reports the firmware version
TIME?	Reports the time stored in the FPU60 controller

The system has been tested for compliance using a 3 m serial cable. If a serial cable >3 m 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 optimization is required.

Performance Optimization

The performance of the **finesse** system can be optimized using the ‘OPTMISE’ menu on the LCD screen. This will ensure the system is operating at peak performance.

Set-up Conditions

On the front panel of the **fpu60**:

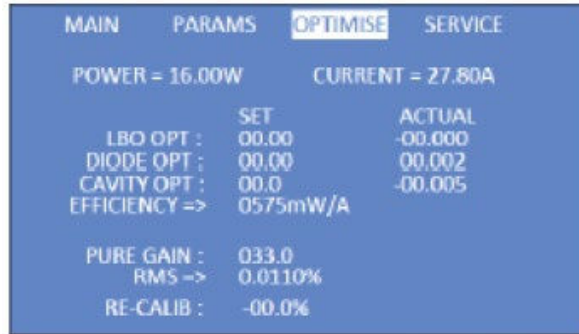
'Up' button is marked



'Down' button is marked



To adjust the laser configuration the operator must select a parameter in the 'OPTIMISE' menu. The screen shown below will be displayed.



Power Optimization

On the front panel of the **fpu60**:

'Up' button is marked



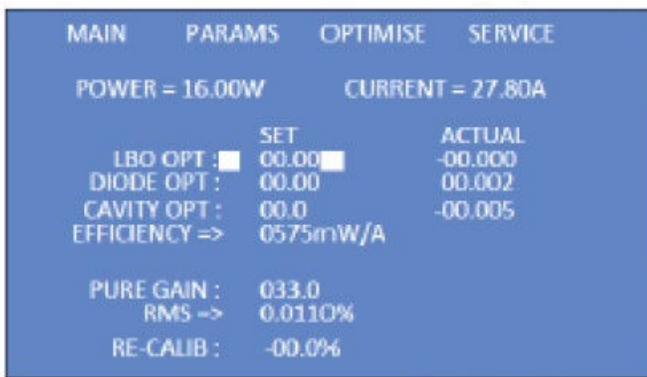
'Down' button is marked



The laser power in Watts and the diode current needed to deliver the laser power are both displayed on the screen. The 3 parameters that can be optimised by the operator are listed as:

LBO OPT; DIODE OPT; CAVITY OPT; **Note – Some Finesse Heads do not have a controlled CAVITY**

In each case the objective is to maximise the EFFICIENCY => value displayed in mW/A



By rotating the jog wheel, position the cursor over the LBO OPT and press the 'down' button. This will select the SET value for LBO OPT, as indicated by the modify cursor (shown above)

By using the jog wheel again slowly change the SET value in a positive or negative direction. The ACTUAL value will automatically begin to change as the system tries to achieve the new SET value. Simultaneously the EFFICIENCY value will change too. Continue to move the SET value across the range permitted until the maximum value of EFFICIENCY is reached.

Press the 'up' button when the maximum EFFICIENCY value is reached.

Repeat the above process for both the DIODE OPT and CAVITY OPT. It should be noted that these parameters respond slowly so patience is needed to allow time for the ACTUAL value to reach the SET as it is changed.

It is normal to see the ACTUAL values fluctuate in keeping with the operation of the control loops. On completion of the Power Optimization procedure press the 'up' button twice and check the cursor returns to the OPTIMISE menu tab. This will ensure the new values are stored.



Important Note: 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.

Power Calibration

On the front panel of the **fpu60**:

'Up' button is marked



'Down' button is marked



The output power of the **finesse** as shown on the LCD can be calibrated to match that of the operator's own Power Meter. This is a simple procedure requiring a pre-calibrated Power Meter suitable for measuring a laser source at 532nm at least the maximum wattage of the system.

With the laser set up in accordance with Section 5, place the Power Meter at the laser aperture of the finesse head and open the Shutter. (Note: There must be no other optics between the laser head and the Power Meter.)

Using the jog wheel select the RE-CALIB value and press the 'down' button. The modify cursor will appear either side of the % value displayed. Rotate the jog wheel steadily until the POWER reading on the LCD matches the external Power Meter reading. Then press the 'up' button twice to store the new value in the memory.

MAIN	PARAMS	OPTIMISE	SERVICE
POWER - 16.00W		CURRENT - 27.80A	
	SET	ACTUAL	
LBO OPT :	00.00	00.002	
DIODE OPT :	00.00	00.004	
CAVITY OPT :	00.0	00.008	
EFFICIENCY =>	0575mW/A		
PURE GAIN :	033.0		
RMS =>	0.0120%		
RE-CALIB :	█-00.0%█		

All the factory settings are not affected when the new off-sets are stored in the memory. To return to the factory settings simply return each of the parameters to zero SET value.

When the modulation voltage is applied this will cause an offset between the actual and target powers of the system. If the required powers are outside the +/- 1.5% to +/- 3.0% range then the target power can be changed via the serial link (or encoder wheel on the fpu front panel) to adjust the range up or down in power level.

Cooling Requirements and Power Consumption

Cooling Requirements

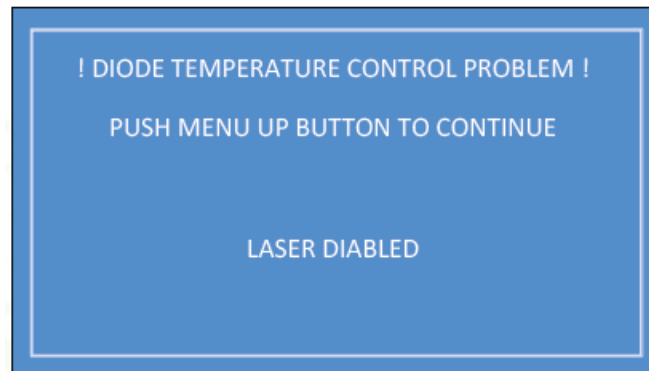
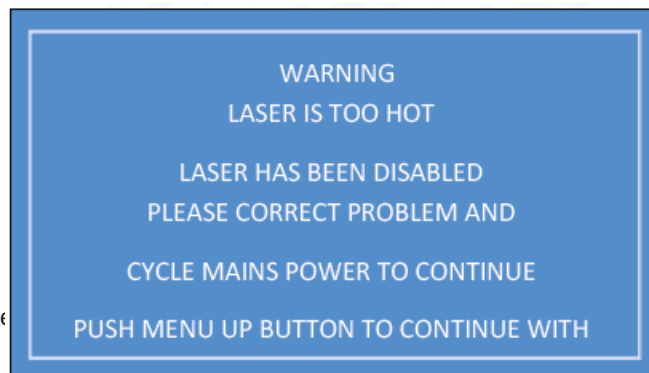
The laser has a characteristic warm-up period before it reaches specification; this time depends partly on the heatsink to which it is attached. However, the typical warm-up time is 10 minutes from switch on.

In order for the laser to perform to specification, it must be adequately heatsinked. Operating the laser on an inadequate heatsink will adversely affect its stability and may lead to overheating and the laser shutting down. Operating the laser on a water-cooled plate will produce optimum performance. For further information on heatsinking your **finesse**, please consult your sales representative who may be able to provide a heatsink solution.

If the **finesse** is not attached to an adequate heatsink or cooling solution or the **fpu60** cooling intakes are blocked, then these components will gradually increase in temperature.

If the temperature of the laser head reaches 42.5°C the following warning screen will appear:

If the temperature of the diode



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 stabilised and the system is operating at the specified power. Peak values are shown in all cases.

Maximum at power consumption:

300 W

Laser System: Maximum (laser system power shown in blue)

- 4 W: 240 W
- 8 W: 240 W
- 12 W: 300 W
- 16 W: 300 W

Laser System: Typical Power Draw (laser system power shown in blue):

- 4 W: 160 W
- 8 W: 190 W
- 12 W: 220 W
- 16 W: 240 W

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

Laser Maintenance

If the **finesse** 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 misalignment 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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