

# Whitelase Supercontinuum

## SC-4x0

### User Manual



## Table of Contents

1.	Explanation of symbols .....	4
2.	Product Safety.....	5
3.	Place of Manufacture .....	6
4.	Labels Fixed to this Unit.....	7
4.1	Position of the labels .....	8
5.	Installation and maintenance.....	9
5.1	Installation .....	9
5.2	Maintenance .....	10
6.	Key Procedures to follow .....	11
7.	Description .....	12
7.1	System.....	12
7.2	Output optic .....	12
8.	Technical Specification .....	13
9.	System Overview .....	14
9.1	Laser Front Panel .....	14
9.2	Laser rear panel .....	16
9.3	Interlocks .....	18
9.1	Status LED (C) .....	19
9.2	Master source train monitor (F) .....	19
9.3	NIM / AOM1 Monitor Port (G) .....	20
9.4	USB port (I) .....	20
10.	Operating instructions .....	21
10.1	Power up Procedure .....	21
11.	USB communication .....	27
11.1	Software Installation .....	27
11.2	Command Reference.....	27
11.3	Software commands .....	27

12.	Display Modes .....	29
12.1	Default mode (X=1) .....	29
12.2	System integration mode (X=2) .....	29
13.	Alarms .....	30
13.1	Mode Lock alarm. ....	30
13.2	Back reflection alarm. ....	30
14.	Customer Service .....	31

# 1. Explanation of symbols



**Important information.** Non-compliance with the information within these sections may result in improper operation of the laser or adversely affect the performance of the system.



**Critical information.** Non-compliance with the information within these sections may result in serious system damage and potentially void your warranty.



**Laser safety information.** These sections advise on proper conduct when operating high power laser systems. Observe the instructions to avoid personal injuries.

## 2. Product Safety



Use of controls or adjustments or performance of procedures other than those specified in this manual unless performed under the direction of Fianium Engineer, may result in hazardous radiation exposure for which Fianium Ltd will not be liable. In addition, any of these operations will also void the product warranty.



The laser beam is emitted from the armoured cable at the rear of the unit where the laser aperture label is fixed. This is a collimated beam.

There is a facility for an external laser safety interlock to be connected into your existing interlocks if required. The supplied D-plug has a wire loop which closes the interlock. If the interlock is opened, the laser output will be disabled. To enable the laser, close the external safety interlock and cycle the key switch between the OFF and ON positions.



This is a sealed laser unit. The removal of any panels will invalidate the warranty.

### 3. Place of Manufacture

Fianium Limited

20 Compass Point

Ensign Way

Southampton

United Kingdom

SO31 4RA

Tel: +44 (0)2380 458 776

Fax: +44 (0)2380 458 734

## 4. Labels Fixed to this Unit

These labels are typical of the types fitted to Whitelase Supercontinuum laser systems. There will be some variation, based upon specific laser parameters.

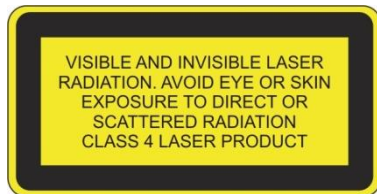


Figure 1 Laser Classification Label



Figure 2 Manufacturing Address Label



Figure 3 Emission Warning Label



Figure 4 Laser Aperture Label

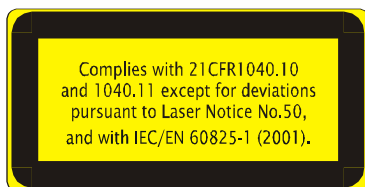


Figure 5 Laser Compliance Label

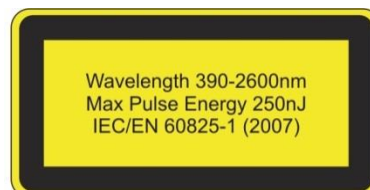


Figure 6 Optical Parameter Label

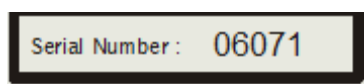
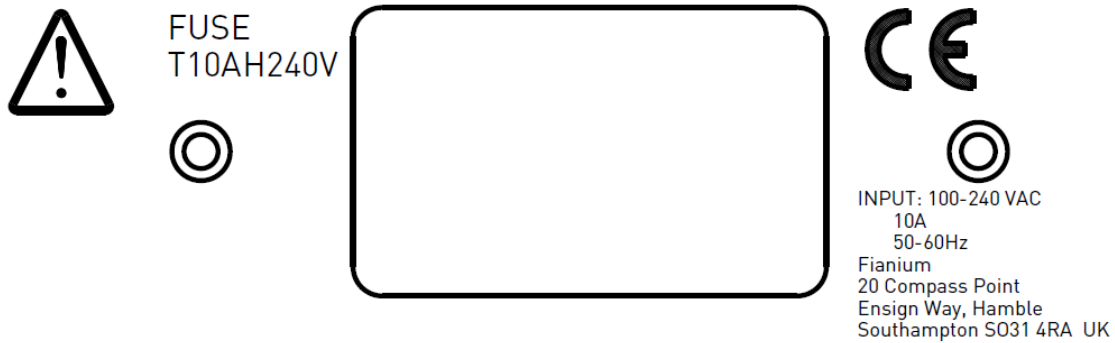


Figure 7 Laser Serial Number Label



**Figure 8 Fuse rating, CE Mark and Voltage Rating Label**

#### **4.1 Position of the labels**

Figure 1 Located on the left side panel of the laser.

Figure 2 Located on the right side panel of the laser

Figure 3 Located on the front panel of the laser, adjacent to the key switch and laser output warning LED.

Figure 4 Located on the armoured cable near to the laser output optic.

Figure 5 Located on the left side panel of the laser.

Figure 6 Located on the right side panel of the laser.

Figure 7 Located on the rear of the laser.

Figure 8 Located on the rear of the laser.



## 5. Installation and maintenance

### 5.1 Installation

- This laser is intended for use in an Industrial or Laboratory environment. It should be installed on a sturdy bench or 19" Rack capable of holding 20kg of weight. Two feet are located on the bottom of the laser at the front to allow the front panel to be raised and viewed more easily.
- The laser must only be connected to the mains supply using an IEC320 rated mains cable, capable of carrying up to 10A of current.
- Protective earthing is required for this product.
- The laser requires ventilation for the cooling of internal components. The air vents on both sides of the laser and at the rear of the laser chassis must not be blocked by other equipment.
- End of line safety tests according to EN61010-1 Annex F is carried out on all Laser chassis.

## 5.2 Maintenance

- There are no user serviceable parts inside this laser.
- Before switching on the electrical power, inspect the output optic for dust contamination. Remove any with an inert gas duster.
- The chassis panels must not be removed. They can be cleaned using a damp cloth.
- The front panel display is a resistive touch screen. It can be cleaned using a damp cloth or IT equipment cleaning tissue.
- Any damage to the front panel display must be reported to Fianium Support for advice.
- Only T10AH240V fuses must be used to replace those in the laser power socket. Remove the power cable and switch off the mains socket before replacing both fuses.

## 6. Key Procedures to follow



Read the [Product Safety Section](#) on Page 5 of this manual, before operating the Laser.

It is important to minimize the risk of back reflection into the laser. In particular:

1. In bulk-optic systems, try to make sure that all reflective optics are not creating spurious back reflected light into the laser. Also the optics should be bolted down to avoid accidental spurious back reflected light into the laser.
2. When setting up a new experiment for the first time, be careful not to cause back reflection into the laser.

Note: There is an automatic back reflection cut off in the laser. If the laser shuts down whilst aligning bulk optics, check the optical train for alignment before increasing the laser output power again.

## 7. Description

### 7.1 System

The WhiteLase™ SC400 & SC450 systems are high-power fiber lasers generating ultrafast broadband Supercontinuum radiation. Operating in the MHz repetition rate range, with picosecond pulses, the systems can be utilised effectively for both steady-state and lifetime measurement. The inherently robust all-fiber design provides unsurpassed performance combined with high reliability and ease-of use. The touchscreen interface enables one-touch access to all laser settings, presets, diagnostics and live system status.

The lasers are easy to use and offer simple and safe operation with a touchscreen interface. The inherent robust all-fiber design allows for unprecedented levels of reliability.

### 7.2 Output optic

Depending on the particular system configuration, the output can be either collimated or a divergent optic. The output optic is designed and manufactured to collect as much light as possible from the nonlinear fiber and deliver it to the user. This is achieved by a combination of optical design and coating of the optical surfaces.

The output optic is aligned in the factory. Tampering with the output optic is not recommended, as this may severely affect the performance or cause serious damage to the system.



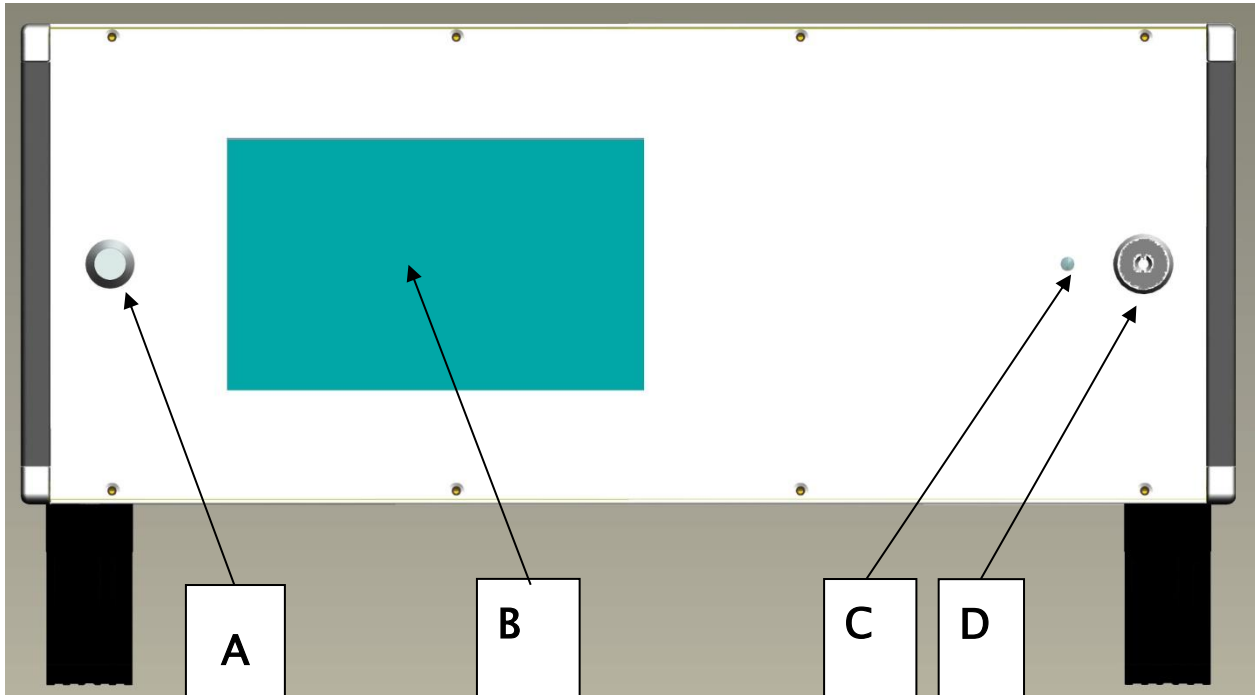
## 8. Technical Specification

Model	SC450-8	SC400-6 SC450-6	SC400-4 SC450-4	SC400-2 SC450-2
Minimum Wavelength	<460nm	SC400: <420nm SC450: <460nm		
Maximum Wavelength	>2200nm			
Total Power (full spectrum)	>8W	>6W	>4W	>2W
Visible Power (400-750nm)	>1200mW	>900mW	>600mW	>300mW
Average Spectral Power Density	>4mW/nm	>3mW/nm	>2mW/nm	>1mW/nm
Fundamental Repetition Rate	80MHz	60MHz	40MHz	20MHz
User Selectable Repetition Rate (with optional pulse picker)	100kHz - 80MHz	100kHz - 60MHz	100kHz - 40MHz	100kHz - 20MHz
Spectral Flatness	<6dB			
Power Stability	<±1%			
Fundamental Pulsewidth	≈6ps			
Output Optic	ø16 x 50mm Collimator			
Beam Diameter	≈1.5mm @ 530nm ≈2mm @ 633nm ≈3mm @ 1100nm			
Armoured Fiber length	1.5m			
State of polarisation	Unpolarised			
User Interface	1. Integrated touchscreen graphical user interface 2. PC via USB interface			
Sync (trigger) Outputs	1. NIM Compatible trigger with adjustable delay (SMA) 2. Oscillator monitor photodiode (SMA)			
NIM Trigger Specifications	>10ns adjustable delay in 10ps steps <10ps timing jitter			
Cooling	Integrated air cooling			
Power Requirements	100-240V, 50/60Hz			
Dimensions (mm)	450 x 390 x 180 (19" benchtop chassis, 4U height)			
Weight	<20kg			
Operating temperature range	+15 degrees C to 30 degrees C			
Humidity	30% up to 80% non-condensing relative humidity			

## 9. System Overview

### 9.1 Laser Front Panel

The layout of the system's front panel is shown in the figure below.



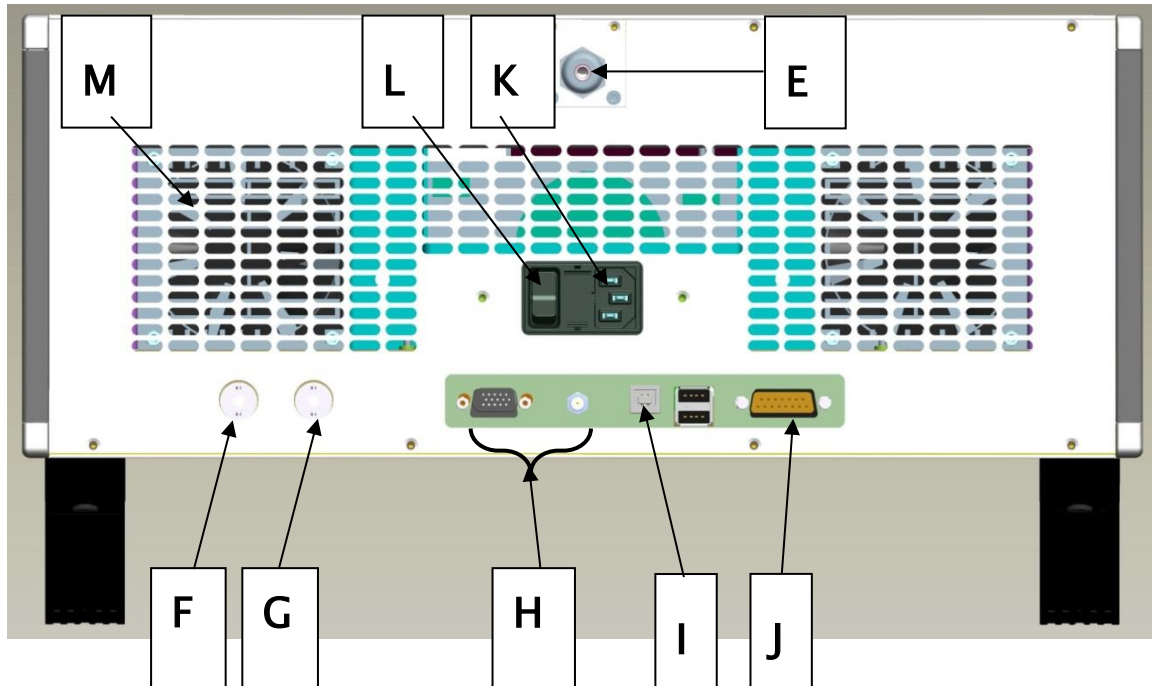
The labelled components are described below:

- A
  - Stand-by button. Depressing this button will shut the system electrical power down. In order to protect sensitive optical components **this will not function if the laser output is enabled. The keyswitch must be switched off first.**
- B
  - Touch-screen. This display is used for both controlling and interrogating the laser system. It also displays the operating parameters of the laser system. Section 3 offers a detailed description of the operation procedure.
- C
  - Multi-colour LED. This LED is energised when the laser is enabled (using key-switch D) or the software “enable” command. When the system operates normally, the LED is white. If the LED has any other colour, the system has encountered an error. Please refer to

the display or use the software “a?” command for the detailed error code. If no error is displayed, please contact Fianium support.

## 9.2 Laser rear panel

The layout of the system's rear panel is shown below:



The labelled parts of the rear panel are detailed below:

- E
  - Optical output. A 1.5 m fibre cable protrudes through the rear panel and carries the system's optical output.
- F
  - Seed oscillator monitor. This BNC connector produces an electrical version of the oscillator's pulse train. To visualise properly, please connect this output (using the cable supplied) to the 50-ohm input of a >200 MHz oscilloscope. The trace is best viewed on 50 ns/div, 50 mV/div.
- G
  - Trigger output. This BNC connector produces an electrical version of the laser output.
- H
  - These connectors are reserved for future expansions of the system's functionality. Please leave them unconnected.
- I



- USB connectors. To achieve computer control of the system, connect the supplied USB cable to the USB Type B socket.
- J
  - Interlock plug. Connect the supplied interlock plug to this connector.
- K
  - Mains connector. Connect a 115/230 V mains lead. The internal power supply is auto-ranging.
- L
  - Mains switch. The mains switch is the only way to completely switch off the laser system.
- M
  - Cooling exhaust. This is the cooling air exhaust port. Do not block this port, as the system's cooling performance will be affected. The air intake port is located behind a grille on the side of the system and must be left free, as well.

### 9.3 Interlocks

To ensure safe operation, the laser system has a two safety interlocks that minimize the risk of user exposure to harmful laser radiation.

#### Remote interlock.

This interlock, available on pins 1 and 2 of the 15 pin control connector (J), can be connected to an external switch.

#### Key switch interlock

The key switch enables the master source oscillator and the high power section of the laser. It can only be enabled if the remote interlock is enabled first.

Remote interlock	Key switch	Laser enabled
Off	Off	Off
Off	On	Off
On	Off	Off
On	On	On

Interlock operating sequence

The pin layout of the interlock connector is shown below.

Pin	Signal	Direction	Format	Description
1	Interlock	Output	+5V	Current limited output for remote interlock

2	Remote Interlock	Input	TTL	Return signal for remote interlock
4	Modulate	Input	TTL	Switches on and off the high power amplifier stage.  0 V = disabled +5 V = enabled (default)
3, 5, 6, 7, 11, 12, 13, 15	Do not connect			
8, 14	0 V	Output		0V reference for control signals.
9	nAlarm	Output	TTL	Indicates when an alarm has occurred.  0 V = Alarm +5 V = No Alarm
10	nLaser Emit	Output	TTL	Indicates when the laser output has been enabled.  0V = Laser output enabled +5V = Laser output disabled

### 9.1 Status LED (C)

The front panel LED will illuminate when the key-switch (D) is in the 1 position, indicating that the master source and the preamplifiers are operating properly. The LED is turned off if an alarm occurs. Refer to the “Alarms” section of the manual for information on how to identify the alarm type.

### 9.2 Master source train monitor (F)

This port can be used to monitor the pulse train produced by the master source. Use a fast oscilloscope (200 MHz or faster) with an input impedance of 50 Ohm.

### **9.3 NIM / AOM1 Monitor Port (G)**

This port allows the operator to monitor the operation and the repetition rate of the pulse picker. It can be connected to a channel on an oscilloscope with an input impedance of 50 Ohms.

### **9.4 USB port (I)**

Use this port to connect your system to a PC. The port supports both USB 1.1 and USB 2.0 specifications. The USB socket is used for all communication between a PC and the laser system.

# 10. Operating instructions



This is a Class 4 Laser device: Ensure the safety notices within this manual are adhered to before any operation is attempted. If in doubt consult your laser safety officer.

## 10.1 Power up Procedure

- Connect a mains lead to the laser system. Connect the D-plug interlock.
- Power up the laser system using the mains power switch (L). The laser control system will initialize and perform self-tests.
- Once the laser self-tests have been completed, the main menu will be displayed. At this point the laser can be operated.

## Using the Touch Screen Display

The touch screen display allows the setting of output power and repetition rate on request and removes the need for applications such as “PuTTY”, “HyperTerminal” and “Kermit”. in order to control the laser system.

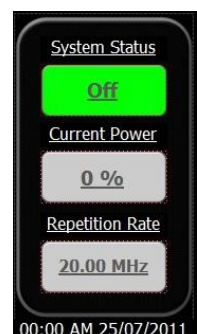
## Common Controls

There are a number of buttons that are common across almost all available screens. These buttons are grouped into the “Status Bar” and the “Control Bar”.

### Status Bar

The Status Bar is along the right hand side of every screen other than the Warning, Alarm and Loading screens.

Each of the buttons report an element of the systems status and if pressed will take you to a related screen. The status bar reports if the system is “On” or “Off”, the current power percentage and the current repetition rate of the system. If pressed, the buttons will take you to the System Status screen, Power Menu and Rep Rate Menu respectively.



### Control Bar

These buttons are Home, Back, Sleep and Date/Time. Pressing either the Home button or the Fianium logo will return you to the Main Menu screen directly. Pressing the back button will allow you to go back through the 10 most recently accessed screens.



The sleep button will deactivate the screens backlight. It is recommended that the sleep facility is used whenever the screen will be displaying the same screen for a period of time in order to prevent damage being done to the screen. The screen does have an automatic timeout feature that will turn off the backlight after a certain period of time has elapsed.

To turn on the backlight after it has been turned off, either automatically or manually, just touch the screen anywhere and the system will turn the backlight on again.

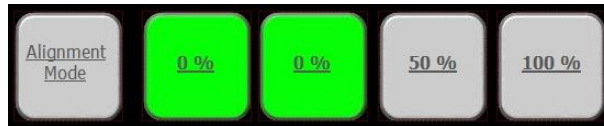
Pressing the Date/Time will forward you directly to the Date/Time Settings menu which can also be accessed through the Settings Menu.

### **Setting the Output Power**

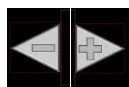
Note: In order for the power menu to function, the laser has to be switched on – i.e. the key switch has to be set to the on position. Please note that when the key switch is in the on position residual radiation will be output from the optic.

The Power Menu contains 5 preset buttons that can be used to set the output power. The value of the Alignment Mode and 0% buttons cannot be changed, the remaining 3 buttons can hold user defined values. The value of

the alignment mode button is factory set and can be used to collimate or aim the beam.



Using any of the 5 preset buttons will set the output power to the indicated level. The power can also be set using the + and - buttons to choose a required power level and the “Set Power” button to transmit the new power setting.



Please be aware that the current output power is only displayed in the system status bar on the right hand side of the screen, the requested power value below the slider bar may not be displaying the current output power.

### **Customising Power Preset Values**

In order to set one of the 3 customizable preset buttons use plus and minus buttons to select the required power. Then press the set preset button, when the set preset button is highlighted in green press one of the 3 customizable preset buttons in order to assign the required value to that preset button.

As standard the laser will load into screen control mode but it is still possible for the system to be controlled using a PC.

### **Setting the Repetition Rate**

On pulse picked lasers it is possible for the repetition rate to be selected by the user. The repetition rate can be selected before the laser is activated as well as while the laser is active. When the repetition rate is changed while the laser is activated you will be presented with a warning screen that will ask if the current power level should be used (When the lasers output power is above 0%) or not. When yes is selected the system will automatically set the

output power level to the current output power percentage, when no is selected the system will set the output power to 0%.

The Repetition Rate Menu contains 8 customizable preset buttons arranged in two pages which can be changed using the double headed arrow button on the left side of the screen. Using any of the 8 preset buttons will set the repetition rate to the indicated value.



The plus and minus buttons below the preset buttons will allow you to scroll through the available repetition rates with the value being contained in the round button in between the two arrows. Pressing this middle button will set the repetition rate to the displayed value.



### **Customising Repetition Rate Preset Values**

In order to set one of the 8 customizable preset buttons use plus and minus buttons to find the desired repetition rate. Then press the set preset button, when the set preset button is highlighted in green press one of the customizable preset buttons in order to assign the required value to that preset button.

### **Settings Menu**

The settings menu provides access to screens that allow for the setting of the power Control Mode, Date and Time, PC Control Mode state and the Engineering Mode. The settings menu also contains a tick box that allows for the system to be muted.



### **Power Control Mode**

This screen contains two options – Analogue Control or Screen Control. The currently selected control mode is the highlighted and will usually be the On Screen Control option. Selecting the Analogue Control option will disable the power screen on the touch screen device and a PC will be required in order to set the output power level.

### **Date/Time**

The Date/Time screen allows the adjustment of the date and time being displayed in the bottom right of the screen. It also allows for the changing of the display format. Access to the Date/Time menu can also be gained by pressing the date and time on any screen.

### **PC Control Mode**

As standard the laser will load into screen control mode but it is still possible for the system to be controlled using a PC. Pressing the PC Control Mode button will present a warning to prevent accidental activation of PC Control Mode.

Please note that once PC Control Mode has been activated the laser will no longer take input from the front panel and the screens backlight will be deactivated. In order to put the laser back into screen control mode the command Switch = 0 must be sent via a PC or the laser must be reset by turning it completely off and back on again.

When in PC Control Mode the laser can only be controlled by a PC connected via the USB Type B port on the back of the laser. In order to communicate with the laser it is necessary for USB drivers to be installed from the product CD. In addition, it is necessary to use a COM-enabled communication handling application such as “HyperTerminal”, “PuTTY”, “Kermit”. For full details on operating the laser using a PC please refer to Section 11.

## System Menu

The System Menu provides access to a number of screens that display diagnostic and system information as required.

The System Information screen contains the Laser Model, Serial Number, Manufacture Date, Warranty Expiry Date, Operating Hours, Software Version and Firmware Version.

## The Alarm Screen



The Alarm Screen will be presented whenever the laser reports a fault that is critical to the lasers operation. The screen will present a brief description of the alarm as well as turning off the system.

In the case of a back reflection alarm it will be possible to reset the laser by turning off the hardware key switch and pressing the “Reset” button. This will return the display to the Main Menu screen.

It is recommended that you always follow the advice contained in the alarm description.

# 11. USB communication

The Whitelase SC400 can be controlled remotely using the USB interface located on the rear panel. This interface becomes available when the option “PC Control Mode” is selected from the “System” menu.

## 11.1 Software Installation

Install the laser USB drivers provided on the product. Install and connect the communication handling application. Refer to the relevant Software Installation Manual for your operating system for installation of USB device drivers.

## 11.2 Command Reference

The USB communication between the laser and PC is carried out via a virtual COM port. The virtual COM port settings are shown below.

Parameter	Value
Data transfer rate (baud)	19200
Number of data bits	8
Parity	None
Stop bit	1
Flow control	No

The commands should be sent as ASCII strings terminated by a Carriage Return (CR) code. The laser replies are in the same format.

## 11.3 Software commands

The following commands are available on the USB interface. This type of formatting allows the laser system’s output to be viewed easily on terminal emulator software.

Command	Argument	Description
A?		Get Alarms
A=	0	Clear all alarms
B?		Get back reflection monitor value
C?		Get amplifier alarm threshold (optional feature)
D?		Get master source alarm level
H?		Display list of commands
I?		Get status display interval
I=		Set status display interval
J?		Get laser serial number
L?		Get back reflection alarm level
M?		Get laser control mode
O?		Get master source warm-up timer status
P?		Get preamplifier monitor value
Q?		Get amplifier control DAC value
Q=		Set amplifier current control DAC value in USB mode
S?		Get maximum permissible Q value (factory set)
R?		Get Repetition Rate
R=		Set Repetition Rate
T?		Get chassis temperature
V?		Get control software version and release date
W?		Get laser operating time counter
X?		Get status display mode
X=	1 / 2	Set status display mode
switch=	0	Return laser control to the front panel display

## 12. Display Modes

In the PC communication mode, the laser source has distinct display modes, selectable by using the X command.

### 12.1 Default mode (X=1)

The default mode is the mode the laser reverts to after power off. It is a non-scrolling mode (no information is displayed on the terminal screen). The user may enter this mode at any time by typing X=1.

### 12.2 System integration mode (X=2)

This mode should be engaged when the user want to integrate the laser in an automation system, controlled by a computer. The System Integration Mode is essentially identical to the Default Mode, but the information returned to the terminal is minimised, making it easier for user-written software to interpret the laser command output.

## 13. Alarms

When an alarm occurs, the laser is disabled and the LED on the front panel will switch off. The alarm will be displayed onscreen and, in PC control mode, can be identified using the “a?” command. It can be cleared by using the command a=0 (see the [Software Commands](#) section for more details). The system has predefined types of alarms and this section describes the alarm type and possible remedies. Should the system fail to recover from an alarm please consult Fianium for assistance.

### 13.1 Mode Lock alarm.

This alarm indicates a problem with the master source.

The master source is no longer oscillating reliably. Try to restart the system. If the error persists, contact Fianium.

### 13.2 Back reflection alarm.

A backwards facing photodiode, within the laser, has detected a light level above a predefined level. This can be caused by pointing the laser output at a reflective surface. The laser has been shutdown to prevent damage to the optical amplifiers.

## 14. Customer Service

In the unlikely event of a malfunction within your laser system, contact Fianium Ltd for onsite diagnosis or return ([support@fianium.com](mailto:support@fianium.com)).

If the product is to be returned to Fianium, ensure that all relevant return documentation is included within the shipment. Details of the documentation required can be obtained from Fianium Ltd.

The laser source should be returned within the original packaging and include all accessories and documentation as originally delivered in order to prevent damage to the product during transport. If the original packaging is unavailable, please contact Fianium Ltd for a replacement

End of document