The・Premium Fiber Laser

KKFL-20

User Manual

KIMMON KOHA CO., LTD.

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1. INTRODUCTION

1-1 GENERAL

The KKFL-20 is a high power polarized fiber laser operating at a wavelength of 1064nm. The laser is capable to emit up to 20W of laser power through a polarization maintaining (PM) fiber output optical cable terminated with a high power collimator.

This manual contains the information the user need in order to safely unpack, install, operate, maintain and service the KKFL-20 laser.

1-2 SYSTEM COMPONENTS

The system is comprised of the KKFL-20 laser box and a power cable.

The laser box contains all the laser's optical components, drivers and control electronics. The radiation is emitted through an armored output optical fiber.

1-3 SPECIFICATIONS

PARAMETER	SPECIFICATION	NOTE
MODE OF OPERATION	CW	
WAVELENGTH (nm)	1064	
RATED POWER (W)	>20	AT END OF FIBER
TRANSVERSE MODE	TEM_{00}	
BEAM QUALITY M^2	<1.1	
POLARIZATION	Linear	
POLARIZATION RATIO	>250:1	
NOISE(RMS) (%)	<1.0 (1-10MHz)	
LINEWIDTH (nm)	<0.2	
WARM-UP TIME (minutes)	<1	>90% RATED POWER
POWER STABILITY (% / 8hour)	<±1	At 25℃ constant
POWER STABILITY (%)	<5	10-50℃
OUTPUT FIBER DELIVERLY	PM	Collimator
FIBER LENGTH (m)	2	
LIFE	>10,000	>70% RATED POWER
ENVIRONMENTAL CONDITION OPERATION	TEMP. 10～50 (℃) HUMI. <90%RH	
ENVIRONMENTAL CONDITION STORAGE	TEMP. -10～60 (℃) HUMI. <90%RH	
VIBRATION RESISTANCE (OPERATION)	0.2G (15-200Hz)	IEC60068-2-64
VIBRATION RESISTANCE (STORAGE)	2G (15-200Hz)	IEC60068-2-64
SHOCK RESISTANCE	15G	During transportation
INPUT VOLTAGE / FREQUENCY	90-264V , 48-62Hz	
DIMENSIONS	2U 19" RACK	
COOLING	AIR	
CLASS	Class Ⅳ and Class 4	
APPLIED STANDARDS	IEC60825-1/2007-03 IEC61010-1/2010-03	

2. CONTENTS OF THE KKFL-20

The KKFL-20 contains the following components:

#	Description	Note
1	KKFL-20	
2	Power cable	
3	Interlock connector	Connector for connecting to an interlock circuit and to laser emission control circuit
4	Operation manual	
5	Operating software	USB flash drive
6	Storage case	
7	USB communication cable	
8	Blower	

3. SYSTEM DESCRIPTION

Warning: KKFL-20 laser radiation is hazardous to your eyes. It is forbidden to look into the laser apertures (fiber) when the system is in use.

Warning: Dirt on the fiber end might reduce the transmission intensity of the laser. Furthermore it might cause permanent damage to the fiber. It is recommended to clean the collimator before each use. Make sure the collimator is clean before using the system.

3-1 KKFL-20

The KKFL-20 box contains all the hardware necessary for generating the laser output power. It comprises of all the optical components needed for producing the laser radiation as well as power and control electronics.

The laser radiation is emitted out through a PM fiber. The PM fiber is covered by an armored protection sheathing to minimize the chance of fiber breaking. The fiber is terminated with a collimator or FC/APC connector (optional).

The KKFL-20 box is connected to one phase AC 100-240V 50/60Hz power grid via a power input connector using a standard detachable electrical power cable. The laser has 9 pin D-SUB connector for external interlock and external lase capability. Monitoring and control are available via USB communication cable.

The following figures show the KKFL-20.

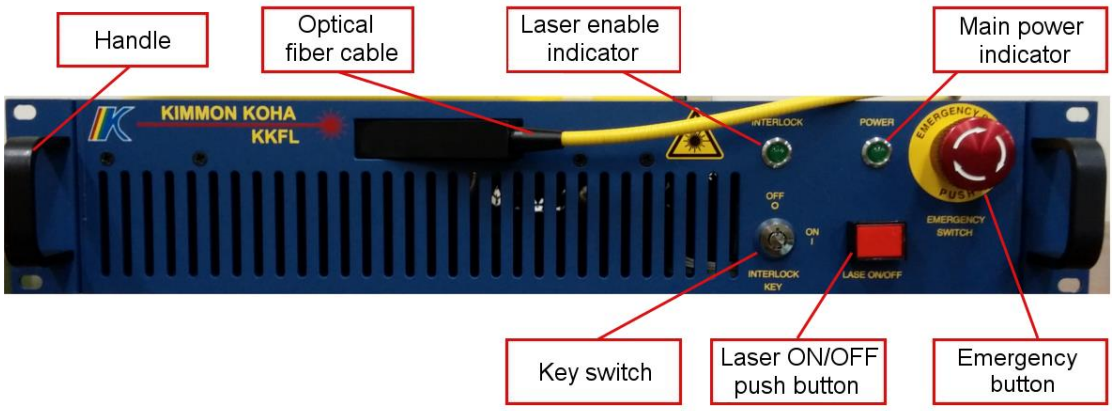


Figure 1 KKFL-20 Front Panel

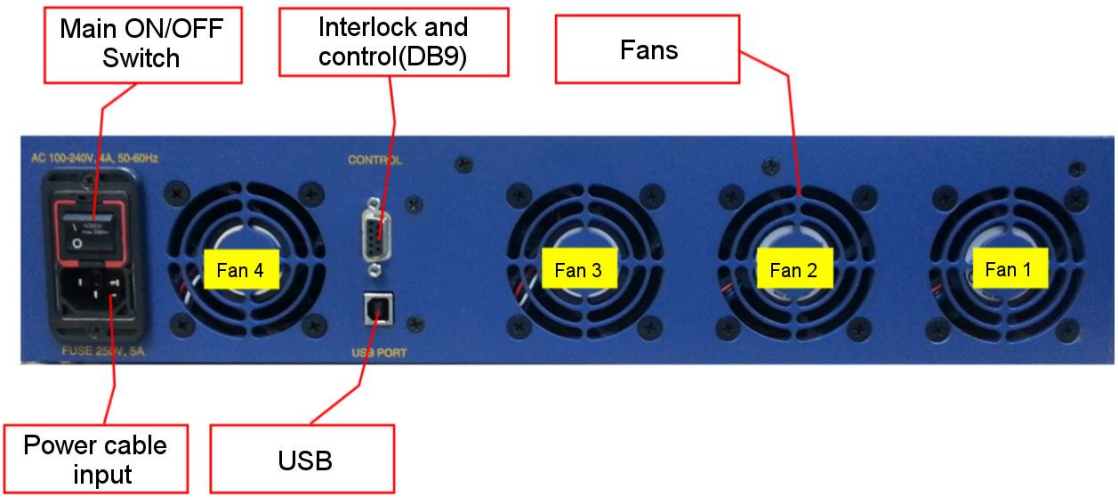


Figure 2 KKFL-20 Back Panel

3-2 SYSTEMS CABLES DESCRIPTION

The system contains two cables and DB9 connector:

1. Power cable connects the KKFL-20 laser to the power grid.
2. DB9 connector is supplied.
3. USB cable connects the KKFL-20 laser to the control computer.

3-3 LASER CONTROL SOFTWARE

Laser control software is supplied on a USB flash drive. The software can be installed on a personal computer to allow monitor, control and tuning of the laser power, to allow inspection of status and maintenance of the laser.

4. KKFL-20 TEST REPORT

Refer to attached data sheet.

5. OPERATING INSTRUCTIONS

Warning:The laser shall be operated only by personnel who have passed appropriate training and have been qualified for laser operation.

5-1 SYSTEM PREPARATION

- Position the KKFL-20 laser in the working place.
- Make sure to keep a 20cm space gap between the cabinet and the front and back panels of the laser to allow proper air flow.
- For installation in the cabinet, fix the KKFL-20 laser to its place using the mounting screws.
- Connect the laser to the power grid using the AC power cable.
- Connect the laser to the interlock using the control connector. (refer to the following table for the connector pin out)

  For external interlock connect pin 1 to 5 or pin 8 (GND).
- For external lasing connect the laser to lase hardware line using the control connector. (refer to the following table for the connector pin out)

Pin #	Designation
1	Interlock
2	
3	
4	
5	GND
6	Laser ON
7	
8	GND
9	

- Connect the laser to the control computer using the control cable or USB cable.

Caution: Make sure that nobody is able to turn the laser on while the output fiber cable is being connected to another fiber cable, to the optical head or to the work piece.

Caution: In case of a FC/APC fiber cable operating the laser when the output fiber cable connector is not properly connected to another high power fiber connector will cause permanent damage to output fiber cable.

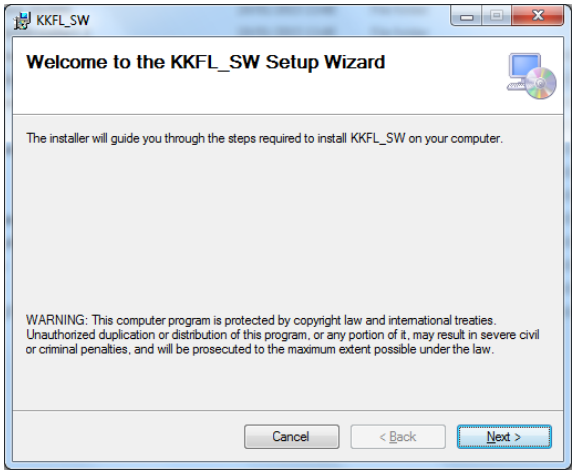
- Set the Lasing switch is turned OFF.
- Set the Interlock key switch is in off position.
- Set the emergency switch to release position.
- Remove the Collimator protection cup.
- Verify that the collimator lens is clean. If needed use lens cleaning paper to clean it.
- Connect the output fiber cable to an optical head or a work-piece. Ensure proper cooling of high power fiber connector or collimator.

5-2 SOFTWARE INSTALATION

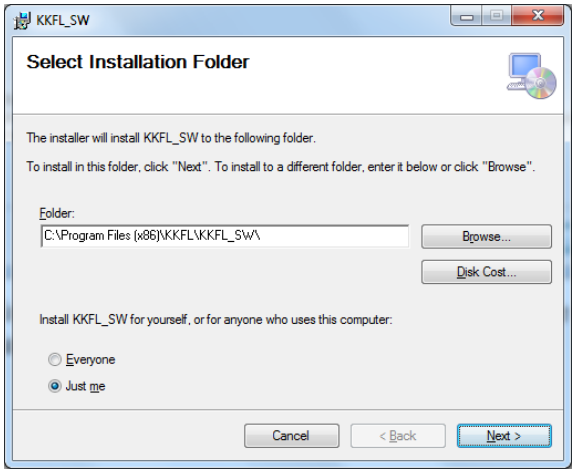
The laser operation is controlled and monitored by a computer. The minimum computer requirement is a computer with Windows7 or 8.

In order to control the laser from the computer dedicated software is supplied on a USB flash drive. To install the software follow the following steps;

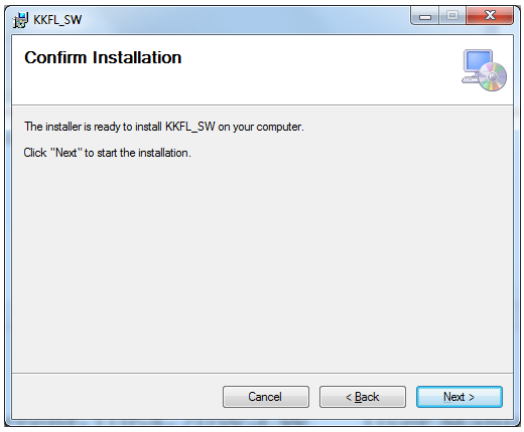
- Connect the USB flash drive to the computer USB port.
- Open the software folder and double click on the setup icon.
- The following screen appears. Press next.



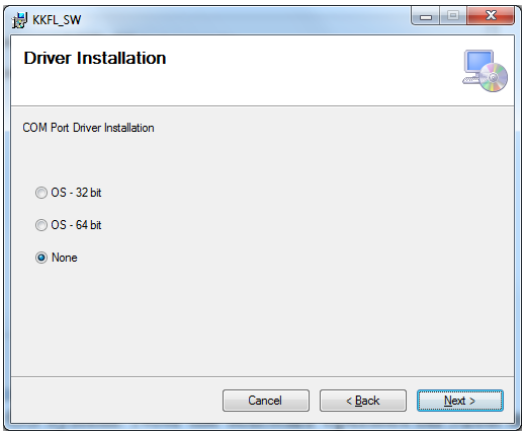
- Select the folder for the software installation and whether the software is for every user in the computer or just you. Press next,



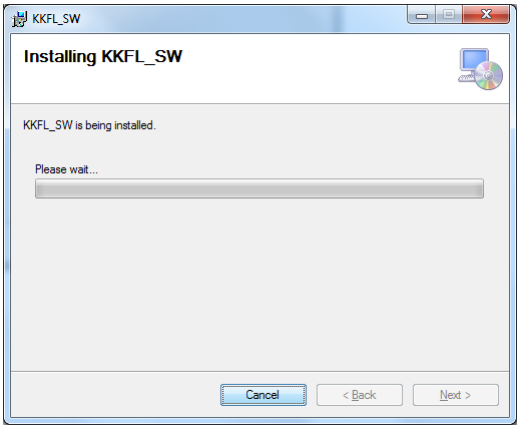
- The installer is ready for installation. Press Next



Choose the OS system. Note the software operates on 32bit and 64bit OS.
If you choose none you will not be able to install the COM Port Driver.



- The installer will start the installation.



- When the installation is finished press finish.

5-3 Hardware Operation

- Turn the power switch ON at the laser back panel to provide AC power input to the laser internal power supply. This enables communication with the laser. The power on green ramp will light ON.
- In the laser front panel turn the enable laser key switch ON. This provides power to laser driver and enables laser emission. No laser is emitted when the key switch is turned ON without additional command for laser to start. The interlock green ramp will light ON.

Put on laser safety goggles

- To start lasing press the laser push button. When lasing the laser push button is lit red.

•Any change in KKFL-20 switches will set the laser power OFF.

In order to set Power on again do the following.

•Set the lasing switch to OFF position.

•Set laser to the Interlock stage, INTERLOCK ramp will set ON.

•Set the lasing switch to ON position.

5-4 Software Operation

The laser is connected to the computer using a USB cable. The computer should identify the laser automatically. There is no need for special computer configurations.

The laser software is used for controlling the laser and monitoring its operation. The following figure shows the laser software main screen.

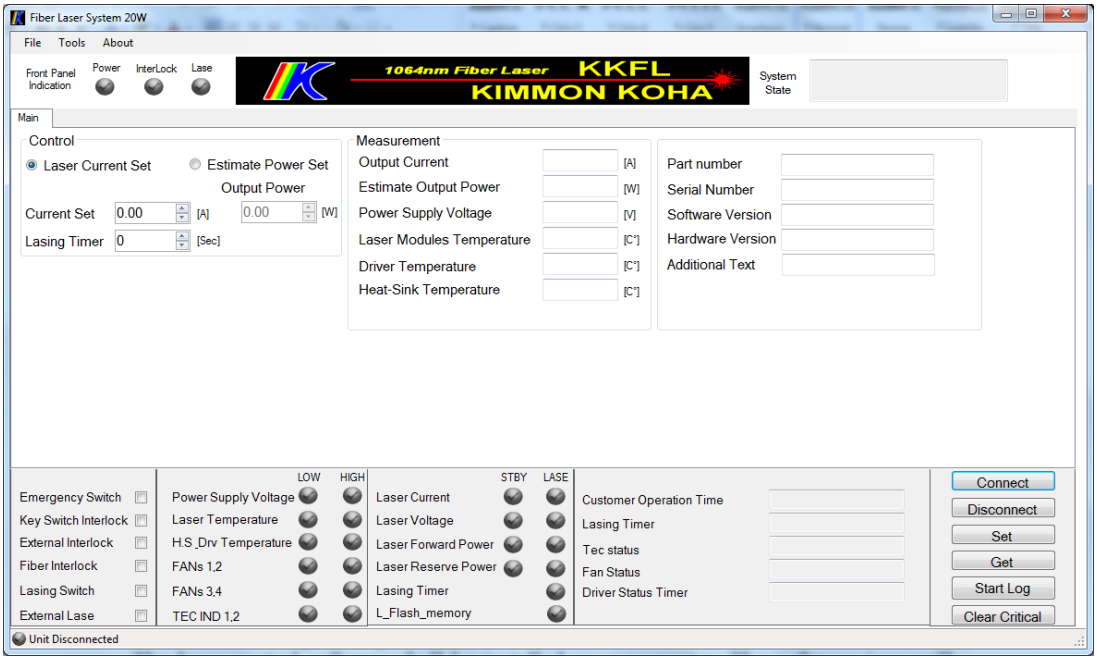


Figure 3 - Software main screen

5-4-1 Starting the Software

The laser control software shall be installed on a computer. The software icon will appear on a desktop screen of the computer.

Click on the KKFL-20 laser control software icon (icon name "Rain" or "KKFL"). The laser control software will load and the following screen will appear as shown in the figure 3. The main screen includes all the laser indications and alarms. The main screen provides means for entering the operation parameters and for reading laser information and status.

5-4-2 Connecting the laser to the computer

Make sure the computer is connected to the laser via a USB cable.

The following image shows the network interface in the main screen.

1. From the main menu choose "File"
2. Choose the "Com Port" that the laser is connected to.
3. Press the "Connect" button to connect the computer to the laser.
4. The "Connected" ramp in the bottom of the main screen is lit green and "Unit Connected" label appears, if the connection is successful.

Figure 4 - Network setting

5. Press the "Disconnect" button if you would like to disconnect the computer from the laser.
6. After disconnecting the "Connected" ramp in the bottom of the main screen is turned off and "Unit Disconnected" label appears.

5-4-3 Setting the laser parameters and laser operation

The following figure shows the Settings parameters. The input parameters are used to control the laser power level and setting a lasing timer operation.

The laser operates in current mode. The laser current is set to constant current level and a resulting power is emitted. An 'expected power level' field shows the expected output power level for the selected current level.

It is possible to set the laser current using the 'expected power level' field by checking the relevant button in the GUI software.

Furthermore the lasing time (in seconds) can be set so that the laser will stop automatically when the timer reaches zero seconds. If the timer is set to 0 the laser will operate continuously and will not stop automatically.

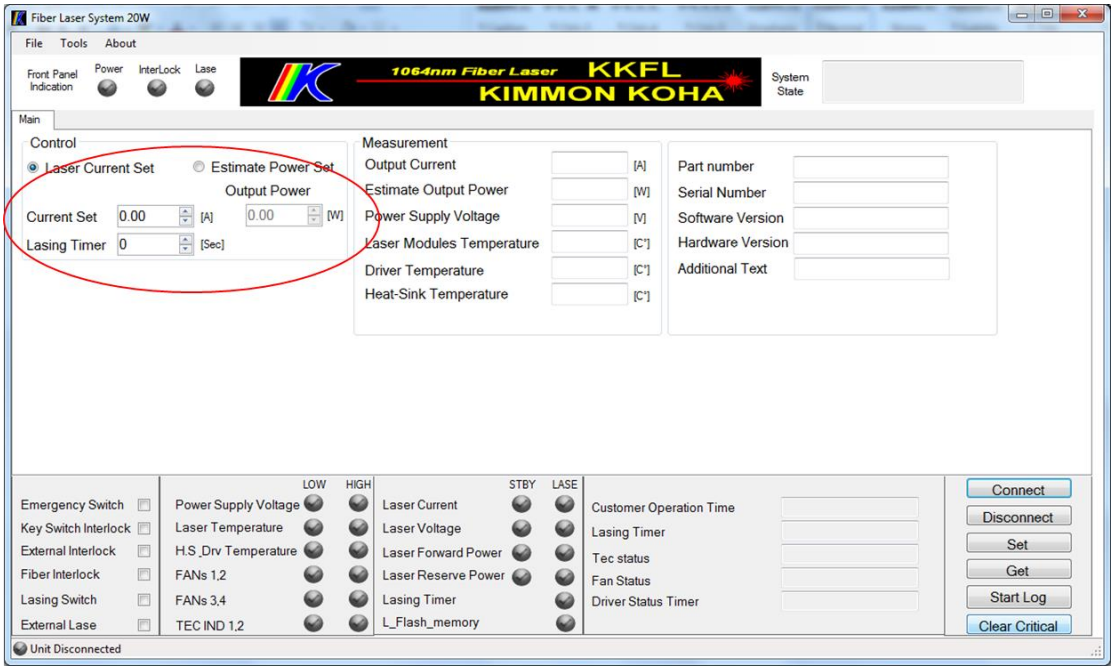


Figure 5 – Setting the laser parameters

Caution: After applying the following steps the laser will lase at a predefined output power. Make sure all the safety precautions are taken.

5-4-4 Operating the laser in power mode

1. Choose the control mode "Estimate Power Set"
2. Set the required laser power in the "Output Power" box.
3. Set the timer as needed. Otherwise make sure it is set to 0.
4. Press "Set". The laser will present the expected output power. Operating the laser in power mode.
5. It is possible to restore the previous laser parameters, if the "Set" was not pressed by pressing the "Get" button.
6. The laser will set the current according to the measured system temperature.
7. Make sure that the laser is in INTERLOCK state.
   (Key switch is ON, External interlock is connected in the control connector, and Emergency switch is not pushed).
8. To start LASING press the Lase ON/OFF switch button, Lase ramp will lit RED during lasing.
9. To set LASING OFF press the Lase ON/OFF switch button. Lase ramp will turn off.
10. In order to change the laser power:
    a. Turn the laser OFF
    b. Change the power and press "SET"
    c. Turn the laser ON

5-4-5 Laser indications

The main screen contains many fields that show the laser system and some of it sub-modules status.

The following figure shows a group of system measurements.

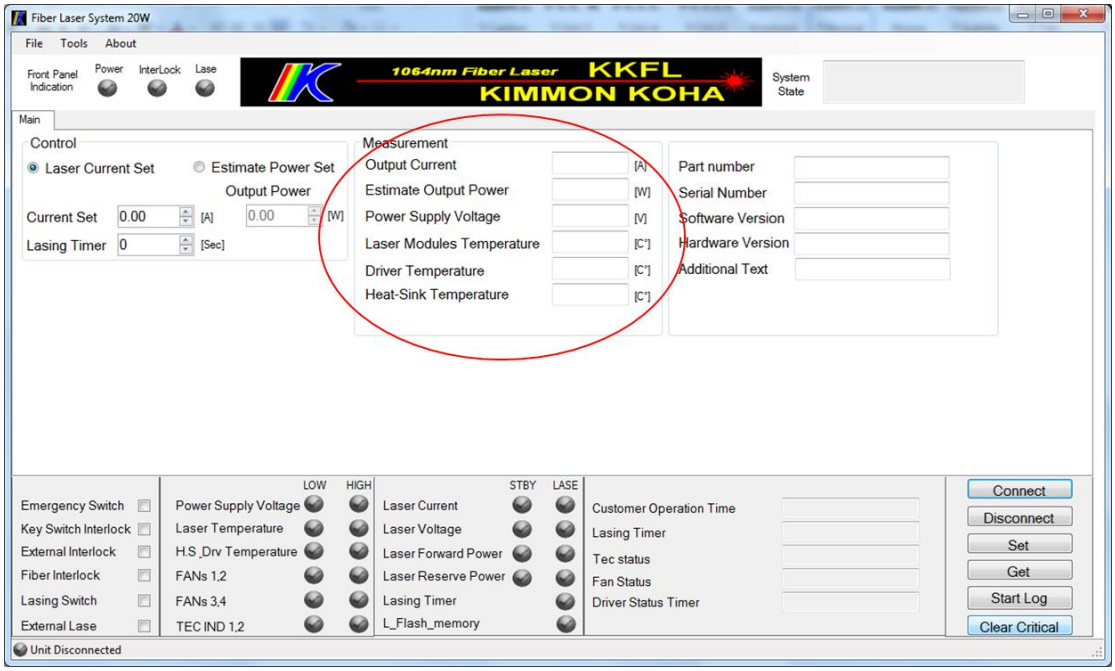


Figure 6 - System measurements

- Output Current [A] - the actual laser current in Amperes.
- Output Power [W] - the actual laser output power.
- Power Supply Voltage [V] - the power supply output voltage.
- Laser Module Temperature [degC] - the laser temperature.
- Driver Temperature [degC] - the electronics temperature.
- Heat-Sink Temperature [degC] - the laser heat sink temperature.

Another set of indications are placed at the bottom of the main screen. The following figure shows these indications.

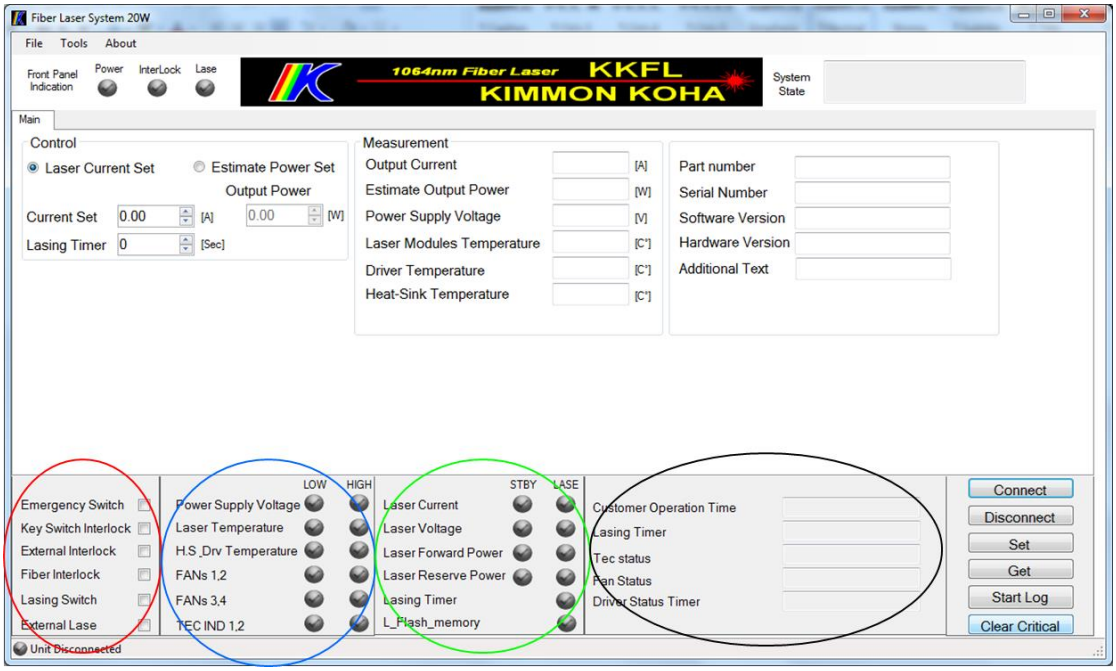


Figure 7 – Another set of indications

On the left (red circle) there are six user inputs indications that indicate if the user has applied a hardware line to the system.

- Emergency Switch - the checkbox is checked if the emergency switch is not pushed.
- Key Switch Interlock - the checkbox is checked if the key switch is turned on.
- External Interlock - the checkbox is checked if the laser external interlock (door interlock) is connected.
- Fiber Interlock - not used .
- Lasing Switch – the checkbox is checked if the lasing switch is on.
- External Lase - the checkbox is checked when lasing is done using an external line instead of using the "lase on/off" push button.

The ramp indications in the other circle indicate system fault or malfunctions.

- Power Supply Voltage - indicates if the power supply voltage is lower or higher than a predetermined value. If the PS voltage is outside it normal range one of the ramps will lit and critical fault occurs.
- Laser Temperature - indicates if the laser temperature is lower or higher than a predetermined value. If the laser temperature is outside it normal range one of the ramps will lit and critical fault occurs.
- H.S DRV temperature - indicates if the driver temperature is lower or higher than a predetermined value. If the driver temperature is outside it normal range one of the ramps will lit and critical fault occurs.
- FANs 1,2 - These ramps indicate if the fans malfunction. Left ramp (low) is for fan number 1. Right ramp (high) is for fan number 2.
- FANs 3,4 - These ramps indicate if the fans malfunction. Left ramp (low) is for fan number 3. Right ramp (high) is for fan number 4.
- TEC IND 1,2 – These ramps indicate if the TECs malfunction. Left ramp (low) is for TEC number 1. Right ramp (high) is for TEC number 2.
- Laser Current - indicates if laser current exists. If laser current exist in standby mode then a malfunction occurred. Laser current in lase mode is OK.
- Laser Voltage - indicates if laser voltage exists. If laser voltage exist in standby mode then a malfunction occurred. Laser voltage in lase mode is OK.
- Laser Forward Power - indicates if laser forward power exists. This means the laser is lasing. If the laser power exists in standby mode then a malfunction occurred. Laser power in lase mode is OK.
- Laser Reserve Power - indicates if laser backward power exists. This means the laser is lasing. If the laser power exists in standby mode then a malfunction occurred. Laser power in lase mode is OK up to a certain predetermined value.
- Lasing Timer - this ramp is lit if the timer is ON.
- Flash memory - This ramp is lit red when a parameter is not written to the laser flash memory.

The message boxes in the black circle give indications on different laser parameters.

- Customer Operation Time - indicates the total time that the laser was ON (electrical power ON).
- Lasing Timer - indicates the remaining time (in seconds) the laser has to operate according to the set time in lasing timer.
- TEC status - indicates the TEC status; heating, cooling, off.
- Fan Status - indicates the fans status; on, off.
- Driver Status Timer - indicates the status of the laser driver; on,off.

The following figure shows the laser System ramps Indications (at the top left corner) and the laser System state (at the top right corner).

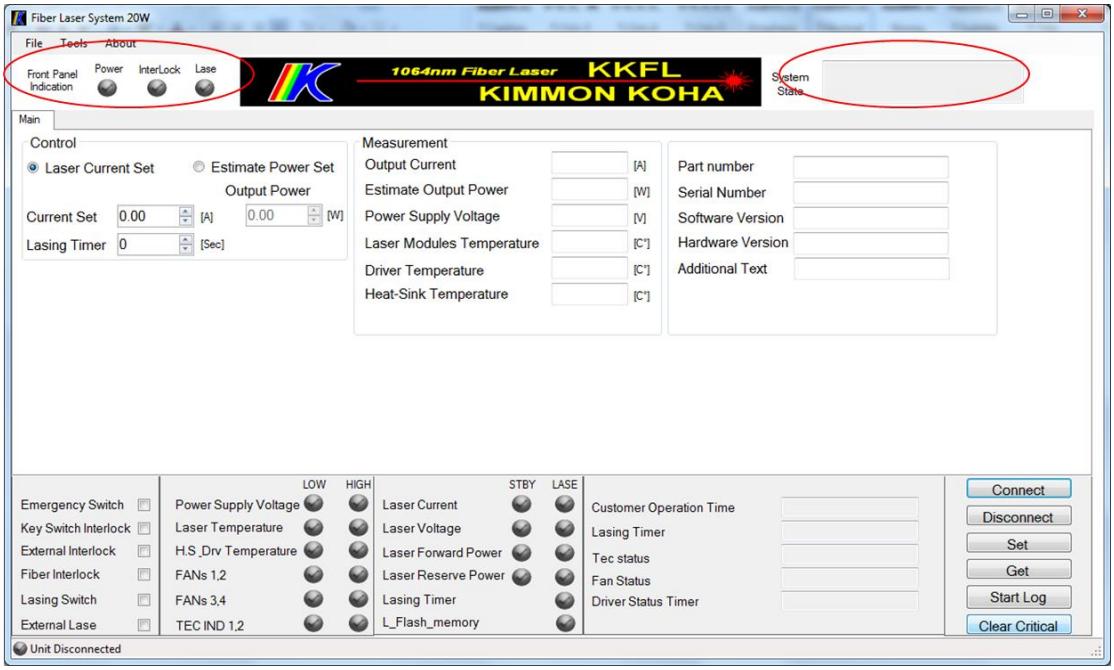


Figure 8 – Laser system state

The three ramps of screen corresponds to the ramps on the front panel of laser

- Power - laser main power is ON
- InterLock - laser key switch is ON in Interlock state
  This led is blinking in Critical
- Lase – laser is lasing (corresponds to the red light in the laser push button)

There are 5 System states

- Standby - laser electrical power on
- Interlock - all interlocks (key switch and external interlock) are enabled
- Lasing - Lasing - the laser "power on" - the laser warning sign ( ) will lit as well near the system state window at the top right corner of the main screen.
- STOP - emergency button is pushed
- Critical Fault - a critical fault occurred and the laser shuts down.

5-4-6 Laser Critical Fault

Laser critical fault appears when the laser operating conditions are out of the normal conditions limits. The system shuts down the laser when a critical fault occurs and it shows critical fault after it occurs.

Note: when a critical fault occurs the laser shuts down to prevent laser damage.

It is possible to release the critical fault by pressing the "CLEAR CRITICAL" button or by pressing the emergency button and then releasing it.

5-4-7 Laser information

The following figure shows the laser information section in the main screen (circled red).

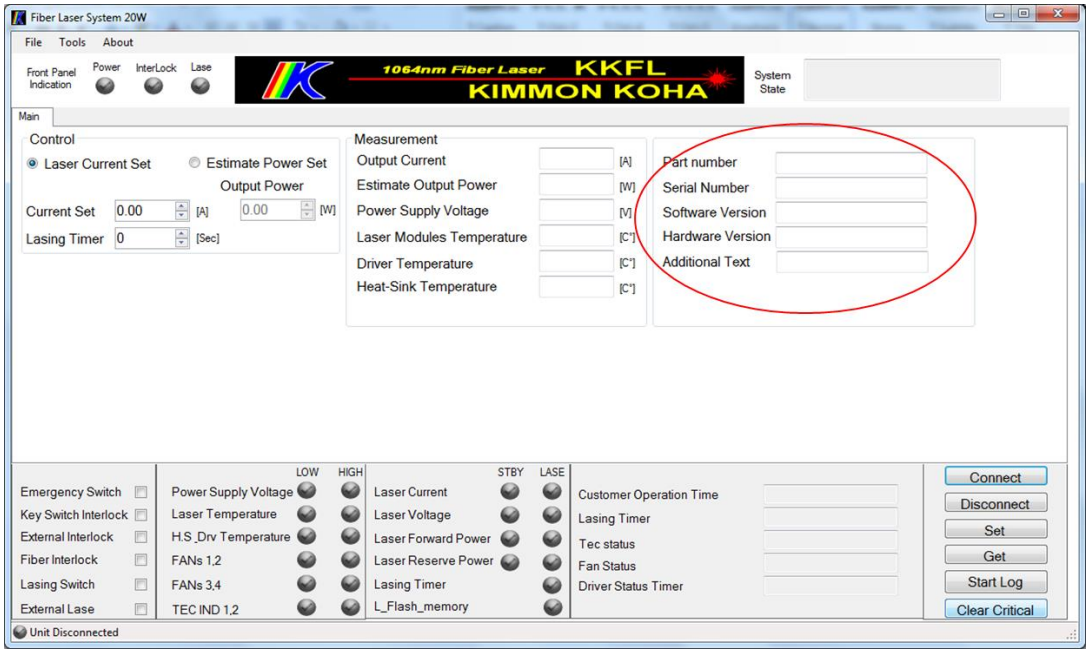


Figure 9 – Laser information

The fields in system information are;

- Part number – the part number.
- Serial number – the laser serial number.
- Software version. – the laser system current software version.
- Hardware version – the laser system current hardware version
- Additional text - a text box that may contain free text entered by manufacturer or user.

6. TROUBLESHOOTING

6-1 LASER IS NOT LASING

6-1-1 Description

The laser system does not emit laser radiation.

6-1-2 Possible solutions

- Check the laser switch at the back panel is turned ON.
- Check that the laser key switch in the front panel is turned ON.
- Make sure the laser push button is turned ON.
- Make sure that the emergency switch is not pushed.
- Verify that the interlock is connected.
- Verify that the Laser Current is not zero.
- Make sure that the "Set" button was pressed to send the parameters to the laser system.
- In the case of remote control make sure that the differential hardware line operates correctly.
- If the laser on push button ramp is ON and there is not laser emission.
    - Check the power meter.
    - Connect with PC software for monitoring.
    - Verify there are not any "Critical Faults".
    - Check the measured laser current. If measured current is lower than expected send print screen to Kimmon koha or your distributor.
- Verify that the fiber cable and collimator are not broken.
- NOTE do not continue operating the laser at high current, reduce the current setting to 1A.
- Start the lasing process again at 1A. If still doesn't work, please send screens to Kimmon koha or your distributor.

6-2 THE LASER POWER IS LOW

6-2-1 Description

The laser output power is lower than the set output power.

6-2-2 Possible solutions

- Verify that the laser operates in normal temperature conditions.
- Verify that the power supply output voltage is in normal range (about 24V).
- Verify that laser current is set correctly.
- Make sure that the output collimator or fiber tip is clean.

If you do not see improvements after the suggested measures, please send screens to Kimmon koha or your distributor.

Caution: Before checking the output fiber make sure that the laser is turned off.

6-3 Power ramp is OFF

6-3-1 Description

The laser AC power ramp is OFF.

6-3-2 Possible solutions

- Verify that the laser is connected to the power grid.
- Verify that the electricity is OK.
- Verify that power switch is ON.
- Verify that AC Power cord cable is connected.
- Try to replace AC power cord cable.
- Verify the laser fuses are not burnt.

If the ramp is still OFF, the laser needs to be replaced. Please contact to Kimmon koha or your distributor.

6-4 Laser Enable ramp is OFF

6-4-1 Description

The laser Enable ramp is OFF. This might indicate that lasing operation will not be permitted.

6-4-2 Possible solutions

Verify the following;

- Emergency switch is released.
- Key switch is set to ON.
- Interlock is connected
- DB9 connector is connected.
- Replace Customer D-sub connector with the Original D-sub connector.
- Connect the laser to the computer and check the laser status.
- In the software check that all inputs are connected and recognized by the laser.
- Check the status if there is a "Critical Fault" and try to identify the fault (temperature, voltage, other).
- Try to reset the fault by pressing clear critical fault in the software window and restart the laser system.

If you do not see improvements after the suggested measures, please send screens to Kimmon koha or your distributor.

6-5 Lasing push button ramp is OFF

6-5-1 Description

The lasing push button ramp is OFF. This might indicate that the laser is not lasing.

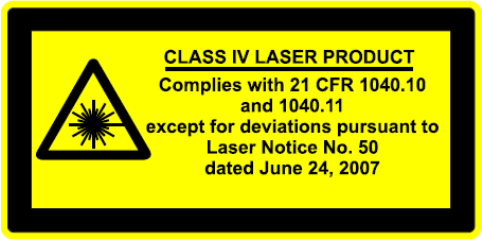
6-5-2 Possible solutions

- Make sure laser enable ramp is ON.
- Connect with PC software for monitoring and check the system status
- If lase ramp is ON and after few second ramp is OFF
  - Connect the PC software for monitoring
  - Check for system status

If you do not see improvements after the suggested measures, please send screens to Kimmon koha or your distributor.

7. LASER SAFETY

The KKFL-20 laser system contains a one wavelength laser (1064nm). The laser in is classified as a Class 4 laser. For all activities with the KKFL-20 laser system the ANSI136 Laser Safety Standard rules should be adhered to.



Because of its special properties, laser light poses safety hazards not associated with light from conventional sources. The safe use of lasers requires that all laser users and everyone else near the laser system are aware of the dangers involved. The safe use of the laser depends upon the user becoming familiar with the instrument and the properties of intense and coherent beams of light.

The greatest concern when using a laser is eye safety. In addition to the main beam, there are often many smaller beams present at various angles near the laser system. These beams are formed by specular and diffusive reflections of the main beam from different surfaces such as optical components and walls. While weaker than the main beam, such beams may still be sufficiently intense to cause eye damage.

Laser beams can be intense enough to burn skin, clothing or paint. They can ignite volatile substances such as alcohol, gasoline, ether and other solvents, and can damage light-sensitive elements in video cameras, photomultipliers and photodiodes. The laser beam can ignite substances in its path, even at some distance. The beam may also cause damage if contacted indirectly from reflective surfaces.

In light of the above, it is recommended to take the following precautions:

1. Strictly follow all precautions given in the user manual.
2. Extreme caution should be exercised when using solvents in the area of the laser.
3. Limit access to the laser to qualified users who are familiar with laser safety precautions and who are aware of the dangers involved.
4. Do not look directly into the laser beam or into secondary beams resulting from reflections. When necessary use appropriate protective glasses.
5. Do not aim the laser beam towards the eyes of another person.
6. Do not design an optical setup in which the laser beam or part of it is at eye height. Do not sit in the laboratory when a test with a laser is under way.
7. In order to prevent eye exposure to the laser, the operators shall wear protective glasses intended for withstanding the wavelength and intensity of the laser they are working with.
8. Prevent exposure of skin and clothing to laser radiation. Laser radiation can cause burns and set fire to clothing.
9. To the extent possible be sure to limit the laser beam to a defined region in order to prevent exposure of people not involved in the test.
10. Before operating the laser, warning signs should be posted to warn the operators and other personnel of laser operation. The type of laser, its wavelength and its classification shall be indicated on the signs.
11. All personnel working with the laser shall be notified of the precautions to be taken when working with a laser system. It is recommended to work with a laser system only in an entry-controlled region.

8. RECOMMENDATIONS FOR HANDLING THE SYSTEM

a. The system is an electro-optical system and should be handled with caution.

b. The system is sensitive to electrostatic discharge (ESD). The operators shall prevent exposure of the system to currents as a result of ESD.

Warning: The system is sensitive to electrostatic discharge (ESD). Electrostatic charges causing voltages of about 4000 V are produced easily on the human body and on equipment with no capability of being detected. Even though the system is resistant to ESD, it can be damaged by very high currents. Therefore precautions should be taken against ESD in order to prevent damage to the laser system.

c. Refrain from using strong detergents.

d. It is recommended to avoid exposing the system to water.

e. The KKFL-20 laser system is not protected against large shocks and protected against strong vibrations.

f. **Before using the system, make sure that the output fiber is clean.** If necessary it should be cleaned using an appropriate cloth and alcohol.

g. In order to prevent fiber damage it is recommended to connect the output fiber connector to another high power fiber connector or fiber collimator.

h. **Output fiber connector or output fiber collimator shall be properly cooled and connected to a heat sink.**

9. WARRANTY

- Do not open the KKFL-20 system.
- Any attempt to open the system voids the warranty.

The warranty covers the system characteristics as were measured during the acceptance test procedure, mechanical parts, optical parts and defects caused during the system assembly.

The warranty does not cover changes in the system or failures caused as a result of attempts to open it or operating it outside the system specifications.

10. CONTACT

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