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SPARKLIGHT TURN-KEY LASER SYSTEM OPERATION MANUAL				
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# SPARKLIGHT TURN-KEY LASER SYSTEM OPERATION MANUAL

## 1 QUICK REFERENCE

This chapter describes the Modulight SparkLight turn-key laser system. This chapter is not meant to describe every operating feature in detail. It is simply a quick reference guide to quickly become familiar with the essential components of the laser system.

### 1.1 The Turn-key Laser System – At a Glance

The Modulight SparkLight turn-key laser system is a 808 nm CW/QCW light source. SparkLight is operated in constant power or constant current mode. Output power and PWM parameters are set using front panel or external digital/analog control.

The laser system is equipped with a power supply with automatic AC voltage detection.

The status of the laser system is displayed on the front panel display. The information displayed includes set power, actual power, temperature of the laser, status of the output, and the cumulative laser operating time. The output status of the laser system is also indicated by a large red indicator, which is lit when the output is enabled.

The front panel controls enable the user to set the output status and power and PWM frequency and pulse ON-time. Furthermore, there is a key-switch for selecting external control and locking the unit as well as an emergency shutdown switch on the front panel.

The rear panel contains a mains power connector, a mains switch, and a fuse. It also contains two DE9F connectors and USB type B receptacle.

## 1.2 The Front Panel – At a Glance

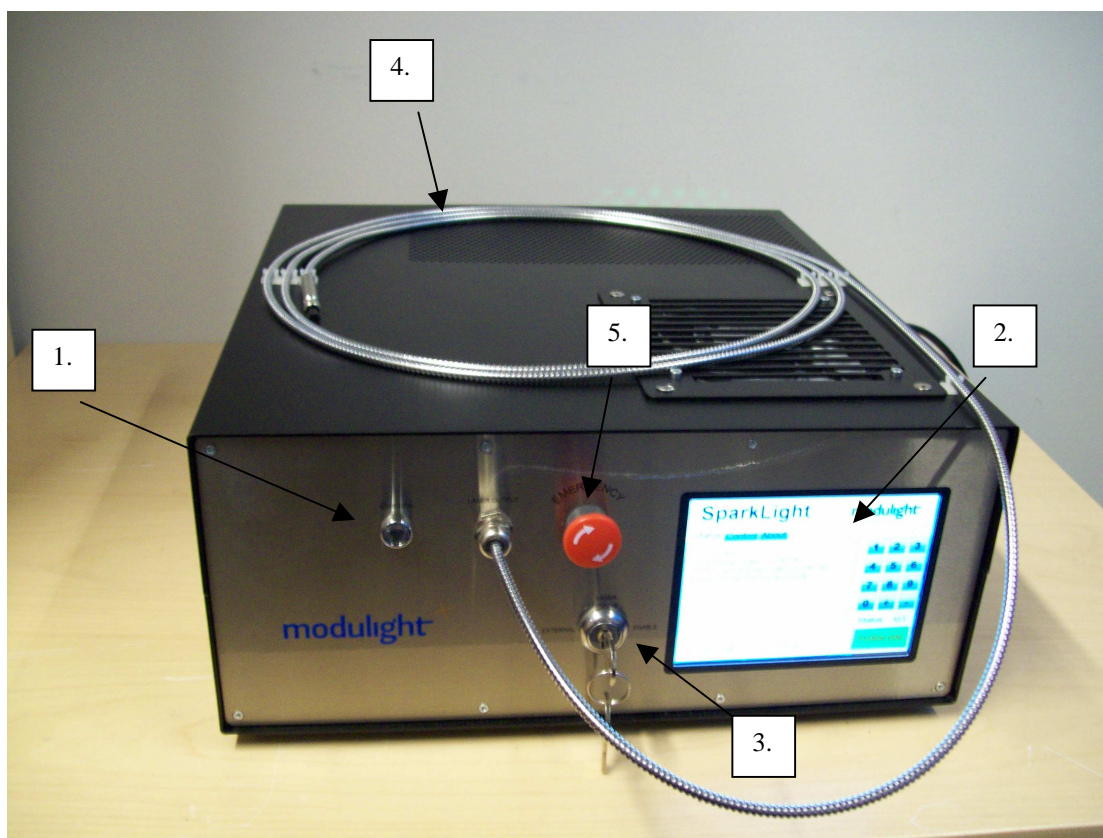


Figure 1. front panel

Item	Name	Description
1.	Emission indicator	Indicates when the laser in the unit is (potentially) operating
2.	Touch-screen display	Displays the system status including data such as drive power and laser temperature as well as any errors.
3.	Key switch	This switch enables internal or external control and can be used to lock the system.
4.	Output fibre	Output 400um fibre with SMA-connector
5.	Emergency stop switch	The whole system can be shut down in an emergency by pushing here

### 1.3 The Rear Panel – At a Glance

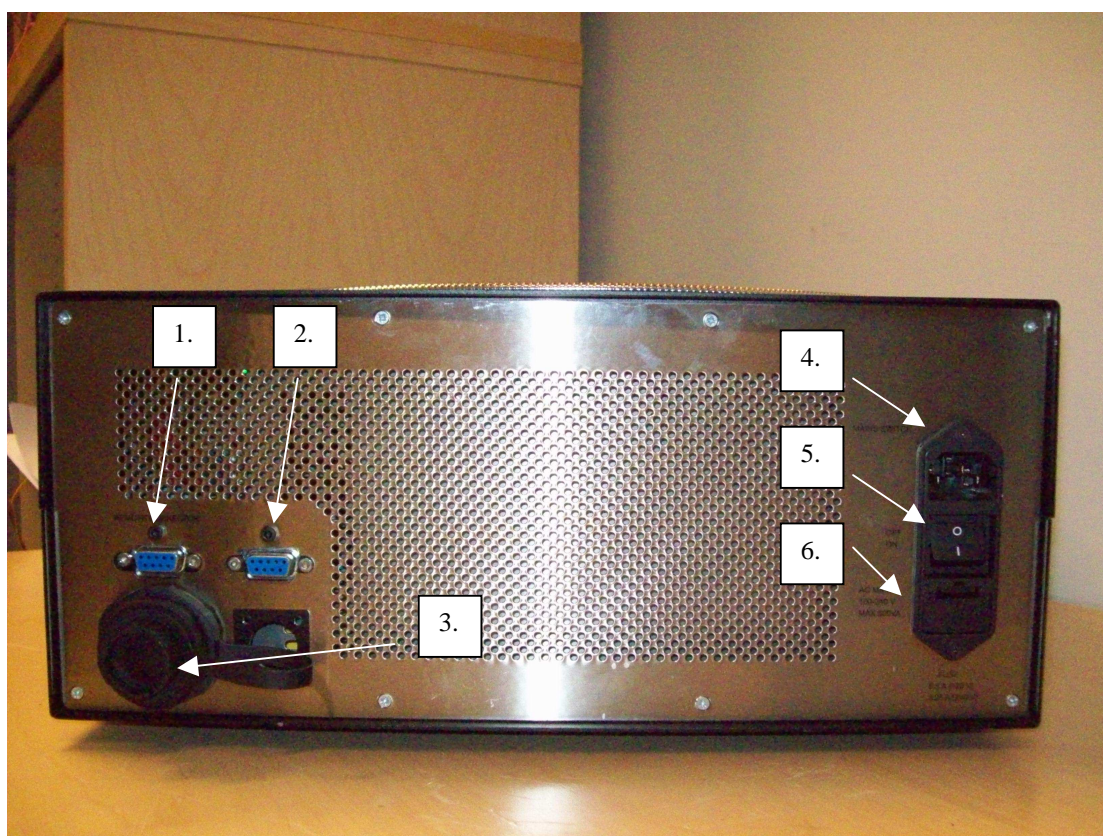


Figure 2. back panel.

Item	Name	Description
1.	Remote connector	Allows remote operation of the unit. DE9F
2.	Interlock connector	Safety interlock connector and ISP-interface. DE9F
3.	USB-connector	USB remote interface. Type B receptacle.
4.	Power cord receptacle	The supplied power cord (or compatible) is connected here. IEC60320
5.	Power switch	The unit is powered turning this switch on
6.	Fuse	A glass cartridge fuse corresponding to the local mains voltage

## 2 INSTALLATION

This chapter describes how to install your laser system. It discusses installation, placement, and line cord connections.

This chapter also discusses how to connect your equipment to the output of the laser system.

Before getting started, check the list under “Items Supplied” and verify that you have received these items with your equipment. If anything is missing, please contact Modulight Sales.

## 2.1 General Information

### Items Supplied

Item	Description
Power Cord	A power cord appropriate for your location
Interlock key	This must be connected to interlock connector for laser to be operable
Keys	2 keys for internal/external/disable key lock

## 2.2 Inspecting the Unit

When you have received the unit, inspect it for any damage that may have occurred during shipping. If any damages are found, immediately inform the shipping carrier as well as Modulight Sales.

Until you have inspected the unit, please save the shipping carton and packing materials in case the unit has to be returned.

## 2.3 Installing the Unit

### Safety Considerations

This laser system has a protective earth terminal. That terminal must be connected to earth ground through a power source with an earth receptacle. Protective eye-ware is mandatory for all persons within possible range of scattered or direct light emitted from the output of the system.

### Environment

The equipment must be operated indoors in a controlled environment. Do not operate the equipment in conditions where the ambient temperature exceeds 35 °C or in condensing humidity.

### Airflow

The laser system is fan cooled and the unit must be installed in a location with sufficient space for cooling. At least 10 cm of space must be available for ventilation from the top, the rear, and the sides of the unit. The unit may not be installed in a cabinet without ventilation.

## 2.4 Connecting the Line Cord

Before connecting the unit to a mains outlet make sure that a fuse located below the AC receptacle on the back of the unit is of the correct rating for your local AC voltage.

Connect the power cord to the IEC60320 connector on the rear of the unit. The IEC connector provides the safety ground connection when the AC cord is plugged into a grounded AC receptacle.



The maximum power requirement of the unit is 1000 VA. Ensure that your power supply is capable of handling this load.

## **2.5 Connecting the Fiber**

Remove the protective cap from the fiber-optic cable and make sure that you do not touch the tip of the fiber. Insert one end of the cable into your equipment such that the key on the cable goes into the matching slot on the connector and then twist the ring on the cable clockwise until resistance is felt. Be sure not bend the fiber to less than 20cm radius.

## **2.6 Safety Interlock**

A safety interlock is connected to pins 5 and 9 on the interlock connector on rear panel of the unit. When these pins are shorted, the output of the laser is enabled. When these pins are left open, the output of the laser is disabled. System is provided with safety interlock key that may be connected to interlock connector to enable laser.

## 3 OPERATING THE LASER SYSTEM

This chapter contains examples on how to operate your laser system. The examples cover the normal operation of the system as well as various errors.

### 3.1 Powering the System up

The unit is powered up from the mains switch on the rear of the unit. If the unit does not power up, make sure that emergency button is released by twisting it clockwise and proper fuse is installed.

The unit first shows Modulight logo and performs an initialization sequence. When the initialization sequence is finished, the display shows a status screen. The screen has been devised into 4 sections.

- **Top section** of the display contains SparkLight and Modulight logos.
- **Left section** of the screen contains current tab view with tab selection buttons on top.
- **Right section** of the display shows the numeric pad, quick status and output power toggle button.
- **Bottom section** has the actual power and laser temperature display.

### 3.2 Status screen

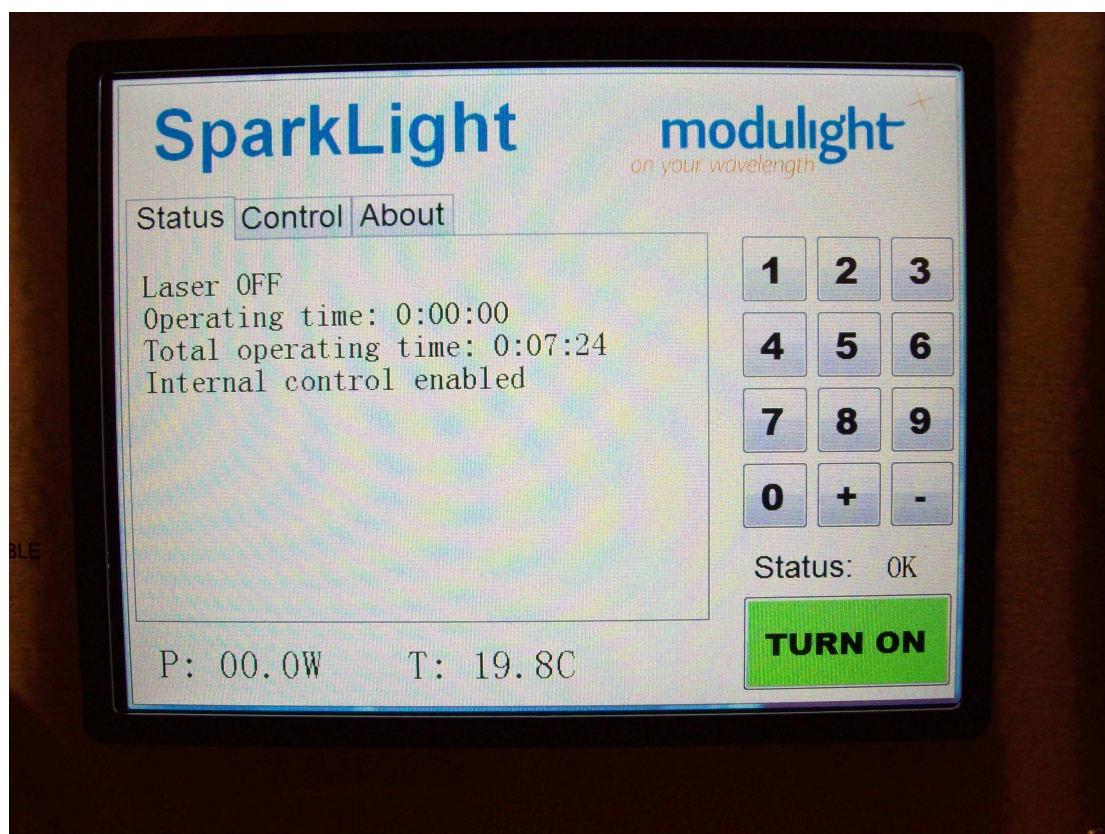


Figure 3. Status tab

Status screen shows laser status (ON/OFF), operating time and total operating time (H:MM:SS), control mode (Internal/External) and error status. When external control is enabled, screen also shows external analog control voltage. Error statuses are listed and explained below.

Message	Description
Interlock	Interlock key not connected
Laser disabled by keylock	Key switch is in center position
Temperature out bounds	Temperature is too low or high <15°C or >30°C
ON-time too long	ON-time is longer or equal to pulse period
ON-time too short	ON-time is too short for selected frequency, laser is off
DAC error	Internal error, contact Modulight support
Driver not ready or overloaded	May be caused by combination of high frequency and high output power. Power off system and let it cool before switching on. If still this error appears, contact Modulight support.
Driver error	Internal error, contact Modulight support

Quick status is displayed below numeric pad. Quick status messages are listed and described below.

Status	Description
OK	Internal control is set and laser is on or ready to be turned on
LCK	Interlock key is not connected, laser is turned off
KEY	Key switch is in disabled position, laser is turned off
EXT	Key switch is in external control position, laser is on or ready to be turned on
TMP	Temperature is out of bounds, laser is turned off
PWM	Pulse parameters are incorrect, see status tab, laser is turned off
ERR	Generic error, see status tab, laser is turned off



### 3.3 Setting the Output Power

The output power of the unit is set by entering the laser power for the laser. Control window is opened from the “Control” button.

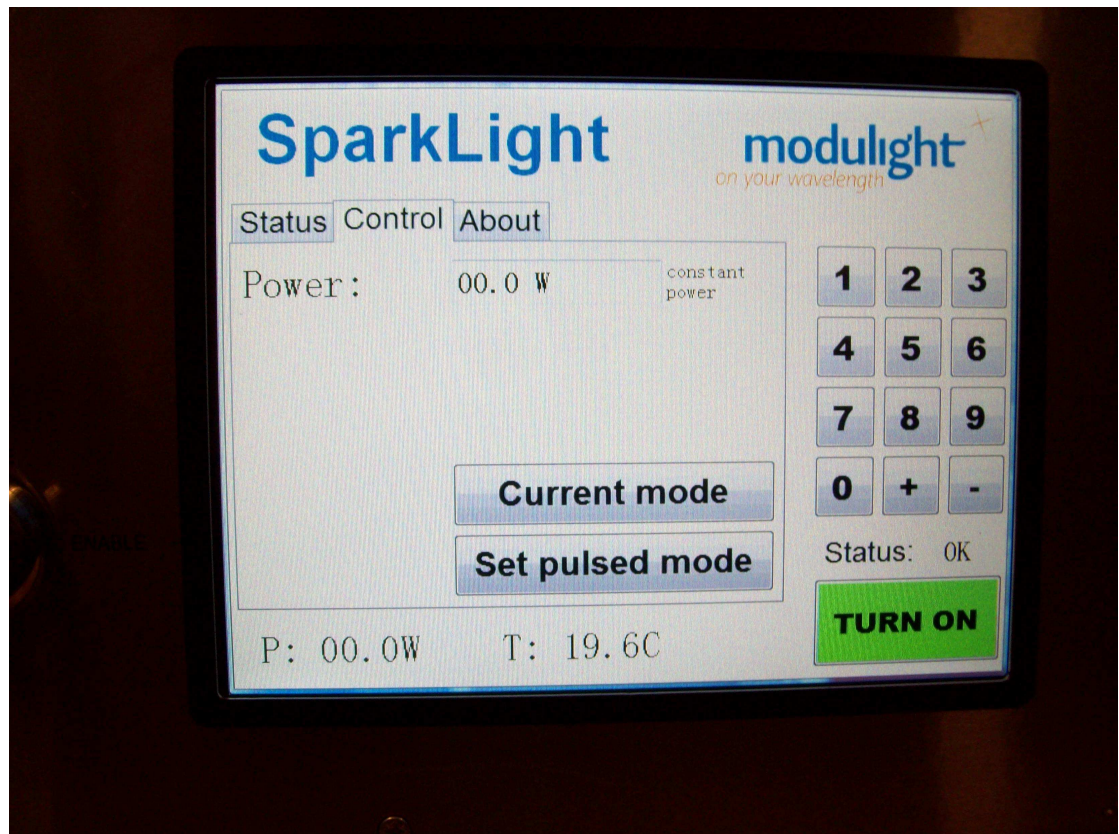


Figure 4. Control tab – CW mode

Input starts by pressing the power value field. An arrow next to field appears when field is selected. After the value is fed to the system using numerical pad, pressing “Set” key sets the output power. Value will null if too many numbers are fed. Laser drive mode is selected by pressing “Current mode” or “Power mode” buttons. **Current mode is displayed next to power value field. Constant power mode uses power feedback and power value is more accurate. In constant current mode output power is more stable but not as accurate as in constant power mode.** Actual measured power is displayed in bottom left of the screen. “TURN ON” button turns laser on. “TURN ON” button turns into red “TURN OFF” button and emission led is lit. Laser is turned off by pushing “TURN OFF” button.

### 3.4 Setting pulsed (QCW) mode

Pressing “Set pulsed mode” button on control tab sets pulsed mode. ON-time and frequency fields are displayed on the screen and constant current mode is selected. Also actual power value is not displayed. ON-time (laser on-time during pulse period) and pulsing frequency is set same way as power value described earlier. Minimum ON-time is  $0.2\mu\text{s}$  and maximum ON-time is  $500000\mu\text{s}$  (0.5s). Maximum frequency is  $200000\text{Hz}$  and minimum frequency is  $1\text{Hz}$ . Note that safe operating area (SOA) limits the use of high frequency and output power with short ON-time. Note also that minimum ON-time is dependent on frequency. Low frequency ( $152\text{Hz}$  and below) reduces slightly ON-time accuracy and limits minimum ON-time. Check that quick status is OK after setting pulse parameters.



Figure 5. Control tab – pulsed mode



### 3.5 Version information

About tab shows the version information of the unit.



Figure 6. About tab

### 3.6 Remote operation

SparkLight can be operated remotely using analog or digital (USB/UART) control.

#### 3.6.1 Analog control

Analog control is selected by turning key switch into “external”-position. Voltage in pin 6 of remote connector sets output power set point. One volt corresponds to 10 W output power, so for example 1.77 volts in analog control pin sets output power to 17.7 W. Maximum control voltage is 5.00V but note that maximum output power is still limited to 42W so 4.20...5.00 V corresponds to 42 W set point. Laser drive mode (constant power or constant current) is selected from control panel. Laser pulse modulation (TTL) is fed in pin 9 of remote connector. Logical high (5V) corresponds to pulse and logical low (0V) corresponds to pause.

Laser is turned on by pushing “TURN ON” button. Now external pulse input (external control connector pin 9) controls laser. Note that pulsed mode cannot be selected from panel in external control mode. **CAUTION!** When SparkLight is in internal control mode, pin 9 of remote controller operates as pulse output for pulse

monitoring. In that case no low impedance source should be connected to pin 9 or module may operate in undesired manner.

Actual power is measured in external control mode but value is reliable only when operating in CW mode (i.e. pulse signal is continuously high). When operating in pulsed mode, power reading should not be used.

### 3.6.2 USB / UART(TTL) control

All parameters that are controlled by touch screen can also be controlled via USB or UART interface. Module does not have to be set in external control mode and following commands are used mainly in internal control mode. When using USB interface connect USB A-B cable between rear panel USB connector and PC. Unit has internal USB to serial port adapter and SparkLight recognizes as a new COM-port. In case of USB driver problems please contact Modulight support. When using UART interface, disconnect USB cable and connect UART(TTL) controlling device to remote connector according to pin layout. Note that UART interface can't be driven straight from computer serial port. Remote control commands are similar in USB and UART mode and are described below. All stated characters are encoded in ASCII format. Interfaces use 115200bps with 8 data bits, 1 stop bit, no parity and no flow control.

All commands starts with start character 'A' (0x41) and commands with numeric input ends in carriage return \r (0x0D). Commands with description and output are listed below. # is numeric value in ASCII format. All characters are echoed if echo is not turned off. Start character 'A' is an exception that echoes "\n\rCommand:" (\n is new line character and \r is carriage return).

Command	Description	Output
P#\r	Set power to #	'.' (0x2E) or '!' (0x21) if value out bounds
F#\r	Set frequency to #	'.' (0x2E) or '!' (0x21) if value out bounds
D#\r	Set ON-time to #	'.' (0x2E) or '!' (0x21) if value out bounds
1	Set laser ON	
0	Set laser OFF	
m	Set CW mode	
M	Set pulsed mode	
c	Set constant power mode	
C	Set constant current mode	
E	Echo off/on	
Any other character	No operation	'?' (0x3F)

Power, frequency and ON-time values are inputted as in touch screen interface. For example 12.3 W is set by string "AP123\r" and 100.4 $\mu$ s is set by string "AD1004\r". Note that '\r' is a carriage return character (0x0D). Laser is set on by string "A1" that is 0x41 0x30 in hexadecimal format. Note that no carriage return is used.

There is also a quick command 'V' (0x56) that does not require start character or carriage return. It returns a status string with actual power, laser temperature, laser driver status and laser status information. Example status string with description is presented below.

"P:01534 T:00198 R:1 O:1"

P:01534 shows actual laser power in 0.01W resolution and T:00198 shows laser temperature in 0.1°C resolution. R:1 states that driver is ready and (R:0 means driver is not ready) and O:1 states that laser output is on (O:0 means laser is off). So in this case output power is 15.34 W, laser temperature is 19.8°C, driver is ready and laser is on. Note that actual power value is reliable only when laser is operating in CW mode. In pulsed mode actual power value should be discarded.

If unknown commands are inputted after start character, device returns '?' (0x3F) and requires a new start character for next command.

### 3.7 Shutting the System Down

The unit is shut down by toggling the mains switch on the rear of the unit into the off position.

### 3.8 Emergency Shutdown

An emergency shutdown switch is located on the front of the unit. In case the unit has to be shut down immediately, push the red emergency shutdown switch. This completely cuts off power supply to the unit. To reset the emergency shutdown switch and resume normal operation, twist the switch clockwise until the switch pops out to its normal position. After an emergency shutdown the unit starts with its normal initialization sequence and with the output disabled.

### 3.9 Safe operating area

SparkLight should not be operated in its highest frequency and highest output power simultaneously. Table below gives rough outlines for configuring pulse parameters. Values stated here may be exceeded briefly in a burst manner. In this case system needs to cool down before next burst.

Frequency	Power	ON-time
100...200kHz	0...10 W	>1μs
10...100kHz	0...20 W	>0.2μs
1Hz...10kHz	0...42W	>0.2μs

In external control mode frequency may be up to 1MHz but in burst mode, provided that an average of 200kHz is not exceeded.

If internal driver is overloaded, quick status shows 'ERR' and status screen shows "Driver not ready or overloaded". In this case switch power off and let system cool down.



## 4 SPECIFICATIONS

This chapter lists the specifications and supplemental characteristics of SparkLight. Unless otherwise noted, the specifications are warranted over an ambient temperature range of 0 to 35 °C.

### 4.1 Electro-Optical Characteristics

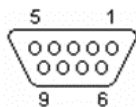
Parameter	Symbol	Typical value	Unit
Optical Output Power	$P_{OPT}$	42	W
Peak Wavelength	$\lambda$	805.6	nm
Spectral Width	$\delta\lambda$	2.1	nm
Pulse rise-time	$t_{rise}$	100	ns
Pulse fall-time	$t_{fall}$	57	ns

All above values are typical for operation at 20 °C (factory set value).

### 4.2 Absolute maximum ratings

Parameter	Symbol	Rating	Unit
Relative Humidity	RH	95	%
Storage Temperature	$T_{STG}$	-20 ... +50	°C
Operating Temperature Range	$T_{OP}$	0 ... +35	°C
Input Voltage	$V_{IN}$	90 ... 264	VAC
Input Frequency	$f_{in}$	47 ... 63	Hz
Input Power	$P_{IN}$	1000	W
External control voltage	$V_{ext}$	0...5	V

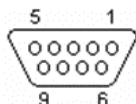
### 4.3 Remote Connector



Pin	Assignment
1	N/C
2	UART RX (TTL)
3	UART TX (TTL)
4	N/C
5	GND
6	Analog control (0...5V)
7	GND
8	GND
9	Pulse in/out (TTL)

- In internal control mode (selected by key switch) pin 9 acts as pulse out signal (0V off 5V on) and should be used only in monitoring purposes and should not be connected to any low impedance source.
- In external control mode pin 9 acts as a pulse input (0V off 5V on).
- Pin 3 (UART TX) should be left unconnected when USB cable is connected.
- Pin 6 and 9 has internal 10k $\Omega$  pull-down resistors.

### 4.4 Interlock connector

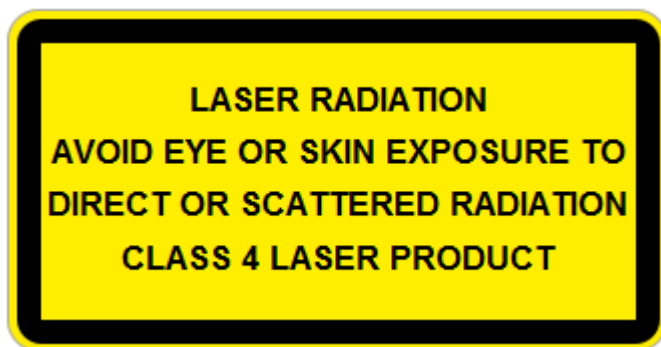


Pin	Assignment
1	N/C
2	N/C
3	Internal
4	Internal
5	GND
6	Internal
7	Internal
8	Internal
9	Interlock

- Pin 9 is internally pulled high and laser is enabled when it is shorted to pin 5 (GND).
- Do not connect any pins assigned as "Internal".

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## 5 SAFETY INFORMATION



The output of SparkLight exceeds 500 mW, and as such is classified as a class 4 laser product. By definition, a class 4 laser can burn the skin, in addition to potentially devastating and permanent eye damage as a result of direct or diffuse beam viewing. These lasers may ignite combustible materials, and thus may represent a fire risk. Class 4 lasers must be equipped with a key switch and a safety interlock.