Lumencor

Lumencor Operation Manual

SOLA and SOLA FISH Light Engines®

Regulatory Models
Lumencor utilizes regulatory model names for all certified and CE marked products. The regulatory model names are traceable to all regulatory documentation, third party reports and certifications.

"Regulatory Model: Sola" is used as a representative model for all certified and CE marked Sola products.

"Regulatory Model: Sola FISH" is used as a representative model for all certified and CE marked Sola FISH Products.

Emissions
This equipment has been tested and found to comply with the limits of EMC directive 2014/30/EU and FCC part 15 (CISPR 11:+A1:2016). These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Safety Certifications
TÜV SÜD America, CB Certification (IEC 61010-1:2010)
TÜV SÜD America, NRTLus Certification (UL 61010-1:2012/R:2016-04)
TÜV SÜD America, cNRTL Certification (CAN/CSA-C22.2 No. 61010-1:2012/U2:2016-04)
TÜV SÜD America, EN Certification (EN 61010-1:2010)

CE Marking
Low Voltage Directive (2014/35/EU)
EMC Directive (2014/30/EU)
RoHS Directive (2011/65/EU)
REACH Regulation (EC) No. (1907/2006/EC)

EU Declarations of Conformity can be found at https://lumencor.com/company/compliance

For EU customers discarding end-of-life Lumencor electrical and electronic equipment: Please submit an online RMA request as described in the "Customer Support" section of this manual with "Recycle product under WEEE" in the *Description of Issues* field of the request form. For disposal in countries outside of the European Union: This symbol is only valid in the European Union (EU). If you wish to discard this product, please contact your local authorities or dealer and ask for the correct method of disposal.

Research Use Only Lumencor Light Engines as supplied, and as represented in this manual, meet safety and regulatory requirements for research use only. If the light engine is incorporated into an instrument or system for a specific end-use application, it is the responsibility of the system integrator to verify that the light engine, and the system into which it is incorporated, meet all safety and regulatory requirements of that end-use application.

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Table of Contents

1. Introduction

Lumencor's SOLA and SOLA FISH light engines are designed for laboratory use by bioanalytical researchers and/or developers of life science instrumentation. SOLA and SOLA FISH light engines generate white light output by combining the outputs of 4, 5 or 6 solid state light sources. The light engine output is directed into a liquid light guide connected to the light output port on the front panel. Most applications of the SOLA and SOLA FISH light engines use a 3 mm diameter liquid light guide, which is included with light engine orders. SOLA light engines with 5 mm diameter liquid light guide outputs are also available. The distal end of the liquid light guide is typically connected to a collimating adapter attached to an optical instrument such as a fluorescence microscope. The on/off status and intensity of the white light output is electronically controlled via serial commands from a USB-connected computer workstation or a control pod accessory. On/off status can also be controlled manually via a button located on the front panel or a foot switch accessory that plugs into a 3.5 mm connector on the rear panel. SOLA and SOLA FISH light engines manufactured after August 2023 can also be controlled by an onboard graphical user interface (GUI) accessed via an ethernet-connected web browser. This manual covers SOLA, SOLA FISH, SOLA V-N, and SOLA U-N light engine models, which are defined by their spectral outputs shown in Figure 9 of this manual.

2. Precautions and Warnings *{Précautions et avertissements}*

A few simple practices will ensure trouble-free operation for the life of the light engine.

Les quelques règles simples suivantes permettront d'assurer un fonctionnement fiable pendant toute la durée de service de la source lumineuse.

Safety Instructions:
Please read and follow all safety instructions provided BEFORE using the SOLA or SOLA FISH light engine. Failure to comply with the safety instructions may result in fire, electrical shock, or personal injury and may damage or impair protection provided by equipment. Retain all safety instructions for future reference.

Instructions de sécurité:
Veiller à lire et à respecter toutes les instructions de sécurité fournies AVANT d'utiliser le SOLA ou SOLA FISH light engine afin d'écarter les risques d'incendie, de décharge électrique, de blessure corporelle et de possibles dommages ou défaillance de la protection offerte par l'appareil. Conserver toutes les instructions de sécurité pour référence future.

Safety Definitions *{Définitions relatives à la sécurité}*:

Warning: Statements identify conditions or practices that could result in personal injury.

Avertissement: *déclarations qui identifient des situations ou des pratiques susceptibles d'entraîner des blessures corporelles.*

Caution: Statements identify conditions or practices that could result in damage to your equipment.

Attention: *déclarations qui identifient des situations ou des pratiques susceptibles d'endommager le matériel.*

Safety Items *{Mesures de sécurité}*:

Warning: ONLY use the power supply provided by Lumencor. The Lumencor-supplied 24 V/5 A external DC power supply is required for use with the SOLA or SOLA FISH light engine. It is imperative that the DC power supply has output over-current protection, as the power input of the SOLA or SOLA FISH is not fused. The DC power supply must have the AC power cord connected to a receptacle with a protective safety (earth) ground terminal.

Avertissement: *Utilisez UNIQUEMENT l'alimentation électrique fournie par Lumencor. L'alimentation CC externe 24 V/5 A fournie par Lumencor est requise pour une utilisation avec le moteur d'éclairage SOLA ou SOLA FISH. Il est impératif que l'alimentation CC soit dotée d'une protection contre les surintensités de sortie, car l'entrée d'alimentation du SOLA ou du SOLA FISH n'est pas protégée par un fusible. L'alimentation CC doit avoir le cordon d'alimentation CA connecté à une prise avec une borne de terre de protection (terre).*

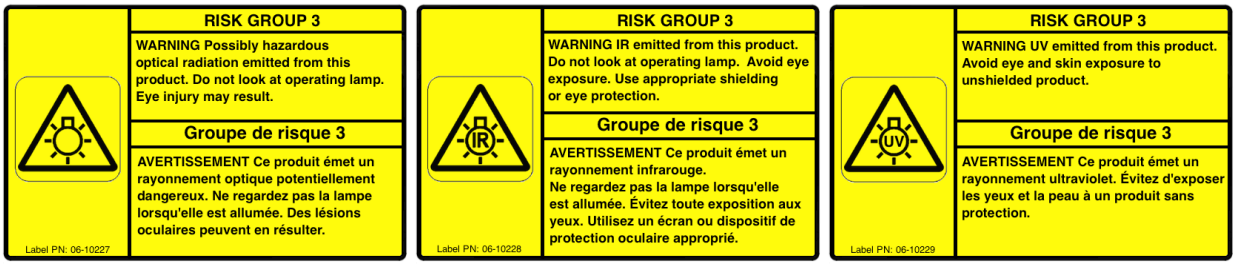
Warning: DO NOT look into the output of the light engine. The brightness of this light source is higher than most commercial lighting fixtures and is intended to couple directly into a microscope or other bioanalytical instrument.

Avertissement: *NE PAS regarde directement la sortie de la source lumineuse. L'intensité lumineuse de cette source est supérieure à celle de la majorité des appareils d'éclairage disponibles dans le commerce et est conçue pour un raccordement direct à un microscope ou autre appareil de bioanalyse.*

Warning: DO NOT turn on the light unless the output end of the light guide is safely directed into an enclosed optical path. DO NOT point the light output directly onto any flammable or burn-susceptible material. This includes all animal or vegetable tissues, plastics, fabrics, paper and liquids.

Avertissement: *NE PAS allumer la lumière sans l'extrémité de sortie du guide de lumière dirigée en toute sécurité dans un chemin optique fermé. NE PAS pointer la sortie de lumière directement sur un matériau susceptible d'être inflammable ou susceptible de brûler. Cela comprend tous les tissus, les plastiques, les tissus, le papier et les liquides animaux ou végétaux.*

RISK GROUP 3



Warning: Possibly hazardous optical radiation emitted from this product. Do not look at operating lamp. Eye injury may result**.**

Warning: Infrared (IR) radiation emitted from this product. Do not look at operating lamp. Avoid eye exposure. Use appropriate shielding or eye protection.

Warning: Ultraviolet (UV) radiation emitted from this product. Avoid eye and skin exposure to unshielded product.

GROUPE DE RISQUE 3

Avertissement: *Rayonnement optique peut-être dangereux émis par ce produit. Ne regardez pas la lampe d'exploitation. Une blessure oculaire peut entraîner.*

Avertissement: *Rayonnement infrarouge (IR) émis par ce produit. Ne regardez pas la lampe opératoire. Évitez l'exposition des yeux. Utilisez un écran de protection ou une protection oculaire appropriée.*

Avertissement: *Rayonnement ultraviolet (UV) émis par ce produit. Évitez l'exposition des yeux et de la peau au produit non protégé.*

Caution: DO NOT open the unit. There are no field-serviceable parts inside the case enclosing the light engine's optical and electronic sub-systems. Removing the outer case and accessing the optical and electronic sub-systems will void the manufacturer's warranty.

Attention: *NE PAS ouvrir l'appareil. Il n'y a aucune pièce réparable sur site à l'intérieur du boîtier renfermant les sous-systèmes optiques et électroniques du moteur lumineux. Le retrait du boîtier extérieur et l'accès aux sous-systèmes optiques et électroniques annuleront la garantie du fabricant.*

Caution: DO NOT set liquids on the light engine. Spilled liquids may damage your light engine.

Attention: *NE PAS placer de liquide sur la source lumineuse. Les liquides renversés peuvent endommager la source lumineuse.*

Caution: DO NOT drop the light engine. It contains glass optical components that could be damaged or misaligned by the shock produced by a drop onto a hard surface.

Attention: *NE PAS laisser tomber la source lumineuse. Elle contient des composants optiques en verre susceptibles d'être endommagés ou désalignés par le choc résultant d'une chute sur une surface dure.*

DISCLAIMER: Lumencor shall not be liable for injury to the user or damage to the product resulting from the SOLA or SOLA FISH light engine being used in a way for which it was not intended or in disregard or contravention of any posted safety precautions and warnings.

AVIS DE NON-RESPONSABILITÉ: *Lumencor ne sera pas responsable des blessures à l'utilisateur ou des dommages au produit résultant de l'utilisation du moteur d'éclairage SOLA ou SOLA FISH d'une manière pour laquelle il n'est pas destiné ou au mépris ou en violation des précautions de sécurité et des avertissements affichés***.**

3. Installation

3.1 Contents

SOLA and SOLA FISH light engines ship with the following list of standard items:

1. SOLA or SOLA FISH light engine configured with an output adapter for coupling to a 3 mm or 5 mm diameter liquid light guide according to the order specification.
2. A 24 V/5 A DC power supply (Lumencor part number 27-10001).
3. A region-specific 6 ft AC power cord for the power supply (Table 1).
4. A 6 ft USB A (M) to USB (B) M cable (29-10058) for serial connection to a light engine control pod or host computer.
5. 3 mm liquid light guide (Lumencor part number 10-10992) or 5 mm liquid light guide (Lumencor part number 10-10256).

Table 1. AC Power Cords

Region	Part Number
North America	29-10002
Europe	29-10005
United Kingdom	29-10004
Israel	29-10008
Australia/New Zealand	29-10024

Figure 1. SOLA Light Engine rear panel. The serial number of the light engine shown is **29336.** The rear panel also carries the input connections for the optional **foot switch** controller, the electronic **shutter, USB** control devices and ethernet access to the onboard control GUI (**LAN,** only on units manufactured after August 2023). The input connection for the DC power supply is labele**d 24V/5A**. The air cooling exhaust port is located at the upper right.

The model name, unique 5-digit serial number and certification markings of the light engine are carried on a label affixed to the rear panel (Figure 1). Performance specifications for individual light engines are listed on the certificate of conformance included with the shipping documents e-mailed to the customer on the date of shipment from Lumencor. It is important to retain the certificate of conformance for reference, as it provides the performance benchmarks for the light engine. **If the light engine is resold, the Certificate of Conformance should be transferred to the new owner.**

3.2 Installation

When setting up the SOLA light engine, place the unit on a hard surface within 6 feet (2 meters) of an AC electrical outlet and 6 feet (2 meters) of the microscope (assuming use of a standard 2 meter liquid light guide). Avoid blocking or restricting airflow at the air inlet (front panel; Figure 2, #5) or exhaust port (Figure 1). Restricting the airflow will cause the unit to operate at elevated temperatures and will result in decreased product lifetime and/or premature failure. Complete the external connections as follows:

3.2.1 Connect the DC power supply to the input port on the rear of the light engine (Figure 1). Do not connect the DC power supply to the AC utility supply until you are ready to power up the light engine.

3.2.2 **Fully** insert the liquid light guide in the light output port as shown in Figure 3. The output port incorporates a safety interlock that will disable light output until the light guide is fully inserted. Secure the light guide with the set screw on the right-hand side of the port. In the event that the M3 thread set screw is mislaid, one of the twelve case screws may be used as a temporary replacement.

Figure 2. SOLA Light Engine front panel
1. Master power button. **2.** Manual light output control button **3.** Light output port with liquid light guide inserted. **4**. Distal end of liquid light guide**. 5.** Air intake.

Figure 3. 3 mm diameter liquid light guide inserted in front panel light output port.

3.2.3 Connect the distal end of the light guide (Figure 2, #4) to the microscope illumination port [1]. Do not bend the light guide beyond its specified minimum bending radius (40 mm or 1.6 inches). Extreme bending of the light guide may cause permanent deformation, resulting in

decreased light transmission. In the event that the light guide is retracted from the output port during operation, light output will cease immediately. To restart light output: 1) turn the master power switch OFF, 2) fully insert and secure the light guide in the output port (Figure 3), 3) turn the master power switch back ON, and then 4) activate light output using the manual light output control button, foot switch or USB control device (control pod or PC).

3.2.4 Connect cables to the control ports on the rear panel (Figure 1). The number and types of cables to be installed will depend on operational requirements, as further described in Section 4.

Footnote
[1] Lumencor offers accessory liquid light guide adapters for use with microscopes that do not provide them. Contact Lumencor Technical Support (Section 8) for information on compatibility.

4. Operation

4.1 Description of Controls

The **master power button** on the front panel (Figure 2, #1) turns the electrical power to the unit on or off. A green inlay in the button is lit when the power supply is connected to the light engine and the power button is in the on position. After the master power button is turned on, the green inlay light will blink intermittently during the initialization of the onboard microprocessor (approximately 30 seconds). Cessation of blinking indicates that initialization is complete [1].

The **manual light output control button** (Figure 2, #2) is a toggle control turning light output ON and OFF with successive presses of the button. Light output stabilizes instantaneously (<1 second after ON command). A green inlay in the button is lit when light output is active [2]. The manual light output control button should remain in the OFF position when controlling the light engine using a USB-connected PC or control pod or a foot switch accessory. When light output is switched on, the cooling fan will start automatically. After light output is switched off, the cooling fan will continue to run for 5 minutes, after which it will automatically stop until light output is turned back on [2].

Footnotes
[1] The blinking power button inlay is implemented only on SOLA light engines manufactured after August 2023. On units manufactured December 2020–August 2023, the master power button inlay is steadily lit during and after initialization.
[2] Light output indication and fan operation are independent of the control method (manual, USB, LAN or foot switch).

4.2 Start Up and Shut Down

4.2.1 Connect the isolated DC power supply to the light engine (input connection shown in Figure 1).
4.2.2 Connect the AC power cord to the DC power supply.
4.2.3 As soon the DC power supply is energized, the master power button inlay (Figure 2, #1) will begin to blink [1]. The light engine automatically starts when the power is connected; there is no need to push the master power button [2].
4.2.4 Wait 30–45 seconds for the initiation sequence (onboard microprocessor boot-up) to complete. Do not press any buttons or insert any plugs during this time.

4.2.5 When the initiation sequence completes, the intermittent blinking of the master power button inlay will become static. At the same time, the fan will come on for about 2 seconds and then shut off automatically [3].
4.2.6 The light engine is now ready for use.
4.2.7 When the light engine is no longer required for immediate use [4], make sure that light output is OFF (manual light output control button inlay (Figure 2, #2) is unlit). Then press the master power button to shut down the light engine. Shut down can also be accomplished using the Shut Down button in the control GUI (Figure 4).

Footnotes

[1] The blinking power button inlay is implemented only on SOLA light engines manufactured after August 2023. On units manufactured December 2020–August 2023, the master power button inlay is steadily lit during and after initialization.
[2] If the DC power supply remained energized after the the previous shut down, press the master power button to start.
[3] If the liquid light guide insertion interlock (Section 3.2.2) is open, the fan will remain on after the initiation sequence is complete.
[4] Availability of light output after restarting is limited only by the 30–45 seconds required for initiation (see 4.2.4).

4.3. Ethernet Connection and Control GUI

WARNING: Prior to turning the light output on, be sure the output end of the liquid light guide is safely directed into an enclosed optical path (e.g. a beam dump).

AVERTISSEMENT : Avant d'activer la sortie de lumière, assurez-vous que l'extrémité de sortie du guide de lumière liquide ou de la fibre optique est dirigée en toute sécurité dans un chemin optique fermé (par exemple, une décharge de faisceau).

The onboard control GUI provides a quick and easy way to control the Light Engine using a static LAN connection and a web browser. The GUI consists of the **Control** page and the **Settings** page (Figure 4). The control page primarily contains light on/off and intensity controls. Responses to these controls are essentially instantaneous (<1 second). The settings page contains various configuration settings, system on time and cumulative light output time data for each light source.

To access the control GUI, follow the protocol below:
4.3.1 Connect the LAN port of the light engine (Figure 1) to a computer ethernet port using a RJ45 ethernet cable [1,2,3].
4.3.2 On Windows systems, go to the the Start menu > Control Panel > Network & Internet and/or Network & Sharing Center.
4.3.3 Click Change Adapter Settings.
4.3.4 Right-click on Local Area Connection.
4.3.5 Click on Properties (in pop-up).
4.3.6 Select Internet Protocol Version 4 (TCP/IPv4).
4.3.7 Click Properties button.
4.3.8 Use the following IP addresses:
IP Address: 192.168.201.201
Subnet Mask: 255.255.255.0
Default gate way and DNS Server are OK to leave blank.

4.3.9 Type the Light Engine IP address (factory default IP address is 192.168.201.200) into any web browser address bar to access the resident Web GUI. Do not use https://prefix.

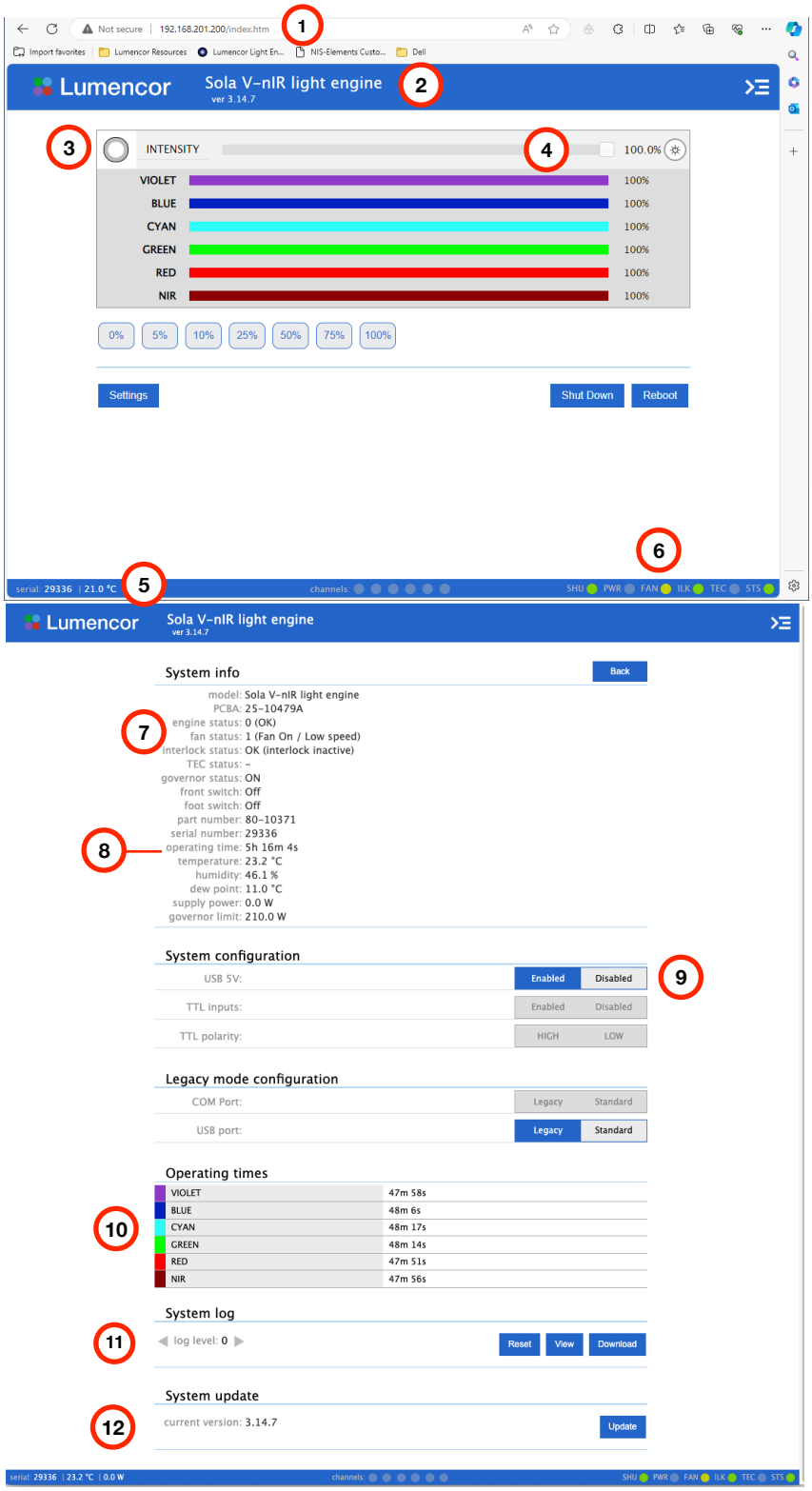


Figure 4. SOLA Control GUI, **Control Page** (Top) and **Settings Page** (Bottom). (1) Light Engine IP address in web browser address bar. (2) Lumencor light engine model name and software version. (3) Light output ON/OFF toggle control (= ON, = OFF). (4) Intensity slider control. (5) Serial number of light engine, live temperature read out. (6) System status indicators. (7) Fan operating status. (8) Cumulative system on time (light output ON + OFF). (9) On/off for USB 5V supply for control pod. (10) Cumulative light source operating time read out. (11) System log portal (set log level = 0 (zero) under normal operation conditions). (12) Portal for installing operating software updates.

Footnotes

[1] Any type of computer may be used, including Windows, MacOS and Android systems.

[2] If the computer does not have an available ethernet port, a USB-to-ethernet adapter may be used instead.

[3] The control GUI and image acquisition software connected via the USB port can be run simultaneously.

4.4 Control from PC via USB connection

WARNING: Prior to turning the light output on, be sure the output end of the liquid light guide is safely directed into an enclosed optical path (e.g. a beam dump).

AVERTISSEMENT : Avant d'activer la sortie de lumière, assurez-vous que l'extrémité de sortie du guide de lumière liquide ou de la fibre optique est dirigée en toute sécurité dans un chemin optique fermé (par exemple, une décharge de faisceau).

The SOLA light engine may be controlled by third-party image acquisition software via the USB port (Figure 1). Connection to the computer requires a USB-A-to-USB B cable (29-10058, included with the light engine). A compatible device driver must first be selected; this selection is typically found under the “Devices” tab of the third-party software. The COM port address assigned by the computer to the light engine USB serial port must be correctly registered in the third-party software at the same location (Figure 5). If you have questions about device driver selection in a particular acquisition software package, e-mail Lumencor Technical Support at techsupport@lumencor.com.

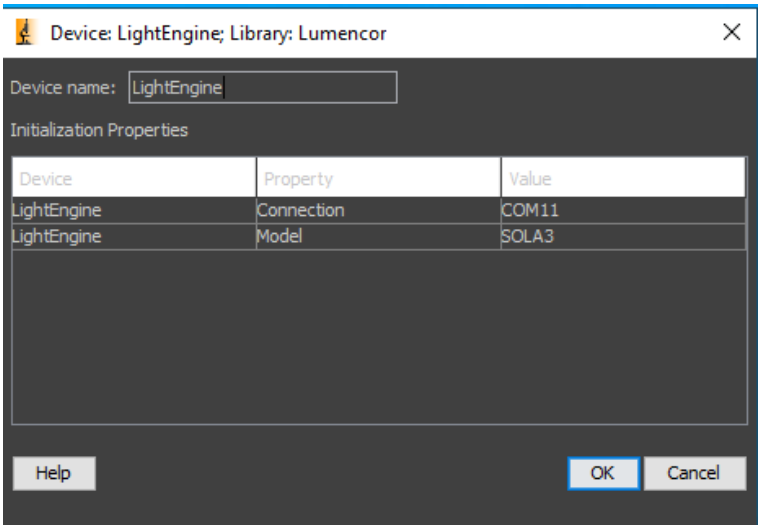


Figure 5. SOLA USB driver selection in MicroManager image acquisition software. This driver is compatible with all SOLA light engines manufactured after December 2020.

The SOLA light engine uses LEGACY mode hexadecimal commands described in *SOLA Command Reference,* (p/n 57-10058), download from https://lumencor.com/customer-center/downloads?category=control-software. The serial communications protocol is 9600,8,N,1.

4.5 Control From Light Engine Control Pod

WARNING: Prior to turning the light output on, be sure the output end of the liquid light guide is safely directed into an enclosed optical path (e.g. a beam dump).

AVERTISSEMENT : Avant d'activer la sortie de lumière, assurez-vous que l'extrémité de sortie du guide de lumière liquide ou de la fibre optique est dirigée en toute sécurité dans un chemin optique fermé (par exemple, une décharge de faisceau).

4.5.1 Before starting up the light engine, use the USB A-to-USB B cable (29-10058) to connect the SOLA to the control pod (Figure 6). The control pod is available for purchase as an optional accessory (p/n 83-10007).

4.5.2 Check that USB 5V is set to ENABLED on the settings page of the control GUI (Figure 4, #9).

4.5.3 The pod must be set in SOLA control mode. The Light Engine control mode setting is shown in green letters at the bottom of the pod display screen. If the pod is not in SOLA control mode, change the setting by holding down the MODE button on the pod until the Light Engine selection menu appears. Move the cursor to “SOLA SE” by turning the pod control knob. Press the MODE button again to select SOLA control mode and return to the main control screen.

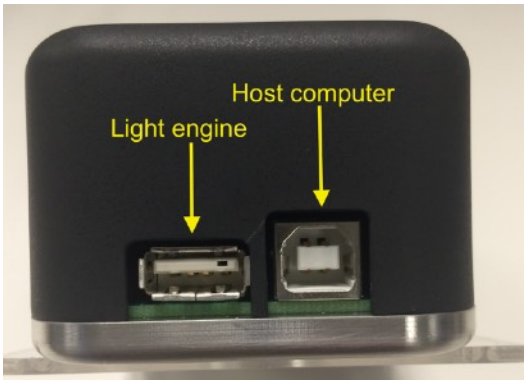


Figure 6. USB connectors on the rear of the light engine control pod (83-10007).

4.5.4 Follow the instructions on Lumencor’s *Light Engine Control Pod Operation* sheet (p/n 54-10036). In brief, press the MODE button to toggle light output ON and OFF and turn the control knob to adjust intensity. Dialing intensity to zero automatically issues an OFF command to the light engine. Press the right button to turn the light output on again. When the pod is powered down, the current intensity setting is saved and will be restored at the next restart.

4.6 Foot Switch Control

Connect the foot switch accessory (p/n 29-10045) to the input connector on the rear panel of the light engine (Figure 1) with the master power button (Figure 2, #1) in the **OFF** position. The ON/OFF status off the toggle foot switch cannot be determined from its position. Connecting the foot switch while the power is off is a necessary precaution to avoid unintentional initiation of light output. After connecting the foot switch, and with the light guide output safely directed into an enclosed optical path (e.g. microscope input collimator or a beam dump), turn the light engine power ON using the master power button to begin operation. To avoid command conflicts, do not intermix light output ON/OFF control using the foot switch with light output ON/OFF commands from the manual light output control button or USB control devices (control pod or PC).

4.7 Electronic Shutter Control

WARNING: Prior to turning the light output on, be sure the output end of the liquid light guide is safely directed into an enclosed optical path (e.g. a beam dump).

AVERTISSEMENT : Avant d'activer la sortie de lumière, assurez-vous que l'extrémité de sortie du guide de lumière liquide ou de la fibre optique est dirigée en toute sécurité dans un chemin optique fermé (par exemple, une décharge de faisceau).

SOLA and SOLA FISH light output can be selectively enabled and disabled using TTL levels applied to the BNC connector marked “shutter” on the rear panel (Figure 1). A >1.5 V DC “high” signal applied to the BNC connector will enable white light output, while a <1.5 V signal will disable it. The SOLA and SOLA FISH light engines can support an on/off switching rate up to approximately 1 kHz. Note that DC control levels applied to the shutter connector are not TTL source triggers. Light output must first be turned on using the manual light output control button (Section 4.1), onboard control GUI (Section 4.3), USB–connected PC (Section 4.4) or control pod (Section 4.5). The output intensity remains under the control of the serial device.

The electronic shutter input can be used to allow a camera to control light output. The cable required (Figure 7) is typically supplied with the camera. The characteristics of the synchronizing output by the camera must be configured in software control settings as shown in Figure 8.

Figure 7. Cable connection from Timing 1 port of Hamamatsu ORCA-Fusion camera to SOLA light engine electronic shutter input.

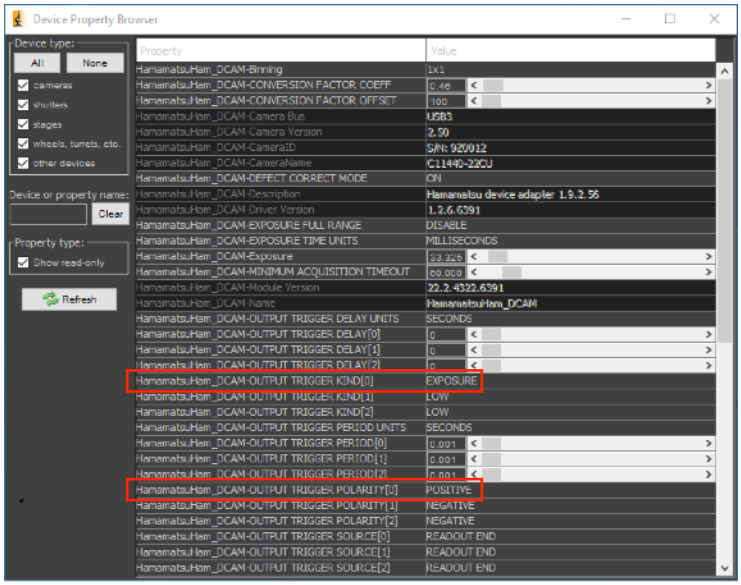


Figure 8. Configuration of camera exposure synchronizing signal in MicroManager image acquisition software. The critical settings are outlined in red.

5. Light Output Characteristics

5.1 Spectral Distribution

Typical output spectral distributions of SOLA, SOLA FISH, SOLA V–N and SOLA U–N light engine models are shown in Figure 9. Note that because the SOLA model has no output in the 400–450 nm range, it has a pale yellow (not white) visual appearance.

5.2 Output Intensity

Output intensity settings in the control GUI (Figure 4, #4) are expressed as 0–100% and can be set in 0.1% increments. Light output power is linear as a function of intensity setting. The recommended operating intensity range is 5–100% [1].

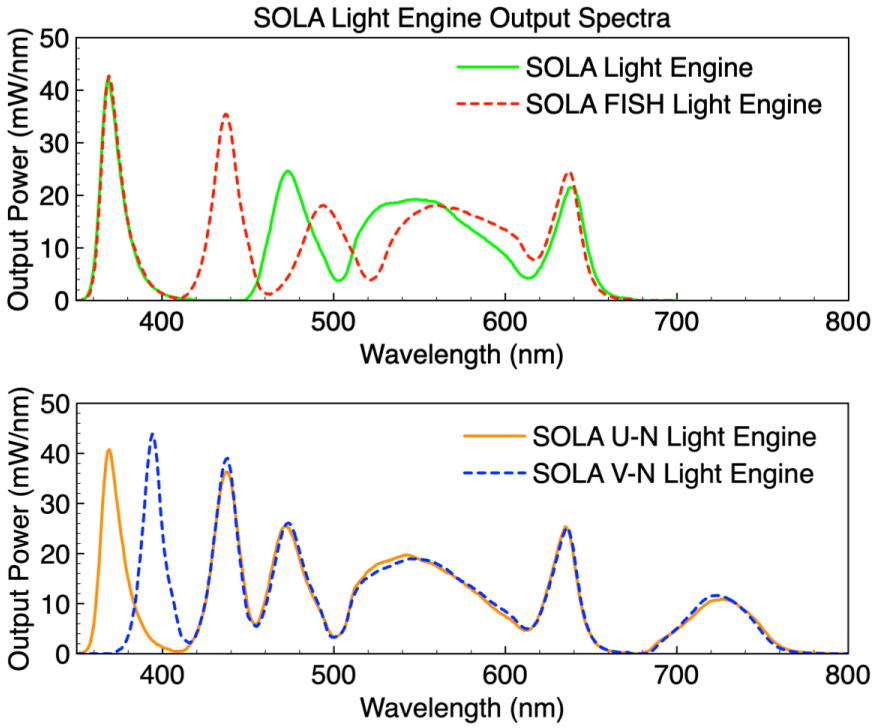


Figure 9 SOLA, SOLA FISH, SOLA U–N, and SOLA V–N light engine spectral output distributions.

Footnote

[1] An intensity setting of 0% (Figure 4, #4) is NOT functionally equivalent to OFF (Figure 4, #3).

6. Operating Specifications

SOLA Light Engines must be operated and stored under the environmental conditions specified in Table 2. Performance specifications for individual light engines are listed on the certificate of conformance included with the shipping documents e-mailed to the customer. It is important to retain the certificate of conformance for reference. In the event that the light engine is sold, the certificate of conformance should be transferred to the new owner. Certificates of conformance are also recorded in Lumencor's database and copies can be requested by e-mail to techsupport@lumencor.com. The request message must include the 5-digit serial number of the

light engine marked on the rear panel ID sticker (Figure 1) and also displayed in the control GUI (Figure 4, #5).

When the light engine is operating, internal temperature control is provided by the onboard microprocessor in conjunction with an onboard temperature sensor and the cooling fan located at the rear of the light engine. The fan starts automatically in response to light output ON commands. The fan will remain on for the duration of light output and for 5 minutes after light output is turned off, after which the fan will automatically shut off. If the internal temperature exceeds 50°C OR the fan rotor is stopped, all light output is automatically turned OFF and is locked in this state until the internal temperature is below 50°C and/or the fan restarts. The current reading of the onboard temperature sensor is displayed in the Control GUI (Figure 4, #5).

Table 2. SOLA and SOLA FISH Light Engine Operating Specifications

Specification	Detail
External temperature	
Operating	68 to 86° F (20 to 30° C) but it can vary depending on the specific model
Non-operating	-4 to 158° F (-20 to 70° C)
Humidity	
Operating and non-operating	0 to 80% relative humidity, non-condensing
Altitude	
Operating	0 to 10,000 feet (3,048 meters)
Non-operating	0 to 45,000 feet (13,176 meters)
Dimensions	
Size (W x L x H)	12.5 cm x 26.3 cm x 16.3 cm (4.90 in x 10.4 in x 6.40 in)
Weight	4.3 kg /9.5 lbs
System	
Lifetime	Time for light engine output power to decrease to 70% of the value recorded on the original certificate of conformance¶
AC power requirements	100–240 V, 50–60 Hz
DC Power supply	120 W (24 VDC /5 A)
Power consumption	60 W (light output on at 100%); 3 W (light output off)
Temperature control	Automatic. Onboard microprocessor coupled to internal temperature sensor and cooling fan
Sound Level	Sound level at 1 meter < 65dB(A)
Control Interfaces	Manual light ON/OFF, USB, ethernet, electronic shutter, foot switch accessory light ON/OFF
Warranty	24 months parts and labor
¶The corresponding number of days/months/years may vary considerably depending on the duty cycle implemented by the user and the prevailing environmental conditions during operation.	

7. Maintenance and Troubleshooting

Table 3. SOLA and SOLA FISH Light Engine Troubleshooting

Problem	Check the following
No light output in response to ON command	Check that the liquid light guide is fully inserted in the front panel receptacle and is secured by the set screw (Figure 3).
Light engine does not respond to light ON/OFF commands from the control pod or PC	Check that the manual light output control button in the top right corner of the front panel (above the light output port) is in the OFF position.
Unusually weak fluorescence signals across all detection channels	Weak fluorescence in all detection channels (DAPI, FITC, TRITC, Cy5 etc) is likely to be due to poor light transmission by the liquid light guide, the collimating adapter or another distal component of the microscope optical path and not to abnormally low light output from the SOLA or SOLA FISH light engine.
Unusually weak fluorescence signals in a single detection channel (e.g. DAPI)	Check that the filter cube in the microscope is compatible with the output spectrum of the SOLA or SOLA FISH model that you are using (Figure 9). If no filter compatibility problem is found, then contact Lumencor Technical Support as directed in Section 8.
Signal crosstalk in multicolor fluorescence images	When using a monochrome camera for detection in conjunction with SOLA light engines, single bandpass filter sets must be used for multicolor imaging applications.

No routine maintenance is required. There are no user-replaceable components or sub-assemblies inside the SOLA Light Engine. Opening the light engine enclosure will void the manufacturer's warranty. In the event that the light engine fails to perform in accordance with the specifications listed on the certificate of conformance, follow the troubleshooting procedures detailed in Table 3. If the problem remains unresolved, please contact Lumencor Technical Support for assistance, as directed in Section 8.

8. Customer Support

For technical support on the installation and operation of SOLA and SOLA FISH light engines, please contact Lumencor by phone at 503-213-4269 or through e-mail at techsupport@lumencor.com. Please be prepared to provide the 5-digit serial number of the light engine. Any light engine returned to Lumencor for repairs requires a pre-issued return material authorization (RMA) number. To request an RMA number, fill out and submit the online request form. It is the customer's responsibility to properly package and safely ship products to Lumencor. Instructions for shipping will be provided in the e-mail giving notification of the RMA number.

9. Warranty

SOLA and SOLA FISH Light Engines are backed by a 24 month warranty to end users. Warranty coverage starts on the original date of shipment from Lumencor. Light Engines qualifying for warranty service must be verifiably delivering performance that is substantially at variance with the levels documented on the certificate of conformance. The light engine must also have been used and maintained under operating conditions consistent with the specifications given in Section 6 of this manual, and observing all the Precautions and Warnings notified in Section 2. This warranty does not extend to light engines that have been subject to shipping damage, misuse, accident, tampering or improper installation. Accessories including (but not limited to) liquid light guides, collimators, cables and control pods are not covered by the warranties attached to light engines. Please fill out and submit the online warranty registration form. This will facilitate provision of warranty service should it be required.