

## Lumencor Light Engine Manual

# CELESTA and CELESTA quattro Light Engine



## 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: Celesta**” is used as a representative model for all certified and CE marked CELESTA 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

TUV SUD America, CB Certification (IEC 61010-1:2010)

TUV SUD America, NRTLus Certification (UL 61010-1:2012-05)

TUV SUD America, cNRTL Certification (CAN/CSA-C22.2 No. 61010-1:2012)

TUV SUD America, EN Certification (EN 61010-1:2010)

Underwriters Laboratories (UL), CB Certification (IEC/EN 60825-1:2014 Safety of laser products)

## CE Marking

Low Voltage Directive (2014/35/EU)

EMC Directive (2014/30/EU)

RoHS Directive (2011/65/EU+2015/863/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 RMA request with “Recycle product under WEEE” in the Description of Issues field.

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.

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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## 1. Introduction

The CELESTA and CELESTA quattro Light Engines consists of individually addressable solid-state laser light sources with integrated electronic control systems. Identification of each model is dependent on the number of sources (see table below). The outputs of the laser light sources are refined by bandpass filters and merged into a common optical train directed to the light output port on the front panel. The light output port has a built-in adapter for connection to an SMA-terminated optical fiber. An onboard photodiode array continuously monitors the light output and generates a reference signal that is applied to the constituent sources in a feedback loop to maintain constant light output over time. The light sources within each model of the CELESTA Light Engine are controlled by software; via one of two serial interfaces, USB/RS-232 or TCP, to an onboard microprocessor operating Lumencor firmware. The user can enable or disable each source independently by serial commands as well as change the intensity of each source independently. The CELESTA and CELESTA quattro Light Engines can be controlled by third party microscopy data acquisition software or by a GUI resident on the onboard microprocessor. Alternatively, the light sources may be turned on and off by TTL inputs from a trigger device such as a camera or a real-time controller. Optimal internal operating temperature is maintained by negative pressure air cooling with the air intake at the front of the Light Engine and the exhaust fan at the rear.

CELESTA Light Engine PRODUCT MATRIX	CELESTA	CELESTA QUATTRO
Electronic Control	✓	✓
Internal Bandpass Filters	✓	✓
Number of Sources	7	4*
749 nm near-IR source	✓	✓*

\*Optional 5th laser line at 749nm

## 2. Precautions and Warnings {Précautions et mises en garde}

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 CELESTA 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. Please save all safety instructions.

### Instructions de sécurité:

Veiller à lire et à respecter toutes les instructions de sécurité fournies **AVANT** d'utiliser le CELESTA Light Engine afin d'écartier 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.

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 VDC, 9.2 A external power supply is required for use with the CELESTA Light Engine. The Light Engine is required to be supplied by an approved/certified DC power source meeting the minimum electrical ratings of the product. The DC power supply must have the AC power cord connected to a receptacle with a protective safety (earth) ground terminal.

**Avertissement: utiliser uniquement l'alimentation fournie par Lumencor.** Le Lumencor fourni 24 VDC/9.2 A alimentation externe est recommandé pour une utilisation avec le moteur de lumière CELESTA . Le moteur léger doit être alimenté par une source d'alimentation CC approuvée/certifiée répondant aux caractéristiques électriques minimales du produit. L'alimentation CC doit avoir le cordon d'alimentation CA connecté à une prise avec une borne de terre de sécurité (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 apply/remove power or turn on the light without the output end of the light guide 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 appliquer/couper l'alimentation ou 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.

**Caution:** Use of controls or adjustments or performance of procedures other than this specified herein may result in hazardous radiation exposure.

**Attention:** L'utilisation de commandes ou de réglages ou l'exécution de procédures autres que celles spécifiées dans le présent document peuvent entraîner une exposition à des radiations dangereuses.

#### Class 4 Laser Warning



**Warning:** This product contains Class 4 laser sources. Avoid eye and skin exposure to direct or scattered visible and invisible laser radiation.

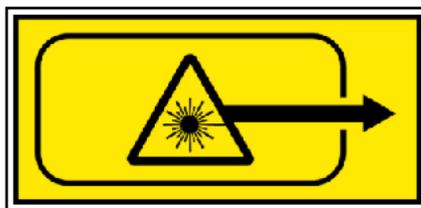
**Avertissement:** Ce produit contient des sources laser de classe 4. Évitez l'exposition des yeux et de la peau au rayonnement laser visible ou dispersé visible et invisible.

Laser Sources			
Color	Center Wavelength (nm)	Power	Beam Divergence
See label located on product.	300-1150nm. See label located on Product.	See label located on product.	Beam divergence shall be calculated at the end-system. Refer to CoC for the Light Engine beam divergence (NA) at the output aperture.

#### Laser Aperture Warning



or



**Warning:** Avoid exposure - laser radiation is emitted from this aperture. Do not apply/remove power or turn on Light Engine without first connecting a light guide to the output aperture. The distal end of this light guide must be coupled into an enclosed optical path prior to operation. Each operational control and laser aperture that can be separated by 2m or more from a radiation warning device shall itself be provided with a radiation warning device. Do not exceed 2m without providing a radiation warning device in accordance with EN 60825-1:2014.

**Avertissement:** Évitez l'exposition - le rayonnement laser est émis à partir de cette ouverture. N'appliquez/coupez pas alimentation et n'allumez pas Light Engine sans d'abord connecter un guide de lumière à l'ouverture de sortie. La sortie est interverrouillée et un guide de lumière doit être connecté et couplé dans un chemin optique inclus avant l'opération. Chaque commande opérationnelle et l'ouverture laser qui peuvent être séparées de 2 m ou plus à partir d'un dispositif d'avertissement de rayonnement doivent être munies d'un dispositif d'avertissement de rayonnement. Ne dépassez pas 2m sans fournir un dispositif d'avertissement de rayonnement conformément à la norme EN 60825-1:2014.

**Warning: DO NOT open the unit.** There are no serviceable parts inside and opening the Light Engine enclosure will void the manufacturer's warranty.

**Avertissement: NE PAS ouvrir l'appareil.** Il ne contient aucune pièce réparable et l'ouverture de son boîtier a pour effet d'annuler la garantie.

**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 CELESTA Light Engine being used in a way for which it was not intended and in complete disregard for any posted safety precautions and warnings.**

**AVIS DE NON-RESPONSABILITÉ:** Lumencor décline toute responsabilité pour les blessures corporelles ou les dommages au produit résultant d'une utilisation du CELESTA Light Engine autre que celle prévue et du mépris total de les mesures de sécurité et mises en garde affichées.

### 3. Installation and Operating Instructions

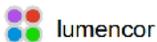
#### 3.1 Contents

Each CELESTA Light Engine model ships with the following list of standard components:

1. The CELESTA Light Engine, configured with 7 output channels OR the CELESTA quattro Light Engine, configured with 4 output channels (colors) and an output adapter for connection to an SMA-terminated optical fiber as documented on the certificate of conformance (Figure 1).
2. A 24 V/9.2 A DC power supply (Lumencor part number 27-10019).
3. A region-specific AC power cord for the power supply (see adjacent table).
4. RJ45 ethernet cable
5. Control key, external gate jumper, and remote interlock jumper (Figure 2)
6. Quickstart Guide instruction document (85-10049)

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



#### Certificate of Conformance

Performance Measurements For Lumencor Light Engine SN 21698

Color Channel	Bandpass Filter	Power (mW)
n/a	n/a	n/a
Red	537/12	993
Green	545/12	785
Cyan	478/12	747
NIR	748/12	2000
Violet	405/12	203
n/a	n/a	n/a
n/a	n/a	n/a
Total Power		4708

Burn-in Pattern Cycle Definition:

1. Each color is on at 100% for 5 seconds and then off for 1 second.
2. Pattern is repeated 20 times.
3. Next, all colors are turned on at 100% for 12 minutes.

Repeat cycle 15 times.

COC Output Adapter: SMA Interlock - DS  
Beam Divergence (NA): 0.10

#### Measurement Method

This product was measured using the custom output adapter installed on the light engine. The output power was directed at a coherent thermopile sensor head, model number 79610, SN 1448194, attached to a coherent LabMaster Power Meter, SN 0538209. The measurement system was calibrated on Oct 27, 2020. The meter scale was set to average mode and the meter zeroed for each measurement. Measurements were taken at room temperature and at initial turn on.

Lumencor Build Recipe: Celesta-VGI-5F-A2      Model Name: Regulatory Model: Celesta  
Product Part Number: 89-10357 (Rev. C)      Customer Drawings: n/a  
Packaged Assembly: 99-10634 Rev. A

Customer Part Number:

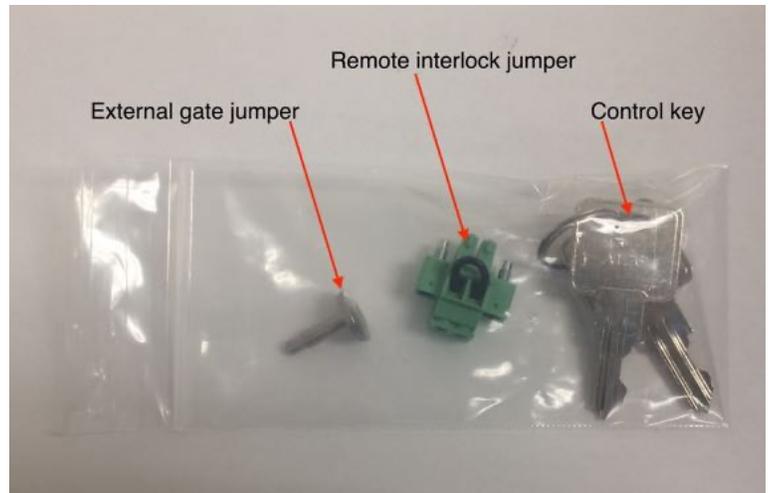
Customer Specification:

Inspected By:

Jun 9, 2021

Document Part Number: 50-10027 rev E

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**Figure 2 .** Control key, remote interlock jumper and external gate jumper. These items are packed in a plastic bag inside the shipping box. Their functions are described in Section 3.3.1

**Figure 1.** Example certificate of conformance (C of C) for a CELESTA Light Engine. The C of C identifies the color channels installed in the Light Engine and the bandpass filters associated with each channel. Full (100%) power outputs measured at the terminus of the optical fiber are recorded in the third column.

The model name, unique 4- or 5- digit serial number and certification markings of the Light Engine are carried on a label affixed to the rear panel. Performance specifications for individual Light Engines are listed on the certificate of conformance included with the shipping documents e-mailed to the customer (Figure 1).

### 3.2 Installation

Note: Any end-product/system incorporating or coupled to a Lumencor Light Engine shall be fully evaluated to verify all applicable safety and regulatory compliance requirements prior to use.

When setting CELESTA Light Engines up for use, place the unit on a hard surface and avoid blocking or restricting airflow at the air inlets (front panel; Figure 3) or exhaust ports (rear panel) on the enclosure. Restricting the airflow will cause the unit to operate at elevated temperatures and will result in decreased product life and/or premature failure.

CELESTA Light Engines must be operated in a non-condensing environment (dew point  $<10^{\circ}\text{C}$  with controlled ambient temperature  $<30^{\circ}\text{C}$ ). Thermal overload protection is provided by the on-board computer in conjunction with an on-board temperature sensor. If the internal temperature registered by the sensor exceeds  $50^{\circ}\text{C}$  **OR** the fan rotor is stopped, all light output channels automatically turn OFF and are locked in this state until the internal temperature is below  $50^{\circ}\text{C}$  and/or the fan restarts. The current reading of the on-board temperature sensor is displayed on the front panel status display (Figure 3) and in the GUI (Figure 5).

The CELESTA Light Engine® may be configured for light delivery via a 3 mm liquid light guide or an SMA-terminated optical fiber. The output couplers are built into the Light Engine front panel and are not field-exchangeable (Figure 3). The 3 mm liquid light guide output coupler incorporates an electrical power interlock switch in the back of the receptacle. The liquid light guide must be fully inserted in the receptacle to activate the interlock. Electrical power supply to the Light Engine cannot be turned on via front panel power switch until the interlock is activated. After fully inserting the liquid light guide, lock it in position using the set screw on the side of the receptacle to prevent inadvertent disconnection of the light guide during use.

Connect the DC power supply to a grounded AC wall outlet using the power cord supplied with the Light Engine. Connect the DC output to the 6-pin receptacle on the front of the Light Engine (Figure 3). Turn the Light Engine on using the master



Figure 3. CELESTA Light Engine front panel



Figure 4. CELESTA Light Engine rear panel.

power switch. The embedded green indicator will illuminate (if applicable, ensure that the liquid light guide is inserted and secured; see above).

### 3.3 Operation

#### 3.3.1 Controls and Interlocks

The **Master Power Switch** button on the front panel (Figure 3) turns the electrical power to the unit on or off. A green power indicator embedded in the button is lit when the power supply is connected to the Light Engine and the power button is in the on position. Initialization of the onboard computer takes about 30 seconds after the master power switch is turned on. When initialization is complete, the status indicator display (Figure 3) will activate.

The **Key Control** (Figure 3) must be in the on position before the lasers can be turned on. The key must be removed and stored in a secure location when the product is not in use. **ONLY** trained individuals should use and have access to the key. The **Master Power Switch** button, **Key control** and **Remote interlock** (Figure 2) can be used to shut off laser output.

The **Source Enabled** indicator LED (below the status indicator display; Figure 3) provides a warning indication that one or more laser sources are active and emitting invisible and/or visible radiation.

The **Remote Interlock Connector** (Figure 4): is provided to allow for connection of a remote interlock. When this interlock is open it will shut off laser output. After the interlock has been opened, the **Manual Reset** button will need to be pushed to resume laser output.

**WARNING:** The Remote Interlock relies on a passive continuity circuit for proper operation. It does not provide a voltage source for external circuitry, nor can external voltage sources be applied to it. **UNDER NO CIRCUMSTANCES** should a voltage or voltage source be applied to the Remote Interlock circuit. **APPLYING A VOLTAGE OF EITHER POLARITY MAY RESULT IN ANOMALOUS OPERATION AND/OR DAMAGE THE PRODUCT, AND COULD IMPACT SAFETY.**

Customers planning to connect multiple Light Engine remote interlocks together will need to contact Lumencor prior to integration. **INTERCONNECTING LIGHT ENGINES OR USING THE REMOTE INTERLOCK INCORRECTLY CAN RESULT IN ANOMALOUS BEHAVIOR AND/OR DAMAGE TO THE PRODUCTS.**

**AVERTISSEMENT :** Le verrouillage à distance repose sur un circuit de continuité passif pour un fonctionnement correct. Il ne fournit pas de source de tension pour les circuits externes, et aucune source de tension externe ne peut lui être appliquée. **EN AUCUN CAS**, une tension ou une source de tension ne doit être appliquée au circuit de verrouillage à distance. **L'APPLICATION D'UNE TENSION DE POLARITÉ OU DE POLARITÉ PEUT ENTRAÎNER UN FONCTIONNEMENT ANOMAL ET/OU ENDOMMAGER LE PRODUIT, ET POURRAIT AVOIR UN IMPACT SUR LA SÉCURITÉ.**

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Les clients prévoyant de connecter plusieurs verrouillages à distance Light Engine ensemble devront contacter Lumencor avant l'intégration. **L'INTERCONNEXION DE MOTEURS LÉGERS OU L'UTILISATION INCORRECTE DU VERROUILLAGE À DISTANCE PEUT ENTRAÎNER UN COMPORTEMENT ANOMAL ET/OU ENDOMMAGER LES PRODUITS.**

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

**AVERTISSEMENT :** Avant d'appliquer/de couper l'alimentation ou 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).

**Note:** In the event of **ANY** normal or abnormal interlock fault condition (including high ESD/EMP/EFT conditions ~2kV) you **MUST** clear the latched fault condition, either by pressing the manual reset button or by cycling the power switch.

### 3.3.2 Start Up

1. Insert the light guide and secure it with the set screw<sup>1</sup>.
2. Insert the external gate jumper (Figure 2) in the labeled socket on the front panel (Figure 3). Insert the interlock jumper in the labeled socket in the lower left corner of the rear panel<sup>2</sup> (Figure 4).
3. Insert the control key, turn it to the **ON** position.
4. Connect the isolated DC power supply to the Light Engine.
5. Connect the AC power cord to the DC power supply.
6. As soon the DC power supply is energized, the master power button (top right) will automatically light up. The Light Engine automatically starts when the power is connected; there is no need to push the master power button<sup>3</sup>.
7. 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.
8. When the initiation sequence completes, “LUMENCOR” will flash on front display panel and then be replaced by a display showing the current Light Engine IP address, the internal temperature and the fan status. At the same time, the fan will come on at HI for about 2 seconds and then shut off automatically. The Light Engine is now ready for use. Prior to turning the light output on, verify the output end of the liquid light guide or optical fiber is safely directed into an enclosed optical path (e.g. a beam dump).

#### Notes:

- 1 Ensure that the distal end of the light guide or optical fiber is safely directed into an enclosed optical path (e.g. microscope epi-illuminator or a beam dump) before applying/removing power or

turning the light output on. If the Light Engine is equipped with an output adapter for an SMA-terminated optical fiber, connect the fiber to the output adapter using the integral threaded sleeve.

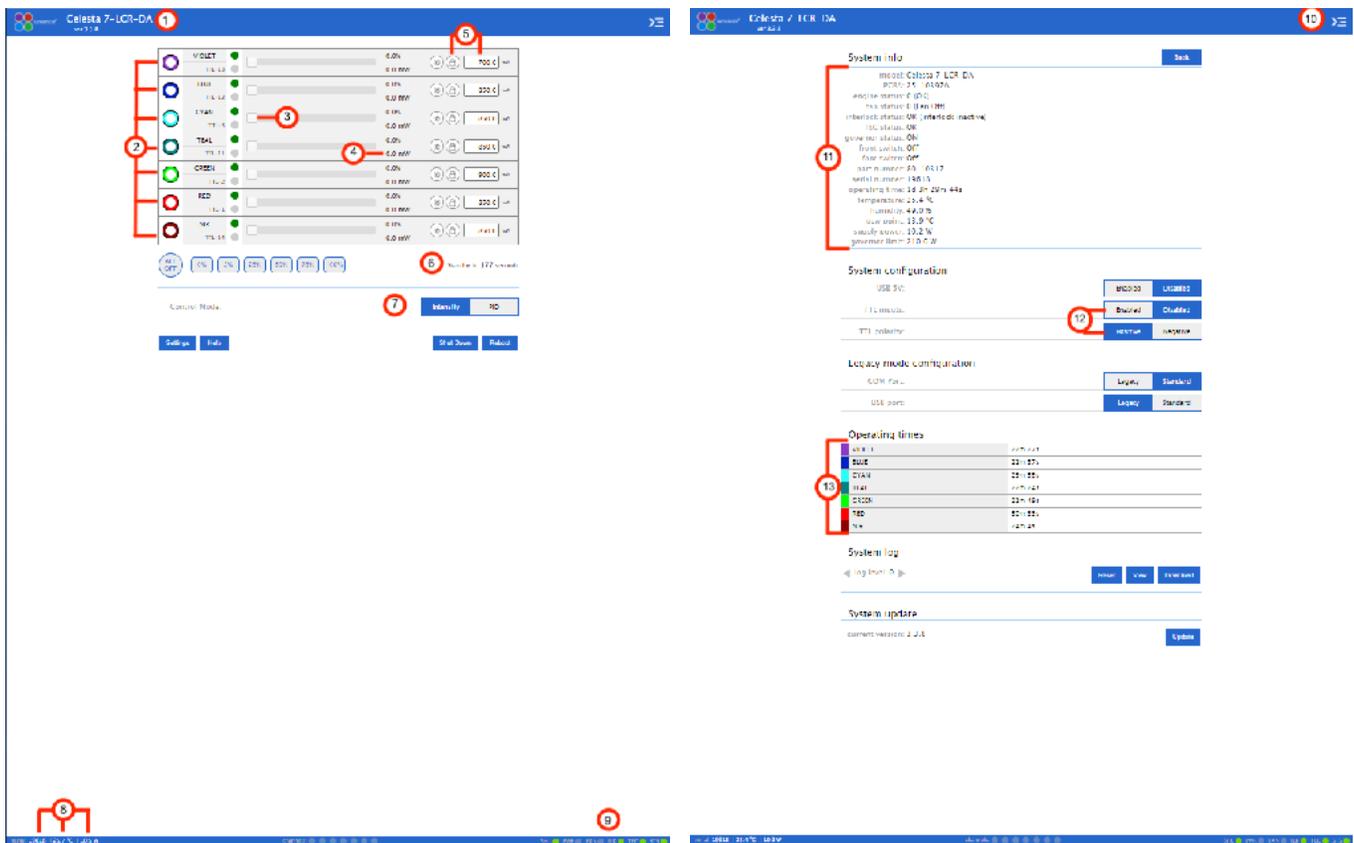
**2** To enable light output of the CELESTA Light Engine the external gate jumper, control key, remote interlock jumper, and liquid light guide must be inserted.

**3** For subsequent start ups, use the master power button to start or shut down the Light Engine. Shut down can also be accomplished using the “Shut Down” button in the GUI (Figure 5, left).

### 3.3.3 Ethernet Connection and Control GUI

The Web GUI provides a quick and easy way to control the Light Engine, providing the ability to turn each source on/off (Figure 5, Control Tab [left], 2), adjust the power of each source independently from off to full power (Figure 5, Control Tab [left], 3). The GUI also tracks the total on time and the power sensor readings (Figure 5, Control tab [left], 5). A channel map stored on the onboard computer is used to define the association of control addresses with light sources. The channel map can be viewed by sending the command GET CHMAP to the LAN port. To set up the Web GUI, follow the protocol below:

1. Go to Start menu > Control Panel > Network & Internet and/ or Network & Sharing Center
2. Click Change Adapter Settings



**Figure 5.** CELESTA GUI, Control Tab (Left) and Settings Tab (Right). The GUI is accessed by typing the light engine IP address (198.168.201.200 in this example) into a web browser. 1) Lumencor light engine model number and software version, 2) ON/OFF control of source channel, 3) Intensity slider, 4) Live power read out in mW, 5) power regulation controls: locked in when padlock and input box are grey, 6) Count down timer to Standby mode, 7) Control mode setting, 8) serial number of light engine, live temperature read out, and live power draw read out, 9) Status indicator buttons, 10) Command line access, 11) System information, 12) TTL controls, 13) Light source on time read out.

3. Right-click on Local Area Connection
4. Click on Properties (in pop-up)
5. Select Internet Protocol Version 4 (TCP/IPv4)
6. Click Properties button
7. 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

8. Connect the RJ45 cable (supplied with the Light Engine) between the LAN port on the Light Engine and an ethernet port on the computer.

9. Type the Light Engine IP address (Figure 3) into any web browser address bar to access the resident Web GUI. The factory default IP address is 192.168.201.200.

Control of CELESTA Light Engines is implemented through a built in library of software commands. A complete listing of the commands is provided in the *Lumencor Light Engine Command Reference* (Document Number 57-10018). These commands can be delivered using using Transmission Control Protocol (TCP) to the LAN input. The IP address of the Light Engine required for LAN communication is shown on the front panel status display (Figure 3) or can be obtained using the GET IP command addressed to the RS-232 or USB serial ports. The Light Engine software commands can also be delivered via the USB or RS-232 serial ports (Figure 3) from various third-party data acquisition software packages.

CELESTA Light Engines that are operating on software version 2.1.19 and above (Figure 5, Control Tab [left], 1) have a **standby mode** (Figure 5, Control Tab [left], 6) to conserve power during periods when no active light output generation is required. The Light Engine automatically switches into standby mode after a latency period (i.e. after the last light output = OFF command was issued). The default latency period is 300 seconds (5 minutes), this can be temporarily reset by the user by using the “WAKEUP” command in the **command line** (Figure 5, Setting Tab [right], 10). Standby mode is also marked by an automatic shut-off of the main cooling fan. Standby mode automatically terminates when the next light output = ON command is issued.

Output power regulation allows users to eliminate variations in light output due to temperature fluctuations and other environmental factors in photometric and quantitative imaging applications where reproducibility and accuracy are essential. To use power regulation, a desired power reference value in milliwatts is entered in the onboard control GUI (Figure 5, Control tab [left]). To activate power regulation, simply click the padlock icon next to the reference power value (Figure 5, Control Tab [Left], 5). Gray shading of the padlock icon and the reference power value shows that power regulation is active for the selected output channel. When power regulation is active, the intensity setting for the channel is controlled by the onboard microprocessor, based on feedback from the Light Engine’s reference photodiode array. The microprocessor continuously adjusts the intensity setting so that the output power matches the power reference value set by the user.

### 3.3.4 Control via Serial Ports

CELESTA Light Engines have two serial ports, labeled USB and RS-232 (Figure 3), which can be set to receive either LEGACY or STANDARD mode commands. Connection to the computer requires a USB-A-to-USB B cable (29-10058) or USB-to-RS-232 cable (29-10011). LEGACY commands are

limited to controlling on/off switching and intensity adjustment of selected individual color channels. Only one of the two serial ports can be set to LEGACY mode at one time. The STANDARD mode command set gives access to an extensive panel of operating status reports and configuration settings in addition to the the basic control functions of the LEGACY command set. A complete listing of STANDARD mode commands is provided in *Lumencor Light Engine Command Reference* (Document number 57-10018). Note that LEGACY and STANDARD mode communications use different serial protocols (9600,8,N,1 and 115200,8,N,1 respectively). Changes to the command mode setting for a serial port can be made via the **Settings** screen of Web GUI (Figure 5, right). Changes are applied instantaneously and are retained between power cycles.

Select the command mode setting for the serial port that is compatible with the Light Engine device driver in the control software. This selection is typically found under the “Devices” tab. The COM port address assigned by the computer to the Light Engine USB serial port must be correctly registered in control software at the same place.

### 3.3.5 Control From Light Engine Control Pod

1. Connect the CELESTA to pod (p/n 83-10007) using USB A-to-USB B cable (p/n 29-10058)
2. Open the Web GUI control interface as described in Section 3.3.3.
3. Go to the SETTINGS page in the Web GUI. Make sure that the USB port configuration is set to LEGACY mode and USB 5V is set to ENABLED.
4. The pod must be set in CELESTA 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 CELESTA 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 “CELESTA” by turning the pod control knob. Press the MODE button again to select CELESTA control mode and return to the main control screen.
5. Follow the instructions on Lumencor’s Light Engine Control Pod Operation sheet (p/n 54-10036). In brief, press the COLOR button to select output light output channel, press the MODE button to toggle light output on and off and turn the control knob to adjust intensity for the current light output channel selection.

### 3.3.6 TTL Control

The TTL Interface provides users with a faster method of switching color channel outputs on and off. Individual TTL inputs are provided for each color channel, as shown in the adjacent table. As a safeguard against unintended light output when the inputs are initially connected, the Light Engine TTL port is disabled and must be enabled by a serial command. To enable the TTL input, click the **Enabled** button next to “TTL inputs” in the GUI under the **Settings** tab (Figure 5, right) or send the standard mode command SET TTLENABLE to the LAN port. Input TTL signals can be conveniently addressed using an accessory BNC breakout cable (Lumencor part no. 29-10156 or 29-10216; Figure 6) connected to the front panel TTL port. The breakout cable also provides a global shutter input (labeled “shutter”). TTL signals input to the global shutter will synchronously toggle all currently enabled source channels on and off.

#### TTL Connector Pin Definitions

OUTPUT COLOR	Pin#	OUTPUT COLOR	Pin#
RED	1	BLUE	12
GREEN	2	VIOLET	13
CYAN	3	nIR	14
TEAL	11		
Gnd	6,7,8,10		
$V_{i\text{high}}(\text{min}) = 2.0\text{V}$ , $V_{i\text{high}}(\text{max}) = 5.5\text{V}$ $V_{i\text{low}}(\text{min}) = 0.0\text{V}$ , $V_{i\text{low}}(\text{max}) = 0.8\text{V}$			

#### 4. Light Output Characteristics

The solid state laser sources installed in the CELESTA Light Engine and the bandpass filters associated with each are shown on the Certificate of Conformance included with the shipping documents e-mailed by Lumencor to the customer. The certificate of conformance also shows full (100%) power outputs for each source measured at the terminus of the optical fiber (Figure 1). Not all sources may be turned on simultaneously. To prevent exceeding the capacity of the DC power supply, power consumption is tracked by the onboard computer. If a set limit (see **Governor**, Figure 5, right) is exceeded, either by increasing intensity settings for sources that are already on, or by turning on additional sources, commands will be rejected. To clear the error condition, reduce intensities of sources that are on or turn off additional sources.

Light source outputs are refined by internal bandpass filters. The specifications of these bandpass filters are recorded on the certificate of conformance as CWL/ FWHM where CWL = center wavelength and FWHM = full width at half-maximum transmission, both measure in nanometers (nm). In fluorescence microscopy applications, having a second excitation filter located in the microscope cube is generally **not required**. The internal bandpass filters are not user-exchangeable and changes require return of the Light Engine to Lumencor's factory for service (see Section 7). A new certificate of conformance will be provided as part of this service.



**Figure 6.** BNC breakout cable (p/n 29-10156). The same cable configuration with SMB connectors instead of BNC is also available (29-10216)

#### 5. Operational Specifications

CELESTA Light Engines must be operated and stored within the environmental conditions specified in the table below. Performance specifications for individual Light Engines are listed on the certificate of conformance included with the shipping documents e-mailed to the customer (see example shown in Figure 1). 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](mailto:techsupport@lumencor.com). The request message must include the 4- or 5-digit serial number of the Light Engine.

#### 6. Routine Maintenance and Trouble Shooting

No routine maintenance is required. There are no user-replaceable components or sub-assemblies in the CELESTA 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, please contact Lumencor Technical Support for assistance, as directed in Section 7.

**CELESTA AND CELESTA QUATTRO LIGHT ENGINE OPERATIONAL SPECIFICATIONS**

Specification	Detail
<b>Temperature</b>	
Operating	32 to 86° F (0 to 30° C)
Non-operating	-4 to 158° F (-20 to 70° C)
<b>Humidity</b>	
Operating and non-operating	0 to 80% relative humidity, non-condensing <sup>1</sup>
<b>Dew Point</b>	
Operating	32 to 59° F (0 to 15° C)
<b>Altitude</b>	
Operating	0 to 10,000 feet (3,048 meters)
Non-operating	0 to 45,000 feet (13,176 meters)
<b>Dimensions</b>	
Size (W x L x H)	145 mm x 340 mm x 203 mm (5.7 in x 13.4 in x 8.0 in)
Weight	8.7 kg /19.1 lbs
Lifetime	Time for light engine output to decrease to 70% of the values recorded on the original certificate of conformance <sup>2</sup>
Power supply	24VDC / 9.2A
Warm-up Period	1 s
Protection	Thermal overload (Section 3.2). Power overdraw (Section 4)
Sound Level	Sound level at 1 meter < 65dB(A)
Control Interfaces	USB, RS-232, TCP, TTL
Warranty	24 months parts and labor
<sup>1</sup> The CELESTA Light Engine must be operated in a non-condensing environment (dew point <15°C with controlled ambient temperature <30° C). <sup>2</sup> 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.	

Troubleshooting Procedures	
Problem	Check the following
No response to serial (USB or RS-232) commands	Check that the LEGACY or STANDARD command mode selection (GUI Settings; Figure 5) is compatible with the software driver.
No response to TTL trigger commands	Check that <b>TTL inputs</b> are ENABLED (GUI Settings; Figure 5) and that the <b>TTL polarity</b> setting is consistent with the trigger inputs. Also check that all serial ON/OFF controls are in the OFF state.
No light output in response to source <b>ON</b> command (serial or TTL).	There are 4 interlocks that need to be closed, check all of these: <ol style="list-style-type: none"> <li>1. Control key must be inserted in front panel and turned to “on” position<sup>1</sup>.</li> <li>2. Liquid light guide must be inserted in light output receptacle<sup>1</sup>.</li> <li>3. Remote interlock jumper must be inserted in rear panel<sup>1</sup>.</li> <li>4. External gate jumper must be inserted in front panel (Figure 3).</li> </ol>
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 optical fiber, the adaptor connecting the fiber to the microscope epilluminate or another distal component of the microscope optical path and not to abnormally low light output from the light engine.
Unusually weak fluorescence signals in a single detection channel (e.g. DAPI)	<ol style="list-style-type: none"> <li>1. Check that the light engine power output reading in the Web GUI (Figure 5) is normal.</li> <li>2. Check that the dichroic beamsplitter and emission bandpass filter in the microscope are compatible with light engine excitation filter specifications shown on the certificate of conformance (Figure 1)<sup>2</sup>.</li> </ol>
High, spatially uniform fluorescence background	Check that the dichroic beamsplitter and emission bandpass filter in the microscope are compatible with light engine excitation filter specifications shown on the certificate of conformance (Figure 1).
<sup>1</sup> Open interlocks for these conditions will be indicated by a red status indicator in the lower right corner of the GUI control screen (Figure 5). <sup>2</sup> Excitation filters are installed in the light engine. Excitation filters installed in the microscope cube are generally redundant and it is recommended that they are removed.	

## 7. Customer Support

For technical support of the CELESTA or CELESTA quattro Light Engines, please contact Lumencor by phone at 503-213-4269 or through e-, mail at [techsupport@lumencor.com](mailto:techsupport@lumencor.com). Please be prepared to provide the 4- or 5-digit serial number of the Light Engine. Any Light Engine returned to Lumencor for repairs or upgrades 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.

## 8. Warranty

The CELESTA Light Engine is 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 in the certificate of conformance. The Light Engine must also have been used and maintained under operating conditions consistent with the specifications given in Section 5, and observing all the Precautions and Warnings notified in Section 2. This warranty does not extend to Light Engines that have been subject to misuse, accident, tampering or improper installation. Accessories including (but not limited to) optical fibers, collimators, cables and control consoles are not covered by the

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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.