SPECTRA and SPECTRA X Light Engine® Instruction Manual

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: Spectra**" is used as a representative model for all certified and CE marked Spectra Products.

Emissions

This equipment has been tested and found to comply with the limits of EMC directive 2014/30/EU. 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)

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 http://lumencor.com/company/regulatory-compliance/

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Table of Contents

1. Introduction

Lumencor SPECTRA and SPECTRA X light engines are designed for laboratory use by bioanalytical researchers and/or developers of life science instrumentation. The SPECTRA provides 4, 5, 6 or 7 spectrally discrete, bright, controllable light outputs directly to a sample; or in the case of fluorescence microscopy, to the objective. Each of the colors is produced by an independent module that has been optimized to produce a precise set of wavelengths. The SPECTRA X provides 6 solid state light sources whose outputs are refined by user-exchangeable bandpass filters. Light output can be coupled into a liquid light guide (LLG) or SMA-terminated optical fiber via exchangeable output adapters. This manual covers all SPECTRA and SPECTRA X models.

The SPECTRA and SPECTRA X can be controlled by serial commands to the RS-232 port from Lumencor's Light Engine Control Pod accessory (part number 83-10007), from a computer workstation running 3rd party image acquisition control software or from Lumencor's SPECTRA control GUI. The GUI controls only the light engine. Third-party image acquisition control software is required for co-ordinated operation of the light engine with cameras and other peripherals. The Light Engine Control Pod accessory controls light source selection, on/off switching and output intensity using two push buttons and a rotary dial in combination with menus and status displays on a built-in screen. A second USB port on the pod allows pass-through control of the light engine from computer workstations. The SPECTRA and SPECTRA X are also equipped with TTL control interfaces. TTL provides source selection and light output on/off switching but not intensity control. However TTL signals elicit much faster responses than serial commands. TTL control signals are typically derived from hardware peripherals such as cameras or digital acquisition (DAQ) cards.

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 your new SPECTRA. 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 nouveau SPECTRA 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.

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: DO NOT use an unapproved power supply. The Lumencor supplied external power supply (see Section 3.1) is recommended for use with SPECTRA and SPECTRA X light engines. The equipment is required to be supplied by a properly approved/certified DC power source meeting the minimum electrical ratings of the product. it is imperative that the DC power supply has output over-current protection, as the light engine power input is not fused. Connect the AC power cord to a receptacle with a protective safety (earth) ground terminal.

Avertissement: NE PAS utiliser une alimentation non approuvée. L'alimentation externe fournie par Lumencor (voir la section 3.1) est recommandée pour les moteurs légers SPECTRA et SPECTRA X. L'équipement doit être fourni par une source d'alimentation DC homologuée et homologuée répondant aux caractéristiques électriques minimales du produit. Il est impératif que l'alimentation en courant continu ait une protection de surintensité de sortie, car l'entrée de puissance légère du moteur n'est pas fusionnée. Connectez le cordon d'alimentation secteur à une prise avec une borne de terre de sécurité (terre) protégée.

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 required to couple directly into a microscope or other bioanalytjcal 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 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 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: UV emitted from this product. Avoid eye and skin exposure to unshielded product.

GROUPE DE RISQUE 3

Avertissement: UV émis par ce produit . Évitez les yeux et la peau exposition au produit non blindé.

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

Caution: DO NOT open the unit. There are no serviceable parts inside and opening the light engine enclosure will void the manufacturer's warranty.

Attention: 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 connect a video cable to the TTL input enable port. Although the connector might look compatible, this input is not intended to be driven by a video signal.

Attention: NE PAS raccorder un câble vidéo au port d'activation d'entrée TTL. Bien que le connecteur puisse paraître compatible, cette entrée n'est pas conçue pour être contrôlée par un signal vidéo.

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 SPECTRA being used in a way for which it was not intended and in complete disregard for all 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 SPECTRA autre que celle prévue et du mépris total de toutes les mesures de sécurité et mises en garde affichées.

3. Installation and Operating Instructions

3.1 Contents

SPECTRA and SPECTRA X light engines all ship with the following list of standard components.

1. SPECTRA or SPECTRA X light engine, configured with four, five, six or seven output channels. The installed excitation filter configuration will be listed on the certificate of conformance supplied with the unit (Figure 1).

2. A 24V/9.2A DC power supply (Lumencor part no. 27-10019) [1].

3. A region-specific 6ft AC power cord for the power supply (see adjacent table).

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. Specimen certificate of conformance for SPECTRA X Light Engine.

4. A USB-to-RS232 cable (Lumencor part no. 29-10011) for serial communication with computer workstations or the Light Engine Control Pod.

5. Output adapter for light delivery via 3 mm diameter liquid light guide or SMA-terminated optical fiber (Figure 2).

Notes

[1] SPECTRA X light engines shipped before March 2017 were supplied with a 28V/7.9A power supply (Lumencor part no. 27-10003). The correct power supply rating for the light engine is marked above the DC power input connector on the back of the light engine (Figures 3 and 5).

3.2 Installation

When setting the SPECTRA or SPECTRA X up for use, be sure to place the unit on a hard surface and avoid blocking or restricting airflow at the air intake (front panel, left of the light output port) or exhaust ports (on the underside of the unit, see Figure 9). Restricting the airflow will cause the unit to operate at elevated temperatures and will result in decreased product life and/or premature failure. Position the unit in such an orientation that allows unrestricted access to the
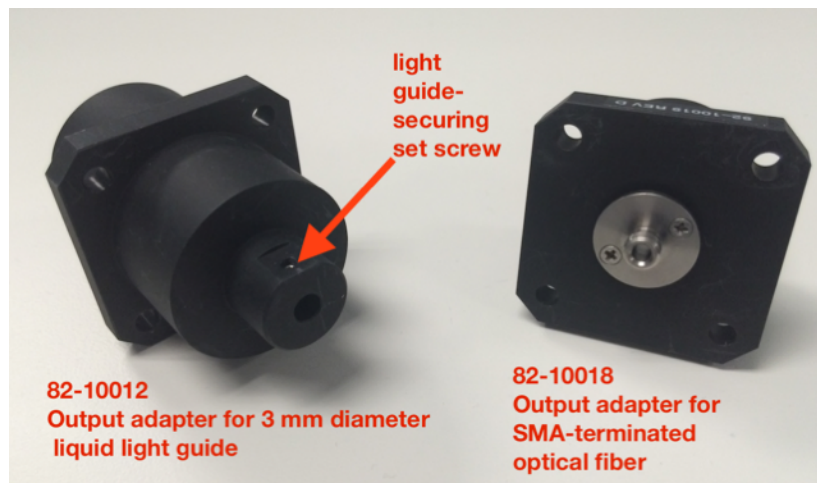

Figure 2. Output adapters for SPECTRA and SPECTRA X light engines.

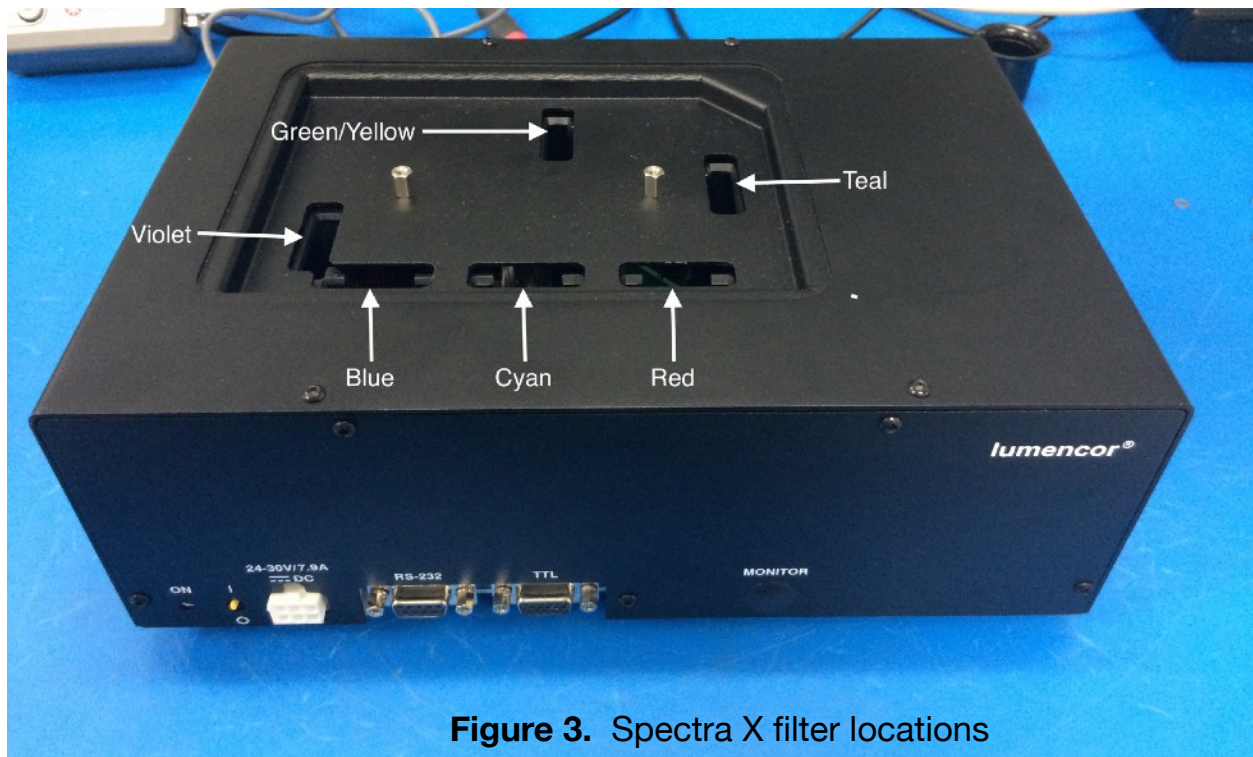DC power connector. In an emergency, you may need to disconnect power to the unit quickly.
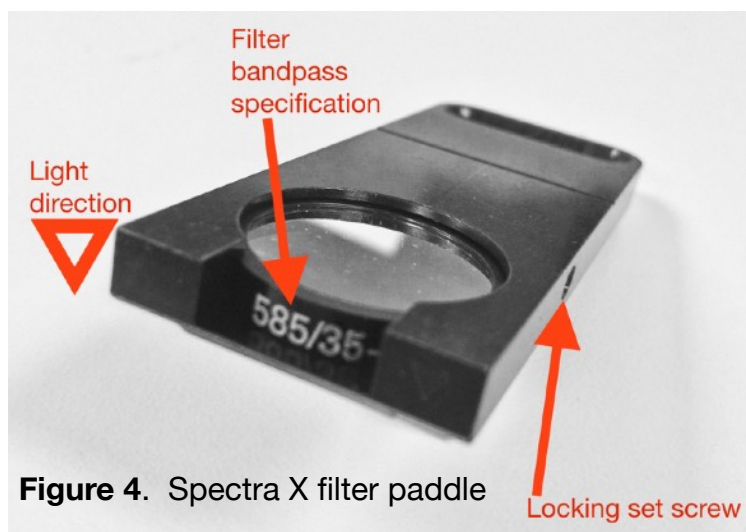

Figure 3. Spectra X filter locations

Figure 4. Spectra X filter paddle

To install the output adapter, remove the shipping cover from the light output port on the front panel by extracting the four M4 fixing screws. Insert the output adapter (Figure 2) into the output port and secure it with an M4 fixing screw in each corner. Retain the light output port shipping cover and re-install it in the event that the light engine requires transportation. Attach the optical fiber or liquid light guide to the output adapter. In the case of liquid light guides, secure the tip of the light guide in the output adapter using the set screw provided (Figure 2). Prior to activating light output, be

sure the output end of the light guide or optical fiber is safely directed into an enclosed optical path (e.g. microscope input collimator or a beam dump). **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.

SPECTRA light engines have bandpass filters associated with each light source. These filters are part of the order specification and are not user-exchangeable. SPECTRA X light engines have user-exchangeable filters installed in

Figure 5. Control interface connections on SPECTRA light engine rear panel.

removable paddles which the user can access once the top cover retained by two thumb screws is removed (Figure 3). The paddles accept standard 25 mm diameter filters. A set screw recessed in the body of the paddle engages the perimeter mounting ring of the filter to secure it in place (Figure 4). A listing of standard bandpass filters available for installation in SPECTRA and SPECTRA X light engines can be found at http://lumencor.com/products/filters-for-spectra-x-light-engines/

3.3 Operation Using the Light Engine Control Pod

1. Move the master power switch on the lower left of the SPECTRA rear panel (Figure 5) to the **ON** position. A green LED next to the switch indicates that power to the light engine is ON.
2. Connect the USB A port of the light engine control pod accessory (83-10007) to the RS-232 port on the SPECTRA (Figure 5) using the USB-to-RS-232 cable (29-10011). Connect the USB B port of the control pod to a USB A port on a host computer [1].
3. Press and hold the **right** button on the pod until a menu of light engines appears. Turn the rotary dial to select "SPECTRA" from the menu. Press the **right** button again to return to the main (0–100 analog intensity) display screen.
4. Before turning the light output on, be sure the output end of the light guide or optical fiber is safely directed into an enclosed optical path (e.g. microscope input collimator or a beam dump).
5. Press the **left** button to select the desired color channel. Successive presses will cycle through the available color channels.
6. Press the **right** button to turn the selected light source on [2]. Adjust the output intensity using the rotary dial [3,4]. Press the **right** button again to turn the selected light source off.

7. Press and hold the **left** button to view a digital rendition of the intensity setting [5]. Press the **right** button to return to the main display screen.

8. Serial commands sent from a host computer to the USB B port of the control pod will automatically switch the pod from local to pass-through mode, indicated by the message "PC pass through mode active" shown on the pod display screen. Local command mode is disabled as long as pass-through mode remains active.

9. To quit pass-through mode and return to local command mode, press the **right** button on the pod twice.

10. Further details of control pod operation are provided in a downloadable instruction sheet.

Notes

[1] When configured for pass-through operation, the host computer supplies electrical power to the pod. The pod will turn on when the connection is made. For stand-alone operation (no pass-through), connect a DC power supply (5V/500mA) to the USB B port of the pod.

[2] There is no warm-up time; the light engine output stabilizes less than 1 second after the light output is switched on. Light output can be switched off during intervals when it is not required for active viewing or data collection. 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.

Figure 6. USB connectors on the rear of the light engine control pod.

[3] Output intensity can be set from 0–100% in 1% increments; however operation in the 0–5% range is not recommended.

[4] Dialing intensity to zero automatically issues an OFF command to the light engine. Press the **right** button to turn the light output on again.

[5] The current intensity settings are internally stored. When the pod is powered down, the settings are retained and will be restored at the next restart.
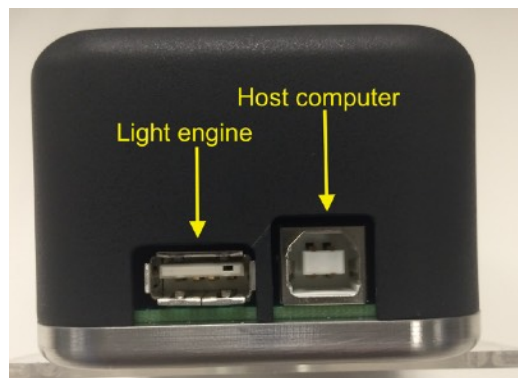
3.4 Operation Using Computer Workstation

1. Although the following instructions specify Lumencor's SPECTRA GUI, operations using third-party image acquisition control software that provide co-ordinated operation of the light engine with cameras and other peripherals are generally similar.

2. Operation and installation of the SPECTRA GUI requires a computer running the Windows operating system with a free USB port.

3. Download the zip file for the SPECTRA GUI INSTALLER from http://lumencor.com/resources/documentation-software/.

4. Unzip the file and run setup.exe to install the SPECTRA GUI.

5. Connect the USB A-to-RS-232 cable between the computer and the RS-232 serial port on the SPECTRA (Figure 5).

6. Successful installation is indicated by the appearance of "USB Serial Port (COM #)" under the "Ports (COM &LPT)" tab in the Windows Device Manager. If the virtual COM port (VCP) is not registered by the operating system, download and install the VCP driver from http://lumencor.com/resources/documentation-software/.

7. Connect the DC power supply to the SPECTRA.

8. Check that the liquid light guide or optical fiber is securely connected to the output adapter on the front panel and that the output end is safely directed into an enclosed optical path (e.g. microscope input collimator or a beam dump).

9. Toggle the power switch on the rear panel to the ON position. The green LED next to the switch (Figure 5) indicates that power to the light engine is ON.
10. Run the GUI by going to the Program Menu and selecting LLE 7CH GUI.
11. In the COM pulldown menu (GUI window, upper right), select COM # assigned to USB-Serial port.
12. Press the "INIT" button in the GUI.
13. The computer should now have control of the SPECTRA. In the GUI window, a graduated slider controls the output intensity for each component light source [1,2]. The ON-OFF button below each intensity slider turns light output from the selected source on or off.
14. The G/Y button selects green or yellow light output from SPECTRA light engines. Green output is the default selection on start up. For SPECTRA X light engines, this control is inactive and green/yelllow output selection is accomplished by manual interchange of filters (Figure 3).
15. There is no warm-up time; the light engine output stabilizes less than 1 second after the light output is switched on. Light output can be switched off during intervals when it is not required for active viewing or data collection. 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.

Notes

[1] Output intensity can be set from 0–100%; however operation in the range 0–5% is not recommended.

[2] Setting the intensity slider to zero is **not** functionally equivalent to turning light output off using the ON-OFF button. In this condition, the fan will continue to run as the light sources are still energized, even though their output may not be detectable.

3.5 TTL Interface

The TTL interface provides users with a faster method of switching color channel outputs on and off. Individual TTL lines are provided for each color channel (Figure 5). These can be conveniently addressed using an accessory BNC breakout cable (Lumencor part number 29-10015 or 29-10080) connected to the rear panel DB15 TTL port. Note that TTL and serial on/off commands have a logical OR relationship. Therefore source on/off controls on the light engine control pod,

TTL (DB15HD) Connector Pin Definitions

Pins	Definition	DC Characteristics
1, 2, 3, 11, 12, 13	Red, Green, Cyan, Teal, Blue, UV respectively	$VCC = 5.0V$ V_{ilow} (max) = 1.5V, V_{ihigh} (min) = 3.3V, $I_{ilow} = 0.5mA,$ $I_{ihigh} = 1.0\mu A$
15 - Green/Yellow	Excitation Filter Select V_{in} = H => Green, V_{in} = L => Yellow	$VCC = 5.0V$ V_{ilow} (max) = 1.5V, V_{ihigh} (min) = 3.3V, $I_{ilow} = 0.5mA,$ $I_{ihigh} = 1.0\mu A$
6, 7, 8, 10	Gnd	
4, 9, 14	N/C	
TTL polarity may be set ACTIVE = HIGH **or** ACTIVE = LOW. This setting is part of the order specification provided by the customer.		

RS-232 (DB9) Connector Pin Definitions

Pins	Definition	DC Characteristics
1, 2, 3, 4, 6, 7, 8	DCD, RXD, TXD, DTR, D3R, RTS, CTS	$VCC = 5.0V$ V_{ilow} (max) = 0.8V, V_{ihigh} (min) = 2.4V, $I_{ilow} = 0.5mA, I_{ihigh} = 1.0\mu A$
5	Gnd	
9	N/C	
This port conforms to standard RS-232 interface protocol.		

in the SPECTRA GUI or in third-party image acquisition control software must be set in the "OFF" state when using TTL control. The TTL interface does not control source output intensity, which remains under serial (RS-232) control. TTL polarity (ACTIVE = HIGH or ACTIVE = LOW) is factory set according to order specifications.

3.6 Metered Dosage Operation

Open loop and closed loop output monitoring and feedback systems are available as optional add-ons for SPECTRA and SPECTRA X light engines. These systems consist of a modified output adapter that directs a small fraction of the light output to an onboard reference photodiode, together with supporting signal processing electronics. For open loop monitoring , the reference signal is output to a rear panel BNC connector (Figure 7) for external display or processing. In closed loop operation, activation of the selected light source starts an onboard counter that accumulates the active reference count from the photodiode and compares it to a control count value input by the user. When the reference count reaches the control value (i.e. when the metered light dose has been delivered), the light output automatically shuts off. All closed loop metered dosage functions are controlled from a serially connected computer. A Windows GUI implementation is available free on request. The GUI also includes standard SPECTRA source selection and intensity setting controls (Section 3.4). Further details of metered dosage operation are provided in a downloadable technical bulletin.
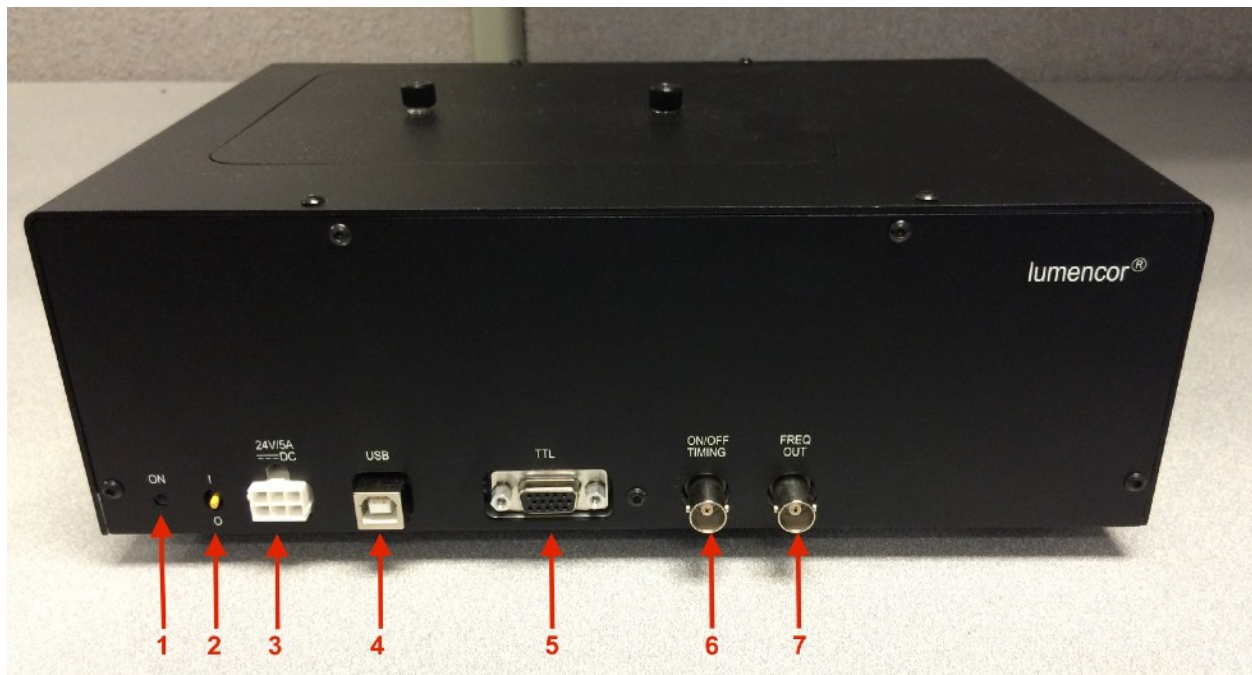

Figure 7. Rear panel of a SPECTRA X light engine equipped with metered dosage option. **1.** Indicator LED. Illuminates when DC power supply (**3**) is connected and power switch (**2**) is ON. **2.** ON (l)/OFF (O) electrical power switch. **3.** Input connection from DC power supply. **4.** Serial port for control from Lumencor GUI or third-party software. Requires virtual serial port (VSP) driver installation on host computer. **5.** Provides independent on/off control of each component light source via TTL pulses delivered via BNC breakout cable (Lumencor part number 29-10080 or 29-10015). **6.** Outputs analog signals synchronized to light dose on and off time points. **7.** Outputs 0–5V square wave with frequency proportional to light flux detected by the reference photodiode for external display or processing.

4.Spectral Output

SPECTRA light engines can have 3–7 discrete spectral outputs, depending on their customer-specified configuration. SPECTRA X light engines have 7 discrete outputs (Figure 8) derived from an array of 6 solid state light sources. The SPECTRA X teal source can optionally be replaced by a near-infrared (nIR) source providing output from 710–750 nm (depending on the associated filter bandpass).
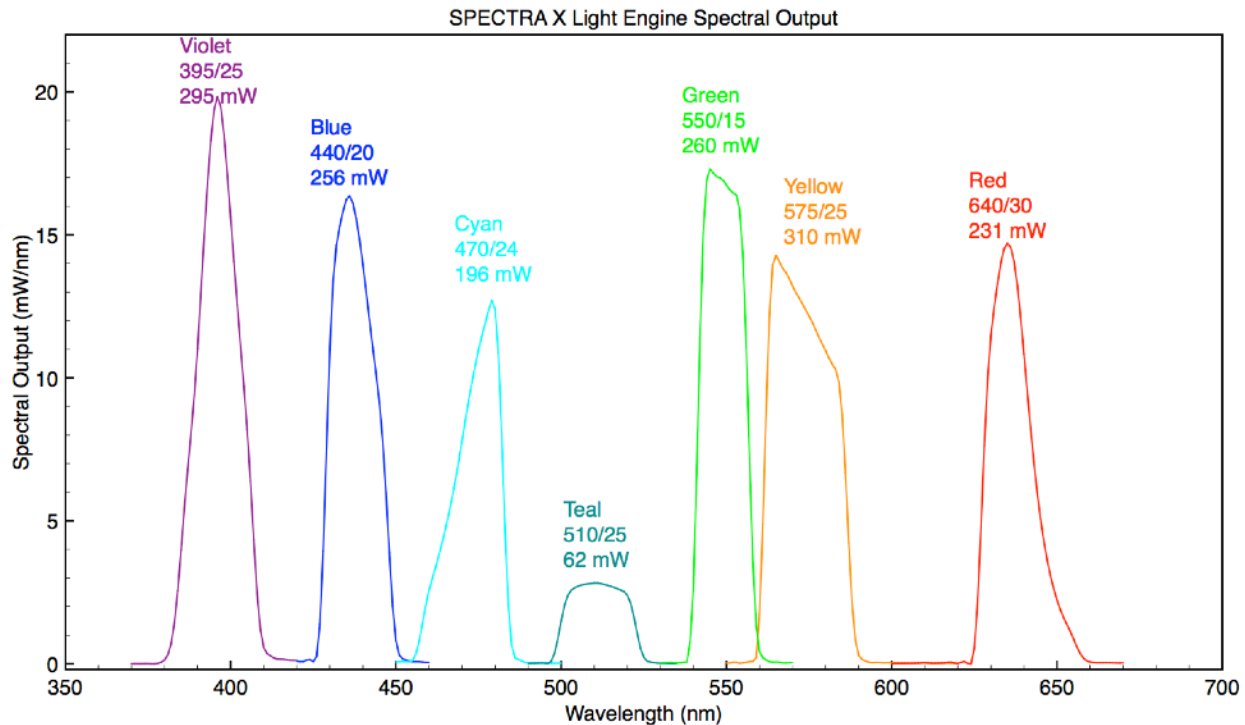

Figure 8. Representative spectral output of a SPECTRA X light engine equipped with bandpass filters compatible with Chroma Technology quad band dichroic VCGR-SPX-P01-PC and emitter VCGR-SPX-P01-EM. All outputs are electronically selectable except for Green/Yellow, which is accomplished by manual interchange of filters.

5. Routine Maintenance and Trouble Shooting

Remove any built-up dust or accumulation on the air intake ports. A vacuum may be used to remove debris so that a steady supply of air is available for cooling. It is recommended that these dust-filters be cleaned by a gentle suction device at least every 6 months and more often in dusty or smoke-filled environments. There are no user-replaceable components or sub-assemblies inside the SPECTRA. Opening the light engine enclosure will void the manufacturer's warranty. The same stipulations apply to the SPECTRA X with the exception of permitted access to the filter compartment as shown in Figure 3.

6. Customer Support

For technical support of SPECTRA and SPECTRA X light engines, please contact Lumencor by phone at 503.213.4269 or via e-mail at techsupport@lumencor.com. Please be prepared to provide the 4- or 5-digit serial number of the light engine (located on an identification label on the underside; Figure 9), a description of the problems encountered and in-
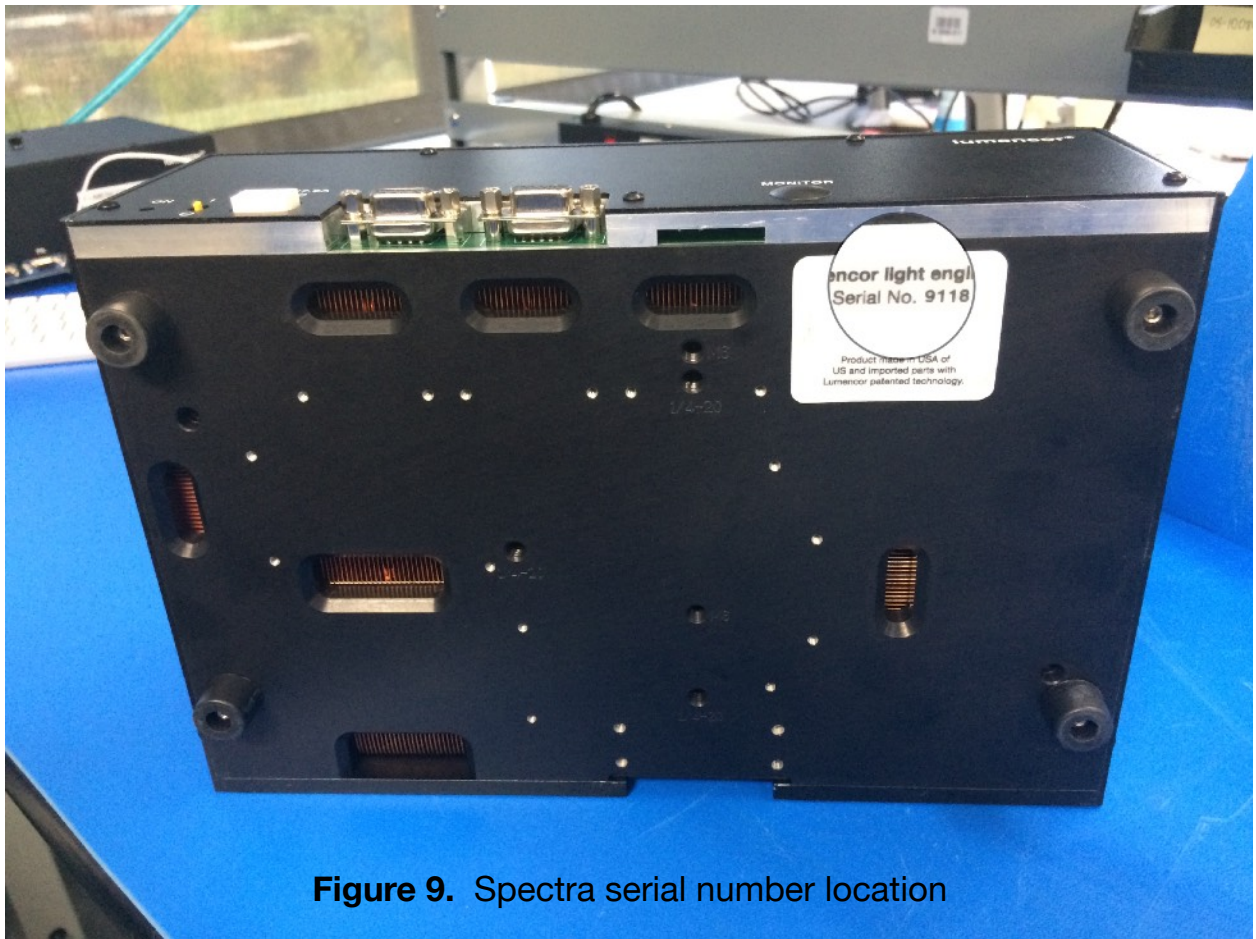
Figure 9. Spectra serial number location

formation on the usage context (e.g. what microscope and what control software is being used). This information will help to determine whether the problems can be resolved in situ by adjustments to the system configuration, or whether a fault has developed in the light engine that requires its return to Lumencor's facility in Beaverton, Oregon for evaluation and, if necessary, repair. Any light engine return to Lumencor for service or repair requires a material authorization (RMA) number. To obtain a RMA number, submit the online request form at http://lumencor.com/support/lumencor-rma-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.

7. Product Specifications

SPECTRA and SPECTRA X light engines must be operated and stored within the environmental conditions specified below. 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). It is important to retain the certificate of conformance for reference. In the event that the light engine is sold or transferred, the certificate of conformance should be conveyed 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 4- or 5- digit serial number of the light engine.

Specification	Detail
Temperature	
Operating	32 to 95° F (0 to 35° C)
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 (WxLxH)	28 cm x 19 cm x 11 cm /11.0 in x 7.5 in x 4.3 in
Weight	9.9 lb / 4.5 kg
Input Power Requirements	24V DC / 9.2A
Warm-up Period	1 s
Ingress Protection	IP Rating of IPX0
Sound Level	Sound Level at 1 meter < 65db(A)
Connections	RS-232 (DB9) for serial connection to controller pod or host computer. TTL (DB15HD) for independent source triggering via accessory BNC breakout cable
Warranty	36 months parts and labor

8. Warranty

SPECTRA and SPECTRA X light engines come with a 36 month warranty, starting on the original date of shipment from Lumencor. 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 7, 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) liquid light guides, optical fibers, collimators, cables and control consoles 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.