LPA-2

LIGHT PROJECTION ARRAY

SENSORA LIGHT MODULATION

USERS MANUAL

Revision 2.0
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1 OVERVIEW

1.1 Introduction to the LPA-2

The LPA-2 Light Projection Array is a self-contained LED[1] projector capable of generating complex light patterns based on Sensortech's unique ***Light Modulation*** technology. Light Modulation allows the embedding of pulsations within light projections, enabling a union of **colored light** with the world of **frequency-specific** information (for more details on this process, refer to Section 8.2).

The LPA-2 is capable of two modes of operation:

- **Autonomous Mode:**
  In this mode the LPA-2 autonomously runs built-in Light Programs. On their own, these programs can be used for a wide variety of beautiful "mood lighting" and luminotherapy applications.
- **External-Control Mode:**
  In this mode the LPA-2 is driven by an external PC running appropriate control software. This allows complete flexibility in creating your own light patterns and assembling them into complete custom Light Programs. This mode will be appreciated by professional light therapists who want to apply the power of Light Modulation to their work.

In addition, the LPA-2 has the capability to act as a control center for all the components needed to create a complete ***Sensora™*** multi-sensorial environment, as detailed in Section 5. The Sensora environment includes the following components:

- Immersive color projections on a large circular screen, with a Laser focal point
- A Transducer Chair for kinesthetic sound perception
- A multi-channel spatialized audio environment
- Automatic control of the room Ambiance lighting

[1] LED: *Light Emitting Diode*

As shown in Figure 1, the LPA-2 is composed of two main parts:

- A **base enclosure** containing an electronic control board. This board integrates a complete Light Modulation processor together with the LED drivers needed to power the LED Projector.
- A **LED projector head** containing 5 independent beams. Each LED beam is capable of projecting the full color spectrum, and can be oriented to conform to various projection surfaces and screens.

Figure 2 details the light beams of the LED projector head (5 x color projection beams and 2 x infrared beams). Figure 3 and Figure 4 show the various controls and sockets on the LPA-2's front and rear panels.

The LPA-2 is designed to generate light projections to be viewed as reflected on a projection surface or screen. Since it is powerful enough to illuminate an entire room, it is capable of generating light levels potentially damaging to the naked eye when looking directly into the projection beams**.**

CAUTION: *avoid looking directly into the LPA-2 light beams, only look at the reflected light on a projection surface or screen.*

The LPA-2 includes an external **DC Power Supply** compatible with all international voltages from 100VAC to 230VAC, 50-60Hz. The supply has an IEC connector (specifically: IEC 60320-C14) allowing the use of standard country-specific power cords (these are the same power cords used for PCs). Connect the power supply to the "DC Supply" socket (6) on the rear panel and push the "Power" switch (5) to turn On the LPA-2.

CAUTION: *only connect the LPA-2 to the supplied DC Power adaptor! Using any other adaptor may result in damage to the equipment.*

1.2 The LPA-2 Enclosure

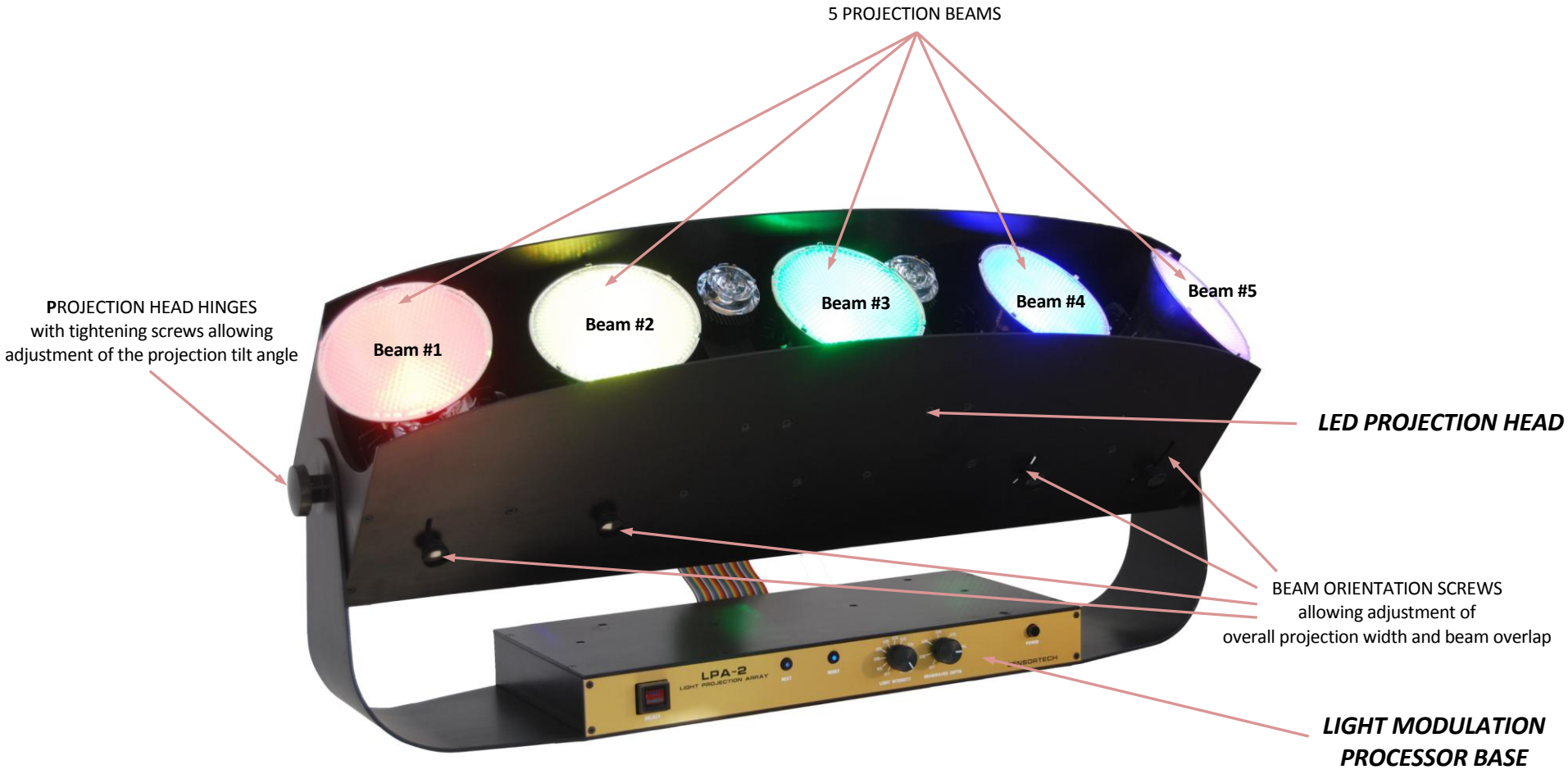

Figure 1 – LPA-2 Enclosure Overview

1.3 The LPA-2 Light Beams

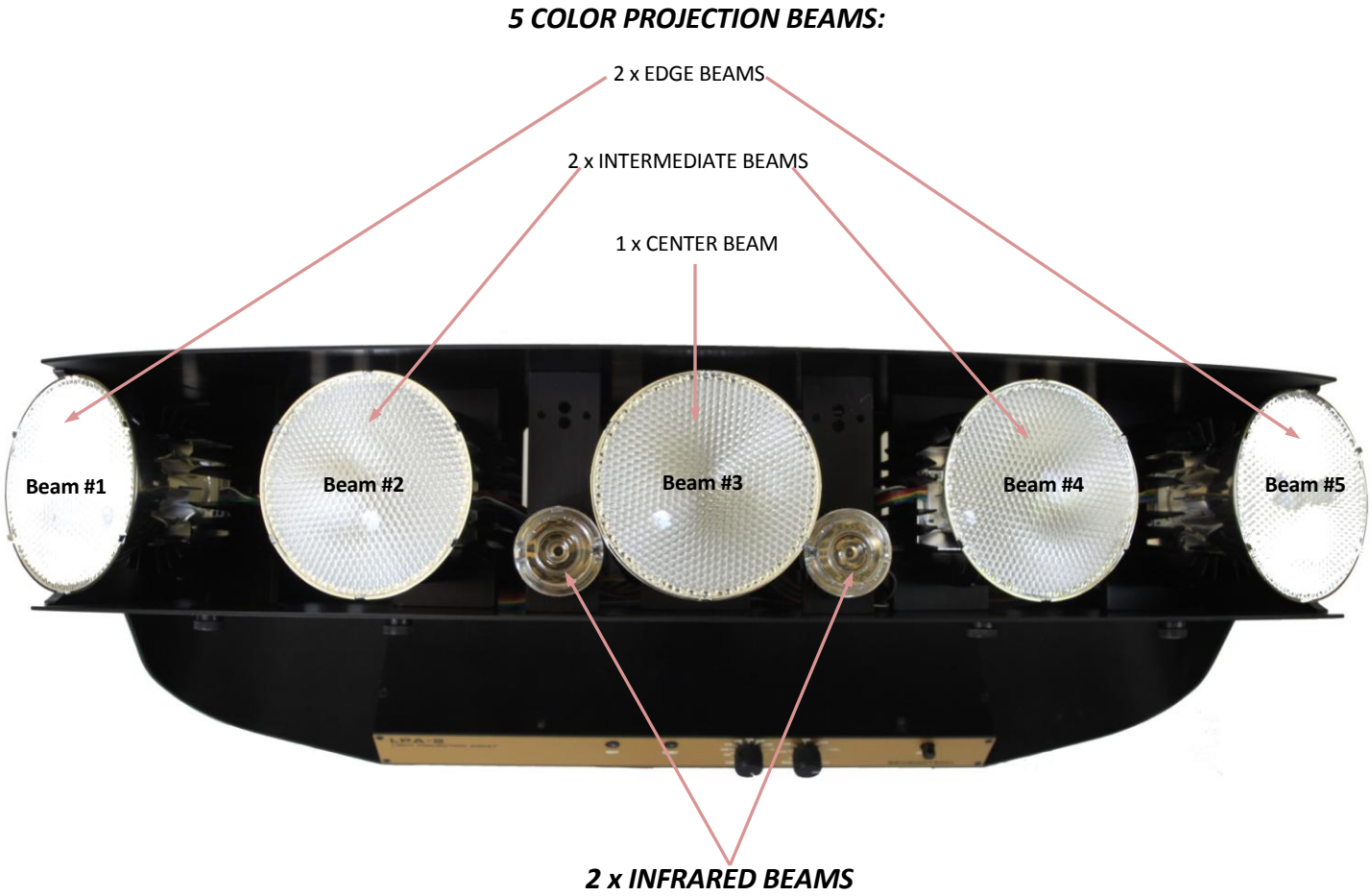

Figure 2 – LPA-2 Light Beams

1.4 LPA-2 Front & Rear Panels

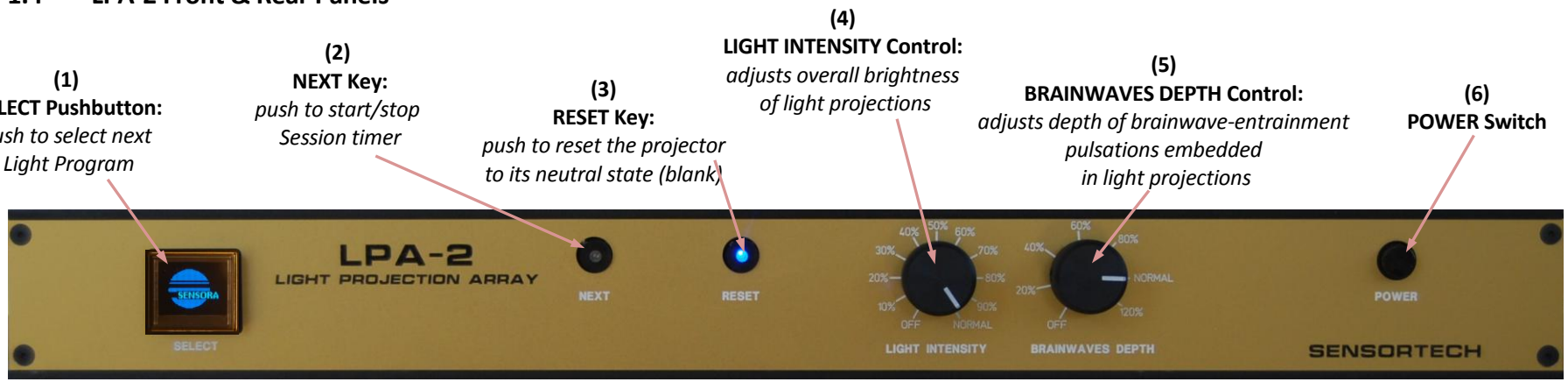

Figure 3 - LPA-2 FRONT PANEL

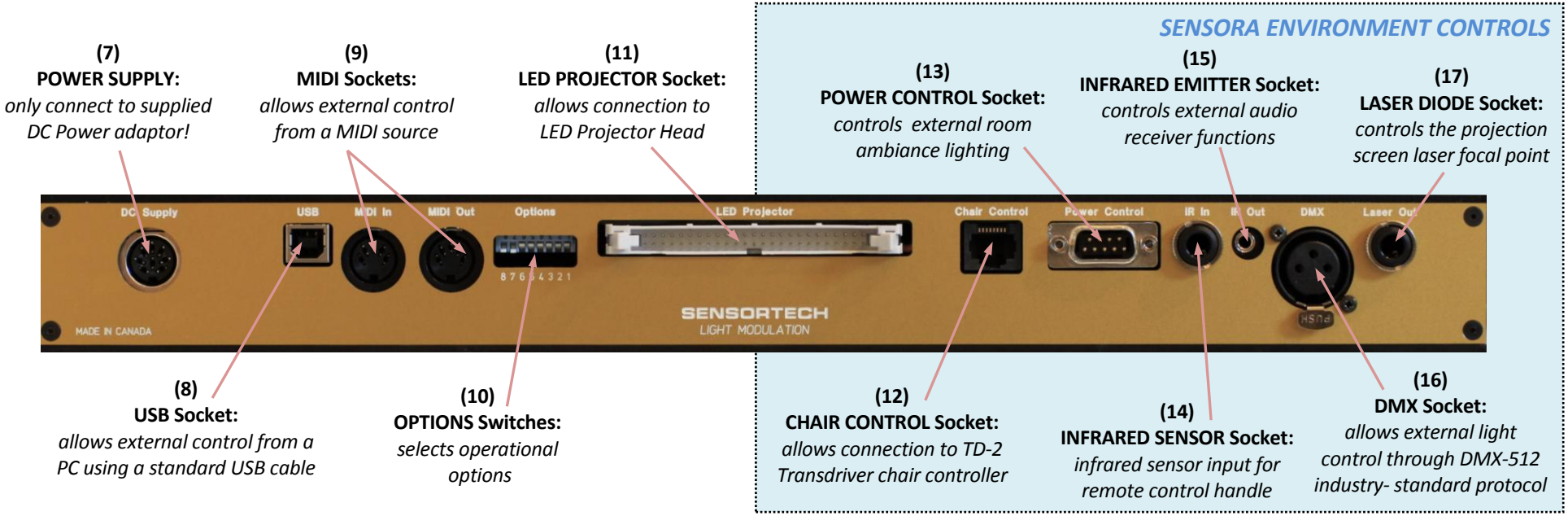

Figure 4 - LPA-2 REAR PANEL

2 AUTONOMOUS OPERATION

2.1 "RESET" Key (3)

Pushing the "RESET" key (3) on the LPA-2 front panel (see Figure 3) restores the **Neutral Mode** in which the light projection is blanked out.

2.2 "SELECT" Pushbutton (1): Selecting Internal Light Programs

Pushing the "SELECT" key (1) on the LPA-2 front panel (see Figure 3) cycles through the 15 available internal Light Programs, as described below:

- At Power On, the LPA-2 is initially in **Neutral Mode**, indicated by the "Sensora" logo displayed on the "SELECT" pushbutton.
- Pushing the "SELECT" pushbutton successively selects the 15 available **internal Light Programs**. Pushing one more time cycles back to the Neutral Mode.
- Internal Programs #1 to #3 are complex light sequences having the following main themes: "Relaxing", "Balancing" and "Energizing" (see Section **Error! Reference source not found.**).
- Internal Program #4 to #15 are 12 "Pure Colors" spanning the rainbow range (see Section 4.4).
- You can always interrupt a running internal Program and return instantly to the Neutral Mode by pressing the "RESET" key (3).
- While an internal Light Program is selected, the "NEXT" key (2) can be used to activate the Timer feature, as detailed in the following section.

"NEXT" Pushbutton Action	Operation Mode	"NEXT" Pushbutton Action
Push Once	**Neutral Mode** *(initial state at Power On, or during External Control via USB or MIDI)*	None
Push Once	**"Relaxation" Program** (Internal Program #1)	Push to start/stop Timer operation *(see Table 2 below)*
Push Once	**"Balancing" Program** (Internal Program #2)	
Push Once	**"Energizing" Program** (Internal Program #3)	
Push Once	**Pure Color #1** (Magenta)	
Push Once	**Pure Color #2** (Scarlet)	
… Push 9 times	**Pure Colors #3 to #11….** (Red, Orange, Yellow, Lime , Green, Turquoise, Sky Blue, Blue, Midnight Blue)	
Push Once	**Pure Color #12** (Purple)	

Table 1 – Selecting Internal Programs in Autonomous Mode

2.3 "NEXT" Key (2): Timer Operation

This feature allows the automatic timing of 20 minutes light Sessions; this duration was determined as optimal to allow a deep psycho-physiological effect of the light. It is available during any of the Internal Light Programs.

- To enter Timer mode, push the "NEXT" key (2) once; the light fades-out to darkness and the Timer is in a Pause state. The "SELECT" pushbutton will show a "PAUSE" display.
- To start the timed Session, push the "NEXT" key once more; the light will fade in to full projection level and the Timer starts its 20 minutes count-down.
- After 20 minutes, the light will automatically fade-out to darkness and the Timer will return to its Pause state, with The "SELECT" pushbutton (1) showing a "PAUSE" display. The Timer can also be interrupted at any moment by pressing the "NEXT" key.
- Pressing the "SELECT" pushbutton at any moment aborts the Timer operation and restarts the internal Program.

The following Table summarizes the Timer operation:

"NEXT" Pushbutton Action	"NEXT" LED State	Timer Operation Mode
Push Once	**Off**	**No Timer:** projection is On *(initial state when selecting a Program with "Select" pushbutton)*
Light Fades Out		
Push Once to start Timer	**Short Pulse**	**Timer Pause State:** projection is Off
Light Fades In		
Push Once to interrupt Timer	**Slow Flashing**	**Timer Count-Down:** projection is On during 20 minutes, then automatically fades out
Light Fades Out		**Light Fades Out**

Table 2 – Activating the Timer operation (for internal Light Programs only)

2.4 Light Intensity Control (4)

The "Light Intensity" knob (4) on the front panel can be used at any moment while a Light Program is running to adjust the overall brightness of the light projections, from 0% (light Off) to 100% (full brightness). While the control will normally be left at 100% (labeled as "Normal"), it is sometimes useful to reduce the light intensity for particularly sensitive people, or during certain stages of light therapy sessions.

2.5 Brainwaves Depth Control (5)

The "Brainwaves Depth" knob on the front panel can be used at any moment while a Light Program is running to adjust the brainwaves-entrainment pulsations embedded in light projections (refer to Section 8.3 for more details on brainwaves entrainment). The control ranges from 0% (no brainwaves pulsations) to 125% (amplified brainwaves pulsations, labeled as "MAX"), with the 100% position labeled as "Normal" providing a brainwaves pulsations level calibrated as optimal.

While the brainwaves pulsations generated by the LPA-2 at the Normal level are quite soft and gentle, the control can be reduced for people who have a particular sensitivity to light pulsations, or dislike them. It should be turned Off (0%) for people with epileptic tendencies.

While this is not recommended under normal circumstances, the control can be increased up to the "MAX" Setting to slightly boost the brainwaves pulsations for people who enjoy a more intense experience.

CAUTION: *brainwaves pulsations are potentially dangerous to some individuals in rare cases - refer to Section 8.3 for further details. In case of doubt, reduce the "Brainwaves Depth" control to 0%.*

2.6 Options Switches (10)

The "Options" cutout (10) in the LPA-2 rear panel provides access to 8 miniature DIP-switches which can be used to select some operational options.

NOTE: For normal operation, keep all 8 DIP-Switches in their "Up" position.

DIP Switch	Function	Switch Setting
Switch #1	* Reserved *	Must be "Up" for normal operation
Switch #2	DMX Mode	Up = 3 Projectors/Group Down = 4 Projectors/Group
Switch #3	Color System	Up = RGB Down = RYGB
Switch #4	Auto Power Off	Up = Auto Power Off after 1 hour Down = Auto Power Off disabled
Switch #5	Laser Focal Point	Up = Laser Focal Point On Down = Laser Focal Point Off
Switch #6	* Reserved *	Must be "Up" for normal operation
Switch #7	Pure Color Range *(applicable to " Pure Colors" built-in Light Programs #4-15 only)*	SW7 Down & SW8 Down = **Off** (Only the pure color selected is shown)
		SW7 Up & SW8 Down = **Low** (Subtle color variations around the selected pure color)
Switch #8		SW7 Down & SW8 Up = **High** (Wider color variations for a less monotonous display)
		SW7 Up & SW8 Up = **Normal** (Moderate color variations: this is the normal, default state)

Table 3 – Options DIP Switches

- **DIP-Switches 2 and 3** only relate to the addressing scheme used for the optional light control of external light projectors through the DMX output (16) on Figure 4.
- **DIP-Switch 4** activates the "Auto Power Off" function, in which the LPA-2 reverts to a rest state whenever no action has been taken (whether by pushing a front panel key, or by sending commands from a control PC) for one hour. The rest state includes the following properties:

  1. Neutral Mode is restored, and light projection is blanked.
  2. If a full Sensora environment is installed, Ambiance lighting is turned Off, audio system power is turned Off, and the Transducer Chair is brought to its "Up" position.

- **DIP-Switch 5** activates the optional Laser focal point used at the center of the Sensora projection screen.
- **DIP-Switches 7 & 8** together allow the selection of "Color Range" option related specifically to built-in "Pure Colors" Light Programs #4-15. This option allows varying the color range spanned by the Light Modulation effects, while remaining centered on the currently selected Pure Color.
- **DIP-Switches 1 & 6** are currently not used, and should be left in the "Up" position for normal operation.

2.7 Light Test Mode

Pushing simultaneously both the "NEXT" (2) and "RESET" (3) keys triggers the LPA-2 Test mode, which displays light patterns useful for testing and calibration purposes. The "NEXT" key LED will flash quickly to indicate Test Mode activation, and the "SELECT" pushbutton will display the Test pattern name.

Successive Test light pattern are cycled through by pushing the "SELECT" (1) pushbutton, as listed in the following table. Pushing the "NEXT" key cycles backwards through the same Test light patterns. To exit the Test Mode, simply press the "RESET" key.

"NEXT" Pushbutton Action	"NEXT" LED State	Test Mode Pattern
Push NEXT and RESET keys together	**Off**	
Push Once	**Flashes Quickly**	Rainbow Test Pattern
Push Once	**Flashes Quickly**	Red Test Pattern: all 5 beams in Red
Push Once	**Flashes Quickly**	Yellow Test pattern: all 5 beams in Yellow
Push Once	**Flashes Quickly**	Green Test pattern: all 5 beams in Green
Push Once	**Flashes Quickly**	Blue test Pattern: all 5 beams in Blue
Push Once	**Flashes Quickly**	Beam #1 only (Red)
Push Once	**Flashes Quickly**	Beam #2 only (Red)
Push Once	**Flashes Quickly**	Beam #3 only (Red)
Push Once	**Flashes Quickly**	Beam #4 only (Red)
Push Once	**Flashes Quickly**	Beam #5 only (Red)

Table 4 – Selecting test light patterns in Test Mode

3 GUIDELINES FOR EFFECTIVE LIGHT PROJECTION

3.1 The Light Projection Environment

The LPA-2 is capable of creating light projections with very pure and saturated colors. In order to maintain the full psycho-physiological impact of these projections, the following guidelines are recommended:

- Project on a surface having good optical reflective properties, such as a slide or video projection screen with a white or silvery background. While direct projection on a wall is possible, the quality of the results will likely be degraded.
- The projection environment should be as dark as possible, either through light-proofing of the room, or by projecting after sundown. Projecting in a non-darkened environment will result in diluted colors and will reduce their potency.
- The projection area should cover as much of the spectator's field of view as possible, in order to create an immersive sensorial experience. This is achieved by a proper positioning of the LPA-2, the projection surface and the spectator. The immersive quality can be further enhanced by tilting the projection surface downwards (up to 45°) toward the spectator, and even further by using a rounded or curved projection surface.
- Figure 5 shows an example of an optimal setup for light therapy purposes, with the spectator resting on a reclining chair.
- The LPA-2 can optimally illuminate a projection surface of 1.5-2m (vertical) by 3-4m (horizontal). While projecting on larger surfaces is possible, the light intensity may then be overly diluted.

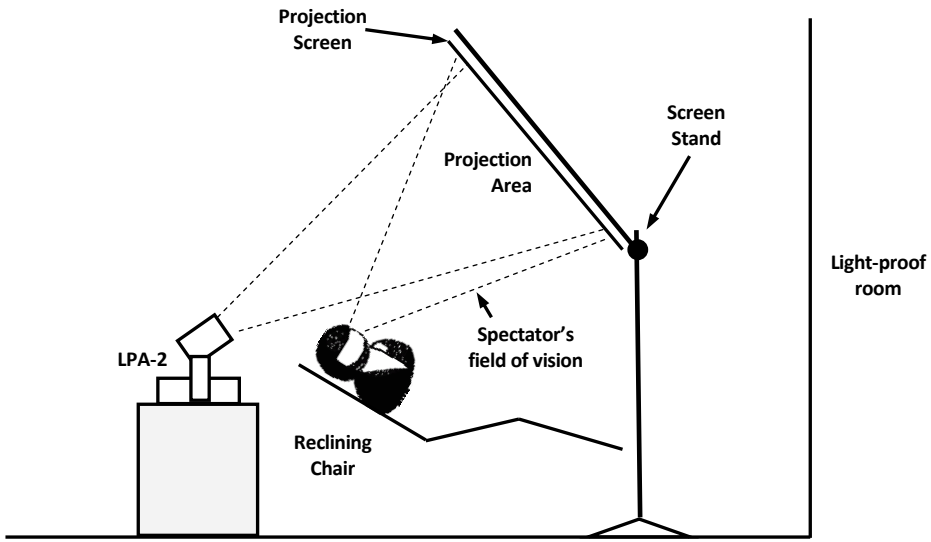

Figure 5 – Optimal Light Projection Environment

3.2 Projection Beams Alignment

The LPA-2 provides two options for the alignment of its light projection beams:
The complete LED Projection Head can be tilted around its main axis and pointed towards the projection screen. Simply un-tighten the 2 Projection Head hinge screws (see Figure 1), adjust the Head aiming direction as desired, and re-tighten the hinge screws.

The lateral projection angle of the 4 edge and intermediate beams can be individually adjusted to optimize the projection width and the beam overlap, as described below. While the LPA-2 is projecting some light pattern, un-tighten each beam orientation screws (2 per beam, see Figure 1), tilt the beam to align it as desired on the screen, and re-tighten the screws. Take care to maintain a good symmetry between each beam pair (2 x edge beams and 2 x intermediate beams).

Note:
The Test Mode patterns obtained by pushing together both the "RESET" and "NEXT" keys (see Section ***Error! Reference source not found.****), are a good choice to facilitate beam alignment.*

The LPA-2 is delivered with the lateral projection angles of each of its beams locked into positions optimized for normal use. However, some projection environments may benefit from a different beam angles adjustment: this would for example be the case when projecting on a surface that is unusually near (or far), or special-purpose applications (such as projecting light directly on the body of a user).

The rule of thumb for optimized lateral beam angle adjustment is to have each of the 5 beams overlap its adjacent beams on the projection surface by 30% to 50%: this ensures that the light transitions and movements generated by the LPA-2 Light Modulation processor appear fluid and continuous. Figure 6 illustrates this best overlap range. In contrast, Figure 7 and Figure 8 show examples of Projection Beams distributions that will not work so well (too close, or too far apart).

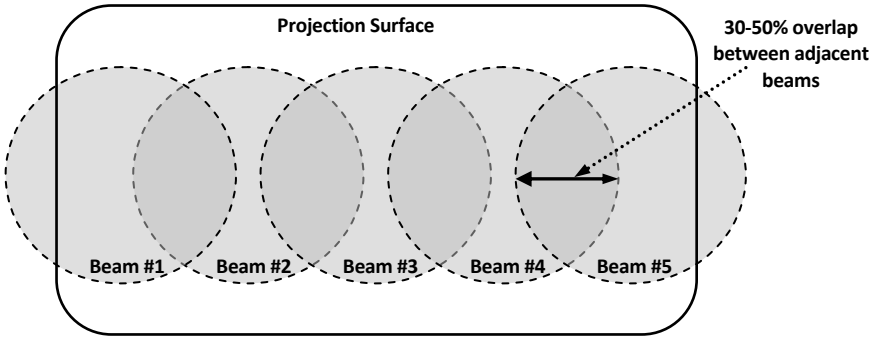

Figure 6 – Optimal lateral distribution of Projection Beams

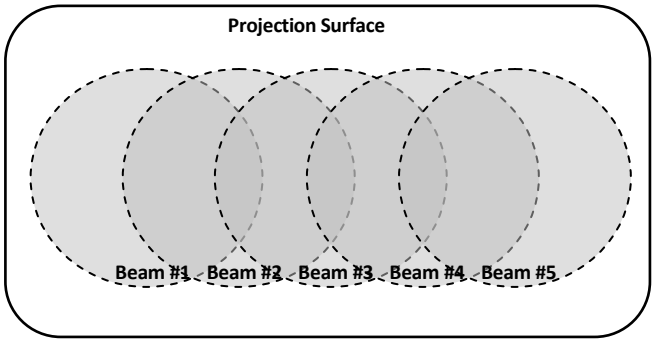

Figure 7 – Projection Beams too closely spaced

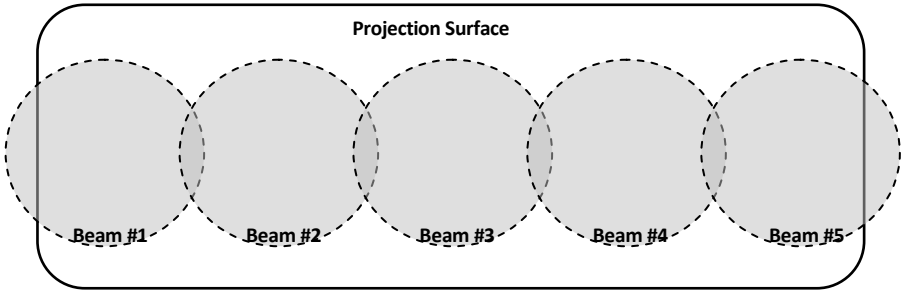

Figure 8 – Projection Beams too far apart

4 BUILT-IN LIGHT PROGRAMS

The LPA-2 includes 15 built-in Light Programs, described below.

When running, these are actually generated live by the LPA-2 Light Modulation processor. This enables a unique feature of the Light Programs: while maintaining their basic properties, they incorporate a certain element of ***randomness*** in the colors, textures, speed and duration of their light patterns. Watch carefully: a fleeting, ephemeral light pattern which you find particularly beautiful may never reappear in precisely the same way! This randomness ensures a lasting attractiveness for the Light Programs and prevents them from becoming boring even after extended visioning.

When selected, each Light Program will keep on playing indefinitely, gradually changing and never repeating exactly. The LPA-2 includes an optional timer to automatically fade-out programs after 20 minutes.

Note:
The Pure Colors (Programs #4-15) are by their nature more stable, since they are designed to focus on a specific color. While still present, their random variations therefore have a more limited scope.

4.1 Built-in Program #1: Relaxation

This program is based on the "cool" colors, spanning the range of **blue**, **turquoise** and **green**. These colors are known to soothe and calm down. They tend to reduce the pulse rate, blood pressure and the respiration rate. The program presents the light using slow, flowing rhythms which invite peace and serenity. Occasional glimpses of **yellow-lime** and **magenta**, which are more neutral colors, bring a touch of overall balance.

➔Suggested Usage:

This program is ideal when you feel stressed or tense, or when you want to calm restless thoughts or emotions. It can be used at any time of the day, although it is not recommended just before going to sleep as the blue color may contribute to keep you awake. At that time, the Balancing program is the best choice.

4.2 Built-in Program #2: Balancing

This program displays **colors of the whole rainbow**, providing a balanced "color bath". The rainbow is displayed in a variety of ways, going in turn through forward, reverse and random sweeps of the full color spectrum. All colors are presented in equal amounts, ensuring an overall harmonizing effect.

➔Suggested Usage:

This session is beneficial at any time of the day, and is compatible with almost any mood. It can be used for general toning and harmonization, or simply to enjoy a feast of colors. You can also play it when you feel unstable or dispersed and want to bring back some equilibrium in your energy.

4.3 Built-in Program #3: Energizing

This program is based on the "warm" colors ranging from **red** to **orange** to **yellow**, which are invigorating and mood cheering. They tend to increase the pulse and respiration rate, energizing you when you feel down or drained. The program uses slightly faster rhythms, which stimulate the nervous system and gently help to uplift and wake you up. Here again, occasional touches of **lime** and **magenta** colors help to round up the effects of the light sequence.

➔Suggested Usage:

Play this session whenever you feel you need an energy boost, either physical or cerebral. Try using it to stimulate creativity and facilitate mind activity, for example to prepare yourself for a mentally demanding task.

4.4 Built-in Programs #4-15: Pure Colors

These programs each focus on one of **12 pure colors** spanning the whole color wheel:

1 – Magenta
2 – Scarlet
3 – Red
4 – Orange
5 – Yellow
6 - Lime
7 – Green
8 – Turquoise
9 – Cyan
10 – Sky Blue
11 – Blue
12 – Purple

The colors are presented with slight light modulation variations to make them more attractive.

➔Suggested Usage:

These 12 segments allow focusing on the effects of one specific color. They will be especially useful for light therapists who want to work with one main color, or a specific sequence of colors.

Note:
You can control the amount of color variation allowed in each Pure Color segment with DIP-Switches 7 & 8 (see Section 2.6).

5 SENSORA ENVIRONMENT CONTROLS

In addition to its light projection functions, the LPA-2 is capable of acting as a control center for a complete **Sensora multi-sensorial environment**. This is achieved by connecting external equipment to a set of Sensora environment control ports on the LPA-2 rear panel, shown on Figure 4.

5.1 Chair Control Port

This an RJ-45 socket (12 on Figure 4) allowing control of the Sensortech TC-2 Transducer Chair. For more information, follow this Transducer Chair TC-2 link.

Figure 9 – Sensortech TC-2 Transducer Chair

5.2 Power Control Port

This is an RS-232 port with standard DB-9 connector (13 on Figure 4). It provides one of two methods of controlling the Sensora room Ambiance lighting, through an external lighting controller. A second method is available through the DMX port (16) – see Section 5.5.

5.3 Infrared Sensor Port

This is a 1/4" Jack input (14 on Figure 4) connecting to an optional Infrared Sensor (Sensortech Part #IRS-100), allowing remote control of some Sensora functions through the matching Remote Control Handle (Sensortech Part #IRH-100).

5.4 Infrared Emitter Port

This is a 1/8" minijack output (15 on Figure 4) connecting to a standard IR Mouse Emitter (e.g. Xantech Model #284M), allowing the Sensora system to control external audio equipment. The current version of the LPA-2 is programmed with the IR protocol of the Denon AVR-1700 series audiovisual receiver, which is the model specified for reproduction of the Sensora spatialized soundtracks.

5.5 DMX Port

This is an XLR 3-pin port (16 on Figure 4) connecting to industry-standard DMX-512 lighting controllers, providing two main functions:

- DMX Channels 1-40 are used to control a set of external RGB or RYGB color light heads with the same Light Modulation patterns that are generated by the LPA-2 LED Projection Head. This allows projecting these exquisite light patterns on any scale (depending on the power of the light heads used), for example for stage performances or architectural illumination.
- DMX Channels 41-44 are used to control Ambiance lighting and audio system power in the Sensora Environment. This is an alternate Ambiance lighting control method, the first one being provided by the Power Control Port (13) - see Section 5.2.

Refer to the Annex for technical details of the DMX channel assignations.

5.6 Laser Diode Port

This is a ¼" Jack output (17 on Figure 4) connecting to a special laser-diode illuminated crystal (Sensortech Part #LFC-100), designed to be located at the center of the Sensora projection screen. This coherent light focus point acts as an anchor for the viewer's attention, enhancing the Sensora multi-sensorial experience.

6 EXTERNAL CONTROL OPERATION

6.1 Connecting to an external PC

The LPA-2 is equipped with 2 types of external control ports, located on the rear panel:

- The **USB socket** allows connection through a supplied standard USB cable to a USB 2.0 port on a PC running Windows (compatible with either Windows XP or Windows Vista). This is the preferred method of external control, which will be used in most cases.
- The **MIDI sockets** allow connection to the MIDI[2] ports of an external computer (either PC or Mac) through standard MIDI cables. The LPA-2 can be then controlled through MIDI "Continuous Controller" commands sent by any MIDI Sequencer software capable of handling them. *This method of external control is designed for special applications only and requires rather complex programming: please contact Sensortech to obtain the specific MIDI protocol used by the LPA-2.*

External control of the LPA-2 through the USB port requires one of the dedicated PC software packages offered by Sensortech, introduced below. The LPA-2 can be used as the central controller for the **Sensora**® environment.

Sensora, Sensortech's flagship product, is a **mind tool** consisting of a set of sophisticated audio-visual components that transform an average room into an automated relaxation space. Sensora is the first commercially available relaxation system that fully integrates **light, sound**, and **touch**: three essential levels of sensation. For more web information, look at www.sensora.com.

Note:
The LPA-2 is solely a light projection device. It therefore cannot reproduce on its own the sound and touch aspects of the multi-sensorial Sensora system (such as kinesthetic transduction through a special reclining chair) or room ambient controls; these functions require additional optional equipment (see Section 5).

6.2 "Light Painting" Software

This easy-to-use software is included with the LPA-2. It allows the interactive creation of complete light patterns, called "Light Paintings", incorporating the full capabilities of Light Modulation. These Light Paintings can then be saved on the PC, recalled at will, and played for specific durations using a built-in Session timer. The software also includes a Music module, allowing the linking of your own soundtracks with the light Sessions.

For more web information, follow this Sensora Light Painting link. Refer to the "Light Painting" **User's Manual** for complete details.

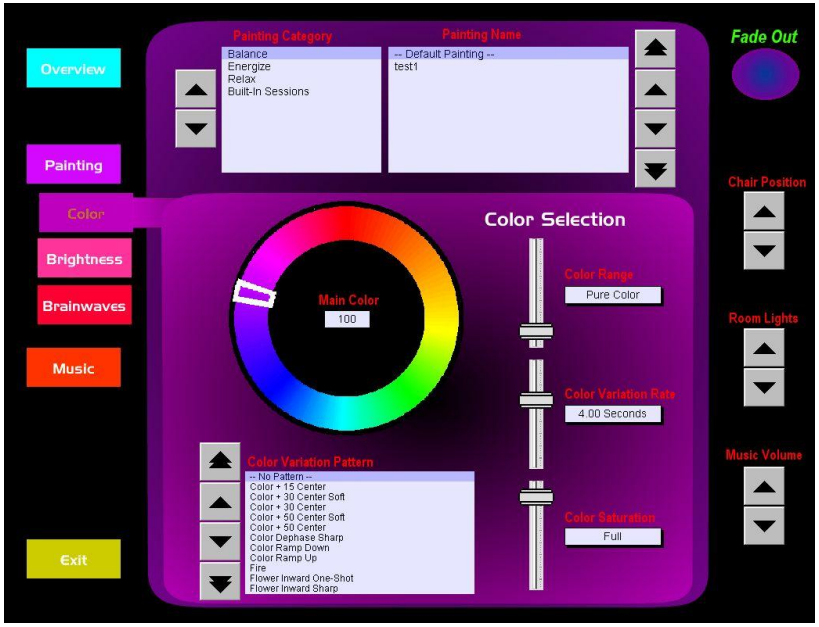

Figure 10 – Light Painting software screenshot

[2] MIDI: Musical Instrument Digital Interface

6.3 "Sensora Sequencer" Software

Like the **Light Painting** software, this tool allows the creation and editing of Light Modulation patterns; however it goes a step further with the capability of assembling and timing sequences of light paintings into detailed, complex light Sessions, and synchronizing them with your soundtracks. It also automatically smoothens the transition between successive light paintings by interpolating their parameters.

For more web information, follow this Sensora Sequencer link.

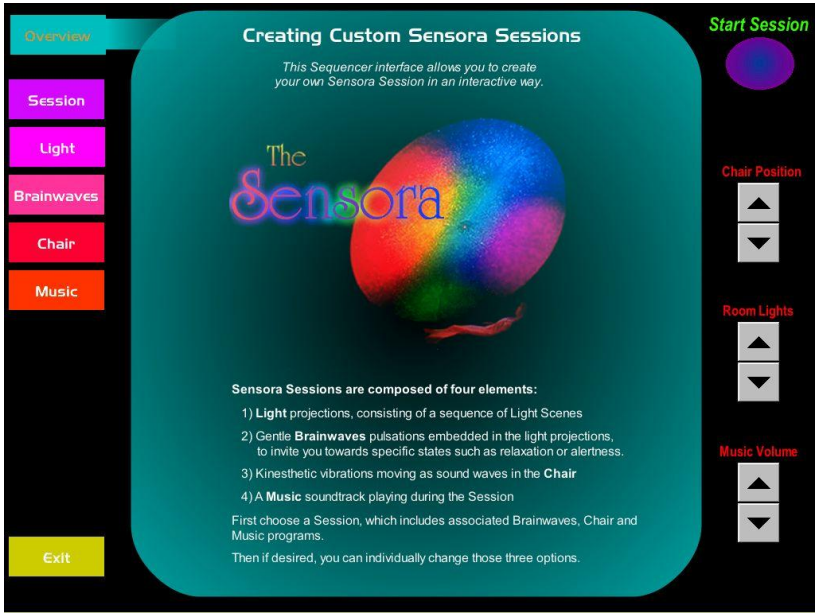

Figure 11 – Sensora Sequence software screenshot

6.4 Sensora "Core Sessions" Software

The **Core Sessions** are sophisticated multi-sensorial Sessions that form the basis of the Sensora's capabilities and have been developed by a team with expertise in psychology, psychotherapy, physics and art. Typically lasting 20 to 25 minutes, each is designed for a different application having its own range of specific colors and frequencies.

Musical scores are adapted from top composers specializing in the field of relaxation music, and are combined with natural sounds recorded around the world. They are available with soundtrack in stereo version ("*mp3*" format) or in spatialized version (Dolby® Digital multi-channel format), making full use of Sensortech's Sound Spatialization technology.

Sensora Core Sessions are played with the special Sensortech **Core Session Player** software. The available library currently includes 10 Sessions in Relaxation, Energy and Meditation categories. For more web information, follow this Sensora Core Sessions link.

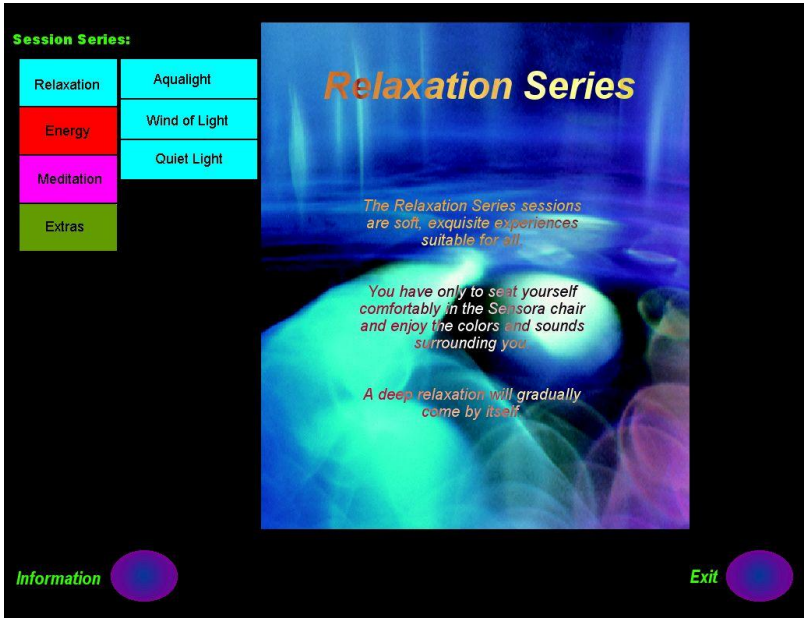

Figure 12 – Core Sessions software screenshot

6.5 Sensora "Color Balancing" Software

The Sensora **Color Balancing** tool is a software package enabling the LPA-2 to generate Color Balancing light Sessions precisely matching the user's current color needs. It is based on the color system developed by the **"Van Obberghen Color Institute"** from Switzerland and its process is licensed from their IP.

The program uses a simple but remarkably effective Color Test which can be performed within a few moments on the computer screen. The test is an easy process where you are guided into clicking a number of colored dots out of a random selection to remove the colors that are least appealing to you in this moment.

For more web information, follow this Sensora Color Balancing link.

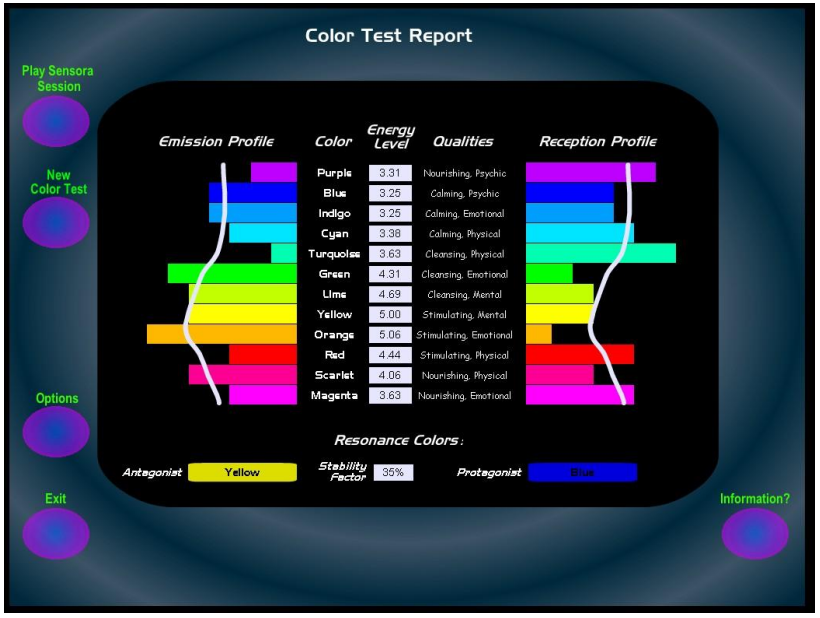

Figure 13 – Color Balancing software screenshot

7 LPA-2 SPECIFICATIONS

Dimensions	Overall: 72x36x20 cm
Weight	12 Kg
Supply Voltage	100 to 220VAC, 50 to 60Hz IEC 60320-C14 connector
Power Consumption	150W (max)
Light Sources	5 x Color LED Beams with 3 Primary colors each (Red, Green and Blue), capable of generating the full color spectrum through additive color mixing. 2 x Infrared LED Beams, automatically synced to the color projections of the main LED beams.
LED Power	30W per Color LED Beam (10W per LED color) 10W per Infrared LED beam
Projector Head Tilt Angle	Adjustable from -90° to +90°
Light Modulation Capabilities	Independent Low Frequency Oscillators (LFO) for light intensity and color modulation capabilities for each of the 5 light beam channels, with frequency range of 0.01Hz to 50Hz
Projection Area Surface	Optimal: 1.5-2m (vertical) by 3-4m (horizontal), at a projection distance of 2-4m
Built-In Light Programs	15 Programs (Relaxation, Balancing, Energizing & 12 Pure Colors)
External Control Capabilities	1 x USB 2.0 Port for connection to PC (Windows XP, Vista, 7) 2 x MIDI Ports (1xIN and 1xOUT) for connection to MIDI controller 1 x DMX-512 port (3-pin XLR) to control external light projectors
Sensora Environment Control Ports	1 x Transducer Chair Control port (RJ-45) 1 x Power Control port (RS-232, DB-9 Male) 1 x Infrared Sensor port (1/4" stereo jack) 1 x Infrared Emitter port (1/8" minijack) 1 x Laser Focal Point port (1/4" mono jack)

8 BACKGROUND INFORMATION ON LIGHT & BRAINWAVES

This Section provides general background information on light and brainwaves that will be useful to better understand the applications and capabilities of the LPA-2.

8.1 Therapeutic Applications of Light

Historical Perspective

The 21st century has been called the "century of the photon": the use of photons, or light, will dominate many fields such as electronics and telecommunications, and possibly even medicine. The last few years have seen an unprecedented rise in the study of the effects of light on our physiology, and new discoveries are changing our understanding of the deep influence light exerts on us.

The therapeutic use of light and colors has a long historical tradition, originating in ancient cultures such as Egypt, Greece and India. After Newton's discoveries it became clear that the sun's white light is in fact composed of a number of pure colors, as seen in a rainbow or through a prism. In the nineteenth and early twentieth centuries, a few pioneers started developing sophisticated systems of healing with light and colors with various degrees of success. It is surprising to learn that the first Nobel Prize in medicine was given in 1903 to Dr. Finsen, a Danish physician who cured some forms of tuberculosis with light.

The medical use of light was then eclipsed by the development of new chemical drugs such as antibiotics, until by the 1940s it was more or less forgotten by modern medicine. Only now is there a renewed interest in the subject throughout the world, with the impetus of research institutions such as NASA.

Action pathways of light

Light acts on us through a number of different pathways:

- ***On the brain's visual cortex, through the eyes:*** specialized color processing centers in the brain are stimulated through the optical nerve, allowing us to perceive and feel colors. Since sight constitutes such a large proportion of our mental activity, this is the most obvious influence of light.
- ***On our hormonal system, through the eyes:*** a direct link between the eyes and the brain centers controlling our hormonal balance has been suspected for many decades. This link, distinct from the optical nerve, is now well established and has been called the "energy pathway" of the visual system. As recently as in 2002, previously unknown color-sensing receptors have been discovered in the eye's retina, through which light regulates our body's inner rhythms in ways that are still being explored.
- ***On the blood, through the eyes:*** the transparent blood capillary vessels of the eye's retina are irrigated by a tremendous amount of blood (the body's entire blood supply flows through the retina every two hours). Our blood is therefore directly exposed to the colors we are looking at, which act as catalysts in various biological processes.
- ***Through the skin:*** light penetrates deep into our body tissues, where it ***interacts*** with our blood and cells. While most light interaction occurs within the first few centimeters below the epidermis, a minute amount of light photons reach throughout the whole body. Recent discoveries have shown that living cells actually emit and exchange light photons, and that these "*biophotons*" may play a vital role in biophysical processes.

Influencing mood with light

Our scientific understanding of the specific healing effects of light and colors is still in many ways in the early stages of development, and is bound to grow in the coming years. However, there already is a significant consensus on the broad influence of colors on our mood. While this subtle influence of light is surely not meant to have medicinal effects, it is perfectly suited to provide relaxation and enhance general wellness.

General properties of colors
The following broad tendencies of colors are quite universally accepted:

Red, Orange	Energizing, invigorating colors; activate the sympathetic nervous system
Yellow	Considered to be an excellent facilitator for intellectual work; anti-depressive
Green	The color of nature, associated with heightening the emotional qualities of the heart
Blue	Contributes to the creation of ordered thought and harmonious mood; activates the parasympathetic nervous system
Pink	Has a calming and soothing effect on the disposition
Magenta, Violet	Associated with feelings of being uplifted; facilitates accessing higher spheres of consciousness

Table 5 - Known properties of the main colors

Note:
*An excellent source of further information on the therapeutic modalities of light can be found on the web site of the "**International Light Association**" (to which Sensortech is associated) at* www.international-light-association.org

8.2 Light Modulation

Light Modulation is a new type of light control technique developed and patented by Sensortech allowing the creation of a class of lighting effects hitherto difficult - or impossible - to realize, with direct applications in many fields of lighting design, such as luminotherapy and Mood Lighting.

Light Modulation is based on an array of Low Frequency Oscillators (or *LFOs*) combining to create *modulations* of the intensity and color of light, i.e. cyclic variations controlled by the oscillators. In essence, this process applies to ***LIGHT*** the type of modulation algorithms that have long been for ***SOUND*** in audio synthesizers.

While this basic principle is simple, it has been substantially refined in order to lead to practical applications. The main challenge lies in the proper design of multi-LFO modulation structures, and in the optimization and synchronization of the numerous control parameters (such as frequency, waveshape and phase) driving the modulation LFOs.

As with successful sound synthesizer designs, this achievement has required a long and patient development: a Light Modulation processor such as the LPA-2 now uses over 100 control parameters, organized into an efficient architecture allowing the creation of rich, complex synchronized light patterns.

The end result of this technique is the creation of shimmering, ever-changing light patterns that can have a remarkably organic quality of aliveness or give fleeting astral-like impressions, imbuing them with the ability to elicit visual fascination. Also, the oscillatory nature of the modulation patterns naturally leads to brainwaves entrainment.

A world of vibrations: not such an esoteric business…

Using oscillators by definition involves creating light pulsations with specific frequencies. The objective effect of various frequencies on viewers is not a particularly esoteric phenomenon: it derives from resonances with physiological properties, many of them being well-known. Working with Light Modulation, it is possible for the first time to tap into these vibrational effects in a safe way even for public lighting installations.

Figure 14 shows the frequency range where Light Modulation operates: broadly speaking, from 1/50 to 50Hz (or cycles per second). The upper limit of this range is determined by what is known as the *flicker fusion* frequency: this is the highest frequency that the eye can commonly perceive, above which a pulsing light increasingly looks like an averaged continuous source. Generating higher frequencies can be of interest, but not for purely visual effects. In practical terms, however, not all lighting sources can generate pulsations up to the flicker fusion frequency: the thermal inertia of their filaments limit even the fastest incandescent light bulbs to around 20Hz. By contrast, LED light sources such as the LPA-2 can easily be driven at higher frequencies.

The lower limit of the range corresponds to roughly 1 cycle per minute. Below this, oscillations are so slow that they stop being perceived as a single connected phenomenon.

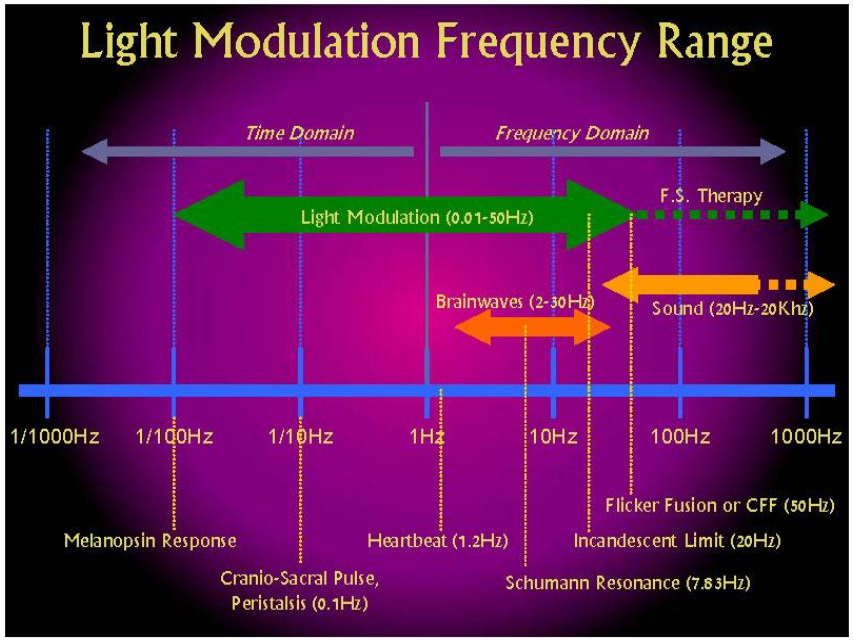

Figure 14 – Light Modulation frequency range

Many fundamental biological phenomena are related to frequencies accessible through Light Modulation, and their pulsations resonate deeply within us. For example, pulsations near the typical heartbeat frequency of 1.2Hz immediately attract us. Another striking example is the 7.8Hz frequency known as the *"Schumann Resonance"*, which relates to the resonance frequency of the electromagnetic field surrounding the Earth; living organisms have been permeated by this field during their whole evolution and for most of us, delicate light pulsations at that frequency are profoundly soothing. Brainwaves are another fundamental biological phenomenon, and they are important enough to deserve a discussion of their own.

8.3 Brainwaves Entrainment

The human brain generates weak electric signals called EEG (electroencephalographic) waves. These EEG waves cover a frequency range of about 2 to 100 cycles per second (Hz). While the research linking EEG waves and their associated mental states is complex and ongoing, their basic properties are by now well known and established *(see Table 6 below).*

When the brain is exposed to pulsations of **s**ound or light in the range of these EEG wave frequencies, it tends to spontaneously fall in synch with the pulsed frequencies. This resonance phenomenon is known as ***photic driving*** (in the case of light) and has been widely studied. It has been found, for example, that stimulating the senses with pulsations in the Alpha range will help the brain to move toward the relaxed state normally associated with Alpha waves.

The LPA-2 is ideally suited to make use of this brainwave entrainment. A subset of the frequencies available in the Light Modulation process overlaps the frequency range of EEG waves, and the LPA-2 light projections can perform excellent photic driving.

EEG Phase	Frequency Range	Associated Properties
Gamma	30 to 100 Hz	While the function of Gamma waves is still not fully understood, their capacity to sweep across the whole brain has led some researchers to suggest that they may provide a "temporal binding into a single cognitive experience".
Beta	14 to 30 Hz	Brain waves in this range indicate the normal waking state. This is a state of mental activity and attention turned out towards the world. Most of us spend the majority of our waking hours in this state.
Alpha	8 to 13 Hz	Alpha waves accompany relaxation. This state indicates attention turned inward, as in meditation and deep unwinding, let-go.
Theta	4 to 7 Hz	The hypnagogic state just before falling asleep. This state plays an important role in visualization, creativity and learning.
Delta	1 to 4 Hz	Delta waves appear during the deepest portions of sleep. They are also associated with states such as trance mediumship.

Table 6 - EEG Brainwaves phases and their associated mental states

The complex nature of the Sensora light projections enable unique refinements in photic driving, not found in other simpler devices:

Modulation Depth Control:

Our experience has shown that some individuals find the use of raw light pulsations (such as with common brainwave entrainment light goggles) rather unpleasant or too intense; the Light Modulation parameters of the Sensora provide a fine proportional control over the modulation depth of light pulsations, allowing the generation of gentler pulsations which are more universally appreciated. This lower intensity does not detract from the overall experience, since brainwave entrainment is not the primary purpose of Sensora sessions but is only used as a support for the multi-sensorial process.

Enhanced Laterality Control:

It is well known that laterality is critical in brainwave activity, since each of the brain's hemispheres is linked to different psychophysical functions. In implementing effective brainwave entrainment, it is therefore important to be able to act on each hemisphere separately.

The optical nerve linking the retina of each eye to the brain is divided in two separate bundles channeling each eye's left and right field of vision. The left and right bundles from each eye are then merged in the *optical chiasma* region of the brain and crossed before reaching the brain's visual centers. Therefore the combined left field of vision from both eyes reaches the right-brain hemisphere, while the combined right field of vision reaches the left-brain hemisphere.

Simple goggles with pulsing lights for each eye cannot completely resolve each brain hemisphere even when separately pulsing each eye, since each eye is partially linked to both hemispheres.

By contrast, the Sensora light projections are viewed on a large external screen and simultaneously reach both of the user's eyes with the appropriate laterality: for example a pulsation projected on the left side of the screen will reach the same side of both eyes' retina, and will be relayed through both left optical nerve bundles to the right-brain hemisphere only.

Peripheral Vision Temporal Sensitivity:

The retina's central region (the *fovea*) has an enhanced spatial resolution, while the lateral regions have a higher temporal resolution: they can detect faster movements, but with less spatial details. In a proposed explanation for this phenomenon, it is seen as an evolutionary adaptation to the need of quickly detecting predator movements at the vision's peripheral edge.

We have found that brainwave entrainment seems less obtrusive – while still remaining effective – when primarily performed on the peripheral lateral vision field, and de-emphasized on the central vision field. This makes sense since it optimally uses each vision field's specialization: the spatially sensitive fovea is less distracted by reduced central pulsations, while the peripheral vision is most tuned to the fast temporal variations of brainwave frequency pulsations.

These three examples illustrate how the Sensora instruments may currently be the only ones in the world allowing such fine-tuning of brainwaves entrainment light patterns.

Epileptic Photosensitivity

Exposure to pulsating light may increase the risk of an epileptic seizure in a small proportion of the population. While this risk is minimal (current research indicates that 1 in 20,000 adults over 25 have this photosensitivity, without necessarily being aware of it), it cannot be ignored. It accounts, for instance, for special considerations in roadway lighting design standards to avoid flicker at certain frequencies.

But the Light Modulation process described here brings a new aspect to the question, by virtue of its ability to control the light pulsation depth and spatial distribution more finely than has previously been possible. By toning down pulsations until they are barely perceptible, a new mode of interacting with brainwaves is revealed. Here the point is not to entrain brainwaves, but rather to imbue the light with the particular qualities related to brainwave frequencies.

Embedding pulsations at such non-invasive "homeopathic" levels results into what could be called a *"psychoactivation"* of light. Light softly shimmering at

frequencies in the Beta range (14-30Hz) has a zesty wakening quality; fine pulsations in the Alpha range (8-13Hz) are peaceful and relaxing; subtle vibrations in the Theta range (4-7Hz) intrigue and inspire creativity.

In the years of development of the Sensora, thousands of people have been exposed to its gentle light pulsations and not a single case of epileptic trouble has ever happened. On the contrary, we have seen a few cases of known epileptic subjects who were pleased to have a way of learning to "tame" their discomfort relative to light pulsations by playing with the delicate modulations of Sensora light projections. For such cases, and in any case of doubt relating to a viewer's epileptic photosensitity, **it is highly recommended to use the "Brainwaves Depth" control *(see Section* *Error! Reference source not found.)* to reduce or eliminate the brainwaves pulsations.** In the case of Sensora programs run from a control PC, the Brainwave Depth can be adjusted directly from the Touch Screen (see the relevant software User's Manuals).

9 ANNEX 1: DMX CHANNELS ASSIGNATION

As mentioned in Section 5.5, the DMX Port (16 on Figure 4) allows control of various lighting channels through the industry-standard DMX-512 protocol.

The Light modulation patterns generated by the LPA-2 Processor are transmitted over DMX channels 1-40. These patterns are designed to be reproduced with 5 Groups of light heads with either 3 primary colors (RGB) or 4 primary colors (RYGB) per Group. The 3 or 4 primary colors of each Group are focused into a single beam, to obtain additive color synthesis through color mixing.

The LPA-2 provides 4 possible DMX channel assignations, selected with DIP-Switches 2 & 3 on the Option switches (10) on the rear panel *(see Section 2.1)*, as detailed in Table 7 below.

DMX Channel	3 Projectors/Group DMX Mode *(SW2 = Up)*		4 Projectors/Group DMX Mode *(SW2 = Down)*	
	RGB System *(SW3 = Up)*	RYGB System *(SW3 =Down)*	RGB System *(SW3 = Up)*	RYGB System *(SW3 =Down)*
1	Beam#1 Green	Beam#1 Green	0ff	Beam#1 Yellow
2	Beam#1 Blue	Beam#1 Blue	Beam#1 Green	Beam#1 Green
3	Beam#1 Red	Beam#1 Red	Beam#1 Blue	Beam#1 Blue
4	Beam#2 Green	Beam#2 Green	Beam#1 Red	Beam#1 Red
5	Beam#2 Blue	Beam#2 Blue	Off	Beam#2Yellow
6	Beam#2 Red	Beam#2 Red	Beam#2 Green	Beam#2 Green
7	Beam#3 Green	Beam#3 Green	Beam#2 Blue	Beam#2 Blue
8	Beam#3 Blue	Beam#3 Blue	Beam#2 Red	Beam#2 Red
9	Beam#3 Red	Beam#3 Red	Off	Beam#3 Yellow
10	Beam#4 Green	Beam#4 Green	Beam#3 Green	Beam#3 Green
11	Beam#4 Blue	Beam#4 Blue	Beam#3 Blue	Beam#3 Blue
12	Beam#4 Red	Beam#4 Red	Beam#3 Red	Beam#3 Red
13	Beam#5 Green	Beam#5 Green	Off	Beam#4 Yellow
14	Beam#5 Blue	Beam#5 Blue	Beam#4 Green	Beam#4 Green
15	Beam#5 Red	Beam#5 Red	Beam#4 Blue	Beam#4 Blue
16	Off	Off	Beam#4 Red	Beam#4 Red
17	Off	Off	Off	Beam#5 Yellow
18	Off	Off	Beam#5 Green	Beam#5 Green
19	Off	Off	Beam#5 Blue	Beam#5 Blue
20	Off	Off	Beam#5 Red	Beam#5 Red
21	Off	Off	Off	Off
22	Off	Off	Off	Off
23	Off	Off	Off	Off
24	Off	Off	Off	Off
25	Off	Off	Off	Off
26	Off	Off	Off	Off
27	Off	Off	Off	Off
28	Off	Off	Off	Off
29	Off	Off	Off	Off
30	Off	Beam#1 Yellow	Off	Off
31	Off	Beam#2Yellow	Off	Off
32	Off	Beam#3 Yellow	Off	Off
33	Off	Beam#4 Yellow	Off	Off
34	Off	Beam#5 Yellow	Off	Off
35	Off	Off	Off	Off
36	Off	Off	Off	Off
37	Off	Off	Off	Off
38	Off	Off	Off	Off
39	Off	Off	Off	Off
40	Off	Off	Off	Off

Table 7 – DMX Channels for color projection with external light heads

In addition, DMX channels 41-44 are used for the following Sensora environment controls:

DMX Channel	Function	Range	Description
41	Ambiance Light #1	0-255	Room ambiance lighting, for general Sensora room illumination
42	Ambiance Light #1	0-255	Room ambiance lighting, aimed towards the projection screen
43	"Session Ongoing" Light	0 = Off 255 = On	Optional light at Sensora entry door, indicating whether a session is currently ongoing
44	Audio System Power	0 = Off 255 = On	Turns auxiliary power for the audio system On/Off

Table 8 – DMX Channels for Sensora environment control

DMX DIMMER PACK SETUP:

A typical Sensora installation will use a 4-channels DMX Dimmer Pack connected to the LPA-2 DMX port to implement the Sensora environment control functions. One such Dimmer Pack is the Chauvet DMX-4, which will require the following configuration setup:

SELECT DMX MODE & SET STARTING ADDRESS

1) Press the **MODE** button until the display reads {Annn}, where n represents a number between 001 and 512.
2) Press the **(▲ Button)** and **(▼ Button)** to increase or decrease values until the value 041 is displayed, which is the desired DMX starting address.

DIMMER/RELAY SETTING

1) Press the **MODE** button until the display reads {A041}
2) Press the **MENU** button until the display reads {S-nn}, where nn represents either (oF) for relay mode or (oN) for dimmer mode.
3) Press the **(▲Button)** and **(▼ Button)** to select {S-oN} (dimmer mode)
4) Repeat steps 1-3 to set dimmer mode {S-oN} for address {A042}
5) Repeat steps 1-3 to set relay mode {S-oF} for address {A043}
6) Repeat steps 1-3 to set relay mode {S-oF} for address {A044}

DMX CONTROL CHANNEL MODES

1) Press the **MODE** button until the display reads {Annn}, where n represents a number between 001 and 512.
2) Press the **MENU** button until the display reads {CH:nn}, where n represents a number between 01 and 04.
3) Press the **(▲Button)** and **(▼ Button)** to increase or decrease values to select value {CH:04} (4-channels mode).