

## ***INTRODUCTION TO LIGHT MODULATION***

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## 1 INTRODUCTION

The “Light Modulation” process uses a new type of light control algorithm, allowing the creation of a class of lighting effects hitherto difficult - or impossible - to realize. This algorithm is based on a structure of LFOs (*Low Frequency Oscillators*) combining to create light intensity and color modulation, i.e. cyclic variations controlled by the oscillators.

In essence, this process applies to **light** the type of modulation algorithms that have long been used for **sound** in sound synthesizers.

The Light Modulation process introduced here was developed and refined by Anadi A. Martel over the last 10 years, and is now owned by Sensortech Inc. The basic principle for the process is contained in our patents: «*Light Color And Intensity Modulation System*» (1991 US #5,070,399 and 1992 Canada #2,009,302-1). While this basic principle is simple, it has been substantially refined in order to lead to practical products.

The main challenge lies in the proper design of multi-LFO modulation structures, and in the optimization and synchronization of the numerous control parameters driving the modulation LFOs. As with successful sound synthesizer designs, this achievement required a long and patient development involving many cycles. Our typical Light Modulation Controller now uses more than 100 control parameters, organized into an efficient architecture allowing the creation of rich, complex synchronized light patterns.

## 2 PHYSICAL IMPLEMENTATION

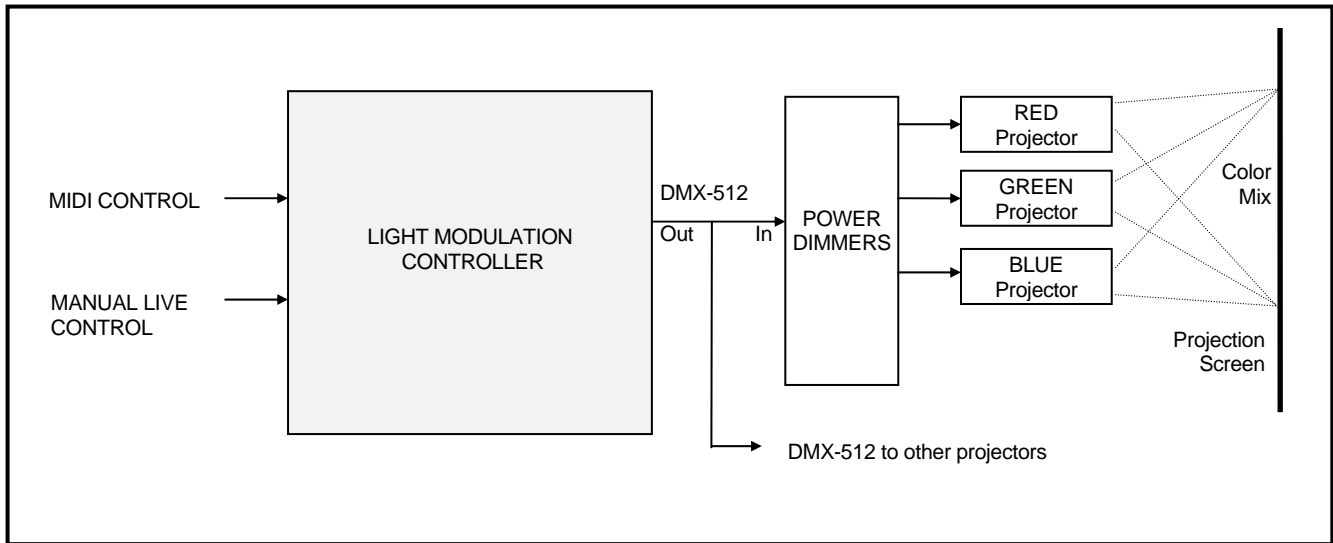
A Light Modulation Controller normally generates light patterns through an array of light projectors, grouped in triads of primary colors: typically (though not exclusively) Red, Green and Blue. In a typical implementation it can control up to 10 such triads (which we will call *Groups*), for a total of 30 individual light projectors. This will normally be done through an industry-standard DMX-512 output, driving digital Power Dimmers.

The Light Modulation Controller achieves color modulation through *additive color synthesis*, i.e. by combining in various proportions the 3 primary colors light output from the 3 projectors of each Group. Note that in a typical implementation the Controller only generates *saturated colors* (the pure colors of the rainbow), therefore only using a combination of 2 primary colors at the same time.

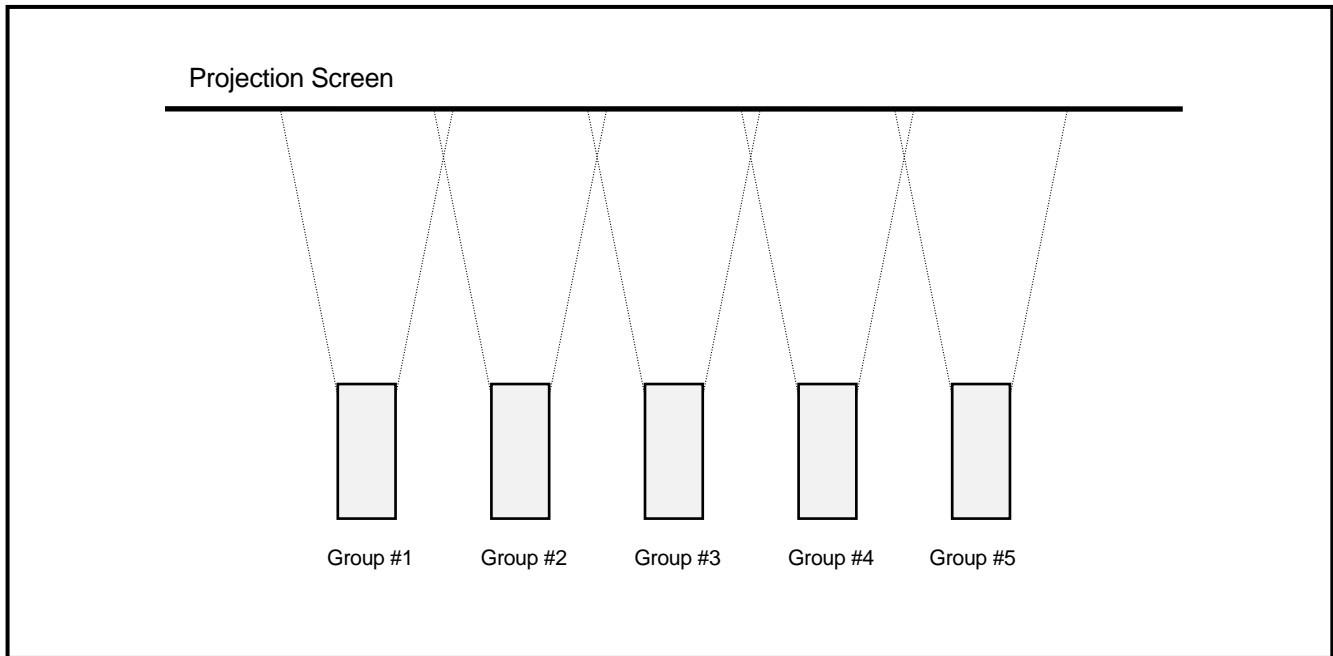
For proper operation, the 3 projectors of each Group therefore need to be illuminating the same spot, as illustrated in Figure 1. An efficient way (though not the only one) to achieve this result is to use tri-color lightheads (or “Color Changers”), which internally mix 3 primary color light sources.

Normally, the Groups of projectors in the array will be installed in a row, with the light spot from adjacent Groups slightly merging, so as to form a “wall of light”. This is illustrated in Figure 2, using an example with 5 adjacent projector Groups. The Light Modulation Controller can then create remarkable patterns over the projection surface by synchronizing the output of all Groups into a coherent whole.

Naturally, special applications deviating from this standard projector configuration can also be created.



**FIGURE 1:**  
*LIGHT MODULATION CONTROLLER DRIVING  
A GROUP OF 3 PROJECTORS WITH PRIMARY COLORS*



**FIGURE 2:**  
*CREATING A "WALL OF LIGHT" WITH ADJACENT PROJECTOR GROUPS*

### 3 SPECIFICITY OF LIGHT MODULATION EFFECTS

A regular Lighting Controller is optimized to design, store and recall specific *static* light configurations consisting of set intensity levels for all light projectors: this function is and remains essential for professional stage lighting.

In contrast, a Light Modulation Controller is adapted to the generation of *dynamic* light patterns, seemingly alive and in perpetual motion. It will therefore not replace the regular Lighting Controller, but will best be used for occasional spectacular special effects overlapping and complementing the main, static lighting patterns.

Also, in order to achieve their full potential Light Modulation effects require a specific configuration: some form of background screen together with an array of adjacent groups of primary colors projectors.

### 4 APPLICATION EXAMPLES OF LIGHT MODULATION

Here is a sample of possible applications for Light Modulation effects:

- Creation of complex, self-generating light patterns with only a few simple commands – in either live venues or pre-programmed situations. Depending on the frequencies and modulation settings used, these patterns can cover a whole range of possibilities:
  - From gently hypnotic, shimmering light patterns;
  - To flowing light effects with an uncannily “organic” feel: fluid waves, flower-like patterns softly expanding or contracting...
  - Up to highly energetic, “explosive” or psychedelic light patterns.

The nearly-infinite variety of combinations of parameters defining Light Modulation patterns will appeal to creative lighting designers: successful Light Modulation programs could be distributed and/or sold in the same way as sound synthesizer patches currently are.

- Because of their inherently cyclic nature, Light Modulation patterns are ideally suited to be synchronized to the beat of dance music. This creates unprecedented visual effects that could potentially launch a new trend in discotheques and rave venues around the world.
- Light Modulation projections are rich enough to be considered as “*Light Paintings*”. This opens a whole range of novel applications where light projection is not only used as a support for a show, but becomes a self-sufficient show in itself: for art installations, architectural “*Walls of Light*” covering whole buildings or fountains...
- An intriguing property of Light Modulation is its ability to introduce the phenomenon of brainwave entrainment (technically known as *photic driving*) in lighting patterns, through the use of brainwave-frequency (2 to 16Hz) pulsations in the LFOs. This powerful function is related to the effect of strobe lights, but in a vastly more complex and subtle way. It can be used to generate delicate shimmering light effects that actively encourage a variety of moods, ranging from deep relaxation to creative stimulation.

## 5 THE “SENSORA”: AN EXISTING LIGHT MODULATION CONTROLLER

The Light Modulation process was originally developed as a central part of a revolutionary multi-sensorial installation called the *Sensora*. The *Sensora* is a high-technology relaxation room, a kind of “magical space” where one can lie down on a special transducer chair and be surrounded in an exquisite environment of 3-D sound and pure colors.

Designed by a team combining scientific, artistic and therapeutic expertise, the *Sensora* targets Health Centers, Spas, high-end Resorts,... More information can be found on the web site [www.sensora.com](http://www.sensora.com).

In the *Sensora*, a Light Modulation Controller generates light patterns projected on a hemispherical screen covering the user’s field of vision. In this application they are optimized to lead the user to a state of deep relaxation. Sensortech Inc. has a demo installation of the *Sensora* near Montréal (Canada), which you are welcome to visit to gain first-hand experience of Light Modulation effects.

