color pro

User Manual

2209 WEST BRAKER LN.
AUSTIN, TX. 78758

Part No. 60600008
# COLOR PRO

## USER MANUAL

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LIGHTWAVE RESEARCH, INC.
AUSTIN, TEXAS USA

REV. 4/ JANUARY '91
by
Anthony S. Monday
Part No. 60600008
1) **KEY SWITCH** applies power to controller and enables fixtures.

2) **STANDBY** disables controller output to all fixtures regardless of status.

3) **REGION** control performs the following functions: allows for viewing of luminare's **RGB** percentages, shows status of 16 outputs, and editing.

4) **IMP DISPLAY** - indicated by decimal points at the TOP of each display, and consists of Intensity, Memory, and Page information.

   **INTENSITY** - master dimmer assigned to all regions.

   **MEMORY** - 9 sections, each containing 99 pages.

   **PAGE** - a "scene" which is visualized in the **Region** display. A Page contains information about programmed regions.
5) RGB DISPLAY - with the display in the RGB mode, indicated by decimal points at the BOTTOM of each display, percentages of Red, Green, and Blue available in each Region are shown.

6) ↑/↓ - these controls are used for changing Intensity, Memory and Page (IMP), and RGB values.

7) SELECT - used to choose a Region for Programming. Also toggles controller between Master and Slave.

8) RECORD - used to store Programming in Memory and to download Memory to a personal computer. Holding Record down for ten seconds causes the Intensity display to read SA, prompting "save to computer" or download Memory.

9) ERASE - removes Programming from Memory and is used to upload Memory from a personal computer. Holding ERASE down for 10 seconds causes the Intensity display to read PL, prompting "play from computer" or upload Memory.

10) ADVANCE - Pages are advanced by this section with the following controls:

   AUTO - Automatic Advance of the Pages as set by the Rate control.

   AUDIO - Advances Pages with Audio synchronization.

   RANDOM - Pages are Advanced randomly in all Advance modes.

11) CONTROL - This section allows the user 3 types of control over active Regions on a Page.

    PROGRAM - active Regions are controlled by user preset colors and intensities.

    MODULATE - special effect creates colors and Intensities derived from the amplitude and frequency of the musical information supplied to the controller input. Audio trim is set by the Audio level control.
active Regions cycle through the Color Pro spectrum of colors with the Rate of change controlled by Rate level control.

12) CROSSFADE - This feature is used to provide Page-to-Page crossfading with the controller under Program control. Crossfade times are set by the rate control below it.

13) AUDIO - Adjusts Audio input level.

14) LEVEL - Indicates Audio input.

15) RATE - Adjusts Crossfade and Cycle times.

16) RATE - Adjusts Automatic Page Advance time.

17) DATA LINK OUTPUT - Serial data link providing pulse modulated digital signals to the fixtures.

18) SERIAL PORT RS-232 - For connection to a personal computer operating at 9600 BAUD for external Memory storage, special communication and Master/Slave configuration.

19) REMOTE PAGE SELECT - (2) 8-pin locking DIN connectors for direct access of 99 Pages.

20) REMOTE ENABLE JACK - 3.5mm mini-plug allows remote standby of controller.

21) STEREO AUDIO INPUT - RCA type connection of line level Audio signal @ 1.4V.

22) 240/120 Voltage Selector - for 240V operation a new Eprom must be installed for optimum performance.

23) LINE CORD - Mains supply for controller.
CONTROLLER SPECIFICATIONS

- 9 Memories - 99 Pages each
- Remote Page interface
- Page crossfade
- Music color synthesis
- 16 channels
- Master dimmer
- Remote enable
- Editing functions
- Master/Slave function
- Region lockout
- Positive feel switches
- RS-232 computer backup
- Stereo Audio input
- Security keylock
- 19" rack mount - 3 units
- Voltage - 120V / 240V
- Fuse - 1A 5mm x 20mm Slow Blow @ 120V - 1/2A @ 240V
- Current - 1/2 Amp @ 120V - 1/4 Amp @ 240V
- Weight - 5.9kg (6.9kg packed)
- Dimensions - 133mm H x 482mm W x 203mm D
  330mm H x 558mm W x 330mm D (Packed)

specifications subject to change without prior notice
LUMINAIRE ILLUSTRATION

1) LED - Logic and fan enable indicator
2) DIGITAL REGION SELECTOR
3) LENS CLAMPING SCREW
4) GOBO SLOT
5) LAMP SERVICE DRAWER
6) MAINS CORD
7) 1/4" (3 WAY) INPUT/OUTPUT CONNECTOR
LUMINAIRE SPECIFICATIONS

• Dichroic color change system
• Hard edge beam - Fresnel lens available
• Adjustable focus
• Pattern capability
• Digital assignment selector
• Auto off function
• Logic enable LED
• Electronic over temperature protector
• MRI6 lamp technology
• Easy lamp replacement
• Lightweight aluminum construction

• Voltage - 120V / 240V (selected at factory)
• Fuse - 10A 5mm x 20mm Fast Blow @ 120V / 7A @ 240V
• Wattage - 750w total (3) 250w ENH lamps
  900w total (3) 300w ELH lamps
• Current - 6 Amps @ 120V (ENH) - 4.5 Amps @ 240V
  7.5 Amps @ 120V (ELH) - 5.5 Amps @ 240V
• Weight - 5.5kg (6.5kg Packed)
• Dimensions - 180mm H x 190mm W x 450mm D
  330mm H x 330mm W x 558mm D (Packed)

specifications subject to change without prior notice
INSTALLATION

Each box containing a Color Pro fixture should also include:
(1) #10 Phillips screw to replace lens clamping screw in vertical installation of fixture

Plug no more than 2 fixtures into a single 120V 20A (USA), 240V (European) grounded non-switched, non-dimmable circuit. Simple hookup of low voltage controller output requires **shielded** Low Capacitance 2-conductor wire. The correct hookup is shield to sleeve, black to ring, and red to tip. Be certain to observe polarity throughout hookup or the system will not function properly.

Run the cable from the controller to the first fixture and then turn the controller on. Check to be sure the first fixture functions properly and then continue connecting the remaining fixtures, being aware of any changes to the light output as you hook up each additional fixture. This method will allow you to spot bad cables as they are installed.

Cable may also be **paralleled** up to 5 times to allow for individual runs to different locations. Maximum number of fixtures per **Region** is 8 (128 per controller), though you may have an uneven number of fixtures on each of the 16 **Regions**, i.e.:

- Region 1 = 8 fixtures
- Region 2 = 6 fixtures
- Region 3 = 5 fixtures

**COLOR PRO SIGNAL CONNECTIONS**

<table>
<thead>
<tr>
<th>Signal</th>
<th>XLR</th>
<th>1/4&quot; phone jack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground</td>
<td>PIN 1</td>
<td>Sleeve</td>
</tr>
<tr>
<td>Strobe</td>
<td>PIN 2</td>
<td>Ring</td>
</tr>
<tr>
<td>Data</td>
<td>PIN 3</td>
<td>Tip</td>
</tr>
</tbody>
</table>

Color Pro fixtures with 1/4" phone jacks automatically terminate the data link line wherever there is an unused jack (the last fixture in the line).

XLR equipped fixtures need a terminating connector for the last fixture in the line.

Take a blank male XLR cable connector and solder a 4.7K 1/4 watt resistor from PIN 2 to PIN 1 and PIN 3 to PIN 1, as shown below.

![Connection Diagram]

**CONNECTION SIDE OF MALE XLR**

Install this plug in the unused female XLR connector on the last Color Pro fixture in the line.
PROGRAMMING

There are 9 Memories available, each containing 99 Pages or "scenes" for a total of 891 Pages or "scenes." A Page contains 16 output Regions that contain RGB percentage information. The primary keys for Programming are the yellow Select, Record, and Erase. The Red, Green, Blue, and Region keys will also be used.

Turn the controller power switch on. A Memory test will be performed and the Memory display will count 1-9 twice and then the display will read F.L., 0.1, 0.1, F.L indicating full intensity. The Standby and Program LEDs will both light and the controller will be in manual mode.

Programming may be done with the controller in Standby and no visible output from the fixtures. Begin by choosing the Memory number with the Green keys and the Page number with Blue keys. Master Intensity does not have to be set during Recording as it is an adjustable playback feature and has no Memory, though it may be helpful during early Programming to see the Intensities of a Program as it is being assembled.

USING
SELECT/RECORD/ERASE

Depress the Select button once and the Select LED will flash. Momentarily depress the Region you want to adjust, its LED will flash in unison with the Select LED, and the display will change to RGB, indicated by the decimal points being at the BOTTOM of the displays.

During Programming, the RGB up/down keys have a built in Wrap Around function. That is, instead of having to go from 0.0 to 9.9 sequentially, you may go "backwards" the other way. Depress the down key once and the display will go to 9.9. If depressed and held, these keys will accelerate the display to either limit and then stop. If depressed once again they will go to the next value in that direction.

Set the color output you desire from that Region by using the Red, Green, and/or Blue up/down keys. When the RGB levels of the Region are set, depress Record and the display will return to IMP, indicated by the decimal points at the TOP of the displays. The LED of the Region adjusted will remain lit and Select will go off. Other Regions on this Page may be activated or edited in the same manner. If a Region is mistakenly adjusted and it is noticed before depressing Record, depress Select again and the Region will be restored to its previous setting.

Blank Regions may be Recorded. Depress Select and then the Region you wish to adjust. Using the RGB controls adjust the RGB to 0.0, 0.0, 0.0 and then depress Record. This will Record no output for that Region on that Page.

To Clear an entire Page, depress Select then Erase. To Record entire blank Pages, depress Select, then Erase, followed by Record. A blank Page will have been Recorded.
Copying Regions - A Region’s RGB values may be copied to another Region easily. Depress Select and then the Regions to be adjusted (they will flash in unison) before depressing Record.

For example, depress Select and then the Regions to be Programmed - all keys that were depressed will flash their LEDs simultaneously. Adjust the values of RGB and depress the Record key. To restore previous settings, do not depress Record but depress Select again and Select’s LED will go out, with all adjustments ignored, and the Regions restored to their previous (if any) setting.

After the Page has been recorded, merely depress the Blue up/down key to go to the next Page you wish to Program.

Copying Pages - Complete Pages may also be copied to other Pages in the same or other Memories. These Pages may be Copied forwards or backwards. To perform Page Copying, select the Page you wish to Copy, then depress Select and the display will go blank with decimal points at the bottom. Depress either of the Green and Blue up/down keys to bring back the display which will read P.C., _, _, indicating Page Copy and the previously Programmed Memory and Page information. The information contained on this Page can be copied to any other Page in any Memory. This is accomplished by depressing the Blue or Green keys again to direct the Copied information to another location and then the Record key. The Page Copy function may be repeated over and over again by following these instructions.
INITIALIZED / NONINITIALIZED PAGES

INITIALIZED PAGE - is one that has RGB values of 0.0, 0.0, 0.0 or greater. This can be a blank or dark Page with no output.

NONINITIALIZED PAGE - is one that has been "removed" by the Select Erase Erase method (where by depressing the keys in that order, a page is "removed"). The display will read ___ , ___ , ___ any time a Noninitialized Page is viewed with a Region key.

If you want to make a Sequence after recording a number of Pages totalling less than 99, a Noninitialized Page must be created. This is done by Advancing to the next Page and depressing Select Erase Erase. This tells the controller how many steps have been Programmed, so it can run them in a loop. Several different loops may be Recorded in a Memory.

Example: Program Pages 1-40. Advance to Page 41 and depress Select Erase Erase (Installing a Noninitialized Page). The display will return to IMP. Next, go to Page 42 and Program to Page 60. Then go to 61 and repeat the above procedure. This allows for "multiple sequences" in each Memory.

If the controller is Advanced manually to a Noninitialized Page and then placed in an Auto mode, it will revert to the lowest value Initialized Page.

Example: As in the above, manually go to Page 61 and press Auto; the controller will then begin running through Pages 42 to 60 in a loop until instructed otherwise.

In Random, Pages from 1-40 or 42-61 would be accessed. Pages 41 & 61 or any other Noninitialized Page would not be accessed, as they would have values of less than 0.0, 0.0, 0.0.
CONTROLLER OPERATIONS

The following sections of the Color Pro controller are the "operational" areas which manipulate the Active Programmed Regions. These are Advance (Manual, Random, Audio, and Auto) and Control (Program, X-fade, Modulate, and Cycle).

THE ADVANCE SECTION

Advance provides 4 basic ways, plus combinations to step through the Initialized Pages of a Memory:

1. Manual only - if no Advance mode is chosen and no LED's are lit in the Advance section. Depressing the Blue keys beneath the Page/Blue display causes the controller to Advance up or down through the Pages.

2. Random only - instructs the controller to Randomly Advance through the Initialized Pages in a Memory. For example: (15,8,29,89,60,72 etc.) when one of the Blue keys is depressed or if advancing by Audio or Auto. To disable, depress the Random key again.

3. Audio only - allows the controller to Sequence through the Pages to the bass step of the music information. The Audio level may be fine tuned with the aid of the Audio Level pot and LED in the bottom right corner. To disable, depress Audio again.

4. Auto only - allows the controller to Sequence through the Pages in order at a speed set by the Rate pot below it. To disable, depress Auto again.

5. Combination - Audio or Auto may be depressed at any time to provide Random or sequential Page changes either to the bass step or Automatically. Depressing either Audio or Auto turns the other off.
MEMORY SEQUENCING

You may **Automatically Sequence** through the different **Memories**. This is achieved by depressing and holding the **Green "up or down" key** until the **Memory** display reads **A1** and the **Page** display reads **L0**. (Intensity will remain where it is set until adjusted). Release the key and **Memory 1's Initialized Pages will be Sequenced** through according to the **Advance mode**. On the completion of **Memory 1's highest Initialized Page** the controller will advance to **Memory 2**; then **Memory 2's will and so on through Memory 9**, with an "A" preceding each **Memory**. The controller will continue to run through **Memories 1-9 until instructed to perform another function**. To disable **Memory Sequencing**, depress and hold the **Green "up or down" key** until "A" is no longer in the display.

THE CONTROL SECTION

Determines the type of **Control of Active Regions** on a **Page**. One of the LEDs in this section will be lit at all times. There are three basic types of **Control** afforded here plus various combinations.

1. **PROGRAM** - when this LED is on, the **Active Regions** on a **Page** are controlled by user-Programmed information of **RGB** values. Changing **Pages** results in sharp cuts from one **Page's Programmed settings** to the next. **X-fade** can be used with **Program** only and is controlled by the **Rate** pot below its key. **X-fade** allows for smooth changes between **Pages**.

2. **MODULATE** - depress the **Modulate** key to activate this effect; **Modulate's LED** will flash and **Program's will remain lit**. To turn off **Program**, depress the **Program key** again and **Program's LED will go out**. Now the controller overlooks the Programmed **RGB values** and all **Active Regions** on a **Page** are randomly assigned a color value corresponding to the bass and treble frequencies. Bass becomes one color and treble another for random lengths of time, and then reassigned different colors. The level of **Modulate Audio** is fine tuned by the **Audio** pot.

3. **CYCLE** - depress the **Cycle** key, **Cycle's LED will flash**, and **Modulate's LED will remain lit**. To turn off **Modulate**, depress **Modulate key** again. **Cycle accesses the Active Regions on a Page** but not their **RGB values**. It will **Cycle through the ColorPro spectrum of colors from Page to Page**. Speed of **Cycling** is controlled by the **Rate** pot below the key.
4. COMBINATIONS -  Program, Modulate, and Cycle may also be used in various combinations, though at least one must always be engaged. To toggle between any two Effects, follow the above examples but do not turn off the previous Effect. The LED that is flashing indicates the Effect in Control. After a Random length of time the other Effect will flash indicating that it is in Control. All three Effects can be toggled through by depressing the third key after the other two have been Selected. A function may only be turned off if it is not the last function remaining on. (Program will be the default function if the others are turned off).

REGION LOCKOUT

Region Lockout provides the ability to take a Region out of a Programmed Sequence without reprogramming. This would be necessary if for some reason a Region were acting erratically or a lamp fails and you wish to remove the fixture from Programming. To remove a Region, depress and hold that Region's key down for 15 seconds. The decimal points will begin to flash and then the display will show L.O, indicating a Locked Out Region. The Locked Out Region will display L.O anytime its key is depressed on any Page and any Memory. To restore a Region, turn the controller Key Switch to off and then back on, and all Regions will function normally.
TOUCH PANEL / REMOTE PAGE SELECT INTERFACE

Two locking 8-pin DIN connectors located at the rear of the controller provide direct access to the Pages of a selected Memory. Any control device with the ability to provide at least 12 channels of 0VDC to +5VDC through +16VDC output may be used. A touch panel providing 12 outputs is discussed here although many other types of Programmable lighting controllers may be used. Any function (Chase, Auto, Audio) available on the touch panel or controller may be used to Advance through Color Pro's Pages.

The pinouts for hookup are as follows:

REMOTE PAGE CONNECTOR 1 - 6

<table>
<thead>
<tr>
<th>KEY NUMBER</th>
<th>PIN NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>common negative</td>
<td>2</td>
</tr>
<tr>
<td>not used</td>
<td>1</td>
</tr>
</tbody>
</table>

REMOTE PAGE CONNECTOR 7 - 12

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>3</td>
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<tr>
<td>8</td>
<td>4</td>
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<tr>
<td>9</td>
<td>5</td>
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<td>10</td>
<td>6</td>
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<tr>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>common negative</td>
<td>2</td>
</tr>
<tr>
<td>not used</td>
<td>1</td>
</tr>
</tbody>
</table>

With a touch panel connected to a Color Pro controller, it will have priority on Page selection. If a key is pressed and latched you may not change Pages on the controller until you change the touch panel setting.
There are two modes of Control afforded by the touch panel hook up:

First, if Color Pro is in Standby the touch panel will override it and act as a momentary. For example, touch a key and the controller will go to that Page. If the key is touched for a moment and then released, the controller will return to Standby with no output, however, the last page accessed will be displayed. During the time the touch panel keys are being used, the Standby LED will flash. When the keys are released, the controller will return to the normal Standby mode.

Second, if not in Standby and touch panel outputs are activated, then the controller will go to that Page and stay there (disabling Advance method) until instructed otherwise. Touch panel still has priority and the interface acts as a latching controller, latching to a particular Page. The Standby LED will also flash in this mode whenever there is input to the controller from the touch panel.

Keys 1-12 Access pages 1-12

Keys 10, 11, & 12 are also special function keys.

Key #10 - Functions as the "tens" key. Any other key (1 - 9) touched in conjunction with the #10 key allows access to Pages 10, 20, 30, 40, 50, 60, 70, 80 & 90.

Key #11 - Functions as the "doubler" key. Any other key (1 - 9) touched in conjunction with the #11 key allows access to Pages 11, 22, 33, 44, 55, 66, 77, 88 & 99.

Key #12 - Functions as the "reverse" key. The two lowest numbered keys pressed with this key will "reverse." 2, 3, & 12 is 32, not 23 as it would be normally without the #12 key pressed.

If more than 2 keys are pressed with the #10, 11 or 12 key, only the lowest value integer will be selected. Crossfade, Cycle, Modulate and/or Program will remain on while the touch panel is in use unless turned off directly. Only the Remote Enable plug will override the touch panel.
REMOTE ENABLE OF SYSTEM

On the back panel of the controller there is a 3.5mm mini jack that accepts a 3.5mm mini jack plug. This is a normally closed jack so that the controller functions normally when nothing is in it. Inserting the plug causes the controller to go into Standby until voltage (+5VDC through +16VDC) is applied and then the controller is restored to the mode of operation it was in prior to Remote disable.

MASTER / SLAVE CONFIGURATION

Color Pro offers practically infinite expandability. Via its RS-232 port, up to 9 additional controllers may be connected allowing for 160 channels capable of handling 1280 fixtures. Hookup of the Master/Slave configuration requires the use of cable #2 shown on p. 21 to interconnect two or more controllers together. Individual serial data outputs must be run for each 16 Regions of control as shown on p. 18.

Example: For a 32-channel system, Programming for each Region of 16 must be carried out on its own controller, though the Master will dictate the mode of playback for all connected Slaves. Each controller will function normally until it is put in the Slave mode. This is accomplished by depressing and holding the Select button on the Slave controller until SL is displayed in the first window. Then release Select and the displays will revert to normal, in this case a Copy of the Master controller’s display. All Standby, Advance, and Control LEDs will also be copied on the Slave’s front panel.

The only usable functions on the Slave controller(s) are Power, the Region RGB levels, Select, Record, and Erase. All others when depressed will cause SL to be displayed in the first display window.

When Select is depressed on the Master and held, the first window of the display will read CL for Control; if it is continually held down, the display will toggle between CL and SL and Select will flash.

Note: Even though Programming a 32-Region or greater combination is done with the additional controllers in Slave mode, Memory downloading or uploading must be done with the controller in Master mode. Please refer to page 17 for more information.
EXTERNAL MEMORY STORAGE / RETRIEVAL
AND COPYING BETWEEN CONTROLLERS

Your Color Pro controller contains an internal battery for secure memory backup. External Memory storage capability is provided to increase the amount of programming and storage available for special events, performances or simply as extra protection.

The Color Pro Backup disk provided with this manual (inside front cover) requires an IBM (Trademark) compatible computer with a disk drive and RS-232 serial port. A standard RS-232 cable is also required (like cable #3). The controller must be set to Full Intensity (F.L.), and be in Master mode, displaying C.L. when Select is depressed, in order to begin the procedure.

Insert the backup disk after booting up the computer and type CPB. Color Pro Backup, version 1.02 will appear on the top of your screen and then a menu. To make a selection, type the letter or move the light bar with the arrow keys and press enter. Instructions will appear to direct the upload or download procedure and simplified directions follow below.

To Upload (Play or load) memory from the computer to the controller:
Depress and hold Erase until the display reads P L, 0 1, 0 1 (Note: the decimal points will be at the top indicating IMP as the Play process is activated). Release the key and Select will be lit. When the file begins to Upload to the controller reads Memory 9, Page 99, depress Select once to return controller to the normal mode with the new Memory replacing what was there.

To Download (Save to computer) the controller’s memory:
Depress Record until the display reads S A, 0 1, 0 1 (Note: no decimal points in this display, though they do return to the top as the Memory and Page begin counting after Record is depressed again). When the computer is ready to receive data from the controller, depress Record again to begin controller transmission to the computer. Controller will display Memory and Page number as it is being saved to disk. When all 9 Memories and 99 Pages have been copied, turn off the computer 'receive.' Now return the controller to normal operation by depressing the Select key. All Memories have been Downloaded to disk and Saved but still reside in the controller until written over.

To Copy Memories from one controller to another:
Requires RS232 cable with PIN 2&3 reversed on one end as in cable #2. The procedure is essentially the same, but does not require the disk or computer. Both controllers must be in the Master mode with one set to Save (S.A) and the other to Play (P.L). Depress Record on the controller in S.A mode to begin transfer of its Memory to the other controller. When the process is complete, depress the Select key once on each controller to return to regular operation.
BASIC COLOR PRO HOOKUP

COLOR PRO MASTER CONTROLLER

TO OTHER FIXTURES

DATA LINK OUT

COLOR PRO MASTER / SLAVE HOOKUP

COLOR PRO MASTER CONTROLLER

TO OTHER MASTER FIXTURES

COLOR PRO SLAVED CONTROLLER

TO OTHER SLAVE FIXTURES

cable #2

For description of cable pinouts refer to page 21.
COLOR PRO HOOKUP WITH COMPUTER BACKUP CAPABILITY

TO OTHER FIXTURES

COLOR PRO MASTER CONTROLLER

PERSONAL COMPUTER

The cable for connecting one Color Pro controller in the Master mode to your personal computer is a straight, one-to-one, 25-conductor ribbon cable with a male RS-232D connector at one end (for the controller) and a female connector at the other end (for connecting to the RS-232 port on your personal computer).
DESCRIPTION OF OPERATION

Setting all RS-232 switchboxes on their "A" setting allows normal Master/Slave operation. In the example above, setting box-1 on "B" allows saving or playing (uploading or downloading) of Programming between computer and Master. Setting box-2 on "B" allows saving or playing of Programming between computer and Slave, operation of linked switchboxes for more Slaved controllers is identical.

Caution!!
Never allow more than one switchbox at a time to be set on "B"!

For description of cable pinouts and signals refer to page 21.
DESCRIPTION OF CABLE PINOUTS

CABLE #1: This is a one ribbon cable with the first connector going to the computer and following connectors going to linked switchboxes.

CABLE #2:
MASTER CONTROLLER OR "A" ON MASTER CONTROLLER'S RS-232 SWITCHBOX

Pin 3 7 M-A 7 7 M-B 7 SLAVE CONTROLLER OR "A" ON SLAVE CONTROLLER'S RS-232 SWITCHBOX

CABLE #3: This is a one to one ribbon cable with one male RS-232 connector at each end.

CABLE #4:
SLAVE CONTROLLER TO IN/OUT ON RS-232 SWITCHBOX, ELSE N/C TO "A" ON NEXT RS-232 SWITCHBOX, OR ANOTHER SLAVE CONTROLLER

LEGEND

| = Standard 25-pin RS-232D connector, labeled M-(letter) for male and F-(letter) for female -- letter after hyphen is used to differentiate one end of a finished cable from another.

| = Twenty five conductor ribbon cable.

| = Standard wire cable, number of lines denotes number of conductors needed.

Signals used: Pin #2 - Transmitted data, #3 - Received Data, #7 - Signal Ground, #16 - Secondary Received Data.
RS-232 PROTOCOL

The correct protocol information sent via the RS-232 port (see Page 1, #18.) allows a computer or other external device to operate a Color Pro controller in Slave mode. A Color Pro controller used in this manner is as capable as any theatre board. The computer could then be programmed with exact time between Page changes, the manner of change, and the ability to link Pages together. This linking can be from one Page to any other Page of any Memory with variable user-programmed Crossfade times. Programming of colors and Intensities must be done on the controller itself with all playback modes controlled by the external device.

The following information along with the pinout diagrams on Pages 19 and 21 provide the necessary information to allow external devices access to the controller. All front panel functions with the exception of Select, Record, Erase, Audio Level, RGB, and Region controls, are available and variable with the use of the RS-232 port.

Color Pro master-slave communications are done at 9600bps, 8 data, no parity, 1 stop bit. Master controllers need only transmit data, not receive. Therefore, master control of a Color Pro network requires just two wires: data and ground. For best results, a 70-100 microsecond pause is recommended between transmitted bytes to provide better start-bit detection.

There are five packets types used for remote control of Color Pro systems. These packet types are called:

I. System State packets.
II. Memory/Page packets.
III. Modulate packets.
IV. Crossfade packets.
V. Cycle packets.

All control packets begin with a CONTROL SYNC byte. For all five CONTROL packet types, the CONTROL SYNC character (first byte of packet) has value ’16’ hexadecimal.

All packets’ second byte are PACKET IDENTIFICATION bytes. Their values can be found in the packet descriptions which follow.

The next portion of all packets is the DATA field. This field can be anywhere from two to four bytes in length. Each packet type has its own specific length which is as short as possible to reduce traffic on the 9600bps serial line, yet convey all necessary information.

The last portion of all packets is a CHECKSUM field. The checksum field length also varies with the packet type, in an effort to reduce transmission time.
To encode data efficiently and to avoid confusion between SYNC bytes and packet data, some fields are encoded in a manner to be called (for brevity) 'ASCII-SHIFTED.' Data encoded this way still requires just one byte but its hexadecimal value (NOT ASCII equivalent) resides in the normal 'text' area of the ASCII character set. Perform this encoding by adding 20 hex to a single-byte number. This scheme will not work for binary numbers above ODF hex but they are not needed for proper Color Pro remote control. See a reference on the ASCII character-code set for more information.

For Example:
1) intensity setting 4 is a single-byte number 04hex.
2) add 20h to 04h to yield 24hex. This is an ASCII-SHIFTED '4.'
3) To recover '4' at the reciever, Color Pro simply subtracts 20 hex.

In cases where ALL binary values are needed, some fields are encoded in a manner called (for brevity) 'ASCII-ENCODED' representation. A binary 8-bit or 16-bit number is converted to its human-readable ASCII equivalent. This scheme requires two ASCII bytes to represent one binary byte.

For Example:
1) Binary 16-bit number 'C5C5' hex has a four-byte ASCII-ENCODED representation: '43' hex, '35' hex, '43' hex, '35' hex. ('43' hex is the printable ASCII character 'C' and '35' hex is the printable ASCII character '5.')
Again, refer to an ASCII chart for more information.

**PACKET DESCRIPTIONS**

Each control packet type is listed below in chronological byte order. Contents will vary according to system settings, but packets will not vary from their descriptions.

I. Packet: System State

<table>
<thead>
<tr>
<th>Field</th>
<th>Packet-byte</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4,5</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>7,8,9,10</td>
</tr>
</tbody>
</table>

Sum of fields 3,4,5 (bytes 3-6) BEFORE shifting/encoding.

Description:
This packet type alters the Color Pro system status to match the master controller's dinner, option settings, and current special-effect setting as it cycles around.
Field 3. - 'Master Intensity' 8-bit value is 0 to 30 decimal. Subject to change, depending on optional resolution of the master dimmer. ASCII-Shift before transmission.

Field 4. - 'System options' bit positions:
7 (MSB) - Standby
6 (MSB) - Random
5 (MSB) - Audio
4 (MSB) - Program
3 (MSB) - Modulate
2 (LSB) - Cycle
1 (LSB) - Crossfade

For Example:
Desired state is Standby off, Random on, Audio on, Auto off, Program on. Modulate off, Cycle off, Crossfade off. System options' binary value should be '01101000' binary or '68' hex. The ASCII-ENCODED equivalent for the Options byte should be the two 8-bit characters '36' hex, '38' hex. Therefore, the 8-bit system options value requires 16 bits for ASCII-encoding. ASCII-Encode before transmission.

Field 5. - 'Prog/Mod/Cycle' 8-bit value is 0 to 2. PROGRAM = 0, MODULATE = 1, CYCLE = 2. ASCII-Shift before transmission.

Field 6. - 'Checksum' is the sum of values in fields 3,4,5 BEFORE they are encoded. Then ASCII-ENCODE this 16-bit sum into four bytes for transmission. Color Pro will decode back to 16 bits and compare against the received packet values. Garbled packets will be ignored. ASCII-Encode before transmission.

II. Packet: Memory/Page

<table>
<thead>
<tr>
<th>Field</th>
<th>Packet-byte</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>5,6</td>
</tr>
</tbody>
</table>

Description:
This packet type alters the Color Pro memory and page setting to match the master controller’s settings.

Field 3. - 'System memory' number is an 8-bit integer from 1 to 9 decimal. ASCII-Shift before transmission.

Field 4. - 'System Page' number is an 8-bit integer from 1 to 99 decimal. ASCII-Shift before transmission.

Field 5. - 'Checksum' is the 8-bit sum of fields 3 and 4. 8-bit sum should be ASCII-ENCODED into 16 bits for transmission.
III. Packet: Modulate

<table>
<thead>
<tr>
<th>Field</th>
<th>Packet-byte</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Description:
This packet type alters the Color Pro RGB values when in MODULATE mode. Modulate is only activated when Option 'modulate' is selected and the system 'Prog/Mod/Cycle' 8-bit value is set to MODUALTE. See System-state packet description.

Fields 3, 4, & 5. - 'Red,' 'Green,' 'Blue,' values are 8-bit integers from 0 to 99 decimal. ASCII-Shift before transmission.

Field 6. - 'Checksum' is the sum of red, green and blue values BEFORE ASCII-Shift. 8-bit sum should be ASCII-ENCODED before transmission. Checksum for this packet type is optional.

IV. Packet: Crossfade

<table>
<thead>
<tr>
<th>Field</th>
<th>Packet-byte</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>5, 6</td>
</tr>
</tbody>
</table>

Description:
This packet type alters the Color Pro RGB values when in CROSSFADE mode. Crossfade is only activated when Option 'crossfade' is selected and the system has recently changed scenes.

Field 3. - 'Fade-rate' is an 8-bit integer from 0 to 30 hex. Smaller numbers cause fastest crossfade speed. Allows crossfade action to be smoothed out between crossfade steps (see fade-step below) for slower fades, yet provide fast-cut capability. ASCII-SHIFT before transmission.
Field 4. - 'Fade-step' is an 8-bit integer from 1 to 99 decimal. Allows crossfade synchronization at all speeds. Crossfade begins when Color Pro's MEMORY or PAGE number is changed, and continues for a maximum of 99 decimal PARTIAL crossfade steps. Multiple controllers can crossfade at the same rate by sending all controllers the same fade-step number. This step number can be sent as quickly or as slowly as necessary; crossfade times from sub-second to hours long can be accomodated with this scheme. In case of garbled data, Color Pro will attempt to catch up to the last-sent master step value while crossfading. ASCII-SHIFT before transmission.

Field 5. - 'Checksum' is the sum of fields 3 and 4 BEFORE ASCII-Shifting. 8-bit sum should be ASCII-ENCODED before transmission.

V.PACKET: Cycle

<table>
<thead>
<tr>
<th>Field</th>
<th>Packet-byte</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3,4,5,6</td>
</tr>
<tr>
<td>4</td>
<td>7,8</td>
</tr>
</tbody>
</table>

Description:
This packet type alters the Color Pro RGB values when in CYCLE mode. Cycle is only activated when Option 'cycle' is selected and the system 'Prog/Mod/Cycle' 8-bit value is set to CYCLE. See System-state packet description.

Field 3. - 'Cycle phase' allows synchronized color fading from shade to shade around the color spectrum. This 16-bit integer (0-599 decimal) specifies a unique color about the wheel; 0=reds, midway=greens, and max=magenta. ASCII-ENCODE before transmission.

Field 4. - 'Checksum' is the 8-bit sum of field 3 BEFORE encoding. ASCII-ENCODE before transmission.
DEFINITIONS

ACTIVE REGION - indicated by a lit LED shown in the Region display indicating an RGB value for that Region greater than 0.0, 0.0, 0.0.

NONINITIALIZED PAGE - one that has had all value removed by the Select Erase process, therefore no LEDs will light in the Region display when this Page is accessed. A Noninitialized Page will be indicated in the display; by ──, ──, ── when a Region key is depressed.

INITIALIZED PAGE - one that has had an RGB value Programmed into it of 0.0, 0.0, 0.0 or greater. When an Initialized Page is accessed, the Active Regions may not be shown in the Region display as only Active Regions (indicated by an RGB value greater than 0.0, 0.0, 0.0) will display lit LEDs. Initialized Regions with RGB values of 0.0, 0.0, 0.0 will not cause LEDs to light.

SERIAL DATA LINK - pulse modulated digital signals are sent via this to control fixtures’ output, Intensity level, and activity.
MAINTENANCE

Your Color Pro system has been designed for longevity with minimum maintenance, and cleanliness will enhance its life. Controllers should be cleaned regularly with a soft cloth. Luminaires will need to have their lenses cleaned with a soft tissue and a glass cleaning solution.

Important: The cooling fan and insides of fixture will need to be periodically blown clear of any dust which could cause overheating. This is best done with a can of compressed air or an air compressor set for low pressure.

The dichroic filters will also need periodic cleaning. To gain access, loosen the drawer access screw and pull and drawer out to its stops. The six dichroics will then be exposed, though you must remove the lamps to access both sides of some filters. A soft tissue and glass cleaner should be used but do not attempt to clean them while warm or hot.

Controller and power should be off when any cleaning or maintenance is done.

WARRANTY

Your Color Pro system is covered by a limited, 6 month parts and labor warranty. It is the owner’s responsibility to furnish receipts or invoices for verification of purchase, date, and dealer or distributor. It is necessary to obtain a return authorization number BEFORE any units are sent in for repair to the manufacturer. The manufacturer will make the final determination as to whether or not the unit is covered by warranty. This warranty does not cover lamps of fuses.

Warranty is void if the product has been opened, misused, altered, or modified in any way.

Shipping will be paid by the purchaser and warranted items shall have return shipping paid by the manufacturer in the continental United States. Under no circumstances will freight collect shipments be accepted! Prepaid shipping does not include rush expediting such as air freight. Air freight can be sent customer collect in the continental United States.

PRECAUTIONS

Please note on the fixture and the controller the various precautions. Keep both units away from rain or moisture to reduce the risk of fire or electrical shock. These units are not for residential use and contain no user-serviceable parts inside. Servicing must be conducted by the manufacturer or other qualified service personnel. For continued protection against fire, fuses must be replaced only by those with the specified voltage and current ratings. Use lamp type ENH, ENG, or ELH only.
TROUBLE SHOOTING

Your Color Pro luminaire is equipped with an LED indicator on the front lower left of the fixture. This LED will light and the cooling fan will run when the fixture is first plugged in and then both will turn off after approximately 60 seconds. With the serial data lines plugged in and the controller turned on, the LED and the fan will be on continuously until the controller is turned off or the serial data line is unplugged, at which time the fan will continue to operate for 60 seconds to cool the lamps. The LED will extinguish as the fan turns off. Should this LED fail to light when the controller is turned on, check for voltage at the fixture and that all serial data cables are plugged in.

OTHER PROBLEMS

<table>
<thead>
<tr>
<th>SYMPTOM(S)</th>
<th>CAUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNITS FLASHING UNCONTROLLABLY AND/OR FAILING TO GO DARK WHEN STANDBY IS DEPRESSED</td>
<td>SHORTED CONNECTION IN DATA LINE OR PLUG NOT INSERTED COMPLETELY IN JACK.</td>
</tr>
<tr>
<td>COLOR OUTPUT OF FIXTURE(S) NOT THE SAME AS OTHERS OR THEIR RGB SETTINGS</td>
<td>ONE OR MORE LAMPS OUT OR INCORRECT REGION ASSIGNMENT</td>
</tr>
<tr>
<td>S.L. DISPLAYED IN FIRST WINDOW WHEN ANY ADVANCE OR CONTROL KEY IS DEPRESSED</td>
<td>CONTROLLER IN SLAVE MODE - DEPRESS AND HOLD SELECT KEY UNTIL C.L. IS DISPLAYED</td>
</tr>
<tr>
<td>ADVANCE NOT RESPONDING TO AUDIO INFORMATION</td>
<td>AUDIO LEVEL POT SET TOO LOW OR HIGH -- SET WHERE LED JUST FLASHERS WITH BEAT</td>
</tr>
<tr>
<td>CROSSFADE NOT WORKING - LIGHTS SEEM TO BE STUCK ONE COLOR</td>
<td>CROSSFADE RATE TOO LOW FOR ADVANCE RATE - MUST BE THE SAME OR FASTER</td>
</tr>
<tr>
<td>REGION NOT RESPONDING TO CONTROLLER - L.O. DISPLAYED WHEN REGION IS DEPRESSED</td>
<td>REGION LOCKED OUT - TURN CONTROLLER OFF AND THEN BACK ON TO RESET</td>
</tr>
<tr>
<td>UNABLE TO RECORD PROGRAMMING IN A MEMORY - L.C. DISPLAYED WHEN RECORD IS DEPRESSED</td>
<td>MEMORY HAS BEEN LOCKED TO PROTECT A MEMORY, PREVENTING ADJUSTMENT - CONTACT INSTALLER</td>
</tr>
</tbody>
</table>
ATTENTION:
ABOUT LAMP LIFE

DETRIMENTAL EFFECTS OF OVER-VOLTAGE

BECAUSE OF DRASTIC LAMP LIFE REDUCTION AT OVER-VOLTAGE, LIGHTWAVE RESEARCH RECOMMENDS THAT ANY OVER-VOLTAGE CONDITION BE CORRECTED BEFORE OPERATION OF THE COLORPRO SYSTEM.

A lamp that is stressed by over-voltage, even if just for a day or two, may be very near failure. For example, a lamp operated just 5% above rated voltage (126 volts rather than 120 volts) will last half of its rated life! (See figure 1.)

![Figure 1](image)

If your lamps have been stressed, Lightwave Research recommends that all lamps be changed immediately after rectifying the over-voltage problem. Continued use of stressed lamps will result in constant lamp maintenance problems. Lightwave Research does not warranty lamps that have been stressed by over-voltage.

DETERMINING LINE VOLTAGE

Measuring line voltage with a Volt-OHM-Meter does not give an accurate indication of lamp operating voltage. Assuming the meter is properly calibrated (most are not!), the reading it gives is only an instant in time.

A power line monitor, connected to the line for one week, will chart on paper line voltage fluctuations versus time. Monitoring for one full week allows all power consuming businesses to shut down (line voltage goes up), and gives a realistic "picture" of line voltage during those times your Colorpro system is operated. Most local utilities will provide this service at no charge.

If over-voltage conditions exist, the power company can often correct this at the service transformer. If not, Lightwave Research offers 95% and 90% power options, easily retrofitted to the Colorpro controller.
AVERAGE LAMP LIFE

Colorpro luminaires are shipped with ENH-MR-16 LAMPS, a Tungsten Halogen lamp rated for 175 hours. This lamp life, given by the lamp manufacturer, is the average life of a large group of lamps tested at their rated voltage.

Normally, some lamps will fall short of their rated life, even when operated under laboratory conditions, and others may last half again longer than their rated life. At 175 hours, approximately 50% of ENH lamps in a large group will have burned out and 50% will remain burning as indicated in figure 2.

![Figure 2.](image)

Table 1 provides a summary of voltages, average lamp life, and power options. Notice that, given normal line voltage of 120 volts, lamp life can be extended with the 95% or 90% power option, with only a slight reduction of light output.

240 VOLT/50 CYCLE USERS

The Colorpro luminaires are set at the factory so that when connected to a 240 volt/50 cycle line, there will be 120 volts RMS at the lamps. Expected lamp life in 240 volt/50 cycle areas are also shown in table 1. For example, if line voltage in your area is 5% high, the numbers in the middle row will apply.

<table>
<thead>
<tr>
<th>POWER OPTION: LINE VOLTAGE</th>
<th>100% LAMP VOLTAGE AVERAGE LAMP LIFE</th>
<th>95% LAMP VOLTAGE AVERAGE LAMP LIFE</th>
<th>90% LAMP VOLTAGE AVERAGE LAMP LIFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORMAL 120V/60Hz (240V/50Hz)</td>
<td>120V 175HR</td>
<td>114V 332HR</td>
<td>108V 500HR+</td>
</tr>
<tr>
<td>+ 5% 126V/60Hz (252V/50Hz)</td>
<td>126V 88HR</td>
<td>120V 175HR</td>
<td>114V 332HR</td>
</tr>
<tr>
<td>+10% 132V/60Hz (264V/50Hz)</td>
<td>132V 53HR</td>
<td>126V 88HR</td>
<td>120V 175HR</td>
</tr>
</tbody>
</table>

Table 1.