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Lighting a sculpture

This application note is based on an actual application, but the timings, number of channels and levels have been modified to make this more understandable.

Problem: A large sculpture has 4 different colors of lights built in to it. The artist is not a programmer and needs a simple way to have the lights change level over time in a continuous loop in unattended operation. Power will only be turned on during business hours. The artist would also like to be able to easily make changes to the levels and timing whenever he wants.

Solution: Our Model 4201 Converter/Controller was programmed to run in stand-alone mode and controls a standard multi-channel dimmer pack to which the lights are connected. The host computer used for programming the 4201 was the artist's Mac notebook, the software used on the Mac was ZTerm (a simple terminal emulator).

Details: The 4201 has the capability to automatically execute a script on power-up. The script can set and monitor a real-time clock and base lighting changes on this clock. The 4201 can hold up to 127 different presets (lighting looks) and each preset can handle up to 512 channels of lights.

While this exact same approach could be used for any number of lighting channels from 1 to 512, the example will use 4 channels and a limited loop length for simplicity.

First write out a timeline of lighting looks, when they should happen, and fade times between them for the entire time of the loop. Then assign each look to a preset number which will be all we need to know to get that look again (once the presets are programmed into the 4201).

Timeline

Time (m:ss)	Function	Red	Green	Blue	White	Preset #
0:00	snap on, no fade	100%	100%	100%	100%	1
0:10	begin 30" cross fade	0%	100%	75%	40%	2
0:40	cross fade ends					
1:23	begin 10" cross fade	50%	10%	0%	0%	3
1:33	cross fade ends					
1:33	begin 20" cross fade	100%	20%	0%	0%	4
1:53	cross fade ends					
2:00	begin 60" cross fade	0%	0%	0%	100%	5
3:00	cross fade ends					
3:00	jump to time 0:00					

Next we convert the presets into hexadecimal (see our other app notes for conversions). Red is connected to the first dimmer channel, green to the next, then blue, then white. The dimmer rack considers the first channel to be channel 1 and the 4201 calls the first channel zero. This isn't a problem, once the dimmer is set up we can forget about its numbers. So, for our purposes, Red is channel zero, followed by Green, Blue, and White.

Preset	Data for the 4 channels (in hex)			
1	FF	FF	FF	FF
2	00	FF	BF	66
3	80	1A	00	00
4	FF	33	00	00
5	00	00	00	FF

The first data column is channel 0, the second column is channel 1, and so on. If you have more than 4 channels, simply extend this table to the right. If you have more presets, extend the table down. Presets are also numbered in hex, there are 127 available (1-7F hex) and can be used in any order, however keeping them sequential might make it easier to remember.

Next we write a script to handle the timing. Script commands we will use are:

- **:0** label, can range from 0-FF, auto-exec script starts at :0
- **TS** set clock, if no time is given, clock is set to all zeros
- **TW** wait for a certain time (like an alarm clock)
- **F** cross fade from the current levels to a preset (all channels fade together). Time is in **TENTHS** of a second (range 0-FFFF, about 109 minutes max).
- **J** jump to a label
- **;** end of command, all commands end with a semi-colon

The auto-exec script can be up to about 400 characters long, if you need more, you can use a Link command to use any spare preset(s) as additional space (511 additional characters per preset). See our manual for more commands.

The script will be entered as all one line, but each command will be shown below on a separate line for clarity. It is often best to compose the script in a text editor and then cut and paste it to

your terminal program. You can even cut and paste from an e-mail.

The Script

:0; Label, all scripts need at least one label and the auto-exec script needs label zero to know where to start.

TS; Set the clock to all zeros. The clock counts in hours, minutes, seconds, and tenths of a second. We'll only be using minutes and seconds. This is especially important when you come back here for the second and later loops. If this wasn't here, the time would still be counting and all the TW commands wouldn't wait.

F 1 0; Fade to preset 1 in 0 seconds. In this case we could have also used the command P1 (load Preset #1).

TW 0 0 A; Wait until the time is 0 hours, 0 minutes, and 10 seconds (A hex = 10)

F 2 12C; Fade to preset 2 in 300 TENTHS of a second (12C hex = 300)

TW 0 1 17; Wait until the time is 0 hours, 1 minute, 23 seconds (17 hex = 23)

F 3 64; Fade to preset 3 in 100 tenths of a second (64 hex = 100)

F 4 C8; As soon as preset 3 is done fading, start a new fade to preset 4 over 20 seconds (C8 hex = 200). The next command will NOT be executed until the previous one finished. We could have added a TW command, but there wouldn't have been any actual waiting done (if the time has already passed, TW does nothing in a script).

TW 0 2; Wait until the time is 0 hours, 2 minutes.

F 5 258; Fade to preset 5 over 60 seconds (258 hex = 600).

J 0; As soon as the fade to preset 5 is done, jump to label 0. This will start the loop over.

Here's the script all as one line:

:0; TS; F 1 0; TW 0 0 A; F 2 12C; TW 0 1 17; F 3 64; F 4 C8; TW 0 2; F 5 258; J 0;

The space after each semi-colon isn't needed, but it helps readability. If you are running out of room in the auto-exec script, leave out the spaces after the semi-colon and after a command and the first number ("F 1 0" becomes "F1 0").

Now we actually have to hook up the computer so we can program this into the 4201. Since our Mac driver isn't available yet, the 4201 was connected to the Mac with a normal RS-232 serial cable. ZTerm was downloaded off the web, installed, and set up (9600 baud, no parity,

CTS/RTS handshaking, local echo). On Windows you could use HyperTerm which should already be installed on your system. HyperTerm will work with either a USB or RS-232 connection. Pressing the return key on the computer should make the yellow light on the 4201 flash and you should receive a prompt (">") on your screen. You're now ready to program the 4201.

Now that you can communicate with the 4201, there are a few set up things that should be checked. Press the RETURN/ENTER key and make sure you have a prompt (">"). Next type the letter "I" and press RETURN/ENTER again. You should see copyright information along with some other settings. You should see that Handshaking is ON and that the number of channels is equal to or greater than the number of dimmer channels that you are using. The number shown is in hex. In our case, any number over 4 will do (lower numbers speed up script execution, but for this application we aren't concerned with a tenth of a second here and there). To change the handshaking to ON, enter the following command:
> **H 1**
Followed by pressing the RETURN/ENTER key and noting that you get the prompt back.

To change the number of channels to 4, enter the following command:
> **N 4**
Followed by pressing the RETURN/ENTER key (ALL commands are followed by RETURN/ENTER).

Note that backspace DOES NOT WORK with the 4201. It may appear to work on your screen, but it hasn't done what you intended. If you make a typing mistake, simply press RETURN/ENTER and type the command in again. If the 4201 doesn't understand something, it will send an exclamation point ("!") to you.

If the green DMX LED isn't lit on the box, type:
> **P 1**
This will immediately turn on the DMX output and send the levels stored in preset 1 out to the lights.

Now enter the following command:
> **Z**
This saves all the setup information so that the next time the 4201 is powered up, all these settings will be restored. You should not have to set these again unless you change the number of dimmers in your system.

Now we're going to write the lighting levels into the presets. If you have a lot of channels and/or a lot of presets, this could take some time. Cut and paste is HIGHLY recommended.

If you have the dimmers and lights all connected, you'll see the lighting levels change as you type in the values. The simplest way to enter this is to first send the levels to the "Active Memory", basically this is what is sent out to the dimmers. When you have all the values for one look entered, then we'll copy the Active Memory to whichever preset this look is to be saved in. This will erase all data in that preset, replacing it with the current levels your lights are

displaying.

The commands we'll be using are:
> **W 0**   Write levels into one or more channels starting with channel 0
>
> **C 0 1**   Copy all the levels from Active Memory (preset 0) to some other preset (in this case, preset 1)

So, let's do preset 1:
> **W 0 FF FF FF FF**

You remembered to press your RETURN or ENTER key at the end of that, right?
All your lights should now be full on. They would have changed AS you typed the levels in. This is why backspace doesn't work, the 4201 executes commands as they're received to save time, so it can't undo what it's already done.

If you want to play with different levels before saving simply reenter the line with the new levels. You can also change an individual channel by giving the W command with a different starting address. If you want to just change channel A7 (hex) to a level of 23 (hex), you'd enter the command:
> **WA7 23**

Once you're happy with the levels, copy them to preset 1:
> **C 0 1**

This will copy all 512 channels, even if you're only using a few.

Now, go back to the W command and do the same thing for all the other presets.

Once you've finished all the presets, you need to write the auto-exec script and test it out. The simplest thing is to add the command to write the script to the beginning of the script in your text file, and then cut and paste the entire thing at once. So, the line would look like:
> **XW 0 :0; TS; F 1 0; TW 0 0 A; F 2 12C; TW 0 1 17; F 3 64; F 4 C8; TW 0 2; F 5 258; J 0;**

Followed by the RETURN/ENTER key, of course. The "XW 0" at the beginning means Write the following to Script #0 (the auto-exec script). Note that you need a space after the zero and before the colon.

Now it's time to see if this all works. For now we'll start the script manually, but it will also start automatically the next time you power up the box (unless you power it by plugging it into a USB port, that will abort any script or fade running if you have the latest firmware).

Type the following and your script will be running:
> **XE 0**

Followed by RETURN/ENTER. The command means Execute Script #0. The script will now be running. If an error is detected, a message will appear on your screen telling you where in the script the error is and the script will abort. You should fix the error, write it again, and then try running it again.

When a script is running, any commands you type will be held in a buffer until the script is done (in this case, never). If you type more than about 220 characters, the 4201 will tell your computer to stop sending, and you won't be able to type any more commands into the box. This means you won't be able to send the ABORT command to stop the script. If this happens, unplug the box power (and USB cable, if used) and then plug it back in. The script will start again but the buffer will now be empty.

To stop a script that is running, type an asterisk ("*"). That will halt any fade or script and discard anything that was in the buffer.

Now you can change levels in one or more presets and/or change the script. There is no need to re-enter all the presets and the script, they will all be saved from before. You only need to enter what you need to change.

So, now we're ready for the show. Unplug the 4201 from your computer, and if it isn't connected to your dimmers, go connect it. If the AC adapter is plugged in, unplug it, wait a few seconds, then plug it back in. Your sculpture is now lit the way you wanted it.

Since this particular sculpture was only to be lit during business hours, the 4201 was plugged into a cheap wall timer. It is powered up at the start of business and powered off at the end of the day. For safety, it would be good to turn off power to the dimmers, too, but this isn't strictly required (dimmers SHOULD, but may not, turn off all the lights within a couple of seconds of you turning off power to the 4201).

As always, feel free to contact us with questions. If you purchase a 4201 from us, we'll even program a simple script into it before shipping it to you, if you'd like.

Note that updating the firmware in the 4201 will erase the auto-exec script, all the settings, and preset #1. As long as the 4201 is working to your satisfaction, there is no need to update the firmware.