SanDevices E680 Pixel Controller Operating Manual

Sep 13, 2011

Revision History:

Sep 13, 2011 added typical 4-string layout diagram and info re vers 3 PCB.

August 22, 2011 added information for latest firmware version (2.20)

Added current PC board layout drawing. Added fuse warning.

June 21, 2011 corrected information for Default (DE) command

Added color-code for 4-wire waterproof cables

Mar 29, 2011 added notation that currently shipping firmware will, default to static IP address of 192.168.1.206

Introduction

The SanDevices E680 is a controller intended to be used as part of a system to operate a lighting display that consists of many individual RGB pixels. To form a complete system, one or more E680s are used together with a power supply, one or more strings of pixels, and a PC equipped with lighting display software that supports RGB pixels, and the E1.31 DMX over Ethernet lighting protocol.

The E680 installs near the pixels it controls and their power supply, and acts as the bridge between the pixels and the PC. The E680 receives the lighting intensity signals from the computer via a network (LAN) connection, and converts them into a form suitable for operating the actual pixels.

Feature Summary

Single PC board, 2.5” x 3.8”

Small parts count, all through-hole components

DMX data input via E1.31, DMX over Ethernet, up to 4 universes, eliminates the need for multiple DMX ‘dongles’ at the controlling PC.

On-board connectors for up to 16 pixel strings

Pixel strings powered from the board, no external pixel power wiring needed

Extremely versatile, with many programmable options, and many pixel types supported

Including 5-bit, 8-bit, and 12-bit pixels.

Multiple pixel types/voltages can be driven simultaneously

Simple programming via a web page

Specifications:

Input: E1.31, streaming DMX over Ethernet, **multicast format**, up to 4 universes, or a total of 2048 DMX channels. **The E680 does not support unicast E1.31.**

Output: 16 connectors for pixel strings. The board can control up to 680 individual pixels using up to 2040 DMX channels. (The limitation is the number of available DMX channels, and if some or all of the pixels are to be controlled in groups, then the total pixel count can be much larger.)

Power: There are two connections for pixel power, allowing the use of two separate power supplies. This also allows a mix of 5 volt and 12 volt pixels to be controlled by a single board. Each power inlet supplies power to 8 pixel strings. The E680 itself requires 4-7 VDC at about 300ma. If one of the pixel power sources is 5 volts, that pixel power can also power the E680 module itself. If all pixels are 12 volts, then a separate 5VDC power source must be connected to the board via the 2-terminal power strip at the bottom. The dip jumper near the power terminals is put in place to power the board from pixel power, it is removed if using an external 5V supply.

The E680 has a large number of programmable options to allow the board to be used in many different configurations. Programmable options are set using a web page. This page also displays operating statistics and the current configuration data.

Mounting the module

The pixel driver consists of a single PC board measuring 2.5” x 3.8”. There are (4) .125” mounting holes (suitable for #4 screws) on 2.25” x 3.55” centers.

#4-40 nylon hardware is the preferred method to mount the module. **If using metal hardware, take care to GUARANTEE that there is no contact with the board traces on the two left-hand mounting holes, TOP or BOTTOM!** Traces near these holes carry the pixel power. The lower-right hole is grounded (except on V3 boards) and isn’t a concern. The use of 4-40 nylon spacers and 4-40 nylon 1/4” machine screws is preferred. You can either bolt or hot-melt glue the other end of the spacers to your enclosure.

Since the E680 must be located near the pixel strings it controls, this will often mean mounting the unit outdoors. It is the user’s responsibility to provide a suitable enclosure for the E680 and power supply, that will protect these items from direct exposure to moisture.

When referring to parts locations on the board, using the following illustration, the assumption is that you are looking at it “right-side up”, i.e., the large green power terminal block will be on the left as shown:

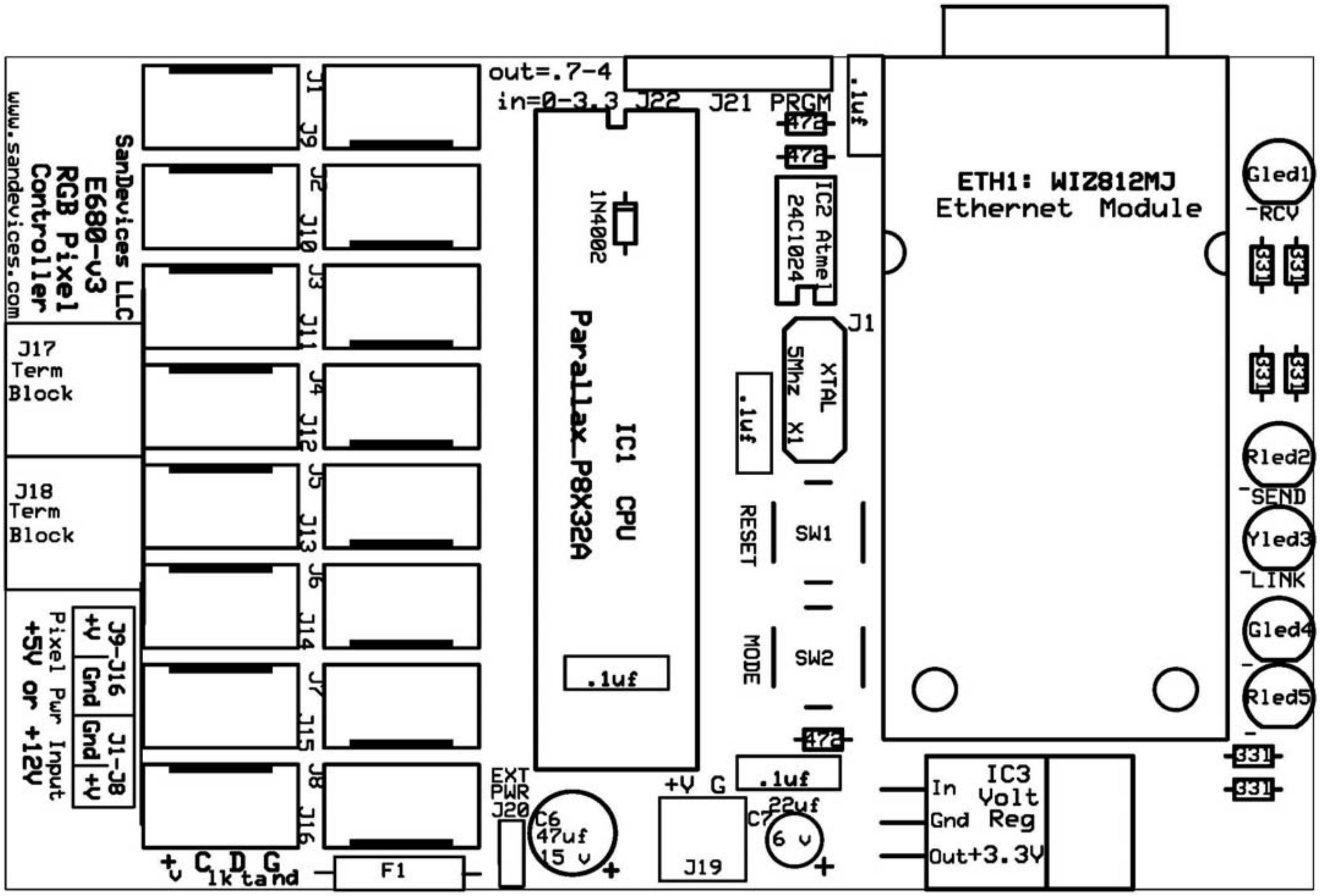
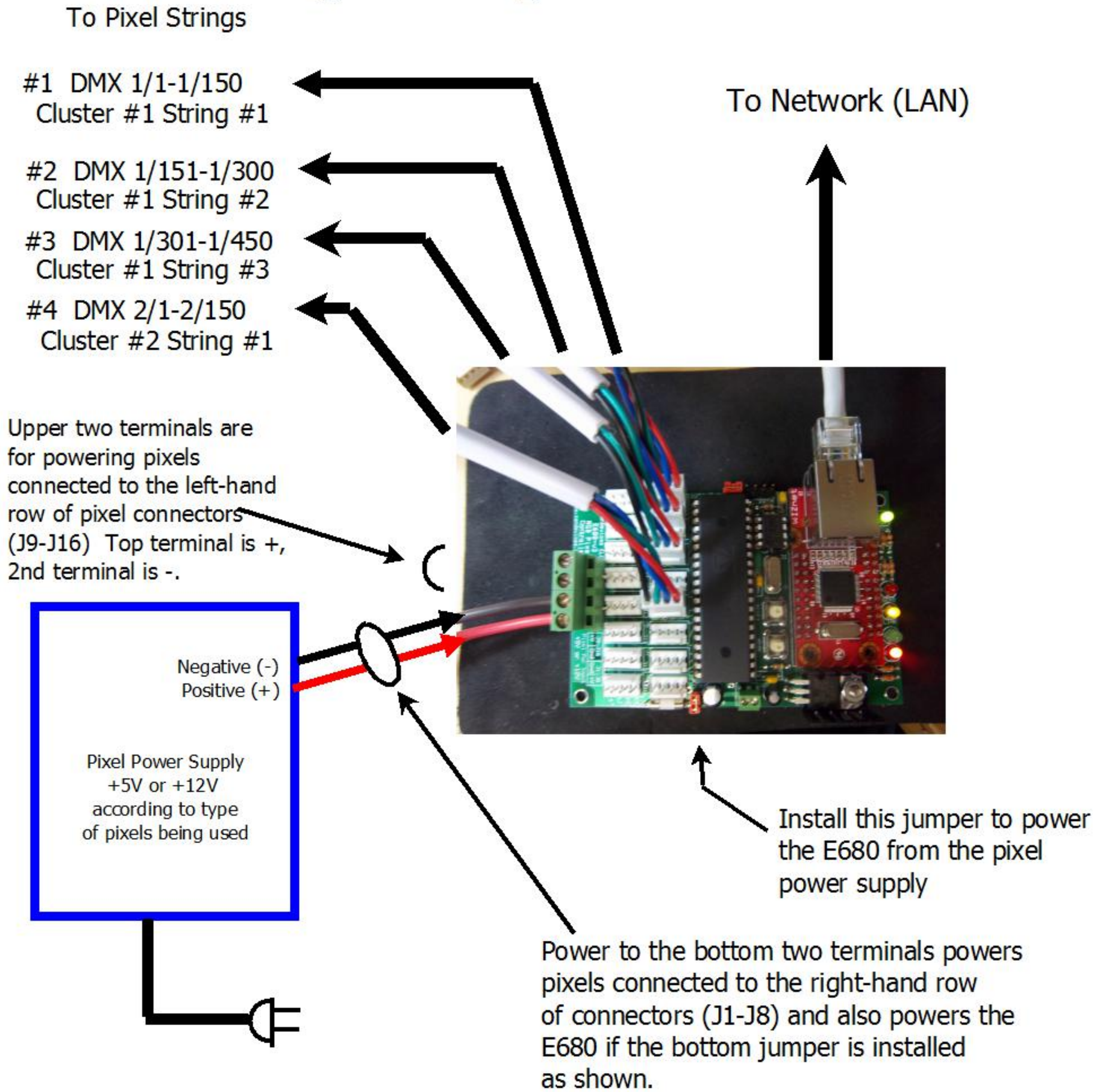


Figure 1: **E680 Circuit Board Layout- Vers 3 Shown**

Notes re PCB version 3

Version 3 of the E680 circuit board is the most recent as of Sep 12, 2011. Version 3 adds a new jumper position to the left of the programming port. This jumper, when NOT installed, shifts the output signal voltage of the E680, which can help in driving certain pixel types, or longer wiring between E680 and pixels. Please refer to the E680 V3 specific documentation at the end of this document before removing this jumper.

E680 Typical 4-String Wiring



Making Connections

There are four types of connections to the E680: Pixel Power, Pixels, Module Power, and network. The illustration above shows a typical arrangement where 4 strings of pixels are connected, and the E680 is powered from the pixel power supply.

Power for the pixels is connected to the large green 4-terminal screw block on the left side of the board. There is a legend silk-screened on the board below the terminal block. The top terminal is +V for the strings connected to the left column of string connectors (J9-J16), and the bottom terminal is +V for the string connectors labeled J1-J8 (the right-hand column), and this power source may also provides power to the board itself if it is 5VDC. The E680 may also be powered from a 12 volt pixel supply but be aware that the heat sink will get quite warm. This is normal and well within the rating of the components.

Both center terminals are ground. One power supply can power both sides, using a jumper wire between top and bottom terminals, or you can use two separate supplies. Figure a maximum current requirement of about 3 amps per typical 50-pixel string at 5 volts. **To power a full load of 12 50-pixel 5 volt strings, you should have a power supply rated at a minimum of 40 amps, and use short runs of 12 gauge wire or larger between the power supply and the board.** The negative side of the power supply should be connected to earth ground.

Note: Typically, RGB pixels will operate off of 5 volts, or 12 volts. It is important that you match your power supply to the requirements of your pixels. The module is capable of driving both 5V and 12V pixels at the same time. To do this, you would connect the 12V power supply to the top 2 terminals of the power block, and the 5V power supply to the bottom 2 terminals, keeping in mind that the middle terminals are ground, and the outside terminals are +. The 12 volt strings would then plug into string connectors J9-J16, the left-hand row; and the 5V pixels would plug into connectors J1-J8, the right-hand row. **It is very important, when using a dual voltage setup, that you do not plug 5V pixels into the 12V side!**

Power for the E680 module itself can be supplied in one of two ways: The pixel power connected to J1-J8 (the bottom 2 terminals of the power block) can also power the module. To do this, plug the supplied dip jumper across the 2 pins immediately to the right of J8. If a jumper is installed here, then the E680 is powered from the pixel power supply, and no other power is needed. This is the preferred arrangement. If you prefer to power the E680 from a separate power supply, remove the jumper and connect a 5-8 VDC power supply, rated at 500ma or more, to the small green power terminal block at the bottom center of the board. +5V on the left, ground on the right.

The Ethernet jack on the red Ethernet module must be connected to your LAN, or directly to the LAN card of the PC that will be controlling the pixels. The E680 LAN port is capable of running at 100mb/sec.

The pixel strings plug into the 4-pin polarized connectors labeled J1-J16. Please note that the two rows of string connectors are oriented in opposite directions. In general, pixel strings can be plugged and unplugged while the system is powered up, but it is recommended, to reduce risk of damage to pixels, that pixel connection/disconnection be done only while the system is off. **If using the GE ColorEffects strings, they will not function properly if plugged in while the module is powered up.**

Connecting Pixel Strings to the E680

Use 4-pin female Molex type “KK” housings and pins, or equivalent, as illustrated below. The pins are intended to be crimped, but you can also solder them. The connectors are polarized so they will only plug into the board one way.

In the above illustrations the housing and pin are both “right-side up”. An alternate style of female connector is available that eliminates the need for the crimped pins.

If you are using Sandevices-supplied 4-wire waterproof cable assemblies the color code is as follows:

RED +V pixel power

BLUE Clock (not used on 3-wire pixels)

GREEN Data

BLACK Ground

If you look at the board, beneath J16, there is a legend for the pins that is silk-screened on the board. For connectors J9-J16, from left to right, the pins are:

+V This is the +5V or +12V power from the terminal block to the string.

Ck This is the clock line, NOT USED for GE strings or 18xx strings.

Dt This is the data line . It is required for all strings.

Gnd Ground.

Pixel power connections are NOT fused on the E680. You should provide external inline fuses on all pixel strings and the pixel power supply to prevent damage in the event of a short circuit.

Note that the order is reversed (mirror-image) for the right-hand row of connectors (J1-J8) because they are mounted in the opposite orientation. Another way to look at it is that the GROUND pin is ALWAYS the pin closest to the center of the group of 16 connectors, the +5V pin is ALWAYS on the outside of the cluster of connectors, and the data pin is always next to the ground pin.

Length of wiring between E680 and pixel strings should be kept as short as possible for maximum reliability in driving pixels. Also avoid using twisted pair cabling if possible. Loosely grouped individual wires, or multi-conductor non-twisted wire is best. The maximum possible distance between board and 1st pixel will vary with pixel type and timing. If pixels exhibit flickering, try shortening the length of wire between controller and pixels. For those that need longer cable runs, the E680 has a feature called Null Pixels. Just insert a single extra pixel in line near the controller, then repeat if needed to reach the desired driving distance. After the 1st pixel, you should be able to go 10-20 feet between these extra pixels. Then the board can be configured to 'know' how many extra pixels are wired into each string, and the software automatically ignores these, and starts lighting the string at the first real pixel. This feature is described in more detail later.

An alternative method to achieve more reliable operation over longer wire lengths is available on E680 version 3. Please refer to the V3 specific documentation before using this feature. That document also described the procedure for retrofitting earlier boards.

A future software revision will support a programmable timing option, that will allow you to run pixel strings at slower refresh speeds (still much faster than dmx), where longer string separation is needed, for those pixel controller types that support variable speed operation.

Obviously, you need to be 100% sure that your wiring is correct before plugging in a string, I suggest checking voltages at the 'string' end of the connecting cables that you make up to verify that the proper voltage is on the proper wire, before splicing to the string itself.

Incorrectly wiring a string may cause irreversible damage to the pixels.

Initial Startup

The recommended procedure is to supply power and a LAN connection to the E680, access the web page to configure the E680 for your particular arrangement of pixels, then connect pixel strings and test.

There are 5 LEDs on the board, all along the right-hand edge. The upper 3 LEDs are for the ethernet module, YELLOW for LINK, RED for SEND, and GREEN for RECEIVE. These LEDs always indicate activity on the ethernet link. The lower 2 LEDs are used for displaying E680 status, and for selecting options at system start-up. During normal operation, the lower green LED will flicker whenever a DMX data packet is received, and the red LED will light whenever the web server is running. You can only access the E680 via a web browser when the red LED is lit. References to the red and green LEDs in the following text always refer to the lower red and green LEDs.

There are 2 pushbuttons, immediately to the right of the large CPU chip. The upper one is RESET, pressing it at any time resets the processor. The lower button is the PROGRAM button, it is used to perform certain operations at start-up, such as forcing the web server to start, or forcing specific network modes.

LED Activity During Startup

During startup, after a few seconds of delay, the lower green LED will flash one or more times to indicate the current network configuration:

1) Currently saved IP MODE is DHCP, and an IP address was obtained from a DHCP server.

2) Currently saved IP MODE is Static, and the last STATIC IP address saved into memory page 0 was used.

3) IP address was obtained from DHCP, because it was forced by the pushbutton.

4) IP address was set as the last saved STATIC IP address, because it was forced by the pushbutton.

5) Currently saved IP mode is DHCP, but no DHCP server responded, so our IP address has been set to 169.254.74.73.

7) IP address was forced to DHCP by the pushbutton, but no DHCP server responded, so our IP address was set to 169.254.74.73.

Note that for blink codes 5 and 7 there will be about a 10 second delay before the code is flashed. During this time the system is waiting for a DHCP server.

After this flash code, the red LED will flash 4 times, then either come back on again and stay on, or remain off. The final state of the red LED indicates whether or not the web server is running. <u>Note: The web server doesn’t operate continuously because the E680 is only capable of 4 simultaneous internet connections. So, although the first 3 connections can be dedicated to receiving DMX dimmer data full-time, the last connection has to be shared between receiving DMX and running the web server.</u>

<u>**As of March 28, 2011, the firmware as shipped will default to an initial static IP address of 192.168.1.206. If this is incompatible with your network, see instructions below to force the use of DHCP at startup.**</u>

<u>**As of September 12, 2011, eeproms and assembled boards will be shipped with a test pattern enabled as a default. This will allow you to verify proper operation of the controller without using a network connection.**</u>

Forcing a Specific IP Mode at Startup

It is possible to over-ride the default network configuration, if necessary, using the on-board program pushbutton. At power-up, or after restarting by pressing the RESET button, <u>**press and hold**</u> the program button. After a few seconds, the red and green LEDs will begin flashing on and off together at a rate of one flash per second. To over-ride, <u>release</u> the PROGRAM button:

<u>After 1 flash</u> to force the web server to start without affecting the network mode.

<u>After 2 flashes</u> to bring up the web server, and force the IP mode to be static.

<u>After 3 flashes</u> to bring up the web server, and force the IP mode to be DHCP.

These functions are in place to allow you to communicate with your E680 via a web browser, regardless of the state it was in. For example, you may have your E680 configured for a static IP address, but you've moved it to a new network where that address isn't available. Or perhaps it's configured for a static IP, but you don't know the saved address. Or perhaps in your configuration you have disabled the web server.

Using the over-ride option at startup, you can force your E680 to enable its web server, and you can force it to get an address via DHCP, or force it to static address 169.254.74.73. Then can you access its configuration page with your browser, change the configuration, and save it.

As supplied, the E680 is configured to use DHCP to obtain a network address. If it's plugged into your LAN, it should obtain a network address automatically from your router. To see what address has been assigned, you need to connect to your router with a web browser, and access its "DHCP Clients" table. You can identify which connection belongs to the E680 either by its name "Sandevices", or by the fact that it's MAC address will always begin with 4A:49:4D. See your router's documentation for its specific procedure to access the DHCP client table.

Once you learn the assigned IP address from your router, you can type that IP address directly into your web browser's address bar to access the E680. A typical IP address in a small LAN would be 192.168.0.xxx or 192.168.1.xxx.

An alternative method to access the web page for the first time is to connect an ethernet cable directly between a PC (that is configured for DHCP) and the E680, and power both up. At startup, if you're not sure of the saved configuration, or you know it's configured for a static IP, force the E680 to DHCP mode using the pushbutton procedure detailed above. Since no DHCP server will be found by the E680 or by the PC, they will both have assigned addresses in the 169.254.x.x range. After bootup, type 169.254.74.73 in the address bar of your browser and press ENTER. This should bring up the E680 web page. From there, you can use the system configuration commands described later, to re-configure the module to use a static IP address that is available in your network.

<u>It is recommended that you assign each E680 a permanent static IP address on your network.</u> That way you won't have to access your router to find out what the IP address of a particular unit is. Although typically the IP address assigned by your router with DHCP will be the same every time you start up the board, it's possible that it could change from time to time. Also please be aware that at this time the E680 does not support "renewing" of DHCP addresses. Again, in the vast majority of cases this shouldn't cause any issues, however the recommended practice is to use DHCP for initial access to the E680, then to reconfigure it to use a static IP address.

The procedure to select an appropriate static IP address is beyond the scope of this document. Briefly, on a typical network that uses IP addresses beginning with "192", the first 3 number of every IP address will be the same, only the last varies, so we'll just refer to the addresses on the lan by the value of the last number. Typically your router will use "1". 255 and 0 aren't allowed. You also need to avoid the range of IP addresses that your router assigns automatically, see your router's setup pages to learn which addresses these are.

Configuring the E680 to operate with your pixels

Before you can program the E680 to operate your pixels, you'll need to plan the pixel layout; in other words which types and lengths of pixels will attach to which connector on the E680. In order to determine how to attach your pixels, it's important to understand how the E680's pixel outputs are organized. There are 16 pixel string connections. These are divided up in two ways, there are 2 columns of 8 connectors, and there are 4 clusters of 4 connectors.

The importance of the columns of 8 relates to the operating voltages of the pixels. If all of your pixels use the same voltage, then you need not be concerned about this, but if you are using two different voltages of pixels, then you must remember that the left-hand column of 8 is powered by the top power connector, and the right-hand column by the bottom power connector. Therefore, you can't, for example, have 10 5-volt strings, and 6 12-volt strings, because the power is always divided 8 and 8.

As mentioned, pixel connectors are also divided into clusters of 4. Clusters 1 and 2 are J1-J4, and J5-J8, in the right column. Clusters 3 and 4, are J9-J12, and J13-J16, in the left column.

The significance of clusters, is that all string plugged into the same cluster **MUST** be identical in many ways, since many of the E680s programmable options are done "per cluster". For example, every string in a given cluster must use the same type of controller chip, they must be the same length, etc. Please keep this in mind when planning how your strings will be organized. The concept of a 'cluster' of strings will become more clear when we look at how the E680 is configured. Also note that starting DMX addresses are assigned by cluster. In other words you tell the board what the DMX address will be for the 1st pixel on a cluster, and all of the other pixels in that cluster will follow in order.

In most cases the capabilities of the board will be more than adequate, but bear in mind that not everything is possible. For example, if you want to use 5 volt 6803s, 12-volt 6803s, 5-volt 2801s, 5-volt 1804s, and 5-volt GE pixels all at the same time, you can't do it, because that's 5 different types, each would require its own cluster, and we only have 4 clusters available.

Some guidelines on planning the pixel configuration:

If you are using both 5 volt and 12 volt pixels, connect the 5 volt power supply to the lower terminals of the power block, and connect the 5 volt pixels to J1-J8, and install the dip power jumper to power the board from the 5 volt pixel power.

If you are using all 5 volt pixels, either connect a single 5 volt supply to both upper and lower power terminals, or connect 2 separate supplies. As above, install the power jumper to power the E680 board from the pixel power.

If you are using all 12 volt pixels, you may still power the E680 form the pixel power, but be aware that the heat sink will become quite hot. An alternative is to **remove the**

power jumper, and connect a small wall-transformer-type 5-7VDC power supply to the small green power block on the bottom edge of the board.

Plan on connecting pixel strings in order, beginning with the first available connection with the proper voltage. Strings that must light sequentially, in other words typically all of the strings in a given display element, such as a mega-tree, should be plugged into consecutive connectors, possibly spanning more than one cluster.

Typical pixel strings are 50 pixels in length, and 50 doesn’t divide evenly into 680. If using 50-pixel strings, the suggested arrangement is to use 3 strings per cluster, and start each cluster’s DMX address with the channel 1. This will use 450 DMX addresses of each universe.

Also please keep in mind that a single E680 can control a maximum of 680 individual pixels, or groups of pixels. Understanding pixel grouping is important because it can allow your total number of pixels to be larger than 680. For example, if some elements of your display don’t require individual control of every single pixel, by grouping pixels you can reduce the number of DMX channels needed for that display element, freeing up channels for another display element that perhaps does require control of every pixel.

Using grouping, you can have a single set of 3 DMX channels control as many consecutive pixels as you like, a few, many, even an entire string or multiple strings. For example, if you’re putting 300 pixels on your roofline, but you can get by with controlling them in groups of 4 pixels (say 1 linear foot of pixel string), then you have ‘saved’ enough DMX channels to control 225 more pixels or pixel groups. Or if you have a wreath, candy cane, etc that will always light a solid color, you can control all of those pixels with just 3 DMX channels.

Once you have a plan, you’re ready to access the E680s built-in web server to enter your configuration information. Configuration is pretty easy, so if you get started and realize you need to re-think your arrangement, it’s no big deal.

Accessing the Web Configuration Page:

Please be familiar with the information listed earlier regarding IP addressing, particularly “Forcing a Particular IP Mode at Startup”. Using the techniques described there, you should be able to know the IP address of your E680, either from your router’s DHCP client table, or if no DHCP it’ll be 169.254.74.73.

Make sure the lower red LED stays on after the startup sequence. If it doesn’t you’ll need to use one of the over-rides to force the web server to come on. **You can’t access the board with your browser if the red LED is off.**

Type the E680s IP address into your web browser's address bar and press ENTER. This should being up a web page similar to this one:

SanDevices E1.31 Pixel Controller Model E680

CPUs Used: Main E1.31 TIMER Array PixA1 PixB2 PixB3 PixA4

Current Network Mode is: Normal STATIC
IP Address: 192.168.001.206 Subnet Mask: 255.255.255.000 Gateway: 192.168.001.001 DNS Server: 192.168.001.001
Mac Adrs: 4A:49:4D:C9:4F:F1
System Up-Time: 0000:20:49 Firmware Version: 2.020   Web Timeout in: 300

E1.31 Packet Statistics:

	Socket s1	Socket s2	Socket s3	Socket s4
Universe Number	1	2	3	4
Packets Received	32,234	32,224	0	0
Sequence Errors	31	34	0	0
Invalid Packets	0	0	0	0

Global Configuration:
Static Network Information:
IP Address: 192.168.001.206 Subnet Mask: 255.255.255.000 Gateway: 001.000.000.000 DNS Server: 192.168.001.001

Dynamic Page Select Address: OFF   Last Firmware Update Status: None Tried
Default IP Mode: STATIC Web Srvr Mode: Boot+Auto   No Data Timeout: Disabled   Test Pattern: 00

Pixel String Configuration:

Cluster#	Strings	Chip	Pixels	Grp	Str Len	RGB DMX	Address Range	Reverse	Zigs	Null Pixels	Refresh	Gamma
1	3	WS2801	050	001	0050	RGB	s1-001 thru s1-450	NNNN	0000	0-0-0-0	0212	
2	3	TLS3001	050	008	0400	RGB	s2-001 thru s2-450	NNNN	0000	0-0-0-0	0010	2.0
3	3	TLS3001	050	001	0050	RGB	s3-001 thru s3-450	NNNN	0000	0-0-0-0	0081	2.0
4	3	WS2801	050	001	0050	RGB	s4-001 thru s4-450	NNNN	0000	0-0-0-0	0212	

Current Page is: 3

Command: no 15

Note: The illustrated screen capture is for firmware version 2.20. Other versions of the firmware may have slightly different page layouts.

Once you have the web page displayed, put your cursor on the command box and type this command: QUIT 999. This tells the web browser not to time out. If you don't do this, the web browser may (depending on how it's configured from the last setup) timeout after 5 minutes. The "Web Server Timeout in" entry on the web page tells you the seconds until the server will timeout.

Note: The E680s web page is ALWAYS static, in other words it NEVER updates by itself. It will stay as-is until you either hit refresh or type in a command. The times and statistics shown on the page are as of the last time the page was displayed.

What’s Displayed on the Web Page:

First we’ll talk about the information that you see on the web page, and what every entry means. Then we’ll talk about the commands that you can enter to change that information.

The line beginning with “Current Network Mode is” displays information about the current network connection: the IP address, the subnet mask, the gateway, and the DNS server. If this is a STATIC IP, this will be from information that was previously saved in the E680s memory, if this is a DHCP address, it will be information that was assigned by the DHCP server on your network. Network mode will be “Normal” or “Forced”, followed by “Static” or “DHCP”, and optionally, “Failed”. Normal means the mode, static or DHCP, was selected based on the saved configuration. Forced means the current network mode was forced using the pushbutton at startup, over-riding the stored setting. DHCP or Static shows the type of address currently in use, and failed means the E680 tried to use DHCP, but no server was found.

DHCP server, if not 0.0.0.0, is the IP address of the server that gave the E680 an IP address, usually it will be the IP address of your router. MAC address is this boards unique MAC address, it will always begin with 4A.49.4D. DHCP Lease Time Remaining shows the time before the IP address given to us by the DHCP server ‘expires’. Please note: There are some limitations of the DHCP capabilities of the E680 at present, and one of them is that it will not attempt to renew a lease. Once it has obtained an IP address it will keep that address until the next reboot. Once again, the preferred method is to assign every E680 a unique STATIC IP address. Life will be simpler.

System up-time is hours, minutes, and seconds since the last restart. Also displayed on this line is the version number of the E680 firmware, and the remaining time in seconds, until the web server shuts down. If the latter shows as “---“ it means the server won’t time out.

The next few lines show statistics of the E1.31 data that has been received, and which DMX universes are assigned to the available four internet connections, or “sockets”. The 1st line is the “socket”, or connection number. There are 4 sockets on the E680, numbered s1 through s4. The next line displays which DMX universe is assigned to each socket. These numbers may range from 1 to 63999. Any valid universe number may be assigned to any of the 4 E1.31 sockets. Normally they would be consecutive, eg, 1,2,3,4, but any assignment can be made. Note that the four assigned universe numbers should be unique, <u>do not use the same universe number twice.</u>

The next line shows the total number of E1.31 packets received since the last restart, followed by the number of ‘missed’ E1.31 packets (sequence errors), and the number of improperly formatted E1.31 packets. Skipped packets may occur on occasion when accessing the E680 via the web browser. Large numbers of skipped packets would indicate a problem at the source, or a network problem. An occasional skipped packet isn’t significant, as this is repeated at about 40 times per second.

The next section of the web page is for global configuration data, in other words all configuration options that aren’t related to the pixel strings themselves. This is where the static IP information is entered: IP address, Subnet Mask, Gateway, and DNS Server. Other entries in this section include:

Dynamic Page Select Address: This allows the controller to switch between various configurations based on DMX data received. This is a specialized feature discussed in detail later.

Last Firmware Update Status: The E680 (with firmware versions 2.10 and above) can update its own firmware over your network. This entry shows the result of the last firmware update.

Default IP Mode: Determines whether the normal system network mode will be STATIC or DHCP.

Web Server Mode: This defines when the web server will be operational. One of the limitations of the Ethernet module used in the E680 is that it can have a maximum of 4 simultaneous connections. Normally these are all used for DMX data, hence the number of available DMX universes is four. In order to operate a web server, one of those four channels must be temporarily reassigned as a web server. During the time the web server is up, DMX data may only be received on the first three universes.

The specific Web Server Modes are:

Button: Server does not ever start. If you select this mode and save it, the only way to restart the web server is to use the pushbutton over-ride at start-up.

Boot: Server comes up for 5 minutes after any system restart.

Auto: Server comes up after a loss of incoming DMX data on socket 4. Every few seconds socket 4 will alternate between looking for web connections and looking for DMX data.

Boot+Auto: Both boot and auto modes.

No Data Timeout: (only supported in firmware versions 2.20 and later)

This specifies how long to wait before turning off the pixels in the event that E1.31 data is no longer being received. A value of 0 means DISABLED, and no automatic shutoff occurs. A value other than 0 (1-999) means the controller will shut off all pixel output if no data is received for the specified number of seconds.

Test Pattern: (Only supported in firmware versions 2.20 and later)

Test patterns may be used to verify proper pixel operation without having to connect the controller to a source of E1.31 pixel data. They may also be used to verify that pixel colors are correct, and that pixels are responding in the proper order.

0 means no test pattern is displayed, this is the normal operating mode. If a value other than 0 is entered, the pixels will no longer respond to incoming data. Values 1 through 6 are presently defined as test patterns:

1 All pixels full on RED

2 All pixels full on GREEN

3 All Pixels full on BLUE

4 A bright RED pixel chases through a dim RED background

5 A bright GREEN pixel chases through a dim GREEN background.

6 A bright BLUE pixel chases through a dim BLUE background.

Note that all test patterns will activate every possible pixel.

Important: Make sure to turn test patterns off by entering in a value of 0. Any non-zero value will disable normal pixel operation. As of Sep 12, 2011 the default will be to ship eeproms and assembled boards with test pattern #4 enabled to allow testing of the E680 without a source of E1.31 data.

The next portion of the page entitled **"Pixel String Configuration"** is where the pixel strings are defined. As previously mentioned, strings are divided into four clusters of up to four strings each. All strings within a given cluster must have the same operating voltage, controller chip type, RGB mode, length, and grouping.

The first column is simply the cluster number, 1 through 4. The second column is the number of active strings on that cluster, this can range from 0 (no strings) through 4 (maximum). Next is the chip type. This defines the type of pixel controller chip used by these strings. Examples would be 2801m 6801, GE, 1804, etc. Next is the number of pixels. If controlling every pixel individually, pixels will be the same as the length of the string. If controlling pixels in groups, pixels multiplied by grouping will equal the length of the string. The number of DMX channels assigned to each string = pixels X 3.

Grp is the grouping factor. This will be 1 if we are controlling each individual pixel. If more than one, then each set of 3 DMX channels will control that many consecutive pixels on the string. String Length is calculated and displayed automatically depending on the values entered for pixels and grouping.

RGB defines the order in which the 3 color channels appear on the DMX channels. Ordinarily this will be RGB, meaning red first, followed by green, then blue. For whatever reason some pixel strings use BGR instead. Who can figure those Chinese? In any case this allows you to handle ANY possible combination that you may encounter. To the controlling software, every string will appear to be R first, followed by G, then B.

The next entry is the range of DMX address for this cluster. Starting DMX addresses are entered as U-CCC, where U is the universe number, 1-4, and CCC is the channel number within that universe 1-510. Why not 512 you say? Well, pixels aren't allowed to overlap universes, in other words all 3 DMX channels for a given pixel must be within the same universe. If a pixel started at address 511 or 512, it would overlap to the next universe. So just pretend that channels 511 and 512 don't exist. Also please remember that the universe number entered here is always 1-4, and corresponds to one of the four actual physical universes that are assigned to the four DMX sockets. So think of the universe number here as meaning the 1st, 2nd, 3rd, or 4th universe used by the controller, rather than being an actual physical universe number. **Physical universe numbers are set in the E1.31 Packets section.**

The ending DMX address for this cluster is calculated automatically, you cannot change it. It may be in a higher universe, depending on the starting address and the number of DMX channels this cluster needs. The number of DMX channels needed by a cluster is (# of strings) * (# of pixels) * 3.

Reverse is four Y/N values, one for each string in this cluster. A Y means that the string is reversed, ie, it is driven from the 'far' end. Sometimes it's advantageous to be able to do this. For example, if you are lighting a roofline and want to use two 128-pixel strings. That would give you a total length of > 60 feet. The easiest configuration is to mount the controller at the midpoint of the 2 strings, that keeps each string connection short. But to do that, and for it to work properly as a single long string, the controller needs to know that one of those strings is "reversed". That way as you light up pixels 1-256 in order, they will light up from one end of your roofline to the other, not from the middle to one side, then from the middle to the other.

Or if you want to connect your mega-tree strings at the top, but your sequencing assumes pixel#1 is at the bottom, just define all strings as reversed and you are good to go.

Zigs. Well this one can be a bit confusing. Let's say you're doing a mega-tree, and you want it to be 50 pixels high, but your strings are 100 pixels long. If you light pixels 1-100 in order, you want to light the first strand from bottom to top, then the 2nd strand from bottom to top. But if you go up and down with your 100-pixel strings that's not what will happen. You'll light the first strand from bottom to top, then the 2nd strand will light from top to bottom. To fix this you tell the controller that your strings 'zig' after 50 pixels. The Zigs value applies to every string in this cluster. Set Zig to 0 if not used, Zig=1 is the same as Zig=0. Normally Zigs will divide evenly into the length of the string. For example, you may have a string length of 100, and a zig of 25 or 50. If you wanted a zig of 33, define the string as 99 pixels long instead of 100, and the last pixel won't be used.

The final configuration entry for strings is Null Pixels. The purpose for this option is due to the fact that there is a limitation on how far a string can be from the controller. This in turn is due to the fact that the signals that drive the pixels simply aren't intended to be sent over a long piece of wire. The exact limitation depends on the type of controller chip, and other variables, but can range from a few feet to maybe 20 feet. So, what if you need to have some strings that are farther away from the controller than is normally allowed? Well, the neat thing about these pixels is that each pixel 'regenerates' the data signals, allowing them to travel up to another 15-20 feet or so. So, what we can do, is make an "extension" cable that has a single pixel wired in every 15 or 20 feet. Say we need to drive a string that is 100 feet away. Our 100 foot extension cable would have perhaps 5 to 7 pixels wired in it, spaced every 15 feet or so. But, if the controller doesn't know we are doing this, it will just light up those pixels as if they were the 1st pixels of the string. By telling the controller that these strings have 'null pixels' the controller knows to leave those pixels dark, and start lighting up pixels where the real string starts.

The final two display items in the pixel string configuration area are Refresh and Gamma.

Refresh is a calculated value, and indicates approximately how many times per second the pixels in that cluster will be refreshed. Gamma represents the gamma correction value, at present it is only used for the TLS3001 pixel type.

Immediately above the command box is a line that displays the number of the current memory page (0 thru 7) and a warning if changes have been made to that page but not yet saved.

The command box is where we type in commands to modify the setup. After modifications are made, the current configuration data can be saved to any one of 8 memories to be recalled later.

That sums up the information displayed on the web page. Now we'll look at the commands that you can use to configure the system to your needs.

Configuration Commands

Note: The following commands are new in software versions 2.20 and above:

NO TE GF GV and DP

Every command consists of a command word followed by 1 or more numeric values. Only the first two letters of the command word need to be entered, more won't hurt, but only the first two are checked, so "GROUP" is the same as "GROPE". Upper or lower case may be used.

Numeric commands must be separated from the command word, and from each other, by one or more characters that aren't digits. Values are always positive integers. The following commands would all be interpreted the same:

Strings cluster 4 quantity 3

ST 4 3

ST 4.3

ST 0004-003

We'll divide the commands into groups:

First we'll look at the commands that allow you to load and save the configuration data.

There are 8 memory pages in the E680, numbered 0 through 7. Each page stores the entire board configuration, from networking information, to pixel information. By having multiple pages, you can have more than one saved configuration that you can recall easily.

When the system starts up, it always loads memory page 0. So, whatever configuration is saved here is what will run the lights. When you make configuration changes using the web commands, those changes will be shown immediately on the web page, but they are not automatically saved to system memory, so they won't be immediately shown on the pixels. Only the SAVE command does that, it stores the configuration data shown on the web page, in one of the 8 memory pages. So please remember, after making changes, SAVE them.

You will see a warning message reminding you if there are unsaved changes.

The multiple memory pages are handy if you want to experiment with different commands, but don't want to disturb your basic configuration. First save the current configuration into another memory page, say page 1. Then play around as much as you like with the configuration. To see the effect of your changes on the pixels, type SAVE 0. When finished, if you want to go back to your original setup, just LOAD 1, then SAVE 0, and you are back where you started. **Remember: the pixels will ALWAYS operate on whatever configuration was last saved into page 0 unless you have dynamic page selection enabled.**

SAVE n where n is a memory page number from 0 to 7

Writes the currently displayed configuration to the specified memory page

LOAD n where n is a memory page number, 0-7

Loads the specified memory page and displays the information on the web page.

The BOOT command forces a restart of the E680 (if BOOT 999).

BOOT 999 will restart the system, make sure you SAVE first if you have made any changes!

The QUIT command is used if you have finished making (and saving!) changes, and want to shut down the web server to allow socket 4 to resume receiving DMX data. One gotcha: If your last command was QUIT, and you later bring the web server back up and press F5 or 'refresh' on your browser, it will send the same command (quit) again. Be aware of this.

Normally you would use QUIT when the web browser isn't running continuously. If socket 4, for example, is hunting between looking for DMX data and looking for web 'hits', your first access to the page will bring the web server up with a 5 minute timeout. This automatic timeout is there in case you forget to quit the browser manually. So, first use the QUIT command as QUIT 999 to 'lock' the browser on. Make you changes, save them, then type QUIT. The browser will shut down 10 seconds later and you're back receiving DMX on all 4 sockets.

The value used with the quit command can't be less than 10. This is to give you time to re-enter a different quit command if you enter a quit command in error.

QUIT n Quit tells the web server to stop running. If no

Number is entered, it will stop in 10 seconds, if

10-998 is entered it will stop in that many seconds.

QUIT 999 will keep the web server running forever.

The **UNIVERSE** command is used to map physical DMX universe numbers to the E680's four Ethernet connections, or sockets. This information is displayed in the E1.31 Packet Statistics section of the web page.

In a simple configuration, the first E680 might be assigned to universes 1-4, the 2nd to 5-8, etc. But these assignments can be made using any four universe numbers, and universe numbers can be as high as 63,999. **Important: please make sure that there are no duplications,** in other words don't assign the same universe number to more than one socket. It won't work. Command Example:

UNIVERSE 1 1000 this command would assign DMX universe #1000 to socket #1.

The following group of commands set the configuration data displayed in the Global Configuration portion of the web page.

Every configuration page has an area to store a static IP address. Even if you set the network mode to DHCP, you can still save static information. This eliminates the need to re-enter the static information every time you switch from DHCP to static. There are 4 entries here, Static IP, Subnet Mask, Gateway, and DNS Server. Usually, DNS and Gateway will be the same, the address of your router. In most small LANs this will be either 192.168.0.1 or 192.168.1.1. Subnet mask in a '192' LAN will be 255.255.255.0, or just 24. The commands are:

IP a.b.c.d where a.b.c.d is any valid IP address

SUBNET a.b.c.d or SUBNET n where a.b.c.d is any valid subnet mask value, or n is the size of the subnet in bits.

GATEWAY a.b.c.d where a.b.c.d is any valid internet address. Usually the address of your router.

DNS a.b.c.d where a.b.c.d is any valid internet address. Usually the address of your router.

If you are only using DHCP (not recommended), you can leave the static IP areas unused.

Network addressing (static or DHCP IP) is only needed to access the E680's configuration page with a web browser. Once configured, no IP address is needed for normal operation.

The Default IP Mode, Web Server Mode, No Data Timeout, and Test Pattern commands affect what happens when the system starts up.

DEFAULT n where n is 0 or 1. DE 0 sets a default network mode of STATIC, DE 1 sets a default network mode of DHCP. (corrected 06/21/2011)

WEB n where n is 0 to 3. 1=start server for 5 minutes on every Restart, 2=start server if no DMX data received on slot 4. 3 is both of the above. 0 means never start the web server.

NO n where n is 0-255. If non-zero, after n seconds of no DMX Data being received, pixels will go dark. (vers 2.20 and higher)

TEST n Where n is a test pattern number, or 0 for OFF. (versions 2.20 and higher)

The final group of commands is where you enter the configuration information for your clusters of pixels. We will discuss these commands in the order the information appears on the web page.

All of these commands will have more than one numeric value. The first numeric value is always the cluster number, from 1-4. In the command descriptions that follow, the designation 'n' is always used to represent a cluster number 1-4.

The **strings** command defines how many pixel strings are attached to a particular cluster, this may range from 0 (none) up to 4.

STRINGS n a — Define number of strings attached to cluster n, 0-4
Example: STRINGS 1,4 says there are 4 strings on cluster 1.

The **CHIP** command tells the E680 what type of pixel controller IC, or chip, is used on the pixels that will be attached to this cluster. Enter 2 numeric values, first the cluster number, then the chip number. The following chip types are defined:

0=6803, 1=2801, 2=GECE (GE ColorEffects), 3=1804 (fast), 4=1804 (slow), 5=Native DMX, 6 and 7 not presently defined, and 8=TLS3001 12-bit pixels.

CHIP, n, x — where x is a valid chip number 0-8. Defines the type of chip used on cluster n's pixel strings. Example:
CHIP, 1, 0 (sets chip type to 6803 for cluster 1)

The **pixels** command sets the number of pixels assigned to each string of this cluster. A pixel here refers to a set of 3 DMX channels. A pixel may light more than one light on the string if the group size is more than 1. If the grouping is 1, then # of pixels = string length. If the grouping is more than 1, then Pixels X Group Size = String Length. For example, if you have a 50-count string, and will be lighting up LEDs in groups of 5, you would set pixels to 10, group to 5, and the string length will be automatically calculated as 50.

PIXELS, n, aaa — Defines the number of pixels on each string in cluster n
Example: PIXELS 1, 50

The **Group** command tells the E680 how many consecutive lights on the string to light up for each set of 3 DMX channels. Normally this will be 1, meaning you are controlling each LED individually. This gives the maximum possible flexibility, but at the expense of number of DMX channels used. Using pixel grouping, in situations where control of every pixel isn't needed, can reduce the DMX channel count significantly, allowing a single E680 to control more pixels. For example, if you are lighting a single display element, such as a wreath or mini-tree, you may want to use pixels to be able to select any color, but you may not need control of every pixel on that item. You might group the entire string as 1one group, thus being able to light that display element with only 3 DMX channels.

GROUP, n, aaa — Defines the pixel grouping for strings in cluster n to be aaa pixels. Example: GROUP 1, 1 says that all pixels in cluster #1 will be controlled individually.

String Length is calculated automatically by multiplying pixels X grouping.

The **RGB** command defines the order in which the 3 color channels are assigned to the pixels in a given cluster. Most pixels use the same sequence that the name RGB would imply: RED first, followed by GREEN, then BLUE. Some pixels however assign their color channels in a different order. BGR is fairly common. To cover all possibilities, the RGB command lets you define the RGB pixel order of a cluster’s strings to be any of the 6 possible combinations, using a number from 0 to 5. The numeric codes, and the sequence they assign, is as follows: 0=RGB, 1=RBG, 2=GRB, 3=GBR, 4=BRG, and 5=BGR.

RGB, n, a — Defines the pixel color order for strings in group n RGB 1,5 would define cluster #1 pixels to be BGR.

The **DMX** command sets the starting DMX address for the pixels attached to this cluster. Only the start address is specified. All pixels on the cluster (every pixel in every string) will then be assigned sequential DMX addresses, beginning with the specified starting address. In some cases the ending DMX address will be in a different universe, this is allowed. The number of DMX addresses used by a cluster will be equal to:

(number of strings) X (number of pixels per string) X 3

Starting DMX addresses are entered in the form of s-ccc, that’s a slot number (1-4) followed by a channel number (1-510). In other words, if we enter our DMX command as: “DMX 1, 2-101” what we are saying is that the DMX addresses for cluster #1 will begin with the 101st channel of the DMX universe assigned to our 2nd slot. Now, if you happen to have assigned slots 1-4 to DMX universes 1-4, then slot# and DMX universe number will in fact be one and the same. Just to be clear, you first assign DMX universes to SLOTS, then you assign SLOTS to CLUSTERS. Ending DMX addresses for a cluster are displayed, but you can’t change that value. It’s possible for DMX address ranges to overlap, this may or may not be intended.

Now, the question that’s gnawing at some of you, if there are 512 channels per DMX universe, why can a starting address not be more than 510? Because each pixel takes 3 channels (3 dmx addresses), and all 3 of those channels must be in the same universe. In other words, a single pixel’s DMX addresses can’t span a universe boundary. The reason for this is that different DMX universes are updated at different times. If a pixel spanned a universe boundary, then there would be a short period of time when part of the pixels channels had updated, but not all. This would produce a brief color change in that pixel. So just pretend that channels 511 and 512 don’t exist. The E680 will never use those 2 channels.

DMX, n, s-ccc — Defines starting DMX address for 1st pixel of cluster n as the universe assigned to slot x, channel CCC.

The DMX ending address is automatically calculated and cannot be changed with a command. It is a function of the starting address, the number of strings, and the number of pixels per string.

The **reverse** command defines which, if any, of the strings in this cluster are reversed. A reversed string is one where the pixel nearest the controller is considered to be the last pixel in the string, and the farthest-away pixel is the first. It is used when it is more convenient to attach a pixel string to the controller at what would normally be the 'far' end. Although reverse is specified on a per-string basis, it is entered a s a single numeric value obtained by adding the reverse values of all strings that are reversed. String #1 is 1, String #2 is 2, String #3 is 4, and String #4 is 8. For example, if you want strings 1 and 4 to be reversed, you would enter a reverse value of 9 (1+8).

REVERSE, n, a Defines reversed status (Y/N) for each string in cluster n, value (a) is the sum of the reverse values for all reversed strings. REVERSE 1,15 would indicate that every string in cluster #1 was reversed. REVERSE 2,0 would mean that none of the strings in cluster 2 are reversed.

The **zigzag** command is typically used when you are building a matrix of pixels, and the height of your matrix is less than the string size. Say, for example, you want a 25 high x 48 wide matrix of pixels, and your pixel strings are 100 lights long. The easiest way to construct this matrix is to start the 1st srring from bottom to top, reverse after 25 pixels and come back down, then reverse again every 25th pixel. So one pixel string is actually 4 columns of your matrix. The problem is, when the controlling software in the PC starts lighting up pixels, we want them to light the 1st row from top to bottom, then the 2nd row from top to bottom, etc. But the way we have it strung, what will actually happen is that the 1st column will light from bottom to top as expected, but the second will light from top to bottom, and this pattern will repeat.

The zigzag command allows you to tell the E680 that you have hung these strings in a zigzag pattern. The controller then automatically re-arranges the addresses assigned to the pixels so that they light in the proper order. In this example we would use a zigzag of 25, meaning the pixels reverse direction every 25th pixel.

The zigzag command is per cluster, in other words this zigzag factor applies to every string in the cluster. Zigzag of 0 or 1 has no effect.

ZIGZAG n, a Defines all strings in cluster n to zigzag every a pixels.

(Please note that SOME sequencing software also has the ability to define string as being in a snake or zigzag pattern. If you are using software with that capability, then you can define the zigzag either in the sequencing software, OR in the E680, but not both at the same time.)

The Null Pixels command defines, on a per-string basis, if there are any extra pixels in line before the start of the 'real' string. Null pixels are a method of controlling strings that aren't close to the controller. Normally, there is only a fairly short distance allowed between the controller and the pixel string. If you need to mount some strings at greater distances, you can make up an extension wire that has a single pixel built in every 15 feet or so, starting near the controller. These pixels act to 'regenerate' the data signals so that they are good for another 15-20 feet. For example, by using about a half-dozen pixels in this fashion, you could control a pixel string that was perhaps as far as 100 feet from the controller. The **Null Pixels** command lets the controller know that these pixels are there. Otherwise they would light up as the first few pixels of the string, not what we want. This way the controller knows to skip those pixels, and start lighting the string at the proper point.

Although null pixels is entered for each individual string, the values for all 4 strings of the cluster must be entered in a single command: NULLS 1 0-0-3-3 would define the 3rd and 4th strings of cluster 1 as having 3 null pixels each.

NULLS, n, a,b,c,d	Defines the number of null pixels on each string of Cluster n. Example: NULLS 1, 0,0,0,0

Null Pixels, Zigzag, Reverse, and Grouping may be used in any combination. You could, for example, have a string that has 4 null pixels, is lit in groups of 5, zigzags every 25, and is driven from the far end.

The following commands are only implemented in the most recent firmware versions, 2.20 and above:

GF	This command is used to load a new firmware file over the Network. Refer to separate firmware update documentation.
GV, a.b	This command sets the gamma correction value.

Gamma correction is only applicable to 12-bit pixels such as the TLS3001, and is used to make the dimming response of the pixels more like incandescent bulbs. A typical value would be 2.0, acceptable values are 1.0 to 3.0 in steps of 0.2.

DP, n	Enables dynamic page switching. N from 0-512, 0=off.

Dynamic page switching is an advanced feature. This allows the controller to switch between different configurations “on the fly” based on a value that’s sent over a specified DMX channel. When this feature is made active, by entering a value between 1 and 512, then the DMX value that is received on that channel of the first universe is used to select one of the 8 configuration pages. The page selected is the dmx value received divided by 32:

DMX Value	Page Selected
0-31	0
32-63	1
64-95	2
96-127	3
128-159	4
160-191	5
192-223	6
224-255	7

Before enabling dynamic page selection it is important that you make sure that you have the desired configurations loaded into any memory pages that you will be using. **This is an advanced feature that should only be used once you are comfortable with the basic controller operation.**

This concludes the command definitions. Remember, changes aren't saved until you do a SAVE command. Changes won't affect the operation of the strings until you do a SAVE 0 command.

E680 PC Board Version 3 Version-Specific Documentation

Version 3 of the E680 controller addresses an issue that can cause flickering on certain pixel types. It also allows, in most cases, pixels to be driven over longer lengths of wire.

This issue involves the signaling voltage sent from the E680, which is either 0 for off, or +3.3 volts, for on. Most pixels recognize about 2.5 volts as the level at which they distinguish a 0 from a 1. Recently it was discovered that certain pixel types may have a higher threshold, and it can cause erratic operation with the E680s 3.3V signal levels. The particular pixels in question where type 1809 pixels, in strip form, operating at 12 volts.

This issue can be resolved using a feature added to the version 3 E680, and this can also be accomplished with a retrofit of earlier boards.

On the V3 boards, removing the jumper located immediately to the left of the programming port will enable the extended-voltage range feature, shifting the signal levels to 0.7 volts for off, and 4.0 volts for on. This provides additional signal margin at the high level.

This should only be used when necessary as there are some limitations when this feature is in use. These limitations are as follows **for Version 3 boards**:

The metal can surrounding the Ethernet jack **should not be in contact with a metal enclosure**, as this will defeat the feature.

Use caution to prevent inadvertent short circuits between the CLOCK and DATA wires to ground. Shorting these signal wires to ground could damage the CPU if the extended voltage feature is enabled.

It is recommended, though not required, that the feature be disabled by reinstalling the jumper when the programming port is used.

For information on retrofitting earlier boards with this feature, contact jim@sandevices.com. **These restrictions apply to retrofitted boards:**

The metal can surrounding the Ethernet jack should not be in contact with a metal enclosure; otherwise the feature will not work.

Use caution to prevent inadvertent short circuits between the CLOCK and DATA wires to ground. Shorting these signal wires to ground may damage the CPU if the extended voltage feature is enabled.

Make sure that only NYLON mounting hardware is used to mount the E680. On pre-V3 boards the lower-right mounting hole is at ‘ground’ potential. With retrofitted boards, the board ‘ground’ must be kept isolated from chassis ground, so metal mounting hardware can’t be used in this location. Grounding PC board ground to chassis ground will not cause damage, but it will prevent the extended voltage feature from working.

If powering the E680 from an external power source on a retrofitted pre-V3 board, connect the external power supply’s POSITIVE lead to the small terminal block in the normal fashion, but **connect the NEGATIVE lead to a PIXEL POWER – (negative) terminal** rather than to the – (negative) terminal on the small terminal block.